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## Exchange Rate Modelling in Ghana: Do the Purchasing Power Parity and Uncovered Interest Parity Conditions Hold Jointly?

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### Abstract

We employ the cointegration and Vector Error Correction methodology to explore exchange rate modelling in Ghana by considering the interactions between the goods and capital asset markets using monthly data spanning from 1997:1 to 2007:12. The empirical evidence supports a long-run relationship between prices, interest rates, and exchange rates in which the signs are consistent with the joint validity of the unrestricted PPP and UIP conditions. Further likelihood ratio tests based on the cointegration vector show that the strict forms of the PPP and UIP conditions between Ghana and the USA do not hold as stationary relations. The findings suggest that the interactions between the goods and capital asset markets matter for the conduct of monetary policy and exchange rate modelling in Ghana.

**Keywords:** Exchange Rate Modelling, Multivariate Cointegration Analysis, Purchasing Power Parity, Uncovered Interest Parity

### 1. Introduction

Due to the central roles played by international parity conditions such as purchasing power parity (PPP) and uncovered interest rate parity (UIP) in the modelling of exchange rates, prices and interest rates, researchers have made considerable efforts to test their empirical validity. A substantial fraction of the empirical evidences for the equilibrium relationships have failed to establish whether the exchange rate is determined by the level of prices as claimed by the PPP theory, or by the interest rates differential as suggested by the UIP. On the whole, the two parity conditions have individually produced mixed empirical results.

The theoretical motivation for the PPP is based on the assumption that internationally produced goods serve as perfect substitutes for domestic goods in such a manner that a backward adjustment mechanism due to the price differentials is established. The empirical verification of this hypothesis has generally been very poor (Dornbusch, 1989). A number of reasons have been cited for this, such as the relative importance of the tradable and non-tradable sectors between the countries and technology differentials, which imply that if the PPP mechanism functions at all, it must only be in a long-run perspective.

The UIP condition, which functions in the capital market, postulates that the interest rate differential between two countries is equal to the expected change in the exchange rates. However, just like the PPP, the empirical validity of the UIP as a forward-looking market clearing mechanism in the capital market has not been influential. Among other things, this failure has been ascribed to the existence of a stationary time-dependent risk premium, learning effects and expectation errors.

A seminal work by Johansen and Juselius in 1992 attributes the failure of earlier studies and lack of empirical support for the parities to the disregard for the possible interactions between the goods markets and the capital asset markets. A consideration of the systematic relationship between the two conditions implies that omission of interest rates or price levels from cointegrating vector for PPP or UIP conditions can lead to a rejection of a long-run relationship between exchange rate, the price differential and the interest rate differentials. Undeniably a joint model of the parities enables one to properly capture the linkages between the variables. It also allows for different short-run and long-run dynamics so that the error correction terms of the PPP and the UIP ensure that the model is consistent with the two parities in a steady state. In the short run it is presupposed that the conditions describe a tendency in the markets to react toward parity, connoting that neither prices nor interest rates can diverge substantially without inducing adjustment forces that tend to restore equilibrium.

Following this development, a growing body of the empirical literature has documented support for the joint modelling of PPP and UIP. Most of them argue that since exchange rates are affected by developments in both the goods and asset markets, the two parity relationships may not be independent of each other in the long-run (see, Camarero and Tamarit, 1996; Caporale *et al.* 2001; Juselius 1995; Juselius and MacDonald, 2004; MacDonald and Marsh 1997; Miyakoshi 2004; Ozmen and Gokcan, 2004). At the same time, other arguments support that disequilibrium in one market may

have consequences on the other (see, for example, Johansen, 1992, MacDonald and Marsh, 1999; Sjöo, 1995). The joint PPP and UIP model is noted to outperform the individual parity conditions in the model (Pesaran *et al.*, 2000).

Since the empirical literature provides more supportive for the joint PPP and UIP, we combine the arbitrage relations and investigate whether the behaviour of the Ghana cedi follows that line of movement. Within the multivariate cointegration and vector error correction model this study shall look at the extent to which the parity conditions hold during the examined sample period. Particularly, we shall examine the strong and weak forms of the parities, thus allowing for even more channels of interaction among the variables. One important issue worth considering is the exogeneity status of the foreign variables which can shed more light on the formation of prices, interest rates and exchange rates and possible effects of economic development in the US.

The remainder of the paper is structured as follows: Section 2 sets out the theoretical framework within which the linkages between the exchange rate, prices and interest rates are established by the joint model. The data and methodological issues are discussed in Section 3, while Section 4 presents the empirical results and analysis of the statistical tests. The last section is the conclusion.

## 2. Theoretical Framework

The PPP assumes that nominal exchange rates moves in such manner that an equilibrium relationship is established between the price of goods and services across countries. In relative terms, the PPP relationship can be defined by as follows:

$$e_t = p_t - p_t^* \quad (1)$$

Where  $e_t$  is the nominal exchange rate (defined as the price of U.S. dollars in Ghana cedi i.e. domestic currency per U.S. dollar).  $p_t$  and  $p_t^*$  are domestic and foreign price indices. Allowing a constant in this relation would represent a permanent deviation from absolute PPP due to productivity differentials and other factors.

At the same time, the PPP seems more of a long-run interaction than implied by equation (1) since arbitrage in the goods market may be slow. Such temporary deviations of the exchange rate from PPP could be due to factors including relative growth differentials, interest rates, speculative price movements or commodity prices. This requires that the exchange rate drifts in such a manner as to restore the relative PPP. This is expressed algebraically by:

$$\Delta e_{t+1} = p_t - p_t^* - e_t \quad (2)$$

The UIP, which relates the expected exchange rate ( $\Delta e^e$ ) to domestic interest rates ( $i$ ) and foreign interest rates ( $i^*$ ), can be expressed as follows:

$$e_t = \Delta e^e + i - i^* \quad (3)$$

This condition defines that the difference between the domestic and foreign interest rate produces an expected depreciation of the exchange rate. The implication of this definition is that, if the domestic interest rate is high compared to its foreign counterpart, the domestic currency would be expected to depreciate. As a forward-looking market clearing mechanism, the UIP condition tends to be relatively fast under an efficient asset market assumption compared to the adjustment in the PPP.

As documented by Frenkel (1976), the PPP and UIP propositions establish theoretical linkages between exchange rates, interest rates and prices assuming flexible prices of goods, perfect capital mobility, and perfect substitution of domestic and foreign assets. The recent development in the literature suggests that since PPP and UIP describe theoretical partial equilibrium equations in the goods and capital markets respectively, it is reasonable to treat PPP and UIP jointly to allow for gradual convergence towards PPP, since there are more persistent deviations from PPP than deviations from UIP (Pesaran *et al.*, 2000).

Judging from equation (3), deviations from long-run PPP become increasingly important in the formation of expectations, as the forecast horizon grows, thereby providing a link between the capital and the goods markets. This yields an expected exchange rate defined by the price differential as follows:

$$\Delta e^e = p_t - p_t^* \quad (4)$$

Following this, we base our empirical investigation on the combined PPP and UIP conditions and model the nominal exchange rate as:

$$e_t = p_t - p_t^* - i_t + i_t^* \quad (5)$$

A necessary condition for this equation to make sense is that the interest rate differential and PPP conditions are either stationary process [ $i_t - i_t^* \sim I(0)$  and  $p_t - p_t^* - e_t \sim I(0)$ ] or that if the processes are non-stationary [ $i_t - i_t^* \sim I(1)$ ]

and  $p_t - p_t^* - e_t \sim I(1)$  ] their combination as implied by (5) produces a stationary process  $[e_t - p_t + p_t^* + i_t - i_t^* \sim I(0)]$ . Denoting the real exchange rate by  $q_t$ , the above equation can be reformulated as:

$$q_t = e_t - p_t + p_t^* + \frac{1}{\theta} i_t - \frac{1}{\theta} i_t^* \quad (6)$$

In this case, the speed of adjustment to changes in the interest differential is denoted by  $\theta$ . This condition for exchange rate determination assumes a long-run interaction of the price level and interest rate differentials as proposed by Dornbusch (1976).

### 3. Data and Methodology

The study seeks to investigate the behaviour of the exchange rate based on an empirical model which supposes that the joint long-run PPP and UIP conditions hold. We consider a model formulation that does not directly impose any of the two conditions but, assumes that a tendency in the goods and asset markets adjusts to deviations from their equilibrium relationships. The Johansen (1991) cointegration test employed in the study is considered more powerful than the Engle-Granger approach (Engle and Granger, 1987; Granger, 1988). Again, the technique clarifies the number of cointegration relationships between the variables, and also allows each of the variables in the model to be used as dependent variable while maintaining the same cointegration results. However, as pointed out by Cheung and Lai (1993), the Johansen's approach does suffer from small sample bias.

Considering a well-defined five-dimensional vector  $Y_t = [e, i, i^*, p, p^*]'_t$  we can examine the long run relationships by using the cointegration test based on the maximum likelihood estimates from the following VAR specification:

$$\Delta Y_t = \Gamma_1 \Delta Y_{t-1} + \dots + \Gamma_{k-1} \Delta Y_{t-k+1} + \Pi Y_{t-k} + \gamma D_t + \mu_t + \varepsilon_t \quad (7)$$

where  $Y_t = (e_t, p_t, p_t^*, i_t, i_t^*)'$  is a (p, 1) vector of observations at time t,  $D_t = (p, 3)$  matrix of dummy variables,  $\Gamma_i = (p, p)$  matrix of short-run dynamic coefficients,  $\varepsilon_t = (p, 1)$  vector of error terms, and  $\Pi = (p, p)$  matrix of long-run dynamic coefficients. It is defined as  $\Pi = \alpha\beta'$ , where  $\alpha$  contains the coefficients for the speed of adjustment in each of the  $p$  equations, while  $\beta$  contains the coefficients of the  $r$  (p, 1) cointegrating vectors. The rank of  $\Pi$  can be determined by calculating the  $p$  eigenvalues according to the Johansen trace and maximum eigenvalue tests.

We analyse monthly data for nominal exchange rate (expressed in units of national currency per unit U.S. dollar), domestic and foreign price levels and interest rates for the period 1997:1 to 2007:12. We have chosen this period because it covers the most recent exchange rate regime following the financial liberalization in Ghana. We use data from the International Financial Statistics (IFS) database published by the International Monetary Fund (IMF). They are expressed in logarithm forms, therefore, the estimated parameters of their coefficients measure elasticity.

The descriptive statistics of the data summarized in Table 1 indicate that the levels exchange rate has the lowest mean and median. The standard deviation shows a lower variance of 0.11 for the foreign price level, while a greater variation comes from the foreign interest rate. With the exception of the foreign prices, the levels of all the variables are negatively skewed and are characterized by a relatively low positive kurtosis. This leads to rejection of the null hypothesis of normality by the Jarque-Bera test. The first differences of the series exhibit much lower variances ranging from 0.01 to 0.05. Exchange rate and domestic prices are positively skewed distributions, with excess kurtosis. Consequently, the Jarque-Bera statistics indicates that the assumption of normality is violated due to excess kurtosis.

### 4. Empirical Results and Analysis

#### 4.1. Unit Root and Stationarity Tests

The actual cointegration analysis begins with the verification of the integration consistency of the variables by using conventional unit root and stationarity tests. We employ the PP and KPSS tests to determine the number of times the variables need to be differenced to become stationary. The PP unit root test results in Table 2 indicate that the test statistics for all the variables in levels are greater than the critical values, indicating failure to reject the null of unit root. Including a constant and trend does not change the results for all the variables. The estimated statistics for the first difference of the variables leads to the rejection of the null hypothesis of unit root. These imply that, considering the 1% significant level, the PP test supports that the data generating process of the variables are integrated of order 1,  $I(1)$ .

According to Table 2, the KPSS which tests the null of stationarity indicates that the variables are not mean-reverting (non-stationary) in the levels as the estimated test statistics for all the variables are greater than the critical values at the 5% significant level. Of particular interest is the evidence that  $i^*$  is stationary at the 10% level. This means that the variables are  $I(1)$ , providing a consistent set of first difference stationary Gaussian process for the proposed model.

#### 4.2. Long-Run Relationships

According to the PP and KPSS tests all the variables are integrated of order 1, so we proceed to test if there is a long-run relationship between the variables. The methodology employed is the Johansen (1991) multivariate Full

Information Maximum Likelihood (FIML) cointegration test. Since the Johansen cointegration test and the behaviour of the residuals are sensitive to the lag order we first consider the optimal lag length for the model specification. The Akaike, Schwarz, and Hannan-Quinn information criteria provide different orders for the model, which requires particular attention to residual autocorrelation and heteroskedasticity. While the FPE and AIC support lag length of 5, the SIC and HQC opt 2. We follow the SIC and HQC and use 2 lags as they give residuals that are reasonably well-behaved and theory-consistent.

In order to identify the cointegrating relations, we apply the Johansen cointegration technique to the pentavariate model which includes both the PPP and UIP conditions by assuming an intercept and trend in the cointegrating equation. The estimated trace and maximum eigenvalue statistics reported in Table 3 support one long-run relationship between the variables at the 0.05 level. This also suggests that the system is stationary in one direction in which the variables have an error correction representation with error correction terms incorporated into the equations indicate the speed of convergence and the presence of causality (Engle and Granger, 1987; Granger, 1988). The evidence suggests that price and interest rate differentials play significant roles in the modelling of exchange rates in Ghana such that movements in the cedi can better be controlled by interest rate movements and price stability. Table 3a displays the unrestricted cointegrating vectors. When normalized on the nominal exchange rate, the vector has signs consistent with the theory of combined PPP and UIP (see Table 3). The relationship corresponds to (1.00, -6.08, 2.26, 0.23, -0.31).

Considering the magnitudes of the coefficients, we find that in the long-run, the nominal exchange rate is more responsive to domestic price levels than their foreign counterpart. Interestingly, however, the exchange rate seems more responsive to the foreign interest rate dynamics/movements than the domestic rates. The misspecification and diagnostic tests reported in Table 4 reveal that the model is well-behaved in terms of residual serial autocorrelation and heteroskedasticity. However, we disregard the violation of multivariate normality caused by excess kurtosis since the cointegration estimates have been argued to provide robust results (Gonzalo, 1994).

#### 4.3. Hypothesis Testing

We proceed by testing the validity of the combined PPP and UIP restrictions through likelihood ratio tests developed by Johansen and Juselius (1992). The restricted cointegrating relations will be estimated accordingly to test how consistent it is with the theoretical restrictions postulated by equation (6). If we find that the combined PPP and UIP is significant, then we can impose the restriction in the exchange rate model. In the event that the strict form is rejected, we can examine less restrictive alternatives. Table 5 reports the LR test results.

The strict forms of the PPP and UIP are tested by imposing the following restrictions among the variables of the cointegrating vectors:  $[\beta_1 = \beta_2 = \beta_3 = 1, \beta_4 = \beta_5 = 0]$  and  $[\beta_1 = \beta_2 = \beta_3 = 0, \beta_4 = \beta_5 = -1]$ . Under this assumption, the test statistics distributed as  $X^2(4)$  yields the values 36.3 and 35.2, which reject the strict forms of PPP and UIP respectively. This indicates that none of the two conditions is itself a stationary process. That is, combinations of the restricted variables do not produce any stationary process. Further tests of the combined strict-form PPP and strict-form UIP gives  $X^2(4) = 35.7$  and a p-value is 0.00. This rejects the null hypothesis that both price and interest rate differentials affect the exchange rate proportionally/symmetrically.

Since the strict-forms of the parity conditions are rejected, we explore the weak forms of PPP and UIP. We formulate the hypothesis as  $\beta_4 = \beta_5 = 0$  (for weak form PPP) and  $\beta_1 = \beta_2 = \beta_3 = 0$  (for weak form UIP). The p-values, 0.01 for  $X^2(3)$  and 0.00 for  $X^2(2)$ , reject the weak forms of the parity conditions. Notably, under each of the restrictions, the signs of the coefficients of the eigenvectors are not consistent with the PPP and UIP.

Following this, we consider if a combination of the strict form of one and the weak form of the other hold. We express the hypothesis of strict form PPP and weak form UIP by imposing restrictions on the first three elements as  $[\beta_1 = -\beta_2 = \beta_3]$  and leave the interest rate variables unrestricted. It postulates that price differentials affect the exchange rate proportionally while interest rates affect it in a non-symmetrical manner. The p-value rejects the null hypothesis. The signs of the unrestricted interest rate variable are not consistent with the UIP condition. The weak form PPP and strict form UIP is formulated as  $[\beta_4 = -\beta_5]$ . Here, we hypothesise the interest differential affects the exchange rate proportionally while prices affect it non-symmetrically. The estimated p-value rejects the null hypothesis. In this case, the LR test statistics distributed as  $X^2(1)$  with p-value 0.82 fails to reject the null hypothesis. The signs of the coefficients of the eigenvectors are consistent with the PPP condition.

Again, a test is conducted to find whether the price differential or nominal interest differential enters the equilibrium relation by imposing a restriction that  $\beta_2 = -\beta_3$  and  $\beta_4 = -\beta_5$  respectively. The former assumes that relative price movements affect the exchange rate symmetrically no matter where they initiate, but not proportionally. The LR test statistic indicate that the null hypothesis that only the price differential enters the cointegrating relation is rejected while a p-value of 0.82 fails to reject the null that only the interest rate differential enters the long-run relation. We note with



particular interest that, in the latter, the signs for the exchange rate, domestic and foreign prices are consistent with the PPP condition.

Just like in the case of the weak form restrictions, we test proportionality and symmetric restrictions expressed as  $\beta_2 = \beta_3$  and  $\beta_4 = \beta_5$ . This test hypothesizes that prices and interest rates affect the exchange rate irrespective of where they originate. While the PPP symmetry is rejected, the test fails to reject the null of the UIP symmetry. The coefficients of the first three variables retain their signs consistent with the PPP condition.

#### 4.4. Speed of Adjustment and Long-Run Weak Exogeneity

Considering the deviations from the PPP and UIP conditions explained above, an important issue worth addressing is how fast the variables revert to the long run equilibrium relationship. Table 6 illustrates the speed of adjustment parameters. The sign and magnitude of these convergence parameters give information about the direction and speed of adjustment towards the long-run equilibrium course. We find that the adjustment coefficients of the nominal exchange rate, domestic prices and interest rates are statistically significant in the short-run mechanics of the process. The percentage of the total adjustment offset in each successive month is 2.8%, 3.8% and 4.6% for exchange rate, domestic prices and interest rates respectively. This shows that the adjustment process lies between 1.75 and 3 years for the system to restore the long-run relationship.

In this section we employ the Likelihood Ratio test developed by Johansen (1991) for restrictions on the matrix loading factors. We formulate the long run weak exogeneity test as a zero row in the loading factor,  $\alpha$  and the null hypothesis that the variable is weakly exogenous. If no evidence is found against the null hypothesis, the variable would be said to push the system without being influenced, and thus can be considered as a driving force in the system.

Table 7 below presents the LR test results of weak exogeneity for the system (Johansen and Juselius, 1990). Foreign prices and interest rates are found to be weakly exogenous indicating that none of the cointegrating vectors enters the foreign equations. The weak exogeneity of the foreign interest rate is not a surprising result considering that US financial shocks are usually believed to disturb international capital markets. A joint test for weak exogeneity of the foreign variables gives a p-value of 0.80 suggesting that, a shock in the foreign variables cause the PPP and UIP to deviate from the equilibrium relationships, but they do not adjust to restore the condition. One can argue that, the US prices and interest rates are not affected by the equilibrium relations; though, the rest of the variables move so as to establish the equilibrium relations. This result confirms that the cedi/U.S. dollar exchange rate, the domestic prices and interest rates are affected by developments in the foreign variables. The exchange rate can therefore be said to be a channel through which U.S. monetary policy is transmitted to the Ghanaian economy.

### 5. Conclusion

The paper has explored exchange rate modeling in Ghana by considering the interactions between the goods and capital asset markets using monthly data spanning from 1997:1 to 2007:12. The analysis was done by following the cointegration and VEC methodology to define the long-run stationary relationships as well as common stochastic trends. The vector variables considered were nominal cedi/US dollar exchange rate, consumer price index for Ghana and the US, short term interest rates for Ghana and the US.

The results show that the variables are integrated of the first degree but form a stationary process when combined linearly, which provides evidence that there exists a steady-state relationship between them. The cointegration vector shows signs that are consistent with the joint validity of the unrestricted PPP and UIP conditions. Based on the likelihood ratio test we find that the stationarity hypothesis of the strict form PPP and UIP conditions are strongly rejected. Also, the strict form UIP holds when the weak form PPP is allowed in which case the symmetric and proportionality conditions of the UIP are not rejected. This implies that the nominal exchange rate is defined when the interest differential is allowed to affect it proportionally while prices affect it non-symmetrically.

The weak exogeneity tests reveal that significant causality runs from the foreign variables to the Ghana cedi exchange rate and domestic variables. Further we find that in case of deviations from the equilibrium relationship are offset by adjustments in the nominal exchange rate and the domestic variables such that a percentage of the total adjustment required is accomplished in each successive month. Since the foreign variables serve as the driving force of the system, they do not take part in the adjustment process. The findings suggest that the interactions between the goods and capital assets markets matter for the conduct of monetary policy and exchange rate dynamics in Ghana.

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Table 1. Descriptive Statistics

	$e$	$p$	$p^*$	$i$	$i^*$
<i>Levels of variables</i>					
Mean	-0.54	4.98	4.66	3.12	1.28
Median	-0.21	5.03	4.62	3.25	1.61
Std. Dev.	0.58	0.55	0.11	0.52	0.59
Skewness	-0.87	-0.21	0.68	-0.42	-0.83
Kurtosis	1.98	1.62	2.10	1.87	2.12
Jarque-Bera	22.4	11.3	14.6	10.9	19.4
Probability	0.00	0.00	0.00	0.00	0.00
<i>First difference of variables</i>					
Mean	0.01	0.01	0.00	-0.01	-0.00
Median	0.00	0.01	0.00	0.00	0.00
Std. Dev.	0.02	0.01	0.01	0.05	0.05
Skewness	2.93	2.12	-0.20	-1.12	-1.02
Kurtosis	12.2	16.2	4.11	8.06	6.78
Jarque-Bera	654	105	7.75	167	101
Probability	0.00	0.00	0.02	0.00	0.00

Table 2. Unit Root and Stationarity Tests

Variable	levels		difference	
	Constant	Constant and trend	Constant	Constant and trend
<i>Phillips-Perron (PP) Test</i>				
$e$	-2.14	-0.96	-5.91***	-6.47***
$p$	-1.26	-1.26	-6.30***	-6.32***
$p^*$	1.49	-1.95	-9.93***	-10.2***
$i$	-0.70	-2.06	-7.19***	-7.16***
$i^*$	-1.21	-0.92	-5.23***	-5.23***
<i>Kwiatkowski, Phillips, Schmidt and Shin (KPSS) Test</i>				
$e$	1.19**	0.31**	0.33	0.07
$p$	1.41**	0.25**	0.18	0.05
$p^*$	1.27**	0.28**	0.42	0.05
$i$	1.18**	0.22**	0.07	0.05
$i^*$	0.38**	0.25**	0.25	0.09

The critical values for the PP at 10%, 5% and 1% significance level are -1.61, -1.94 and -2.57. \*\*\*, \*\*, \* denotes the rejection of the null at 10%, 5% and 1% significance levels. The critical values for a test with a constant and trend are -3.14, -3.44 and -4.03, respectively. The critical values for the KPSS test with a constant are 0.11, 0.14 and 0.21 at the 10%, 5% and 1% significance level, respectively. For a constant and trend the critical values are 0.34, 0.46 and 0.73, respectively. \*\*\*, \*\*, \* denotes the rejection of the null at 10%, 5% and 1% significance levels.

Table 3. Cointegrating Coefficients

	$e$	$p$	$p^*$	$i$	$i^*$
<i>Unrestricted cointegrating coefficients</i>					
$\beta_1$	6.19	-37.6	14.0	1.44	-1.94
$\beta_2$	4.76	-6.03	33.3	-7.75	-2.70
$\beta_3$	-1.11	-0.72	-31.0	0.35	0.77
$\beta_4$	6.05	3.46	20.6	-2.65	0.18
$\beta_5$	-3.43	-11.1	19.0	5.51	-3.13
<i>Normalized cointegrating vector</i>					
Coefficient	1.00	-6.08	2.26	0.23	-0.31
Standard error		(0.82)	(1.06)	(0.18)	(0.10)
Test statistics		[-7.37]	[ 2.12]	[ 1.26]	[-3.12]

Table 4. Misspecification and Diagnostic Tests

Test	$X^2$ (df)	p-value
Autocorrelation LM (1)	30.7(25)	0.19
Autocorrelation LM (4)	22.6(25)	0.59
Normality	3637(105)	0.00
Portmanteau Tests for Autocorr.(4)	72.1(50)	0.02
Portmanteau Tests for Autocorr.(6)	110(100)	0.22
Heteroskedasticity tests: No Cross Terms	358(330)	0.13
Heteroskedasticity tests: With Cross Terms	1217(1155)	0.09

Table 5. Restricted Cointegrating Relation

Hypothesis	$e$	$p$	$p^*$	$i$	$i^*$	$X^2$	p-value
<i>Individual parity conditions</i>							
Strict PPP	1	-1	1	0	0	36.3(4)	0.00
Strict UIP	0	0	0	1	-1	35.2(4)	0.00
Weak form PPP	5.99	-24.9	-1.22	0	0	8.40(3)	0.01
Weak form UIP	0	0	0	0.98	0.27	26.2(2)	0.00
<i>Combined parity conditions</i>							
Strict form PPP and strict form UIP	1	-1	1	1	-1	35.7(4)	0.00
Strict form PPP and weak form UIP	1	-1	1	-3.35	-0.71	26.0(2)	0.00
Weak form PPP and strict form UIP	3.20	-20.3	6.80	1	-1	0.04(1)	0.82
<i>Proportionality and symmetry conditions</i>							
$\beta_2 = \beta_3$	7.41	-32.1	32.1	-1.54	-2.70	5.96(1)	0.01
$\beta_4 = \beta_5$	5.90	-37.4	12.5	1.83	-1.83	0.04(1)	0.82
PPP symmetry $\beta_2 = \beta_3$	1.08	-17.3	-17.3	4.05	0.68	11.9(1)	0.00
UIP symmetry $\beta_4 = \beta_5$	7.88	-33.0	17.5	-1.81	-1.81	3.35(1)	0.06
Joint symmetry for PPP and UIP	3.32	-15.5	-15.5	0.86	0.86	15.9(2)	0.00

Table 6. Adjustment Coefficients

	$e$	$p$	$p^*$	$i$	$i^*$
Coefficient	0.03	0.04	-0.00	0.05	-0.02
Standard error	(0.01)	(0.01)	(0.01)	(0.02)	(0.02)
Test statistics	[ 2.87]	[ 5.63]	[-0.21]	[ 1.76]	[-0.78]

Table 7. Long-run Weak Exogeneity Tests

Hypothesis	$e$	$p$	$p^*$	$i$	$i^*$	$X^2$	p-value
$\alpha(3,1) = 0$	6.19	-37.6	13.6	1.41	-1.93	0.03(1)	0.84
$\alpha(5,1) = 0$	6.43	-38.1	16.5	0.90	-2.18	0.40(1)	0.52
$\alpha(3,1) = \alpha(5,1) = 0$	6.42	-38.1	16.1	-2.17	0.89	0.42(2)	0.80



## Impact of Cognitive Biases on Decision Making by Financial Planners: Sunk Cost, Framing and Problem Space

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### Abstract

The **aim** of this paper is to test the existence of the framing effect and sunk cost effect whilst examining the influence of cognitive factors. The **approach** to this research involved combining two frameworks, Prospect Theory and Image Theory, to analyse the outcomes of financial decision making from a survey of financial planners. The **findings** confirm the existence of the framing effect and a sunk cost effect. In particular the lowering of the amount of sunk cost produced a higher mean funding outcome than that attained in the positive frame. With regards to cognitive factors a significant correlation between perception of responsibility and the amount of funding granted was identified. This is consistent with the existence of escalation commitment behaviour, which is considered to be a manifestation of feelings of responsibility. The perception of the problem space produced an unexpected set of results. In particular both low image compatibility and high image compatibility were significant predictors of the level of funding granted.

**Keywords:** Framing effect, Sunk cost effect, Decision-making, Prospect Theory, Image Theory

### 1. Introduction

An emerging issue for investment analysis and financial decision making has been the trend for individuals to seek financial advice concerning investment for future financial security in particular with regards to superannuation. The growth in this sector has led to the recognition of Financial Planners as experts in investment analysis arising from the process of professional training they are required to undertake (Oskamp, 1965; Bradley, 1981; Sundali & Atkins, 1994).

Portfolio theory which is commonly used in investment analysis starts with the proposition that all investors are “risk-averse” and will seek to maximize their return for the level of risk they are prepared to accept (Markowitz, 1959). The underlying principle is that decision makers will act in a rational manner (Rich & Oh, 2000). However, empirical research has found that the axioms of rationality (Savage 1954; and Sugden 1991), are violated across a range of financial decision making situations (Hernstein 1990; and Keen 2001). One focus of prior research has been concerned with exploring a person’s level of risk tolerance and the reliance on mental accounts (Thaler 1985, 1990; and Kahneman & Tversky, 1979). That individuals formulate as a cognitive process which they then rely upon to evaluate events or choices. Kahneman and Tversky (1979) found that the cognitive process can be influenced by the way in which the prospects of the alternative courses of action are framed, that is as positive (gains), or negative (losses). Financial planners’ tolerance for risk may influence the nature of the investment choices they make. Their tolerance for risk may be the result of a misdirected perception of risk (Fischhoff, Slovic & Lichtenstein, 1981), arising from a reliance on biased heuristics.

The purpose of this paper is to empirically examine the decision processes of practicing financial planners using a situation which is representative of financial investment decisions. The instrument used is grounded in the behavioural literature and should therefore be expected to provide reliable measures of the respondents’ decision processes. The paper contributes to the behavioural finance literature concerned with the effects of heuristic biases on financial decisions. The paper analyses more closely the relationship between Prospect Theory and Image Theory in order to provide an integrated framework for examining financial decision making.

### 2. Literature Review

The literature on decision-making assumes that individual decision-makers use some form of judgemental heuristics as a general strategy to simplify complex decision tasks. Research has identified a number of anomalies that highlight the subjective nature of decision making in real world settings. Factors, such as the sunk cost effect (Arkes & Blumer, 1985), and escalation of commitment (Staw 1976, 1981) have been shown to adversely influence decision making. Behavioural models such as Prospect theory (Kahneman & Tversky, 1979) and Image theory (Beach, 1990) are particularly relevant to examining the cognitive biases that individuals encounter when forming judgmental heuristics for making decisions.

Prospect theory (Kahneman & Tversky, 1979) is based upon the notion that there are two phases to decision making: an initial editing phase and a subsequent evaluation phase. The editing phase allows for the information to be organised

and reformulated, thereby simplifying the evaluation phase. The evaluation phase is based upon the assumption that values are attached to changes rather than final states and that decision weights do not coincide with stated probabilities. The theory predicts that when outcomes are framed in a positive manner (gains), there is an observable propensity for decision makers to be risk-averse, and conversely when the frame is negative (losses), decision makers are more likely to be risk-seeking (Kahneman & Tversky, 1979; Tversky & Kahneman, 1981, 1986). Decision framing has also been described (Tversky & Kahneman, 1981, 1986), as involving mental accounting in which individuals form psychological accounts of the advantages and disadvantages of an event or choice. This infers that individuals create mental images that influence their decision making process.

Image theory (Beach, 1990) provides a model for examining images created by decision makers. The theory predicts that the decision made by an individual is a function of the perception of three images (Mitchell, Rediker & Beach, 1986; Dunegan, Duchon & Ashmos, 1995). Value image is related to the value, moral or ethical nature of the choice and is the basis for establishing goals. Trajectory image relates to the agenda that underlies the goals. Strategic image implies tactics and forecasts which relate to the goals. Image compatibility is considered to act as a moderating variable, influencing the degree to which information may be used by an individual when making a decision. The conceptual representation of the images constructed by an individual is identified as by Payne (1980), as the problem space and has been shown to be related to the framing effect in prospect theory (Dunegan, Duchon & Ashmos, 1995).

### 2.1 Framing Effects

Research has shown that individuals will respond differently to the same decision problem when the problem is presented in a different format. This phenomenon is referred to as a framing effect (Kahneman & Tversky, 1979). Framing effects can have the potential to impede the accuracy of financial decisions. Empirical research has demonstrated that an individual can be influenced by the way in which information is presented (Kahneman & Tversky, 1979). A frame according to Beach (1990, 23) is *“a mental construct consisting of elements, and the relationship between them, that are associated with a situation of interest to a decision maker.”* The frame may therefore be thought of in terms of a representation of a situation through which a decision maker gains understanding or makes sense of the alternative courses of action available.

One explanation for this phenomenon is that when a decision maker focuses on the negative, there is a greater urgency to engage in preventative behaviour rather than explore other options. Research (March & Shapira, 1992) suggests that individuals are likely to become more survival oriented when focusing on losses which threaten to deplete their resources and more aspiration oriented when focused on positive goals. Since *“losses loom larger than gains”* according to Kahneman and Tversky (1979), examining the negative frame should shed more light on the propensity to take risks by financial planners. The assumption being that decision makers are more likely to be influenced by negative framing leads to the following null hypothesis to be tested.

Ho<sub>1</sub>: The negative framing of the task will not result in a higher amount of funding allocation.

### 2.2 Sunk Costs

Decision models in finance follow normative economic decision theory and implicitly, rather than explicitly, are dismissive of sunk costs. This is evident in finance theory, which holds that only future cash inflows and outflows should influence decisions. Sunk costs are by definition *“past and irreversible outflows. ... they cannot be affected by the decision to accept or reject the project, and so they should be ignored.”* (Brealey & Myers, 1991, 95) Portfolio theory and the net present value method are commonly used to assess alternative investment opportunities. In an investment decision, past costs, or sunk costs, are deemed to be irrelevant. Despite this, there is evidence which demonstrates that sunk costs, are not always ignored as prescribed; this is described as the *“sunk cost effect”* or the *“sunk cost phenomenon”* (Tversky & Kahneman, 1981; Akers & Bulmer, 1985).

Prior research has demonstrated that individuals can be influenced by past costs when making economic decisions (Arkes & Blumer, 1985). Tversky and Kahneman (1981), suggested that individuals form accounts (psychological accounts), regarding the advantages and disadvantages of an event or option in order to appraise costs and benefits of outcomes. This suggests that past experiences, such as sunk costs, can influence the way in, which an individual makes a decision and this leads to the following null hypothesis for testing.

Ho<sub>2</sub>: The amount of sunk cost will not result in a different amount of funding allocation.

### 2.3 Escalation of Commitment

Linked to the sunk cost effect is the bias to commit resources to justify previous actions, whether or not the rationale for those initial commitments is still valid. Staw (1976, 1981) found that individuals tend to escalate their commitment to previous decisions, even if the behaviour does not appear rational. Research has shown that individuals who are responsible for making an initial decision are more likely to make further decisions in a biased way to justify their earlier decision (Staw & Ross, 1978; Teger, 1980; Bazerman, Beekun & Schoorman, 1982; Bazerman, Guiliano &

Appleman, 1984; Brockner & Rubin, 1985; Schoorman, 1988). A consequence of this bias is that further funds may be committed to justify previous actions, whether or not the rationale for those initial actions are still valid (Brockner & Rubin, 1985; Schoorman, 1988). The possibility that escalation to commitment may occur in investment appraisal leads to the following null hypothesis.

H<sub>03</sub>: The perceived level of responsibility for the initial decision will not be positively correlated to the amount of funding allocated.

#### 2.4 Problem Space

The role of cognition is well documented as a salient factor in decision making (Newell & Simon, 1972; Lord & Maher, 1990). Specific research has explored the processes that result in perceptions about conditions regarding the decision (Bowen, 1987; Lord, 1985). Payne (1980) referred to these perceptions collectively as the problem space, which is an individual's cognitive representation of a task environment. Framing has been shown to have a direct influence on the perception of the problem space and therefore the decision outcome (Dunegan, 1993). The problem space relates to the conceptual representation of the task constructed by an individual (Payne, 1980). Examining the problem space may provide greater insight into the cognitive representation or perception that an individual has of the task. Therefore, if the framing effect can influence the problem space perception it may provide a better understanding of the anomalies related to decision making process. The following null hypothesis was developed to test whether differences in perception of the problem space may explain the decision outcome of individuals.

H<sub>04</sub>: The framing of a task will not influence the perceptions of the problem space.

The way in which a decision maker cognitively processes information can be measured by the cognitive perception of the problem space (Langer, 1989; Isen, 1989; Fazio, 1990; Maheswaran & Chaiken, 1991; Louis & Sutton, 1991). The proposition is that when controlled modes of cognitive processing are used, information is subjected to a more comprehensive, deliberate and thorough analysis. Conversely, when automatic modes are used, the processing of information is limited. In addition, there is reduced attention to detail and fewer incoming cues to contribute to a cognitive representation of the task (Dunegan, 1993). Controlled processing was expected to produce a significant relationship between problem space measures and decision outcomes (funding), because problem space should be more easily recalled and used in the controlled mode. In the automatic mode, the problem space is not easily recalled for conscious use and the relationship between problem space and decision outcomes should be weak or non-significant. The following null hypothesis was developed to test whether different perceptions of the problem space caused by the framing effect are likely to produce different decision outcomes.

H<sub>05</sub>: The eight problem space variables will not be positively correlated to the variance in funding allocation.

#### 2.5 Image Compatibility

Image Theory posits that decisions made by individuals are a function of the perceptions of three images (Beach, 1990; Beach & Mitchell, 1990; Mitchell & Beach, 1990). The three images are value images, pertaining to a consolidation of morals, principles and predispositions; trajectory images, pertaining to an individual's future objectives or targets; and strategic images, consisting of current plans and tactics (Mitchell, Rediker & Beach, 1986; Dunegan, Duchon & Ashmos, 1995). These images are relevant to decisions concerning adoption and progress choices. Adoption decisions are concerned with new projects, plans, or activities. Progress decisions are related to deliberations concerning projects, plans or activities already commenced. These are the types of activities that investment appraisal is concerned with.

In both adoption and progress decisions, image theory implies that image compatibility acts as a catalyst for differentiated actions (Dunegan, Duchon & Ashmos, 1995, 32). When information is perceived as positive, the trajectory and strategic images are compatible and no change in course of action is deemed to be warranted by a decision maker. Conversely, when information is perceived as negative, images appear incompatible and the decision maker is more likely to take action intended to rectify the situation (Beach et al., 1992). Research has shown that image compatibility can act as a moderating variable, influencing the degree to which information is used by a decision maker in choosing a course of action (Dunegan, Duchon & Ashmos, 1995). To test whether image compatibility would act as moderating variable influencing the degree to which information was used in choosing a course of action the following null hypothesis was designed.

H<sub>06</sub>: The perception of the problem space will not be correlated with the perceived image compatibility.

Research has further identified that when image compatibility was high, that is, progress toward the goal on the trajectory image was perceived to be acceptable, then the relationship between the problem space and funding levels are low (Dunegan, Duchon & Ashmos, 1995). Conversely, when image compatibility was low, the perception of the problem space and funding decisions were significantly higher. Therefore, the following two null hypotheses were developed to test the expectation that the decision outcome and the perception of the problem space would be opposite to the image compatibility.

H<sub>07</sub>: The perceived image compatibility will not differ between decision outcomes.

H<sub>08</sub>: The perceptions of the problem space and decision outcomes will not be high when perceived image compatibility is low.

### 3. Data Collection

#### 3.1 Target Population and Sample Selection

The target population was selected from the category “Financial Planners” in the Australian Yellow Pages Telephone CD Rom edition. Several stages were involved in developing the database for the sample. First, the search was restricted to Queensland Financial Planners: a total population of 863. This was done to keep the survey at a manageable level and because the issues presented in the survey instruments are relevant to financial planners, no matter which state in Australia they were situated. A sample of 265 was randomly selected from the remaining population. The sample size was determined in accordance with Leedy (1997, 211). and random sampling method followed the steps prescribed by Krathwohl (1998).

#### 3.2 Survey Instruments

Three versions of the investment tasks were developed which differed slightly with regard to specific details. The first two contained the same amount of sunk cost, however, one had a positive frame and the other a negative frame. The third version had a negative frame, however, the amount of the sunk cost was reduced. In addition to the framing and sunk cost manipulations there were questions, which addressed cognitive perceptions of problem space and image compatibility in all three versions.

For the purpose of this research, the decision maker was referred to as the “Fund Manager”, which was used to compliment the nature of financial planning and investment advising consistent with the industry role of the subjects. In introducing the instrument’s task, the subjects were asked to adopt the role of a Fund Manager who, having instigated an investment project sometime in the past, is now confronted with a request for additional funds by the team responsible for the investment project. The team is seeking an additional \$100 000AUD, as the investment project is behind schedule and over budget. The actual sunk cost of the initial investment was identified as \$400 000AUD. This was considered a reasonable amount to influence the subjects as the \$100 000AUD requested now represented one quarter of this sunk cost. The Fund Manager has \$500 000AUD in unallocated funds; however these funds may be required for other projects and there is some time left before the end of the current financial year. The details of the differences between the sunk cost and framing for the three scenarios are highlighted in Table 1 below.

Insert Table 1 Here

In addition, the subjects were instructed that they believe there is a “fair chance” the project would not succeed. The final statement was the pertinent framing effect. The final statement given to the subjects specifically established the pertinent framing effect. The positive frame stated that, “*Of the projects undertaken by this team, 30 of the last 50 have been successful*”, while the negative frame differed with respect to the last part of the statement “*Of the projects undertaken by this team, 20 of the last 50 have been unsuccessful*”. Note that in both the negative and positive scenarios, the ratios lead to the same result.

Subjects were advised that the actual time remaining till the end of the financial year was 6 months; this imposed a time frame that was considered a reasonable challenge to the subject’s perception of risk. The subjects could view the 6 months as half the year being past or as half the year remaining (Dunegan, 1993). The variables for this scenario are summarised in Table 2 below:

Insert Table 2 Here

#### 3.3 Sample Size and Response Rate

Where the actual population is known, the statistical method for determining an appropriate sample size can be employed. In this case the appropriate sample size was determined to be 265 ( $N=850$   $s=265$ ). (Leedy, 1997, 211). Following the initial mail out of surveys, 30 were returned with the notification that the address was no longer correct. These were replaced by randomly selecting 30 replacements. Eighty-six useable responses were received, the response rate was 32.5%. This response rate was considered satisfactory for the size of the population and the purpose of the survey.

#### 3.4 Non-Response Bias

The likelihood of non-response bias was assessed using late responses as a proxy for non-responses. A comparison of the variables provided little difference between early and late respondents. The chi-square for early/late responses was  $\chi^2$  0.641 with  $df=1$ . Since the subjects were selected from a population that was known to be largely homogenous, major differences between respondents was unlikely.



## 4. Data Analysis

### 4.1 Statistical Methods

Eight hypotheses were generated with regard to the reinvestment decision scenarios. These called for the use of a *t*-test (for null hypothesis 1), an ANOVA (for null hypotheses 1, 2 and 3), a MANOVA (for null hypothesis 4), and a multiple regression analysis (for null hypotheses 6, 7, and 8). A principal component factor analysis was conducted as an additional test on the data regarding the perceptions of problem space and image compatibility. The results and their interpretation are discussed below. The results of the analysis of the data are presented in order of the null hypotheses established earlier in this paper.

### 4.2 Analysis of Reliability

Table 3 presents the mean and standard deviations for the funding amounts and the total subjects in the sample for each of the task versions that were administered.

Insert Table 3 Here

There were differences between the means of the negative framed and positive framed versions of the task. Having established that the funding levels were significantly different between each version of the task further analysis was warranted to examine the significance of the framing effect on the amount of funding.

### 4.3 Testing the Framing Effect on Funding

Testing the framing effect on funding involved using the funding (or resource allocation from \$0 to \$100 000), as the dependent variable and framing (dummy coded 1 or 2), as the independent variable.

A comparison of the means uses a two-sample independent *t*-test (two-tailed). Revealed a significant difference between funding levels ( $t = 2.338$ ,  $p < .023$ ). This result indicates that the frame manipulation was successful. The null hypothesis ( $H_{01}$ ) is therefore rejected.

To test the difference between the experimental conditions (decision choices versus positive and negative framing), an analysis of variance (ANOVA) for repeated measures was performed by comparing task versions 1 against 2 ( $F = 4.755$ ,  $p = 0.011$ ,  $df = 2$ ). Since each of the three groups was treated identically, except for framing; differences were expected to be evident among them. This result confirms that the total variance in funding was significantly related to the differences in framing.

### 4.4 Testing the Sunk Cost Effect on Funding

To test the Sunk Cost Effect on Funding a one way analysis of variance (ANOVA) was conducted with the funding (decision outcome), as the dependent variable and framing (dummy coded). As the independent ( $F = 8.596$ ,  $p < 0.005$ ,  $df = 1$ ). The scenarios relevant to the testing of this null hypothesis are task version 1 (negative framing with high sunk cost), and task version 3 (negative framing with low sunk cost). The null hypothesis ( $H_{02}$ ) is therefore rejected. This result shows that there was a significant difference between the mean of funding for the high sunk cost frame and the low sunk cost frame scenarios. The direction of the difference was the low level of funding (\$39 354), in the high sunk cost version and the higher level of funding (\$60 227), in the low sunk cost version. This suggests that the difference in the amount of sunk cost may have an impact on the sunk cost effect.

The sunk cost effect was significant and the mean for funding allocation was greater in the task version with the lower sunk cost. These findings are consistent with the assumptions of prospect theory.

### 4.5 Testing the Perception of Responsibility on Funding

To test the perception of responsibility on funding allocation a one-way analysis of variance (ANOVA) was conducted with the problem space item for responsibility as the dependent variable and the amount of funding as the dependent ( $F = 4.023$ ,  $p = 0.005$ ,  $df = 4$ ). Testing involved funding (from \$0 to \$100,000), as the dependent variable and perceived level of responsibility (scaled from 1 to 5), as the independent variable. This result shows that there were statistically significant differences between the amount of funding and the perception of responsibility. The null hypothesis ( $H_{03}$ ) is therefore rejected. A further ANOVA was conducted using the intention to fund against the perception of responsibility ( $F = 0.809$ ,  $p = 0.523$ ,  $df = 4$ ). This result shows that there were no statistically significant differences between the intention to fund and the perception of responsibility.

### 4.6 Testing the Framing Effect on Perceptions of Problem Space

To test the framing effect on perceptions of problem space a multivariate analysis of variance (MANOVA) was conducted with eight (8), problem space items as dependent variables and framing (dummy coded), as the independent ( $F = 2.235$ ,  $p < .038$ ). The test was restricted to task version 1 (negative frame and high sunk cost), and scenario 2 (positive frame and high sunk cost). To compare task version 2 against task version 3 would be to introduce a

confounding variable, That is task version 3 whilst consisting of a negative frame has a low sunk cost, which could invalidate the findings and it was therefore not used in this test.

The result indicates that the perception of problem space differs between the task version 1 (negative frame). and 2 (positive frame). Therefore, there is a significant difference (at  $\alpha = .05$ ). due to framing. Interestingly, the mean of the funding amount was lower in the negative frame (\$39 354), than in the positive frame (\$53 484). This confirms the influence of a framing effect on the perceptions of problem space. The null hypothesis ( $H_{04}$ ) is therefore rejected.

To test the relationship between the variance in funding allocation and the problem space items a series of multiple regression analysis was performed, one for each framing condition, with funding as the criterion variable and all eight problem space variables simultaneously entered as predictors. The results of these tests are reported in Tables 4, 5, and 6. The reason for entering all eight problem space variables in the model simultaneously was to control for any shared variance among the predictors.

Insert Table 4 Here

The results for the negative framed task resulted in only 43.9% of the variance in funding being explained by the eight independent variables the result is therefore not significant. The perceptions of problem space are not significantly related to the funding decision in this negative framed task. This is a surprising and most unexpected result and inconsistent with the findings of previous research, which indicated that negative framing could be expected to result in a higher level of controlled decision processing.

Insert Table 5 Here

Insert Table 6 Here

To determine whether significant differences existed between the predictive powers of the regression models, a comparison was conducted of adjusted  $R^2$  values using Fisher's transformation for multivariate  $R$  (refer Hayes, 1988, 644-645). The capacity of the positive frame model was found to be significantly greater.

*Negative Frame* =  $C_R = 0.388$ ; critical value = 1.96, two-tailed test, not significant.

*Positive Frame* =  $C_R = 2.08$ ; critical value = 1.96, two-tailed test, **significant**.

*Negative Low Sunk Cost Frame* =  $C_R = 1.270$ ; critical value = 1.96, two-tailed test, not significant.

These results are not consistent with previously reported findings (Dunegan Duchon and Ashmos, 1995). in which the negative framing resulted in a stronger relationship to the amount of funding. The results indicate that the positive framed task exhibited stronger cognitive relationships to the problem space perceptions than the negative framed tasks.

A number of possible explanations and observations are considered here. First, that the negative framing did not elicit the expected cognitive behaviour may be due to the unexpected risk-avoidance exhibited in the negative framed outcomes. The negative frame should cause decision makers to exhibit risk-seeking behaviour, which would be manifest in the means of the funding being larger (not smaller), than the positive framed scenario outcomes. Second, the additional information and modifications to the wording of the task may have been responsible. The respondents may have felt more certainty about the financial situation and this could also explain the higher funding in the positive framed scenario. The significantly different (higher amount of funding), from the positive frame suggests that the information may well have influenced characteristics of the cognitive modes exhibited by the subjects in their decision making.

#### 4.7 Analysis of Internal Structure Image Compatibility

The internal structure of the four image compatibility items was explored by a principal-component analysis using an orthogonal Varimax rotation. By specifying a minimum eigenvalue of 1.0, a single factor for image compatibility was determined. The factor accounted for 81.7% of the variance in the four items. The items were collapsed into a single measure of image compatibility. The procedure of collapsing these data involved adding the scores of the four items to produce a single measure (Dunegan, Duchon & Ashmos, 1995). The component matrix is reported in Table 7.

Insert Table 7 Here

Extraction method: Principal Component Analysis.

Only one component was extracted. The solution cannot be rotated.

Descriptive statistics for the survey items are shown in Table 8. These data indicate that funding levels were significantly correlated with image compatibility and all but three of the problem space items.

Insert Table 8 Here

#### 4.8 Testing the Correlation between Perceptions of Problem Space and Image Compatibility

To test the correlation between perceptions of problem space and image compatibility two regression analyses were performed to control for shared variance among problem space items. First, funding (decision outcome) was regressed

on the eight problem space items. Fifty percent of the variance in funding was predicted by the group of eight problem space items ( $F=9.729$ ,  $p<.000$ ). The null hypothesis was rejected. Second, image compatibility (collapsed measure) was regressed on the eight problem space items. Eighty-nine percent of the variance in image compatibility was predicted by the group of eight problem space items ( $F=80.244$ ,  $p<.000$ ). The null hypothesis was rejected. These results indicate that there was a significant relationship between perceptions of the problem space and perceived image compatibility. This finding is consistent with Dunegan, Duchon and Ashmos (1995).

To test the perceived image compatibility as a moderating variable on the decision outcome three steps were involved. First, to test whether image compatibility added anything to the predictive powers of the model the same regression analysis was performed, except that in this model image compatibility (the factor condition) was added to the independent variables (that is,  $\text{Funding} = \text{Intentions} + \text{Risk} + \text{Disappointment} + \text{Importance} + \text{Responsibility} + \text{Minimise loss} + \text{Sunk costs} + \text{Control} + \text{Image}$ ). The addition of image compatibility increased the model's ability to predict funding allocation increased from 55% to 59% ( $R^2 = 0.550$ ,  $F = 10.313$   $p<0.000$ ).

Second, the regression model was then expanded to include the eight first-level interactions between image compatibility and the problem space items. The interaction variables were created by multiplying each problem space item by the image compatibility factor, as reported by Dunegan, Duchon and Ashmos (1995, 35). The expanded model is represented by the following [ $\text{Funding} = \text{Intentions} + \text{Risk} + \text{Disappointment} + \text{Importance} + \text{Responsibility} + \text{Minimise loss} + \text{Sunk costs} + \text{Control} + \text{Image} + (\text{Intentions} * \text{Image}) + (\text{Risk} * \text{Image}) + (\text{Disappointment} * \text{Image}) + (\text{Importance} * \text{Image}) + (\text{Responsibility} * \text{Image}) + (\text{Minimise loss} * \text{Image}) + (\text{Sunk costs} * \text{Image}) + (\text{Control} * \text{Image})$ ].

With the addition of the interaction items the model's ability to predict funding increased from 55% to 59% ( $R^2 = 0.594$ ,  $F = 5.842$ ,  $p<0.000$ ). This increase was significant at the  $p<.05$  level. Therefore, these data indicate that image compatibility does moderate the relationship between decision outcomes and problem space perceptions.

To determine the nature of the interaction between image compatibility and the group of eight problem space items the compatibility measure was split at the mean into two groups, a low compatibility group and a high compatibility group (Dunegan, Duchon & Ashmos, 1995, 36). The ability of problem space items to predict the level of funding in the High and Low image ranges was similar. The result of the regression model for Low image compatibility was ( $F = 3.925$ ,  $p < .002$ ,  $R^2 = .452$ ). The result of the regression model for High image compatibility was ( $F = 2.714$ ,  $p < .022$ ,  $R^2 = .420$ ). However, when the image compatibility was low, the predictability was statistically significant.

#### 4.9 Additional Tests of the Data

The internal structure of the eight problem spaces was explored by a principal-component analysis with an orthogonal Varimax rotation. By specifying a minimum eigenvalue of 1.0, three factors were determined to be contributing significantly to the patterning of variables. These three factors accounted for 81.7% of the variance (cut off at .30) between the factors identified by the principal- component analysis.

Insert Table 9 Here

Extraction method: Principal Component Analysis.

Rotation method: Varimax with Kaiser Normalisation.

Rotation converged in 5 iterations.

\* The response scale for this item was reversed; therefore negative result indicates a positive correlation

The prominent item in Component 1 was sunk cost which combined with the other items in the factor suggested the title "sunk cost" as an appropriate descriptor. The details of the component matrix for all three factors are presented in Table 9. As expected, the sunk cost was a major issue in the decision to commit to further investment in the project. This is positively correlated with the amount of funds allocated and provides additional support for the existence of the sunk cost effect.

The combination of items in Component 2 was suggestive of the concept of the "autocentric" style as this consisted of items relating to personal feelings of importance, responsibility, and control. Accordingly, the term autocentric appeared to be an appropriate descriptor for this factor. Component 2 was consistent with cognitive and personality variables which suggest an autocentric side to the behaviour. That is the person was more likely to be responding to issues concerning the perceived level of personal responsibility and locus of control over the events. That all three items were positively correlated is consistent with the notion that these are underlying drivers which when combined would motivate a person to commit further funds to an investment.

The items in Component 3 were suggestive of the concept of "risk" with the prominent items being risk, and disappointment. Accordingly, the term risk appeared to be an appropriate descriptor for this factor. This component was

intuitively consistent with the notion of risk utility, with both the level of disappointment in the progress of the project and the level of perceived risk.

Separate descriptive statistics were computed for the data in each of the three framing conditions. A brief examination of the results indicates that two problem space elements were significantly correlated with funding when the frame was positive. In addition, one problem space element was significantly correlated with funding when the problem space was negative and the sunk cost lower.

## 5. Discussion

First, the granting of additional funds was significantly higher for a positive framed task than a negative framed task that had the same level of sunk cost. This finding was contradictory to the predicted risk propensity of prospect theory. However, the findings were consistent with some other studies. When the amount of sunk cost was reduced, the provision of additional funds increased. Task version "3" consisted of a negative frame with low sunk cost. However, the interesting aspect of this result was that the positive frame produced a higher mean funding outcome than the negative frame which implies that the positive framing elicited risk-seeking behaviour contrary to the prediction of prospect theory.

Second, the perception of responsibility for the initial decision was found to exert an influence over the amount of funding provided. Staw and Ross (1978) predicted that responsibility for the initial decision would cause subjects to escalate their commitment as a form of justification that the initial decision was correct. The results support this theory since the level of responsibility was positively correlated with the level of funding provided.

Third, the results of the test concerning the problem space were not consistent with the previously reported findings. The results indicated that the positive framed scenarios exhibited stronger cognitive relationship to the problem space perceptions than the negative framed scenarios. This is incongruent with the findings of Dunegan Duchon & Ashmos (1995). They found that the negative framing resulted in a stronger relationship to the amount of funding.

A number of possible explanations and observations are considered here. First, that the negative framing did not elicit the expected cognitive behaviour may be due to the unexpected risk-avoidance exhibited in the negative framed outcomes. The negative frame should cause decision makers to exhibit risk-seeking behaviour, which would be manifest in the means of the funding being larger (not smaller) than the positive framed scenario outcomes. Second, the additional information and modifications to the wording of the task may have been responsible. The respondents may have felt more certainty about the financial situation and this could also explain the higher funding in the positive framed scenario. The significantly different (higher amount of funding) from the positive frame suggests that the information may well have influenced characteristics of the cognitive modes exhibited by the subjects in their decision making.

Fourth, testing of image compatibility produced mixed results. Consistent with the theory, low image compatibility was a significant predictor of the level of funding. The surprise finding was that high image compatibility was also a significant predictor of the level of funding. However, the statistical significance was smaller compared to that of the low image compatibility and the percentage increase in the  $R^2$  was also smaller by comparison.

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Table 1. Summary of Task Details Pertaining to R&amp;D Reinvestment (N=86).

Version	Wording	Framing
1 (n=31).	High Sunk Cost (\$400 000).	Negative
2 (n=33).	High Sunk Cost (\$400 000).	Positive
3 (n=22).	Low Sunk Cost (\$100 000).	Negative

Table 2. Summary of Variables for Reinvestment Decision

Variable Category	Number	Details
<b>Treatment Effect:</b> (Treatment Variables).	One	Framing (positive vs negative). Sunk Cost (high vs low).
<b>Demographic Variables:</b> (Independent Variables). [Predictors]	Two	Problem space inventory Image compatibility
<b>Dependent Variables:</b> (Criterion Variables).	Two	Choice to provide NIL funds Choice to provide a level of funds

Table 3. Descriptive Details of Investment Task

<i>Task version</i>	<i>N</i>	<i>Mean</i>	<i>Std. Deviation</i>
1 Negative~S/C High	31	39 354	22 536
2 Positive~S/C High	33	53 484	25 601
3 Negative~S/C Low	22	60 227	29 296
Total	86	50 116	26 667

Table 4. Multiple Regression – Funding Regressed on All Eight Problem-Space Measures (Negative~1).

	<i>Measure</i>	<i>F</i>	<i>dfs</i>	<i>R2</i>	<i>Adjusted R2</i>	<i>Standardised beta coefficients</i>	<i>t</i>	<i>Sig.</i>
1	Funding	2.149	8, 22	.439	.235			
2	Intentions					0.504	2.614	0.016
3	Risk					-0.192	-1.101	0.283
4	Disappointment					-0.215	-1.192	0.246
5	Importance					0.020	0.096	0.924
6	Responsibility					0.162	0.790	0.438
7	Minimise loss					0.279	1.283	0.213
8	Sunk costs					-0.028	-0.112	0.912
9	Control					-0.059	-0.305	0.764

Table 5. Multiple Regression – Funding Regressed on All Eight Problem-Space Measures (Positive~ 2).

	<i>Measure</i>	<i>F</i>	<i>dfs</i>	<i>R2</i>	<i>Adjusted R2</i>	<i>Standardised beta coefficients</i>	<i>t</i>	<i>Sig.</i>
1	Funding	5.122*	8, 24	.631	.507			
2	Intentions					0.248	1.822	0.081
3	Risk					-0.559	-3.621	0.001
4	Disappointment					0.002	0.013	0.990
5	Importance					0.254	1.344	0.191
6	Responsibility					0.289	1.896	0.070
7	Minimise loss					0.193	1.189	0.246
8	Sunk costs					0.206	1.310	0.203
9	Control					-0.152	-0.894	0.380

\* Significant at  $p < 0.001$

The analysis of the positive framed task found 63.1% of the variance in funding could be explained by the eight independent variables (perception of problem space). in the positive framed scenarios. The framing condition was significant at  $F=5.122 (8,24)$ ,  $p<.001$ .

Table 6. Multiple Regression – Funding Regressed on All Eight Problem-Space Measures (Negative~ 3).

	<i>Measure</i>	<i>F</i>	<i>dfs</i>	<i>R2</i>	<i>Adjusted R2</i>	<i>Standardised beta coefficients</i>	<i>t</i>	<i>Sig.</i>
1	Funding	3.223*	8, 13	.665	.459			
2	Intentions					0.358	1.672	0.118
3	Risk					-0.272	-1.224	0.243
4	Disappointment					-0.329	-1.390	0.188
5	Importance					-0.104	-0.491	0.631
6	Responsibility					0.310	1.521	0.152
7	Minimise loss					0.233	1.319	0.210
8	Sunk costs					0.173	0.756	0.463
9	Control					-0.139	-0.728	0.480

\* Significant at  $p < 0.030$

The analysis of the negative framed task with low sunk cost found that 66.5% of the variance in funding could be explained by the eight independent variables in the positive framed scenarios. The framing condition was significant at  $F=3.223 (8,13)$ ,  $p<.030$ .

Table 7. Component Matrix

	Component
	<b>1</b>
Close	.923
Terms	.914
Moving	.909
Given	.870

Table 8. Overall Means, Standard Deviations and Correlations (N=86).

	Variable	M	SD	1	2	3	4	5	6	7	8	9
1	Funding	50.11	26.67	-								
2	Image	17.84	6.08	.674*								
3	Intentions	3.65	.97	.300*	.188							
4	Risk	3.56	.99	-.446*	-.425#	.046						
5	Disappointment	3.29	1.12	-.310*	-.258#	-.003	.448*					
6	Importance	3.67	1.11	.081	.039	.079	.071	.286*				
7	Responsibility	3.08	1.31	.383*	.291*	-.024	-.153	.032	.333*			
8	Minimise loss	2.60	1.28	.155	.084	-.132	-.177	-.208	-.133	.005		
9	Sunk costs	3.95	1.37	.243#	.170	.316*	.106	.124	-.018	.146	-.407*	
10	Control	4.27	1.54	-.064	-.014	.048	-.045	.119	.344*	.112	.078	-.167

# Significant at 0.05 level (2-tailed). \* Significant at 0.01 level (2-tailed).

Table 9. Rotated Component Matrix

	Component		
	1	2	3
Sunk	<b>.854</b>		
Minimise	<b>-.644*</b>		-.321
Intention	<b>.584</b>		
Importance		<b>.801</b>	
Control		<b>.661</b>	
Responsibility		<b>.651</b>	
Risk			<b>.830</b>
Disappointed			<b>.798</b>





## Empirical Test of the Relationship between the Performance and the Concentration on Stocks of Chinese Security Investment Funds

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### Abstract

The concentration on stocks of security investment funds reflects fund managers' utilization degree of the inefficiency of market, so certain relationship exists between the performance of funds and the concentration on stocks. By analyzing practical data of Chinese stock investment funds, the relationship between the performance and the concentration on stocks is tested in the article, and the result shows that properly high concentration on stocks can help to enhance the risk adjusted return of funds, but too high concentration on stocks will influence the timing selection of funds. And in the test, some different results are discovered.

**Keywords:** Fund, Performance, Concentration on stocks

### 1. Introduction

The security investment funds, as one of most important institutional investors in the security market, are always concerned by the market participators. Their investment performances, performance sources and risks are key factors which are concerned by most investors and supervisors. At the same time, in theory, whether the actively managed funds can continually acquire excess incomes is one important factor to test the efficiency of the market, so it is very important and meaningful to study the performance of funds both in theory and in practice.

In fact, in 1960s, based on the theory of CAPM, Treynor (Treynor, 1965, P.131-136), Sharpe (Sharpe, 1966, P.119-138) and Jensen (Jensen M, 1968, P.389-416) took the risk adjusted return as the performance evaluation index of funds to replace originally single index of yield, and these indexes about the risk adjusted return including the three-factor model proposed by Fama & French (Treynor, 1966, P.131-136) based on that became into classic performance evaluation indexes of funds, which have been applied widely up to now. In addition, in Treynor & Mazuy (Treynor, 1966, P.131-136)'s model, the source of the fund performance were divided into the stock selection ability and the timing selection ability of funds, and Henriksson & Merton (Henriksson, 1981, P.513-533) also put forward similar model subsequently, and these two selection abilities were adopted by many researches. And the research about the performance of funds had been the durative hot spot from that time.

In China, the industry of funds just started from 1990s, and it have been developed quickly in recent years, and with the accumulation of data, the theory and empirical researches taking domestic funds as the objects are more and more. For example, in 2001, Wang Cong (Wang, 2001, P.31-38) early introduced and evaluated the foreign fund evaluation model in detail, and at the same year, Shen Weitao and Huang Xingluan (Shen, 2001, P.22-30) applied the model which had been widely used in the foreign fund performance to empirically study the performance of Chinese security investment funds with short history. After that, Wu Chongfeng et al (Wu, 2002, P.128-133) also completely reviewed the theories of west security investment fund performance evaluation, and Zhang Xin and Du Shuming (Zhang, 2002, P.1-22) comprehensively measured the performances of domestic funds by the classic performance evaluation indexes of funds, and discussed the timing selection ability of funds, the risk diversification degree and the asset allocation.

Except that taking the risk adjusted return as the measurement index to review the performance of fund, the concentration on stocks is also used to directly judge the asset management ability of funds, for example, in 1997, according to the character of the concentration on stocks of funds, Daniel (Daniel Kent, 1997, P.1035-1058) studied whether the funds could select the stocks with positive excess incomes in the stocks with same characters, and in 2006, Hu Wei and Zhang Ming (Hu, 2006, P.26-32) used similar method to study the stock selection ability of domestic funds.

In fact, to study the concentration on stocks of funds, except for establishing the performance evaluation index which is different with the classic model, the relationship between the performance of funds and the concentration on stocks can be also studied. Marcin et al (Marcin, 2005, P.1983-2011) put forward that if the fund managers had some advantages in some industries, the investment combinations managed by them might centralize in a few industries, not in every industry, and they empirically tested the common actively managed funds of US from 1984 to 1999, and the result indicated that when the risk and the style difference are controlled, the funds centralized in a few industries would obtain better performance. In the research about the US mutual Funds from 1984 to 2002, Hany & David (Hany, 2005,

P.481-495) proved above opinion, and they found that the funds with good concentration on stocks had good performance, and after considering the charges and other characters, they thought the performance of funds was positively correlative with the stock holding amount. Many domestic scholars also developed the research about this aspect, and Liang Bin (Liang, 2007, P.7-11) reviewed the relationship between the performance and the concentration on stocks of Chinese close-ended funds in 2007, and the result showed that the performance of the funds with centralized stock holding were better than the funds with dispersive stock holding, and Xie Hongtao & Zhou Shaofu (Xie, 2008, P.52-56) studied the data of Chinese open-ended funds from 2003 to 2007, and found that the asset allocation concentration in the selection of stocks could bring excess incomes for funds, and too high industrial concentration would bring losses for funds.

Above research results are not consistent completely, but these opinions are very meaningful, that is to say, as the fund managers who are the experts managing the investment portfolios, whether they should trust that they have the ability to win in the market and should focus in their familiar domains to look for proper investment opportunities, or they should believe traditional theory about the investment portfolios, i.e. reducing the risks by the diversification investments? Based on above research ideas and the data of domestic stock funds, the relationship between the performance of funds and the concentration on stocks is discussed as follows.

## 2. Theoretical model

According to traditional investment portfolio theory, the diversification investment can reduce the risks, so the fund managers, as the investment expert, should invest capitals in more stocks as possible to acquire same benefits when the risks are possibly low. However, a premise must be considered, i.e. the market should be efficient. But the market is often inefficient, and the inefficiency of the market is just one important reason for the existence of funds. Just thinking, if the market is efficient and the pricing of all securities are reasonable, so investors can directly invest in stocks, and why they let experts to manage their capitals? Therefore, for the funds investors, the fund managers should try to look for the mispriced stocks in the market to obtain the premium over the average return in the market (except for the index funds), but fund managers have only limited energies and resources, and facing thousands of stocks in the market, they can not pay attention to each one, so the reasonable method is to pay attention to part of stocks or industries which they are familiar. Therefore, the first deduction can be obtained.

The funds with high stock holding or industrial concentration on stocks should have better performances.

Though the market is not completely effective, but the function of the diversification investment to reduce the risks still exists. Except for the returns, the risks should also be considered more when we evaluate the performances of funds, for example, whether they take the risk adjusted returns as the evaluation index of fund performance. Therefore, when the concentration on stocks of funds is too high, the risks will increase and the performances will be influenced. So the second deduction which is similar with Hany & David's (Hany, 2005, P.481-495) can be obtained.

The performance of the funds with too high stock holding or industrial concentration on stocks will descend.

Next, the data of domestic stock funds will be used to test above two deductions.

### 2.1 Index of fund performance

There are many indexes to reflect the performances of funds.

(1) The excess yield ( $y$ )

$$y = R_{Fund} - R_{Mkt} \times Ratio \quad (1)$$

Where,  $R_{Fund}$  and  $R_{Mkt}$  respectively are the net yield of the fund and the market index yield, and  $Ratio$  is the stock holding proportion of this fund. This index directly reflects the excess return of the stock part in the fund in the whole stock market, and the risks are not considered.

(2) Jensen index ( $jensen$ )

$$jensen = (R_{Fund} - R_f) - \beta \times (R_{Mkt} - R_f) \quad (2)$$

Where,  $R_f$  is the risk free rate,  $\beta$  is the value of Beta obtained according to the model of CAPM, and it reflects the system risk. This index is a risk adjusted return index comprehensively considering the incomes and risks, and it is the usual performance evaluation index of funds.

(3) Net asset volatility ( $vol$ )

$$vol = \sqrt{\frac{1}{n-1} \sum_{i=1}^n (R_i - \bar{R})^2} \quad (3)$$

Where,  $R_i$  is the return of net asset of the fund at the  $i$ 'th term, and  $\bar{R}$  is the average value of  $n$  terms. This index is not a performance evaluation in fact, and it is just a risk index reflecting the instability of the return. It can be used to show

the risks of the funds with different concentrations on stocks.

(4) Treynor & Mazuy (Treynor, 1966, P.131-136)'s stock selection ability and timing selection ability (*ss* and *tim*)

$$R_{Fund} - R_f = ss + \beta \cdot (R_{Mkt} - R_f) + tim \cdot (R_{Mkt} - R_f)^2 + \varepsilon \quad (4)$$

This model can decompose the excess return of the fund, and *ss* and *tim* can be obtained by the regression, and they respectively denote fund managers' abilities to select stock and select the market opportunity.

## 2.2 Index of concentration on stocks

In different researches, there are many indexes to denote the concentration on stocks of funds, for example, Marcin et al (Marcin, 2005, P.1983-2011) established a index to measure the industrial concentration on stocks by computing the difference between the proportion of stocks in each industry in the stock portfolio and the proportion that the industry in the market combination. Hany & David (Hany, 2005, P.481-495) directly used the amount of stock hold by the fund to measure the concentration. And Travis & Yan (Travis, 2008, P.27-49) used same index with Marcin et al (Marcin, 2005, P.1983-2011) in the stock concentration degree from the industrial concentration, and called it as the Herfindahl index, and obtained same result. Liang Bin et al (Liang, 2007, P.7-11) used the Gini coefficient and Herfindahl index, and Xie Hongtao & Zhou Shaofu (Xie, 2008, P.52-56) used the index which is similar with Marcin's. The Herfindahl index used by Liang Bin et al was an index to measure the market concentration degree of certain industry in the market. This index can better reflect the stock holding concentration of funds, so it is used to denote the stock holding concentration of funds ( $H_{stk}$ ) and the concentration of industry ( $H_{ind}$ ).

$$H_{stk} = \sum_i w_{stk,i}^2 \quad (5)$$

$$H_{ind} = \sum_i w_{ind,i}^2 \quad (6)$$

Where,  $w_{stk,i}$  and  $w_{ind,i}$  respectively denote the market value proportions of the  $i$ 'th stock and the  $j$ 'th industry holding stocks in all stocks. From (5) and (6),  $H$  is bigger, it denotes that stock invested by the fund is more centralized in individual stock or individual industry, and when  $H$  equals to 1, the fund completely invests in certain one stock or one industry. Therefore,  $H$  is bigger, and the concentration degree is higher.

## 2.3 Regression model

Based on the practical data of domestic stock investment funds, the regression model is used to test the relationship between the performance and the concentration on stocks. According to former two deductions, the following regression models are used in the research.

$$Per_{i,t} = \alpha + \beta \cdot H_{i,t} + \gamma_1 \cdot D_{1,t} + \gamma_2 \cdot D_{2,t} + \gamma_3 \cdot D_{3,t} + \varepsilon_{i,t} \quad (7)$$

$$Per_{i,t} = \alpha + \beta_1 \cdot H_{i,t} + \beta_2 \cdot H_{i,t}^2 + \gamma_1 \cdot D_{1,t} + \gamma_2 \cdot D_{2,t} + \gamma_3 \cdot D_{3,t} + \varepsilon_{i,t} \quad (8)$$

Where,  $Per_{i,t}$  denotes the performance of the  $i$ 'th fund in the year of  $t$ , i.e. those indexes from the formula (1) to the formula (4).  $H_{i,t}$  denotes the stock holding concentration or the industry concentration of the  $i$ 'th fund in the year of  $t$ .  $D_1$ ,  $D_2$  and  $D_3$  are dummy variables, and because the panel data from 2004 to 2007 are selected, and the data in each year are significantly different, so these three dummy variables are introduced to denote the years.

$$D_{1,t} = \begin{cases} 1 & t = 2005 \\ 0 & else \end{cases} \quad D_{2,t} = \begin{cases} 1 & t = 2006 \\ 0 & else \end{cases} \quad D_{3,t} = \begin{cases} 1 & t = 2007 \\ 0 & else \end{cases}$$

$\alpha$ ,  $\beta$  and  $\gamma$  are parameters, and  $\varepsilon$  is the residual error. According to the anticipation in above discussions,  $\beta$  in (7) should be positive, and  $\beta_1$  in (8) should be positive but  $\beta_2$  in (8) should be negative (the instance that *vol* denotes the performance is not included).

## 3. Data

The data of Chinese stock funds from 2004 to 2007 are used to empirical test the index, and all data are picked up from the financial terminal of Wind. For each fund, one performance evaluation index in each year is computed, and the week data are used to compute the risk return index and the stock selection ability and the timing selection ability, and the data of the end of last year are used to compute the index of concentration degree.

Table 1 is the description statistics for the data used in the article.

From the average data of various funds, both the excess yield and the risk adjusted return all exceed zero, and comparing with the whole market, the funds have certain advantages, but there are large differences in different years. The risk indexes, the stock selections and the timing selections are also different in different years. The stock holding concentrations of fund and the industrial concentrations change little in different years.

#### 4. Empirical result and analysis

The regression results of the formula (7) and the formula (8) are seen in Table 2 and Table 3.

From Table 2, the regression coefficient of Jensen index to the concentration on stocks is significantly positive, which indicates that the risk adjust return of the fund with centralized stock holding is higher, and the regression coefficient of the volatility (*vol*) to the concentration on stocks is significantly negative, which shows the fund with high stock holding concentration can better control the net asset volatility, and there is another possibility, i.e. the high risk adjusted return of these funds comes from the control of risk. In addition, though the regression coefficients of the timing selection and the stock selection to the concentration on stocks are positive, but they are not significant.

For the relationship between the performance of funds and the concentration on stocks, the regression coefficient of Jensen index to the industrial concentration is significantly positive, which reflects that the funds with high industrial concentration can acquire better performances, but being different with the regression to the concentration on stocks, the regression coefficient of the volatility to the industrial concentration is positive, but not significant, which indicates that the risk adjusted returns of these funds come from actual returns, not controlling risks. In addition, the regression coefficient of the stock selection to the industrial concentration is significantly positive, which shows that the funds which absorbed in certain industries have the ability to select the predominant stocks in the industry or predominant industries.

In the regression results of the fund performances to the concentration on stocks and its square item, the regression result of the timing selection index accords with the anticipation, i.e. the first-order item is positive, and the second-order item is negative, and both of them are significant. That indicates that the funds with proper concentration on stocks have strong timing selection ability, and the funds with higher or lower concentration possesses weak timing selection ability. The regression coefficients of other performance indexes to the concentration on stocks and its square item are not significant, which doesn't support above deductions.

In the regression results of the performance to the industrial holding concentration and its square item, only the regression result of the stock selection index can narrowly accord with the anticipation, i.e. the first-order item is positive, and it is significant under 10%, and the second-order item is negative, but not significant. That shows the funds with proper industrial concentration have better stock selection ability than other funds with higher or lower industrial concentration. But the regression result of the timing selection index is opposite with the anticipation, i.e. the first-order item is negative, and the second-order item is positive, and both of them are significant. That indicates the funds which are absorbed in a few industries and are decentralized in various funds have stronger prediction ability for the market index, i.e. they have strong timing selection ability, but the funds which are dispersed properly in industrial allocation may more concern the stock selection in the industry, and they less predict the market index, and possess weak timing selection ability.

#### 5. Conclusions

Through the analysis of the empirical data of the relationship between the fund performance and the concentration on stocks in China, following results can be obtained.

- (1) When the risk adjusted return is the index to evaluate the performance of funds, the funds with higher concentration on stocks have good performance, which may comes from the control of risks.
- (2) When the risk adjusted return is the index to evaluate the performance of funds, the funds with higher industrial concentration on stocks have good performances. At the same time, the funds with higher industrial concentration on stocks have stronger stock selection ability.
- (3) The funds with lower or higher concentration on stocks have weak timing selection ability.
- (4) The funds with lower or higher industrial concentration on stocks have strong timing selection ability.

According to above results, when the funds hold centralized stocks, the fund managers have times and energies to carefully study and analyze the stocks which they hold, and they can select the stock portfolio with low risks and high returns to invest, but when the holding stocks are too centralized, the difficulty to adjust the fund position will increase, so the timing selection ability will decrease. But when the holding stocks are centralized in certain industries, the fund managers have times and energies to carefully study and analyze these industries, so they can select the stocks with high incomes and low risks in these industries to invest, and as viewed from the timing selection ability, the funds with proper industrial concentration have weak timing selection ability, that may be because these funds pay more attention to the analysis and comparison of the stocks in various industries, but ignore the prediction and analysis of the whole market, and the funds with lower or higher industrial concentration will have higher timing selection ability because they will expense limited energies to select or analyze the industries.

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Table 1. Descriptive statistics of various variables

Year	Sample amount	Statistics	$y$	$jensen$	$vol$	$ss$	$tim$	$H_{stk}$	$H_{ind}$
2004	62	MIN	0.33	-0.0006	11.89	-0.0012	-1.41	0.01	0.04
		MAX	30.02	0.0050	18.72	0.0055	1.01	0.10	0.66
		MEAN	9.82	0.0016	15.69	0.0018	-0.22	0.05	0.32
		STD	5.73	0.0012	1.37	0.0011	0.53	0.02	0.11
2005	76	MIN	-2.46	-0.0009	11.75	-0.0016	-2.31	0.01	0.17
		MAX	22.36	0.0039	22.52	0.0050	4.68	0.09	0.57
		MEAN	10.73	0.0017	15.89	0.0010	0.85	0.04	0.28
		STD	5.17	0.0010	1.66	0.0011	0.99	0.02	0.09
2006	92	MIN	-22.42	0.0000	14.50	0.0015	-4.40	0.01	0.13
		MAX	75.11	0.0079	29.89	0.0088	-0.14	0.12	0.63
		MEAN	20.10	0.0035	21.18	0.0044	-2.13	0.04	0.23
		STD	18.59	0.0014	2.97	0.0015	0.88	0.02	0.08
2007	127	MIN	4.14	0.0014	21.54	-0.0010	-2.57	0.01	0.15
		MAX	161.50	0.0130	34.69	0.0125	3.52	0.11	0.61
		MEAN	52.98	0.0053	27.72	0.0035	1.11	0.04	0.28
		STD	21.90	0.0020	3.09	0.0023	0.95	0.02	0.08

Table 2. Regression result of the formula (7)

Performance index (Per)	Intercept	$H_{stk}$	$H_{ind}$	$D_1$	$D_2$	$D_3$
$y$	9.88 (2.78)	-1.20 (-0.02)		0.90 (0.29)	10.28 (3.46)	43.16 (15.26)
$jensen$	0.001 (3.45)	0.009* (1.76)		0.000 (0.96)	0.002 (7.53)	0.004 (14.62)
$vol$	16.76 (31.78)	-16.65** (-2.02)		-0.12 (-0.25)	4.89 (11.10)	11.15 (26.58)
$ss$	0.001 (3.69)	0.008 (1.53)		-0.001 (-2.34)	0.003 (9.26)	0.002 (5.69)
$tim$	-0.34 (-1.80)	2.51 (0.86)		1.21 (7.37)	-1.85 (-11.79)	1.42 (9.54)
$y$	7.39 (1.83)		7.67 (0.73)	1.16 (0.37)	10.94 (3.54)	43.45 (15.24)
$jensen$	0.001 (1.89)		0.003*** (2.87)	0.000 (1.19)	0.002 (7.98)	0.004 (14.94)
$vol$	15.73 (26.05)		0.70 (0.45)	-0.05 (-0.10)	5.03 (10.89)	11.22 (26.33)
$ss$	0.001 (2.29)		0.002** (2.44)	-0.001 (-2.16)	0.003 (9.53)	0.002 (5.94)
$tim$	-0.14 (-0.68)		-0.22 (-0.40)	1.19 (7.25)	-1.88 (-11.49)	1.41 (9.35)

Note: The values in the brackets are statistics of  $t$ , \*, \*\* and \*\*\* respectively denote the significances under the level of 10%, the level of 5% and the level of 1%. The significance of the regression coefficients of variables about the concentration on stocks is only concerned, and the significances of other variables are not considered here.

Table 3. Regression result of the formula (8)

Performance index (Per)	Intercept	$H_{stk}$	$H_{ind}$	$D_1$	$D_2$	$D_3$	$H_{stk}$	$H_{ind}$
$y$	15.76 (2.59)	-239.03 (-1.15)	2,179 (1.19)			0.75 (0.24)	9.95 (3.34)	42.90 (15.14)
$jensen$	0.001 (1.18)	0.027 (1.46)	-0.167 (-1.03)			0.000 (1.00)	0.002 (7.59)	0.004 (14.66)
$vol$	16.97 (18.76)	-25.29 (-0.82)	79.18 (0.29)			-0.12 (-0.26)	4.88 (11.01)	11.14 (26.44)
$ss$	0.002 (2.92)	-0.010 (-0.50)	0.168 (0.94)			-0.001 (-2.38)	0.003 (9.14)	0.002 (5.60)
$tim$	-0.86 (-2.68)	23.55** (2.16)	-192** (-2.01)			1.22 (7.49)	-1.82 (-11.6)	1.45 (9.72)
$y$	6.63 (0.86)			12.85 (0.28)	-7.78 (-0.12)	1.14 (0.36)	10.98 (3.53)	43.43 (15.18)
$jensen$	0.001 (0.86)			0.003 (0.81)	-0.001 (-0.16)	0.000 (1.18)	0.002 (7.94)	0.004 (14.88)
$vol$	15.38 (13.40)			3.04 (0.45)	-3.51 (-0.35)	-0.05 (-0.11)	5.05 (10.85)	11.21 (26.20)
$ss$	0.000 (0.11)			0.008* (1.82)	-0.008 (-1.3)	-0.001 (-2.2)	0.003 (9.62)	0.002 (5.85)
$tim$	0.77 (1.92)			-6.43*** (-2.7)	9.33*** (2.68)	1.21 (7.44)	-1.92 (-11)	1.44 (9.61)

Note: The values in the brackets are statistics of  $t$ , \*, \*\* and \*\*\* respectively denote the significances under the level of 10%, the level of 5% and the level of 1%. The significance of the regression coefficients of variables about the concentration on stocks is only concerned, and the significances of other variables are not considered here.



# A Reappraisal of Trade Deficit and Income Inequality in the United States: 1985-2007

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## Abstract

The recent resurgence of income inequality in the United States has spawned a wide-ranging discussion to its causes, which has often focused on America's historically high trade deficit in the past two decades. Our paper revisits this issue by investigating the latest trends in the U.S. income disparity from 1985 to 2007, and systematically examining the factors that might have influenced the income inequality. To better understand income disparity, three different measures are employed: Gini, Theil and Atkinson indices. Results show that, only in the cases of Gini and Theil, international trade explains a part of income inequality, but it surely cannot be the whole story. Other factors, such as the net migration rate, the changing role of women, and the sectoral distribution of employment also play important roles in accounting for America's income inequality.

**Keywords:** Income Inequality, Trade Deficit, Gini, Theil, Atkinson

## 1. Introduction

The recent resurgence of income inequality is one of the most difficult economic problems confronting the world today, which poses great challenges to policymakers in both advanced industrial societies and emerging market economies.

Kuznets (1953 and 1955) conjectures that income inequality will first rise, peak, level off and then decline as an economy reaches a certain level of prosperity. In the case of the U.S., for instance, historical data before 1920s had verified the success of Kuznets hypothesis. However, the more recent empirical facts suggest a radical reversal of Kuznets's findings. Harrison and Bluestone (1988) identified a "great U-turn" in the development pattern of income inequality, which presents the phenomenon of widening income disparity in the U.S. after the 1960s. At the same time, such an upswing in inequality has also been experienced by other developed countries such as the United Kingdom. As Bernanke (2008) points out, even though average economic well-being has increased considerably over time, the degree of inequality in economic outcomes over the past three decades has increased as well. Economists are eager to grapple with the reasons for this trend, which has spawned a wide-ranging debate with no consensus that has been achieved by far. Diverse factors that might influence income inequality have been proposed, and among them, globalization is most frequently under the spot light.

Our paper aims to fill the gap in the literature by documenting the most recent trends in the U.S. income disparity from 1985 through 2007, and then studying the distributional impact of globalization, in particular, the trade deficit, on the inequality.

Two features are noteworthy here. First of all, in previous literature, globalization is usually measured in terms of foreign direct investment (FDI), the north-south trade and migration. In the current framework, we introduce a new element in addition to those three distinct aspects and evaluate the degree of openness in terms of the trade balance with the rest of the world. Statistics show that in the past two decades, the U.S. trade deficit has soared to unprecedented heights, surpassing the levels reached in the 1980s. This record deficit is fueling public concerns that it could badly hurt the U.S. economy by destroying domestic jobs, lowering wages, raising corporate profits, burdening future generations, and in turn leading to a rising income inequality. Some trade protectionists therefore, advocate that international trade should be boycotted in order to eliminate the negative impact of globalization on income distribution. Is their argument true? Is the U.S., as they claimed, trading away its future? Our paper tries to answer this question by applying a generalized linear regression model to assess the ways in which the trade deficit relates to the income inequality.

Secondly, to better understand the income disparity, three different measures are employed, among which the Gini coefficient is so far the most popular and widely used indicator. However, Gini coefficient is not always an adequate measurement of inequality, since it is only able to provide a general image of the level of aggregate income disparity. Our paper contributes to the literature by incorporating another two metrics into our model: Theil index and Atkinson index. Therefore, a more accurate description of the impact of globalization on the actual income distribution is presented.

Our results show that, only in the cases of Gini and Theil indices, international trade explains a part of income inequality. It is found that the imports from southern countries and trade deficit actually decrease Gini index by pushing down the aggregate price level and therefore improving the overall economic conditions. In addition, trade deficit tends to shrink the disparity at the higher end of the income spectrum as well, measured by Theil index, but its role appears to be secondary. In the case of Atkinson coefficient, the impact of trade on income inequality is not significant at all. Other factors, such as the changing role of women, the net migration rate and the sectoral distribution of labor force are also found to be very important in accounting for America's rising income disparity in the last two decades.

The remainder of this paper is organized as follows. In Section 2, we present a brief review of the literature on globalization and income inequality. In Section 3, the empirical evidence of U.S. income inequality from 1985 to 2007 is introduced. In Section 4, we set up a generalized regression model with a set of explanatory factors to understand such a rising inequality. In Section 5, the regression results are presented and policy measures will be briefly discussed. Section 6 is a conclusion.

## **2. Literature Review**

By far, a number of empirical studies have contributed to the literature by investigating the channel through which globalization affects income inequality. The results, however, are mixed.

For example, Mahler (2001) finds little evidence of a systematic relationship between globalization and income distribution. Instead, politics continues to dominate in determining distributive outcomes in the developed world. On the other hand, Miller (2001) argues that a significant increase in income disparity results from globalization. Such economic integration has changed the structure of production in U.S. by outsourcing unskilled-intensive jobs to low-income countries, and therefore depressed the relative wages of unskilled workers in the U.S. since the late 1970s. Almost at the same time, Dollar and Kraay (2002) obtain some other interesting results. They use an unbalanced data of 92 countries spanning four decades (1960 – 1999), and show that the openness to international trade has insignificant effect on the income share of the bottom quintile. Then, Scott (2001) maintains that international trade itself does not suffice to assume convergence of income between countries. He points out that immigration barriers set up by the highly developed countries prevent wage equalization and therefore create wider income gaps.

In sum, there is a large body of literature examining the impact of globalization, particularly, international trade, on income distribution. Alderson and Nielsen (2002) is one of the most influential pieces of work. Their study represents one of the first systematic, cross-national examinations of the role of globalization in the inequality "U-turn". The results indicate that the percentage of the labor force in agriculture dominates globalization in explaining the increasing trend in inequality within and across countries. However, their work is subject to substantial data limitations. Only 57 observations from the Luxembourg Income Study (LIS) are available for 16 Organization of Economic Co-operation and Development (OECD) countries and therefore, methods of estimation have to be employed to provide more comparable information. The paucity of data, with no doubt, has hampered their cross-national and longitudinal study. Moreover, all observations focus on the period from the late 1960s to the early 1990s.

Our paper follows the footsteps of Alderson and Nielsen and tries to explain the most recent patterns in the U.S. income inequality. A panel data set is carefully assembled, containing 575 observations for 25 variables over 23 years, i.e. 1985-2007 (see Table 1 for details).



### 3. An Overview of the U.S. Income Inequality

A natural place to begin is by studying the empirical evidence. The following section first presents the overall trend in the U.S. income inequality. Then, the impulse function from a “structural vector autoregression” (VAR) estimation is employed to demonstrate the impact of international trade on income disparity.

#### 3.1 Income inequality and economic development

[Figure 1, 2 and 3 here]

Gini coefficient by far has been used the most extensively in the literature. It is derived from the Lorenz curve, which shows the percentage of total income earned by cumulative percentage of the population. This coefficient is a number between 0 and 1, which describes the degree of evenness of income distribution in a country. In general, a lower Gini coefficient indicates a more equitable distribution of wealth, while a higher Gini value implies a more economically polarized society.

Gini coefficient is easy to generate, but is incapable of differentiating different kinds of inequalities. By assigning varying weights to different parts of the income spectrum and incorporating implicit social judgments, Atkinson (1983) introduced a new method - the Atkinson index. This measure is more concerned about inequalities at the bottom of the income distribution. Based on Atkinson, the Theil index was then developed. As an alternative inequality indicator, it pays more attention to inequalities at the top of the income distribution. For convenience, we multiply all three types of inequality coefficients by 100 and express them as an index between 0 and 100.

Since a large body of literature has examined the U.S. income disparity before 1990s, our paper therefore, will focus on its latest trend over 1985 through 2007. Figures 1 and 2 present the evolution of U.S. income inequality measured by Gini, Theil and Atkinson coefficient respectively. Ignoring the short-term variation, we observe a clear upswing in the overall income inequality since the mid 1980s. In particular, the Gini indices over the past two decades were all above 40, a level typically interpreted by economists as an "unfair" income distribution.

Figure 3 plots the logged real GDP (base 10) per capita against the income inequality, where the former is usually a measure of the economic development. As mentioned earlier, the Kuznets hypothesis suggests that a negative relationship between inequality and development should be found for advanced industrial societies. However, the recent stylized facts in the U.S. evidently show the opposite, which is demonstrated by the ascending slope of inequality and economic development in Figure 1, 2 and 3.

#### 3.2 The impact of trade balance on income inequality

[Figure 4 here]

To take a closer look at the relationship between globalization and income inequality, we estimate a structural four-variable VAR, including trade balance, Gini, Theil and Atkinson indices (see Note 1). Dynamic response functions are calculated and reported in Figure 4, which provides a convenient framework to investigate the impact of globalization on income disparity.

In this scenario, globalization is represented by trade balance. At the beginning, a temporary positive shock is introduced in trade balance, and then the responses in these three inequality indices are observed. It is clear that under a positive shock in trade balance (or trade surplus), all three indices rise on impact. A higher inequality index indicates a more polarized society, and vice versa. Therefore, Figure 4 shows that an improving condition in trade balance does not necessarily result in better social welfare as some economists expect. The opposite might occur instead as suggested by these VAR findings. In recent decades, a great deal of literature has concerned about the negative effect of the worsening U.S. trade balance on its income inequality. However, strong empirical evidence is absent to support such arguments. Starting in the next section, we will explore in details the ways that important economic indicators relate to the income inequality in the U.S., and then try to estimate the importance of each of them.

### 4. Methodology

What drives up the U.S. income inequality? The previous studies suggest that there is no single "smoking gun". After a thorough review of the stylized facts, we will proceed with an assessment of some leading factors that have been advanced to explain the income disparity.

#### 4.1 Model

In this section, the model of income inequality devised by Alderson and Nielsen (2002) is borrowed and then expanded to test hypotheses regarding the distributional impact of globalization, in particular, the trade deficit. The core model can be specified as follows:

$$ineq = f(sdu_{it}, l_t, m_t, dem_t, edu_t, union_t, glob_t) \quad (1)$$

where *ineq* is a particular inequality metric, such as Gini, Atkinson or Theil; *sdu* is the sector dualism, where *i* = a, manu, and s, denoting the agricultural, manufacturing and service sectors, respectively. Additionally, *l* is the aggregate labor market conditions, *m* is the monetary stability, *dem* is the demographic transition, *edu* is the overall education, *union* is the density of unionization, and finally *glob* represents the globalization. In the following section, we will explain how the above factors are measured.

## 4.2 Data

### 4.2.1. Sector dualism

The generalized sector dualism, as defined by Alderson and Nielsen (2002), measures the contributions to the overall inequality of differences in average income between sectors and the relative size of the sectors. The agricultural dualism, for instance, is written as

$$sdu_a = |l_a - gdp_a| \quad (2)$$

where  $sdu_a$  is the agricultural dualism,  $l_a$  is the percentage of labor force in agriculture and  $gdp_a$  is agriculture's share of GDP. The absolute value is taken to guarantee a positive value in the hypothetical case where the agricultural sector is more productive than the nonagricultural ones. The dualism for the manufacturing and service industry, can be defined in a likewise manner as follows

$$sdu_m = |l_{manu} - gdp_{manu}| \quad (3)$$

$$sdu_s = |l_s - gdp_s| \quad (4)$$

### 4.2.2. The aggregate labor market conditions

Three important aspects of the aggregate labor market conditions will be studied. Firstly, the distribution of the labor force across sectors. As proposed by Kuznets (1955), the agricultural sector, for instance, is typically associated with the lowest income inequality. Thus, the larger the agricultural sector, the lower the overall inequality. The indicator  $l_{it}$  is used to describe the sectoral size of labor force and the dynamic shifts taking place across sectors, where *i* = a, manu, and s. Secondly, we examine the changing role of women. Two kinds of arguments are taken into consideration. One studies the distributional implications of the increasing female labor force participation, and the other focuses on the rising proportion of households headed by women. Due to women's lower average earnings, either of these two factors is expected to be associated with a greater income disparity. Thirdly, the impact of the unemployment on income disparity is considered. It is well known that the turnovers in the labor market are likely to change the economic well-being of the workforce and therefore, lead to the relocation of household income.

### 4.2.3. The monetary stability

The recent literature has found that monetary policy and income inequality are possibly related (Fowler and Wilgus (2008)). The empirical evidence shows that, unexpected inflation acts to redistribute income by taxing the poor more heavily, since they hold a larger fraction of their wealth in cash. On the other hand, Bernanke (2003) argues that under certain conditions, accommodative monetary policy is able to mitigate the inequality. In this model, the monetary stability is captured by the annual inflation rate and fluctuations in the federal funds rate.

### 4.2.4. The Demographic transition

The shifts in the age distribution of the labor force are studied by looking at two variables here. One is the natural rate of population increase, which focuses on the cohort of young (less skilled) workers and the other is the seniority ratio of the population, measured by the percentage of people who are over 65 years old. The life-time income profile for an average worker shows that the youth and seniority are usually at the bottom of the earnings scale. As a result, we expect that both variables will exert positive effects on income disparity.

### 4.2.5. Education

It is important to recognize that the wage gap between college graduates and those with a high school education or less has widened since the middle 1980s. Such a shift in the return to education implies that the educational attainment of the workforce surely affects income disparity. This dispersion of education is measured by the college graduates ratio. Greater access to high education and training is able to increase the share of population that can take advantage of the technological progress. The rising premium on higher skills in recent decades is associated with an increasing income inequality. For a given level of technology, another related factor is the diffusion of education, which reflects the average education level in a society and is measured by the overall secondary school enrollment ratio. A more diffused education is expected to reduce the income disparity by improving the general living standards of the labor force.

### 4.2.6. Unionization

In the past twenty years, the union power has been declining and the trend shows every indication of continuing in the near future. In this model, the union density is measured as the total union members as a percentage of total wage and

salaried employees. Most researchers believe that the declining union power is due to the spread of skill-based technology jobs. During the period of deunionization, income inequality obviously climbed up. We will check the ways in which these two trends are related.

#### 4.2.7. Globalization

To account for the rising income inequality in recent decades, the role of globalization cannot be ignored. In previous literature, the distributional impact of globalization on income is mixed. Typically, globalization is measured by three distinct dimensions: growing capital mobility (FDI/GDP), southern import penetration/GDP, and the net migration rate. To provide a well-round study of the distributional impact of globalization, another indicator is embedded into this framework: the trade balance/GDP. We will investigate their separate contributions to income inequality. To simplify our analysis of southern imports, two countries are specifically chosen, China and Mexico, the two developing countries among the U.S.'s top five trading partners. The trade deficit is the U.S.'s trade indebtedness with the rest of the world.

### 5. Results and Policy Analysis

Research on inequality has re-entered the mainstream development policy agenda by the World Bank since 2000. Why income inequality arises, persists and exacerbates are frequently debated issues among economists. Another central point of contention is how to appropriately measure income inequality itself. In fact, a variety of methods exist and yet a consensus has not emerged. To develop a more nuanced understanding of the income distribution, two additional measures (Theil and Atkinson indices) are considered in this paper besides Gini coefficient.

Now, a question naturally occurs. Will the impact of globalization on income inequality depend on the choice of inequality measures? Kawachi et. al (1996) answers "no". By comparing the behavior of six different measures of income inequality, their analysis indicates that the measures work very similarly and are highly correlated, with Pearson correlations ranging from 0.86 to 0.99. In the next part, we will examine the robustness of the distributional hypothesis of globalization under three inequality measures.

#### 5.1 Regression results

To avoid paradoxical regression results, it is necessary for us to first perform a simple diagnostic test of collinearity. Variables falling in the same category, such as labor market conditions, measure essentially the same thing, and therefore are usually highly correlated with each other. The variance inflation factor (VIF) for each variable is calculated. Values of VIF exceeding 10 are considered evidence of collinearity (see Note 2). Then we remove those variables with intolerable VIF values from our model to reduce the possibility of collinearity.

The regression results indicate that, not every factor proposed above is found to be statistically significant in affecting the U.S. income inequality. We drop one insignificant explanatory variable at a time from the regression until the remaining factors in the model are all shown to be significant. The main findings are presented in Tables 2-4, where STD is the standard deviation of the estimated coefficients, and the relative importance indicates the relative impact of each significant factor on inequality outcomes, which allows us to evaluate the substantive importance of each variable. Note that we are only interested in the "absolute values" of the relative importance (see Note 3 for more details).

[Table 2, 3 and 4 here]

It is shown that the choice of inequality indicator does indeed matter for the results generated by the analysis. We see several similarities and also very notable differences across three indices. In the following section, we will attempt to explore these results and explain how they have been affected as such.

In Figure 1, the inequality is severed in the mid-1990s, and a high-jump is clearly observed. A time dummy variable is thereby used to capture this effect. The dummy equals 1, if the period is prior to 1992. Otherwise, the dummy is 0. The results indicate that a negative relationship exists between this dummy and Gini index. The same phenomenon arises across three indexes. Obviously, there should be some major events that have caused such an upswing in the inequality. We might be able to attribute this sudden jump in income inequality in the middle 1990s to three distinct factors: (1) the NAFTA (North American Free Trade Agreement) was enacted on January 1st of 1994; (2) the sudden increase in CEO incomes with the apparent rise in the stock markets was also concurrent with this time; (3) the adverse consequence of a wide-spread banking crisis in late 1980s and the early 1990s. The NAFTA greatly increased the trade volume and has been a contributor to the variations in trade balance, which in turn affects the income disparity. The increase in CEO incomes and the crashed financial system are likely to result in a greater income gap.

Next, the sector dualism, which explains the difference in average income between sectors, still remains a significant predictor of inequality. For instance, agricultural dualism negatively relates to Gini coefficient, which sheds light to Alderson and Nielsen (2002). Service dualism is found to be positively related to Atkinson index. In the past two decades, technological progress has been shifting employment from the agriculture to the manufacturing and service. Even though service industry is generally typified by a higher productivity and average wages, many people at the bottom of income distribution still have to work for low-pay service jobs, such as waiting tables in restaurants. Hence a

higher income disparity at the bottom quintile (measured by Atkinson index) resulted from such an intra-industry labor movement.

By checking the role of women, we find that the percentage of females in the labor force and the percentage of female-headed households explain part of the story. Technological progress and the change of social value have allowed more females to get out of housework and bring additional earnings back home. This surely helps reduce the disparity among low-income households and lower the value of Atkinson index, as we see in Table 3. However, the fact that more women begin to participate in labor force or lead the household, does not necessarily imply that more equality will be created in the whole society. According to the survey by the National Bureau of Economic Research, women are earning significantly less than their male counterparts. The situation is even worse for female professionals, for instance, women who have MBA degrees and work in finance or business services. Such growing gender gaps generate a positive effect on both Gini and Theil index.

Seniority is also playing a part in income inequality measured by Gini index. Most seniors live off of a fixed income, such as social security or pension funds. Therefore, we expect that a bigger percentage of seniority will positively affect the income inequality, which is verified by the results in Table 2. With a more aging population, the income inequality will surely rise.

We find a curious case when investigating the impact of education on inequality. The large increase in educational attainment earlier in the twentieth century produced greater economic equality and shared prosperity. However, we did not obtain enough evidence in our model to support such a point of view for the period of 1987 through 2007. The two measures of education, college graduates ratio and secondary school enrollment ratio, are both found insignificant in accounting for the recent rise in economic inequality. In terms of the Atkinson index, we find a small negative but insignificant relationship, which exactly fits the traditional theory: more educated population would bid inequality down. Since the Atkinson index focuses more on the bottom of the income profile, it seems that education still remains the primary way for the poor to get out of poverty.

Then, let us examine the aggregate labor market conditions by checking the union density. A stronger union is associated with a rise in the income share of the poor and better welfare for workers, particularly for low-income workers. That is why the union density negatively relates to the Atkinson index. It is insignificant in another two cases.

Another interesting result is the impact of monetary stability on inequality. In Table 4, inflation produces a positive effect on Theil index, the measure of the inequality among the high-income people. As we know, the financial sector has claimed an ever-growing share of the nation's income over the past generation, making the people who run the industry wealthy. It makes sense that a higher inflation reduces the value of financial assets and shatters the confidence in financial market, which possible leads to a higher income gap between the rich and the hyper-rich.

Now, we turn to the standing-out result in this model, the impact of globalization on income inequality, which is illustrated by four distinct aspects: trade balance, imports from southern countries, net migration rate and FDI inflow to the U.S.

The role that international trade has played in explaining inequality patterns is demonstrated by the trade balance and southern imports. In the case of Gini coefficient, it is found that the U.S. trade deficit and imports from southern countries both have significantly reduced the income inequality. Statistics show that the imports from southern countries help narrow down the income gap by reducing the aggregate price level. It hence increases the effective income and improves the overall economic conditions in a country. In the case of Theil index, trade deficit relates to income inequality in a negative way. This is equivalently saying that a positive trade balance results in a wider income gap, which is associated with a higher Theil index. This actually matches the impulse response of Theil coefficient demonstrated in Figure 4.

Another important component of globalization that has contributed to a higher income disparity is the net migration rate. It exerts significant effects on each of the three indices. The recent migration has been mostly from the South and the Central America. Many immigrants from these regions have lower incomes and are more willing to work for less pay, which exacerbates the income inequality accordingly. In addition, the immigrant population is highly bifurcated. Many of them are very low-skilled as we just discussed. By contrast, many are highly skilled and / or even very rich, like immigrants from Europe and East Asia. Such two-polarized immigrants' skills tend to expand the inequality measured by all three indices.

FDI inflow is supposed to spread technological progress across countries, and therefore result in productivity advancement and a generally higher income. It is expected to lower inequality. However, in our study, it seems to be an insignificant variable.

### *5.2 The relative importance of factors*

Finally, let us check the transformed regression coefficients in Tables 2-4 and compare the importance of explanatory variables based on the relative strength of their effects on inequality. Table 2 shows that the strongest influence on Gini

index comes from the seniority ratio. Specifically, if the seniority ratio rises by 1 standard deviation, the Gini coefficient will accordingly increase by 0.5663 units of standard deviation. International trade takes the fifth position on the list. In Table 3, the most important factor that affects Atkinson index is the union density besides the dummy variable. International trade does not show significance in this scenario however, which lends support to Dollar and Kraay (2002). In Table 4, it is clear that international trade influences Theil index negatively. Its role is pretty small though.

To summarize, the inequality upswing may be due to a combination of factors. Globalization does not necessarily worsen the income distribution. Other factors, such as the changing role of women, seniority, union density and net migration rate play important roles in accounting for the rising income inequality in the U.S. as well.

### 5.3 Policy analysis

Understanding the possible causes of income inequality is the key to devising policy measures. To achieve a more egalitarian society, we should encourage the government to pursue social policies along the following dimensions.

Globalization is the long-term trend nowadays. The economic interdependence among countries will only become stronger in the future. Our empirical results are consistent with the classical theory of international trade. Overall, trade will increase prosperity in a country due to specialization and product differentiation in the globalized market. Trade is not the evil force that drives up the U.S. income disparity in recent decades. Therefore, trade protectionism is not the right solution that any government should adopt to fight poverty.

To increase the number of people who are able to win from globalization, the government should encourage a more flexible, mobile labor force. There is some evidence that trade will cheapen labor by exporting some low-skilled jobs overseas. If the less skilled labor cannot successfully shift to more productive tasks in service or manufacturing, they will lose because of such international relocation, which leads to a rising income disparity. Hence, the government should invest more heavily into education and further training. Increased and better access to higher education will definitely provide more opportunities to a greater share of population (including the immigrants) and help them engage in high-skill activities. That is greater access to education would make the endogenous sectoral and demographic transition much easier.

The government should also try to provide a more effective shield to the female labor force and strengthen their social competence. Additional assistance to female employees might be helpful to narrow down the gender gap in terms of income. For example, better child care will help prolong women's working hours and increase their average earnings. Income support may also be given to female headed households.

Last, but not the least, more priority should be given to the senior citizens. The government should provide a safety net with better health care and retirement benefits to the senior.

## 6. Conclusion

The last decade has witnessed dramatic developments in social economics with substantial contributions to both the theory and the empirical understanding of income inequality. However, a number of challenges remain. Why income inequality arises, persists and expands are frequently debated issues among economists, which have received extensive attention in recent years.

However, there has been no consensus in the literature on the causes of inequality upswing. The previous studies suggest there is no single "smoking gun". A growing literature has attempted to understand the expanding income inequality by focusing on skill biases due to technological progress. At the same time, some economists blame globalization, in particular the historically high trade deficit for America's rising income inequality.

This paper documents the resurgence of income inequality in the U.S. by collecting the latest data from 1985 to 2007. To provide a more complete picture of income distribution, three different inequality measures are particularly employed: Gini, Theil and Atkinson index. Then a generalized linear regression model is used to estimate the extent and channels through which all kinds of factors influence the income distribution.

Our results show that international trade does not play a starring role in explaining changes in recent inequality. In the cases of Gini and Theil index, international trade does affect income inequality, but it surely cannot be the whole story. Other factors, such as the changing role of women, union density, net migration rate, sectoral dualism and even inflation play quite important roles in accounting for America's rising income inequality. In the case of Atkinson coefficient, the effect of trade on income inequality is not significant at all. Therefore, international trade generates different distributional impact on different income groups.

Inequality matters in its own right and it is fundamental to combating poverty. Our study is a systematic and novel examination of the recent income inequality in the U.S., which provides a very nice framework for government policy evaluations.

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## Notes

Note 1. To generate the impulse functions in Figure 4, we used the annual US data over the period of 1985 through 2007. The trade balance is adjusted to the ratio of trade balance and GDP. The VAR is estimated assuming a Wold ordering. Lags are chosen to be 1 using the Akaike criterion.

Note 2. VIF is a simple procedure in **R** (a programming language and software environment for statistical computing and graphics) to test the collinearity.

Note 3. The relative importance of each economic variable in Table 2-4 is defined as the unstandardized regression coefficient multiplied by the sample standard deviation of the corresponding independent variable X. It represents the change in dependent variable Y (i.e. the income inequality metric) associated with an increase of one standard deviation in X, in original units of Y.

Table 1. The Cross-section Dimension of the Data

Sector Dualism	Agricultural dualism; manufacturing dualism; service dualism; GDP share of agriculture sector; GDP share of manufacturing; GDP share of service.
Labor Market Conditions	Percentage of labor force across sectors (agriculture, service and manufacturing); percentage of female labor force participation; percentage of households headed by females; unemployment rate; poverty rate.
Monetary Stability	Annual inflation rate; federal funds rate.
Demographic transition	Natural rate of population increase; seniority ratio.
Overall education	College graduates ratio; secondary school enrollment ratio.
Density of Unionization	Union density.
Globalization	FDI / GDP; southern import penetration / GDP; net migration rate; trade balance / GDP; U.S. oil imports.

Table 2. Generalized Linear Regression Results: Gini Index

<i>Significant Variables</i>	<i>Estimates</i>	<i>STD</i>	<i>Relative Importance</i>
Dummy (time effect)	-1.5831 ***	0.3232	-0.5116
Seniority	0.9378 •	0.6039	0.5663
Net migration rate	0.5067 *	0.2304	0.1167
Trade balance (a deficit)	-0.9708 ***	0.1929	-0.1873
Southern imports	-1.6696**	0.3167	-0.5288
Agricultural dualism	-0.6087 •	0.5362	-0.3264
% Female in labor force	0.3911 *	0.1225	0.0479
Adjusted R <sup>2</sup>	0.9692		

Note: • P < 0.1; \* P < 0.05; \*\* P < 0.01; \*\*\* P < 0.001 (two-sided test).

Table 3. Generalized Linear Regression Results: Atkinson Index

<i>Significant Variables</i>	<i>Estimates</i>	<i>STD</i>	<i>Relative Importance</i>
Dummy (time effect)	-1.86390***	0.19439	-0.3623
Net migration rate	0.21285 •	0.12580	0.0267
% female-headed households	-0.4552*	0.17536	0.0798
Service dualism	0.24762**	0.08066	0.0200
Union	-0.46365 *	0.19901	0.0923
Adjusted R <sup>2</sup>	0.9637		
Secondary enrollment ratio	-0.05552	0.10016	

Note: • P < 0.1; \* P < 0.05; \*\* P < 0.01; \*\*\* P < 0.001 (two-sided test).

Table 4. Generalized Linear Regression Results: Theil Index

<i>Significant Variables</i>	<i>Estimates</i>	<i>STD</i>	<i>Relative Importance</i>
Dummy (time effect)	-6.42753***	0.72790	-4.6786
Trade balance (a deficit)	-0.43751***	0.0823	0.0360
Net migration rate	0.86385 •	0.44665	0.3858
% Female in labor force	0.49824 *	0.19342	0.0964
Inflation	0.37119 •	0.19076	0.0708
Adjusted R <sup>2</sup>	0.9827		

Note: • P < 0.1; \* P < 0.05; \*\* P < 0.01; \*\*\* P < 0.001 (two-sided test).

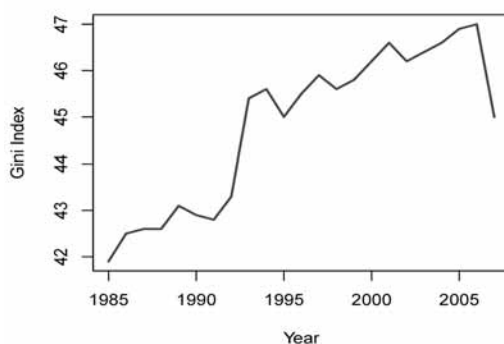


Figure 1. Income Inequality (Gini Coefficient) in the U.S. 1985 – 2007

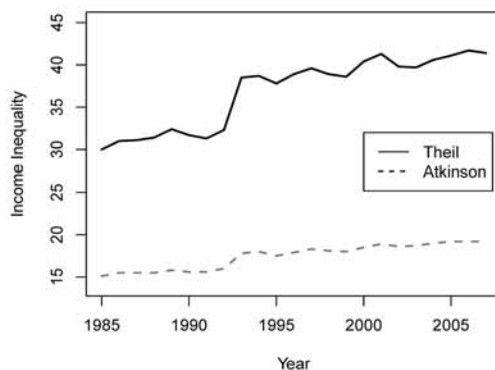


Figure 2. Income Inequality (Theil and Atkinson Coefficients) in the U.S. 1985 – 2007

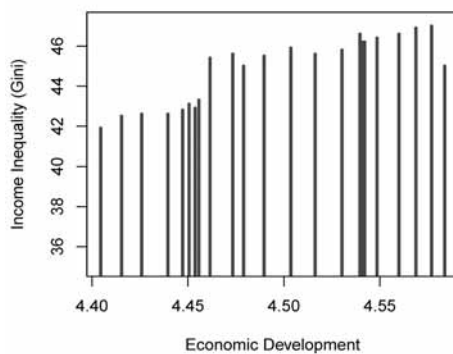


Figure 3. U.S. Income Inequality and Economic Development: 1985 – 2007





Figure 4. The Dynamic Responses of Inequality Indices from Structural VAR Estimation



## Regional Growth in the Euro Mediterranean Countries: Effects of Increasing Returns and Spatial Externalities

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### Abstract

Most of the recent contributions analysing the regional disparities in growth have stressed on the convergence equation which derived from the traditional neoclassic model of Solow (1956). However, this type of approach presents the main drawback that is the lack of consideration for increasing returns to scale, which are at the origin of endogenous growth and new economy geography models. In that purpose, we find more appropriate to use Fingleton's (2001) model. We develop a spatial model to endogenously detect the presence of spatial externalities and to estimate their effect on regional growth. We extend this specification to a panel of 26 euro Mediterranean countries over the period 1995-2004. Results of estimation with recent tools of spatial econometrics permit to detect the presence of increasing returns to scale. In addition, we conclude that the external effects are geographically burned and they are associated to a substantive phenomenon meaning that the growth in a country depends on the growth in neighbouring countries via pecuniary and technological externalities. These results are related to the predictions of endogenous growth theory and new economy geography model.

**Keywords:** Regional disparities, Endogenous growth, New economy geography, Increasing returns to scale, Spatial econometrics

### 1. Introduction

There has been a remarkable surge of interest in 'geographical economics' or 'the new economic geography', prompted by the publication of the book by Fujita, Venables and Krugman(1999). This new wave of theory put economic geography centre stage within mainstream economics, since it established the notion that increasing returns could coexist within a theoretical framework with explicit microeconomic foundations. Regional science and regional economics, which had tended to be somewhat marginalized, has now become a focus of attention. However the development of formal models has been at a cost, for although the idea of externalities is central to the new economic geography theory, and in related urban economic theory (Abdel Rahman and Fujita, 1990, Rivera Batiz 1988), in the purest form of these models the only externalities present are pecuniary externalities, representing market interdependence. The idea that technological externalities are also relevant is somehow squeezed out, being too difficult to accommodate within formal models. Or, the endogenous growth models (Marshall, 1980; Saxenian, 1994; Jaffe, 1989, Feldman, 1994) show that this type of externalities is likely favour the agglomeration phenomenon. Thus, the endogenous growth theory underlines their role in terms of growth.

The integration between the endogenous growth theory and the geography economic distinguish between the two types of agglomeration admitting a particular importance to the agglomeration of activities of innovation (Englmann and Wals, 1995; Martin and Ottaviano, 1999). In side, of pecuniary externalities (related to market interdependence) influencing the production, are introduced the technology externalities (related to hors market interdependence) influencing particularly the innovation. As in the case of endogenous growth models with R&D, the output of research in a firm is favoured by the importance of activity in other firms in the economy. The activities of innovation are thus incited to locate in the region where the number of innovate firms is higher.

The industrial agglomeration results then from the imbrications of these phenomenon: *"an economic agglomeration is created as well by the technological externalities as by pecuniary externalities"* (Fujita and Thisse, 1997).

The empirical analysis of these forces of agglomeration can be treated by recent tools of spatial econometrics. Without controlling also for externalities, in the form of spillovers between regions, the spatial models are invariably poorly

specified and fail the diagnostic tests that are the accepted professional standards of the spatial econometrics community. Various approaches have been adopted in attempting to introduce externalities into spatial econometric models, with two main strands appearing in the literature. One treats the externalities in a somewhat ad hoc manner as random shocks, which impact within a specific region and simultaneously spill over into other, frequently neighbouring, regions. In these models there is no attempt to explicitly model the sources of these external effects. The second strand attempts to model the causes of the externalities.

However, in this paper we are interested in investigating the link between the spatial externalities and their impact on the economic growth of the Euro Mediterranean countries. We will base on the theoretical growth model with increasing returns to scale of Verdoorn, to which we introduce the spatial dependence. We propose to apply the appropriate spatial econometrics tools to test the presence of these externalities and to estimate their magnitude on the regional growth.

On this base, the paper is organized as follow: In Section 2 we describe specification of Verdoorn's law with different types of spatial dependence and we discuss the type of externalities related to the resulting specification. Section 3 presents the major characteristics of a model growth that includes externalities across regions caused by technological diffusion. It is shown the similarity between his empirical specification and the spatial lag model. In section four, we present data and the weight matrices used. Results of estimation based on a panel of 26 euro Mediterranean countries over the period 1995-2004 are reported in section 5. Finally, section 6 concludes.

## 2. Theoretical model of Verdoorn's law and spatial dependence

Empirical implementation of the Verdoorn's law is initially proposed by Kaldor (1957) and successively extended by Kaldor (1970) and Dixin and Thirlwall (1975). They suppose that the motif of growth results from a linear relation between the growth of productivity and output.

Then, in its simplest form, the empirical specification for the dynamic Verdoorn's Law can be written as:

$$p = b_0 + b_1 q + \varepsilon \quad [1]$$

Where  $p$  is the level of growth of productivity,  $q$  is the growth of output and  $\varepsilon$  is an error term. The usual interpretation of parameters in (1) is that a value of  $b_1$  around 0.5 implies the existence of increasing returns to scale. (Note 1)

The introduction of spatial dependence in the Verdoorn's Law permits to consider the geographic externalities.

Different types of models can be used to treat the spatial dependence in observations. Applied for the Verdoorn's Law, they give different interpretations of coefficients associated to geographic externalities. We study the case of two models which are more used: the lag spatial model and the spatial error model.

### 2.1 The spatial Lag model:

In the spatial lag model we allow the growth of productivity in country  $i$  to depend on a weighted average of growth rates of its neighbours, in addition to the explanatory variables of Verdoorn's Law. The model in equation [1] becomes. (Note 2):

$$p = b_0 + b_1 q + \rho Wp + \varepsilon \quad [2]$$

Where  $\rho$  is a parameter indicating the extent of the spatial interaction between observations with non-zero entries in  $W$ , the spatial weights matrix. Note that this implies that the growth rate of technology in each country depends not only on the values of the explanatory variables in that country, but also on the values of the explanatory variables in other countries, subject to distance decay. This can be seen by expressing the model in reduced form:

$$p = (I - \rho W)^{-1} (b_0 + b_1 q + \varepsilon) \quad [3]$$

This expression indicates that, a marginal increase in output in country  $i$  has a direct effect on the growth rate in that country, and an indirect effect on the growth rate of its neighbours. In addition, the original direct and indirect effects result in induced effects in the neighbours of the neighbours of country  $i$ , and in turn in the neighbours of those neighbours, and so on throughout the whole system, including some feedback effects on country  $i$  itself. The total effect of a marginal increase in output is therefore equal to the sum of the direct, indirect and induced effects, and its magnitude differs across countries.

### 2.2 The spatial error model

In the spatial error model the spatial dependence is restricted to the error term. Intuitively, we can think of the spatial dependence working through omitted variables with a spatial dimension (climate, social norms, exogenous shocks), so that the errors from different countries are spatially correlated. Equation [1] becomes:

$$\begin{aligned} p &= b_0 + b_1 q + \varepsilon \\ \varepsilon &= \lambda W\varepsilon + \mu \end{aligned} \quad [4]$$

Where,  $\lambda$  is a parameter indicating the extent of the spatial correlation between the errors.

Note that since  $\varepsilon = (I - \lambda W)^{-1}\mu$ , the model can be rewritten as follows:

$$p = b_0 + b_1q + (I - \lambda W)^{-1}\mu \quad [5]$$

Estimation of this model using OLS or GLS result unbiased but inefficient estimates. It should therefore be estimated using maximum likelihood or general method of moments (Anselin, 1988). (Note 3).

### 3. Substantive spatial externalities in the Verdoorn's law

In its initial form the Verdoorn's law seems to be more simple and doesn't permit to characterize the endogenously of progress of technology. Moreover, this specification permits to catch only the line between the growth of productivity and the growth of output whereas other factors can influence the growth of output especially in a regional level. Then, we carry the specification of Fingleton (2000, 2001) in which the progress of technology depends on the geographic spillovers, the level of initial technology and the others regions and the level of human capital in regions.

Supposing that technology change is proportional to the accumulation of capital (in form of capital growth) and the capital growth is equal to the productivity, we have the following relation:

$$\lambda = \lambda^* + \phi p + \varpi Wp \quad [6]$$

Where,  $\phi$  and  $\varpi$  are coefficients and  $W$  is the weight matrix which catches the effects of spatial externalities between the regions.  $\lambda$  is proportional to the productivity growth intra-regional and also extra-regional. Thus, we explicitly consider the role of pace by allowing the model to take into account the spillover effect included in the third term on the right-hand side of equation [6]. The growth of productivity in a region depends on the growth in the neighbouring regions by the existence of effect of spillovers via the technology progress. The term  $\lambda^*$  depends on the socio-economic conditions of each region such as the initial level of technology and the level of human capital of each region.

The initial level of technology is introduced by the mean of a technology gap between each region and the region leader to catch the possible effect of diffusion of innovation from a region with high level of technology to a region with low level of technology. This is based on the following hypotheses: first, the differences in level of technology imply differences in productivity (Barro and Sala-i-Martin, 2004). Second, the regions more rich technologically know the growth via the innovation whereas the regions accusing a technological backward proceed by an imitation and adapt technologies of region leader (Baumol, 1986). In consequence, the technology diffusion in backward regions can induce growth faster in these regions and the impact of the region leader is more important as the technology gap is high (Abramovitz, 1986 ; Gomulka, 1987 ; Targetti and Foti, 1997).

Using the approach of Nelson and Phelps (1966), the human capital is supposed to be an increasing function of the level of education, in the measure where an important human capital stock is supposed favour the adoption of foreign technologies successfully and permits to determine the capacity of a nation to develop new ideas.

The introduction of these elements in the specification of Verdoorn permits not only the introduction of concepts of endogenous growth theory, but also those of geographic economy. Indeed, the increasing returns to scale and the effects of spillovers are the fundamental hypotheses of two theories (Englmann and Walz, 1995; Walz, 1996; Martin and Ottaviano, 1999; Baldwin and Forslid, 2000; Rezgui, 2004). Thus, this new specification seems pertinent to study the regional growth following these theories.

After some algebra, we propose a different specification for the Verdoorn's Law, that is:

$$p = \varpi W_1 p + b_0 + b_1q + b_2G + b_3H + \varepsilon \quad [7]$$

Where, for yearly data,  $p$  denotes annual growth rates, a bold character represents a vector

$[N^*(T-1) \times 1]$  with the information for each region and time period ( $t=2, \dots, T$ ).  $W_1 p$  is the spatial lag for the growth rates of labour productivity.

The other variables are defined as following:

\*  $G$  a vector  $[N^*(T-1) \times 1]$  corresponds to the technology gap (approximated by the differential in productivity) in every year between each region of the sample and the region leader.

\*  $H$  a vector  $[N^*(T-1) \times 1]$  corresponds to the level of human capital. It was measured by the population with secondary education and more.

\* Finally,  $W_1$  is a  $[N^*(T-1) \times N^*(T-1)]$  matrix with the following general expression:

$$W_1 = \begin{bmatrix} W & 0 & 0 & . & 0 \\ 0 & W & 0 & . & 0 \\ 0 & 0 & W & . & 0 \\ . & . & . & . & . \\ 0 & 0 & 0 & . & W \end{bmatrix}$$

0 being a (NxN) matrix of zeros and W a (NxN) spatial matrix of weights.

We note that in the literature of spatial econometrics, the specification [7] corresponds to the spatial autoregressive model, in which the coefficient  $\varpi$  reflects the presence of effects of spatial externalities, i.e the growth in contiguous regions (defined by the weight matrix  $w$ ) affects the growth of productivity (via the technology progress) of the considered region.

#### 4. Data and spatial weights matrix

For yearly data, we use the variable “growth of labour productivity on the period  $t$  and  $t-1$ ,  $t = 2, \dots, 10$ ” as an endogenous variable. Labour productivity is obtained by dividing “GDP at constant price 2000” by “number of population in employment”. Data on these two variables and the level of education are obtained from the database: “World Indicator Data; W.I.D” version 2006.

Annual data on technology gap (Q) are approximated by the difference between value of labour productivity in each country and the value in the Leader country (the country with highest value of labour productivity)

We will expose results of empirical validation on a specific sample of Euro Mediterranean countries which is composed from:

- 1) First, the fifteen countries of the European Union: Germany, France, Italy, Luxembourg, Netherlands, Greece, Spain, Portugal, Ireland, Denmark, Sweden, Finland, Austria, Belgium and United Kingdom.
- 2) Second, the eleven south Mediterranean countries: Algeria, Tunisia, Cyprus, Egypt, Israel, Lebanon, Jordan, Morocco, Turkey, Syria and Malta.

**NB:** for the reason of the absence of data availability, the country « Autonomy Palestinian Territory » will be excluded from the analysis.

The period of our analysis is 1995-2004. This period is particularly interesting for the analysis of the impact of spatial externalities on economic convergence, since it corresponds to crescent economic integration between the Euro Mediterranean countries, marked by acceleration of liberalisation of exchanges and by a widening of market. It corresponds also, after the reform of structural funds, to the existence of important regional political aiming to harmonise the potentialities of territories development.

##### 4.1 Definition of weight matrix $W$ :

The concept of weight matrix constitutes a fundamental element in Spatial Econometrics because it permits to model the interactions between observations. Generally, two principal conceptions are reserved to the determination of the elements of the weight matrix, respectively founded on the principle of contiguity and on the principle of distance.

##### 4.1.1 The matrix of contiguity

The matrix of contiguity reposes on the sharing of a common frontier between spatial unities. Formally, a contiguity matrix represents each localisation of spatial system in line and in column. The “spatial weights” (elements of weight matrix)  $w_{ij}$  of matrix of contiguity  $W$  are then defined by the following expression:

$$w_{ij} = \begin{cases} 1 & \text{if regions } i \text{ and } j \text{ are contiguous for order 1.} \\ 0 & \text{else.} \end{cases} \quad [10]$$

Moreover, a same contiguity matrix can represent different arrangements of spatial units: this is the problem of topological invariance (Cliff et Ord, 1981, p. 21). Then, others weight matrices appear useful.

##### 4.1.2 The matrix of distance

The matrix of distance reposes on the idea that two spatial units know high (respectively low) interaction that the distance between them is low (respectively high). Cliff and Ord (1973, 1981) are the first ones that used this type of specification, by combining a function of the reverse of the distance that separates two localisations and the relative length of their common frontier. However, recently the most current specifications in the empirical studies use expressions more simple for the spatial weights.

In our work, we carry a simple matrix of distance based on the reverse of the distance that separate spatial units. In this case the elements of this matrix  $w_{ij}$  are defined as following:

$$w_{ij} = \frac{1}{d_{ij}}, \quad \text{where } d_{ij} \text{ is the distance that separate the centroids of countries } i \text{ and } j. \quad [11]$$

However, the matrices of weights are standardised in lines for facilitating interpretation of spatial parameters after estimation. Thus, each line  $i$  of matrix of weight  $W$  is divided by the sum of elements  $w_{ij}$  that compose it and the resulting spatial weights are:

$$w_{ij}^s = \frac{w_{ij}}{\sum_j w_{ij}} \quad [12]$$

The standardisation of the matrix of weights permits to compare the spatial parameters issued from different models.

## 5. Results of estimations

On the base of panel data in the present section, we will proceed stepwise. Firstly, the model without spatial dependence is considered. Then, we will move forward to considering the issues deriving from spatial autocorrelation.

### 5.1 Estimation of a-spatial model

We start with estimation of a-spatial model (model [2.2] without the endogenous lag variable). We must note that in case of the estimation of a model with the method of panel data, the model can be with individual fixed effects (Within estimator) or with individual random effects (Estimator with GLS). Results of estimation of the equation of convergence under the two specifications of panel are presented in the table 1:

- For the two models, we observe that the coefficient of Verdoorn (coefficient of output) is positive and statistically significant which corroborates the presence of the increasing returns to scale. This coefficient is more significant for the random effects model.
- The coefficient of human capital is also positive, indicating that the level of education facilitates the absorption of foreign technology and the creation of new innovations. An increase of the level of education in one country with one unit raises the labour productivity growth by 31.7% in the case of model with fixed effects and by 45.6% in the case of model with random effects.
- The coefficient of technology gap is not significant in the two specifications.
- We note that the test of Fisher is significant at 5% level, indicating the presence of individual effects. To choose between the two types of specification for individual effects (fixed effects or random effects), we use the test of Hausman (1978). The decision rule of this test is the following: if the realisation of the statistic is higher than  $\chi^2(K)$ . (Note 4) at  $\alpha\%$ . (Note 5) level we reject the hypothesis null and we privilege the adoption of individual fixed effects and the Within estimator is unbiased. On the contrary, if the statistic of Hausman is smaller than  $\chi^2(K)$  at  $\alpha\%$  level, we accept the hypothesis null and we privilege the adoption of random individual effects and the use of GLS estimator. In our case and for a level of tolerance of 5%, we remark that the value of the test of Hausman is low and not significant, indicating the absence of the correlation between the regional specific effects and the explicative variables of model (the hypothesis  $H_0: \text{corr}(\mu_i, X_{it}) = 0$  is not rejected). Thus, the estimators of the model with random effects are convergent (Mundlak, 1978). (Note 6).

### 5.2 Tests of spatial dependence

We use Anselin (1988) and Anselin *et al.* (1996) tests to detect the presence of spatial dependence. In order to identify the form of the spatial dependence (spatial error model or spatial lag), the Lagrange Multiplier tests (resp.  $LM_{ERR}$  and  $LM_{LAG}$ ) and their robust version are performed. The decision rule is subject to Anselin and Florax (1995): if  $LM_{LAG}$  (resp.  $LM_{ERR}$ ) is more significant than  $LM_{ERR}$  (resp.  $LM_{LAG}$ ) and  $R-LM_{LAG}$  (resp.  $R-LM_{ERR}$ ) is significant whereas  $R-LM_{ERR}$  (resp.  $R-LM_{LAG}$ ) is not, then the most appropriate model is the spatial lag model (resp. the spatial error model).

Results of these tests and the associated p-value are presented in the table 2 using the matrix of contiguity (first column) and the matrix of distance (second column).

Adopting the decision rule of Anselin and Florax (1995) we can conclude that the spatial model with endogenous variable is the more appropriate specification for the analysis of the effects of spatial externalities on the regional growth in the euro Mediterranean countries. These externalities are associated to a substantive phenomenon implying that the growth of labour productivity in one country affects the growth in neighbouring countries.

In the next paragraph we will present results of estimation of the spatial model with endogenous lag variable. This specification is conformable to the one in Fingleton (2001) (equation [2.2]).

### 5.3 Estimation of the empirical specification

Table 3 resumes the results of estimation of equation [2.2] in the case of model with random effects, by the Maximum Likelihood method with the matrix of distance (first column) and the matrix of distance (second column).

- We note that in this specification as in the case of a spatial model, the coefficient of Verdoorn and the coefficient of human capital are also positives and statistically significant for the matrix of distance as well as for the contiguity matrix.
- In this model, we note that the coefficient of technology gap is negative and significant at 5% level meaning the absence of a technology catch-up effect in the euro Mediterranean countries. There are many countries possessing low levels of productivity can't catch up the Leader country (Germany) which possesses the high level of technology.
- The coefficient of spatial dependence is high and statistically significant ( $\hat{\omega} = 0.831$ , with the matrix of distance and  $\hat{\omega} = 0.673$  with the matrix of contiguity). This indicates that when the growth of labour productivity in the neighbours of a country  $i$  increase with one unit, the growth of labour productivity in this country increase with 83.1% when we use the matrix of distance and increase with 67.3% when we use the matrix of contiguity. This result confirms that the spatial externalities in the euro Mediterranean countries are associated to a substantive phenomenon implying that the growth in a country affects the growth in neighbours by the effect of spatial externalities, for example the increase in the level of human capital in a country influences on the growth of the labour productivity in this country, but also influences on the growth of labour productivity in the neighbouring countries. Moreover, with the relation of the two weight matrices used in our empirical validation which based on the contiguity and distance effect, we note that the spatial dependence decrease with the distance separating countries of our sample. This shows that the technology diffusion is geographically burned which influences the growth inequality between the north and the south of the euro Mediterranean countries. Thus, the economic integration doesn't permit to eliminate barriers of the absorptive capacity of new technology from the north to the south.

## 6. Conclusions

In this paper, our aim is to analysis the effects of spatial externalities on the regional growth on the base of the common hypothesis of new economy geography theory and the endogenous growth theory "increasing returns to scale". The integration of these two theories suppose that the increasing returns of scale results from the pecuniary externalities (representing market interdependence) and the technology externalities (representing hors market interdependence), and these externalities are geographically burned. To analyse this new approach we have started by the modification the equation of Verdoorn Law to obtain an empirical specification incorporating the increasing returns to scale and also the effect geographic spillovers via the progress of technology. Thus, we suggested that the recent methods of spatial econometrics constitute powerful tools to endogenously detect the effect of spatial externalities on the regional growth.

In our empirical validation we are based on a panel of an integrated space of the euro Mediterranean countries observed on the period 1995-2004. Results of estimation of our empirical specification indicate that increasing returns are significant in determining the level of growth at the regional level. In addition, because of the significant presence of spatial dependence, the growth of labour productivity in one country could contribute to their neighbours via spatial externalities. Also, two other explanatory variables (education and technological gap) have proven to be significant, and their extent is important: the coefficient of education is positive confirming that the level of education facilitates the absorptive capacity of foreign technology and thus favours the growth of productivity. The coefficient of the technological gap is negative indicating that there are some countries can't cutch up the leader country (Germany) in term of labour productivity.

These results confirm the predictions of new economic geography theory and the endogenous growth theory: first external effects (pecuniary and technological externalities) constitute as a source of increasing returns to scale implying that the increase of factor of production leads to a more proportional increase of production. Second these external effects are geographically burned leading to the concentrations of these factors in space and favour the inequality of regional growth.

This note is not in favour of a positive impact of politics of regional growth destiny to reduce inequality between the euro Mediterranean countries. The technology diffusion from the north to the south constitutes a source of the reduction of these inequalities which in their tour necessitate the investment in the productive resources of the south.

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## Notes

Note 1. For a review of the different approaches to the estimation of the Verdoorn's Law see Leon-Ledesma (2000).

Note 2. For simplicity we drop the subscript i in all subsequent equations.

Note 3. By rearranging equation (5) it can be shown that the spatial error model is equivalent to an extended version of the spatial lag model that includes both a spatially lagged dependent variable and the set of spatially lagged independent variables (excluding the constant term). This equivalence only holds if a number of non-linear constraints are satisfied. The resulting model is known as the 'spatial Durbin' or 'common factor' model (Anselin, 2001).

Note 4. k is the number of freedom or also the number of exogenous variables.

Note 5. This value is obtained from the table of  $\chi^2$

Note 6. Details on the model with random effects and spatial dependence are presented in the appendix.

## Appendix: Random effects model and spatial dependence

The spatial autocorrelation can be incorporated in the random effects model in which the coefficients of regressions are supposed fixed (Anselin, 1988a ; Case, 1991 ; Baltagi et Li, 2002). In this model we have:

$$y_{it} = x'_{it}\beta + \varepsilon_{it} \quad i=1, \dots, N; t=1, \dots, T \quad [1]$$

Where  $y_{it}$  is a vector  $NT \times 1$ , i denotes the region and t the period,  $x_{it}$  is a vector  $k \times 1$  of observations relative to k explicative variables and  $\beta$  is a vector  $k \times 1$  of parameters.

The term of error is supposed to incorporate the unobservable effects due to space (Hsiao, 1986; Baltagi, 1995):

$$\varepsilon_{it} = \mu_i + \phi_{it} \quad i=1,\dots,N; t=1,\dots,T \quad [2]$$

$\mu_i$  is a vector  $N \times 1$  of regional specific effects. The vector  $NT \times 1$  of error terms  $\phi_{it}$  with mean null and variance  $\sigma_\varepsilon^2$ , is supposed normal,  $\phi_{it} \sim N(0, \sigma_\varepsilon^2)$ . The  $\phi_{it}$  are supposed independents of effects  $\mu_i$  and explicative variables of model.

### 1. The autoregressive spatial model:

A first formulation of spatial dependence is the specification of autoregressive spatial model (cf. Florax et Folmer, 1992). If we consider an impalement of T observations relative to each region, the random effects model with spatial dependence can be written as:

$$Y = \rho W^1 Y + X\beta + Z\mu + \phi \quad [3]$$

Where  $Z = (I_N \otimes I_T)$  is a  $NT \times N$  matrix of regional indicative variables,  $I_T$  is a vector  $T \times 1$  of 1 and  $I_N$  denotes  $N \times N$  identity matrix. The sign  $\otimes$  is the kronecker product.  $W^1 = (W_N \otimes I_T)$  where  $W_N$  is the  $N \times N$ . spatial weight matrix, standardized.  $\rho$  is the spatial autoregressive coefficient.

The matrix of variances in the case of spatial autoregressive model presents the following structure:

$$\Omega(\rho, \theta_1^2, \sigma_\varepsilon^2) = \sigma_\varepsilon^2 M^{-1}(\rho) [Q + \theta_1^{-2} B] M^{-1}(\rho) \quad [4]$$

Where  $M(\rho) = (I_{NT} - \rho W_1)$ ,  $B = (I_N \otimes T^{-1} I_T I_T')$  and  $Q = (I_{NT} - B)$  are respectively the  $NT \times NT$  operators *between* and *within* and  $\theta_1^2 = \frac{\sigma_\varepsilon^2}{T\sigma_\mu^2 + \sigma_\varepsilon^2}$ .

The determinant and the reverse of  $\Omega$  are respectively:

$$|\Omega(\cdot)| = \sigma_\varepsilon^2 |M|^2 |\theta_1^2|^{-T} \quad [5]$$

$$\text{and } \Omega^{-1}(\cdot) = \sigma_\varepsilon^{-2} M_1' [Q - \theta_1^2 B] M_1 \quad [6]$$

### 2. Spatial model with autocorrelation in errors:

A second formulation of spatial dependence supposes that the errors  $\phi_{it}$  are spatially autocorrelated (cf. Florax et Folmer, 1992; Baltagi et Li, 1999):

$$\phi = \lambda W\phi + v \quad [7]$$

Where  $\lambda$  is the coefficient of spatial autocorrelation. It catches the effects of spatial variables omitted in the model. The vector  $NT \times 1$  of errors  $v_{it}$  is supposed normal,  $v_{it} \sim N(0, \sigma_v^2)$ .  $v_{it}$  are also supposed independents of the effects  $\mu_i$  and the explicative variables of model.

In the case of spatial model with autocorrelation in errors, the matrix of variances possesses the following structure:

$$\Omega(\lambda, \theta_2^2, \sigma_v^2) = \sigma_v^2 [Q + \theta_2^{-2} B + (M'(\lambda)M(\lambda))^{-1} - I_{NT}] \quad [8]$$

Where,  $M(\lambda) = (I_{NT} - \lambda W_1)$ ,  $\theta_2^2 = \frac{\sigma_v^2}{T\sigma_\mu^2 + \sigma_v^2}$ .

The determinant and the reverse of the matrix  $\Omega(\cdot)$  can be written respectively (cf. Anselin, 1988 : 153-154) :

$$|\Omega(\cdot)| = \sigma_v^2 |A_N|^{-2(T-1)} [(A_N' A_N)^{-1} + (\theta_2^{-2} - 1) I_N] \quad [9]$$

$$\text{and } \Omega^{-1}(\cdot) = \sigma_v^{-2} \left\{ (A_N' A_N) \otimes (I_T - \bar{J}_T) + [(A_N' A_N)^{-1} + (\theta_2^{-2} - 1) I_N]^{-1} \otimes \bar{J}_T \right\} \quad [10]$$

where,  $A_N = I_N - \lambda W$

### 3. Estimation by the maximum likelihood method:

The application of Ordinary Least Square (OLS) or Generalised Least Square (GLS) methods for estimation of models with spatial dependence leads to biased and not convergent estimators (*cf.* Dubin, 1988; Florax et Folmer, 1992). An appropriated method of estimation is the maximum likelihood (ML) (Anselin, 1988: 57-59).

The expression of log likelihood with spatial dependence is the following:

$$L(\alpha, \beta, \theta_j^2, \sigma^2) = c_0 - \frac{NT}{2} \ln |\Omega(\cdot)| - \frac{1}{2} u' \Omega^{-1}(\alpha, \theta_j^2, \sigma^2) u \quad [11]$$

$$c_0 = -NT \ln(2\pi) / 2.$$

We deduce the autoregressive spatial model for  $\alpha = \rho$ ,  $j = 1$ ,  $\sigma^2 = \sigma_\varepsilon^2$  and  $u = M(\rho)Y - X\beta - Z\mu$ . And the spatial model with autocorrelation in errors for  $\alpha = \lambda$ ,  $j = 2$ ,  $\sigma^2 = \sigma_v^2$  and  $u = M(\lambda)(Y - X\beta - Z\mu)$ .

The estimation of models with spatial dependence with the likelihood method necessitates a non linear optimisation and implies numeric calculations as much harder and longer when the number of observations is important. In particular, one of difficulties in application of the ML resides in calculation of determinant of the matrix of Jacobean. An alternative proposed by Ord (1975) reposes on proper values of the weight matrix. Then,

$$|I_{NT} - \alpha W_{1NT}| = |I_N - \alpha W_N| = \prod_i (1 - \alpha \omega_i) \quad [12]$$

Where the  $\omega_i$  design the proper values of the matrix  $W_N$  and  $\alpha = \{\rho, \lambda\}$ . The identity [12] implies that the values of coefficients of spatial dependence must satisfy the condition:  $\omega_{\min}^{-1} \leq \alpha \leq \omega_{\max}^{-1}$  where  $\omega_{\max} = 1$  in the case of weight matrices normalised. The advantage of this procedure is that we can determine the proper values of these matrices before the optimisation (since  $W_N$  is supposed known). This reduces considerably the numeric calculation of likelihood of model, at least in the case of small samples.

Table 1. Estimation of a-spatial model

	<u>Fixed effects model</u>	<u>Random effects model</u>
$\hat{b}_0$	-1.245 (0.021)	0.125 (0.001)
$\hat{b}_1$	0.734 (0.021)	0.817 (0.001)
$\hat{b}_2$	-0.081 (0.120)	-0.061 (0.095)
$\hat{b}_3$	0.317 (0.012)	0.456 (0.001)
<b>Test de Fisher</b>		16.241 (0.000)
<b>Test de Hausman</b>		0.024 (0.094)

**Note:** N=26, T=10. The values of critical probabilities are in parentheses. Level of significance = 5%.

Table 2. Tests of spatial dependence in a-spatial model

tests	Matrix of distance	Matrix of contiguity
<b>LMERR</b>	899.251 (0.000)	752.426 (0.000)
<b>LMLAG</b>	1125.524 (0.000)	1005.214 (0.000)
<b>RLMERR</b>	3.011 (0.999)	1.256 (1.000)
<b>RLMLAG</b>	1111.452 (0.000)	914.53 (0.000)

**Note:** The values of critical probabilities are in parentheses. Level of significance = 5%.

Table3. Estimation of the empirical specification: equation [2.2]

	(1)	(2)
$\hat{b}_0$	0.214 (0.009)	-0.025 (0.008)
$\hat{b}_1$	0.871 (0.001)	0.868 (0.001)
$\hat{b}_2$	-0.031 (0.003)	-0.015 (0.005)
$\hat{b}_3$	0.598 (0.001)	0.631 (0.001)
$\hat{\omega}$	0.951 (0.000)	0.899 (0.000)

**Note:** N = 26, T = 10; Estimation by ML method. The values of critical probabilities are in parentheses. Level of significance = 5%.



# Financial Volatility Forecasting by Least Square Support Vector Machine Based on GARCH, EGARCH and GJR Models: Evidence from ASEAN Stock Markets

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## Abstract

In this paper, we aim at comparing semi-parametric method, LSSVM (Least square support vector machine), with the classical GARCH(1,1), EGARCH(1,1) and GJR(1,1) models to forecast financial volatilities of three major ASEAN stock markets. More precisely, the experimental results suggest that using hybrid models, GARCH-LSSVM, EGARCH-LSSVM and GJR-LSSVM provides improved performances in forecasting the leverage effect volatilities, especially during the recently global financial market crashes in 2008.

**Keywords:** Least squared support vector machine, Forecasting Volatility, GARCH, EGARCH, GJR.

## 1. Introduction

Time series method plays a vital role in financial areas, particularly volatility modeling and forecasting. Most of the financial researchers and practitioners are mainly concerned with modeling volatility in asset returns. In this context, volatility is the variability in the asset prices over a particular period of time. It refers to the standard deviation of the continuously compounded returns of a financial instrument with a specific time horizon. It is often used to quantify the risk of the instrument over that time period. Investors want a premium for investing in risky assets. A risk manager must know today the likelihood that his portfolio will decline in the future and he may want to sell it before it becomes too volatile. Therefore, the ability to forecast financial market volatility is important for portfolio selection and asset management as well as the pricing of primary and derivative assets. Researches on time varying volatility using the time series models have been active ever since Engle introduced the ARCH (autoregressive conditional heteroscedasticity) model in 1982. Since its introduction, the GARCH model generalized by Bollerslev (1986) has been extended in various directions. Several extensions of the GARCH model aimed at capturing the asymmetry in the response of the variance to a shock. These extensions recognize that there may be important nonlinearity, asymmetry, and long memory properties in the volatility process as suggested by various researchers based on empirical evidences. The popular approaches can be referred to Exponential GARCH model by Nelson (1991) as well as the GJR model by Glosten, Jaganathan, and Runkle (1993) which both account for the asymmetric relation between stock returns and changes in variance; see Black (1976) the beginning study of the asymmetric effect; Engle and Ng (1993) for further discussion. Other models such as APARCH, AGARCH, TGARCH and QGARCH models have also been developed (by Ding, Granger and Engle (1993); Engle (1990); Zakoian (1994) and Sentana (1995)) for the flexibility of the models. However, all of the models do require specified distribution of innovations in order to estimate the model specification and to appropriately forecast future values. One of the most classic one is Gaussian process and it is widely used in most of literature; but other distributions of innovations are also attracted after the empirical studies of modeling returns have shown the violation of normality conditions. For example, Student's t distribution by Bollerslev (1987), GED in Nelson (1991), Granger and Ding (1995) for the Laplace distribution and Hsieh (1989) for both Student's t and GED as distributional alternative models for innovations. The researches have found that returns usually exhibit empirical regularities including thick tails, volatility clustering, leverage effects (Bollerslev et al, 1994).

Semi-parametric approaches do not require any assumptions on data property (i.e. return distribution). These models have been successfully shown for modeling and forecasting time series, including volatility. One of them is NN (neural network) and it is a powerful tool for prediction problems due to their best ability to estimate any function arbitrary with no priori assumption on data property (Haykin, 1999). Donaldson and Kamstra (1997) proposed neural network to model volatility based GJR-GARCH; their hybrid approach captured asymmetric effects of new impact well like parametric model and also generated better forecasting accuracy. Bildirici & Ersin(2009) fitted neural network based on nine different models of GARCH family such as NN-GARCH, NN-EGARCH, NN-TGARCH, NN-GJR, NN-SAGARCH, NN-PGARCH, NN-NGARCH, NN-APGARCH, and NN-NPGARCH to forecast Istanbul stock volatility and most of the hybrid models improved forecasting performance. This indicates that the hybrid model is also able to capture the stylized characteristics of return. Another efficient (semi-parametric) model is SVM (support vector machine) originally introduced by Vapnik (1995). The SVM, a novel neural network algorithm, guarantees to obtain globally optimal solution (Cristianini & Shawe-Taylor, 2000), and hence it solves the problems of multiple local optima in which the neural network usually get trapped into. Perez-Cruz et al (2003) predicted GARCH(1,1) based volatility by SVM and the proposed model yielded better predictive capability than the parametric GARCH(1,1) model for all situation. Chen et al (2008) developed recurrent SVM as a dynamic process to model GARCH(1,1) based volatility. The experimental results with simulated and real data also showed the model generated better performance than MLE (maximum likelihood estimation) based GARCH model. More applications of SVM in GARCH prediction based on different kernels, wavelet and spline wavelet can be referred to Tang et al (2008, 2009).

Another version of SVM is LSSVM (Least squares support vector machine), modified by Suykens et al (1999). The SVM algorithm requires Epsilon insensitive loss function to obtain convex quadratic programming in feature space, while LSSVM just uses least square loss function to obtain a set of linear equations (Suykens, 2000) in dual space so that learning rate is faster and the complexity of calculation in convex programming in SVM is also relaxed. In addition, the LSSVM avoids the drawback faced by SVM such as trade-off parameters ( $C, \sigma^2, \varepsilon$ ) selection, instead it requires only two hyper-parameters ( $\gamma, \sigma^2$ ) while training the model. According to Suykens et al (2001), the equality constraints of LSSVM can act as recurrent neural network and nonlinear optimal control. Due to these nice properties, LSSVM has been successfully applied for classification and regression problems, including time series forecasting. See Van Gestel et al (2004) for detailed discussion on classification performance of LSSVM and Ye et al (2004) for predictive capability of LSSVM in chaotic time series prediction. Van Gestel et al (2001) proposed to predict time varying volatility of DAX 30 index by applying Bayesian evidence framework to LSSVM. The volatility model is constructed based on inferred hyperparameters of LSSVM formulation within the evidence framework. The proposed model provided a better predictive performance than GARCH(1,1) and other AR(10) models in term of MSE and MAE.

In this paper, we aim at comparing the LSSVM method with the classical GARCH(1,1), EGARCH(1,1) and GJR(1,1) models to forecast financial volatilities of ASEAN stock markets as a new concept to be investigated. The hybrid models denoted as GARCH-LSSVM, EGARCH-LSSVM, and GJR-LSSVM are constructed by using lagged terms as input and present term as output which corresponds to the parametric models. The hybrid models are not the same as the volatility model proposed by Van Gestel et al (2001) but they are similarly built according with the results by Donaldson & Kamstra (1997) and Bildirici & Ersin(2009) with neural network approach, and Perez-Cruz et al (2003) with SVM method. In our experiment, we consider two stage forecasts for the whole year 2007 as first period and 2008 as the second stage which cover global financial crisis period. Several metrics MAD, NMSE, HR, and linear regression R squared are employed to measure the model performances. The paper is organized as follows. Next section briefly reviews LSSVM formulation. Section 3 discusses volatility modeling of hybrid models based on GARCH, EGARCH and GJR. Section 4 illustrates the experimental results and the final section is about the conclusion.

## 2. Least squared support vector machines

In LSSVM formulation, the data are generated by nonlinear function  $y_i = f(x_i) + e_i$  for  $i = 1, \dots, N$  which may be approximated by another nonlinear function

$$y_i = w^T \phi(x_i) + b + e_i. \quad (1)$$

The model parameter  $w$  is called weight and  $e_i$  is random noise. Output  $y_i \in R$  can be referred as return of an asset or volatility, while the input vector  $x_i \in R^n$  may consist of lagged returns or lagged volatility. Mapping  $\phi(\cdot) : R^n \rightarrow R^n$  is nonlinear function that maps the input vector  $x$  into a higher dimensional feature space. The weight vector  $w$  and function  $\phi(\cdot)$  are never calculated explicitly; instead, Mercer conditioned kernel  $K(x_i, x) = \phi(x_i)^T \phi(x)$  which is symmetric and positive definite is applied. One defines the optimization problem as

objective function

$$\min_{w, b, e} J(w, e) = \frac{1}{2} w^T w + \frac{1}{2} \gamma \sum_{i=1}^N e_i^2 \quad (2)$$

subject to the constraints

$$e_i = y_i - (w^T \phi(x_i) + b) \quad i = 1, \dots, N. \quad (3)$$

Here the equality constraint is used in LSSVM instead of the inequality constraint in SVM. Lagrangian can be defined to solve the above minimization problem as

$$L(w, b, e; \alpha) = J(w, e) - \sum_{i=1}^N \alpha_i (w^T \phi(x_i) + b + e_i - y_i)$$

where  $\alpha_i$  denotes Lagrange multipliers (also called support values). From the Karush-Kuhn-Tucker (KKT) theory, a system of equations is obtained as the following

$$\begin{cases} \frac{\partial L}{\partial w} = 0 \rightarrow w = \sum_{i=1}^N \alpha_i \phi(x_i) \\ \frac{\partial L}{\partial b} = 0 \rightarrow \sum_{i=1}^N \alpha_i = 0 \\ \frac{\partial L}{\partial e_i} = 0 \rightarrow \alpha_i = \gamma_i e_i \quad i = 1, \dots, N \\ \frac{\partial L}{\partial \alpha_i} = 0 \rightarrow b = y_i - w^T \phi(x_i) - e_i, \quad i = 1, \dots, N. \end{cases} \quad (4)$$

Note that sparseness is lost from the condition  $\alpha_i = \gamma_i e_i$ . By eliminating  $w$  and  $e_i$ , the following linear system is written as follow

$$\begin{bmatrix} 0 \\ 1_v \end{bmatrix} \begin{bmatrix} 1_v^T \\ \Omega + D_\gamma^{-1} \end{bmatrix} \begin{bmatrix} b \\ \alpha \end{bmatrix} = \begin{bmatrix} 0 \\ y \end{bmatrix} \quad (5)$$

where  $y = [y_1, \dots, y_N]$ ,  $1_v = [1, \dots, 1]$ ,  $e = [e_1, \dots, e_N]$ ,  $\alpha = [\alpha_1, \dots, \alpha_N]$ ,  $D_\gamma = \text{diag}([\gamma_1, \dots, \gamma_N])$ .

Matrix  $\Omega_{ij} = \phi(x_i)^T \phi(x_j) = K(x_i, x_j)$  for  $i, j = 1, \dots, N$  satisfies Mercer's condition and the LS-SVM model for estimating function is obtained as

$$h(x) = w^T \phi(x) + b = \sum_{i=1}^N \alpha_i K(x, x_i) + b. \quad (6)$$

$K(.,.)$  is the Mercer's kernel function representing the high-dimensional feature space that nonlinearly mapped from the input space. In this work, Gaussian kernel or RBF(radial basis function) is used as it tends to give a good performance under general smoothing assumptions. The kernel is defined as  $K(x_1, x_2) = \exp(-\frac{1}{\sigma^2} \|x_1 - x_2\|^2)$ . The kernel and regularized parameters  $(\gamma, \sigma^2)$  are tuned by gridsearch technique to avoid overfitting problem. Matlab toolbox is used in the whole experiment.

### 3. Predictive model of volatility

#### 3.1 Model building

Let  $P_t$  be the stock price at time  $t$ . Then

$$y_t = 100 \cdot \log(P_t / P_{t-1}) \quad (7)$$

denotes the continuously compounded daily returns of the particular stock at time  $t$ .

Let  $F_{t-1}$  be the past information set available up to time  $t-1$ ; this information set contains the realized values of all previous relevant variables. The expected return at time  $t$  after observing the past information up to  $t-1$  defined as

$$\mu_t = E[y_t / F_{t-1}] = f(F_{t-1}). \quad (8)$$

The volatility to investors investing in the particular stock at time  $t-1$  is denoted as follow

$$\sigma_t^2 = \text{Var}[y_t / F_{t-1}] = h(F_{t-1}) \quad (9)$$

where  $f(.)$  and  $h(.)$  are well defined functions with  $h(.) > 0$ .

Then the return of stock  $y_t$  can be modelled

$$y_t = \mu_t + \varepsilon_t \quad (10)$$

and  $\varepsilon_t = \sigma_t z_t$  where  $z_t$  is (iid) independent identically distributed random variables with mean 0 and variance 1. It is common to assume  $\mu_t = 0$  so that square return in (10) is obtained to be the shock squared,

$$y_t^2 = \varepsilon_t^2 = \sigma_t^2 z_t^2. \quad (11)$$

Here, we aim at estimating volatility (or conditional variance of return) in (9) by kernel regression (called semi-parametric method) based on parametric models of GARCH, EGARCH and GJR. One particular approach of the kernel regression is LSSVM (least square support vector machine) presented in the previous section.

LSSVM approximates GARCH(1,1)

$$\sigma_t^2 = \omega + \beta \sigma_{t-1}^2 + \alpha \varepsilon_{t-1}^2 \quad (12)$$

by nonlinear function obtained from the LSSVM algorithm,

$$\sigma_t^2 = h(\sigma_{t-1}^2, \varepsilon_{t-1}^2). \quad (13)$$

Similarly, the hybrid model estimates EGARCH(1,1)

$$\log \sigma_t^2 = \omega + \beta \log \sigma_{t-1}^2 + \alpha. [|\varepsilon_{t-1}|/\sigma_{t-1} - E(|\varepsilon_{t-1}|/\sigma_{t-1})] + \gamma \varepsilon_{t-1}/\sigma_{t-1} \quad (14)$$

$$\text{by } \log \sigma_t^2 = h(\log \sigma_{t-1}^2, [|\varepsilon_{t-1}|/\sigma_{t-1} - E(|\varepsilon_{t-1}|/\sigma_{t-1})], \varepsilon_{t-1}/\sigma_{t-1}) \quad (15)$$

where inputs  $\log \sigma_{t-1}^2, [|\varepsilon_{t-1}|/\sigma_{t-1} - E(|\varepsilon_{t-1}|/\sigma_{t-1})], \varepsilon_{t-1}/\sigma_{t-1}$  must be obtained before training LSSVM. The expectation  $E(|\varepsilon_{t-1}|/\sigma_{t-1})$  is estimated by its corresponding average (or mean) value so that specified distribution on innovation (or return in this case) is not required.

Finally, the GJR-LSSVM obtains GJR(1,1)

$$\sigma_t^2 = \omega + \beta \sigma_{t-1}^2 + \alpha \varepsilon_{t-1}^2 + \gamma S_{t-1}^- \varepsilon_{t-1}^2 \quad (16)$$

$$\text{as } \sigma_t^2 = h(\sigma_{t-1}^2, \varepsilon_{t-1}^2, S_{t-1}^- \varepsilon_{t-1}^2) \quad (17)$$

where  $S_{t-1}^- = 1$  if  $\varepsilon_{t-1} < 0$  and 0 otherwise. So  $S_{t-1}^- \varepsilon_{t-1}^2$  is the squared value of negative shock at  $t-1$ .

Here  $\hat{\sigma}_t^2 = \frac{1}{5} \sum_{k=0}^4 y_{t-k}^2$  suggested by Perez-Cruz (2003), and the function  $h(\cdot)$  is obtained by LSSVM algorithm in (6).

### 3.2 Forecasting

Out of sample forecasts by the hybrid models are obtained as follow:

$$\sigma_{t+1}^2 = h(\sigma_t^2, \varepsilon_t^2) \quad \text{for GARCH-LSSVM from (13),}$$

$$\sigma_{t+1}^2 = \exp\left(h(\log \sigma_t^2, [|\varepsilon_t|/\sigma_t - E(|\varepsilon_t|/\sigma_t)], \varepsilon_t/\sigma_t)\right) \quad \text{for EGARCH-LSSVM from (15) and}$$

$$\sigma_{t+1}^2 = h(\sigma_t^2, \varepsilon_t^2, S_t^- \varepsilon_t^2) \quad \text{for GJR-LSSVM from (17).}$$

## 4. Experimental Analysis

We examine three stock price indexes from three major ASEAN stock markets including Straits time index of Singapore stock market, PSEI of the Philippines and KLCI of Kuala Lumpur stock market. Each stock index price is collected from Yahoo Finance website and is transformed into log return as in (7) before making analysis. Table 1 reports the in-sample and out-of-sample periods of each market for two stages, basic statistics of the data and diagnostics. From the Table 1, we see that mean of all returns is close to zero. Two indexes KLCI and PSEI have positive skewed returns while STI produce negative skewed coefficient. The excess kurtosis appears in all series and the largest is from KLCI (54.152). The Jarque Bera statistics strongly suggest that all returns are non normal. Ljung Box test for squared return at lag 20 and Engle LM test significantly indicate all return series exhibit ARCH effects; that means the homoscedasticity hypothesis is strongly rejected. This shows the presence of volatility clustering and the leverage effects that could be caused by the excess kurtosis. Figure 1 plots price and log return of each index series for the entire sample. Though movement of the index prices of the three markets is almost in similar direction, the returns behave differently. From the plots, we can see some high volatility on log return series after financial crisis in ASEAN in 1997 and during the recent crisis of global market crashes; this is obviously seen that the plots of each stock price fall down sharply during 2008.



#### 4.1 Estimation results

Three parametric models GARCH, EGARCH and GJR are fitted to all return series by (12), (14) and (16) respectively. Each model is estimated twice for each market return as first stage and second stage estimations with updating in-sample.

Table 2.A, 2.B, and 2.C present the model parameters and their corresponding standard errors in brackets. The stationary conditions of the models hold for all series. Furthermore, significance of negative leverage coefficients in EGARCH and positive leverage coefficients of the corresponding GJR indicate the presence of asymmetric effects to the returns for both stages which may be caused by global financial crisis. By log likelihood, AIC and BIC criteria in Table 2.A and 2.C, GJR model is more adequate to the both stage estimations of STI and PSEI returns. For the KLCI return in Table 2.B, the GJR model fits well to the in-sample data at the first stage but the second stage estimation data is favour to EGARCH model according to the log likelihood, AIC and BIC.

Now we proceed to estimation results obtained from training the least square support vector machine. First, return series from all indexes are transformed into input and output format and then get them trained by LSSVM algorithm in (6) so as to get the estimated nonlinear function in (13) for GARCH hybrid, (15) for EGARCH case and (17) for GJR model. The training results are summarized in Table 3.A and 3.B for first and second stages respectively. Each second column of the table 3.A and 3.B shows the costs of training measured by the mean square errors. The third and fourth columns display the optimal regularized parameters and optimal kernel parameters obtained by gridsearch technique while training. The last column tells the bias term of resulted function obtained by the LSSVM.

From the first stage of the cost column in STI index, smallest cost falls to GARCH-LSSVM and the largest value goes to EGARCH-LSSVM. For KLCI series, GJR-LSSVM generates the least cost and the largest cost is from GARCH-LSSVM, but these errors are not far from one another. Finally, PSEI series produces the smallest error to EGARCH-LSSVM and the error is a bit far from the errors driven by GARCH-LSSVM and GJR-LSSVM.

In the second stage, training mean square error for STI and PSEI are analogue to the mean square errors for STI and PSEI in the first stage respectively; that is the STI is in favour with GARCH-LSSVM and PSEI produces the smallest cost while getting trained by EGARCH-LSSVM. For Kula Lumpur stock market, GARCH-LSSVM gives the smallest cost, but EGARCH-LSSVM still produces the highest value of cost like before. In the next section, these hybrid models will be performed to forecast volatility of the three markets and also be compared with the parametric approaches estimated in the previous section.

#### 4.2 Forecasting results

The following Evaluation metrics are used to measure the performance of proposed models in forecasting of the three different stock markets volatilities. They are Mean Absolute Deviation (MAD), Normalized Mean Square Error (NMSE) and Hit Rate (HR) which defined as the following:

$$\text{MAD} = \frac{1}{n'} \sum_{t=1}^{n'} |a_t - p_t|, \quad \text{NMSE} = \frac{1}{s^2 n'} \sum_{t=1}^{n'} (a_t - p_t)^2 \quad \text{where} \quad s^2 = \frac{1}{n'-1} \sum_{t=1}^{n'} (a_t - \bar{a}_t)^2.$$

$$\text{HR} = \frac{1}{n''} \sum_{t=1}^{n''} d_t \quad \text{where} \quad d_t = \begin{cases} 1 & (a_t - a_{t-1})(p_t - p_{t-1}) > 0 \\ 0 & \text{otherwise} \end{cases}$$

Here  $a_t = y_t^2$  actual values and  $p_t = \hat{\sigma}_t^2$  forecasted volatility. Here  $n'' = n' - 1$ .

We also use linear regression to evaluate the forecasting performance of the volatility model. We simply regress square returns on a constant and the forecasted volatility for out-of-sample time point,  $t = 1, 2, \dots, n'$ ,  $y_t^2 = c_0 + c_1 \hat{\sigma}_t^2 + e_t$ . The t-statistic of the coefficients is a measure of the bias and the square correlation  $R^2$  is a measure of forecasting performance. In this regression, the constant term  $c_0$  should be close to zero and the slope  $c_1$  should close to 1. Table 4.A and 4.B illustrate forecasting performances by different models for each market. The MAD, NMSE, HR and R squared with  $c_0$  and  $c_1$  are shown in the second to seventh columns.

*First stage for 2007:*

Beginning with STI series, the hybrid approaches perform better than parametric models for almost all metrics: MAD, NMSE, HR, and R squared. Only R squared criterion is in favour to EGARCH model that generates the highest value. Among all the models, EGARCH-LSSVM is best at a predictive performance because it provides highest HR (0.8273), smallest values of MAD and NMSE and it also satisfies to ( $c_0$  and  $c_1$ ) values which are not far from (0 and 1) respectively. Now by considering Kula Lumpur market, based on MAD and NMSE, the hybrid models are much better but in term of HR and R squared some semi-parametric models especially EGARCH-LSSVM is unable to defeat its counterpart, EGARCH. The KLCI return is well modelled by EGARCH like STI case since it generates least NMSE,

highest R squared and HR among the others. Looking at c0 and c1 criteria, the hybrid models are more satisfied than the parametric approaches. For PSEI, the semi-parametric models are superior to the parametric models for all cases.

#### *Second stage for 2008:*

The STI return series is well forecasted by EGARCH model like its previous performance in the first stage forecast due to the highest values of HR and R squared, which can be seen from the Table 4.B. For the other formed GARCH and GJR, LSSVM is better than the parametric models. From the Table 4.B, the values of c0 and c1 of EGARCH model (with values -3.72, 2.25), though generated best performance, deviate far from the appropriate norm (0, 1) respectively due to the global financial market crashes. However, EGARCH-LSSVM and other LSSVMs are more resistant in forecasting performance to the crashes since their c0 and c1 are not much far from 0 and 1 respectively. For KLCI and PSEI, hybrid approaches beat all parametric models for all criteria and EGARCH-LSSVM is superior among the others. These evidences can argue that LSSVM is more robust than the parametric models in forecasting volatility in spite of the high volatile situation during the global financial market crashes. Figures 2, 3, & 4 plot the out of sample forecasts by parametric models of GARCH, EGARCH and GJR and the corresponding hybrid models for STI, KLCI and PSEI respectively. From the plots, the forecast lines by hybrid models capture more extreme points than the parametric models do and therefore they improve forecasting performance. Noticeably, the LSSVM algorithm here has not been imposed the sparsity and robustness conditions proposed by Suyken et al (2002).

### **5. Conclusion**

In this paper, we combine Least square support vector machine (LSSVM) with GARCH(1,1), EGARCH(1,1) and GJR(1,1) models as a hybrid approach to forecast leverage effect volatility of ASEAN stock markets. To check the performance of the proposed models, we employ the corresponding parametric models to compare with the hybrid models. The forecasts are conducted twice in which the whole year 2007 is treated as the first stage and the second stage is for 2008 including the recent global financial crisis period. From the experimental results, it is found that the hybrid models are resistant and robust to the high volatile situation of the financial market crashes and hence they generate improved forecasting performance. This supports the general idea that LSSVM is the promising machine learning system which is good at estimating nonlinear function without assumptions on data property in time series applications.

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Table 1. Descriptive statistics of each return series

	STI	KLCI	PSEI
In-sample (1 <sup>st</sup> stage)	1/2/1998 - 12/29/2006	1/2/1998 - 12/29/2006	1/2/1998 - 12/29/2006
Out of sample(1 <sup>st</sup> stage)	1/3/2007 - 12/31/2007	1/3/2007 - 12/31/2007	1/2/2007 - 12/28/2007
In-sample (2 <sup>nd</sup> stage)	1/4/1999 - 12/31/2007	1/4/1999 - 12/31/2007	1/4/1999 - 12/28/2007
Out of sample(2 <sup>nd</sup> stage)	1/2/2008 - 12/31/2008	1/2/2008 - 12/31/2008	1/2/2008 - 12/24/2008
Total sample size	2756	2709	2715
Minimum	-9.215	-24.15	-13.08
Maximum	12.87	20.81	16.177
Mean	0.005	0.015	-0.0003
Median	0.022	0.022	-0.013
Variance	2.219	2.395	2.573
Stdev	1.489	1.547	1.604
Skewness	-0.060	0.555	0.456
Kurtosis	7.1018	54.152	11.503
JB <sup>a</sup>	5805	331658	15091
Q <sup>2</sup> (20) <sup>b</sup>	1443.1	1426.1	227
ARCH-LM <sup>c</sup>	372.30	777.28	95.02

**Note:**<sup>a</sup>JB is the Jarque Bera test for normality<sup>b</sup>Q<sup>2</sup>(20) is the Ljung-Box test for squared returns<sup>c</sup>ARCH-LM is the Engle's Lagrange Multiplier test for conditional heteroskedasticity with 12 lags

Table 2.A. MLE estimation of the Parametric models for Straits times index

STI	First stage			Second stage		
Statistics	GARCH	EGARCH	GJR	GARCH	EGARCH	GJR
$\mu$	0.066[0.01]*	0.079[0.02]*	0.044[0.02]**	0.071[0.01]*	0.105[0.02]**	0.052[0.02]*
$\omega$	0.016[0.00]*	0.064[0.00]*	0.016[0.00]*	0.016[0.00]*	0.048[0.00]*	0.017[0.00]*
$\alpha$	0.123[0.00]*	0.416[0.02]**	0.076[0.01]*	0.109[0.00]*	0.349[0.03]*	0.073[0.01]*
$\beta$	0.876[0.00]*	0.915[0.00]*	0.880[0.00]*	0.886[0.00]*	0.918[0.01]*	0.886[0.00]*
$\gamma$		-0.067[0.01]*	0.082[0.01]*		-0.051[0.01]*	0.070[0.01]*
LL	-3550	-3589	-3.538	-3406	-3427	-3397
AIC	7109	7189	7.087	6820	6864	6805
BIC	7132	7218	7.116	6843	6893	6833

**Note:** Values in bracket [ ] indicates standard error of estimates; **LL** denotes Log likelihood values.  
\* significant at the 1% level, \*\* significant at 5% level.

Table 2.B. MLE estimation of the Parametric models

KLCI	First stage			Second stage		
Statistics	GARCH	EGARCH	GJR	GARCH	EGARCH	GJR
$\mu$	0.043[0.01]*	0.011[0.02]	0.032[0.01]	0.052[0.01]*	0.041[0.01]*	0.041[0.01]*
$\omega$	0.010[0.00]*	0.074[0.00]*	0.010[0.00]*	0.008[0.00]*	0.006[0.00]*	0.009[0.00]*
$\alpha$	0.124[0.00]*	0.535[0.00]**	0.090[0.00]*	0.105[0.00]*	0.249[0.01]*	0.080[0.00]*
$\beta$	0.875[0.00]*	0.921[0.00]*	0.876[0.00]*	0.893[0.00]*	0.977[0.00]*	0.888[0.00]*
$\gamma$		-0.013[0.01]*	0.065[0.01]*		-0.045[0.00]*	0.059[0.01]*
LL	-3148	-3191	-3140	-2862	-2842	-2855
AIC	6305	6392	6291	5733	5694	5720
BIC	6327	6421	6319	5756	5722	5749

**Note:** Values in bracket [ ] indicates standard error of estimates; **LL** denotes Log likelihood values.  
\* significant at the 1% level, \*\* significant at 5% level.

Table 2.C. MLE estimation of the Parametric models

PSEI	First stage			Second stage		
Statistics	GARCH	EGARCH	GJR	GARCH	EGARCH	GJR
$\mu$	0.017[0.02]	0.018[0.02]	0.003[0.02]	0.030[0.02]	0.029[0.02]	0.018[0.02]
$\omega$	0.125[0.01]*	0.038[0.00]*	0.094[0.01]*	0.214[0.03]*	0.050[0.00]*	0.212[0.03]*
$\alpha$	0.130[0.00]*	0.217[0.00]*	0.074[0.00]*	0.125[0.02]*	0.204[0.00]**	0.067[0.00]*
$\beta$	0.821[0.01]*	0.964[0.00]*	0.853[0.00]*	0.769[0.01]*	0.936[0.01]*	0.782[0.02]*
$\gamma$		-0.036[0.00]*	0.073[0.01]*		-0.040[0.00]*	0.086[0.01]*
LL <sup>c</sup>	-3873	-3870	-3866	-3764	-3760	-3757
AIC	7755	7751	7743	7537	7530	7525
BIC	7778	7780	7771	7560	7559	7553
Q <sup>2</sup> (20) <sup>f</sup>						
<b>Note:</b> Values in bracket [ ] indicates standard error of estimates; <b>LL</b> denotes Log likelihood values. * significant at the 1% level, ** significant at 5% level.						

Table 3.A. Training results by LSSVM for 1<sup>st</sup> stage

STI	Cost (MSE)*	Optimal Gamma**	Optimal Sigma2**	b***
GARCH-LSSVM	0.2744	1089.0387	4.7055891	7.1706
EGARCH-LSSVM	0.5879	82.465645	1302.1078	4.8840
GJR-LSSVM	0.2904	4515.4671	79.336258	23.9096
KLCI				
GARCH-LSSVM	0.7295	2220.5867	40.007163	7.0168
EGARCH-LSSVM	0.7528	164.14558	1671.9517	4.0787
GJR-LSSVM	0.7002	3735.476	556.81488	12.7939
PSEI				
GARCH-LSSVM	0.5201	199.5209	599.4858	6.6127
EGARCH-LSSVM	0.2476	39.5453	11.5295	-0.0515
GJR-LSSVM	0.5571	170.6817	513.466	6.4879
*Cost of estimation by MSE measure. ** Optimal parameters (Gamma and Sigma2) selected by gridsearch technique. *** b is the intercept value of the function estimated by LSSVM.				

Table 3.B. Training results by LSSVM for 2<sup>st</sup> stage

STI	Cost (MSE)*	Optimal Gamma**	Optimal Sigma2**	b***
GARCH-LSSVM	0.3687	913.3114	1129.7975	-5.9924
EGARCH-LSSVM	0.4471	67.14207	1595.4792	4.6035
GJR-LSSVM	0.4119	1058.6892	1505.9648	-8.9199
KLCI				
GARCH-LSSVM	0.1524	884.44825	1783.175	-4.9433
EGARCH-LSSVM	0.5327	81.229819	1362.0289	3.8441
GJR-LSSVM	0.1898	1097.5405	1726.0707	1.1409
PSEI				
GARCH-LSSVM	1.6928	53.014923	1372.0333	3.6325
EGARCH-LSSVM	0.2825	7966.3458	203.42274	-16.0069
GJR-LSSVM	1.8074	57.086861	1591.2148	3.0683
*Cost of estimation by MSE measure. ** Optimal parameters (Gamma and Sigma2) selected by gridsearch technique. *** b is the intercept value of the function estimated by LSSVM.				

Table 4.A. Forecast performances of ASEAN stock volatilities by different models for 2007

STI	MAD	NMSE	$C_0$	$C_1$	$R^2$	HR
GARCH	1.78136	0.74299	-0.81[-2.41]	1.35[09.60]	0.2710	0.76305
GARCH-LSSVM	1.66240	0.72658	-0.04[-0.15]	1.01[09.51]	0.2676	0.79919
EGARCH	1.61913	0.59971	-1.85[-6.52]	1.80[15.66]	0.4970	0.78714
EGARCH-LSSVM	1.51584	0.60361	-0.56[-2.32]	1.44[13.80]	0.4347	0.82730
GJR	1.77206	0.73001	-0.82[-2.50]	1.35[09.94]	0.2850	0.73493
GJR-LSSVM	1.63353	0.62262	-0.42[-1.66]	1.21[12.44]	0.3843	0.78714

KLCI	MAD	NMSE	$C_0$	$C_1$	$R^2$	HR
GARCH	1.05754	0.69884	-0.39[-2.03]	1.26[10.54]	0.3100	0.70161
GARCH-LSSVM	0.91449	0.50993	-0.15[-1.11]	1.06[15.36]	0.4887	0.79435
EGARCH	1.00633	0.46063	-0.91[-6.34]	1.36[19.31]	0.6020	0.83467
EGARCH-LSSVM	0.83636	0.49243	-0.27[-2.03]	1.34[17.05]	0.5407	0.81451
GJR	1.06043	0.66277	-0.33[-1.87]	1.19[11.34]	0.3430	0.73387
GJR-LSSVM	0.96051	0.56356	-0.05[-0.37]	1.00[13.71]	0.4323	0.68548

PSEI	MAD	NMSE	$C_0$	$C_1$	$R^2$	HR
GARCH	2.67548	1.01961	-2.61[-4.16]	1.97[11.42]	0.3490	0.74590
GARCH-LSSVM	2.47743	0.58031	-0.74[-1.61]	1.27[13.69]	0.4355	0.79508
EGARCH	2.63377	1.03119	-3.38[-4.39]	2.33[09.70]	0.2790	0.74590
EGARCH-LSSVM	2.36726	0.60253	-0.70[-1.52]	1.40[13.54]	0.4303	0.77868
GJR	2.63297	1.03151	-2.47[-3.82]	1.90[10.73]	0.3220	0.71721
GJR-LSSVM	2.49653	0.60887	-0.58[-1.22]	1.22[12.72]	0.3999	0.78688

Note: higher R squared and HR is preferred, while smaller values of MAD and NMSE indicate the forecasted volatility is closer to the actual values. The coefficients of  $c_0$  and  $c_1$  should be close to (0, 1) respectively showing small forecasting errors.

Table 4.B. Forecast performances of ASEAN stock volatilities by different models for 2008

STI	MAD	NMSE	$C_0$	$C_1$	$R^2$	HR
GARCH	4.40025	0.69094	-1.08[-1.34]	1.22[10.51]	0.3142	0.73140
GARCH-LSSVM	3.63287	0.51329	-1.42[-2.34]	1.45[16.72]	0.5371	0.76446
EGARCH	3.72500	0.60189	-3.72[-5.72]	2.25[18.38]	0.5839	0.78099
EGARCH-LSSVM	3.63715	0.58018	-1.32[-2.08]	1.62[15.47]	0.4985	0.77685
GJR	4.46939	0.66002	-1.05[-1.35]	1.14[11.16]	0.3407	0.72727
GJR-LSSVM	3.65591	0.52521	-1.37[-2.21]	1.43[16.20]	0.5213	0.77272

KLCI	MAD	NMSE	$C_0$	$C_1$	$R^2$	HR
GARCH	2.05590	0.81824	-1.38[-2.45]	1.65[8.01]	0.2079	0.71951
GARCH-LSSVM	1.72023	0.77390	-0.35[-0.77]	1.28[8.59]	0.2316	0.78861
EGARCH	1.90105	0.78319	2.05[9.89]	-1.98[-3.69]	0.2857	0.78455
EGARCH-LSSVM	1.62305	0.66531	-0.75[-1.89]	1.64[12.56]	0.3918	0.80081
GJR	2.14153	0.78378	1.42[8.60]	-1.21[-2.30]	0.2323	0.73170
GJR-LSSVM	1.69754	0.74259	-0.57[-1.27]	1.39[9.60]	0.2735	0.78455

PSEI	MAD	NMSE	$C_0$	$C_1$	$R^2$	HR
GARCH	3.89602	0.72265	-4.17[-4.66]	2.55[13.90]	0.4421	0.72244
GARCH-LSSVM	3.79703	0.58720	-1.26[-1.66]	1.37[13.89]	0.4417	0.78775
EGARCH	4.07293	0.79128	-6.55[-6.10]	3.31[13.04]	0.4107	0.76326
EGARCH-LSSVM	3.43509	0.53528	-2.32[-3.51]	1.84[18.64]	0.5875	0.75102
GJR	3.89767	0.68178	-3.95[-4.69]	2.35[14.84]	0.4744	0.72653
GJR-LSSVM	3.86604	0.73799	-0.19[-0.21]	1.14[9.29]	0.2613	0.78775

Note: higher R squared and HR is preferred, while smaller values of MAD and NMSE indicate the forecasted volatility is closer to the actual values. The coefficients of  $c_0$  and  $c_1$  should be close to (0, 1) respectively showing small forecasting errors.

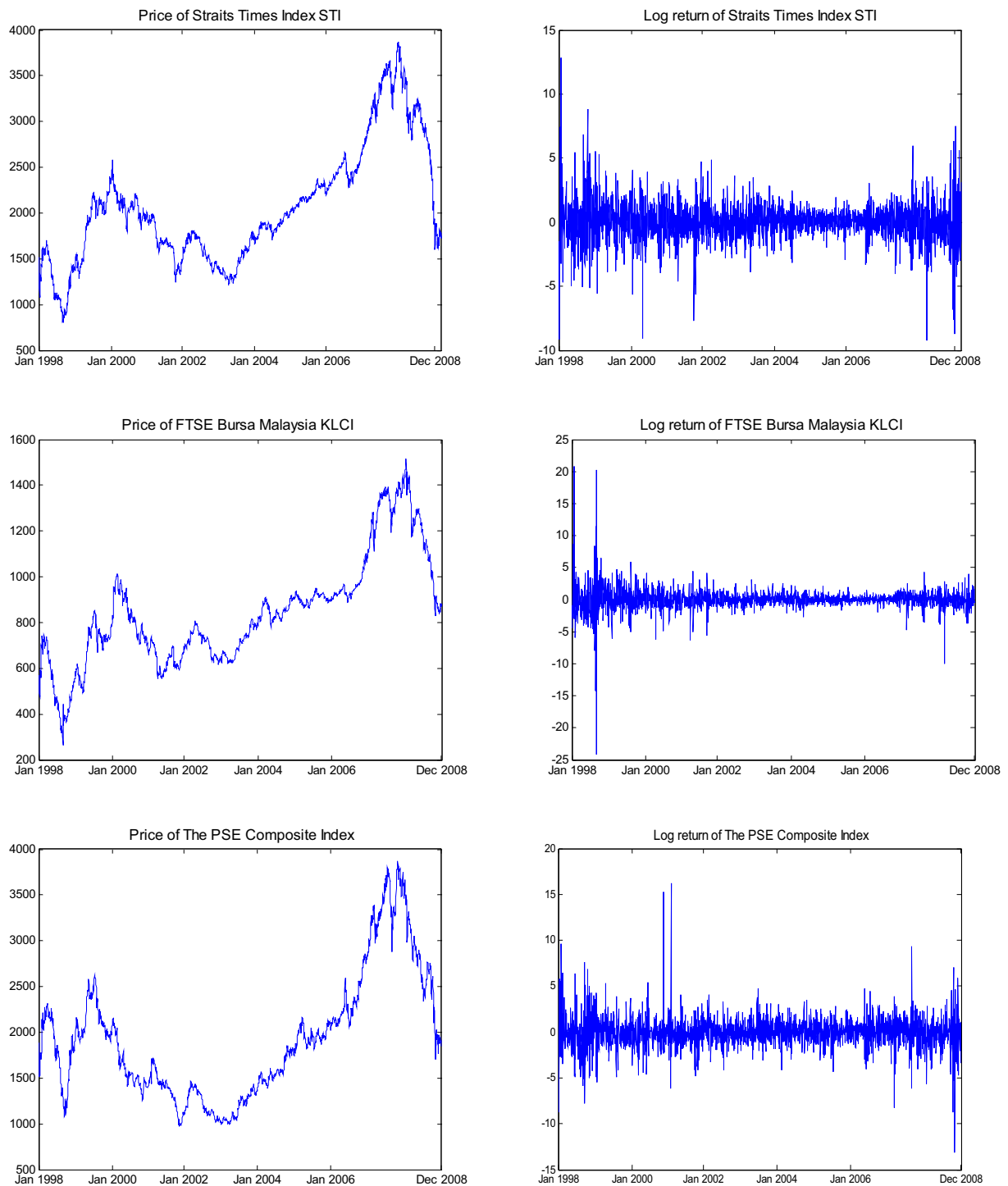


Figure 1. Plots of Prices and log returns of each market index

Plots of each index price (left) and log return (right) for the whole sample. From the left sides, we can see that all index prices movement are almost similar direction but the returns behave differently. The price series of each market falls down sharply at the last period due to global financial crisis. The log return plots exhibit high breaks at 1998 (after ASEAN financial crisis 1997) and in 2008 (the recent financial market crashes).

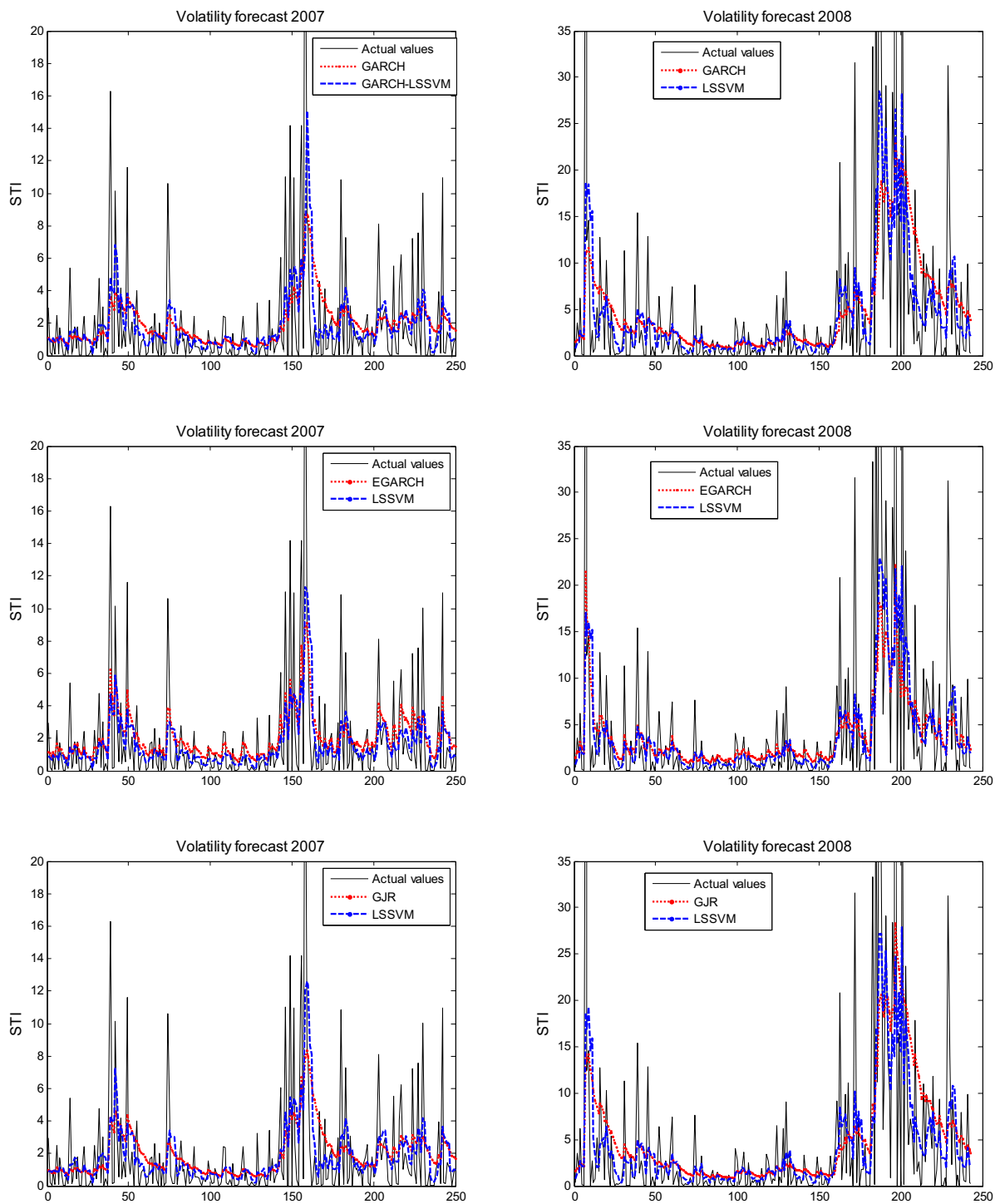


Figure 2. Volatility Forecasts of Singapore Stock Market (STI).

Note: Plots in left part are referred to the First stage forecast in 2007 (before crisis) and plots in the right side are referred to the second stage forecast for whole 2008 (during financial crisis). Small dot line is forecasted by parametric models (GARCH, EGARCH and GJR) while dash line is obtained by hybrid approaches.



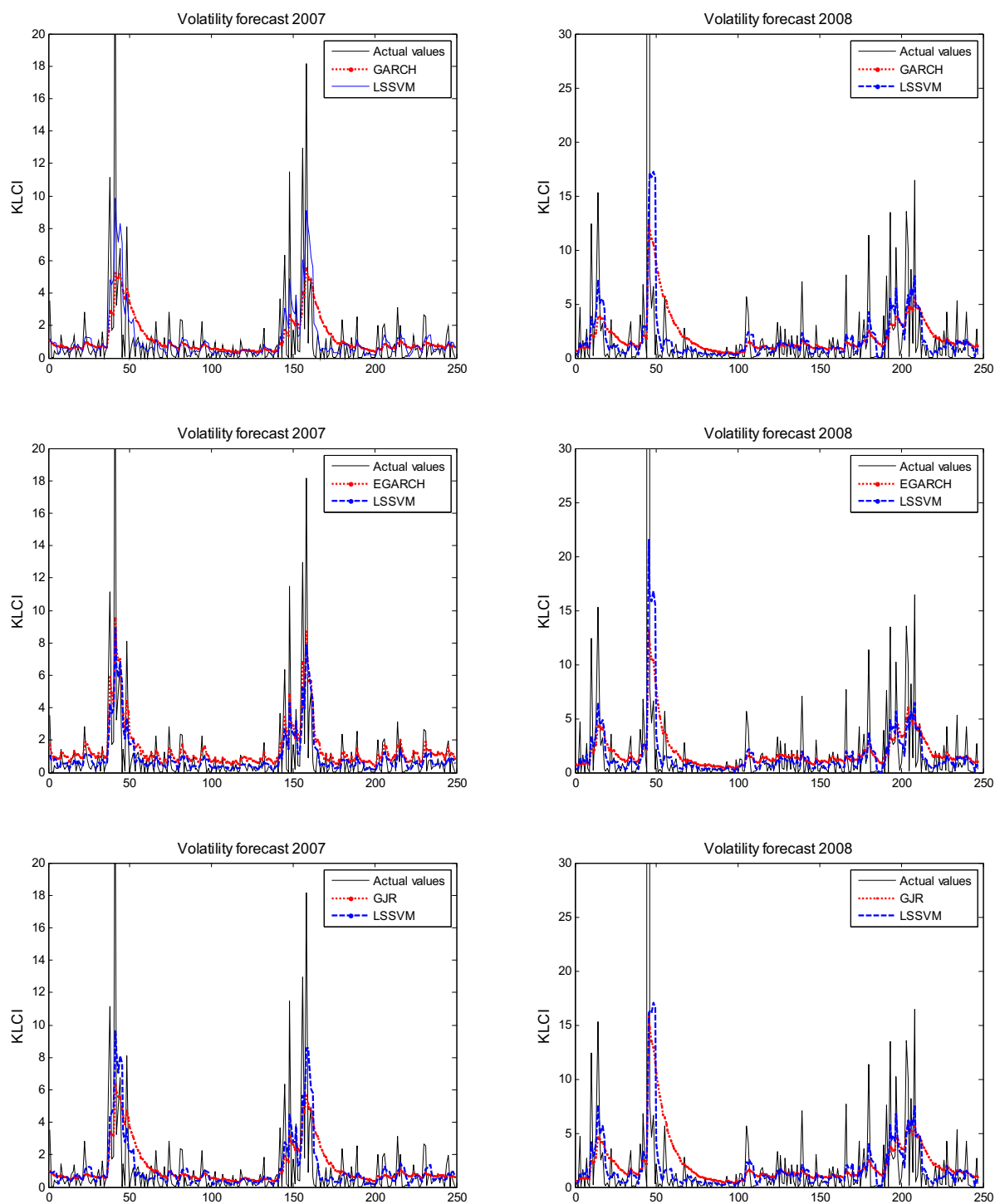


Figure 3. Volatility Forecasts of Kula Lumpur Stock Market (KLCI).

Note: Plots in left part are referred to the First stage forecast in 2007 (before crisis) and plots in the right side are referred to the second stage forecast for whole 2008 (during financial crisis). Small dot line is forecasted by parametric models (GARCH, EGARCH and GJR) while dash line is obtained by hybrid approaches.

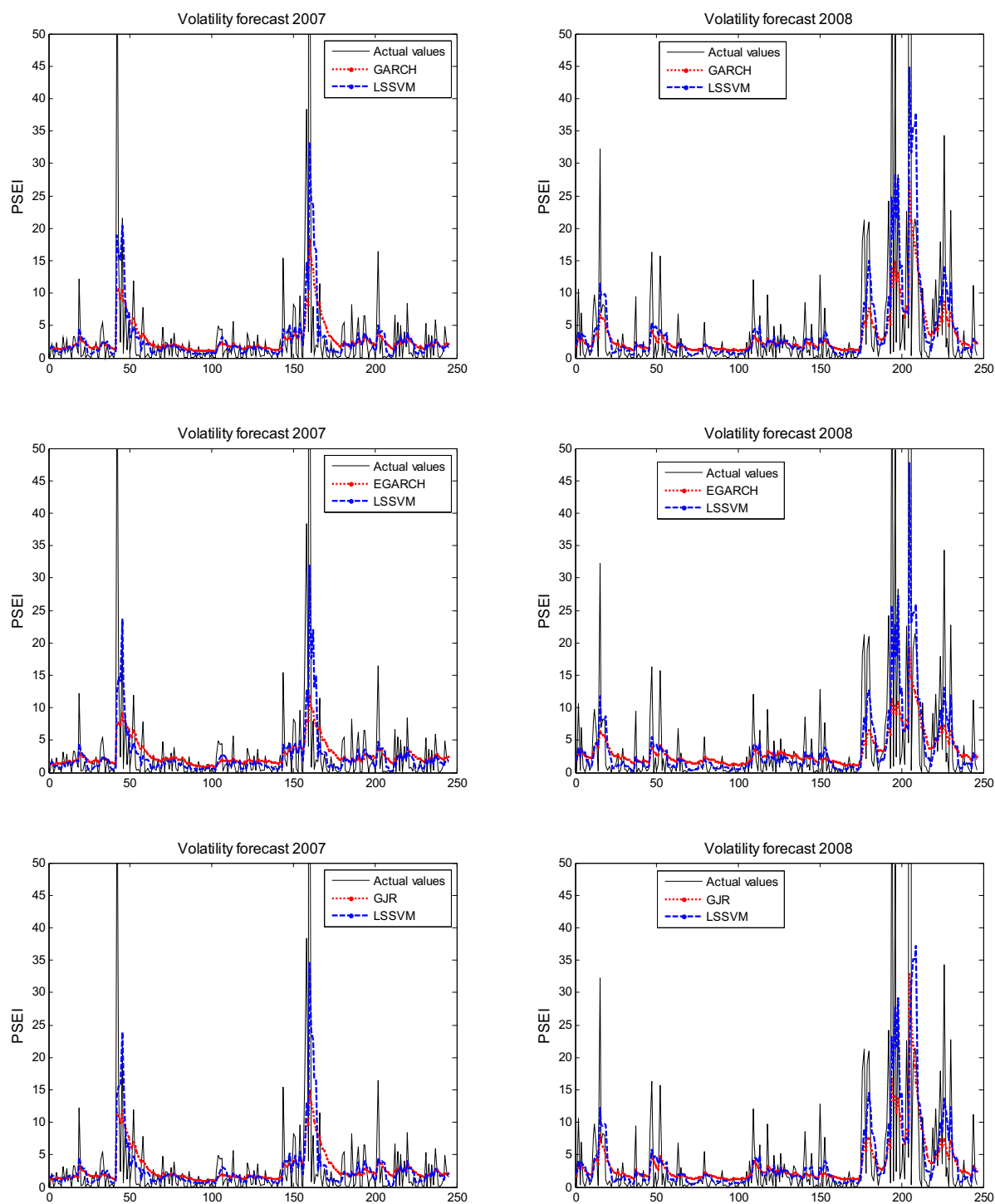


Figure 4. Volatility Forecasts of the Philippines stock market (PSEI).

Note: Plots in left part are referred to the First stage forecast in 2007 (before crisis) and plots in the right side are referred to the second stage forecast for whole 2008 (during financial crisis). Small dot line is forecasted by parametric models (GARCH, EGARCH and GJR) while dash line is obtained by hybrid approaches.



## Organizational Citizenship Behavior as a Predictor of Student Academic Achievement

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### Abstract

This study employed social exchange theory to examine the connection between one of the elements of teaching strategies, that is, lecturers' organizational citizenship behavior (OCB) and students' academic achievement. Student needs for achievement was used as moderator. Analysis was conducted on a survey data of 196 students in one of the local public institutions of higher learning. The results revealed that OCB dimension of altruism and courtesy were significantly related to students' academic achievement. In addition, conscientiousness positively predicted students' academic achievement among students with high needs for achievement. These findings indicate that, in order to enhance motivation and learning among students, altruism, courtesy and conscientiousness are some of the important behaviors among lecturers. Interpretations of results, implications and future research are discussed.

**Keywords:** Organizational citizenship behavior, Academic achievement, Student, Needs for achievement

### 1. Introduction

Employees' behaviors that go beyond formal duties and responsibilities such as assisting co-workers or superiors, willingness to compromise inconvenience at workplace, complying with organisational rules, policies and procedures and actively involved in the organisational development can contribute to organizational success (Katz & Kahn, 1978). Because OCB is believed to contribute to organizational, team and individual performance, studies have attempted to investigate the subordinate characteristics, task characteristics, organizational characteristics and leadership behaviors as antecedents of OCB which lead to a basic understanding of the causes of OCB. Although it is important to understand antecedents of OCB, most prior researches have not adequately assessed the effects of OCB. According to Podsakoff & MacKenzie (1994) and Walz & Niehoff (1996), not much research has concentrated on the effects of OCB on individual, group and organisational performance.

Despite an expanding of OCB literature, there is a gap in the empirical study on the relationship between OCB and its possible outcomes. Bolino (1999) states, "...in contrast to the numerous studies exploring the antecedents of OCB, there is a paucity of research examining the outcomes of citizenship behaviours in organisations." Specifically, only a limited study (e.g. Dipaola & Hoy, 2005; Allison et al., 2001) have been conducted that examine the relationships between OCB and student academic achievement. Hence, this study is attempted to determine the relationship between lecturers' OCB and student academic achievement. Additionally, this study will also investigate the role of students' needs achievement as a moderator of the relationship between lecturers' OCB and students' academic achievement.

### 2. Review of Literature

OCB has been defined as, "individual behaviour that is discretionary, not directly or explicitly recognised by the formal

reward system, and that in the aggregate promotes the effective functioning of the organisation” (Organ, 1988, p.4). According to Organ (1988), the word discretionary, means that the behaviour is not part of employee’s job description. Moorman and Blakely (1995) state that a good citizen is an employee who offers support to the organisation, even when such support is not verbally demanded.

High performance organizations rely on employees who go beyond their formal job duties to carry out their task successfully. In universities, teaching is a challenging and complex task due to continuous interaction with students for the purpose of imparting knowledge and development of related skills and abilities. The expanding roles of lecturers cannot be sufficiently prescribed in lecturers’ job descriptions (DiPaola & Hoy, 2005; Mazen, Herman & Ornstein, 2008). OCB should be considered as an important element of lecturers’ performance. The extent to which lecturers are willing to engage in discretionary behaviours such as OCB may greatly influenced the learning outcomes of students. The willingness of lecturers to exert greater efforts through altruism (e.g. helping students to understand a difficult subject matter), courtesy (e.g. give advance notice to students for postponement of classes), civic virtue (e.g. voluntarily attending students activities), conscientiousness (e.g. efficient use of time allocated for lectures and tutorials) and sportsmanship (e.g. avoid complaining when dealing with wayward students) can be expected to improve students’ academic achievement. A study by Yilmaz and Tasdan (2009) indicate that educators had positive perceptions regarding organizational citizenship.

Studies in OCB have generally adopted the social exchange theory as the theoretical underpinning. The social exchange theory proposes the giving and receiving of material or intangible resources on the expectation of some return in future (Blau, 1964). In general, research findings suggest that positive and beneficial actions directed at employees by an organisation and/or its representatives contribute to the establishment of high-quality exchange relationships (Konovsky & Pugh, 1994). The citizenship behaviours by lecturer’s will make the recipient of the benefits (students) to feel morally obligated to repay the lecturer in beneficial ways by exerting greater efforts to attain higher academic achievement. Lecturers may support the students’ learning by exhibiting a strong determination in the teaching activities, providing personal attention to the students, coaching of the students’ career, or being available if needed. It is possible that recipients of positive actions from the lecturers may seek to reciprocate in beneficial ways by not only viewing OCB as an acceptable commodity for exchange (Settoon, Bennett, & Liden, 1996) but also demonstrating a strong determination to succeed in their study. To date there is only one research conducted to investigate the relationship between educators’ level of OCB and students’ academic achievement. A study by DiPaola and Hoy (2005) found a significant relationship between OCB and student achievement on standardized tests among a group of high school students in USA.

Originally formulated by Murray in 1938, the concept of achievement motive has been refined and extended over the years (Matheiu, 1990). In this study, students’ needs for achievement can be argued to moderate the relationship between lecturers’ OCB and students’ academic achievement. Students with high level of need for achievement may have a strong desire to attain and maintain a high academic accomplishment compared to students with low needs for achievement. Therefore, the extent to which OCB affects academic achievement may vary depending upon a student’s needs for achievement. The extent to which lecturers exhibit OCB in facilitating students’ learning should be most rewarding to students with higher needs for achievement. Conversely, students with lower needs for achievement may not be driven to attain high academic achievement even with continuous support from the lecturers. Therefore, it can be argued that the positive relationship between lecturers OCBs and academic performance is weaker for students who have lower needs for achievement compared to those who have higher level of needs for achievement.

### **3. Methodology**

The subjects for this study include undergraduate students enrolled in courses in the Faculty of Business Management in one of the local public Universities in Malaysia. The study used self-administered questionnaires to capture information relating to the study topic. Questionnaires were administered to 500 students – 219 of the surveys were completed at a response rate of 44 percent. After eliminating a total of 23 survey results due to incomplete information, the resulting sample consisted of 196. The sample consisted of 120 female (61 percent) and 76 male (39 percent). The mean age of the subjects was 20.23 years (SD=1.54). With regards to the sampling method, the method of random quotas was used. In considering the randomness of the data the quotas of the sample were constructed according to the gender of the student.

The independent variable of the present study is OCB. OCB and its five dimensions were assessed from scales developed by Podsakoff and MacKenzie (1994). Overall, there were 17 items measuring OCB. The wording of the items was modified to accommodate the context of the present study. Each dimension of OCB was scored by obtaining the average rating of its component items. The scales have been found to have sufficient levels of reliability and validity (Podsakoff & MacKenzie, 1994). Students were asked to rate the overall level of OCB among their lecturers. Students’ academic performance, that is, GPA is the dependent variable of this study. GPA was measured through a single question: “On a 4.0 scale, what is your cumulative GPA?”. Students’ needs for achievement is the moderator variable.

This variable was measured using a 7-item scale from Steers and Braunstein's (1976) Manifest Needs Questionnaire (MNQ). Sample items are: "I take moderate risks and stick my neck out to get ahead on my assignments" and "I enjoy working hard as much as relaxation". The coefficient alpha for this 7 items scale as reported by Mathieu (1990) was .70. Except for the academic achievement, which was measured as a ratio-scale, all items were rated on five-point Likert scales ranging from strongly disagree (1) to strongly agree (5).

Bivariate correlation was used to test the relationship between OCB dimensions, needs for achievement and students' academic achievement. Correlation coefficient reveals the magnitude and direction of relationships. The magnitude is the degree to which variables move in unison or in opposition (Sekaran, 2000). Hierarchical multiple regression was utilized to test the main effect of each OCB dimensions on students' academic achievement and the interaction terms between OCB dimensions and students' needs for achievement. Aiken & West (1991), Cohen & Cohen (1983) and Stone-Romero & Hollenbeck (1984) recommended the use of hierarchical multiple regression in research concerned with the detection of moderating effects. Baron and Kenny (1986) suggested that a moderator effect is most appropriately tested with multiple regression. The general procedure for testing moderating effects was to enter the sets of predictors into the regression equation in the following order. At step 1, the main effects of the OCB dimensions were entered. At step 2, the moderator variable of needs for achievement was entered into the equation. The two-way interaction terms obtained by multiplying the moderator variable by the independent variables were added at step 3 (Zhang & Leung, 2002). All the variables were mean-centered to minimise the threat of multicollinearity in equation when interaction terms were included (Aiken & West, 1991).

Although regression analysis with tests for anticipated interactions are appropriate for assessing the moderating effect, split regression is useful to illustrate the effect. Significant interactions were further analysed via sub-grouping analysis, in which participants were split into appropriate groups on the basis of hypothesised moderator variable (Sharma, Durand & Gur-Arie, 1981). In this study, the moderator variables of students' needs achievement are split at the median into 2 groups (lower needs for achievement and higher needs for achievement). After sub-grouping the respondents, regression analysis was used to investigate the relationship between the predictor variable and the criterion variable for each subgroup and then the differences between the regression coefficients are compared (Arnold, 1982; Sharma et al., 1981). A moderator exists if participants in one subgroup have significantly higher regression coefficient between the predictor and the criterion than those in other groups (Weiner, Muczyk & Martin, 1992).

#### 4. Results and discussions

The Cronbach-alpha for each variable is presented in Table 1. Internal consistency of the scales can be gauged through these coefficients. The Cronbach-alpha range from .73 to .86, which suggested the specified indicators are sufficient for use (Nunnally, 1978). No alpha coefficient existed for the academic achievement variable because it consisted only one item.

The descriptive statistics and the intercorrelations of the variables are shown in Table 2. All variables were tapped on a five-point scale except for students' academic achievement, which was measured as a ratio-scale. It can be seen that the mean of student academic achievement is 2.97, which is rather high. The data in Table 2 indicate that the use of OCB among lecturers was relatively high, with the mean of all OCB dimensions exceeding the scale midpoint of 3.

<<INSERT TABLE 1>>

The correlation analysis was done to explain the relationship between all variables in the study. Pearson correlation was used to examine the correlation coefficient among the variables. As can be seen from Table 2, the measure of student's academic achievement is significantly correlated with all the five dimensions of OCB. More importantly, each of these variables is significantly correlated with the five dimensions of OCB. The strength of the relationship ranges from .20 to .35. Student's academic achievement correlated significantly and positively with altruism ( $r=.35$ ,  $p<.01$ ), civic virtue ( $r=.20$ ,  $p<.01$ ), conscientiousness ( $r=.21$ ,  $p<.01$ ), sportsmanship ( $r=.21$ ,  $p<.01$ ) and courtesy ( $r=.28$ ,  $p<.01$ ). The positive relationship indicates that high OCB levels among lecturers were more likely to result in high academic achievement among students. Additionally, student's academic achievement was also correlated significantly and positively with the moderator variable, that is, student's needs achievement. The intercorrelations were also inspected for multicollinearity. The majority of the correlation coefficients were below .70. Therefore, variable redundancy did not appear to be of concern (Nunnally, 1978).

<<INSERT TABLE 2>>

The hierarchical multiple regression analysis was carried out to test the lecturer's OCBs and students' academic achievement and academic performance for students. First, the main effects of the five dimensions of OCB were entered. Next, in step 2, the moderator variable of student's needs achievement was entered into the model. Finally, five two-way interactions, that is, between each dimension of OCB and needs achievement, were entered. Results of these regression procedures are shown in Table 3. The set of main effect of OCB dimensions entered at step 1 accounted for approximately 15% of the variance in student academic achievement. However, only altruism ( $\beta=.38$ ,  $t=3.25$ ,  $p=.00$ )

and courtesy ( $\beta=.30$ ,  $t=2.98$ ,  $p=.00$ ) were significantly and positively related to student academic achievement. Sportsmanship ( $\beta=.02$ ,  $t=.13$ ,  $p=.90$ ), conscientiousness ( $\beta=.04$ ,  $t=.26$ ,  $p=.79$ ) and civic virtue ( $\beta=.12$ ,  $t=.93$ ,  $p=.35$ ) were not significantly related to student academic achievement.

The moderator variable entered at step 2 accounted only 1% of the variance in student's academic achievement ( $\beta=.05$ ,  $t=.50$ ,  $p=.62$ ). At step 3, when the two-way interactions were entered, an increase in  $R^2$  was observed and one of the interactions was significant. This interaction is between conscientiousness student's needs for achievement ( $\beta=4.79$ ,  $t=2.30$ ,  $p=.02$ ). Based on the standardized beta weights, conscientiousness explained the student's academic achievement for students with higher level of needs for achievement ( $\beta=.24$ ,  $t=2.02$ ,  $p=.04$ ) than students with lower needs for achievement ( $\beta=.03$ ,  $t=.28$ ,  $p=.78$ ).

The present study found that altruism was related significantly to students' needs for achievement, which is generally consistent to a previous study by DiPaola and Hoy (2005). Specifically, results as presented in Table 3, indicated that among the five OCB dimensions, only lecturers' altruism and courtesy were significant predictors for students' academic achievement.

<<INSERT TABLE 3>>

This finding is consistent to the theory of social exchange. The lack of relationships among the other dimensions of OCB deserves some comments. Perhaps, sportsmanship, conscientiousness and civic virtue were not related to students' academic achievement, at least in this particular context. Lecturers could be high on these OCB dimensions, but these behaviors might not translate into any effect on the students' academic achievement. Second, the bivariate analysis showed a weak relationship between these dimensions and students' academic achievement. This relationship may not be strong enough to hold up in the multivariate analysis. Another plausible explanation is that the mean of sportsmanship, conscientiousness and civic virtue were not sufficiently high for the effect to be apparent in the regression analysis, as compared to altruism and courtesy. Certainly, further research need to confirm these findings.

In terms of offering an explanation for findings pertaining to the strongest effects of lecturers altruism and courtesy on student academic achievement, it appears that altruism and courtesy are the OCB dimensions that benefits specific individual such as students than sportsmanship or civic virtue that are viewed as mainly benefiting the organization as a whole (William & Anderson, 1991). In other words, a lecturer's propensity to engage in altruism and courtesy may strongly influence students to reciprocate by exerting greater efforts in their study.

As discussed earlier, there is evidence to suggest that the relationships between OCB dimensions and students' academic achievement may be moderated by students' needs for achievement. Although intuitively appealing, to date, no study has assessed the possible moderating role of student needs for achievement in the OCB-academic achievement relationship. As such, the findings of this study are preliminary and regarded as exploratory. While previous studies (e.g., Dipaola & Hoy, 2005; Allison et al., 2001) found a direct relationship between OCB and student academic achievement, the result of the present study go beyond this important finding by providing some moderated relationships between lecturers' conscientiousness and students' academic achievement. There are some possible reasons for this finding. Conscientiousness appeared to capture a person's internalization and acceptance of the organization's rules, regulations, and procedures, which results in adherence to them, even without observer or monitor compliance. Perhaps, by being conscientious, the lecturers will exhibit a true willingness to help the students attaining good academic achievement (e.g., always punctual, extra classes). Those students with strong needs for achievement will be benefited from the positive actions by the lecturers. However, these behavior, may not affect those students with lower needs for achievement.

## 5. Conclusion

This study contributes to the existing literature in several ways. First, one of the hallmarks of university performance is students' academic achievement. The present study which attempted to investigate relationships between lecturers' OCB and students' academic achievement will supplement other universities' efforts (e.g. physical facilities, trained lecturer, academic regulations, etc.) in increasing the students' academic achievement. This study makes a second contribution to current OCB literature as the findings complement the findings of previous studies on the relationship between OCB and organizational effectiveness (e.g. Podsakoff & MacKenzie, 1994) which demonstrate that OCB is related to organizational effectiveness. This is because, students' academic achievement investigated in this study is one of the elements of university's effectiveness (Dipaola & Hoy, 2005). Third, this study extends beyond previous research by not only investigating OCB as a predictor of student's academic achievement, but also investigates the roles of students' needs achievement as a moderator of the relationships. As such, the present study will provide a more comprehensive explanation on the effects of OCB on students' academic achievement. A previous research by Dipaola & Hoy (2005) only analysed the main effect of OCB on academic performance without paying attention to any possible moderating effects. This study investigated the needs for achievement as a possible moderator for the relationship between OCB and academic performance.

The fourth contribution relates to the sample investigated. Despite considerable efforts in understanding antecedents and consequences of OCB, there is a dearth of empirical research exploring this concept in the context of university. This study will also provide practical value for university management. To address the students' academic performance, one strategy has been suggested to facilitate students' learning process. University faculty members can act as key players in facilitating students' learning by exerting extra effort, such as OCB.

Whereas this study provides some insights into the importance of OCB, several limitations of the research are notable. First, other potentially important variables beyond facets of OCB, especially the student's family background were not controlled in the model. The importance of OCB may have been reduced if these variables have been included in the model. Second, this study is based on cross-sectional data and thus, causality cannot be firmly established. More longitudinal studies are needed. Lastly, the sample size of this study is considered small. With these limitations in mind, the current results suggest several avenues of future research, which is worthy of pursuit. Since the impact of OCB on individual performance is only beginning to be explored, the findings of the present study suggested that future research should examine the effects of OCB on other forms of student criterion variables such as achievement in extra-curricular activities. Secondly, the present research focused on the relationships between OCB and one of the students' criterion variables at the individual level analysis. Another avenue for future research is to examine this relationship at the organizational level. This is consistent to the suggestion by Schnake & Dumler (2003) that OCB occurs at the individual level. However, it is OCB in the aggregate that impacts organizational effectiveness.

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Table 1. Cronbach alphas for the study variables

Variable	Alpha	Number of Items
Altruism	.77	4
Courtesy	.76	3
Sportsmanship	.73	3
Conscientiousness	.81	3
Civic Virtue	.86	4
Needs for achievement	.77	7

Table 2. Intercorrelation between study variables

	M	SD	1	2	3	4	5	6	7
1. Academic Achievement	2.97	.33	-						
2. Altruism	4.09	.41	.35**	-					
3. Courtesy	4.01	.57	.28**	.64**	-				
4. Sportsmanship	3.64	.62	.21**	.54**	.50**	-			
5. Conscientiousness	3.89	.60	.21**	.62**	.59**	.74**	-		
6. Civic virtue	3.91	.63	.20**	.64**	.58**	.61**	.72**	-	
7. Needs for achievement	4.03	.45	.20**	.54**	.46**	.45**	.59**	.65**	-

\*\* p<.01 \*p<.05



Table 3. Hierarchical multiple regression

Variables	$\beta$	t	Sig.	R <sup>2</sup>	R <sup>2</sup> $\Delta$	F Change
Step 1 (Main Effect)						
Altruism	.38**	3.25	.00	.15	-	4.91**
Courtesy	.30**	2.98	.00	.13		
Sportsmanship	.02	.13	.90			
Conscientiousness	.04	.26	.79			
Civic virtue	.12	.93	.35			
Step 2 (Moderator)						
Needs for Achievement	.05	.50	.62	.16	.01	.25
Step 3 (Interaction Effect)						
Altruism x NA	.59	.32	.75	.22	.06	2.31*
Courtesy x NA	2.94	1.49	.14			
Sportsmanship x NA	1.03	.59	.55			
Conscientiousness x NA	4.79**	2.30	.02			
Civic virtue x NA	.29	.15	.88			

\*p&lt;.05 \*\*p&lt;.01

NA – Needs for achievement



## Evaluation of Default Risk Based on KMV Model for ICBC, CCB and BOC

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### Abstract

After the financial crisis, the market capitalization of Industrial and Commercial Bank of China(ICBC), Bank of China(BOC) and China Construction Bank(CCB) rose to the top three global business, fully representative of the China's overall economic growth, while exposure to the banking industry's high financial risks. In order to identify and compare credit risk of three listed banks, using KMV model calculate default distance of the three banks and then compare default rate: First, use stock data to calculate default point, the default distance, compare the risk of three banks, on this basis analyze financial data of three banks; Finally, identify the reasons for differences of default risk. An Empirical Study of three banks through the second half of 2006 to the end of 2008 stock data and annual information, found that: (1) The risk of three banks have tended to increase, including CCB the highest risk of default; (2) key financial indicators of CCB: non-performing loan ratio, loan-to-deposit ratio, the proportion of non-interest income accounted for revenue are worse than ICBC and BOC, which is reason for CCB risk of default is higher than ICBC and BOC. Suggest CCB adjust loans and reduce non-performing loan ratio; improve asset efficiency and profitability; expand intermediary business to reduce risk.

**Keywords:** Credit risk, KMV model, Default distance, ICBC, BOC, CCB

### 1. Introduction

There are three main types for KMV model: one is the introduction and analysis of KMV model on the base of theory and modeling framework, focusing on the KMV early studies. Representative is Du, Benfeng (2002) "real option theory in the application of credit risk assessment", Wang, Qiong and Chen, Jinxian (2002) "Credit Risk Pricing Methods and Models" and other articles, these studies highlight the framework of the KMV model, but no study of the applicability of KMV model in China.

Another type of research is the use of domestic data sample directly in accordance with the basic framework of the KMV model and use foreign models and the relation functions to authenticate. Yang,Xing and Zhang,Qiang (2003) take one listed company as sample, Ye,Qingxiang (2005) take 22 ST companies as samples, Chen,Jie (2003)divided a number of listed companies into shares of blue-chip stocks and underperformance, Cheng,Peng and Wu,Chongfeng (2002)divided listed companies into blue-chip stocks, underperformance stocks and high-tech stocks and respectively verify KMV model, Xia,Hongfang and Ma,Junhai (2008) verify the distance of four listed companies' five-year stock price of non-compliance. Such studies verified the basic conclusion is that, risk prediction methods of KMV model can make up for deficiencies in traditional methods, can effectively identify the risks. However, there is difference between Chinese and foreign stock markets, so such studies have not been able to support the applicability of KMV model in China.

There is also a type of study to explore the KMV model in China, the specific applicability of the revisions to the KMV model, based on the full use of the sample data for validation. Such studies include: Lu Wei, Zhao,Hengheng and Liu,Jiyun (2003) pointed out that the KMV model, the critical factor "corporate value" and the "volatility of company value," the relationship varies with the market, and they take advantage of China's stock market data, using

constant-growth model FCF (free cash flow) method to calculate a company's value, Use Bollerslev (1986) generalized conditional heteroskedasticity model (GARCH) to calculate value of volatility of equity, and finally a two-parameter Weibull to describe the value of the company respectively, and the relationship between the volatility of company value function, empirical results showed that compared with KMV model with non-amended relationship between the function of fitting, they can more effectively reflect the real situation in China. Chen, Dongping and Sun, Ming (2007) select the listed companies' non-performing loan rate of commercial banks as an alternative default rates, fitting out a function of the non-performing loan ratio and non-compliance distance, indicating that in KMV model using non-performing loan ratio as an alternative measure of listed companies of credit defaults risk is feasible. Sun, Xiaoyan, Shen, Yue and Luo, Luqi (2008) respectively verified ST and non-ST companies with amended KMV model, indicating that KMV model both calculate non-ST companies' value of the assets, but also reflect the ST companies' value of the "shell" resources. Chen, Hongwei and Chen, Fusheng (2008) proved the value of corporate assets by increasing the accuracy of the estimates; KMV model can enhance the recognition of credit risk for listed companies for next two years.

In addition, there is research of the non-tradable shares' conversion price issues caused by the special national conditions of China. Lu, Wei and Zhao, Hengheng et al (2003) proposed weighting methods; Zhang, Yiqiang (2003) proposed to leverage capital surplus as an adjustment factor to adjust the initial sponsor of non-tradable shares. Such research has further strengthened in the study of Chinese listed companies KMV credit risk on the applicability of the results to improve the prediction accuracy and credibility. In recent years, the applicability research of KMV model in China receive higher priority in the application of KMV model, Chinese scholars have done a lot of research in the study of a function to reflect the characteristics of Chinese companies, the study of the corresponding treatment methods in China's special conditions. However, there are still some issues to be addressed: Such as the choice of risk-free rate, default and expected default probability from the mapping relations, etc.

Through the results of the study has also found that, due to the nature of the financial industry itself and the special nature of accounting standards, research of the risks of the financial sector basically by calculating the bank's enterprise customers' credit risk to judge. Less study take the banking industry as a research object, directly use KMV model to identify the bank's own risk of default. Therefore, research of credit risk of China's listed commercial banks has very important significance. This article has been trying to learn from domestic and foreign research results, using KMV model representative of China's three commercial banks: Industrial and Commercial Bank of China, Bank of China and China Construction Bank risk study to compare credit risk of banks of different characteristics, and the reasons with the use of financial data analysis.

## 2. Calculation Method and Process

KMV model developed by the United States KMV Corporation, named by the three company founder, Kealhofer, MeQuow and Vasieek. KMV model is based on Merton (1974) option pricing theory, through the enterprise's financial reports and the market value of equity and debt data such as the possibility of likely future default. KMV model's basic idea is to use stock to show the options nature, through the stock market and its volatility as well as the value of corporate debt data to value corporate assets and their volatility, and in the coming years in order to estimate the likelihood of corporate defaults (refers only to enterprises due non-payment default risk, non-corporate credit rating changes in credit spread risk), that is, the expected probability of default EDF. KMV model is generally divided into four steps to determine a company's expected default frequency. The first step, estimate the company's asset value and its volatility from the company's stock market, value of the volatility of stock price and liabilities book value. According to assumption of KMV, from the equity capital structure, cash equivalent short-term liabilities are regarded as sustainable long-term pension liabilities and convertible preferred stock component. In this assumption, according to the relationship between the classic Black-Scholes-Merton model put option valuation models and default options, current market value of risk loans is determined by five variables.

Value of an option of loan default risk:

$$E = f(V, B, r, \sigma_v, \tau) \quad (1)$$

$$f(V, \sigma_v) = E = V \times N(d_1) - B \times e^{-rt} \times N(d_2) \quad (2)$$

$$d_1 = \frac{\ln\left(\frac{V}{B}\right) + \left(r + \frac{1}{2} \times \sigma_v^2\right)\tau}{\sigma_v \sqrt{\tau}} \quad (3)$$

$$d_2 = d_1 - \sigma_v \sqrt{\tau} \quad (4)$$

V is the market value of assets, B is the price for the loan, r is risk-free rate of interest,  $\sigma_s$  and  $\sigma_v$  Respectively, an enterprise's market value and asset value,  $\tau$  is put option expiration date or the time the loan limit,  $N(d)$ -Cumulative distribution probability function.

In order to calculate the value of assets (V) and its volatility  $\sigma_v$ , According to the relationship between the observable fluctuations in the market value of corporate and non-observable fluctuations in the value of assets of the company has established the function:

$$\sigma_s = g(\sigma_v) = \frac{V \times N(d_1) \times \sigma_v}{E} \quad (5)$$

Then uses a continuous iterative method will be able to find V and  $\sigma_v$ .

Second step, determine the default point (Default Point, DPT). Under a large number of empirical analyses, KMV found violations occurred most frequently in a company's value is greater than the critical point is equal to current liabilities plus 50% of the long-term liabilities. Set: CL for short-term liabilities; LL for long-term liabilities, then:

$$DPT = CL + 0.5LL \quad (6)$$

Third step, estimate the default DD (Default-distance). Default is the value of the assets from the risk fell within the time limit from the current level of non-compliance point of relative distance, but also can be expressed as the expected future asset values and default points exists between the standard deviation of the future number of asset returns, which is used to measure the default risk indicators can be used for comparisons between different companies. Default Distance:

$$DD = \frac{E(V) - DPT}{E(V) \times \sigma_v} \quad (7)$$

The fourth step, estimate the company's expected default probability (EDF). The expected default frequency (EDF) is determined by the mapping relationship between the distance by default distance (DD) and the expected default frequency. Therefore, establishing mapping relationship is a necessary prerequisite to determine the expected default rates. However, due to China's current credit system is not perfect, so the corporate default or bankruptcy of a serious lack of historical statistical data, it is difficult to change the default distance into the actual default rate, to calculate default probability (EDF) is difficult. Based on the one-to-one mapping relations between the default distances (DD) and the expected default frequency (EDF), the length of the distance to a certain extent reflect the company's credit status, and thus evaluate the level of competitiveness of enterprises.

### 3. Empirical process and the result

#### 3.1 Data Source

Study involved data from Guo Tai An Data Research Center and RESET databases, daily stock closing price is the comparable prices of the closing price considering of the cash dividend and re-investment, only take available open days prices, without considering the impact of stock stop plate; Value of circulating stocks market (EC) take the mean value of the circulating stocks from 2001 to 2007 of all transactions for each day, Daily Stock Market Mean Prices(PA,PH)is the comparable mean prices of the closing price considering of the cash dividend re-investment of all stocks all trading days per annum. Related financial data and net assets per share (A), the number of circulating stocks (SC), the number of non- circulating stocks(SNC) and the number of H stocks(SH) came from the semi-annual and annual reports of every bank, the number of non- circulating stocks from current semi-annual reports. Risk-free rate (R) obtained from at least six months less than one year certificate bonds interest rate issued by The People's Republic of China Ministry of Finance, as shown in Table 1:

Insert Table 1 Here

#### 3.2 Important parameters on the amendment of China's banking sector

##### 3.2.1 Market Value Calculation

Reference to the principle that negotiated transfer price of the non- circulating stocks are basically floating around the net assets per share of the market pricing, construct a net asset per share as independent variables, the financial markets financial shares transfer price as the dependent variable of a linear regression model-based, suppose the regression equation is:

$$P = m + nA$$

A--Net assets per share

P--The transfer price of financial shares

In order to determine the equation parameters and to validate the reliability of equation. This paper selected Guo Tai An Data Research Center - Data Services - Company Research Series - Chinese Corporate Governance Structure - Basic data - share transfer documents, all 35 times stock equity transfer data of Finance and insurance sector from 2001 to 2008 to regression analysis, regression results were shown in Table 2:

Insert Table 2 Here

Get the regression equation is:  $P=1.652688+0.906602 \times A$

Market value of the equation as follows: market value = value of A-share circulating stocks + value of A-share non-circulating stocks + value of H-share, namely:  $P=PA \times SC+(1.652688+0.906602 \times X) \times SNC$ .

Insert Table 3 Here

### 3.2.2 Default Point Calculation

Based on Debt Risk Valuation Theory and research of KMV, default point (DPT) is a point between long-term debt (LTD) and current liabilities (STD), and the predictive accuracy is sensitive of the model changes in point of the default point. Learn from empirical research on the banking sector, take  $DPT1 = STD + 0.25LTD$ , calculated as shown in Table 4:

Insert Table 4 Here

### 3.2.3 Asset Value and Asset Value Fluctuation Ratio Calculation

Before calculate the semiannual fluctuation ratio  $\sigma_s$  of bank shares, assuming the stock price to meet the lognormal distribution, calculate the daily stock fluctuation ratio S:

$$u_i = \ln(S_i / S_{i-1}) \quad (8)$$

In formula (8),  $S_i / S_{i-1}$  is the daily relative price of the stocks.

Fluctuation ratio in daily stock returns is:

$$S = \sqrt{\frac{1}{n-1} \sum_{i=1}^n (u_i - \bar{u})^2} \quad (9)$$

In formula(9):  $\bar{u}$  is the mean of  $u_i$ . Number of trading days semiannually of the stock is N, relationship between the semiannual fluctuation ratio  $\sigma_s$  and daily fluctuation ratio S is:

$$\sigma_s = S \sqrt{N} \quad (10)$$

2001-2007 three banks semiannual revenue fluctuation ratio is shown in Table 5.

Insert Table 5.Here

According to formula (3) to (7) can estimate the company's asset value  $V$  and the fluctuation ratio of asset value. Two equations are nonlinear equations, this paper uses mathematical calculation software program MATLAB6.5 to calculate, source code see Appendix A, the calculation results shown in Table 6 and Table 7.

Insert Table 6 and Table 7 Here

### 3.2.4 Default distance calculation

Finally, use formula to calculate the non-compliance DD of various banks for the next six months (first half of 2009).Using data from 2006 to 2008, three banks' calculation results of non-compliance distance is shown in Table 8 below:

Insert Table 8 and Figure 1 Here

As can be seen from Figure 1, the three banks have a downward trend from the default distance; default risk has the trend to increase. The default distance of Bank of China continued to increase from the second half of 2007 to the second half of 2008, indicating that the default risk was lowered, but in the first half of 2009, default distance is expected to fall to 2.949, default risk rise; default distance of Industrial and Commercial Bank of China in the second half of 2008 after experiencing a modest rise in half year of 2008, will continue to decline in 2009 and is expected to drop to 2.922; default distance of China has the most dramatic change, fell from the first half of 08 5.06to the first half of 2009 0.54, which indicates the default risk of China Construction Bank a sharp rise, become bank of top default risk in the three banks.

### 3.3 Empirical Analysis

Three banks vary in default risk, depending on their growth performance, operating characteristics, and asset quality.

#### 3.3.1 Comparison of three bank non-performing loan ratio

Insert Figure 2 Here

As can be seen from Figure 2, Industrial and Commercial Bank of China, Bank of China and China Construction Bank's non-performing loan ratio has a downward trend, compared with the end of 2007, by the end of 2008 respectively decreased by 16.4%, 15.1%, 15.0%, of which the lowest rate of non-performing loans is CCB, as well as the smallest decline degree in non-performing loan ratio.

#### 3.3.2 Comparison of three bank loan-deposit ratio

Insert Figure 3 Here

As can be seen from Figure 3, ICBC and BOC loan-to-deposit ratio were gradually increased, while CCB loan-to-deposit ratio dropped from 2007 61.3% to 2008 59.5%. This shows that the CCB efficiency and profitability of assets is lower than ICBC and BOC. In addition, the loan-deposit ratio of the three banks are generally around 60%, compared with Europe and the United States mature banks' about 90%, there is still a wide gap, which is also reflects the domestic banks have a wider profit room for growth.

#### 3.3.3 Comparison of three bank Non-interest income accounted for the proportion of operating income

Insert Figure 4 Here

Commercial bank's core source of profit for one credit business and second, intermediary business, the former form is known as interest income, which is non-interest income. But the credit business interest income earned by the capital adequacy ratio and policy restrictions on long-term growth is difficult at the same time bear the risk of bad debts, while the intermediary business to generate non-interest income do not take up too much capital, but the lower business risks.

According to statistics, non-interest income to total operating income ratio increase every one percentage, the banks pre-tax profits will increase by 1.5 percentage, there is 1:1.5 leverage. As can be seen from Figure 4, the proportion of ICBC non-interest income showed an upward trend year by year, from 2006 8.8% to 2008 15.1%; BOC, the proportion of non-interest income in the three banks in the highest, while in 2007 non-interest income decline, have a rebound in 2008. CCB fell from 2007 12.2% to 2008 10.7%, this shows that compared with CCB, ICBC and BOC created a lower risk, more rapid revenue growth.

In summary, on the basis of the three main financial indicators: non-performing loan ratio, loan-to-deposit ratio, the proportion of non-interest income accounted for revenues of comparison, CCB are worse than ICBC and BOC, this was part of the reason for CCB has a higher risk of default than ICBC and BOC.

#### 3.3.4 Comparison of three bank core capital adequacy ratio

Insert Figure 5 Here

In accordance with China's current "Basel II agreement" standard to require commercial banks core capital adequacy ratio must be greater than equal to 4%, can be seen from Figure 5, the three banks have reach the standard, while CCB is the lowest in the three banks.

The higher the capital adequacy ratio of banks, the stronger risk-resisting ability it has, indicating banks have sufficient own resources to deal with debt pressure, or cover the losses, such as the event of a run on banks or large non-performing loans and beyond recovery to a vicious risk. It can be seen that solvency of CCB in response to non-performing loans beyond recovery to the risk of such a vicious is lower and face greater financial risks.

## 4. Conclusions and recommendations

### 4.1 conclusion

Through using KMV model to calculate the default distance of ICBC, BOC and CCB, as well as financial data analysis, concluded that: (1) The three banks' risks have the trend to increase, showed that three banks' ability to resist risks have reduced, but CCB with the highest risk, increasing trend of CCB is clearly higher than ICBC and BOC; (2) Reasons for default risk of is CCB higher than ICBC and BOC are mainly: non-performing loan ratio dropped at a lesser extent, loan-to-deposit ratio reduced, non-interest income declined in the proportion of total operating income and core capital adequacy ratio lower, etc; (3) Compared with ICBC and BOC, ability of CCB to use intermediate business to enhance profitability, reduce business risk is weaker.

### 4.2 recommendations

Suggest CCB try the following ways to reduce the proposed credit risk, increase ability to resist risks: (1) take more attention to industries and geographic distribution of loans while increase volume of credit, optimize credit structure,

reduce exposure of business in deterioration of operating conditions or which have policy risk, for example, reduce the loan to business of high non-performing loan ratio;(2)expansion of intermediary business and improve non-interest income accounted for the proportion of revenue and reduce earnings risk, increase profit space; (3)improve the core capital adequacy ratio, improving the ability to cope with a vicious financial risks; (4)insist on sound sustainable development model, timely adjust the capital structure and investment strategies to further consolidate the competitive advantages, accelerate the pace of international development in order to promote innovation and diversification.

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Table 1. At least six months less than one year certificate bonds interest rate (%)

	2006.7-2006.12	2007.1-2007.6	2007.7-2007.12	2008.1-2008.6	2008.7-2008.12
R	0.72	0.72	0.81	0.72	0.72

Source: treasury bonds Notice of The People's Republic of China each year

Table 2. Regression results of all 35 times stock equity transfer data of Finance and insurance sector from 2001 to 2007

Result	m	n	T-test(m)	T-test(n)	F-test	D-W	R2
	1.652688	0.906602	2.128303	4.434704	19.6666	1.915527	0.873417

Table 3. Three banks' results of market value (Unit: 100 million)

	ICBC	BOC	CCB
2006.7-2006.12	9716.260479	8104.699936	
2007.1-2007.6	9697.466489	8575.560609	
2007.7-2007.12	11224.40289	8517.472682	7599.72641
2008.1-2008.6	12039.90369	7244.526519	8000.50426
2008.7-2008.12	10489.69012	6201.539755	7699.76438

Table 4. Three banks' results of DPT (Unit: 100 million)

	ICBC	BOC	CCB
2006.7-2006.12	65645.2275	45497.3075	
2007.1-2007.6	65648.0875	50781.1555	
2007.7-2007.12	75127.4055	52623.7605	59401.5435
2008.1-2008.6	82479.4075	57266.7755	59367.2615
2008.7-2008.12	86835.0675	62042.895	66923.3505

Table 5. Three banks' results of semiannual revenue fluctuation ratio  $\sigma_s$ 

	ICBC	BOC	CCB
2006.7-2006.12	0.169588226	0.164978611	
2007.1-2007.6	0.282845986	0.305306835	
2007.7-2007.12	0.317486889	0.277766628	0.19188921
2008.1-2008.6	0.306305119	0.263333004	0.30992565
2008.7-2008.12	0.332302893	0.326489257	0.35997641

Table 6. Three banks' results of asset value (Unit: 100 million)

	ICBC	BOC	CCB
2006.7-2006.12	75126	53439	
2007.1-2007.6	75110	59174	
2007.7-2007.12	86048	60929	66761
2008.1-2008.6	94223	64306	67154
2008.7-2008.12	97013	68021	68021

Table 7. Three banks' results of asset value fluctuation ratio (%)

	ICBC	BOC	CCB
2006.7-2006.12	0.0219	0.025	
2007.1-2007.6	0.0365	0.0442	
2007.7-2007.12	0.0414	0.0388	0.0218
2008.1-2008.6	0.0391	0.0297	0.0369
2008.7-2008.12	0.0359	0.0298	0.0298

Table 8. Three banks' results of DD

	ICBC	BOC	CCB
2006.7-2006.12	5.762	5.940	
2007.1-2007.6	3.451	3.209	
2007.7-2007.12	3.066	3.513	5.060
2008.1-2008.6	3.188	3.686	3.140
2008.7-2008.12	2.922	2.949	0.540



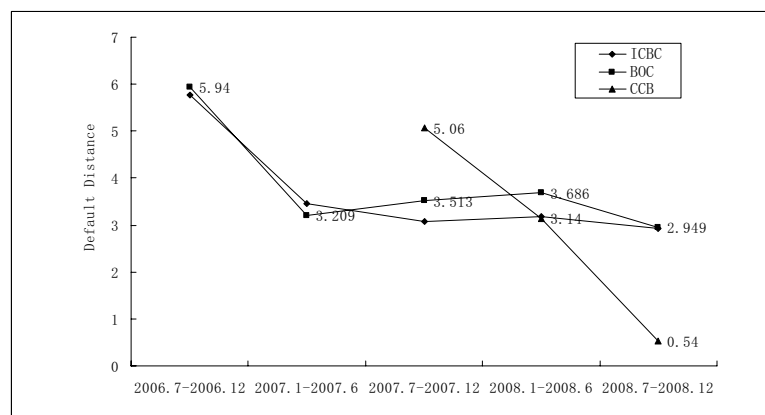


Figure 1. Comparison of three banks from the default distance

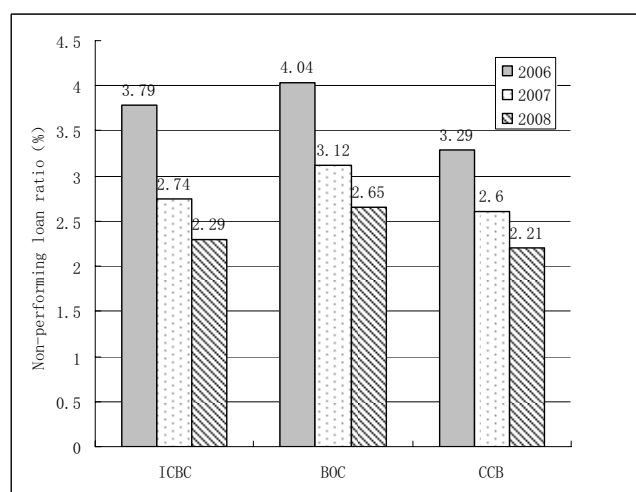


Figure 2. Comparison of three bank non-performing loan ratio

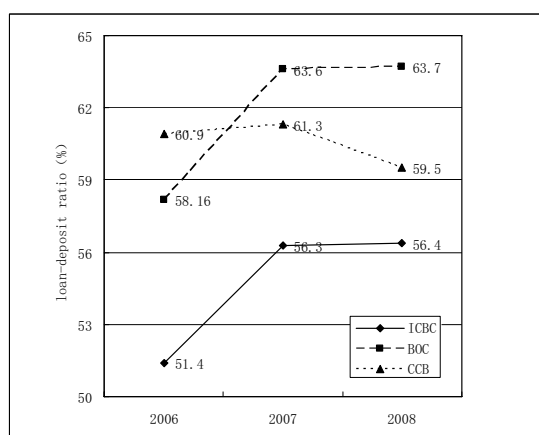


Figure 3. Comparison of three bank loan-deposit ratio

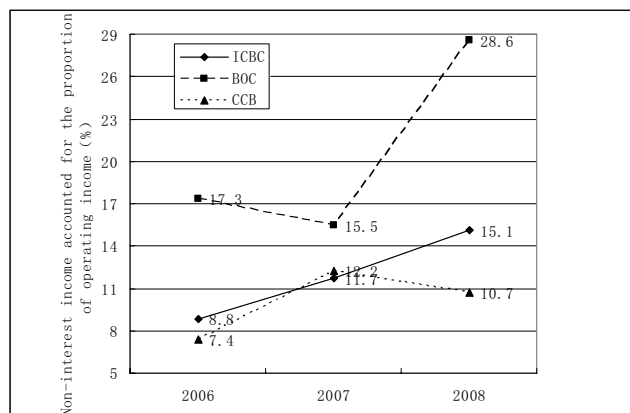


Figure 4. Comparison of three bank Non-interest income accounted for the proportion of operating income

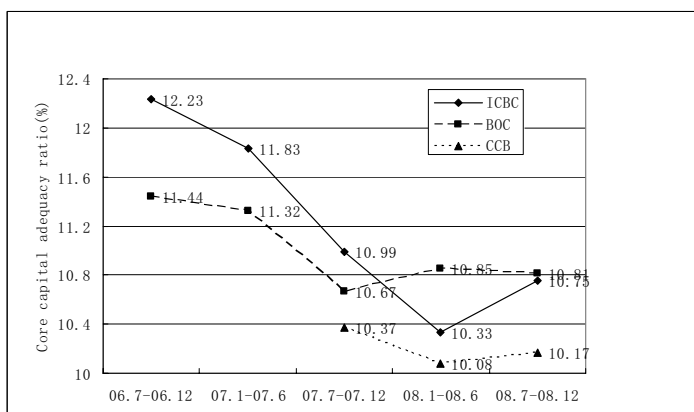


Figure 5. Comparison of three bank core capital adequacy ratio



# Non-Linear Models and the Forward Discount Anomaly: An Empirical Investigation

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*JEL classification: C13;C32;E3*

## Abstract

In this paper, we propose a non-linear approach to explain the forward discount anomaly. We use two classes of non-linear models: models with changes in mean and long memory process. Our empirical results show that the non-stationarity of the forward discount series is the causes of the rejection of the Forward Rate Unbiased Hypothesis (FRUH). By investigating the forward discount series, we show that are characterized by a stationary long memory behavior which is amplified by the presence of breaks.

**Keywords:** Structural breaks models, Long range dependence, Exchange rates

## 1. Introduction

One of the most persistent debates on the international finance concerns the forward discount anomaly. If the forward rate unbiasedness hypothesis holds, then under risk neutrality and rational expectations the current forward exchange rate is an unbiased predictor of the future spot rate. This hypothesis is generally rejected in empirical literature. Engel's (1996) sums up the empirical results: "First, empirical tests routinely reject the null hypothesis that the forward rate is a conditionally unbiased predictor of future spot rate. Second, models of the risk premium have unsuccessful at explaining the magnitude of this failure of unbiasedness".

In empirical literature, to test if the forward exchange rate provides an unbiased forecast of the future spot rate, we regress the forward discount (defined as the difference between the forward and the future spot exchange rates) on the spot exchange rate return. If the FRU hypothesis holds, then the coefficient  $\beta$  associated to the forward discount variable must be equal to the unity, the intercept to zero and the innovations must follow a white noise (iid). Most empirical works find a negative value of  $\beta$ . For example, Froot (1990) notes that the average value of  $\beta$  is equal to -0.88 over 75 published papers. This means that there is not only a problem of rejection of the unbiasedness hypothesis but also a problem in forecasting of the direction of changes.

Until now, there is no consensus about the true reasons of this rejection of the Forward Rate Unbiased Hypothesis (FRUH). Many economics arguments have been proposed to explain this anomaly. Bilson (1986). Fama (1984). and Sweeney (1986) suggest that central bank interventions can be in the origin of the forward discount anomaly. Barnhart and Szakmary (1991) have tried to explain the rejection of FRUH and the instability of the  $\beta$  coefficient by including in the estimated regression a variable that represents the intervention of central Banks. The authors have tried many Banks intervention variables but their results are not significant. Engel (1996) advances some other explanations: "Some progress has been made toward understanding the empirical findings when one allows for peso problems, learning, and possibly a group of agents whose irrational expectations lead to speculative bubbles through a bandwagon effect...".

Several others works have tried to explain the discount anomaly by the wrong econometric specification of the estimated model or by the statistical properties of the data. In the 80 decades researchers have been concentrated their attentions on the non-stationarity of the spot and forward exchange rates series. Recent works favor statistical artifact leads by analyzing the true nature of the non stationarity of the forward discount series, see for instance Baillie and Bollerslev (1994, 2000). Maynard and Phillips (2001). Sakoulis and Zivot (2001) and Choi and Zivot (2007).

In this paper, we privilege this last leads. We follow the empirical strategy proposed by Charfeddine and Guégan (2007). see also Choï and Zivot (2007). First, we analyze the statistical properties (in term of non-stationarity) of the spot, forward and forward discount exchanges rates. Then, by using the Markov switching model of Hamilton (1989) and long memory processes, we show that all the forward discount series are simultaneously characterized by the presence of long memory and breaks. We show also that the non stationarity of the forward discount series is the principal reason behind the rejection of the hypothesis that the current forward rate is an unbiased predictor of the future spot rate.

In this paper, our empirical results differ from previous works in three ways. First, we use a recent and different data sets. Second, we use for the first one the EURO/USD series to test the FRUH. Finally, we use the Markov switching model of Hamilton (1989) to detect the presence of breaks, contrary to all previous works in the literature which have used the Bai and Perron (1998) procedures.

The remaining of the paper is organized as follows. Section 2 presents the forward unbiased hypothesis and reports an exhaustive literature review concerning the forward discount anomaly. Section 3 reports the empirical results concerning the FRU Hypothesis and unit root tests results. Section 4 investigates the presence of breaks and long memory inside the forward discount series. Section 5 concludes.

## 2. Forward discount anomaly and empirical literature

In this section after introducing the forward unbiased hypothesis, we give an exhaustive review of recent empirical literature concerning the forward discount anomaly.

### 2.1 Forward Rate Unbiased Hypothesis (FRUH)

We say that a foreign exchange market is efficient when the two hypothesis of risk neutrality and rational expectations hold. Moreover, if these two hypothesis are verified the future anticipated rate of depreciation must offset the interest rate fluctuations. This hypothesis is known, in the literature, as the uncovered interest rate parity which is given by,

$$\frac{S_{t+k,e}}{S_t} = \frac{1 + i_t}{1 + i_t^*} \quad (1)$$

where  $S_{t+k,e}$  represents the spot exchange rate at time  $t+k$  and  $S_t$  the spot exchange rate at time  $t$ .  $i_t$  and  $i_t^*$  denote respectively the domestic and foreign interest rate (for  $k$  periods maturity). The symbol  $e$  means that the variable is expected. Under logarithmic notations this relationship is approximately, (Note 1)

$$s_{t+k,e} - s_t = i_t - i_t^* \quad (2)$$

where  $s_{t+k,e} = \text{Log}(S_{t+k,e})$  and  $s_t = \text{Log}(S_t)$ . Equation (2) is obtained by considering  $\text{Log}(1+x) \approx x$ , for small values of  $x$  that approach zero, we set here  $x = i_t - i_t^*$ . The second version of interest rate relationship is the covered version which implies that the current forward rate is an unbiased predictor of the future spot rate. We suppose here that there are no transactions costs and no tax, etc. The covered interest parity implies that,

$$\frac{F_t}{S_t} = \frac{1 + i_t}{1 + i_t^*}, \quad (3)$$

where  $F_t$  denotes the forward exchange rate for  $k$  periods,  $S_t$  the spot exchange rate.  $i_t$  and  $i_t^*$  denote respectively the nominal domestic and foreign interest rate (for  $k$  periods maturity). The logarithmic form of (3) is given by,

$$f_t - s_t = i_t - i_t^* \quad (4)$$

If the covered (2) and the uncovered (4) relationships hold, then the forward discount  $f_t - s_t$  must be equal to the expected return on the spot exchange rate,

$$f_t - s_t = s_{t+k,e} - s_t, \quad (5)$$

which can be re-written as follows,

$$f_t = s_t, \quad (6)$$

This later relationship implies that the forward exchange rate is an unbiased predictor of the future exchange rate. To test foreign exchange market efficiency researchers use, generally, a two particular equations. the first is a "level specification" which comes from (6).

$$s_{t+k}^k = \alpha + \beta f_t + \eta_{t+k} \quad (7)$$

Here  $\eta_{t+k}$  is an (iid) white noise.

The second is the well used "differences equation", where we regress the forward discount on the spot exchange return. This version follows from (5).

$$s_{t+k}^k - s_t = \alpha + \beta (f_t - s_t) + u_{t+k} \quad (8)$$

Under these two specifications if the FRUH holds, we get  $\beta = 1$ ,  $\alpha = 0$  and/or the term error is a white noise. Using the first equation researchers have been largely accepted the hypothesis that the current forward exchange rate is an unbiased predictor of the future spot exchange rate, see for instance Levich (1979). Frenkel (1981). Edwards (1983). and Chiang (1986). (1988). This "level" specification do not have a sense unless the dependent and independent variables are stationary or if we will test the co-integration hypothesis between  $s_{t+k}^k$  and  $f_t$ , if these two variables are  $I(q)$  with  $q$  an integer. In the 80's century researchers have used the "level" specification to test the forward unbiasedness hypothesis and not the co-integration hypothesis, see for instance Meese and Singleton (1982) and Meese (1989) and Isard (1995). In that case, no sense can be done to that method because we have a fallacious estimation. This

holds because the use of standard limiting distribution of usual statistics tests cannot be allowed and the obtained results are biased. However, by using the second specification the empirical finding show, contrary to all expectations, that the FRU Hypothesis is rejected for the majority of time series, see for instance Baillie and Bollerslev (1994, 2000). Maynard and Phillips (2001). Sakoulis and Zivot (2001) and Choi and Zivot (2007). Furthermore, not only the FRUH is rejected but we get a significantly negative value of  $\beta$ . Note here that in the rest of the paper, we will use only the differences specification given by equation (8) to investigate the FRU Hypothesis.

## 2.2 Reviews of the empirical literature

In recent literature, several econometrics paths have been followed to test the FRU Hypothesis. Unit root tests and cointegration hypothesis take the wide part of the 80-90 empirical literature. Using equation (7), a contrasting results have been obtained. Results depend on periods and money of study. The majority of works have showed that the spot and forward exchange rates are non stationary and follow an I(1) process. In that case, a possible solution is to test the cointegration hypothesis. Cointegration implies that Granger causality (1969) must runs in at least one direction, that is, at least one of the exchange rates is predictable using current available information. In that sense, the FRUH suggests that  $s_t^k$  and  $f_t$  are cointegrated with a cointegrating vector [1,-1]. This result has been interpreted as foreign exchange market inefficiency. The empirical literature concerning this hypothesis is also controversial. Some works have accepted this hypothesis, see for example Mark et al. (1993) whose provide evidence for cointegration between  $s_t^k$  and  $f_t$  with a vector [1,-1] and Hakkio and Roch (1989). While some other works have obtained opposite results, see for example Evans and Lewis (1995) and Zivot (2000).

Despite this empirical disparity, there exist a some consensus between researchers concerning the stationarity of the spot exchange return,  $s_t^k - s_t$ . So, if this series is stationary, the forward discount series,  $f_t - s_t$ , must also be stationary so that  $\beta$  do not deviates from it's expected unity value. Despite this unanimous consensus about the stationarity of the spot exchange rate return  $\Delta s_t$  series, the true nature of the forward discount series remains ambiguous. Mark et al. (1993) show that the  $f_t - s_t$  series is stationary (an I(0) process). Crowder (1994) show that the forward discount is an I(1) process. This non-stationarity of the forward discount series is considered as the principal cause of the rejection of the forward unbiasedness hypothesis. This comes from the fact that, if we regress an I(1) process on I(0) process, then the value of  $\beta$  will deviate from it's expected value of unity.

Recently, some studies have investigated the hypothesis of presence of non-linearity inside the forward discount series. Baillie and Bollerslev (1994, 2000). and Maynard and Phillips (2001) have showed that the  $f_t - s_t$  series follows an I(d) process where d is a fractional parameter. For the majority of investigated series, we get an estimated value of the long memory parameter d which is higher than 0.5. This means that these series are characterized by a non-stationary long memory behavior. In all cases, there are a mean-reverting behavior in the forward discount. This lead to conclude that regression (8) is not well specified because the left-hand-side variable ( $s_t^k - s_t$ ) and the right-hand-side variable ( $f_t - s_t$ ) have a different degrees of integration.

More recently, researchers have used models with changes in regimes to explain the non stationarity of the forward discount series, see for instance Sakoulis and Zivot (2001). Choi and Zivot (2007) and Baillie and Kiliç (2007). As shown in the literature concerning this kind of models, the presence of breaks inside time series can creates a spurious long memory behavior. In that case, the observed long-range dependence will be a spurious behavior, see for instance Diebold and Inoue (2001). Granger and Hyung (2004) and Charfeddine and Guégan (2007, 2009b).

## 3. The FRU Hypothesis and Unit Root Tests

This section has two mains objectives. First, we confirm the rejection of the FRU Hypothesis in the four currencies (Euro, French Swiss, pound sterling and Canadian dollar) in terms of US dollar. Then, we examine the hypothesis of non stationarity of the forward discount series.

In the following subsection, we present the data and their properties. Then, in the second subsection, we confirm the rejection of the FRU Hypothesis. Finally, in the third subsection, we applied unit root tests on the forward discount series.

### 3.1 The Data

Four times series will be used to investigate the forward discount anomaly. We use a weekly data exchange rates for four countries against the US dollar. This data span the period 06-01-1999 to 16-08-2006 for the Euro/Dollar series and 29-10-1997 to 16-08-2006 for the three others series. All time series are obtained from the Datastream base. The  $s_t$  and  $f_t$  are the logarithm of the level rates of the spot and forward exchange rates multiplied by 100.

Figures 1, 2, 3, and 4 report the trajectories and the autocorrelation functions of the spot, spot return and forward discount series of each exchange rate series. These figures show that the  $s_t$  and  $f_t - s_t$  series seem to be non stationary. The ACF of each forward discount series show the presence of long range dependence behavior. Tables 1, 2 and 3 report the corresponding descriptive statistics for each series. Following these tables, we observe that the  $s_t$ ,

$\Delta s_t$  and the  $f_t - s_t$  series have a Skewness and Kurtosis statistics that differ significantly from those of the normal distribution. Jarque Bera test confirms the later results and shows that for all series the null hypothesis of normal distribution is rejected. This first analysis suggests that the right and left variables in equation (8) seem to have a different degree of integration.

### 3.2 Rejection of the FRUH

The results of estimations of the FRUH, equation (8), are reported in Table 4. The results show that the hypothesis of  $\beta = 1$  is rejected three times out of four. Same results are obtained for the jointly hypothesis of  $\beta = 1$  and  $\alpha = 0$  which is also rejected three times out of four for the following series (EURO/USD, CHF/USD and CAN/USD). In conformity with the empirical literature, the  $\beta$  coefficient has a negative value which is higher than one in absolute value. This means that not only the FRUH is rejected but also the forward discount do not predicts the true direction of exchange rates fluctuations. Table 1 reports also the Durbin Watson (DW), the O-stats of Ljung-Box Q(12), Q(24) and the  $R^2$  coefficient. This table shows also that the four series possess a small  $R^2$  coefficients and a DW statistic close to 2.

<Insert table 1>

To assess the possibility that the left and right variables in equation (8) have different degrees of integration, we propose, in the following subsection, to analyze the statistical properties, in term of stationary, of the spot exchange rates return and the forward discount for each series.

### 3.3 Unit root tests

The unit roots statistics used in this paper to investigate the unit root hypothesis are the ADF, KPSS and the ADF-GLS statistics of Elliot, Rothenberg and Stock (1996). The use of ADF test allows us to compare our results with the 80-90 decades existing empirical literature. The use of KPSS and ADF-GLS tests is motivated by the fact that these tests are known to have good powers against the alternative of long-range dependence, see for instance Lee and Schmidt (1996). Following Ng and Perron (2001) and Choi and Zivot (2007), the lag length of the ADF-GLS test was selected using the modified AIC with a maximum lag of 15.

Tables 5, 6 and 7 report the results of these unit root tests. Following these tables, the spot ( $s_t$ ) and forward ( $f_t$ ) exchange rates series are non stationary and follow an I(1) process.

<Insert table 5>

These Tables show also that the forward discount series ( $f_t - s_t$ ) are non stationary. For the spot exchange return series, unit root tests show that are stationary and follow in I(0) process. No significant difference exists between the three unit root tests. At 5% level significance, the ADF and KPSS tests find a same result except for the  $\Delta s_{t+1}$  CAN/USD time series. At 10% level significance, the results are more mixed. For example, using the KPSS test, three of the forward discount series are stationary. In contrast, using the ADF test, only one series is stationary.

<Insert table 6>

The ADF-GLS unit root test results reported in Table 7 provide evidences for non stationarity of the spot and forward series, these series follow an I(1) process. Moreover, Table 7 shows that the forward discount is characterized by the presence of a unit root. For all the forward discount series, we fail to reject the hypothesis of a unit root in the forward discount. Results concerning the spot exchange return are similar to those of the ADF and KPSS tests.

<Insert table 7>

From the results reported in tables 5, 6 and 7, the dependent and independent variable in equation (8) have a different order of integration. This means that the non-stationarity of the forward discount series is an interesting path in order to investigate the causes of the rejection of the FRUH Hypothesis. (Note 2)

## 4. Long memory process versus switching models

The rejection of the hypothesis of stationarity of the forward discount series in the previous section can be explained by the low power of unit root tests against the alternative of long range dependence. If it is the case, the forward discount series will be characterized by a long memory behavior. Moreover, this long range dependence behavior can be a spurious behavior that is created by the presence of breaks, see for instance Diebold and Inoue (2001). Granger and Hyung (2004) and Charfeddine and Guégan (2009b). Thus, it is very important to investigate the true nature of this non stationarity and to determine if the forward discount series are characterized by a long range dependence behavior, or by the presence of breaks, or simultaneously by the two behaviors.

To do that, we use the following strategy. First, we start by estimating the fractional long memory parameter from each forward discount series by using the well known GPH technique of Geweke and Porter-Hudak (1983) and the Exact Local Whittle (ELW) method of Shimotsu et Phillips (2005). Then, we use the Markov switching model of Hamilton (1989) to investigate the possibility of the presence of breaks. After that, we describe briefly the empirical strategy

proposed in Charfeddine and Guégan (2007) in order to determine if the long memory behavior observed on the forward discount series is a true behavior or spurious one.

#### 4.1 Long memory methods

In the last three decades, several long memory estimation methods have been developed. The first semi-parametric method proposed in the literature is the GPH technique of Geweke and Porter-Hudak (1983). Recently, Shimotsu and Phillips (2005) propose an alternative method, the Exact Local Whittle (ELW), based on the Local Whittle semi-parametric methods of Künsch (1987) and Yajima (1989).

The GPH technique is based on the log-periodogram. For frequency near zero, the fractional long memory parameter  $d$  can be estimated from the following least squares regression,

$$\text{Log} \{I(w_j)\} = a - d \text{Log} \{4 \sin^2(w_j/2)\} + \varepsilon_t, \quad j = 1, \dots, m$$

where  $w_j$  is the periodogram of the process  $(y_t)_t$  at frequency  $w_j = 2\pi j/T$ . Consistency requires that  $m$  grows slowly with respect to the sample size. It is suggested to take  $m = T^r$  with  $r = 0.5$ . In recent literature, many researchers have suggested to use a frequency of order  $O(T^{4/5})$ , see for instance Hurvich et al. (1998). Maynard and Phillips (2001). Kim and Phillips (2000) and Choi and Zivot (2007). The ordinate least-square estimator of  $d$  is asymptotically normal with standard error equal to  $\pi(6m)^{1/2}$ , see for instance Geweke and Porter-Hudak (1983) and Robinson (1995).

The second semi-parametric method used in this paper is the Exact Local Whittle (ELW). see Shimotsu and Phillips (2005). This method avoids some approximation in the derivation of the Local Whittle estimator proposed by Künsch (1987) and Yajima (1989). The method is more attractive than the Local whittle (LW) method because of its more interesting asymptotic properties. The estimated value  $\hat{d}_{ELW}$  is obtained as follows:

$$\hat{d}_{ELW} = \text{Arg min}_{d \in [d_1, d_2]} R(d),$$

where  $d_1$  and  $d_2$  are the lower and upper bounds of the admissible values of  $d$  such that  $-\infty < d_1 < d_2 < \infty$  and,

$$R(d) = \text{Log} G(d) - 2d \frac{1}{m} \sum_{j=1}^m \text{Log}(\omega_j),$$

where  $m$  is the truncation parameter, and  $G(d) = \sum_{j=1}^m I_{\Delta_{y_t}^d}(\omega_j)$  where  $I_{\Delta_{y_t}^d}(\omega) = \frac{1}{2\pi T} \left| \sum_{t=1}^T \Delta_{y_t}^d e^{i\omega t} \right|^2$

is the periodogram of  $\Delta_{y_t}^d = (1-L)^d y_t$ .

Under certain consistency and asymptotic normality assumptions given in Shimotsu and Phillips (2005), the ELW estimator  $\hat{d}_{ELW}$  satisfies,

$$\sqrt{m}(\hat{d}_{ELW} - d) \rightarrow_d N(0, 1/4) \text{ when } T \rightarrow \infty$$

The results of the estimated fractional long memory parameter of the forward discount series (EURO/USD, CHF/USD, UK/USD and CAND/USD series) are reported in tables 8 and 9. For both methods, we use different values of the frequency  $m = T^{0.6}$ ,  $T^{0.7}$  and  $T^{0.8}$ .

<Insert table 8>

Tables 8 and 9 show that the discount forward series  $(f_t - s_t)$  are non stationary. This confirms the slowly decaying behavior observed in the ACF on Figure 1, 2, 3 and 4. Moreover, this result is in pair with some previous empirical works which have also found a fractional long memory behavior inside the discount forward series, see for instance Baillie et Bollerslev (1994, 2000). Phillips and Maynard (2000) and Choi and Zivot (2007) among others. These authors have suggested that the rejection of the FRU Hypothesis is due to the presence of long memory components in the forward discount. Thus, if the independent variable in (8) is stationary and the dependent variable is integrated with a fractional order  $d$ , then regression (8) is a misspecified specification and the estimated value of the  $\beta$  parameter do not be consistent, see Engel (1996).

<Insert table 9>

These results concerning the estimated values of the long memory parameter  $d$  are slightly higher than those obtained by Baillie and Bollerslev (1994) and Choi and Zivot (2007). For example, when we use the ELW method, the estimated order of integration lies inside (0.75, 0.97) contrary to those reported by Choi and Zivot (2007) where  $d$  lies in the range (0.536, 0.866). These disparities can be explained by the higher frequency of our data a weekly data than the monthly data frequency in their works. These disparities can also be due to the difference on the periods of study.

Economically, this hypothesis of long range dependence, in the forward discount series, is very difficult to justify. So, the complexity and the heterogeneity of agents on exchange markets make difficult to suppose that today's exchange rate changes can have a long lasting effects. Thus, we suggest that only strong changes can influence the exchange rate at long horizon. Moreover, the fact that exchange rates fluctuate from one minute to another is not consistent with the long memory behavior hypothesis. In recent econometric empirical literature, many works have showed that long range dependence can be created by the presence of breaks inside time series, see for instance Granger and Hyung (2004) and Charfeddine and Guégan (2009a and 2009b). Therefore, it's very important to investigate the true nature of the long memory behavior observed from the ACF and confirmed by the GPH and ELW methods. The following section analyze this hypothesis of the presence of breaks inside the forward discount series by using the Markov switching model of Hamilton (1989). This hypothesis is economically less-difficult to justify than the long range dependence hypothesis. For example, Banks interventions, heterogeneity of agents inside the exchange market or the peso problem are the reasons that explain the presence of breaks inside the forward discount series.

Thus, we suppose that the long memory behavior detected using the two semi-parametric methods (ELW and GPH). is a spurious behavior. Then, we use the empirical strategy proposed by Charfeddine and Guégan (2007) to investigate the true nature of the long range dependence detected in the forward discount series.

The empirical strategy proposed in Charfeddine and Guégan (2007) is as follow: First one start by estimating the dates of breaks using the Markov switching model. Then, we adjust the data sets from the obtained breaks. After that, we compare the fractional long memory parameter  $d$  before and after adjusting the original series. Finally, we conclude.

#### 4.2 Models with changes in regimes

This subsection introduces briefly the Markov switching model of Hamilton (1989). We say that a process  $(y_t)_t$  follows a MS-5MV-AR(0) Markov Switching process with Five States in Mean and Variance and without autoregressive order if it takes the following form,

$$y_t = \mu_{s_t} + u_{s_t}$$

where  $u_t \rightarrow N(0, \sigma_{s_t}^2)$ , et

$$\mu_{s_t} = \mu_1 s_{1t} + \mu_2 s_{2t} + \mu_3 s_{3t} + \mu_4 s_{4t} + \mu_5 s_{5t}$$

$$\sigma_{s_t}^2 = \sigma_1^2 s_{1t} + \sigma_2^2 s_{2t} + \sigma_3^2 s_{3t} + \sigma_4^2 s_{4t} + \sigma_5^2 s_{5t}$$

with  $s_{jt} = 1$  if  $s_t = j$ , et  $s_{jt} = 0$ , otherwise,  $j=1,2,3,4, 5$  et  $p_{ij} = \Pr[s_t = j / s_{t-1} = i]$  et  $\sum_{j=1}^5 p_{ij} = 1$ . To select

the appropriate MS-NMV-AR(0) model (N is the number of regimes  $N=1,2,3,4$  or  $5$ ). we use the Garcia's test (1998). the residual analysis, the AIC and the HQ criteria's (not reported here). The results concerning the selected Markov switching MS-NMV-AR(0) models are reported in table 10.

<Insert table 10>

From this table, it appears that the hypothesis of simultaneously changes in mean and variance is more supported by the four forward discount series. Moreover, it appears that the data supports the presence of a large number of breaks. Table 11 lists the dates of breaks.

<Inert table 11>

These dates of breaks are selected using the filtered and smoothed probabilities. Table 11 shows also a number of breaks respectively equal to 13, 11, 10 and 14 for the Euro, Franc Swiss, British Pound and the Canadian dollar currencies against the U.S dollar. Presence of breaks inside these series is supported by some economics events. The Peso Problem, the heterogeneity of agents and intervention of central Banks inside exchanges rates markets are generally the major reasons that cause the presence of breaks.

#### 5. Long range dependence or structural changes models?

This section tries to give an answer for the following question: which process describes the true Data Generated Process (DGP) of the forward discount series: long range dependence or models with changes in regime. Moreover, one can also check the possibility that these series are characterized by the presence of these two behaviors. If this later case occurs, then the forward discount series will be characterized by the presence of long memory behavior which is amplified by the presence of breaks.

To analyze the true nature of the long memory behavior observed on the forward discount series. We use the empirical strategies proposed by Charfeddine and Guégan (2007). Once we have selected the breaks dates, the following step



consists on filtering out these breaks. Then, we re-estimate another one the fractional long memory parameter  $d$  from the adjusted date. Finally, we compare the two estimated parameter  $d$  (before and after filtering out the breaks).

<Insert table 12>

The results of the estimated long memory parameter after adjusting the data are reported in table 12 and 13. From these tables, it appears that there are a significantly difference between these values and those obtained after adjusting the data from breaks. Using the GPH method and for a frequencies  $m = T^{0.6}$ , the estimated value of  $d$  is not significantly different from zero. Contrary, for higher values of  $m$ , we detect the presence of a stationary long memory behavior, see table 12.

<Insert table 13>

Using the ELW method, see table 13, the results support also the alternative hypothesis of a stationary long memory behavior. Results seem also to depend on the values of the frequencies  $m$ . In all cases, the new fractional estimated long memory parameter  $d$  lies on (0.3, 0.7), contrary to initial data (before adjusting from breaks) where the values of  $d$  lies on (0.55, 1). This means that the long memory behavior observed in the ACF of the forward discount series is a true behavior which is amplified by the presence of breaks inside these time series.

## 6. Conclusion

This paper advances some new economics and econometrics explanations for the rejection of the FRU hypothesis. Our empirical analysis shows that the dependent and independent variables of the equation used to test the FRU Hypothesis are not integrated with a same order. This is the principal cause of the rejection of the FRU Hypothesis. Also, we have showed that the forward discount series are subject to many breaks. In that case, changes in regimes are caused by changes in anticipations, by the presence of risk premium and the peso problem. Moreover, we have showed that the forward discount series are characterized by the presence of a long range dependence behavior which amplified by the presence of breaks.

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### Notes

1- The use of the logarithmic form allows to avoid the Siegel paradox. Siegel (1972) suggests that the level relationship must be verified from the two exchanges sides which contradicts the Jensen inequality,  $E(1/x) > 1/E(x)$ .

2- In the rest of the paper, we concentrate our analysis only in equation (8). Moreover, our analysis is also concentrated on the forward discount series which is considered as the origin of the forward discount anomaly.

Table 1. Descriptive statistics of  $s_t$

	EURO/USD	CHF/USD	UK/USD	CAN/USD
Mean	0.066	0.491	0.364	0.341
Median	0.072	0.490	0.374	0.383
Std. Dev	0.138	0.087	0.122	0.104
Skew.	-0.134	-0.009	0.064	-0.791
Kurt.	1.632	2.014	1.832	2.371
J-B	32.216	18.614	26.436	55.535
Prob	0.000	0.000	0.000	0.000
Q(12)	4407.8	4941.3	5029.1	4993.8
Q(24)	8201.8	9201.8	9270.1	9003.4

Table 2. Descriptive statistics of  $\Delta s_{t+1} = s_{t+1} - s_t$

	EURO/USD	CHF/USD	UK/USD	CAN/USD
Mean	0.0002	-0.0003	0.0002	-0.0003
Median	0.000	4.1E-05	0.0003	0.0002
Std. Dev	0.014	0.014	0.010	0.009
Skew.	0.024	-0.204	-0.128	0.038
Kurt.	2.943	3.135	3.295	3.613
J-B	0.093	3.074	2.529	6.329
Prob	0.954	0.215	0.282	0.042
Q(12)	8.547	23.478	4.7668	9.2949
Q(24)	18.960	33.650	13.495	22.414

Table 3. Descriptive statistics of  $f_t - s_t$

	EURO/USD	CHF/USD	UK/USD	CAN/USD
Mean	6.91E-05	-0.0003	-0.0004	4.11E-05
Median	5.8E-05	-0.0004	-0.0003	3.85E-05
Std. Dev	0.0003	0.0002	0.0003	0.0002
Skew.	0.101	0.549	-0.306	0.1665
Kurt.	1.521	2.568	1.752	2.328
J-B	36.941	23.081	32.048	9.319
Prob	0.000	0.000	0.000	0.009
Q(12)	4416.8	4649.6	4794.7	4695.5
Q(24)	8145.4	8302.5	8808.3	8308.8

Table 4. Estimation of the percentage change specification

$$s_t^k - s_t = \alpha + \beta (f_t - s_t) + u_{t+k}$$

Currencies	$\alpha$	$\beta$	t-stat	F-stat	$R^2$	DW	Q-stats	
			$\beta = 1$	$\alpha = 0, \beta = 1$			Q(12)	Q(24)
EURO/USD	0.058	-5.175	-2.807	3.969	0.014	2.045	9.08	21.397
	(0.071)	(2.20)						
CHF/USD	-0.247	-4.561	-2.560	3.302	0.010	1.964	5.581	15.628
	(0.121)	(2.171)						
UK/USD	-0.014	-1.702	-1.29	1.406	0.001	1.829	24.428	34.098
	(0.073)	(2.091)						
CAN/USD	-0.045	-3.377	-1.951	2.57	0.005	2.086	9.977	22.952
	(0.044)	(2.243)						

t-stat are in parentheses.

Table 5. Results of the ADF Unit Root Test.

Currencies	$s_t$	$f_t$	$f_t - s_t$	$\Delta s_{t+1}$
EURO/USD	-0.457 (0)	-0.456 (0)	-0.458 (0)	-20.10*** (3)
CHF/USD	-0.755 (0)	-0.755 (0)	-0.659 (0)	-20.92*** (3)
UK/USD	0.374 (0)	0.376 (0)	-1.116 (0)	-13.10*** (3)
CAN/USD	-0.984 (0)	-0.982 (0)	-1.909* (0)	-22.12*** (3)

Note: (.) is the number of lag length selected by the (AIC) and the Schwartz criteria.

Critical values of the ADF test at significance level of 1%, 5% and 10% are respectively -2.57, -1.94, -1.61.

\*, \*\*, \*\*\* indicate that the corresponding statistics are respectively significant at the 10%, 5% and 1% levels.

Table 6. Results of the KPSS Unit Root Test.

Currencies	$s_t$	$f_t$	$f_t - s_t$	$\Delta s_{t+1}$
EURO/USD	.742 (17)	1.610 (16)	0.631*(7)	0.404**(16)
CHF/USD	.52 (17)	1.518 (17)	1.019 (5)	0.185*** (17)
UK/USD	.201 (17)	1.200 (17)	0.517*(7)	0.244*** (17)
CAN/USD	.612 (16)	1.739 (17)	0.674*(5)	0.519*(17)

Note: (.) lag length.

Critical values of the KPSS test at significance level of 1%, 5% and 10% are respectively 0.739, 0.463, 0.347.

\*, \*\*, \*\*\* indicate that the corresponding statistics are respectively significant at the 10%, 5% and 1% levels.

Table 7. Results of the ADF-GLS Unit Root Test.

Currencies	$s_t$	$f_t$	$f_t - s_t$	$\Delta s_{t+1}$
EURO/USD	1.051 (0)	0.051 (0)	-0.509(4)	-5.216*** (10)
CHF/USD	-0.931 (0)	-0.932 (0)	-0.750(6)	-6.669*** (15)
UK/USD	0.850 (3)	-0.849 (3)	-0.812(5)	-9.815*** (0)
CAN/USD	1.230 (0)	0.229 (0)	-0.465(3)	-7.252*** (15)

Note: (.) Bandwidth

Critical values of the ADF-GLS test at significance level of 1%, 5% and 10% are respectively -2.58, -1.98, -1.62.

\*, \*\*, \*\*\* indicate that the corresponding statistics are respectively significant at the 10%, 5% and 1% levels.

Table 8. Estimation of the fractional long memory parameter  $d$  using the GPH method.

Currencies	EURO/USD	CHF/USD	UK/USD	CAN/USD
$T^{0.6}$	0.964 (6.025)	0.899 (8.289)	1.055 (8.953)	1.102 (10.094)
$T^{0.7}$	0.761 (8.014)	0.735 (8.670)	0.912 (10.742)	1.006 (12.679)
$T^{0.8}$	0.583 (8.273)	0.535 (8.920)	0.740 (11.586)	0.817 (13.515)

(.) t-stats in parenthesis.

Table 9. Estimation of the fractional long memory parameter using the ELW method.

Currencies	EURO/USD	CHF/USD	UK/USD	CAN/USD
$T^{0.6}$	0.868 (17.316)	0.843 (18.040)	0.816 (17.463)	0.895 (19.153)
$T^{0.7}$	0.821 (18.912)	0.790 (19.522)	0.784 (19.373)	0.883 (21.820)
$T^{0.8}$	0.802 (22.627)	0.792 (23.973)	0.754 (22.82)	0.882 (26.724)

(.) t-stats in parenthesis.

Table 10. Estimation of the Markov switching model MS-NVM-AR(0) on the forward discount series.

	<b>Euro/USD</b>	<b>CHF/USD</b>	<b>UK/USD</b>	<b>CAN/USD</b>
Par.	MS-5VM-AR(0)	MS-4VM-AR(0)	MS-5VM-AR(0)	MS-5VM-AR(0)
$\mu_1$	-0.030 (0.000)	-0.081 (0.000)	-0.059 (0.000)	-0.023 (0.000)
$\mu_2$	-0.020 (0.000)	-0.068 (0.000)	-0.046 (0.000)	-0.015 (0.000)
$\mu_3$	0.001 (0.000)	-0.043 (0.000)	-0.036 (0.000)	-0.002 (0.000)
$\mu_4$	0.030 (0.000)	-0.015 (0.000)	-0.016 (0.000)	0.012 (0.000)
$\mu_5$	0.045 (0.000)	-	0.007 (0.000)	0.033 (0.000)
$\sigma_1^2$	2.8E-5 (0.000)	1.2E-4 (0.000)	4.2E-5 (0.000)	5.1 E-5 (0.000)
$\sigma_2^2$	4.7E-7 (0.000)	1 E-5 (0.000)	1.1 E-5 (0.000)	1.3E-5 (0.000)
$\sigma_3^2$	1.5E-4 (0.000)	9.6E-5 (0.000)	1.7E-5 (0.000)	3.0 E-5 (0.000)
$\sigma_4^2$	1.9E-5 (0.000)	5.5E-5 (0.000)	4.7E-5 (0.000)	2.8E-5 (0.000)
$\sigma_5^2$	5.8E-5 (0.000)	-	6.8 E-5 (0.000)	3.2E-5 (0.000)
$p_{11}$	0.956	0.864	0.887	0.922
$p_{12}$	0.043	0.035	0.055	0.068
$p_{13}$	0.001	0.001	0.057	0.009
$p_{14}$	0.001	-	0.001	0.001
$p_{21}$	0.069	0.074	0.062	0.058
$p_{22}$	0.906	0.114	0.938	0.933
$p_{23}$	0.024	0.011	0.001	0.088
$p_{24}$	0.001	-	0.001	0.001
$p_{31}$	0.001	0.018	0.014	0.001
$p_{32}$	0.010	0.001	0.007	0.025
$p_{33}$	0.970	0.967	0.951	0.965
$p_{34}$	0.018	-	0.026	0.009
$p_{41}$	0.001	0.001	0.001	0.001
$p_{42}$	0.001	0.001	0.001	0.001
$p_{43}$	0.015	0.006	0.033	0.009
$p_{44}$	0.951	-	0.943	0.980
$p_{51}$	0.001	-	0.001	0.001
$p_{52}$	0.001	-	0.001	0.001
$p_{53}$	0.001	-	0.001	0.001
$p_{54}$	0.001	-	0.001	0.013
$L(.)$	<b>1477.95</b>	<b>1541.787</b>	<b>1652.22</b>	<b>1831.97</b>

p-values in parenthesis.

Table 11. Breaks dates for the forward discount series

	EURO/USD	CHF/USD	UK/USD	CAN/USD
1	17:03:1999	20:05:1998	09:12:1998	14:01:1998
2	23:08:2000	15:07:1998	02:06:1999	19:08:1998
3	27:12:2000	20:01:1999	07:03:2001	11:08:1999
4	04:07:2001	10:03:1999	05:09:2001	06:12:2000
5	01:08:2001	31:05:2000	23:10:2002	18:04:2001
6	15:08:2001	06:12:2000	19:11:2003	25:10:2002
7	05:09:2001	18:04:2004	03:11:2004	25:12:2002
8	18:06:2003	05:10:2005	02:03:2005	04:02:2004
9	03:12:2003	26:10:2005	22:06:2005	24:03:2004
10	17:12:2003	15:03:2006	07:12:2005	15:12:2004
11	16:06:2004	26:04:2006	-	01:06:2005
12	15:06:2005	-	-	13:07:2005
13	12:10:2005	-	-	19:04:2006
14	-	-	-	31:05:2006

Table 12. Estimation of the fractional long memory parameter using the GPH method after filtering the Breaks.

Currencies	EURO/USD	CHF/USD	UK/USD	CAN/USD
$T^{0.6}$	0.460 (4.365)	0.484 (6.057)	0.280 (2.232)	0.293 (2.346)
$T^{0.7}$	0.591 (7.709)	0.470 (6.180)	0.349 (4.268)	0.542 (6.446)
$T^{0.8}$	0.542 (9.125)	0.447 (7.036)	0.369 (6.717)	0.586 (8.514)

(.) t-stats in parenthesis.

Table 13. Estimation of the fractional long memory parameter using the ELW method after filtering the Breaks.

Currencies	EURO/USD	CHF/USD	UK/USD	CAN/USD
$T^{0.6}$	0.579 (6.977)	0.437 (5.499)	0.196 (2.466)	0.436 (5.487)
$T^{0.7}$	0.667 (10.842)	0.468 (8.003)	0.352 (6.019)	0.545 (12.739)
$T^{0.8}$	0.585 (12.827)	0.436 (10.130)	0.454 (10.548)	0.648 (15.056)

(.) t-stats in parenthesis.

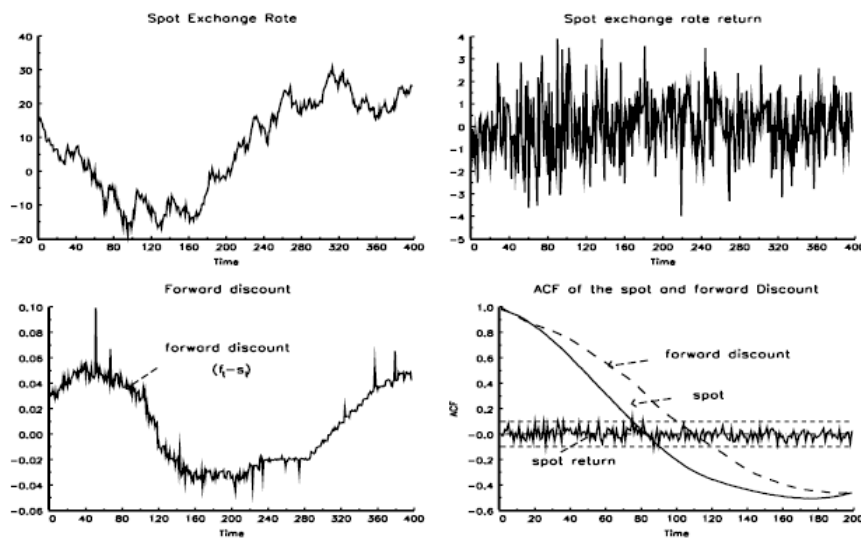


Figure 1. Trajectories and ACF functions of the spot, the forward and the forward discount of the EURO/USD exchange rate series

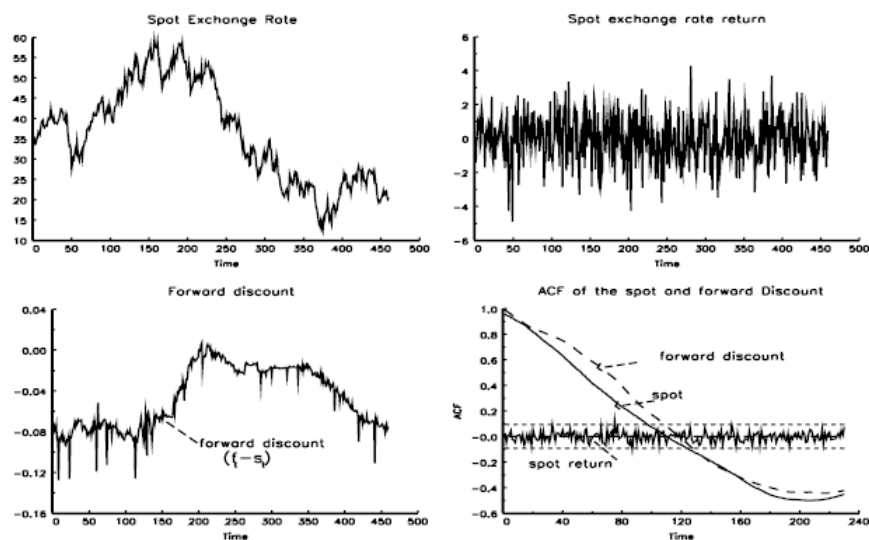


Figure 2. Trajectories and ACF functions of the spot, the forward and the forward discount of the CHF/USD exchange rate series

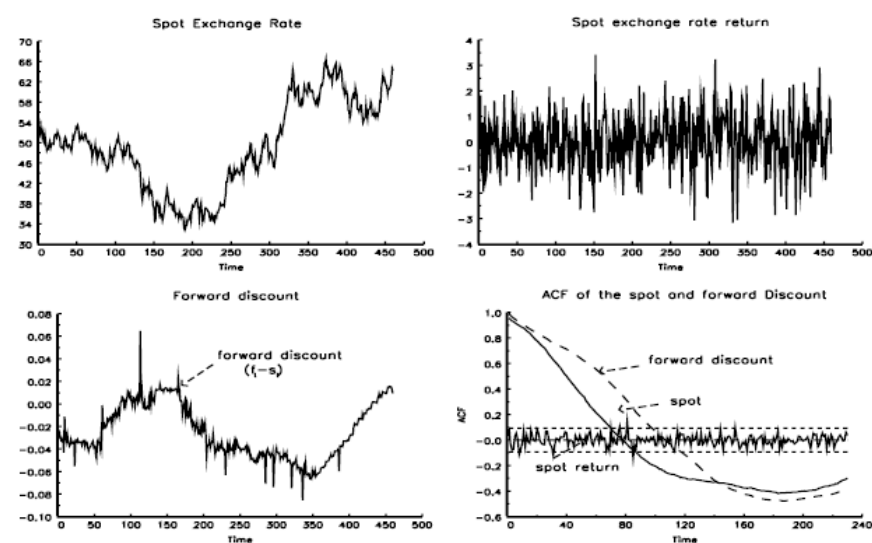


Figure 3. Trajectories and ACF functions of the spot, the forward and the forward discount of the UK/USD exchange rate series

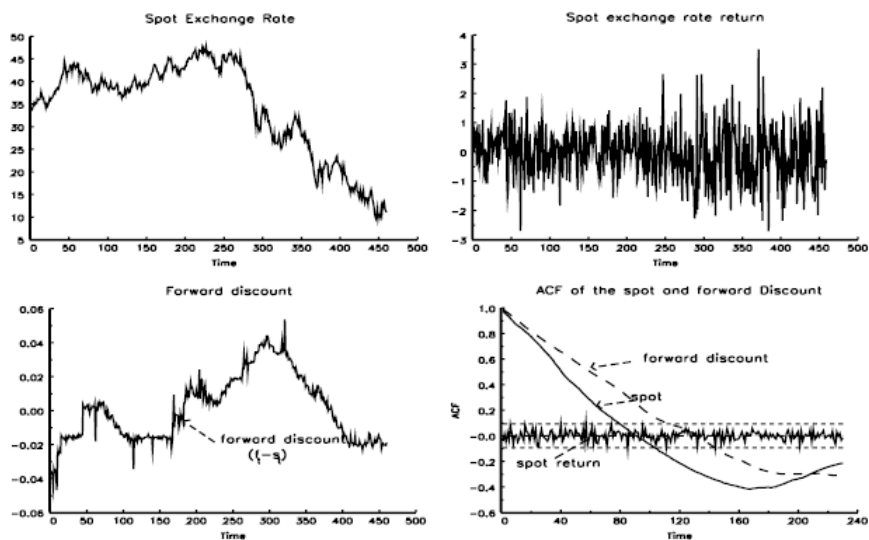


Figure 4. Trajectories and ACF functions of the spot, the forward and the forward discount of the CAN/USD exchange rate series

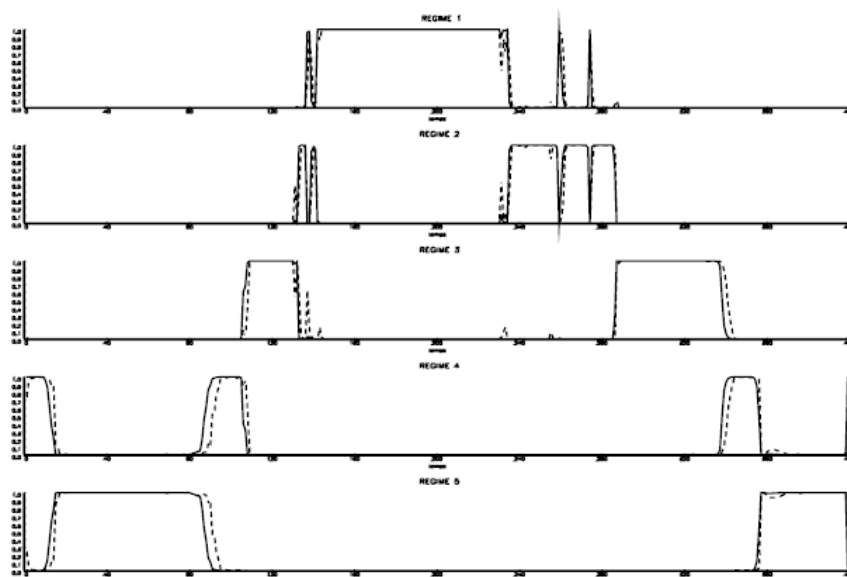


Figure 5. Filtered (dash line) and Smoothed probabilities (solid line) for the EURO/USD forward discount series



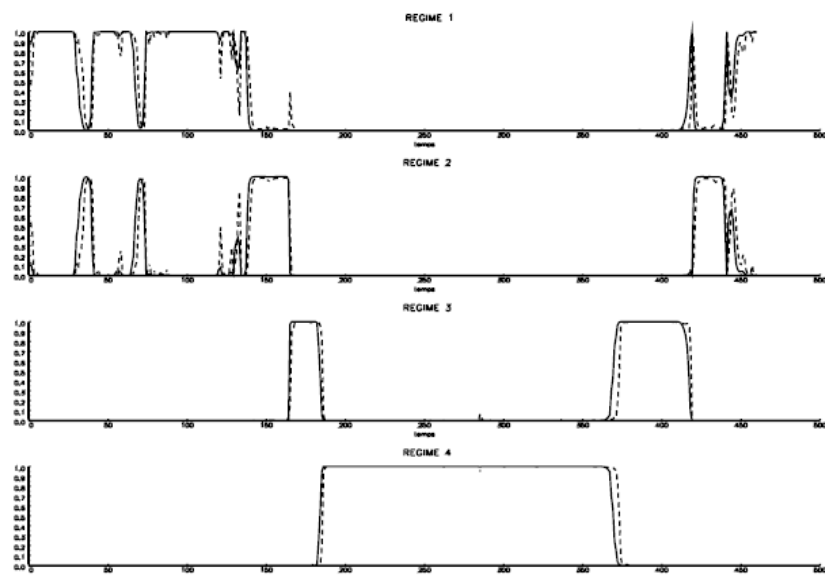


Figure 6. Filtered (dash line) and Smoothed probabilities (solid line) for the CHF/USD forward discount series

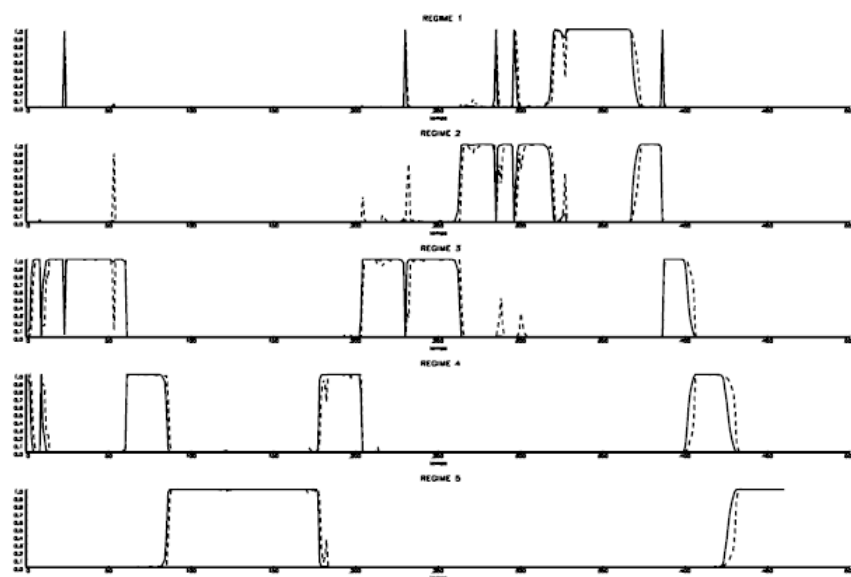


Figure 7. Filtered (dash line) and Smoothed probabilities (solid line) for the UK/USD forward discount series

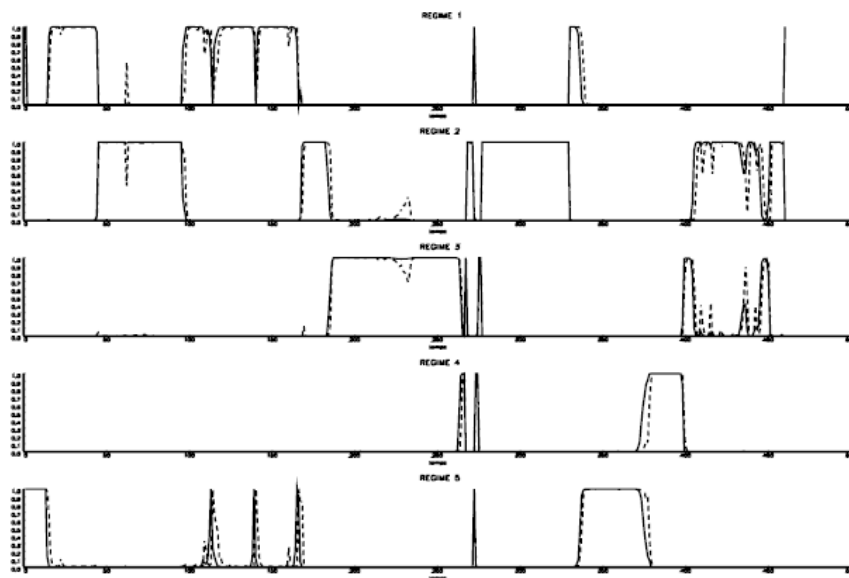


Figure 8. Filtered (dash line) and Smoothed probabilities (solid line) for the CAN/USD forward discount series.

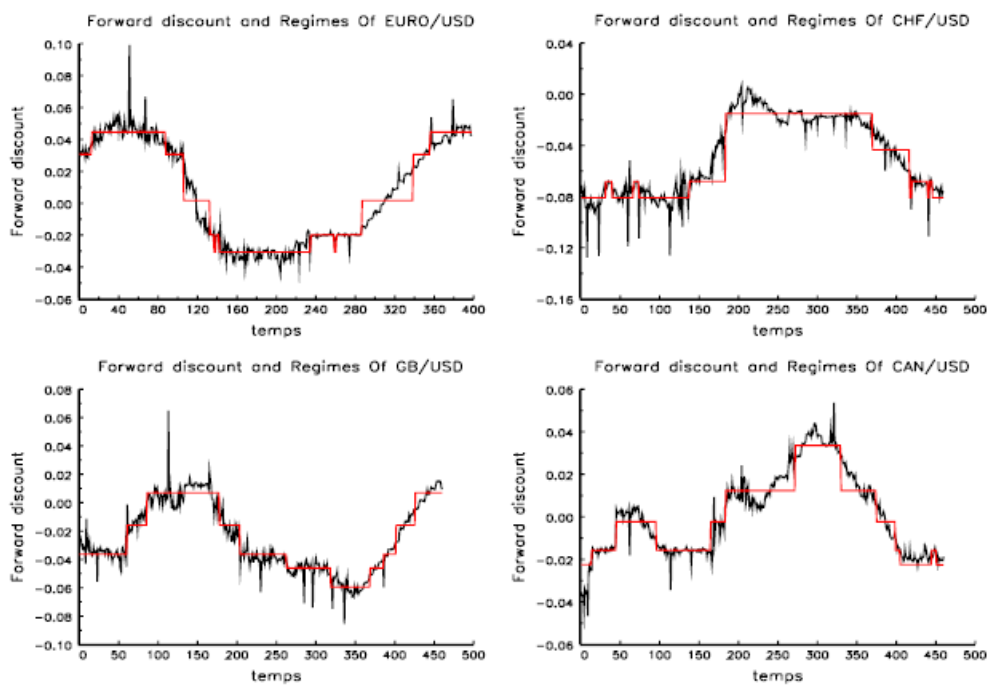


Figure 9. Trajectories and regimes detected using the Markov switching model.



# Nonlinear Noise Estimation in International Stock Markets: Coarse-grained Entropy Method

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## Abstract

With the step-by-step opening of China Stock Market and gradual strengthening of international linkage, how to efficiently measure and manage risk, evaluate and improve market operation efficiency is an important project in present financial research. According to nonlinear dynamics and chaos and fractal theory, we apply phase space reconstruction technique and coarse-grained entropy method to estimate the nonlinear noise levels in stock markets of Chinese Mainland, Hong Kong, US, UK and Japan, and we emphasize on discussing the standard deviation of nonlinear noise  $\sigma$  and noise-to-signal ratio NSR which are two important indexes about risk measurement and efficiency evaluation, and further we make a comprehensive comparison analysis on the risk and operation efficiency of stock markets of above countries or areas.

**Keywords:** Coarse-grained entropy, International stock markets, Market efficiency, Noise estimation, Nonlinear time series, Phase space reconstruction

## 1. Introduction

Traditional financial models are linear equilibrium models based on rational expectation. Excluding the influence of psychological factors such as greed and fear, these models depict the negative feedback leading to the stabilization of financial system and indicate that the response to exogenous disturbance of financial system is reverting to the equilibrium in a continuous and linear way.

Nevertheless, what traditional financial models depict is only an ideal state and is widely divergent from the truth. Subjected to noise trading, positive feedback trading, overreaction and herding behavior which are universal in financial market (see De Long, Shleifer, Summers, and Waldmann (1990a, 1990b), De Bondt and Thaler (1985), Banerjee (1992)), the fluctuation of asset price presents strong nonlinearity. Moreover, the evolution of financial market is driven by numerous heterogeneous investors with bounded rationality, so financial market is a complex dynamic system which is essentially characterized by intrinsic randomness of deterministic system, nonrepetitive aperiodic cycle, equilibrium which is far from balance, sensitivity to initial conditions, tendency, self-similarity and mutation. Therefore, nonlinear dynamics and chaos and fractal theory which have developed rapidly in recent years provide a new perspective for us to study complex financial system.

Among numerous financial research projects, estimating the nonlinear noise level of complex financial dynamic system is of great practical significance. It can provide financial supervision and management departments with efficient decision supports such as evaluating the operation efficiency of financial market, guarding against and managing financial risk and exporting so-called policy function developed by Boldrin and Montrucchio (1986). Nonlinear noise of complex financial system has two kinds of sources, and one kind is measurement noise from outside of system while another kind is dynamical noise from inside of system. Some scholars have put forward a series of methods on estimating nonlinear noise level, among which the methods developed by Cawley and Hsu (1992), Schreiber (1993), Diks (1996) and Oltmans and Verheijen (1997) only apply to the estimation of low level measurement noise while the coarse-grained entropy method developed by Urbanowicz and Holyst (2003) can efficiently estimate high level measurement noise as well as dynamical noise.

In recent years, many scholars have been drawn to the nonlinearity of stock markets. Longbing Xu and Rong Lu (1999) studied the nonlinearity of Chinese stock market by use of R/S method, and their empirical results indicated that both

Shanghai and Shenzhen stock market were characterized by nonlinearity, long memory and volatility clustering. By use of R/S analysis and the calculation of correlation dimension, auto correlation function and Lyapunov index, Haihua Wu and Daoye Li (2001) found that Shanghai stock market was distinctly characterized by fractal and chaos, and was a nonlinear system where strange attractors existed. By implementing a series of tests such as normality test, ADF unit root test, BDS test and ARCH test and calculating correlation dimension and Lyapunov index, Xusong Xu and Yanbin Chen (2001) found that both nonlinearity and chaos existed in Chinese stock market.

But existing literatures are in large limited to testing the nonlinearity and chaos in stock markets, and few literatures focus on how to measure nonlinear risk, how to evaluate the efficiency of a stock market, how to form an efficient investment strategy and how to manage systematic risk. These problems are worthy of deeper research. In this paper, we will make an exploration on studying these problems. We apply phase space reconstruction technique and coarse-grained entropy method to estimate the nonlinear noise levels in stock markets of Chinese Mainland, Hong Kong, US, UK and Japan, and further a comprehensive comparison analysis on risk and operation efficiency of above stock markets is made.

## 2. Sample data and descriptive statistics

We choose the daily return time series of SSE Composite Index (Chinese Mainland), Hang Seng Index (Hong Kong), S&P 500 (US), FTSE 100 (UK) and Nikkei 225 (Japan) as our research objects. The period studied is from December 20, 1990 to June 21, 2007 and the sample data is from RESSET (<http://www.resset.cn>) and Yahoo Finance (<http://finance.yahoo.com>).

To be exempt from the influence of outliers on statistical results, we take values which distances from the mean of time series exceed four times standard deviation as outliers, and then get rid of them from the time series. The descriptive statistics of daily return time series of various stock indexes after getting rid of outliers are given in table 1.

As shown from table 1 and line graph and histogram of time series, the above five daily return time series of stock indexes all significantly deviate from normal distribution and are all characterized by leptokurtic, fat tail and volatility clustering.

## 3. Preliminary tests

### 3.1 Nonlinearity tests

We apply BDS test to detect the nonlinearity of various time series. At first, linear correlation in the time series is filtered by the use of ARMA model, and then BDS test is conducted for residual series. BDS statistics with various thresholds  $r$  and embedded dimensions  $m$  are given in table 2 ( $\sigma_\varepsilon$  denotes the standard deviation of residual series). As shown from table 2, the null hypothesis that residuals are i.i.d. is significantly rejected (the critical value of normal distribution is 1.96 under the significance level of 5%), and it indicates that the stock markets of above five countries or areas are all of significant nonlinearity.

### 3.2 Determinism tests

So-called determinism of system is that the future states can be determined by the past states. The system with determinism usually presents some degree of tendency and self-similarity. We apply the method of recurrence plot developed by Eckmann, Kamphorst and Ruelle (1987) to test the determinism of various time series. At first, phase space reconstruction is conducted by the use of nonlinear dynamics, and the time delays  $\tau$  and embedded dimensions  $m$  (the maximum embedded dimension is 15) of various time series which help to reconstruct phase space are given in table 3, and they are determined by average mutual information method and false nearest neighborhood method.

After phase space reconstruction, recurrence plots of various time series can be made (thresholds are the standard deviations of various time series), and recurrence quantitative analysis (RQA) can be further conducted. By observing the recurrence plots of above five time series, we find that there scatter some small bands parallel with the diagonal, which indicates obvious determinism. Results of RQA on original data and on the new data after randomly disturbing the original sequence of various time series are respectively given in table 4. As contrasted to original data, the determinism of the new data after randomly disturbing the original sequence significantly declined and this indicates that our determinism tests are robust.

### 3.3 Chaos tests

According to G-P algorithm (see Grassberger and Procaccia (1983)), double logarithmic scatter plots of correlated integral  $C(r)$  with respect to threshold  $r$  with various embedded dimensions (as shown in figure 1) are made and we can find the following things. On one hand, with the gradual increase of embedded dimension  $m$ , the slope of linear part in  $\ln C(r) - \ln r$  graph (correlated dimension) gradually goes to stabilization, which indicates that there exists strange attractor in the system. On the other hand, before arriving at stabilization correlated dimension presents obvious jump (SSE Composite Index acts significantly). From these findings, we may believe that various time series are all characterized by chaos in some degree.

#### 4. Nonlinear noise estimation

##### 4.1 coarse-grained entropy method

Let  $\{x_i\}, i=1,2,\dots,N$  be a nonlinear time series. After selecting suitable time delay  $\tau$  and embedded dimension  $m$  we reconstruct phase space, and then get  $m$  dimension vector sequence

$$\overline{y}_i = (x_i, x_{i+\tau}, \dots, x_{i+(m-1)\tau}), i=1,2,\dots,M \quad (1)$$

where  $M = N - (m-1)\tau$ . The correlated integral of embedded phase space is defined as the follows

$$C_m(r) = \frac{2}{M(M-1)} \sum_{1 \leq i < j \leq M} H(r - \|\overline{y}_i - \overline{y}_j\|) \quad (2)$$

where  $H(\cdot)$  is Heaviside function, and  $r$  is threshold and  $\|\cdot\|$  is maximum norm. Therefore, coarse-grained entropy can be estimated as follows

$$K_2(r) \approx -\frac{d \ln[C_m(r)]}{dm} \quad (3)$$

Let  $\sigma$  be the standard deviation of the noise (including measurement noise and dynamical noise) of nonlinear time series  $\{x_i\}, i=1,2,\dots,N$ , and the observation values of coarse-grained entropy  $K_{noisy}(r)$  can be fitted by the following formula

$$K_{noisy}(r) = -\frac{d \ln[C_m(r)]}{dm} = -cg\left(\frac{r}{2\sigma}\right) \ln r + [\kappa + b \ln(1-ar)] \times \left(1 + \sqrt{\pi} \frac{\sqrt{r^2/3 + 2\sigma^2} - r/\sqrt{3}}{r}\right) \quad (4)$$

where  $\kappa, a, b, c, \sigma$  are parameters under estimation, and the function  $g(z)$  is defined as follows

$$g(z) = \frac{2}{\sqrt{\pi}} \frac{ze^{-z^2}}{\text{erf}(z)} \quad (5)$$

where  $\text{erf}(\cdot)$  is error function.

In formula (4),  $g(\cdot)$  shows the influence of noise on correlated dimension, and  $\kappa + b \ln(1-ar)$  is coarse-grained entropy of signal uncontaminated by noise while  $[\kappa + b \ln(1-ar)] \times \left(\sqrt{\pi} \frac{\sqrt{r^2/3 + 2\sigma^2} - r/\sqrt{3}}{r}\right)$  is increment of coarse-grained entropy caused by noise. After estimating the standard deviation of noise  $\sigma$  by the use of fitting formula (4), finally we can calculate noise-to-signal ratio (NSR) of time series as follows

$$NSR = \frac{\sigma}{\sigma_{data}} \times 100\% \quad (6)$$

and we take it as a measurement of noise level of time series.

##### 4.2 Estimation results

Taking the essentiality that correlated integral  $C_m(r)$  varies with embedded dimension  $m$  and threshold  $r$  into account, we choose  $m$  from 1 to 20, and  $r$  takes 100 different values in interval  $[\frac{\sigma_{data}}{2}, 2\sigma_{data}]$ . Observation value of coarse-grained entropy  $K_{noisy}(r)$  can be estimated by the use of OLS method for the following linear regression

$$\ln C_m(r) = k \cdot m + e \quad (7)$$

where the negative of slope  $k$  is just  $K_{noisy}(r)$ .

Then we apply Levenberg-Marquardt method and general global optimization method to fit  $K_{noisy}(r)$  according to (4).

The estimation value of  $\sigma$ , NSR, decision coefficient of fitting  $R^2$  and the root of mean square errors (RMSE) are given in table 5. The statistics in table 5 and figure 2 all sufficiently indicate that the fitting makes great effect.

#### 4.3 Results analysis

Traditional financial models are all based on the hypothesis that stock return is normally distributed (i.e. acts as stationary distribution with characteristic parameter  $\alpha = 2$ , and its variance is limited and stationary), in which variance of return is applied to measure risk. A large amount of empirical research indicates, however, stock return significantly deviate from normal distribution and is characterized by leptokurtic, fat tail and state continuing. The above practical characteristics of stock return can be well depicted by stationary distribution with characteristic parameter  $\alpha \in (1, 2)$ . As population variance in this case is uncertain or infinity, taking sample variance as the measurement of risk is of no significance.

Nonlinear dynamics and chaos and fractal theory which have rapidly developed in recent years provide a new perspective for us to study modern financial risk management and portfolio selection. Complex financial dynamic system is essentially characterized by intrinsic randomness of deterministic system and the fluctuation of the deterministic part is completely predicted in a short period (so we may believe this part of fluctuation to be of no risk in a short period), so as the essential financial risk measurement, the natural choice is the standard deviation of nonlinear noise of financial asset return time series  $\sigma$ . Not only can we apply  $\sigma$  to guard against and control financial risk, but also we can use it to optimize portfolio selection (see Urbanowicz and Holyst (2004)).

By observing the estimation values of  $\sigma$ , we can find that the risks of eastern stock markets including Chinese Mainland, Hong Kong and Japan are higher than that of western stock markets including US and UK. The main reason is that western stock markets are more mature than eastern markets and the later are influenced to a large extent by the free input or output of large amount of capital and regular changes in trading rules. Moreover, we can find that the risks of Hong Kong and Japan stock markets are higher than that of Chinese Mainland stock market. Strong “policy market” characteristic, limitation of margin of rise or fall, relatively weak international linkage and small size of QFII may account for the above finding. As we know, the trial of direct investment in Hong Kong stock market for individual investors of Chinese Mainland will be on the way, and in spite of the great significance of this policy, how to efficiently guard against risk is

the primary challenge faced by investors.

Besides  $\sigma$  discussed above, NSR is another important index and it indicates the extent of operation efficiency of stock market. Higher NSR is (i.e. the proportion of intrinsic random fluctuation in the whole fluctuation is higher), market is more mature and operates more efficiently and is closer to EMH. By observing the values of NSR, we can find that the other four stock markets are more and more mature than the stock market of Chinese Mainland. The statistical results which respectively indicate nonnormality, leptokurtic, fat tail, nonlinearity, determinism and mutation also significantly support above finding. This arises from two aspects. On one hand, efficient securities legislation system, credit system and multi-dimensional supervision and management system are not completely established, and some illegal behaviors such as inside trading, manipulating price and issuing false information usually occur. On the other hand, a rational investment culture which core idea is “value investment in the long run” and a healthy and harmonious ecological environment in securities market are not formed and the size of institutional investors is relatively small, so there exist strong effects of “positive feedback” and “herding behavior”, and with the accumulation of these effects in a long period financial bubble will be prone to arise, and more heavily financial crisis will probably break out.

#### 5. Conclusion

With the step-by-step opening of China Stock Market and gradual strengthening of international linkage, how to efficiently measure and manage risk, evaluate and improve market operation efficiency is an important project in present financial research. According to nonlinear dynamics and chaos and fractal theory, we apply phase space reconstruction technique and coarse-grained entropy method to estimate the nonlinear noise levels in stock markets of Chinese Mainland, Hong Kong, US, UK and Japan, and we emphasize on discussing the standard deviation of nonlinear noise  $\sigma$  and noise-to-signal ratio NSR which are two important indexes about risk measurement and efficiency evaluation, and further we make a comprehensive comparison analysis on the risk and operation efficiency of stock markets of above countries or areas. The following research work will be applying these two indexes to the simulation of stock market based on agent to study the influence of microindividuals on the macromarket.

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Table 1. Descriptive statistics of daily return time series of various stock indexes

	SSE Composite Index	Hang Seng Index	S&P 500	FTSE 100	Nikkei 225
Number of observations	4027	4065	4142	4148	4062
Mean	0.000489	0.000572	0.000364	0.000294	0.000023
Standard deviation	0.020895	0.014261	0.009335	0.009556	0.014206
Maximum	0.1191	0.062	0.0393	0.0406	0.0796
Minimum	-0.1118	-0.0607	-0.0391	-0.0397	-0.0698
Skewness	0.01118	-0.037123	-0.026864	-0.100655	0.147949
Kurtosis	8.742128	4.892077	4.788616	4.540808	5.249315
Jarque-Bera	5532.517	607.2887	552.6178	417.3261	871.1254
P-value	0.000000	0.000000	0.000000	0.000000	0.000000

Table 2. BDS statistics of daily return time series of various stock indexes

		SSE Composite Index	Hang Seng Index	S&P 500	FTSE 100	Nikkei 225
$r = 0.5\sigma_\varepsilon$	$m = 2$	18.62	8.68	7.73	9.66	5.21
	$m = 3$	25.56	10.79	12.30	13.14	8.43
	$m = 4$	34.07	13.63	15.81	17.25	10.89
	$m = 5$	44.73	16.69	20.15	21.00	14.17
$r = \sigma_\varepsilon$	$m = 2$	20.86	9.55	7.80	11.09	5.84
	$m = 3$	25.92	12.70	12.99	14.93	9.11
	$m = 4$	30.42	15.85	16.60	18.88	11.54
	$m = 5$	34.38	18.47	20.63	22.25	14.13
$r = 1.5\sigma_\varepsilon$	$m = 2$	22.36	10.17	8.49	12.59	6.67
	$m = 3$	26.47	13.95	13.57	16.67	9.99
	$m = 4$	29.40	17.03	16.82	20.27	12.19
	$m = 5$	31.40	19.38	20.13	23.16	14.12

Table 3. Time delays and embedded dimensions of daily return time series of various stock indexes which help to reconstruct phase space

	SSE Composite Index	Hang Seng Index	S&P 500	FTSE 100	Nikkei 225
$\tau$	2	1	1	2	1
$m$	9	11	9	12	13

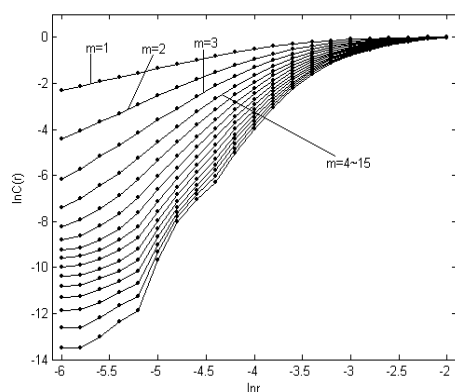
Table 4. RQA results of daily return time series of various stock indexes

		SSE Composite Index	Hang Seng Index	S&P 500	FTSE 100	Nikkei 225
Original data	%recurrence	8.62%	1.06%	2.37%	0.63%	0.41%
	%determinism	37.27%	92.55%	92.59%	3.83%	93.66%
	Longest diagonal line segment	271	45	55	23	51
New data after randomly disturbing the original sequence	%recurrence	1.55%	0.22%	0.61%	0.11%	0.06%
	%determinism	1.64%	82.58%	81.85%	0.10%	80.95%
	Longest diagonal line segment	13	19	16	4	12

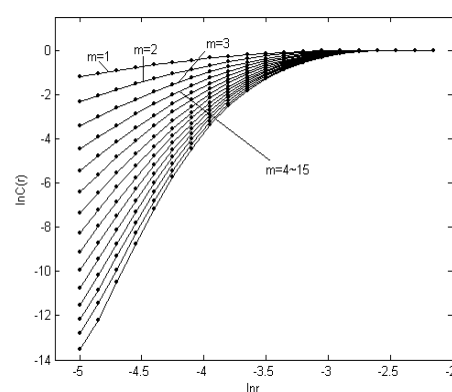
Table 5. Nonlinear noise estimation of daily return time series of various stock indexes

	SSE Composite Index	Hang Seng Index	S&P 500	FTSE 100	Nikkei 225
$\sigma$	0.0079	0.0101	0.0069	0.0066	0.0090
$NSR$	37.8%	70.8%	73.9%	69.1%	63.4%
$R^2$	0.9931	0.9994	0.9988	0.9994	0.9986
$RMSE$	0.00699	0.00437	0.00645	0.00555	0.00594

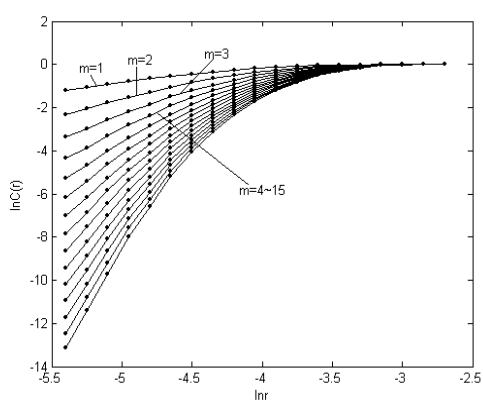




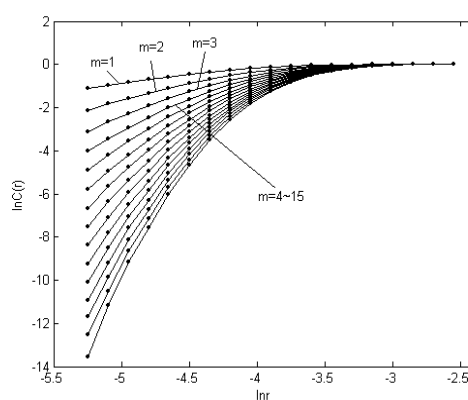
(a) SSE Composite Index



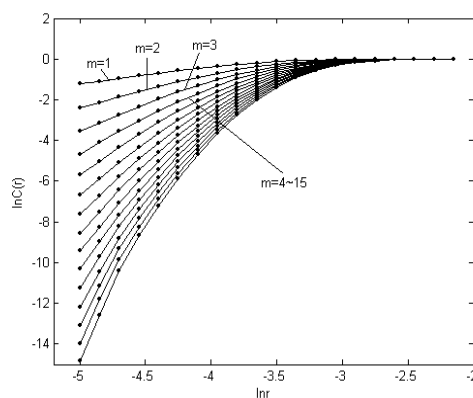
(b) Hang Seng Index



(c) S&P 500

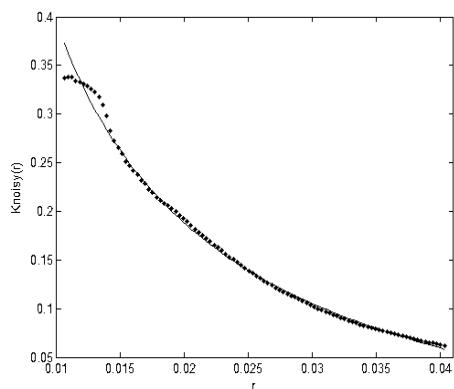


(d) FTSE 100

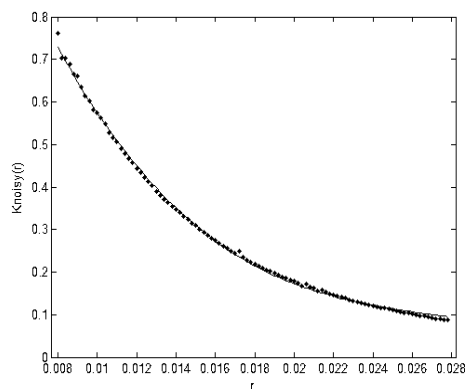


(e) Nikkei 225

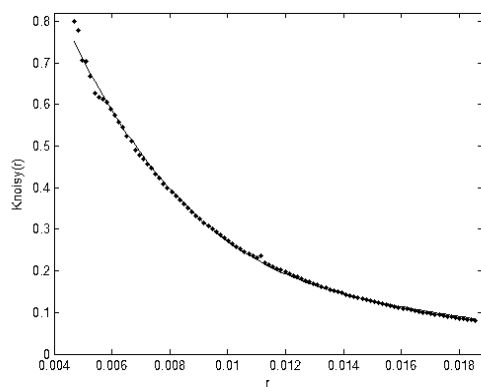
Figure 1.  $\ln C(r) - \ln r$  graphs of daily return time series of various stock indexes



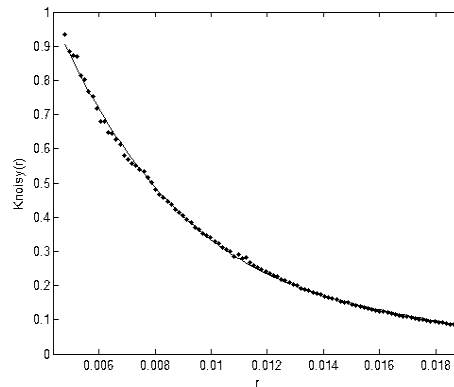
(a) SSE Composite Index



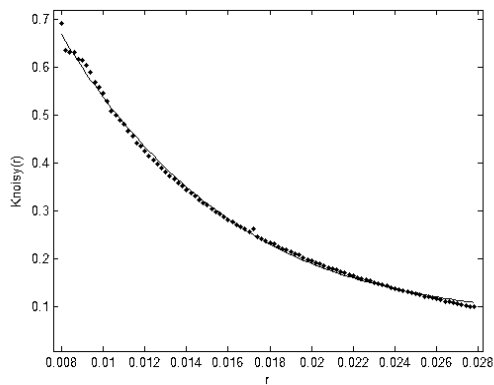
(b) Hang Seng Index



(c) S&amp;P 500



(d) FTSE



(e) Nikkei 225

Figure 2. Fitting plots of coarse-grained entropy of daily time series of various stock indexes



## Corporate Governance Compliance and the Effects to Capital Structure in Malaysia

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### Abstract

This study attempts to investigate the compliance level among public listed companies with the implementation of corporate governance code of best practices and the association to firm's capital structure in Malaysia. The data are gathered from the analysis of companies' annual report and Thompson DataStream for a sample of 126 companies over a period of 1998 to 2006. The study employs multiple regression analyses on board of director's facets such dual leadership, board size and board meeting. The preliminary results of this study reveal most of the company has complied well with the code and there is a significant association to the firm's capital structure.

**Keywords:** Corporate Governance, Dual Leadership, Capital Structure, Board of Directors' Facets

### 1. Introduction

The enforcement of Code of Best Practices by Malaysian Institute of Corporate Governance (henceforth, MICG) to public listed companies in 2001 was an effective measure in the wake of the mid-1997 Asian crisis. As one of major element of the corporate governance, Board of Directors provides additional provisions to the shareholders as well as other investors of the firms because it serves as an effective monitoring mechanism to reduce the agency conflict. It imposes more stringent monitoring by shareholders by increasing involvement and the power of the Board of Directors in the firm's decision making. To the extent that corporate governance is not binding, firms' decision to adopt the Code of Best Practices must be supported by prudent justification. In the High Level Finance Committee Report on Corporate Governance (1999, p.10), corporate governance is defined as,

*"... the process and structure used to direct and manage the business and affairs of the company towards enhancing business prosperity and corporate accountability with the ultimate objective of realizing long-term shareholder value, ..."*

The definition implies that investors of companies that adopt the Best Practices will be able to enjoy higher returns from their investment. The recent surge of studies (Bai et. al. (2003); Bauer et. al. (2005); Black et. al. (2005); Chiang 2005; Drobetz et. al. (2003); Gugler et. al. (2003); Nandelstandh & Rosenberg (2003); Wan & Ong (2005); Noriza et. al (2007), Noriza (2008) on the relationship between corporate compliance and performance signal market (and public) awareness about corporate governance such that firms no longer can ignore the importance of and implication of neglecting corporate governance. In other words, stock returns of non-complying firms would suffer because market will penalize the firms for decisions that do not allow them to realize greater value. Nonetheless, the facts that there are substantial variations in corporate compliance across firms within the same country (Mohamad Ishak et. al. (2004), Klapper and Love (2004) suggest that some firms are not yet convinced about the incentive from adopting the corporate governance. In attempt to find evidence that can convince these non-complying firms, this study will determine whether or not firms with higher level of corporate compliance significantly perform better than those non-complying firms. Consistent with the ultimate objective of corporate governance to realize "long-term shareholder value", this study uses debt to equity (D/E), debt ratio (DR) and interest coverage (IC) to measure capital structure of the company.

Even though there are multiple components in corporate governance, this study emphasizes on Board of Directors (BOD) because it is one (if not the only) of the most important mechanisms of corporate governance. As part of its listing requirement, Bursa Malaysia requires public listed company to comply with and disclose in their annual reports certain areas concerning BOD including the board composition, board size, board meeting and dual leadership.

The extent that all directors are required to undergo a Mandatory Accreditation Programme (MAP) which to be followed up by annual Continuing Education Programme (CEP) for instance, asserts the policymakers belief that BOD is an effective vehicle of corporate governance. As the elected representatives of the firm shareholders, directors serve as the primary overseers in the company, monitoring management to ensure that its decisions is always (Note 2) endeavoring to maximize corporate value in the long term for the shareholders, and (Note 3) prepared to be accountable for its actions to all the stakeholders and in particular to the shareholders (Corporate Governance Committee, 1997).

With economies become increasingly global, companies especially those in the emerging capital markets are under constant pressure to improve their corporate governance infrastructure in order to compete efficiently with their competitors for external capital in the global equity market.

The remainder of the study is structured as follows. Section 2 reviews the existing literature on corporate governance compliance and firm's capital structure. Section 3 describes the data and methodology. Section 4 presents the findings and discussion on the results while, section 5 concludes and recommendations to the company.

## 2. Overview of Literature

### 2.1 Definition of Corporate Governance

The Malaysian High Level Finance Committee (1999, p. 10) defines corporate governance as the process and structure used to direct and manage the business affairs of the company towards enhancing business prosperity and corporate accountability with the ultimate objective of realizing long-term shareholder value whilst taking into account the interest of other stakeholders. According to Mathiesen (2002), corporate governance is a field in economics that investigates how to secure or motivate efficient management of corporations by the use of incentive mechanisms, such as contracts, organizational designs and legislation. This is often limited to the question of improving financial performance, for example, how the corporate owners can secure/motivate that the corporate managers will deliver a competitive rate of return.

In the preceding study made by Cornelius (2005), in the broadest sense, corporate governance can be defined as the stewardship responsibility of corporate directors to provide oversight for the goals and strategies of a company and to foster their implementation. Corporate governance may thus be perceived as the set of interlocking rules by which corporations, shareholders and management govern their behavior. These rules refer to individual firm attributes and the factors that allow companies to maintain sound governance practices even where public institutions are relatively weak. Such factors may include a corporation's ownership structure, its relationships with stakeholders, financial transparency and information disclosure practices as well as the configuration of its managing boards. Another definition that can be include in this literature that made by Cornelius & Kogut (2003), a system of corporate governance consists of those formal and informal institutions, laws, values, and rules that generate the menu of legal and organizational forms available in a country and which in turn determine the distribution of power on how ownership is assigned, managerial decisions are made and monitored, information is audited and released, and profits and benefits allocated and distributed.

Millstein (1998) describes corporate governance as the relationship between managers, directors and shareholders. This constricted definition encompasses also the relationship of the corporation to stakeholders and society. Whereas in the broader version of her definition, corporate governance encompasses the combination of laws, regulations, listing rules and voluntary private sector practices that enable the corporation to attract capital, perform efficiently, generate profit and meet both legal obligations as well as the expectations of society generally. Furthermore she states that, no matter what the definition, basically corporate governance concerns the means by which a corporation assures investors that it has in place well performing management who ensure that corporate assets provided by investors are being put to appropriate and profitable use.

### 2.2 Corporate Governance Compliance and Firm's Capital Structure

Through a survey on annual reports of 556 public listed companies in Bursa Malaysia, formerly known as Kuala Lumpur Stock Exchange, in 2002, Mohamad Ibrahim et. al (2004) found the level of corporate compliance to the Code of Best Practice in these firms is very high. Furthermore, the level of corporate compliance is consistently high for all corporate governance mechanisms or practices concerning BOD that include: (i) BOD composition; (ii) BOD responsibilities i.e. division of power between the Chairman and the CEO; (iii) BOD meeting; (iv) board committees; (v) remuneration of directors; and (iv) BOD training. Their finding is consistent with the score of Governance (GOV) index introduced by Klapper & Love (2004). In their study involving 13 other emerging countries, Malaysia's mean score (54.44) in the Index puts it at the sixth place after South Africa (66.53), Singapore (65.34), Chile (61.63), Hong Kong (58.27), and Brazil (57.26). Focusing the scope to Pacific Basin countries, the results suggest that Malaysia has performed well relative to the other countries in the region because the results also imply that Malaysia stands at the third place after Hong Kong and Singapore. This is beside the fact that in term of economic development, those countries are more established and advanced than Malaysia. As pointed out by Pass, C. (2006), the revised Combined Code introduced new provisions relating to the status and roles of the chairperson and chief executive and the composition of the Board of Directors and its main Committees. These new provisions were especially concerned to provide greater empowerment of a company's non-executive directors in top-level decision making, with a particular emphasis on non-executives being "independent" according to criteria specified in the Code. The new Code requires companies to comply with the provisions of the Code taking appropriate action whenever possible to secure compliance or explain why they have not complied. The Code thus continues the UK tradition of "voluntary" compliance rather

than legal enforcement. Any “enforcement” is left to the discretion of shareholders who if they are unhappy with an explanation can reject it at the AGM.

There are many studies conducted on corporate governance and firm's performance, but limited study focus on capital structure. In theory, financing in capital structure by company is based on the board of director's decision. In compliance to corporate governance code of best practices, BOD serves a good financing decision to the company. According to Abor J. (2007) in his study on corporate governance affect the capital structure was found that is a significantly negative relationship between board size and capital structure and opposite finding on the association between CEO duality and leverage where it implies that larger boards adopt low debt policy and CEO as the board chairman tend to employ high proportion of debt. Similar findings done by Pfeffer & Salancick (1978), Lipton & Lorsch (1992), Berger et al (1997) and Wen et al (2002) on the relationship between corporate governance and capital structure was come out with the decision of corporate governance influenced the capital structure decision of firms. However, contradict with Jensen (1986) where, high leverage or debt ratio because of larger boards.

A study done by Zong-Jun (2006), using a sample of ninety-six financially distressed companies and 96 healthy companies find that large shareholder ownership, state ownership, and the proportion of independent directors are negatively associated with the probability of distress. Additionally, managerial agency costs are badly detrimental to a company's financial status. However, the degree of balanced ownership, managerial ownership, board size, and CEO duality do not significantly affect the probability of default. Furthermore, they test the influence of state-controlling right by sub-grouping the sample into state-controlled and non-state-controlled companies. The results indicate that corporate-governance attributes act differently on the status of financial distress between the two sub-samples.

The evidence on the ultimate effect of corporate governance compliance to high level of debt by company is mixed. For instance, Abor J. & Biekpe N. (2008) tested on small and medium enterprises (SMEs) indicate that is positive relationships between capital structure and board composition, board skills and CEO duality and the result imply that SMEs pursue lower debt policy with larger board size. Another key result that should b e highlight is SMEs with higher percentage of outside directors, highly qualified board members and one-tier board system rather employ more debt. Fama & Jensen (1983) found CEO duality also influences the financing decision of the firm but the relationship is not statistically significant. Another study by Wen.Y, Rwegasira, K. & Bilderbeek,J. (2002) on corporate governance and capital structure decisions of the Chinese listed firms found that manager tend to pursue lower financial leverage when they face stronger corporate governance from the board. However, their finding only shows a significant value of board composition and CEO tenure and insignificant results for board size and fixed CEO compensation.

### **3. Research Methodology**

#### *3.1 Operational Definition of Facets of BOD based on Malaysian Code on Corporate Governance (MCCG) and Capital Structure*

##### *3.1.1 Dual Leadership (DL), Board Size (BS) and Board meeting (BM)*

In the MCCG, it was stated that under DL, there should be a clearly accepted division of responsibilities at the head of company, which will ensure a balance of power and authority, such that no one individual has unfettered powers of division. Where the roles are combined there should be a strong independent element on the board. A decision to combine the roles of chairman and CEO should be publicly explained in the companies' annual report. In this study, it was indicated 1 for the combined position of CEO and chairman and 2 for separated. In terms of BS, every board should examine its size, with a view to determining the impact of the number upon its effectiveness. MCCG also stated that the board should meet regularly, with due notice of issues to be discussed and should record its conclusions in discharging its duties and responsibilities. Data on board size was collected based on the ranking; 1 if number of BOD is less than 5 persons, 2 for 6-10 of BOD, 3 for 11-15 of BOD, 4 for more than 15 BOD and 5 if the company do not disclose the information in the annual report. The board should disclose the number of BM held a year and the details of attendance of each individual director in respect of meetings held. From such disclosure, the study was developed a ranking as same as applied to board size for the board meeting.

##### *3.1.2 Capital Structure*

In finance, capital structure refers to the way a corporation finances its assets through some combination of equity, debt, or hybrid securities. In this study, capital structure refers to debt ratio, debt to equity and interest coverage.

#### *3.2 Determinants of variables*

There are two main variables in this study, dependent and explanatory, and the proxies that represent the dependent variables are (i) Debt Ratio (DR), (ii) Debt to Equity (D/E) and (iii) Interest Coverage (IC) and explanatory variables are (i) Dual Leadership, (ii) Board Size and (iii) Board Meeting.

To examine the firm's capital structure, this study used the following equations;

$$DR_i = \frac{TL_i}{TA_i}$$

$$D/E_i = \frac{TD_i}{TE_i}$$

$$IC_i = \frac{EBIT_i}{InterestExpenses_i}$$

Where  $TL_i$  = Total liabilities of the  $i$ th company for each year,

$TA_i$  = Total assets of the  $i$ th company for each year,

$TE_i$  = Total shareholder's equity of the  $i$ th company for each year,

$TD_i$  = Total Debt of the  $i$ th company for each year, and

$EBIT_i$  = Earnings before interest and taxes of the  $i$ th company for each year.

$InterestExpenses_i$  = Interest Expenses of the  $i$ th company for each year.

Next, the relationship between the BOD facets and firms' capital structure will be estimated using the following regression equations:

$$DR_i = \alpha + \beta_1(DL_i) + \beta_2(BS_i) + \beta_3(BM_i) + \varepsilon_i \quad (1)$$

$$D/E_i = \alpha + \beta_1(DL_i) + \beta_2(BS_i) + \beta_3(BM_i) + \varepsilon_i \quad (2)$$

$$IC_i = \alpha + \beta_1(DL_i) + \beta_2(BS_i) + \beta_3(BM_i) + \varepsilon_i \quad (3)$$

Where  $\alpha$  = the constant term,

$\beta$  = the slope or coefficient estimates of the explanatory variables,

$DL_i$  = the BOD hold two position of the  $i$ th company,

$BS_i$  = the BOD size of the  $i$ th company,

$BM_i$  = the BOD meeting of the  $i$ th company,

$\varepsilon_i$  = the standard error of the  $i$ th company,

$DR_i$  = the debt ratio of the  $i$ th company,

$D/E_i$  = the debt to equity of the  $i$ th company, and

$IC_i$  = the interest coverage of the  $i$ th company.

### 3.3 Sampling and Data Collection

The sample of 126 companies had been randomly selected consist of four industries; (i) consumer products, (ii) industrial products, (iii) trading/services, and (iv) plantations of public-listed companies in the Main Board of the Bursa Malaysia for a nine conservative years period from 1998 to 2006. Financial institutions are excluded because they are governed by special rules. The data before that period constitutes the pre-implementation of corporate governance (pre-ICG) cover year 1998 to 2000, the data between the first implementation and the aforementioned period constitutes the mid-corporate governance period (mid-ICG) cover year 2001 to 2003 and the following data on 2004 to 2006 constitutes the post- implementation of corporate governance (post-ICG). For the purpose of collecting information on the BOD, this study will use the companies' annual reports. Annual reports are sufficient for gathering such data considering listed companies must abide to Securities Exchange Commission's requirement of such disclosure. Thompson's DataStream was used to employ the data on firm's capital structure.

### 3.4 Hypothesis

The null hypothesis of the study is developed to cater for the pooling regression model. The null hypothesis is:

$H_0$ : There is no relationship between capital structure and BOD facets.

$H_1$ : There is a relationship between capital structure and BOD facets.

## 4. Discussion on Empirical Results

### 4.1 Analysis of Corporate Governance Compliance among BOD Facets during Pre, Mid and Post Implementation of Corporate Governance Code of Best Practices in Malaysia

According to Malaysia Code on Corporate Governance (2000), it was stated that if one person hold dual leadership (as a chairman and CEO), they should disclose all the responsibilities and descriptive job between the chairman and the CEO.

It is also visibly stated that there should be a clearly accepted division of responsibilities at the head of the company, which will ensure a balance of power and authority, such that no one individual has unfettered powers of decision. Where the roles are combined there should be a strong independent element on the board. A decision to combine the roles of Chairman and Chief Executive should be publicly explained. As we can see from figure 1 (see appendix), most companies in Malaysia did not combine the role of chairman and CEO of the board of director. It been prove by the result of this study that show more than 70% of overall companies for the pre-ICG and more than 80% for the mid-ICG and post-ICG has two different person that hold the position of chairman and CEO. Only a few of companies apply RD that results are only 10.6% (pre-ICG), 6.9% (mid-ICG) and 12.4% (post-ICG). Hence, before the code of practice is introduced, the board of director already separates the role between the two. According to research done by Shamsul Nahar Abdullah (2004), the role of the board is likely to be minimal as one person is controlling both the operations (as a CEO) and the internal monitoring (as a board chairman). Thus, the leadership and control responsibilities lie in the hands of one individual.

Again, according to MCCG (2000), it was stated that every board should examine its size, with a view to determining the impact of the number upon its effectiveness. See appendix for figure 2, most of the companies assign 6 to 10 board of directors to lead the companies during mid-ICG and post-ICG with 56.3 percent and 79.5 percent respectively. Only 1.9 percent, 3.7 percent and 1.3 percent of the companies that assign more than 16 persons of the board size during pre, mid and post respectively. As for the study period, a total of 31.9 percent of the companies didn't disclose their number of directors. Some point of view saying that corporate performance will be better if there is a larger board because they have a range of expertise to help make better decision. However, Jensen (1986) and Lipton & Lorsch (1992) argue that large boards are less effective and are easier for the CEO to control. When a board gets too big, it becomes difficult to co-ordinate and process problems. Smaller boards also reduce the possibility of free riding by, and increase the accountability of, individual directors.

The corporate governance practices suggested that the board of director should meet regularly, with due notice of issues to be discussed and should record its conclusion in discharging it duties and responsibilities. The practice also suggested that details of attendance of the directors are revealed in annual report during the financial year to make sure the directors are committed to be part of the company. In the study, it was found that majority of the companies complied very well with the practice after the corporate governance was implemented compared to before the code was introduced. As shown in figure 3 (see appendix), for the pre-ICG indicated that 43.7 percent of the companies are not concern to disclose their number of board meeting in their annual report. However, after this code of conduct been introduced, we can see the trend is changing. Most of the companies starting to complied with the code for the mid-ICG (96.8 percent) and post-ICG (98.9 percent). Most of the company was conducted a meeting with in a range of 6 to 10 times a year, for mid-ICG (61.9 percent) and post-ICG (71.1 percent).

#### 4.2 Analysis of the Relationship between BOD Facets with the Firm's Capital Structure

Table 1 (see appendix) shows the result for the multiple regressions for all variables involved in the study. From the result we can see from panel A for the pre-ICG, there are only DE have a relationship with the BOD facets such as DL (-2.069) and BS (2.556) at 5 percent significant level. Therefore, we do not accept the null hypothesis of  $H_0$  and accept  $H_1$  at this level. For the Mid-CG in panel B, where the corporate governance code being introduced, there is a relationship between DL and IC at the p value of 0.05 and t-ratio of -1.976. Another BOD facet that has a relationship is between BS and DE at the p value of 0.05 and t-ratio of 2.136. We can accept  $H_1$  and do not accept  $H_0$  because it shows that there is a relationship between variables. As some authors suggested, the effects of these two factors on firm performance can be both positive and negative (Finkelstein, D'Aveni 1994), which helps to explain why this study found no significant effect of the two factors on firm performance. As for Post-CG in panel C, it shows that the entire three BOD facets have a relationship with the capital structure of the companies such as DL with DR (2.148) and DE (3.106) at 5 percent and 1 percent respectively. IC also has an association with BS (5.045) and BM (-2.219) at 1 percent and 5 percent respectively. Therefore, we can accept  $H_1$  and do not accept  $H_0$  at this level. As pointed out by Keun Lee (2002) that reviewed the post-crisis reform of corporate governance system in Korea from the point of view of the conditions for efficient governance, the Korean system can be said to have been improving although several issues still remains to be settled.

The results in the table 2 (see appendix) shows that the standard deviation for the DR during pre-ICG (panel A) and post-ICG (panel C) indicate the highest 746.91 and 313.99 while the lowest is for DE are 40.78 and 68.59 respectively. However, for mid-ICG (panel B) indicates difference result where the highest is IC (2908.28) and the lowest is DE (36.73). In terms of correlations, the significance level at 5 percent for the pre-ICG only on BS with IC at 0.118 and BS with DL at 0.105. For mid-ICG, the correlation existed between DE and DR at 1 percent (0.256) and BS and DE at 5 percent (0.105). The improvement of significant level for post-ICG where RD are correlated with DR at 5 percent (0.106) and DL with IC (0.160) and BS with IC (0.247) at 1 percent respectively.

## 5. Conclusion and Recommendation

In this study, it can be concluded that majority of the companies listed in Bursa Malaysia have complied very well with the code in corporate governance practices. As we can see in the statistics in section four, it proved that the companies have disclosed their number of board meeting conducted in annual report especially during mid-ICG and post-ICG. In addition, it was also found that majority of the companies have 6 to 10 directors which are consistent with the recommendation by Lipton & Lorcsch (1992) who argued that the preferred board size is 8 or 9 with 10 being the limit in order for a board to be effective. In terms of dual leadership, it was proven by this study that the compliance level to the MCCG is high where a decision to combine the roles of chairman and CEO should be publicly explain in their annual report. This study also found evidence indicating that there is a relationship between corporate governance and the firm's capital structure and at the same time there is evidence to show that there are no relationships between the variables. For the pre-ICG, there is no relationship between BOD facets and firm's DR and IC. It was also found that there is a relationship between the variables (for mid-ICG and post-ICG) despite the fact that the relationship was not a strong relationship as the value of R is below 60%, consistent with suggestion made by Gompers et al. (2003).

For the recommendations, the study has found that still have a several companies did not disclose their number of directors and number of board meeting in their annual report should comply with the MCCG. The study also believe that for future research, more sample should be used. Lastly, for companies that did not comply with the code of corporate governance they should follow the footsteps of the company that comply with the practice. This is because in this study, it was found that the corporate governance had a relationship with the company's capital structure. When companies have good governance system, they will attract investors to invest in their company. These companies in turn can compete in the business that they are involved in because of sufficient capital and resources. It is highly recommended for companies to comply with the code because this would give investor confidence in the company.

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## Notes

Note 1. in chapter 15 of the Listing Requirement Handbook

Note 2. As part of the listing requirement and also pursuant to Practice Note No. 5/2001.

Note 3. mainly those concerning the board of directors (Nikomborirak, 2001).

Table 1. The Results of Multiple Regressions between BOD facets and Capital Structure

Variables	Model 1	Model 2	Model 3
<b>Panel A: Pre-ICG (1998-2000)</b>			
Constant	2.342	4.198	-0.035
	0.020*	0.000**	0.972
Dual Leadership (DL)	-1.500	-2.069	-0.129
	0.134	0.039*	0.897
Board Size (BS)	-1.249	2.556	-1.040
	0.213	0.011*	0.299
Board Meeting (BM)	-0.513	1.194	0.432
	0.608	0.233	0.666
R	0.109	0.168	0.060
R Square	0.012	0.028	0.004
Adj. R	0.004	0.021	-0.004
F-Statistic change	1.508	3.638*	0.450
<b>Panel B: Mid-ICG (2001-2003)</b>			
Constant	2.654	5.316	-0.253
	0.008**	0.000**	0.801
Dual Leadership (DL)	-0.468	-1.038	-1.976
	0.640	0.300	0.049*
Board Size (BS)	-0.232	2.136	-0.023
	0.817	0.033*	0.982
Board Meeting (BM)	-0.803	-1.260	0.257
	0.422	0.208	0.797
R	0.051	0.135	0.039
R Square	0.003	0.018	0.002
Adj. R	-0.005	0.010	-0.006
F-Statistic change	0.324	2.307*	0.194
<b>Panel C: Post-ICG (2004-2006)</b>			
Constant	-1.619	-0.467	-0.413
	0.106	0.641	0.680
Dual Leadership (DL)	2.148	3.106	-0.879
	0.032*	0.002**	0.380
Board Size (BS)	0.874	0.315	5.045
	0.383	0.753	0.000**
Board Meeting (BM)	0.539	-0.697	-2.219
	0.590	0.486	0.027*
R	0.119	0.165	0.273
R Square	0.014	0.027	0.074
Adj. R	0.006	0.019	0.067
F-Statistic change	1.790	3.480*	10.026**

Notes: In each cell, *t*-value appears in the first row and *p*-value (sig.) is in the second row. Symbols

\* indicates significance at the 5 percent level while \*\* indicates significance at the 1 percent level

Table 2. The Results of Descriptive Statistic (ANOVA) and Correlation (Pearson) among Variables

Variables	MIN	MAX	MEAN	S.DEV	DR	DE	IC	DL	BS	BM
<b>Panel A: Pre-ICG (1998-2000)</b>										
DR	-10489.64	7426.90	79.97	746.91	1					
DE	-23.63	372.94	35.44	40.78	0.058	1				
IC	-10322.00	644.20	-41.62	656.34	0.007	0.047	1			
DL	1.00	2.00	2.07	0.52	-0.085	-0.091	-0.012	1		
BS	4.00	1.00	2.24	1.64	-0.072	0.118*	-0.055	0.105*	1	
BM	3.00	5.00	3.37	1.67	-0.027	0.054	0.024	0.030	-0.030	1
<b>Panel B: Mid-ICG (2001-2003)</b>										
DR	-1443.15	3032.93	93.23	304.31	1					
DE	0.00	280.97	33.52	36.73	0.256**	1				
IC	-49974.46	5808.76	-125.01	2908.28	0.006	-0.022	1			
DL	2.00	1.00	1.41	1.77	-0.026	-0.051	-0.037	1		
BS	4.00	2.00	2.27	1.14	-0.015	0.105*	-0.002	0.041	1	
BM	4.00	2.00	2.06	0.85	-0.043	-0.062	0.012	0.033	0.044	1
<b>Panel C: Post-ICG (2004-2006)</b>										
DR	-4871.05	1817.10	61.39	313.99	1					
DE	0.00	993.95	37.39	68.59	-0.02	1				
IC	-1170.25	4729.94	51.77	279.74	0.064	-0.023	1			
DL	3.00	2.00	1.92	0.40	0.106*	0.160**	-0.06	1		
BS	4.00	2.00	2.08	0.60	0.039	0.002	0.247**	-0.071	1	
BM	5.00	2.00	1.95	0.64	0.024	-0.045	-0.088	-0.066	0.078	1

Notes: In all cases of Pearson correlation the symbols \* indicates correlation is significant at the  $\leq 5$  percent level while \*\* indicates correlation is significant at the  $\leq 1$  percent level (2-tailed).

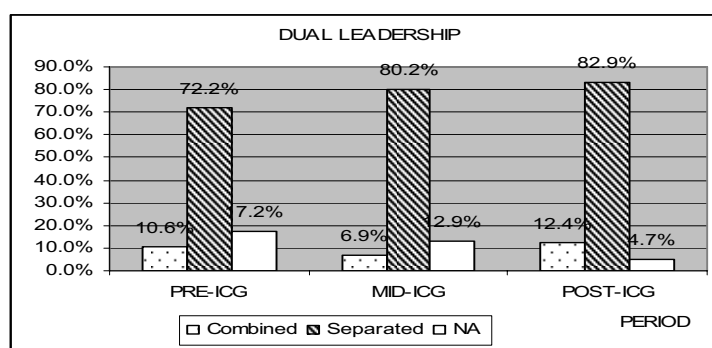


Figure 1. Dual Leadership (Chairman and Chief Executive Officer)

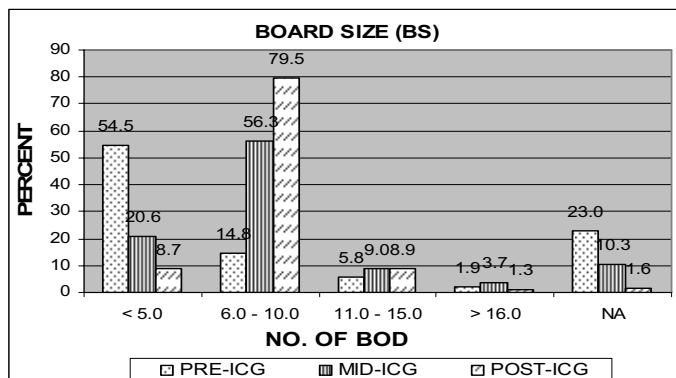


Figure 2. The Number of Directors in the Company

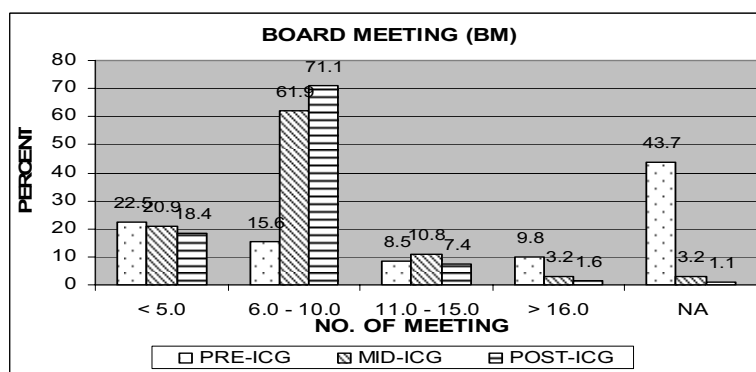


Figure 3. The Number of Board Meeting



## Study on the Reform of the Current Financial Report System of China

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### Abstract

In the times of knowledge economy, the financial environment of enterprises has changed largely, so the current financial report system of China has not satisfied the accounting information users' demand for the financial report. Three deficiencies existing in the current financial report system are analyzed in this article, i.e. lacking in the relativity, lacking in the timeliness, and lacking in the reliability. And corresponding reform directions have been proposed, such as using multiple measurement bases simultaneously, extending the scope of financial information disclosure and ensuring the information relativity, establishing the real time reporting system and ensuring the timeliness of information, and reducing the colors of the financial report and ensuring the reliability of information.

**Keywords:** Knowledge economy, Financial report, Reform

In the 21st century, the development of the economic globalization and the multi-directional development of the competition promote the world economy to enter into a new social economy form, i.e. the knowledge economy. Under the influences of the social economic form which basic characters include globalization, informationization, the networking and the knowledge-driven, the financial environment of enterprise has also changed largely. For example, the management environment of enterprise changes unendingly, and the production and operating activities of enterprise are more and more complex, and the fluctuation in price will be more frequent and drastic comparing with past, and the industrial competition is more and more drastic, which make the uncertainty of the enterprise management is higher and higher. Therefore, the current financial report system of China has not satisfied the accounting information users' demand for the financial report. Though the current financial report system follows the special accounting rule and adopts the standard and current format of presentation, but with the advent of the knowledge economic times, its advantages such as synthesis and standardization have not remedied the deficiencies shown because of the lagging behind the change of the economic environment. The current financial report system urgently needs a profoundly reform oriented by accounting information users' demand. The deficiencies existing in the current financial report system under the new social economy form are analyzed in this article, and advices are provided for the reform direction of the financial accounting report system of China.

### 1. Deficiencies existing in the current financial report system of China

#### 1.1 Lacking in relativity

The information offered by the current financial report mainly includes the historical information facing to the past, and the financial report is basically a historical accounting data sheet, but the users of the financial report hope to reflect the future performance and financial status of the enterprise, especially the cash flow forecasting information which has important reference value for users' future decisions. So this financial report mode which is established in the happened certain trades and affairs require lower information relativity for users' decisions. The historical cost financial report lacks in forecasting information, which can not provide useful information for information users' decisions and send a warning signal, but sometimes may mislead investors and judge the mistakes. For example, in 1980s, about 2000 financial corporations which engaged in the financial instrument exchange in US were misled because of the "good" management performances of their financial reports in the crisis, and found themselves in the financial trouble. Therefore, people gradually realize that the traditional income table which takes the historical cost as the econometric mode lacks in the relativity, and can not satisfied the demand for the forward-looking information.

In addition, the information disclosure range of the current financial report has not satisfied different information users' demand for the information relativity. With the quick development of social economy, many different accounting information users including investors, creditors, government branches, partners, social sectors occur in and out of enterprises. These accounting information users need not only the financial information, but also the non-financial information, need not only the quantitative information, but also the qualitative information, need not only the certain information, but also the uncertain information, need not only the historical information, but also the forecasting information, need not only the total information, but also the part information. The current financial report can not satisfied their demand for the information, so the relativity of the accounting information has been weakened.

### *1.2 Lacking in timeliness*

Managers hope to obtain required accounting information at any time in the decision-making process, but the annual financial report of the enterprise is made in the late four months of the year, and the interim financial report needs to be made in the last two months when the interim term ends. So the disclosure requirement of the current financial report can not achieve the timelessness of the accounting information quality. The traditional accounting tradition requires that the annual disclosure accounting information should be based on users' demands for the annual wealth distribution and the information disclosure cost in the manual accounting, but this financial report based on the time-period concept periodic planning has obviously hysteretic nature, which seriously influences the timelessness of information, even makes the enterprise to lose the commercial chance. The Barings Bank of the British is a classical example. In the late of 1994, the book net value of the Barings Bank was 45 billion to 50 billion dollars, but after two months, i.e. in the late of the Feb of 1995, the financial status of this bank had changed largely, and the bank had entered into the bankruptcy, and at that time, the financial report of 1994 had not be completed. It is obvious that the disclosure requirements of the current financial report have not accorded with the requirements of the development of the modern society.

### *1.3 Lacking in reliability*

The information provided by the current financial report may be influenced by the accounting personnel's subjective factor, and lack in the reliability. To reasonably reflect the key business ratios, report the financial statuses of enterprise, and the management result and the cash flow, accounting personnel would implement large numerous of adjustments and transfer accounts according to the matching principle at the late of the term. Though accounting personnel implement the accounting confirmation and measurement for the financial data based on the actual trading items, but these transfer accounts and the matching processing have certain subjectivity, and the financial report of the enterprise provides the accounting information for the exterior benefit relation group including investors and debtors, and the management layer and the accounting personnel of the enterprise all hope that the financial report could reflect good financial status and the management result of the enterprise, so the accounting personnel may make the financial report with colors when they make the financial report.

## **2. Reform directions of the current financial report system of China**

Aiming at the deficiencies existing in the current financial report of China, following opinions are provided for the reform.

### *2.1 Using multiple measurement bases simultaneously to make information with more relativity*

When selecting the econometric base of the financial report, American Accounting Association, the Institute of Chartered Accountants in England and Wales and the Institute of Chartered Accountants of Scotland all took the relativity as the first standard. American Accounting Association thought that "when selecting the econometric base of the financial report, we will firstly consider the relativity. Though the reliability of the data is important, but the reliability of irrelevant data is useless for anyone." And the Institute of Chartered Accountants in England and Wales and the Institute of Chartered Accountants of Scotland also pointed out that "to reflect their own characters, the assets and liabilities will adopt the compromise solution to compute the price" in "the Mode of Future Financial Report" published in 1991. Therefore, the reform direction of the future financial report is using multiple measurement bases simultaneously, i.e. different assets and liabilities adopt different econometric bases to make information with more relativity. The concrete measure is to first divide the accounting information disclosed by the financial report into the core information and the non-core information, and then to adopt the historical cost with strong reliability as the econometric base to disclose the core information, but for the non-core information, to adopt the similar prevailing market price which reliability is not as good as the econometric base of the historical cost to disclose it.

### *2.2 Extending the scope of the information disclosure to make information with more relativity*

#### **2.2.1 Continue to perfect three basic financial reports**

The current financial report system is the mono layer report mode taking three basic financial reports including the asset balance sheet, the profit statement and the cash flow statement as the core. This mode should be developed to the higher level and deeper layer. Future financial report system should start from the accounting information users' actual demand, and provide a series of relative financial information needed by the development in the modern market economy and the competition with other same industrial enterprises for them. First, some items in the asset balance sheet and the profit statement should be concreted according to information users' actual demand, and the range of the information disclosure should be extended. Second, some items in the asset balance sheet such as the stock, receivables, and market values have large influences, so the current market value can be a corresponding complementation form listing in the asset balance sheet to make information with more relativity.

#### **2.2.2 Enrich and standardize the content of the information disclosure out of the financial report**

With the increasing complexity of the economic activities of the enterprise and the increasing enhancement of

accounting information users' requirement for relative information, and the function of the outside form information (including the annotations of the financial report and other financial reports) for users to correctly understand the data of the financial report and judge the quality of the financial report increase increasingly, so to gradually extend the range of the information disclosure can satisfy report users' demand for useful information.

(1) The information of knowledge capital should be fully disclosed.

The information of knowledge capital mainly includes the intangible assets of enterprise, human capital information, and the human resource information. The intangible assets of enterprise include the intellectual property possessed by the enterprise, the vanguard technology or goodwill. If these intangible assets can not be exactly listed in the report, relative information should be disclosed by other modes. The values of the human resource and the human capital can not be embodied in the current financial report, and in spite of how large the disbursements investing in the human resource, they should be all regarded as the period charges, which will induce that the total assets are underestimated, and the charges are overestimated, and accordingly laborers' economic contributions to the enterprise are underestimated. Therefore, in the future financial report, the disclosure of the knowledge capital information should be emphasized.

(2) The comprehensive income information of the enterprise should be fully disclosed.

The comprehensive income of enterprise means the increase or the decrease of the rights and benefits (net assets) induced by all causes except for the trades with the owners (such as the investors' investment and the distribution of dividend) in the report term. So the comprehensive income includes not only the net yields which have been realized and confirmed in the current profit sheet, but other benefits and losses which have not been realized, such as the unconsummated surplus charge property reappraisal and the unconsummated return and loss on investment. The current financial report follows the realization principle for the confirmation of the accounting income, so the current profit sheet doesn't confirm the unconsummated income, so the comprehensive income of the enterprise in the term can not be reported according to the facts. This method makes the income computation to lack in the coherence of logic, which brings a certain space for the enterprise to manipulate the profit or color the performance. For example, it is a usual profit manipulation method to turn the unconsummated profit or loss to the current profit and loss by the replacement of assets. Therefore, in the future financial report, the disclosure of the comprehensive income information of the enterprise can be emphasized.

(3) The contribution of enterprise to the society and the distribution information of the contribution amount should be fully disclosed.

The contents disclosed by the current financial report mainly include the information about the investors and debtors' investments, the profitability and the financial position about the credit decision, but the contribution of enterprise to the society and the distribution information of the contribution amount can not be reflected. In the day that the politics and economy are more and more democratic, the method of the current financial report can not satisfy the demand of the society for supervising the enterprise implementation, and make against the country to implement the macro-control. Therefore, in the future financial report, the added value statement can be regarded as the fourth accounting statement after the succeeding asset balance sheet, the profit sheet and the cash flow sheet, and the by the added value statement, the contribution of the enterprise for the society can be comprehensively measured.

(4) The forecasting information of the future value of the enterprise should be fully disclosed.

The current financial report can not offer the forecasting information of the future value tendency of the enterprise for users, but the investors and potential investors of the enterprise need more and more grasp the future management development of the enterprise when the capital market of China is gradually perfected. But these report users can not reasonably predict the future development status of the enterprise because they can not know their experiences, technologies and enterprises enough. Therefore, the future financial report should disclose the relative information about forecasting the future value tendency of the enterprise in detail as more as possible, such as the profit prediction of enterprise, the increase or decrease of material cost, the development of new products, and the far-seeing plane of the management authority.

(5) The profit and risk information induced by the derivative financial instruments should be fully disclosed.

In recent years, the derivative financial instruments are more and more, and they will largely influence the future financial state and the profitability of the enterprise, but the current financial report can not disclose the relative risks. This method may be likely to produce potential risk for the accounting information users, and induce their decision mistakes in the investment and credit. Therefore, the future financial report should emphasize disclosing the profit and risk information induced by the derivative financial instruments.

(6) The stockholders' equity dilution information should be fully disclosed.

The development of the securities market induces that the stockholders' economic benefits more come from the market

price different of stock, not only in the profit of the enterprise. So stockholders very care about the market value of the stock. Because the book value of the stock is often lower than the market value of the stock, so when the company issues the convertible bond, the bond interest can be reduced by reducing the convertible price, and the interest charge reduced by the decrease of the interest rate will be turned to the profit of the enterprise, which will increase the profit of the enterprise. This profit increase is based on the stockholders' equity dilution, but the current financial report can only reflect the increased profit, but the accounting of original stockholders' equity dilution is eliminated. This method will certainly induce that investors falsely judge the behavior that the company issues the convertible bond, and make the false decisions. Therefore, the future financial report should fully disclose the stockholders' equity dilution information.

### 2.3 Establishing the real time report system to make information with more timeliness

The development of the modern network information technology provides the possibility that the enterprise publicly discloses the real-time financial information. The "real-time" includes the absolute "real-time" and relative "real-time". The absolute "real-time" report means that the enterprise reports one when one trade happens according the cost benefit principle and the situation of the enterprise. And the relative "real-time" report means that the enterprise can report in one day, in ten days, in half month, or in one month. The real-time report system can effectively solve the time-efficiency of financial information, and it can provide useful multi-directional financial information to make decisions for investors, and help management decision-makers and information users to make right judgment, and make their decisions more face to the future. However, the establishment of the comprehensive real-time report system needs strong internet technology support and a perfect ERP system. By the layer-upon-layer authorization mode of internet interview, the comprehensive real-time report can make some accounting information to occur by the mode of "private goods", which can solve the problem that the accounting report cost can not be reasonably apportioned. The online real-time report can also offer the hardware support for information demander to actively participate and realize the report of "cutting the coast according to the cloth", and realize the "interaction" of the report. In addition, the report users can interview the database of the enterprise of the Internet, and acquire the information that the enterprise issued on the internet, so the printing and the transfer mode of the paper financial report will be gradually eliminated. The expression modes of the information issuance on the internet can adopt the figure and video to more visually express the information and make the information more easily to be understood and accepted by users. Therefore, enterprises should establish and gradually perfect the ERP system, and try to realize the successful and reasonable connection with the Internet, which can build the base for the establishment of the comprehensive real-time system and solve the problem of the lagged financial information.

### 2.4 Reduce the color of the financial report to make information with more reliability

#### 2.4.1 Perfect the enterprise governance structure and reduce the coloring condition of the financial report

First, the enterprise financial report users' motivation and ability participating in the supervision should be strengthened. Second, the interior supervision mechanism of the enterprise should be perfected. By these measures, the financial report users can more deeply understand the behaviors of the management layer, enhance their ability of information collection and judgment, and increase some supervision measures for them.

#### 2.4.2 Perfect the performance evaluation mechanism and the manage personnel salary system, and reduce the coloring motivation of the financial report

At present, the evaluation for the managers of the enterprise should be based on the financial index of this enterprise, so some managers would rather color the enterprise financial report to acquire larger performance and obtain higher salary in more risks. To solve this problem, the enterprise should modify the current performance evaluation method, i.e. the enterprise should comprehensively consider numerous factors such as the leadership, the strategic planning, the management performance and the human resource management when evaluating the performance. By perfecting the performance evaluation mechanisms and the management personnel salary system, the coloring motivation of the financial report can be reduced.

#### 2.4.3 Perfect the CPA system and exert the function of preventing the coloring of the financial report

The independence of CPA auditing should be firstly strengthened, and the licensed environment should be optimized to make the CPA auditing to be independent substantively. Finally, the relative departments of the government should supervise the CPA auditing to enhance the auditing quality and prevent the coloring behaviors of the financial report.

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## “Globalisation” of the Alimentary Consumption Patterns in Greece (1957 to 2005); An Economic Analysis

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### Abstract

An attempt is made in this paper to describe the development of dietary consumption in Greece during the period 1957 to 2005. All dimensions of alimentary consumption patterns are examined here with a specific focus on: a) their natural characteristics (i.e. plant and animal components); b) technical features of the production process (primary, secondary and tertiary transformation processes); c) their biological and nutritious dimensions (as well as related health and safety issues); and d) socio-economic attributes of these patterns of consumption (i.e. consumption features of the different social, economic, demographic, geographic and professional layers of the population).

**Keywords:** Consumption, “Globalisation”, Dietary models

### Introduction

The present work is descriptive in nature and does not deal with the theorisation and justification of the development of alimentary consumption in Greece from 1957 to 2005. An exploratory attempt is rather made to analytically describe these consumption trends during the post-war period (Note 1); their development, changes incurred and re-developments. In that way a basis can be formed for comprehending, interpreting and justifying these social phenomena.

Our analysis is not limited to the description of statistical information of data presented in the National Statistical Service of Greece reports (E.S.Y.E. 1957 - 2005) (e.g. per category of products). Related data are broken down and re-synthesised again using new categorisation dimensions (e.g. rural/industrial, plant/animal features). It is our belief that this break down, re-synthesis and analysis bring into focus the particular qualitative characteristics of each of the categories examined. The existing differentiations and inversions identified are then used to provide a tentative answer on the features of alimentary consumption (Mediterranean dietary patterns as opposed to international/industrial patterns) in the period examined.

### Theoretical Framework and Methodology

The postwar period in Greece was marked by a complete overturning of the alimentary patterns (Sotiropoulos and Demousis 2002). This was a development with ground breaking historical dimensions. An established thirty-five century old tradition (Renaud 1995) on food consumption (underlined by the Mediterranean alimentation – Note 2) has been gradually declining and it is disappearing (Galanos 2001). What has been prevailing instead is an international-industrial dietary consumption trend based on the secondary sector’s food treating processes, and on tertiary sector’s service provision mentality (Lazaridis 1999).

The development of alimentary consumption is examined within the wider frame of demand and supply. Demand for alimentary products is taking place within a fluid "alimentary environment" that rapidly changes (Deaton 1992). Supply relates to not simply offering food but complete "food-packages with specific attributes" (Lancaster 1966, Georgakopoulos and Thomson 2005, Georgakopoulos *et al.* 2006, Georgakopoulos *et al.* 2008).

The data used here have been drawn from a number of sources: statistical studies on "Household Budget Surveys (H.B.S.)" conducted in Greece (E.S.Y.E. 1957 - 2005) (Note 3); the "Statistical Study on the Natural Movement of the Greek Population" (E.S.Y.E. 2008); the Food and Agriculture Organisation of the United Nations (Faostat several years); the World Health Organisation (Health 2002); and the Offices of the Greek Army (2001).

Our analysis is based on a descriptive presentation of statistical information with the help of spreadsheets. In order to construct a basis for the qualitative description of Greek alimentation the qualitative formula from Sotiropoulos (2006b) was used:

$$Q_{\text{alimentary pattern}} = (Q_{\text{natural characteristics}}, Q_{\text{technical characteristics}}, Q_{\text{biological characteristics}}),$$

rewritten as:

$$Q_{\text{alimentary pattern}} = (Q_{\text{plant components}}, Q_{\text{animal components}}, Q_{\text{agricultural components}}, Q_{\text{industrial components}}, Q_{\text{biological components}})$$

### **Natural Characteristics of Alimentary Consumption Patterns (plant and animal consumption)**

Changes in the alimentary models of postwar Greece were rapid and radical. One can observe three different, successive alimentary consumption patterns in the last fifty years (table 1.1).

During the 1950s and 1960s the basic features of the alimentary models were conforming to the so-called "Mediterranean diet". During these decades, cereal (bread), vegetables and legumes, fruits, olive oil, wine, lamb and goat meat dominated Greek alimentation. However these traditional food groupings had been characterised by a gradual reduction in consumers' demand up to 1974.

A large increase in meat consumption in general was recorded in H.B.S of 1974. This became a typical feature of the Greek alimentation until the end of the 90s. From the beginning of the 80s onwards a new trend emerged that also proved elemental in the formation of the contemporary dietary habits in Greece. There was a progressive and constant increase on food expenditure "away from home". This included expenditure on industrial/processed products (such as non-alcoholic beverages for example).

There was a reduction in consumers' demand for red meat (veal/beef) in the 1990s (up to 2005). A similar decreasing trend was also observed in the demand for the other basic food categories of the previous decades. All in favour of expenditure on processed-homogenised food products.

From a natural characteristics' perspective, the rapid decline of the "Mediterranean diet" appeared to begin with a progressive increase in meat intake in the 1960s. It continued with the "food away from home" expenditure from the beginning of the 1980s onwards. However, a separate examination of each of the alimentary categories of table 1.1 indicates the existence of particular features in each of the respective groupings. Their associated attributes (based on legumes, lamb and goat meat, olive oil, wine, ouzo) were very important for the Greek dietary tradition and they provide the new alimentary patterns developed after the 60s with additional features. These are examined subsequently. The basic food categories influenced were meat (in general), cereals, vegetables, and alcoholic drinks.

The importance of meat participation in the Greek alimentation (with the resulting overturning of the traditional Mediterranean diet) was not limited only in its increased consumption (Note 4). It was also extended in its characteristics (table 1.2). Lamb to veal intake (Note 5) was 1:1 proportionately in H.B.S of 1957/58. This became 1:3.1 in H.B.S of 2004/05. The alimentary pattern of Mediterranean meat consumption was completely overturned, if one also considers the: eight-time increase (on a percentage basis) of pork eating; doubling of poultry consumption; tripling of other processed meat product intake (Note 6); and the significant decrease of beef and lamb and goat meat at levels at about or below one percent of total meat consumption. Consumption of frozen food initially increased (1960 to 1980) and it then drastically decreased at very low and continuously reducing levels. Greeks transformed from "...a bread-eating population into meat-eaters" (Montanari 1993: 30) with western typologies of meat alimentation in their diet. Participation of Mediterranean type of food decreased, whereas Northern and Western-origin processed (industrial) products increased.

Processed vegetable intake also increased, while participation of fresh vegetables, potatoes, and especially legumes decreased (table 1.3). Processed vegetables first appeared in the Greek market in 1969. In 2005 in the form of frozen vegetables, packaged vegetables (with additives), tomato paste/juice, etc. covered 15.2% of total vegetable consumption. Fresh vegetable participation on the other hand has stabilised at levels below those of the 1950s with legume eating being at half of the corresponding levels of that same decade. Legumes have a symbolic significance in the so-called "Mediterranean" - Greek diet. This is due to their high nutritious value (calories, vitamins, etc.) and widespread intake (bean soup for example has been traditionally viewed as the "Greek National Dish").

We found similar trends in alcoholic drink consumption (table 1.4). “Western origin” beer had stabilised at high levels after the 70s with decreasing trends in the last H.B.S (2004/05). Wine consumption on the other hand has risen during the last five years. The rest of the alcoholic drinks appear at stable high levels with whisky holding 17,2% of total consumption of this category (this seems to be the highest level per capita worldwide (Note 7)).

We also found similar patterns in the categories of: plant and animal oils; sweets and pastries; non-alcoholic drinks; other food expenditure away from home, etc. (Sotiropoulos and Mygdakos 2004a).

In summation plant-based food products were dominating dietary patterns during the period of the Mediterranean “model”. After a short period in the 1980s of smaller participation they seem to have returned into the contemporary Greek alimentary habits (table 1.5). However the radical decrease of many traditional food categories (legumes, fresh vegetables and fruits, olive oil and cereals) together with the rising of processed food participation (processed vegetables, oils, sweets and pastries, and especially cereals), have removed contemporary dietary patterns from their traditional Mediterranean features. They have brought them closer to processed/industrial (Western-European, North-American) typologies.

### **Technical Features of the Production Process (Agricultural / Industrial Processes)**

One can see the shifting of alimentation to industrial food through the consumption trends in some typical processed products (such as flour, bread, and cereals). Traditional food product participation in the Greek dietary habits decreased, whereas processed food's increased over time. Bread consumption for example had stabilised in 2005 (table 2.1) at the half of total cereal consumption with a slightly decreasing trend. Other processed cereals substituted traditional agricultural food products and captured the other half of total cereal consumption. This is in sharp contrast to the situation at the beginning of the examined period where processed cereal consumption was reflecting levels lower than  $\frac{1}{5}$  of total household expenditure on cereals.

Before continuing with the economic analysis of the alimentary patterns using technical criteria it is important to account for the degree of processing food products have undergone. This takes place here by initially categorising food groupings into traditional agricultural and processed products. Then we examine the extent of their industrial treatment through “processing levels”. In relation to the latter issue and for simplicity purposes two arbitrary levels are used in this paper: level a’; and level b’. These processing levels were chosen in accordance to the level of food product treatment specific food categories go through.

Flour, cheese, yoghurt, butter, olive oil, other traditionally processed food (such as smoked, drained and salted products), sugar and jams were all considered as level a’ processed food products. Cereal foodstuff, pastas, bread and dried bread (rusks), biscuits and related products, processed meat foodstuff and meat byproducts, frozen food, ready food and tinned food, vegetable or other plant based oil, pastry making products, ice creams, chocolate bars, expenditure on café restaurants, non alcoholic beverages, and other products (such as salt, mustard, soups, etc.) represented level b’ processed food products (Note 8). Finally fresh meat, fish, vegetables, fruits, milk, and eggs were classified as traditional agricultural food products.

During the period examined consumption of traditional agricultural, and level a’ processed food products gradually decreased (Note 9). On the other hand participation of level b’ processed food products increased in the dietary patterns from 36,6% in 1957/58, to 56,0% in 2004/05. The traditional agricultural features of early postwar dietary habits lost their significance over time and were substituted by industrialised products.

One can identify two distinct periods in the progressive predominance of industrial food products in contemporary diets. The first period extends until the end of the 1980s. During this period consumption was dominated by expenditure on industrial products within the household. During the second era however (beginning of the 1990s to date), expenditure was mostly focused on food consumption away from home (café – restaurants, cantinas). Thus during the first period value was added on food products through the processing activities of the secondary sector. During the second period value addition takes place through the services of the tertiary sector and alimentation has become part of the service provision mentality (table 2.2β).

Industrialisation/tertiarisation of alimentary consumption did not develop in the same manner for all food categories. For each dietary category particularities and partial developments were observed. As a result the associated to these food groupings’ (e.g. cereals, meat, vegetables, etc.) alimentation had specific configurations that changed overtime.

The symbolic for the Mediterranean diet category of cereals was slowly industrialising in the first two decades (cereal, biscuit, dried bread). At the same time it was rapidly losing its traditional agricultural/cottage-industrial features (flour, bread, rice, wheat, maize). After the 1980s this industrialisation accelerated. New cereal-based processed products appeared (such as corn flakes, savoury snacks - crisps, crackers, pancakes, tarts, pop-corn, porridge, homogenised children food, diet products, etc.). All these products had western origins and complied with the international alimentary patterns.

However these patterns also had social and biomedical repercussions. Associated physical appearance trends promoted now the slim/thin body type (as opposed to the heavier body type of previous periods in Western Europe). This in turn promoted new lifestyles and values (e.g. tourism growth and the male/female physical appearance on the beach). Cereals containing sugar and pastas decreased their participation in the related food consumption expenditure. The extent of this change became even more evident during the “sugar/fat-scare” period (after the 1960s - Malassis 1986, Fischler 1990) and it was also based on medical suggestions, work related/professional demands, sovereignty of picture (and physical appearance issues) in the digital era, etc. Similar observations could also be made for fat based food products (seed-oil substitutes butter), sugar based products (traditional Mediterranean desserts such as baklava for example lose ground against “western” milk based products such as pastries, cakes and ice creams), and others.

In dairy, western alimentary typologies prevailed in two ways. Directly through the importation of western type processed food (Roquefort, Gouda, and Emmental cheese, processed yoghourts, other light dairy food, etc). Indirectly with food preservation methods. These were brought into the country after electrification and general refrigerator usage (substituted salting as a preservation method as in the case of cheese). Electric refrigerator usage affected at a large extent consumption of meat, fish, dairy, desserts, frozen meat, frozen fish, vegetables, and others. In addition new preservation methods (chemical-based techniques) greatly contributed to increasing consumption of intensely produced fruit, vegetable (such as bananas and/or other exotic and basic species like potatoes) and other food products.

The features of the industrial alimentary patterns differ. However characterisation of the associated food remains unchanged as “industrial products”. During the 1950s and the 60s tinned food was dominating. During the 70s freezing preservation techniques, food chemistry, biotechnology and other preserving innovations (treatment, transformation, packing and standardisation of food) gradually prevailed. The associated products were of international origins and preservation know-how. The same could be said for the agricultural production inputs used (pesticides, chemical fertilisers, hormones, antibiotics, meat-based and/or poultry-based flour, genetically engineered products and/or by-products, and others).

Post 1980 health safety issues (food scares) appeared. These relate to biochemicals used, flesh or other pigmentation substances, and other preservation additives (whose usage and health safety is disputed by the medical science and consumer organisations) (Note 10). Examples of these alimentary-related scandals were the existence of toxins (in cooking oil in Spain in 1981 with 400 deceased, and in Ukraine in 2008 with worldwide impacts), dioxins (in Belgian poultry in 1999), salmonella (in poultry and eggs), mad cow disease (BSE) in the 1980s and 90s in Western Europe and Britain, Listeria (in French dairy products with 20 deaths in 1992 – 1995), E.Coli in Scotland (20 deceased in 1996 – 97), to name but few.

Service provision also affected the predominance of contemporary alimentary patterns. Communication, transportation, financial services, commercial services (both domestic and international) and food services offered away from home (on or off vacation periods) had a significant impact (Note 11). Marketing and advertising services have been the focus of daily debates in the media and scientific discussions on the manner the former affect change in alimentary trends.

From the 1980s these new dietary models in Western Europe were seen as “homogenising” and “internationalising” processes accompanied by “deregulation” (Malassis 1986). Indicative of this situation is the estimation of the inflation index for example in Greece. This is based on the “General Consumer Price Index”. Associated additions/deductions are made on the prices of certain homogenised - international products (such as coca cola in 1982, seven up, toasts, fast food restaurant products, pizzas served in restaurants in 1988, filtered coffee, mayonnaise, ready soups in 1994, premade pizza, tea in 1999, ketchup, corn flakes, mash potato, potato crisps, and others).

### **Biological Characteristics of Alimentary Consumption Patterns**

From a biological (and health) perspective two completely different dietary trends are identified. These relate to issues of food deprivation, and food abundance (Karapostolis, 1983, p. 82).

The former condition does not convey only a lack of food and related services on the supply side. It also relays to deficiencies of nutritious components (see tables 3.1a and 3.1b). Contemporary alimentary patterns have a high nutritious value per capita in calories, proteins, and fat. The Greek population as a result is not classified anymore as being at malnutrition levels. It is grouped together with those of Western/North European and North American countries instead.

This development was already apparent since the 1960s (table 3.1a) when the alimentary trends in Greece were rapidly changing. Relaying to this consumption of fat nutrients (animal-based in relation to plant-based) worsened. A 3:7 animal to plant-based fat participation in the dietary patterns in the 60s changed in 1999 to 3.8:6.2 respectively. This when in the U.S. for example there has been a significant improvement in this rate (even though the latter continues lagging the corresponding Greek levels due to the former’s later starting point). Contemporary “biological” alimentary trends in Greece also brought changes into the characteristics of health, physical appearance, and body-type models.

In the contemporary health patterns in Greece food deprivation related diseases (malnutrition, lack of vitamins, anaemia, back pains, scurvy) are very rare. The same applies for extreme cases (Note 12). In contemporary health alimentary patterns there is a predominance of the so-called “Civilisation problems/diseases” (cardiovascular diseases, cancer, diabetes, senility etc). At the same time a downward trend in life expectancy is identified. However there is an improvement in body-type characteristics with an increase in the average body height level.

In greater detail, there has been a rapid increase of cardiovascular disease cases in the past fifteen years (this is the period in which meat and fat component participation in the Greek diet had increased). The frequency of those cases surpassed the corresponding levels of other Western European countries (whose starting point was much higher) in 2001 (table 3.2a and 3.2b).

Contemporary health trends in Greece further align with Western European and North American patterns if high mortality rates from cancerous incidents are taken into consideration. According to medical figures (see table 3.3) at least a quarter of the fatalities from cancer were caused by alimentary habits (especially in the case of bowel, stomach and oesophagus cancer). Bowel cancer incidents in specific have increased dramatically (Trichopoulou and Lagiou 1997, Trichopoulou *et al.* 2000). This relatively steady increase has been documented since 1966. Similar conclusions with lower rates in the increase of fatalities are also associated with stomach cancer, oesophagus cancer and diabetes (Trichopoulou and Efstathiades 1989, Trichopoulou and Lagiou 1997, Trichopoulou *et al.* 2000).

The Greek population has lost the premium position they were commanding until the 70s in life expectancy (at a global level at the time following the Japanese). In 2006 Swedish men have the longest life expectancy at pan-European level with an average age of 79.5 years. Greek men are in the 12<sup>th</sup> position with 77.2 years. The Greek women have fallen from the sixth place they had in the 70s in life expectancy down to the 18<sup>th</sup> place in the 90s. Life expectancy for Greek women was 81.9 years in 2006 on average when for example French were expected to live for 84.4 (Eurostat 2009).

A positive impact of the contemporary alimentary patterns was in the improvement of the body-type indices (such as body height – see table 3.4) of the younger population. In the 90s certain statistical categories (such as “Short” body-types) disappeared, or decreased (“Average” body-types). The “Tall” category increased. These are typical body-type characteristics of the Northern and Western European populations. .

A significantly negative impact was in the increase of the body-volume levels (obesity). Data from Eurostat (2008) show that 53,2% of men (aged 25-64) and 35,4% of women (aged 25-64) were overweight, whereas 11,8% of men and 10,1% of women were obese.

### **Socio-Economic Characteristics of Alimentary Consumption Patterns**

Alimentary consumption trends appear to have some seasonality features. These significantly vary among the different layers of the population (financial, professional, geographic, demographic, age – see Sotiropoulos and Mygdakos, 2004b, c, 2005, 2006a,b). The higher financially professional layers of the population (directors, self employed, and employers in general), younger people, households with few members, and urban area residents, were the early adopters of the contemporary industrial dietary habits. Lower level financial professional layers (unemployed, workers), old people, large households, and rural area residents (see table 4.1) were later adopters or they did not change at all many of the traditional features of their alimentation.

Regardless of their specific features all the different socio-economic layers of the population adopted at a greater or lesser extent the contemporary alimentary consumption patterns in postwar Greece. Old people and the financially-weaker layers of the population still maintain some of the traditional alimentary features in their dietary habits. However these reflect exceptions rather than general trends.

Finally, another worth noticing feature on the socio-economic dimensions examined here involves seasonal alimentary consumption. This seems to maintain its main features, even though the latter might have slightly changed over the past two decades. During summer periods “food away from home” alimentary consumption and plant-based food products dominate. In wintertime this trend reverses into inside the household food consumption and animal-based food products.

In summation all different socio-economic aspects are important in formulating the contemporary alimentary consumption patterns since they have implications for the timing of their adoption.

### **Conclusions**

The examination of the postwar fifty year period has a historical value in describing the alimentary consumption trends in Greece. The traditional “Mediterranean” dietary patterns based on the ancient Greek culture have been declining and disappearing. This in favour of contemporary industrial/global (Western-origin) trends.

The features of this gradual change were described here by qualitatively examining the natural, technical, and biological variables of dietary consumption (see Sotiropoulos 2006).

In the Mediterranean patterns, food consumption was based on cereal, vegetables – legumes, olive oil, wine and lamb or goat meat. Food products were produced in a rural setting. Their treatment was done through simple cottage-industry processing techniques (olive presses, flour-mills, cheese dairies, etc.). From a biological perspective traditional alimentary patterns were based on a low content of calories, proteins, and fat. Related health issues (lack of vitamins, anaemia, etc.) were the outcome of deprivation from certain food nutrients. However life expectancy was long.

In the incorporated with high added value industrial/international alimentary patterns, consumption is based on: foodstuff and other food products that are the outcome of treating processes (tinned food, frozen food, mixes, ready food, pre-cooked food, diet food, etc.); and especially on “food away from home” expenditure. Red meat (veal/beef) played a significant role in the new dietary habits at least in the first decades of the examined period. However its participation in “within the household” food expenditure decreased after the 90s. There was a decrease in the consumption of cereal, legumes (food with a symbolic meaning for the Mediterranean diet), fresh vegetables, fruit, wine, traditional desserts/sweets. The consumption of international western-origin alcoholic drinks, beer and whisky increased. From a biological features’ perspective alimentation was characterised by a food-abundance model. This is underlined by a saturation of calories, proteins and fat. Many health issues (such as cardiovascular diseases, types of cancer, obesity, diabetes, a decrease in life expectancy) and some positive impacts on body-type indices are perceived as also being related to this alimentation model.

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## Notes

Note 1. Referring to the post World War 2 and Civil War era (1940 to 1950)

Note 2. Its health benefits have been accepted internationally. The development of this alimentation has been associated with several socio-economic dimensions (i.e. the local economy, production issues, health and life expectancy, culture, religious and other symbolic representational aspects to name but few).



Note 3. Data omission for specific years is due to non-availability of the corresponding annual surveys from the National Statistical Service of Greece.

Note 4. According to Eksarhos (1977) “...the average consumption of meat reached thirteen kilograms per capita per annum...” during the pre - second world war period and “...until 1940...”. In 1997 it reached 88,4 kgr per capita per annum (ibid.: 532).

Note5. Lamb meat is characterised as a typical Mediterranean product with economic and religious and/or other symbolic representations. Red meat (veal/beef) in contrast is a typical North-American/North-European product (e.g. the picturesque paintings of the green fields of Central and Northern Europe with flocks of cows).

Note 6. Processed meat products (such as sausage, salami, ham, bacon etc.), is the first food category in which substitutions (past the 1960s and more specifically past 1974) do not only happen between Mediterranean and “Western-origin” processed products. They also take place (and mainly) between and within products of the latter grouping.

Note 7. See annual special edition of economic newspaper “Express” (2002).

Note 8. Until the 1950s the a’ level processed food products were treated through cottage and/or traditional manufacturing production units (e.g. windmills or watermills, olive presses, cheese-dairies, etc.). In time through technological progress and the increased concentration of productive resources (land, capital, labour, etc.), a’ level processed products developed more intense (industrial) features. These resulted to higher added values (in addition to this they also developed other tertiary service sector characteristics such as commercial, marketing and financing aspects). These conditions in conjunction with the increased consumption of b’ level processed food intensified the participation of industrial food products in the post war Greek diet.

Note 9. With the exception of data appearing in the latest H.B.S 2004/05, where a small increase in level a’ processed food product consumption was observed. More information can be found on Table 2.2a.

Note 10. See for example Georgakopoulos and Thomson 2005, 2008), Georgakopoulos et al. (2006, 2008).

Note 11. In food away from home alimentation, especially after the 1970s, (see for example Mihalopoulos and Demoussis 2001) the respective areas where food is offered have changed in accordance to the international trends. Traditional taverns and restaurants disappear gradually.

Note 12. The case of the famine in the “German occupation period” during World War II, with deaths from starvation, existence of poor quality and poor nutritious value of food such as maize-based bread known as “Bobota”.

Table 1.1 Alimentary Pattern Structure: 1957-2005, (%).

	H.B.S :	'57/58	'63/64	1974	'81/82	'87/88	'93/94	'98/99	'04/05
1	Cereal	15,6	16,9	9,7	8,6	8,8	10,0	8,7	8,6
2	Meat	16,1	14,6	25,9	26,7	23,2	20,2	15,1	14,4
3	Fish	5,3	6,5	4,5	5,0	4,7	5,0	5,1	5,4
4	Vegetable/Olive Oil	11,1	10,2	8,5	6,6	4,8	4,2	3,5	3,6
5	Dairy Products	12,1	8,1	11,6	11,9	12,6	13,0	12,0	12,0
6	Vegetables	10,0	8,8	9,9	8,8	8,2	8,4	8,1	7,5
7	Fruits	8,0	5,1	7,9	7,1	7,6	6,3	5,4	4,9
8	Sugar and pastry making products	6,4	8,3	6,8	4,8	5,3	4,7	4,0	4,2
9	Other food categories	0,9	1,1	1,3	0,6	0,9	0,9	0,6	0,9
10	Expenditure on food away from home	12,3	12,8	8,9	17,4	21,1	24,4	33,7	34,7
11	Non alcoholic drinks*	2,1	7,6	5,0	2,3	2,8	3,0	3,7	3,7
	Total of Dietary Expenditure	100	100	100	100	100	100	100	100

\* Non alcoholic drinks and ice-creams in H.B.S 1957/58.

Data Source: E.S.Y.E. (1957 - 2005).

Table. 1.2 Alimentary Pattern Structure of Meat Consumption 1957-2005, (%).

	<b>H.B.S.:</b>	<b>'57/58</b>	<b>'63/64</b>	<b>1974</b>	<b>'81/82</b>	<b>'87/88</b>	<b>'93/94</b>	<b>'98/99</b>	<b>'04/05</b>
1	<i>Veal</i>	34,8	17,0	43,5	46,2	43,9	43,9	46,5	39,5
2	<i>Lamb</i>	32,0	29,5	13,9	17,3	13,3	12,0	13,6	12,6
3	<i>Pork</i>	2,1	22,1	5,1	11,1	11,0	9,7	13,0	16,6
4	<i>Poultry</i>	6,7	3,5	13,5	8,0	10,7	14,0	14,3	15,3
5	<i>Beef</i>	8,3	8,1	1,0	0,6	1,2	0,4	0,4	0,7
6	<i>Sheep</i>	5,5	5,6	6,9	2,7	1,7	1,4	1,3	1,1
7	<i>Frozen</i>	3,9	5,3	8,4	5,3	4,0	2,9	1,6	1,2
8	<i>Processed Meat Products</i>	3,6	3,8	4,8	6,4	12,5	13,7	7,7	12,6
9	<i>Other Meat</i>	3,0	5,1	2,9	2,4	1,8	1,9	1,6	0,6
	<i>Total Meat</i>	100	100	100	100	100	100	100	100

Data source: E.S.Y.E. (1957 - 2005).

Table. 1.3. Alimentary Pattern Structure of Vegetable Consumption 1957-2005, (%).

<b>H.B.S.:</b>	<b>'57/58</b>	<b>'63/64</b>	<b>1974</b>	<b>'81/82</b>	<b>'87/88</b>	<b>'93/94</b>	<b>'98/99</b>	<b>'04/05</b>
<i>Legumes</i>	13,5	20,1	12,1	9,1	7,6	7,7	6,9	6,7
<i>Potatoes</i>	16,0	23,6	19,7	24,0	20,7	23,2	20,9	16,2
<i>Fresh Vegetables</i>	70,5	56,3	63,8	61,8	65,5	62,0	63,8	62,0
<i>Frozen Vegetables</i>			1,8	3,2	3,8	3,7	4,8	11,5
<i>Tomato Paste, tomato Juice</i>			2,4	2,0	2,5	3,4	3,5	3,7
<i>Total Vegetables</i>	100	100	100	100	100	100	100	100

Data source: E.S.Y.E. (1957 - 2005).

Table. 1.4. Alimentary Pattern Structure of Alcoholic Drink Consumption 1957-2005, ( %).

<b>H.B.S.:</b>	<b>'57/58</b>	<b>'81/82</b>	<b>'98/99</b>	<b>'04/05</b>
<i>Wine</i>	42,6	26,2	26,1	34,3
<i>Beer</i>	18,0	35,3	35,1	28,6
<i>Other Alcoholic Drinks</i>	39,3	38,6	38,8	37,2
<i>Total Alcoholic Drinks</i>	100,0	100,0	100,0	100,0

Data source: E.S.Y.E. (1957 - 2005).

Table 1.5. Post War Distribution of Plant/Animal Components in the Alimentary Patterns of Consumption in Greece, 1957-2005, (%).

<b>Components</b>	<b>H.B.S.</b> <b>'57/58</b>	<b>H.B.S.</b> <b>'63/64</b>	<b>H.B.S.</b> <b>1974</b>	<b>H.B.S.</b> <b>'81/82</b>	<b>H.B.S.</b> <b>'87/88</b>	<b>H.B.S.</b> <b>'93/94</b>	<b>H.B.S.</b> <b>'98/99</b>	<b>H.B.S.</b> <b>'04/05</b>
<i>Plant Based</i>	60,2	65,8	52,1	47,9	49,3	50,4	53,1	53,0
<i>Animal Based</i>	39,8	34,2	47,9	52,1	50,7	49,6	46,9	47,0
<i>Total</i>	100	100	100	100	100	100	100	100

Data Source: E.S.Y.E. (1957 - 2005).

Table 2.1. Alimentary Pattern Structure of Cereal Consumption, 1957-2005, (%).

<b>H.B.S.:</b>	<b>'57/58</b>	<b>'63/64</b>	<b>1974</b>	<b>'81/82</b>	<b>'87/88</b>	<b>'93/94</b>	<b>'98/99</b>	<b>'04/05</b>
<i>Bread</i>	67,0	31,3	55,3	55,1	49,9	55,6	50,5	50,7
<i>Flour</i>	6,4	24,1	8,7	8,2	5,2	3,9	4,1	3,9
<i>Rice</i>	7,5	11,1	13,2	7,9	8,1	6,5	6,3	6,0
<i>Processed Cereal</i>	18,9	17,5	20,4	23,1	31,1	31,2	39,1	39,4
<i>Wheat, maize, other types</i>		16,0	2,1	5,6	5,7	2,8		
<i>Total Cereal</i>	100	100	100	100	100	100	100	100

Data Source: E.S.Y.E. (1957 - 2005).

Table 2.2a. Participation of Traditional Agricultural and Processed Food Products (level a' and level b' of processing) in Alimentary Expenditure, 1957-2005, (%).

<b>H.B.S.:</b>	<b>'57/58</b>	<b>'63/64</b>	<b>1974</b>	<b>'81/82</b>	<b>'87/88</b>	<b>'93/94</b>	<b>'98/99</b>	<b>'04/05</b>
Traditional Agricultural Food Products	43,5	34,0	47,3	45,3	40,8	38,1	32,7	29,9
Level a' Processed Food Products	19,9	24,6	16,9	15,6	13,8	13,2	11,6	14,1
Level b' Processed Food Products	36,6	41,3	35,8	39,1	45,4	48,6	55,7	56,0
Total of Alimentary Expenditure	100	100	100	100	100	100	100	100

Data Source: E.S.Y.E. (1957 - 2005).

Table 2.2b. Participation of Traditional Agricultural and Processed Food Products (level a' and level b' of processing) and Expenditure on Food Away from Home in Total Alimentary Expenditure, 1957 – 2005 (%).

<b>H.B.S.:</b>	<b>'57/58</b>	<b>'63/64</b>	<b>1974</b>	<b>'81/82</b>	<b>'87/88</b>	<b>'93/94</b>	<b>'98/99</b>	<b>'04/05</b>
Traditional Agricultural Food Products	43,5	34	47,3	45,3	40,8	38,1	32,7	29,9
Level a' Processed Food Products	19,9	24,6	16,9	15,6	13,8	13,2	11,6	14,1
Level b.a' Processed Food Products	24,3	28,5	18,4	21,7	24,3	24,2	22,0	21,3
Level b.b' Processed Food Products ("Expenditure on Food away from home")	12,3	12,8	8,9	17,4	21,1	24,4	33,7	34,7
Total of Alimentary Expenditure	100	100	100	100	100	100	100	100

Data Source: E.S.Y.E. (1957 - 2005).

Table 3.1a. Daily Consumption of Nutritious Components per Capita (1961)

1961	Greece						U.S.					
	Calories		Proteins		Fat		Calories		Proteins		Fat	
Food	kcal	%	kcal	%	kcal	%	kcal	%	Kcal	%	kcal	%
A) Plant based	2447	86	56.2	67	61.1	70	1872	64	32.3	51	40.8	36
B) Animal Based	373	14	27.2	33	26.1	30	1011	36	63.1	49	69.5	64
Total	2820	100	83.4	100	87.2	100	2883	100	95.4	100	110.3	100

According to Lalanne (1958)

A' = Less than 2.400 (men) and 2.200 (women) calories (insufficient nutrition)

B' = more than 3.200 calories (supernutrition)

Table 3.1b. Daily Consumption of Nutritious Components per Capita (1999)\*

1999	Greece						U.S.					
	Calories		Proteins		Fat		Proteins		Calories		Fat	
Food	kcal	%	kcal	%	kcal	%	kcal	%	Kcal	%	kcal	%
A) Plant based	2860	77	54.6	45	94.1	62	2704	72	41.8	36,4	76.6	51,6
B) Animal Based	829	23	64.2	55	57.1	38	1050	28	73.1	63,6	71.9	48,4
Total	3689	100	118.8	100	151.2	100	3754	100	114.9	100	148.5	100

\* Greece, 2001-03: Calories: 3680, Proteins: 117, Fat: 145

U.S., 2001-03: Calories: 3770, Proteins: 114, Fat: 156, but:

Tajikistan, 2001-03: Calories: 1840, Proteins: 48, Fat: 40

Zambia, 2001-03: Calories: 1930, Proteins: 48, Fat: 29

Data Source: Faostat (several years)

Table 3.2a. Ischemic Cardiac Cases in Greece After the Predominance of the Contemporary Dietary Trends.

Cardiac Cases per 100.000 people				
Year	1980	1985	1990	1995
Ischemic Cardiac Cases	296,15	412,24	521	670

Data Source: Health (2002).

Table 3.2b. Ischemic Cardiac Cases in Western Europe (per 100.000 people).

	Netherlands	Sweden	Austria	Denmark	Finland
1980s	498,61	597,43	757,66	721,1	259,7
1990s	558,04	623,85	776,97	738,36	335

Data Source: Health (2002).

Table 3.3. Disease Related Deaths in Greece by case, in the Whole Population.

Cause of Death	1956	2006
Oesophagus Cancer	80	181
Stomach Cancer	924	1328
Bowel Cancer	353	2115
Diabetes	510	700

Data Source: E.S.Y.E. (2008)

Table 3.4. Height Figures per Category (1989/1992 and 1997/2000)

Categories	“Short” (≤1,61m.)	“Average” (1,61-1,73 m.)	“Normal” (1,73-1,79 m.)	“Tall” (1,79-≥1,97 m.)
1989/1992	1,50%	29,30%	30,10%	39,10%
1997/2000	-	16,10%	30,72%	53,18%

Data Source: The Offices of the Greek Army (2001)

Table 4.1. Socio-Economic Features of the Alimentary Patterns (1957-2005).

Adoption of Contemporary Alimentary Behaviour	Traditional Alimentary Behaviour
Financially Stronger Layers	Financially Weaker Layers
Younger Ages	Third Age
One/Few Member Households	Large Households
Directors and Sole Traders/Contractors	Unemployed/Voluntary Workers
Employers	Workers
Urban Areas	Rural Areas

Data Source: E.S.Y.E. (1957 - 2005).

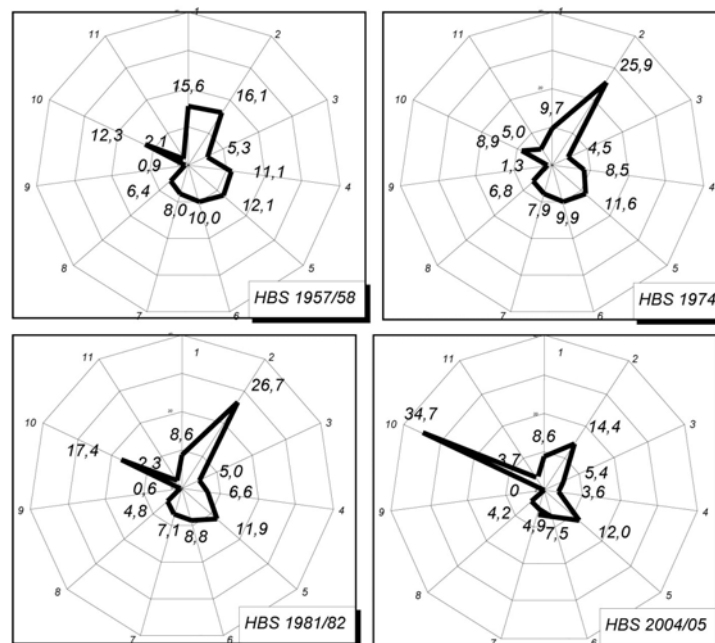


Figure 1.1. Alimentary Pattern Structure: 1957-2005, (%).

Data Source: E.S.Y.E. (1957 - 2005).



## Study on the Accident Insurance for Old People

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### Abstract

With the advent of the era of aging, old age security has become a hot social concern. The old accident insurance can offer guarantees for the treatment and recovery charges of old people in accidents, and it has many advantages such as cheap premium, simple buying procedure, and strong pertinence, so it is fit to be gradually developed in cities and countries. In the article, the actuality and advantages of old accident insurance in Chinese insurance market are analyzed, and advices are proposed from three aspects such as tax preference, extension mode and endowment service.

**Keywords:** Aging, Commercial insurance, Accident insurance, Social security, Medical insurance

China is a "not getting rich before getting old" country, and the arrival of China's population aging without well developed productivity. At the end of 2008, China's population aged 60 and above is 159.89 million, accounting for 12% of the total. Social pension and social security problem is very prominent, so it is very significant for commercial insurance companies to explore "silver market", and actively develop the elderly-related insurance products.

Because of continual enhancement of living level and medical level, both the health status and the anticipated life of modern old people are enhanced than the past. The major risks faced by older persons include financial risks and medical care costs risk, which can be guaranteed by the social medical insurance, the commercial important disease insurance, and long-term nursing insurance. But because the covering face of the social medical insurance is limited, the medical charge induced by usual accidents out of the social medical insurance could produce larger burden for old people, and the old accident insurance can better fulfill this requirement.

### 1. Analysis of advantages of old accident insurance

The insurance period of accident insurance generally is short, and except for the necessary fees and profit of the insurance company, all premium income is used to pay the insurance money as the risk premium, which embodies the mutually dispersion and basic guarantee function of the insurance, and the concrete advantages are embodied in following three aspects.

#### 1.1 Cheap premium and sufficient guarantee

As the pure consumption insurance kind, the premium of the accident insurance is used for guarantee, so the premium is cheap. The premium of the group life accident harm insurance pushed by British Prudential plc is only 2.5 dollars in one season. In China, taking the personal accident risk of "Le Wu You" of Generali China Life Insurance as the example, the premium of the first-class occupation client is only 1.5 Yuan per the sum insured of 1000 Yuan in one year, and the insurance range includes the dieing, deformity, burn induced by accidents, and the pension payment and the sum insured would increase per year by 6%. However, the premium of the endowment insurances with same sum insured generally is hundred times than it in the market. Except for settling claims for dieing and deformity induced by accidents for insurants, the accident insurance with the additional medical accident insurance can settle claims for the medical charge induced by accidents. For example, the insurance responsibility of the "You Ran Ren Sheng" accident insurance of China Pacific Insurance includes dieing, deformity, burn compensation, hospital income compensation, and out patient service compensation. The periodic or all-life life insurance doesn't contain the medical guarantee, and it needs adding two additional insurances at least to achieve thus guarantee effect.

According to the character of accident insurance, the insurance applicant can pay fewer premiums to obtain sufficient guarantee in certain term, which is very fit for the old people with less incomes and high insurance requirements. In old people above 60 years old, quiet more old people (especially in big and middle-sized cities) have strong insurance consciousness, and they actively want to participate in the insurance. Except for that, because of the respect to old people in Chinese traditional culture, many children want to pay insurances for their old parents. But because of the control risk, many insurance companies limit the age of buying life insurance in 65 years old. The insurance age of big disease is limited in 60 years old. Because of the regression of body enginery, various accidents will easily happen in old people. With the old accident insurance, old people settle claims when the dieing, deformity, and burning happen because of accidents, and they can also obtain relative medical charges.

### *1.2 Convenient buying and strong insurance renewal*

The accident insurance has simple articles and specific guarantees, and not only it can be bought by traditional channel such as the agent, but also more and more measures of information technology can be utilized, for example, the phone message, telemarketing, and network platform all can be selected by the insurance companies. AIV Insurance adopts the new mode of TV marketing, which could offer more relax and convenient insurance environment for consumers, especially for old people.

The article of the renewal of insurance is a right that the accident insurance contract gives to the owner of insurance policy, i.e. the owner of insurance policy can renew the insurance policy before the insurance policy fall in to make it effective. This article of the accident insurance is a kind of good protection to the insurability of the owner of insurance policy before certain age (AIA insurance regulates the renewal of insurance can continue to 80 years old).

For the life insurance and medical insurance, with the increase of age, the risk increases quickly, and the insurance companies need to recheck insurants' bodies and perform strict underwriting procedure, and they will always enhance the premium standard largely, even refuse the insurance. The old accident insurance needs not psychical checking, and the renewal of insurance is convenient. With the increase of age, the body enginery will drop, and old people more want to renew the insurance and continue their guarantees. Only to need one call and post the premium to the insurance company, the insurance policy will become effective continually, which can not only offer conveniences for old people, but for reduce the drumbeating charge of the insurance company and maintain stable customer group. At present, almost all old accident insurance in China can be renewed.

Many sons and daughters think that with the increase of parents' age and the dropping of health status year by year, and they want to buy insurances for parents to avoid their future life risks, but many insurance companies limit the insurance age in 65 years old, and the big disease insurance even limits the insurance age below 60 years old. The old accident insurance doesn't connect with the age and heath status, and it only pays attention to the healthy working and normal life of old people.

### *1.3 Brilliant characters aiming at old people*

The insurance people of the old accident insurance are the old people who can work or live normally, and the pricing of perineum includes many factors such as descending body enginery and ascending death rate, and the proposal form also fully embodies the character of the accident insurance, which could more accord with the life rule of old people. This insurance kind more accords with clients' demands in the guarantee contents, and ensure the justice of premium for the insurance companies.

The main contents of the old accident insurance are the charges induced by various accident harms such as fracture and burning in old people. Comparing with the comprehensive insurance kinds including multiple insurance benefits aiming at young people, the old accident insurance is simple and specific, and it is easy to control the risks and reduce the premium rate. In the days that the aging problem is serious increasingly, old people more needs thus "customized" insurance, so its spread will certainly be welcomed by old people.

## **2. Development of Chinese old accident insurance product market**

### *2.1 Supplies*

#### **2.1.1 The start time of old accident insurance is late, and the premium income is lower**

At present, in the incomes of Chinese personal insurances, the premium of life insurance and health insurance occupies large proportion, and the income of accident insurance is lower.

From the incomes of Chinese personal insurance premium in recent five years, the life insurance is the insurance kind occupying the dominant status, and its income always occupies above 87% of the total income of personal insurance. And the proportion of the health insurance was about 8%, and it descended obviously than the last year, and it ascended a little in 2008. The proportion of the accident insurance was about 3%, and both of above two insurance kinds was about 10%. But in 2007, the premium incomes of the accident insurance and the health insurance in US had achieved to 23% (seen in Figure 1), it was obviously seen that the development space of Chinese accident insurance and health insurance was still large. Up to 2002, the first accident insurance which was specially designed for old people, "Yongan Insurance", was pushed by Shanghai AIA. The character of this insurance kind is that it aims at the accident fracture payment and the telephone insurance mode according to the characters of old people. In recent years, the life insurance with characters such as saving and melon-cutting occupies the dominant status of the personal insurance, and though the accident insurance develops quickly but its proportion is still too small, which is obviously different with the flourish old insurance industry in US and Britain.

#### **2.1.2 The development of product is deficient, and the variety is single**

(1) The development of the old accident insurance product is not sufficient.

At the end of 2007, China had 120 insurance institutions, and 22 companies doing business with the elderly accident

insurance. By the end of 2007, the number of older accident insurance is 62, old age & accident insurance accounted for 11.1% of personal insurance. (See Table 2)

With the development of the aging course in China, and up to the late of 2007, the aging population in Shanghai which has the most aging population in China achieved 2.8683 millions, 20.8% of the total population of the city(SRCA,2008). The aging population has large demands for the old accident insurance, but the actuality is that the amount of the company which manages the old accident insurance business in Chinese insurance market is relatively less, and the insurance companies develop insufficiently for the old accident insurance, and the share of the old accident insurance product is still low.

(2) The existing product kind is designed singly.

The Chinese old accident insurance product includes the main insurance and rider insurance, and the design of the insurance policy is simple, and the age limitation, insurance term, and guarantee content of insurants are almost same, lacking in characters and market competitive force. Table 3 is the introduction of Chinese old accident insurance products.

## 2.2 Demands

At present, the social security system of China is not healthy, and the covering of urban employee work-injury and medical insurance is very limited. For the old people with basic endowment and medial securities, the old accident insurance is a powerful compensation. The fracture and disjoint happen frequently in old people, but the medical charge is often out of the compensation of medical insurance, which induces large inconvenience for old people. Their endowment incomes can pay for cheap premium, and only buying proper old accident insurance can solve this problem.

In addition, in recent ten years, the amount of empty-nest family increases quickly. In 1993, the proportion of the empty-nest family occupied 16.7% in the families with elders, and this number ascended to 25.8% in 2003. In recent three years, the amount of empty-nest family in Shanghai is seen in Figure 2, and the amount of the empty-nest family with the elders above 80 years old in 2008 was 24260 thousands. Though the empty-nest elders can be supported by children in economy, but they can not be helped by children's spirit consolation and care and physical helps, so the probability that the accident injury occurs is high, so they more need the guarantee of the old accident insurance.

At the same time, there are many elders out of the social security in China, and they more urgently need the commercial insurance. But most elders without endowment guarantee live in country, and they have not incomes, and only depend on children's supports. Therefore, they essentially can not pay the expensive long-term life insurance, but the old accident insurance with cheap premium and sufficient guarantee could accord with their status. The accident guarantee can not only enhance the elders' life quality in their late years, but can really reduce the endowment burden of modern families. The old guarantee product aiming at the practical demand of elders will certainly be welcomed, but the insurance product in the present market is still difficult to fulfill the demands.

## 3. Causes analysis of slow development of old accident insurance

### 3.1 Psychological factor

Because the accident insurance is the pure consumption insurance, it is often regarded as the luxury product by Chinese people who are used to depend on their own savings and family endowment. Because of long-term economical habits, many elders often don't want to buy the insurance, and repent when the accident happens. The young people's pressure to support their parents increases continually, and the insurance is the best choice to apportion the risk, which is the practical cause that more and more young people buy the insurance for their parents.

In recent years, with the sufficient development of the capital market, people universally hope their assets could be maintained and increased, so they would buy the life insurance product which can cut a melon and obtain investment profit, and it is natural that the consumption insurance such as the old accident insurance is not welcomed.

### 3.2 Social and cultural factor

Because of the influence of thousands of traditional culture of China, people always would not envisage many accidents such as dieing, deformity, and injury, so they would more buy the endowments which can guarantee their old life, not the pure-guarantee product such as the old accident insurance.

In addition, in the quick development of Chinese insurance industry, part agents cheat clients, and individual insurance companies have unfair articles, which make the compensation to be difficult, and many people clash with the insurance.

### 3.3 Risk factor

Because elders' resistance descends seriously, general accidents will induce more serious harm to them. Therefore, the old insurance has large risk, and the insurance companies can not but being cautious. The founded time of many insurance companies is not long, and their accumulation of the calculation technology and experience data is not sufficient, so they can not develop the old insurance easily. In addition, Chinese insurance industry has been limited by

the investment channel for a long term, and in 2005, the insurance capitals begun to be allowed in the stock market, and in 2006, the insurance companies had capitals in bond and stock with 53.14% and 5.22% respectively. Figure 2 shows the proportion of US life companies from 1975 to 2007.

#### **4. Advices to develop Chinese old accident insurance**

##### *4.1 Setting up tax preference, extending investment channels of insurance companies*

Many foreign old-insurances develop depending on the policy and taxation preference. Aiming at the elders above 50 years old, Chinese old accident insurance has high compensation risk. Except for the accumulation of experience and technology from the insurance company, the government can set up the policy of taxation preference to encourage and introduce the insurance company to actively develop the market, which can not only add new drive for the development of Chinese insurance industry, but also revive the endowment pressure because of aging, and realize the multi-layer social endowment system.

According to the experience in US, the occurrence of invested life insurance must increase the investment income of the insurance capitals. China can invest the traditional life insurance and the invested insurance according to different accounts and styles to expend the investment channels of the insurance capitals, which can increase the yield in the range of controlling risk, and increase the profit space of the insurance company, and reduce the compensation pressure.

##### *4.2 Developing the insurance containing nursing charge and aiming at empty-nest families in cities*

In modern society, the work changes frequently, and the quick transfer of population flow makes the structure of big family to convert to small family. With the quick transformation of the society, the generation gap becomes more and more obviously. When the level of material life is enhanced, people begin to pursue the spirit life, and both two generations require independent life space and more and more freedom, and traditional big family resident mode has not adapted people's demands, and the small family is generally accepted. After children grow up, elders always select to live singly, and this phenomenon is more universal in cities. The elders' death rate of the empty-nest family is obviously higher than the death rate that elders live with children (Huang, Suping, 2005; Li, Deming, Chen, Tianyong & Wu, Zhenyun, 2006). And the probability that the accident happens in the elders in the empty-nest families is bigger, and when they suffer some small accident harms, they always need the nursing of a period of time. But because of large completion pressure, it is not practical to make children to nurse elders specially, and the professional nursing will need more capitals. Therefore, aiming at this demand, the insurance kind which can guarantee the short-term nursing charge induced by the accident harm in empty-nest families can be developed. This kind of insurance can obviously reduce the troubles back home for elders and children, and promote the development of Chinese old nursing industry, and strengthen the old insurance industry in China. The risk of the elders in empty-nest family is higher, and this kind of insurance can be combined with other insurance kinds to reduce the total risk.

##### *4.3 Extending mode: from city to country, encouraging children to buy the insurance for parents*

There are many elders with basic endowment guarantee in cities, and elders' insurance consciousness and economic independence are stronger, so the old insurance is more easily extended in cities. More flexible mode can be adopted for elders, such as cooperating with the community. On the other hand, because of the increase of modern social work pressure, children may not often company with their parents, so they can be encouraged to buy the insurance for their parents. The extension in cities can accumulate the experience data, and avoid the risk of premium.

With the opening of urban market, the market can be gradually extended to towns, and the market of the country is wider. With the change of people's endowment concept, the old accident insurance must be developed much more largely. Because the rural elders' economic independence is bad, so the accident insurance can only be bought by their children or relatives, and the marketing objects mainly are the children with labor ability, which can be developed form Chinese tradition, practical guarantee, and endowment pressure.

##### *4.4 Combining the old accident insurance with the endowment service by multiple forms*

In China, there are many elders without basic social security, and most of them live in the country. At present, China has developed the medical plan of big disease, and implemented the part expenses reimbursement system for the medical and hospital charges of big diseases. The old accident insurance can be the powerful compensation of the medial plan of big diseases, and fully guarantee elders' nursing and medical charges because of usual accidents. For many elderly persons of no family and children, China can introduce the old accident insurance based on the comprehensive guarantee, and the premium is paid by the country, and when the accidents happen, the insurance companies can compensate the loss, which can not only reduce the financial burden of the country, but promote the development of Chinese insurance industry. However, the insurance risk needs to be further studied, and it can be balanced between the premium income and the compensation risk of the insurance company.

In the city, accident insurance for old can be combined with community services, which can give full play to the cost of insurance protection functions and community service functions. Shanghai begins to buy accident insurance for the old



for old age agency this year; it may be a good choice.

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Table 1. Premium income distribution of personal insurance (including life insurance, accident insurance and health insurance, and the data of accident insurance and health insurance are collected from P & C insurance companies) in China (Unit: a hundred million Yuan & %)

	Old and other accident insurances	Proportion	Life insurance	proportion	Health insurance	Proportion
2004	86	2.69	2851	89.26	257	8.05
2005	141	3.81	3247	87.76	312	8.43
2006	162	3.61	3953	88.00	377	8.39
2007	190	3.77	4463	88.60	384	7.62
2008	204	2.74	6658	89.41	585	7.86

Data from: China Insurance Regulatory Commission and China Statistical Yearbook (2004-2008)

Table 2. Companies and product amount of accident insurance in China (Unit: %)

The amount of insurance company	The amount of the company managing old accident insurance	Ratio
120	22	18.33
Product of personal insurance	Product of old accident insurance	Ratio
559	62	11.11

Data from: China Insurance Regulatory Commission, Homeway web, and various insurance companies

Table 3. Introduction of old accident insurance product in China

Product	Company	Main insurance & Rider	Insurant's age	Premium	Insurance term	Insurance content	Other regulations
Hale and hearty-accident fracture insurance	Sunshine P & C Insurance	Main insurance	50-75	100 Yuan/ piece	One year	Fracture	Renewal of insurance to 85 years old, 10000 Yuan/ piece
Additional accident insurance	Ping An Insurance	Rider	Open	—	One year	Die, deformity, hospital allowance	—
Kang Shou Bao-old accident insurance plan	Taikang Life	Main insurance	50-75	—	One year	High deformity, fracture, burn, surgery	Renewal of insurance to 75
Jin Se Nian Hua Ji Xiang Ka	China Life Insurance	Main insurance	50-75	150, 228, 358	One year	Die, deformity, medical guarantee, hospital allowance	—
Allianz additional accident medical insurance	Allianz China Life	Rider	18-65	—	One year	Medical charge, hospital allowance	Without limitation of exempt compensation
Comprehensive personal accident insurance	American International Assurance	Main insurance	50-75	—	One year	Die, deformity, fracture, burn, hospital compensation because of accident	—
Yi Shun comprehensive insurance plan 1	Taikang Life	Main insurance	18-60	138	One year	Die deformity, hospital allowance	—
Alltrust parent accident insurance A	Alltrust Insurance	Main insurance	45-75	90	One year	Die deformity, hospital allowance	Additional fracture & disjoint
Alltrust parent accident insurance B	Alltrust Insurance	Main insurance	45-75	150	One year	Die deformity, hospital allowance	Additional fracture & disjoint
Word guardianship card A	Bank of China Insurance	Main insurance	18-65	350	One year	Die deformity, hospital allowance	Additional abroad rescue
Additional accident medical insurance	Minsheng Life Insurance	Rider	3-60	—	One year	Medical charge, hospital allowance	Renewal of insurance to 64

Data from: China Insurance Regulatory Commission, Homeway web, and various insurance companies

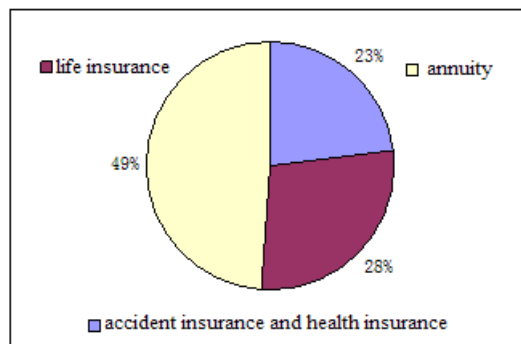


Figure 1. Analysis of Personal Insurance Net Income of 2007 of US (Data from: ACLI Life Insurers Fact Book 2008)

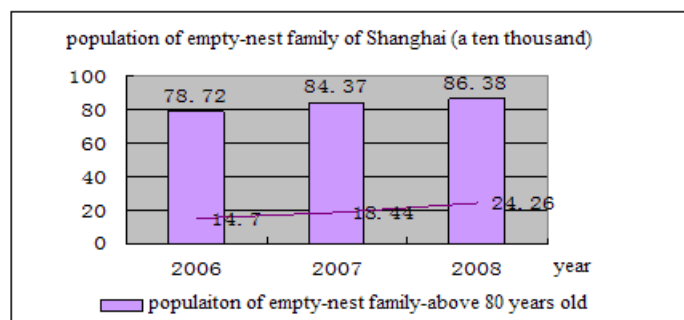


Figure 2. Population of Empty-nest Family in Recent Three Years in Shanghai (Data from: Shanghai Research Center on Aging (SRCA), Shanghai Statistical Information of Old Population and Aging Monitoring of 2008)

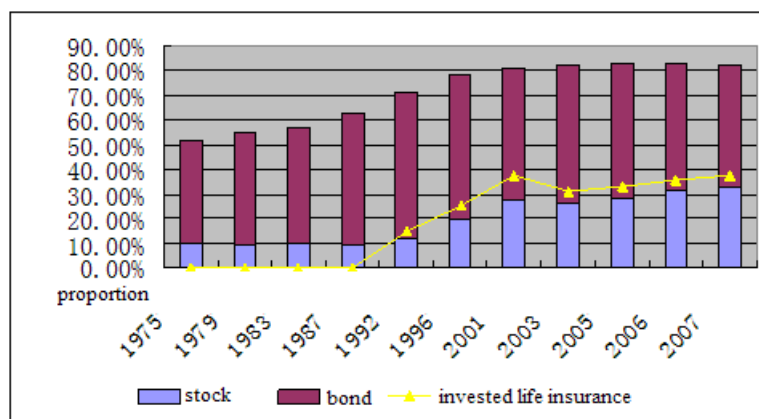


Figure 3. Proportional Tendency of Stock and Bond and Invested Life Insurance Proportion in the Assets of US Life Insurance Company from 1975 to 2007 (Data from: ACLI Life Insurers Fact Book 1976- 2008 (US))



## The Cointegration and Causality Tests for Tourism and Trade in Malaysia

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### Abstract

This paper examines the relationship between tourism and trade that might have evolved in the development of Malaysian economy by using cointegration and causality tests. All analyses have been conducted with quarterly data of international tourism receipts, exports, imports and total trade of Malaysia, over the period of 1995:1 through 2006:4. The results of the unit root tests indicate that the data are stationary in first-difference and not in level. The results of the JJ co integration test however, show that all the series are not cointegrated in the long run, hence, long-run equilibrium did not exist between all the series. Using Granger-causality tests the study found that there is one-way causal effect (unidirectional causality) running from exports to international tourism receipts at 5% significance level. The causality test also shows a one-way causal effect running from imports to international tourist receipts at 5% significance level and total trade to international tourism receipts at 10% significance level. This leads to a conclusion that increase in total trade, exports and imports will cause growth in the tourism sector, which means that most of tourist arrivals are related to business tourism. Therefore, to increase and sustain in the growth of tourism sector, future economic policy should focus more on tourism and trade related, in order to generate more foreign exchange earning to Malaysia.

**Keywords:** Tourism, Trade, Cointegration test, Causality test, Malaysia

### 1. Introduction

Tourism can be classified into several distinct categories. They would include holiday travel, visiting friends and relatives (VFR), business travel, health treatment, shopping, conference, incentive travel, official mission, education, sport and others travel (Malaysia Tourism Promotion Board, 2004). Despite uncertainty in the global economic environment, Malaysian tourism industry continues to perform favorably as reflected in the growth of tourist arrivals and tourist receipts. The share of tourism revenue in total earnings of the services account of the balance of payments increased from 32.7% in 2000 to 43% in 2005. Taking into account the inflow of foreign tourists and outflow of local residents traveling abroad, the net contribution by tourism improved from RM11.2 to RM18.1 billion for the same period. The development in tourism also contributed positively to the expansion of activities in other subsectors, particularly the hotel, travel and tour industry, retail and restaurants as well as transport.

During 2000-2005, total trade expanded at an average rate of 7.2% per annum from RM684.7 billion in 2000 to RM967.8 billion in 2005. Gross exports grew at an average rate of 7.4% per annum to RM533.8 billion in 2005. With this performance, Malaysia ranked 18th largest exporter, contributing 1.5% of world export. While gross imports increased at an average rate of 6.9% per annum to RM434.0 billion in 2005 (Ninth Malaysia Plan, 2006-2010). The pattern of trade and tourism data in Malaysia provides cursory evidence that there is a long-run relationship between the two sectors (Figure 1). However, the significance of such a relationship can only be proven by undertaking appropriate studies.

Is there a relationship between international trade and tourism? If so, how? This question can be taken to a more disaggregated level of inquiry. Evidently, international business creates export sale and/or import purchase. Successful business trips will further lead business travel flows and there will be a series of externality effects on both trade and tourism. Increase business travel may also increase holiday and other travel when friends and relatives seeking adventure and recreation accompany business travelers (Kulendran and Wilson, 2000). Earlier studies by Kulendran and Wilson (2000) lend empirical support to the relationship between tourism and trade. They analyzed the direction of causality between different travel and trade categories for Australia and its four major trading partners, using time series data. The study provides empirical evidence in supporting the idea that there is a long-run relationship between international trade and international travel. Using the same approach, Khan and Lin (2002) investigated the relationship between international trade and tourism for Singapore and its major trading partners. Although the results tend to differ

across countries, the study provides strong support for a systematic relationship between business travel and total trade. Furthermore, the causality between travel and trade could run both ways, whereby business arrivals influence trade or vice versa. However, holiday or pleasure travel, is found to be somewhat unrelated to trade.

Other categories of tourism such as VFR, health treatment, shopping, conference, incentive travel, official mission, education, sport and other travels can also influence trade because tourists may demand certain types of product that are produced or otherwise in that country. If they demand products that are not produced in that country, therefore it has to be imported, this may lead to an increase in import. On the other hand, if tourists purchase products that are produced locally, this will increase income of that country. Higher trading volumes countries are likely to be more open economies and more developed in tourism industry. Therefore, expansion in the tourism industry will also lead to an expansion in the trade when demand for tourist commodities increase (Khan and Lin, 2002). According to the World Tourism Organization (UNWTO) the number of international tourist arrivals recorded worldwide grew by 5.4% and exceeded 800 million for the first time in 2005 (ever from 766 million in 2004). Although growth was more moderate, it was still almost 1.5 percentage points above the long-term average annual growth rate of 4.1%. Tourist arrivals to Malaysia reached its target of 16.4 million tourists by the end of December 2005 exceeding 15.7 million tourists in 2004. From the 16.4 million tourist arrivals in 2005, Malaysia received RM32.0 billion in foreign exchange earnings, representing an increase of 7.8% from 2004.

In terms of traveling pattern, holiday arrival, which represented 71.2% of total arrivals in 2005, had declined by 3.7% as compared to 2004. While tourists who came for business, shopping, conference, official mission and sport has increased by 2.4%, 0.1%, 0.4%, 0.3% and 0.9% respectively (see Table 1). This is in conjunction with aggressive promotions made in new and non-traditional markets, particularly in West Asia as well as increasing number of international conferences and exhibitions held in the country (Economic Report, 2005/2006). Average per capita expenditure also registered an increase of 3.2% from RM1,888.20 to RM1,944.70. Tourists spent mostly on accommodation (33.5%), followed by shopping (20.8%), food and beverage (19.9%), transportation (11.6%), and entertainment (4.0%). From the distribution of items purchased in 2005, clothes/textiles/bag constituted more than 50% from overall shopping items. The second most favorite items was handicraft/souvenir at 45.5%. Items such as liquor, DVD/VCD/CD/Cassette, toys, cigarette/cigar, gold/jewellery, electrical/electronic appliances and others were consumed below 10% in 2005.

Besides, total trade consists of exports and imports. ASEAN accounted for 26.1% of Malaysia's exports and 25.5% of imports in 2005, while Japan 9.4% of exports and 14.5% of imports; Australia 3.4% of exports and 1.9% of imports; the U.S 19.7% of exports and 12.9% of imports and the U.K 1.8% of exports and 1.5% of imports. Internationally, tourism represents an important source of foreign exchange earnings and it has been suggested that the potential contribution to the national balance of payments (Oppermann and Chon, 1997). Although tourism is a powerful tool for balance of payments adjustments, its impact may vary according to countries. In the developed countries, the earnings from international tourism could make a significant contribution to the balance of payments in general, and the invisible account in particular. However, for many developing countries with a limited industrial sector and dependence on international aid, tourism plays a significant role in securing foreign exchange, creating employment and attracting overseas investment (Sharpley, 2002). As indicated by the UNWTO and International Monetary Fund (IMF) data, international tourism is the top export earning sector in the world, exceeding both the automobile industry and the chemicals industry, and together with international fare receipts represents about 8% of total export earnings on goods and services worldwide. Tourism is also one of the top five export earning sectors for 83% of countries in the world, and the main source of foreign currency for at least 38% of the countries. In the 1980s, international tourism receipts grew faster than world trade (commercial service and merchandised exports).

Despite the fact that tourism is a major important sector for the world's economy for many countries, it is one of the largest single employers and exporting service sectors; however, to our knowledge there are very few attempts to investigate the relationship between tourism and trade. In addition, literature on relationship between tourism and trade in the developing countries is completely lacking. The present study seeks to investigate the relationship between tourism and trade that might have evolved in the process of development of Malaysian economy by using cointegration and causality tests. The results of the study seem to have important implications for Malaysia's policy concerning tourism and trade. If we can prove that, there is a long-run relationship between international trade and tourism, future economic policy should focus more on tourism and trade related, in order to generate more foreign exchange earning to Malaysia.

## 2. Methods and materials

All analyses were conducted with quarterly (time series) data of international tourism receipts, exports, imports and total trade (on real terms) of Malaysia, over the period of 1995:1 through 2006:4. These series were obtained by dividing the nominal series by the consumer price indices (2000:Q1=100). In this study, the tourism and trade hypotheses to be tested are as follows, namely: (a) does international tourism receipts cause export. (b) does exports cause international tourism receipts? (c) does an international tourism receipt cause imports? (d) does imports cause

international tourism receipts? (e) does international tourism receipts cause total trade? (f) does total trade cause international tourism receipts? Therefore, with this tourism and trade hypotheses, attempts were made to test and search for evidence of existence of relationship.

Firstly, before estimating the co integration and VAR, it is required to examine the stationarity of the variables. Stationarity means that the mean and variance of the series are constant through time and the auto covariance of the series is not time varying (Enders, 2004). Therefore, the first step is to test the order of integration ( $I$ ) of the variables. Integration means that past shocks remaining undiluted affects the realizations of the series forever and a series has theoretically infinite variance and a time-dependent mean. For the purpose of this study, we use tests proposed by Dickey and Fuller (ADF, 1979, 1981), Phillips and Perron (PP, 1988) and Kwiatkowski, Phillips, Schmidt and Shin (KPSS, 1992) in testing the properties of unit root for all variables used. If all of the series are non-stationary in levels, it should be stationary in first difference with the same level of lags. For appropriate lag lengths, we use the Akaike Information Criterion (AIC) and Schwartz Bayesian Criterion (SBC).

The ADF test takes the following form:

$$\Delta Y_t = \alpha_0 + \delta T + \beta Y_{t-1} + \sum_{i=1}^p \theta_i \Delta Y_{t-i} + \mu_t \quad (1)$$

The ADF auxiliary regression tests for a unit root in  $Y_t$ , namely the logarithm of total tourism receipts, total trade, exports and imports.  $T$  denotes the deterministic time trend and  $\Delta Y_{t-i}$  is the lagged first differences to accommodate a serial correlation in the error,  $\mu_t$ . While,  $\alpha$ ,  $\delta$ ,  $\beta$ , and  $\theta$  are the parameters to be estimated.

Meanwhile, the Phillips-Peron (PP) test is shown by the equation below.

$$\Delta Y_t = \mu + \rho Y_{t-1} + \varepsilon_t \quad (2)$$

The PP test is used because it will make a correction to the t-statistics of the coefficient from the AR (1) regression to account for the serial correlation. The PP test is a test of the hypothesis  $\rho=1$  in the equation 2. But, unlike the ADF test, there are no lagged difference terms. Instead, the equation is estimated by OLS and then the t-statistics of the  $\rho$  coefficient is corrected for serial correlation in  $\varepsilon_t$ .

In the first two methods, the unit root hypothesis corresponds to the null hypothesis. If we are unable to reject the presence of a unit root, meaning that the series are integrated of order one. However, Kwiatkowski, Phillips, Schmidt and Shin (1992) argued that not all series for which we cannot reject the unit root hypothesis are necessarily integrated of order one. To circumvent the problem that unit root tests often have low power, they offer an alternative test, which is KPSS test. In the KPSS test, stationarity is the null hypothesis and the existence of a unit root is the alternative. The KPSS test is shown by the following equation

$$y_t = x_t' \beta + \mu \quad (3)$$

The LM statistics is given by:

$$LM = \sum_{t=1}^T S_t^2 / \sigma_e^2 \quad (4)$$

where,  $\sigma_e^2$  is an estimator for the error variance. This latter estimator  $\sigma_e^2$  may involve corrections for autocorrelation based on the Newey-West formula. In the KPSS test, if the null of stationarity cannot be rejected, the series might be cointegrated. After identifying the order of intergration, we then use the Johansen (1988, 1991), and Johansen and Juselius (1990) Full Information Maximum Likelihood (ML) technique to determine whether there is a long-run relationships (cointegrating) between the various series. If there is a cointegration between two variables, there, exists a long-run effect that prevents the two series from drifting away from each other and this will force the series to converge into long-run equilibrium.

The study further explores the relationship between the series by using Granger-Causality test to test for the bivariate equation. Granger (1988) points out that if two series are cointegrated, then there must be Granger-causation in at least one direction. A variable  $X_t$  Granger causes  $Y_t$ , if  $Y_t$  can be predicted with better accuracy by using past values of  $X_t$  with other factors held constant.

The Granger causality test involves estimating the following model:

$$Y_t = \mu_t + \sum_{i=1}^p \alpha_i Y_{t-i} + \sum_{j=1}^q \beta_j X_{t-j} + \varepsilon_t \quad (5)$$

Where  $\mu_t$  denotes the deterministic component and  $\varepsilon_t$  is white noise. Meanwhile, the null hypothesis can be tested by using  $F$ -test. When the  $p$ -value is significant, the null hypothesis of the  $F$ -statistic is rejected, which implies that the first series Granger-causes the second series and vice versa.

In this study, we used quarterly data of international tourism receipts and total trade for Malaysia spanning from 1995:1 to 2006:4. The data used in this study are obtained from Malaysian Tourism Promotion Board (Planning and Research Division), *Annual report of Bank Negara Malaysia* (the Malaysian Central Bank), the *Statistical Yearbook* (various issues) published by the Malaysian Department of Statistic and the IMF *International Financial Statistics Yearbook*.

### 3. Results and discussion

In order to estimate the long-run relationship between the variables using the cointegration approach, first, we need to examine the stationary properties of the time series data, to avoid spurious regression. Tables 1, 2, and 3 present the stationarity test results of international tourism receipts, exports, imports and total trade in level and first differences, using ADF, PP and KPSS tests. The results of the unit root tests indicate that we could not reject the null hypothesis of the unit root at 1 per cent and 5 per cent critical value. However, the null hypothesis is rejected at 1 per cent critical value, when we test on the first-difference. This suggests that the data are stationary in first-difference and not in level.

Having found that the variables are  $I(1)$ , we proceed with the cointegration tests in testing for the cointegration between the variables, which are non-stationary in level but stationary in first-difference. The Johansen and Juselius (JJ) approach is employed to test whether there is a long-run relationship between the selected variables. The results of the JJ co integration test however, shows that all the series are not cointegrated in the long-run. In a simple word, long-run equilibrium did not exist between all the series.

In order to examine the causal relationships as well as directions of the series, then we run the Granger causality tests, which can be implied by the non-cointegrating series. The results of Granger-causality tests as reported in Tables 4 and 5 indicate that there is one-way causal effect running from exports to international tourism receipts at 5% significance level. The causality test also shows a one-way causal effect running from imports to international tourist receipts at 5% significance level and total trade to international tourism receipts at 10% significance level.

### 4. Conclusion

This study attempts to investigate the relationship between tourism and trade that might have evolved in the development of Malaysian economy by using cointegration and causality tests. The findings of the study indicate that there is a one-way causal effect (unidirectional causality) between all the series. Subject to possible caveats of the study, the following are some important policy implications for Malaysia in terms of tourism and trade that can be drawn from the findings. It seems that increase in total trade, exports and imports will cause growth in the tourism sector, which means that most of tourist arrivals are related to business tourism. Hence, future economic policy should focus more on tourism and trade related, in order to generate more foreign exchange earning to Malaysia. Besides, in order to increase and sustain in the growth of tourism sector, more attention should be given to the business tourism since this category of tourism has shown higher growth rate (see Table 1). Furthermore, Malaysia Tourism Promotion Board should also focus on MICE (Meetings, incentives, conferences and Exhibitions) market because this category of tourism also shown a growth as well as relatively a higher value added market.

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Table 1. Malaysia: Categories of Tourism for 2004/2005

Category	2004 (%)	2005 (%)	Growth
Holiday	74.9	71.2	-3.7
VFR	11.2	11.1	-0.1
Business	8.5	10.9	2.4
Shopping	1.2	1.3	0.1
Conference	0.8	1.2	0.4
Sport	0.2	1.1	0.9
Official Mission	0.4	0.7	0.3
Incentive Travel	0.5	0.4	-0.1
Health Treatment	1.7	0.3	-1.4
Education	0.3	0.2	-0.1

Source: Malaysia Profile of Tourists by Selected Markets 2005

Table 2. Unit Root Tests

Augmented Dickey Fuller (ADF) Test						
Variable	Constant			Trend		
	Level	First-Difference	Conclusion	Level	First-Difference	Conclusion
lnTOUR	-1.2803	-8.3413**	I(1)	-2.9989	-8.2989**	I(1)
lnEXP	-1.0624	-6.3891**	I(1)	-2.9880	-6.3142**	I(1)
lnIMP	-1.1309	-6.1333**	I(1)	-2.4785	-5.9962**	I(1)
lnTRADE	-1.0546	-8.1603**	I(1)	-2.8937	-8.0772**	I(1)
Phillip-Perron (PP) Test						
Variable	Constant			Trend		
	Level	First-Difference	Conclusion	Level	First-Difference	Conclusion
lnTOUR	-1.0307	-10.5225**	I(1)	-3.1842	-11.4526**	I(1)
lnEXP	-1.0328	-7.1319**	I(1)	-3.1506	-7.0258**	I(1)
lnIMP	-1.1528	-6.2162**	I(1)	-2.5757	-6.1324**	I(1)
lnTRADE	-0.6781	-11.6934**	I(1)	-3.1664	-11.5027**	I(1)
KPSS Test						
Variable	Constant			Trend		
	Level	First-Difference	Conclusion	Level	First-Difference	Conclusion
lnTOUR	0.7723**	0.4674	I(1)	0.2381**	0.0304	I(1)
lnEXP	0.8778**	0.1356	I(1)	0.2371**	0.0464	I(1)
lnIMP	0.8659**	0.1293	I(1)	0.3792**	0.0563	I(1)
lnTRADE	0.8742**	0.1080	I(1)	0.2341**	0.0345	I(1)

Notes: 1) For ADF and PP tests, \*\* and \* denote rejection of a unit root hypothesis based on Mackinnon (1991) critical values at 1% and 5% respectively.



2) For KPSS tests, \*\* and \* denote rejection of a unit root hypothesis based on Kwiatkowski *et al.* (1992) critical values at 1% and 5% respectively.

Table 3. Cointegration Tests based on the Johansen, and Johansen and Juselius (JJ) Approach

Ho	Trace Statistic	5% CV	Prob.	Max-Eigen Statistic	5% CV	Prob.
Series: TOUR, EXP						
Ho: $r = 0$	12.440	15.495	0.127	12.221	14.265	0.103
Ho: $r \leq 1$	0.463	3.841	0.496	0.463	3.841	0.496
Series: TOUR, IMP						
Ho: $r = 0$	11.389	15.495	0.189	11.349	14.265	0.138
Ho: $r \leq 1$	0.041	3.841	0.840	0.041	3.841	0.840
Series: TOUR, TRADE						
Ho: $r = 0$	11.978	15.495	0.158	11.818	14.265	0.118
Ho: $r \leq 1$	0.159	3.841	0.689	0.159	3.841	0.689

Notes: 1)  $r$  stands for number of cointegrating vectors

2) Column 1 lists the null hypothesis of zero, at least one cointegrating vector; column 2 lists the trace statistics; column 3 lists the critical values for trace statistics at 5% significant level; columns 4 and 7 lists the probability value; column 5 lists the maximum Eigen value statistics; column 6 list the critical value for maximum Eigen statistics at 5% significant level.

Table 4. Granger-Causality Test Results

Null Hypothesis	F-Statistics	P-value	Conclusion (Hypothesis)
Exports does not Granger-cause Tourism	9.7203*	0.0032	Rejected
Tourism does not Granger-cause Export	0.2899	0.5930	Accepted
Import does not Granger-cause Tourism	9.3191*	0.0038	Rejected
Tourism does not Granger-cause Import	0.0013	0.9713	Accepted
Trade does not Granger-cause Tourism	3.1456**	0.083	Rejected
Tourism does not Granger-cause Trade	2.0654	0.1578	Accepted

Note: \* and \*\* indicate statistical significance at 5% and 10% levels, respectively.

Table 5. Summary of Granger-Causality Test Results

Granger Causality Relationships	Significance Level
Exports $\rightarrow$ Tourism	5%
Imports $\rightarrow$ Tourism	5%
Trade $\rightarrow$ Tourism	10%

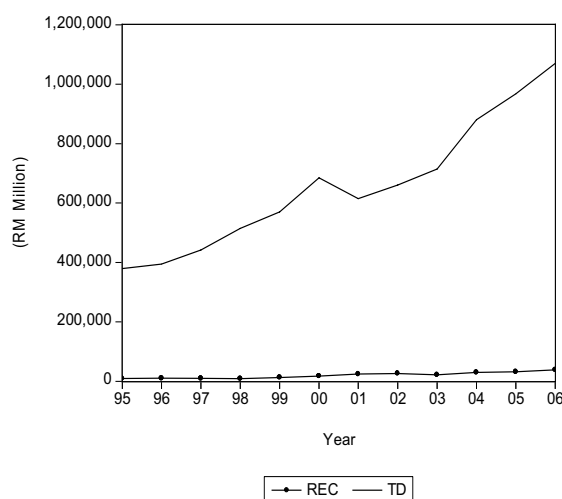


Figure 1. Malaysia: International Tourism Receipts and Trade Earnings



## Revelations of US Financial Crisis for the Financial Development of China

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### Abstract

The financial crisis of 2008 occurring in US not only largely destroyed the financial system and the macroeconomic system of US, but also directly impacted the economy of China because of the increasing mutual infiltration of global capital market. As viewed from financial regulation and financial innovation, the revelations of the financial crisis for the financial development of China are respectively analyzed in this article.

**Keywords:** Financial crisis, Financial regulation, Financial development

The financial crisis of 2008 occurring in US not only largely destroyed the financial system and the macroeconomic system of US, but also directly impacted the economy of China because of the increasing mutual infiltration of global capital market. As viewed from financial regulation and financial innovation, the revelations of the financial crisis for the financial development of China are respectively analyzed in this article.

### 1. Introduction

In recent years, the economic growth speed of China has been maintained at about 9%, and under the premise that economic gross increases, the financial institution and the financial market of China are in the key stage continually developing and deepening. After the financial crisis of 2008 occurred in US, the revelations and lessons of this crisis offer a good change for the learning and self-examination of the financial development of China.

### 2. Revelations for the development of Chinese financial system

#### *2.1 Revelations for the financial regulation of China*

In the tide of the global financial liberalization begun in 1980s, the principle that “the financial products should be benefited in public competition, and reduce the governmental interference to the minimum degree” is being advocated. The former chairman of American Federal Reserve, Greenspan specially said that “the self-regulation of financial market is more effective than the governmental regulation”. According to thus regulation concept, various governments all loosened the regulation standard.

In 1999, US passed the law of “Financial Service Modernization of US”, and allowed that the merchant banking, the mortgage credit, the business of investment bank, and the business of the insurance and asset management were all developed in one subject of enterprise. The expansion of banking operation and the free regulation system quicken the step of financial innovation, and from the following transfer route of financial crisis, the crisis spread very quickly driving by the innovation.

Crisis broke out and the price of relative sub-prime derived products fell, and the assets of institutions such as banks write down and lost, and the public lost confidence to the bank system and make the fluidity to be frozen, and the payment ability of some banks were suspected, and the risk of counterparty increased and the inter-bank market was forced to close, and the large capital and fluidity dried up, the equity financing of third party increased difficultly, and the financing modes of bank decreased quickly, and banks were forced to seek the passive solutions.

The crisis almost made the financial market collapsed, and the crisis also showed that there was not a uniform and optimal financial regulation system in the world, and the financial regulation system of each country must the match with the development of its own financial system, and accord with the stage of opening finance. So the financial regulation of China must enhance the regulation cover from the practice of China, and keep the stable development of the financial system.

With the increase of the integration of various financial markets, it is very important to strengthen the cooperation of international financial regulation. On the one hand, the regulation boundary should be concerned to avoid repeat regulation. On the other hand, the uniformity of the international regulation standard should be strengthened. Different regulation standards will induce the behavior of regulatory arbitrage in the market. The regulation standards about bank, insurance, and securities of China are gradually following the international standards. At present, the financial regulation authority and the monetary policy authority are differentiated in various countries, so except for emphasizing the harmony between China and the monetary policies of other countries, the communication of the financial regulation information and the cooperation between the regulation institution and the central bank are also very important.

## *2.2 Revelations for China to prevent the risk of global financial system*

In recent years, in the falsely flourish feint of real estate of US, the lending institutions loaned moneys under large risks, and pushed many loan products with small monthly repayment and fixed interest in the former stage and floating interest and rising mortgage costs in the later stage, which made some borrowers could not pay the debts in the future. In the securitization of mortgage loan, the investment banks also reduced the consignment or guarantee threshold, and actively extend the risks to wider range in the sale promotion of secondary market. Under the premise with low income level and bad reputation, borrowers bought the house property that they could not assume actually, which induced the present debt crisis. But the speculators of “house traders” played “karate” by means of various circulation credit tools, and once the bubble of real estate broke, they might be changed to “indebted people” from moneybags. The sub-prime crisis made the supply and demand to pay painful costs, and it told us that we should never ignore the existence of risk.

The financial crisis of US reveals that when the finance industry of China actively and stably pushes the opening-up, the risks in the global financial system should not be ignored. One important point is that the financial institutions of Chinese bank industry must be reformed more deeply, and they should improve the ability of risk management and enhance the comprehensive competitive force. At the same time, it is the general trend that Chinese financial enterprises “go to the exterior world”, but they can not blindly extend coarsely, and must put the risk management at the first position.

## *2.3 Revelations for the prudent management of Chinese financial institutions*

The bank industry was the industry suffering most in the financial crisis of US, and the risk concealed back the home mortgage should be fully concerned by the commercial banks of China. In the stage when the real estate rises, the home mortgage loan is the high quality asset for commercial banks, and the loan return rates are relatively higher, and the rate of violation is lower, and once the violation occurs, the mortgaged real estate can be compensated by inch of candle. At present, the mortgage loan of real estate occupies quit large proportion in the assets of Chinese commercial banks, and it is one main source of loan income. However, once the market price of real estate descends universally and the interest of mortgage loan ascends at the same time, house purchasers’ violation rate will ascend largely, and the value of real estate after the auction may be lower than the principal and interest of mortgage loan, even than the principal, which will make the bad debt ratio of commercial banks rise significantly, and impact the profitability and the capital adequacy rate of commercial banks.

In fact, the source of this financial crisis of US is that the financial institutions of US real estate loosened the loan conditions in the flourishing stage of market, and pushed the improper loan product. Before the sub-prime crisis of US occurred, financial institutions reduced the loan standards to pursue profits, and ignored the first payment source of home loan because of continual rise of house price, i.e. the borrowers’ payment ability. For the marketing, the loan companies and banks pushed a series of new products including the so-called “loans without down payment and documents”, but now, these behaviors are not prudent. Banks securitized these loans and transferred the risk to the capital market form the bank account, but the risk had not disappeared, but planted a curse for the crisis.

Chinese commercial banks should fully emphasized the lesson of US financial crisis, and strictly ensure the execution of the down payment policy, properly enhance the rate of down payment, and stop the occurrence of zero down payment. Banks should also adopt strict credit auditing before loaning and avoid the false mortgage. Therefore, Chinese financial institutions should absorb lessen from this financial crisis and fully recognize the important of prudent management.

## **3. Revelations of financial crisis for Chinese financial innovation**

The financial crisis of US shows that the tool of financial innovation could export the management or investment risk of the host country to influence the global capital market. Therefore, in the big background of financial globalization, the financial innovation must insist wide eyeshot and far strategic insight. For long, developed countries such as US have leaded the historical tide of global financial innovation, and various innovational products certainly essentially have changed traditional banking, but the financial innovation also brought continual troubles, especially the financial crisis of US in last year. As viewed from certain angle, this crisis shadowed the financial innovation in the ascendant in the world, but the revelations and lessons in it could help us to make clear the financial innovation of the banking in China.

### *3.1 Preparing for the possible market influences of financial innovation*

In the sub-prime crisis of US, the innovational tools such as the derivative products in financial innovation had large execution which had not been known before hand. The sub-prime debt certainly could fulfill the housing requirement of US families with low income to large extent, especially some of these families wanted to benefit from rising house price. Though US bore the large pressure of this financial pressure, but it also successfully exported the financial risks to the world by the mode of financial innovation. Because US imputed the income and risk of the junior bond to the investors in the global capital market by the financial innovation, the investment risk induced by the junior bond was naturally assumed by the whole global capital market. It may be difficult to judge the securitization of house mortgage loan, but one positive point is that the financial innovation decision of Chinese financial institution should not be gave up, or the

step of financial innovation should not be postponed.

### 3.2 *The financial innovation of Chinese financial institutions can not be divorced from the national situation of China*

In fact, the financial innovation can not leave the economic and financial environment of one country for ever, for example, the sub-prime debt of US was generated in the special age after 9 11. Therefore, in the financial innovation, several basic characters about the change of the national situation of China must be emphasized in certain term.

First, the capital market of China has formed certain scale and gradually gone to the mature state. With the continual expansion and standardization of Chinese stock and fund market, common people continually recognize this new market, and traditional banking certainly faces more and more austere challenges. In the future, even if the development of capital market can not essentially overthrow the monopolization status of traditional loan business, but it will shake the base that the banks mainly depend on the interest difference of deposit and loan.

Second, the income distribution and wealthy structure of urban inhabitants have been changed largely. With the sustainable and high-speed development of Chinese economy in twenty years, the long-term pyramid income structure of Chinese urban residents is being replaced by the olive structure with “two small ends and big middle”. In international experiences, with the forming of this olive distribution structure, the investors with different risk favors will gradually grow, and to continually fulfill investors’ different investment risk favors is not only a tough task before financial institutions, but the necessary choice to implement the operation transition and enhance the competitive force of the market.

### 3.3 *Financial institutions should insist the principles of “prudent management” when implementing financial innovation*

The most profound lesson of this financial crisis of US is that the financial innovation can not breach the basic principle of “prudent management”.

First, the lever effect of financial innovation should challenge the basic principle of “prudent management” of financial institutions in public. The direct result of the home mortgage loan securitization is that the banks or financial companies will expand the credit scale when they obtain the cash flow again, and the junior loans will not only be formed as various financial products, but be distributed into various investment product combinations of financial institutions, and will be amplified as various trades about the sub-prime debts by the hedge fund and other financial lever tools to tens even hundreds times, and finally relative investment and trading risk will be amplified. At the same time, the association between the value of quite more derivative products and the value of real assets, and the lever effect of financial innovation will not keep away from the principle of “prudent management” of financial institutions, but insulate the market participators out of the hedge of “prudent management”.

Second, the after the management risk is transferred to the society, the financial institutions certainly will sacrifice the principle of the “prudent management” to extend the credit scale because of their greedy nature. Once the risks break out, the whole society will be shocked, and it will be too late to give attention to whether the issuance quality of original credit products followed the principle of prudent management. Therefore, the practical issue in the innovation of financial derivative products is that how to effectively link the principle of “prudent management” with the serious lagging of loan behaviors and concealed risks without the limitation of risk.

Third, the financial derivative products kept away from the principle of “prudent management” from the word go. The value of representative derivative product depends on the change of original asset value, but because of financial innovation, after the derivative products are packaged carefully and pushed to the capital market by investment bankers through cutting, packaging, evaluating, pricing, and financial engineering model, their prices and investment values would always been overrated, and the market risk may break out at any time. At the same time, the basic principle of “prudent management” will disappear into thin air. Therefore, the profound less of this financial crisis is that the basic principle of “prudent management” must be insisted very well in the financial innovation. How to effectively deal with the relationship between the innovation and the prudent management may be a long-term and intractable practical problem before us.

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## Market Based Mergers- Study on Indian & Saudi Arabian Banks

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### Abstract

This paper analyses the efficiency and performance of post merger using CAMEL-type variable of selected banks in India & Saudi Arabia which are initiated by the market forces. The results suggest that the mergers did not seem to enhance the productive efficiency of the banks as they do not indicate any significant difference. The financial performance suggests that the banks are becoming more focused on their retail activities (intermediation) and the main reasons for their merger is to scale up their operations. However, it is found that the Advances to total Assets and the profitability are the two main parameters which are to be considered since they are very much affected by mergers. Also, the profitability of the firm is significantly affected after merger.

**Keywords:** Bank Mergers, Efficiency, Post Merger Performance, Mergers and Acquisitions, Forced mergers, financial performance, Market mergers

### 1. Introduction

Mergers and Acquisition are not unknown phenomena in Indian Banking. It started way back in 1920 when the Imperial Bank of India was born out of three presidency banks and several Mergers and Acquisitions (M&A) activities were reported in pre-independence period. In 1949, proper regulation was passed by the regulator to control the banking activities which provided a relief to investors and improved the depositor confidence in the banking system. The first half of the sixties witnessed 45 forced mergers under Section 45 of Banking & Regulation Act. Interestingly, all the M&A activities were of failed private banks with one of the public sector banks. After 1980, the consolidation fever started in both commercial and rural banks. There were about 196 rural banks in 1989 which got consolidated into 103 by merging themselves into commercial banks within the state and in 2000 about 17 urban co-operative banks got merged within the state owned commercial banks. Since about 75% of the Indian banking system consists of public sector banks, there were more consolidations started happening in the late 2000.

Saudi Arabia witnessed only one merger that was between Cairo Saudi Bank and the United Saudi Bank. This was further merged with Saudi American Bank in 1999 and the merged entity was called as SAMBA Bank.

#### 1.1 Evolution of SAMBA

SAMBA was formed in accordance with a program adopted by the Kingdom in the mid-1970s and it was forced to sell majority equity interests to Saudi nationals. SAMBA commenced business on February 12, 1980 and closed its first fiscal year on December 31, 1980. Saudi nationals held 60% of the total share capital and Citibank acquired the remaining 40% of the equity in exchange for assets of its Riyadh and Jeddah branches. Citibank entered into a Technical Management Agreement under which it agreed to manage the new bank.

This agreement provided that Citibank would second staff to the new bank and provide technical support, and that it would not receive compensation for these services other than as a shareholder (except for reimbursement of actual expenses). Towards the end of 1991, Citibank sold part of its equity ownership in SAMBA to two Saudi national agencies for social welfare. As a result, 70% of the share capital of SAMBA was held by Saudi nationals and institutions while Citibank retained 30% ownership of the share capital of Samba. On July 3, 1999, SAMBA merged with the United Saudi Bank (USB) by exchanging 1 new share in SAMBA for each 3.25 existing shares in the USB. The merged bank retained SAMBA name and there was no change in the composition of the Board of Directors. The merger did not affect the Technical Management Agreement with Citibank.

This resulted in Citibank holding 22.83% of the merged bank shares. However, near the end of 2002, Citibank sold 2.83% of its shareholding to a Saudi agency. As a result, Citibank held 20% of the share capital of Samba. On September 14, 2003, SAMBA moved to a full local management, culminating a transition plan previously agreed with

Citigroup. On December 14, 2003, the Extraordinary Shareholders Meeting was held and resolved to amend several of the company's Articles of Association including changing the name of the company to "Samba Financial Group". On May 26, 2004, Citibank sold its 20% share capital to a Saudi agency. On March 9, 2005, the Extraordinary Shareholders Meeting decided to increase the share capital of the company from SR 4.000.000.000 to SR 6.000.000.000 divided into 600.000.000 of equal nominal value of fifty Saudi Riyals cash shares, all of which will be ordinary and as one class in all respects.

## **2. Materials and Methods**

The literature that will be surveyed addresses the question of whether or not under what conditions bank mergers have the potential to produce real efficiency gains. Adel, KabirHassan & Shari Lawrence (2008) investigates the cost and profit efficiency effects of bank mergers on the US banking industry. He used non-parametric technique of Data Envelopment Analysis (DEA) to evaluate the production structure of merged and non-merged banks. The empirical results indicate that mergers have improved the cost and profit efficiencies of banks. Further, evidence shows that merged banks have lower costs than non-merged banks because they are using the most efficient technology available (technical efficiency) as well as a cost minimizing input mix (allocative efficiency).

Ahmad Ismail, Ian Davidson & Regina Frank (2009) concentrates on European banks and investigates post-merger operating performance and found that industry-adjusted mean cash flow return did not significantly change after merger but stayed positive. Also find that low profitability levels, conservative credit policies and good cost-efficiency status before merger are the main determinants of industry-adjusted cash flow returns and provide the source for improving these returns after merger. Anthony (2008) investigates the effect of acquisition activity on the efficiency and total factor productivity of Greek banks. Results show that total factor productivity for merger banks for the period after merging can be attributed to an increase in technical inefficiency and the disappearance of economies of scale, while technical change remained unchanged compared to the pre-merging level.

Benjamin Liu & David Tripe (2002) used accounting ratios and DEA (Data Envelopment Analysis) to explore the efficiency impacts of 6 bank mergers in New Zealand between 1989 and 1998. Acquiring banks were found to be generally larger than their targets, although they were not consistently more efficient. In a majority of cases the merger led to an increase in efficiency, consistent with a trend observed for the banking sector as a whole. Bisceglia (1995) studied the merger-related cost savings and found that No evidence for economies of scale was found. A wide dispersion of average costs was found for banks of similar size. X-efficiency, or managerial, differences were found to be very large relative to scale efficiency differences. Carl Felsenfeld (2008) studied the Antitrust Aspects of Bank Mergers conference -- Banking and the Antitrust Laws -- has received insufficient attention in the legal literature.

Elena Carletti, Philipp Hartmann & Giancarlo Spagnolo (2007) modelled the impact of bank mergers on loan competition, reserve holdings, and aggregate liquidity. The merger also affects loan market competition, which in turn modifies the distribution of bank sizes and aggregate liquidity needs. Mergers among large banks tend to increase aggregate liquidity needs and thus the public provision of liquidity through monetary operations of the central bank.

George E Halkos & Dimitrios (2004) applied non-parametric analytic technique (data envelopment analysis, DEA) in measuring the performance of the Greek banking sector. He proved that data envelopment analysis can be used as either an alternative or complement to ratio analysis for the evaluation of an organization's performance. Marc J Epstein. (2005) studied on merger failures and concludes that mergers and acquisitions (M&A) are failed strategies. However, analysis of the causes of failure has often been shallow and the measures of success weak.

Morris Knapp, Alan Gart & Mukesh Chaudhry (2006) research study examines the tendency for serial correlation in bank holding company profitability, finding significant evidence of reversion to the industry mean in profitability. The paper then considers the impact of mean reversion on the evaluation of post-merger performance of bank holding companies. The research concludes that when an adjustment is made for the mean reversion, post-merger results significantly exceed those of the industry in the first 5 years after the merger.

Ping-wen Lin (2002) findings proves that there is a negative correlation and statistical significance exist between cost inefficiency index and bank mergers; meaning banks engaging in mergers tend to improve cost efficiency. However, the data envelopment analysis empirical analysis found that bank mergers did not improve significantly cost efficiency of banks. In another study, he found that (1) generally; bank mergers tend to upgrade the technical efficiency, allocative efficiency, and cost efficiency of banks; however a yearly decline was noted in allocative efficiency and cost efficiency. (2) In terms of technical efficiency and allocative efficiency improvement, the effect of bank mergers was significant; however, in terms of cost efficiency improvement, the effect was insignificant.

Robert DeYoung (1997) estimated pre- and post-merger X-inefficiency in 348 mergers approved by the OCC in 1987/1988. Efficiency improved in only a small majority of mergers, and these gains were unrelated to the acquiring bank's efficiency advantage over its target. Efficiency gains were concentrated in mergers where acquiring banks made frequent acquisitions, suggesting the presence of experience effects. SU WU (2008) examines the efficiency

consequences of bank mergers and acquisitions of Australian four major banks. The empirical results demonstrate that for the time being mergers among the four major banks may result in much poorer efficiency performance in the merging banks and the banking sector.

Suchismita Mishra, Arun, Gordon and Manfred Peterson (2005) study examined the contribution of the acquired banks in only the non conglomerate types of mergers (i.e., banks with banks), and finds overwhelmingly statistically significant evidence that non conglomerate types of mergers definitely reduce the total as well as the unsystematic risk while having no statistically significant effect on systematic risk. Xiao Weiguo & Li Ming (2008) paper uses DEA (Data Envelopment Analysis) for analyzing commercial banks' efficiency, top five American banks and four Chinese banks and concluded that merger and acquisition (M&A) has greater impact on banking efficiency of Chinese banks than that of American banks. Ya-Hui Peng & Kehluh Wang (2004) study addresses on the cost efficiency, economies of scale and scope of the Taiwanese banking industry, specifically focusing on how bank mergers affect cost efficiency. Study reveals that bank merger activity is positively related to cost efficiency. Mergers can enhance cost efficiency, even though the number of bank employees does not decline. The banks involved in mergers are generally small were established after the banking sector was deregulated.

### 2.1 Data and Methodology

This paper seeks to analyze the efficiency of the banks which are merged due to market forces (not forced by the regulator) and a comprehensive study was undertaken to investigate the performance of those banks. For this research we have considered three private banks and four nationalized banks in India (only 7 banks have merged due to market forces with in 2000) and one bank in Saudi Arabia (since only one merger has been witnessed during this period) has been taken to have a comprehensive study of the framework of entire banking industry. After considering various efficiency techniques, we have used CRAMEL model to assess the firms and also we have used Factor Analysis using Kaiser Normalization method to find out the parameters that we should look for after merger.

The data used in this study is gathered from the annual reports of banks for the post merger period 2000 to 2007. Post Merger financial Performance of the banks was taken in to consideration. The analysis is divided into two parts; namely, Regression Analysis & Factor analysis using Kaiser Normalization method was used with CRAMEL variables as the basic input. An entity specific analysis of the risk profile is done through qualitative cum quantitative approach following a structured methodology called the "CRAMEL" model. Based on the rating criteria, relative strengths and weakness of each entity in comparison to its peer group are evaluated.

The CRAMEL model consists of the following:

- Capital Adequacy
- Resource raising ability
- Asset Quality
- Management and systems evaluation
- Earning Potential
- Liquidity / Asset Liability Management

By performing tests on mean differences for the CRAMEL variables it can be determined whether there are significant differences in the average values of those variables during the post-merger period. Based on the CRISIL (**Credit Rating Information Services of India Limited**) methodology, the following variables are taken into consideration for this current study:

**Capital Adequacy:** Capital Adequacy, Debt- Equity, Advances to Total Assets, Capital buffer Ratio

**Resources:** Cost efficiency (CE), Cost/Total Asset

**Asset Quality:** Loans/ Deposits

**Management Quality:** Total Advances / deposits

**Earnings Quality:** Earnings per share, Interest Earning Ratio, Profit Margin (%), Return on Shareholders Funds (%)

**Liquidity:** Current Ratio, Solvency Ratio (%), Liquid Asset / Deposits, Liquid Asset / Total Advances

An examination of the impact of the CRAMEL model variables is done by data reduction using Factor analysis. By performing Regression analysis and t tests on the CRAMEL variables it can be determined whether there are significant relationship of those variables during the post-merger periods. Detailed description of the variables will be provided in the following section when the empirical findings are discussed. An examination of the impact of the CRAMEL –type variables is done by data reduction using factor analysis.

### 3. Empirical Findings

The results of the regression analysis conducted on CAMEL type variables (Table1) infers that, out of 16 variables considered for the study only five variables such as cost efficiency, Advances to Total Assets, interest earning ratio, Profit margin, current ratio, solvency ratio were found to be highly significant, which is evident from (table no.1) the t test. Also from the analysis of variance (ANOVA) conducted on those significant variables infers that there is a significant relationship between those variables.

Table 1: Regression Analysis

A regression equation has been developed on the significant variables which are shown below:

**Regression Equation:**

$$\text{ROSF} = 0.310 - 3.755 (\text{CE}) + 2.733 (\text{ADVTA}) - 0.0032 (\text{PM}) + 10.584 (\text{CR}) - 2.803 (\text{IER})$$

$$(4.577) \quad (-17.052) \quad (3.034) \quad (-10.357) \quad (13.729) \quad (-19.127)$$

\* note the number in brackets denote the t- values.

The regression equation infers that there is a positive relationship between ROCE and Advances to Total Assets & Current Ratio and there is negative relationship with CE, PM and IER.

#### 3.1 Factor Analysis on the CAMEL Variables

Factor analysis attempts to identify underlying variables, or factors, that explain the pattern of correlations within a set of observed variables. Factor analysis is often used in data reduction to identify a small number of factors that explain most of the variance observed in a much larger number of manifest variables. Factor analysis can also be used to generate hypotheses regarding causal mechanisms or to screen variables for subsequent analysis (for example, to identify collinearity prior to performing a linear regression analysis). The table No.2 shows the factor analysis undertaken on the CAMEL-type variables before bank merger. The variables are rotated through varimax with Kaiser Normalization method and extracted using principal component analysis. Three factors are evolved through this factor analysis.

Table 2: Factor Analysis of CAMEL-type variables on Post merger performance of Indian and Saudi Banks

From the factor analysis on the post merger performance of the Indian and Saudi banking institutions, it is found that three major factors are identified and they are interlinked. In the first factor variables like capital adequacy, Debt- equity, Cost to total Asset , Cost Efficiency and all liquidity ratios join together to form this factor. In the second factor variables like, Total advances to deposits, Capital Buffer Ratio, Loans to deposits, EPS, Return on share holders fund and interest earning ratios joined together. In the last group variables like, Advances to Total Assets, and Profit Margin ratios are joined to-gether which interprets again the profitability is majorly linked with advances and deposits.

To summarize the factors, the CAMEL type variables appropriately combine together to and clearly indicate us which are the variables that we should closely monitor. Variables such as advances to total assets, profit margin, which are grouped together is found to be highly significant variables identified through T-test. So the banks that tend to merge have to carefully analyze those two variables after merger, since they are closely associated with the performance of the banks.

### 4. Conclusion

This paper attempts to analyze the parameter which affects the post merger performance of the banks. The analysis of CAMEL-type variables using t test and further by factor analysis tends to identify the important variables such as CBR, EPS, capital adequacy and profit margin which significantly affect the performance of the mergers after the bank mergers. Also the PROXSCAL multi dimensional analysis confirms the same.

In conclusion, the results on the post merger performance of Indian and Saudi banking Institutions suggests that banks are becoming more focused on their high net interest income activities and the main reason for their mergers are to scale up their operation. Also the performance of various CAMEL type variables suggests that those banks tend to improve on various variables after the merger.

So from the analysis of CAMEL variables on the post merger performance of banks suggest that the profitability is in stake after the merger. Even though the banks tend to improve their operational efficiency, the banks have to concentrate on their profits which must be one of their merger objectives.

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Table 1. Regression Analysis on CRAMEL-type variables

Coefficients					
CRAMEL- type variables	Unstandardized Coefficients		Standardized Coefficients	t	Sig.
	B	Std. Error	Beta		
1 ROSF(Constant)	.311	.538		4.578	.067
Cost Efficiency (CE)	-3.756	.220	-1.144	-17.052	.037
Advances to total Assets (ADVtoTA)	2.734	.901	.380	3.035	.023
Profit Margin ( PM0	-.033	.003	-.873	-10.357	.061
Current Ratio (CR)	10.584	.771	2.001	13.730	.046
Interest Earning ratio (IER)	-2.803	.147	-1.794	-19.127	.033
Adjusted R Square	.995				
Durbin-Watson Score	2.266				

ANOVA					
Model	Sum of Squares	df	Mean Square	F	Sig.
1 Regression	.473	5	.095	256.391	.047
Residual	.000	1	.000		
Total	.474	6			

From the Regression analysis of CRAMEL type variables keeping return on shareholders funds (ROSF) as constant since performance is assumed to be based on the return on the funds employed. From the t values we find that out of 16 CRAMEL type variables considered for the study only 5 variables seems to be significant. Also the adjusted R Square (0.995) and Durbin- Watson Score (2.266) were found to be highly significant. Also the F test signifies that there is a significant relation between the variables.

Table 2. Factor Analysis of CRAMEL-type variables on Post merger performance of Indian and Saudi Banks

**Component Matrix**

	Component			
	1	2	3	4
Capital Adequacy (CA)	0.960	0.069	0.206	0.136
Debt- Equity (DE)	0.987	0.059	0.151	0.005
Advances to Total Assets (ADTA)	0.314	0.878	0.141	0.266
Capital buffer Ratio (CBR)	0.011	0.911	0.388	0.106
Cost efficiency (CE)	0.795	0.113	0.444	0.310
Cost/Total Asset (CTA)	0.961	0.236	0.046	0.097
Loans/ Deposits (LD)	0.286	0.708	0.543	0.289
Total Advances / deposits (TAD)	0.400	0.492	0.341	0.646
Earnings per share (EPS)	0.148	0.935	0.103	0.029
Interest Earning Ratio (IER)	0.424	0.640	0.607	0.107
Profit Margin (%) (PM)	0.048	0.064	0.315	0.810
Return on Shareholders Funds (%) (ROSF)	0.057	0.978	0.178	0.030
Current Ratio (CR)	0.833	0.163	0.426	0.210
Solvency Ratio (%) (SR)	0.098	0.100	0.949	0.279
Liquid Asset / Deposits (LAD)	0.147	0.835	0.425	0.210
Liquid Asset / Total Advances (LATA)	0.183	0.926	0.068	0.151

From the Factor Analysis on the CRAMEL- type variables it is found that 3 major factors are evolved. In the first factor variables like capital adequacy, Debt- equity, Cost to total Asset , Cost Efficiency and all liquidity ratios join together to form this factor. In the second factor variables like, Total advances to deposits, Capital Buffer Ratio, Loans to deposits, EPS, Return on share holders fund and interest earning ratios joined together. In the last group variables like, Advances to Total Assets, and Profit Margin are joined together. The Factors are grouped based on certain significance and we find that the ADTA and PM have formed a factor which is the important finding of the study, since those two variables are seemed to highly significant in regression.



## Research on the Multi-league System Independent Innovation of Enterprises as the Mainstay

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### Abstract

The implementation of multi-league independent innovation, which consists of business, government, research institutes, colleges and universities and intermediary organizations, is basically still in its infancy. According to the relationship between the independent innovation and the alliance, and the researching of the innovative elements, the paper analyses enterprise as the main body of multi-league system of independent innovation, and it offers Materials of technology management decision-making for independent innovation of enterprises and related departments

**Keywords:** Enterprise Entity, Independent innovation, Multi-league

### 1. Introduction

With enterprise's development and the changing of the competitive environment, the win-win idea of cooperation in the competition instead the traditional concept of zero-sum competition. The important role of independent innovation is also increasingly apparent. For enterprises, the innovative capacity and technology level more dependent on the degree of inter-firm alliance. Therefore, the research of multi-league independent innovation has become essential.

### 2. The summary of Enterprises league and independent innovation

#### 2.1 The definition and development of Enterprise Alliance

Enterprise Alliance can be dated back to the early industrialization, and later appeared at a variety of league forms (Wei, Nongjian & Yu, Qin, 2006, pp.5-10). Modern Enterprise league substantially emerge from the early 80's, and league really have become an effective way to make up the strategic gap. However, the practice and theoretical studies of corporate league also are the initial and spontaneous stage.

In this paper, Enterprise Alliance define as corporations and other enterprises, governments, research institutes, colleges and universities as well as the intermediary organization to set up multi-league, in order to achieve resource sharing, the risk and cost sharing, setting up cooperative relations through specific modalities.

#### 2.2 The basic connotation and influencing factors analysis of independent innovation

##### 2.2.1 The basic connotation of independent innovation

Schumpeter first proposed the concept of innovation in "economic development" theory. Many studies from different perspectives by domestic and foreign scholars have been followed. Xie Xiezheng views independent innovation is to master their own intellectual property, so that economic, technological have own characteristics (Xie, Xiezheng, 1995, pp.6-9). Hoskisson, Busenits and Lengnick-Hall and others put forward independent innovation is innovation activity through its own research and technological breakthrough (Hoskisson, R.E. and Busenitz, L.W, 1991, pp.197-227).

In this paper, the concept of independent innovation should be studied from both macro-and micro-level. The former shows that country's industrial technology development should rely on own strength to carry out independent innovation activity. The latter refers to enterprises through its technological breakthroughs to achieve innovative activity.

##### 2.2.2 Independent innovation analysis of the influencing factors

The impact factors of enterprise independent innovation have external factors and internal factors. The internal factors

play a key role.

(1) External factors

① Market demand and market competition. In period of economy rising, innovate power is weak because of expansion of market demand and weak competition. Instead, it will enhance the power of innovation. Setting up Multi-league, the capability of enterprises independent innovation will be enhanced markedly.

② Technology chain and innovation chain. Multiple leagues can be set up perfect technology and innovation chain, so that enterprises significantly improve their capability of independent innovation.

③ National innovation system. National innovation system is the basic environment of the other innovative bodies. Setting up multi-league, will stimulate and guide the country great importance on innovative development, and to provide guidance in the right direction.

(2) Internal factors

① Financial capacity. A low level of enterprise innovation is directly related to lack of investable capacity in technological innovation. Setting up Multi-league, you can raise funds from various aspects for innovation.

② Creative talents and technological capabilities. The table shows China's technological talents mainly concentrated on large and medium-sized enterprises. Setting up enterprises as the mainstay of the multi-innovation league can make up the drawback.

Insert Table 1 Here

③ Entrepreneurial mentality. Entrepreneurs lack of risk-taking and innovative spirit. Setting up alliance multiple can share risk and make entrepreneurs more courage to innovate.

### **3. The analysis of main elements of independent innovation and Development Status**

#### *3.1 The analysis of main elements of independent innovation*

##### *3.1.1 Enterprise*

The enterprises as the main body of independent innovation, is a key part of national system of innovation., therefore, A country's level of economic development depends largely on the level of enterprise self-innovation technology development.

##### *3.1.2 Government*

Government creates a good environment and provides good services for other innovations, promoting the international exchanges and cooperation various components.

##### *3.1.3 Scientific research institutes and Institutions of higher learning*

Research institutions and colleges and universities have become an important source of technological innovation and creators of new industries. So it can improve the capability of independent innovation of countries and enterprises.

##### *3.1.4 Intermediary organizations*

It plays a coordination role in the country's independent innovation, and it is an important link for setting up league between scientific researches institutions and small and medium-sized enterprises.

We can see from the above, National innovation system is mainly composed of the government, enterprises, research institutes, colleges and universities, as well as intermediaries. In the main body of these innovations, company is the main body of research and development, innovation input and output and income, and plays a key role.

#### *3.2 The status of independent innovation in our country*

With constant reforming of the economy and technology, a good trend of China's independent innovation ability is showing now (Wu, Yongmin, Bai, Yingzi, Ji, Yushan and Zhao Fang, 2006, pp.2-5).

##### *(1) Increasing investment in science and technology*

The total of the national technology fund and R & D costs reached 133.391 billion yuan and 245 billion yuan in 2005, growing 17.28% and 19.9% more than last year, and more 10 times and 20 times than 1990 respectively.

##### *(2) Growing number of researchers*

The number of scientists and engineers has a smooth growth in technological activities. Compared with 1990, respectively increase 81% and 115% in 2005.

##### *(3) Enhancing the overall level of independent innovation*

In recent years, the overall level of China's independent innovation has continually improved. The exports of high-tech products reached 218.248 billion dollars in 2005, more nearly 9 times than in 1999.

However, generally speaking, China's independent innovation capacity is still weak. Mainly manifested in lack of scientific research investment; enterprises as the mainstay, the innovation system have not yet formed; low rate of scientific research, and serious shortage of high-tech personnel.

### 3.3 Analysis of enterprises' independent innovation advantage

Enterprises as the most important innovative mainstay, its specific advantages as follows.

#### (1) Having greater flexibility

Because of organizational level clearly, a lot of internal communication, more quickly and effectively convey information, and rapid response to market, so compared with other innovations, there is greater flexibility.

#### (2) High efficiency of independent innovation

Due to strong market competition, enterprises must product new products in the short term; develop new technologies, so enterprise innovation has higher efficiency than the other innovation.

#### (3) Independent R & D capability

Most enterprises have R & D department, in particular, large corporations have abundant capital, knowledge and technology stocks, as well as a better risk-bearing capacity, and therefore the capacity of independent R & D is much larger than the other innovations.

## 4. Setting up multiple leagues' independent innovation system

### 4.1 Guiding ideology

The scientific outlook on development as the guide, set up multi-league to promote the development of technology innovation, and the leagues' independent innovation driven-leap-forward development of Country's independent innovation.

### 4.2 Construction principle

#### (1) The principle of forefront

Independent innovation demands comprehensive and accretive grasp for cutting-edge technology.

#### (2) Personnel structure optimized principle

The fundamental advantage of enterprises is a high-tech talent. We must firmly grasp talent and make good use of talents, and build qualified personnel of innovative capacity.

#### (3) Driven principles of informationization

The direction of independent innovation is more explicit for informationization. Through the deep development of information resources and extensive application of information technology, corporate improves the level of independent innovation.

### 4.3 The form of innovate alliance

The paper integrates Michael • Porter, Bernard • L Simon's theory as well as the independent innovation of China's enterprises, and give the framework of the innovation alliance by enterprises as the mainstay(Xie, Kefan and Tao, Quan, 2005, pp.17-18).

(1) Contract Alliance. The enterprises with other innovation set up the alliance by signing the agreement. The Government takes the leading role; research institutes and colleges provide talents of scientific research, and an intermediary organization plays a coordinating role.

(2) Cooperative Alliance. Enterprise forms a new independent agency with other innovations for common interests. The alliance's ability of innovating product, accessing to information and achieving value are very strong.

(3) The alliance of stock equity participation. Other innovations hold part of stocks to set up the alliance that can achieve complementary advantages, and it has very large flexibility.

(4) Informal cooperation and the international combination. Enterprises and other innovations set up alliance through technology seminars, information exchange, personnel exchange and other cooperation, or through an international unite set up alliance.

Insert Figure 1 Here

#### 4.3.1 Constitution of alliance enterprises independent innovation capacity

According to several forms of business innovation league, in Figure 4.2, league, organization, resources are seen as an input; innovation performance and innovation capability as the output; product innovation, process innovation, technology acquisition and information acquisition constitute the core of the process of innovation. From the overall

look, this is a process of input, action and output.

Insert Figure 2 Here

The model stressed the systematicness and dynamicness of the whole process of innovation. On the systematicness, this model not only reflects its own the innovative composition, but also considers the interaction between it and other elements. About the dynamicness, the innovation process is a learning process of feedback, adjustment and enhancement. Through organizational learning, discover and design innovative program to fit own enterprise.

#### 4.3.2 Enhance the multi-enterprise measures the ability of independent innovation

(1) Government should learn from international experience, quickly make taxable, monetary policy to encourage independent innovation, and create institutional mechanisms and policy environment for independent innovation.

(2) Establish the mainstay status of enterprises as independent innovation, and promote enterprise as the main body of technological innovation. Full play the main role of enterprises in independent innovation.

(3) Continue to promote the scientific research institutes reform, to strengthen the construction of Key Laboratory, to set up enterprises as the mainstay, and full play the backbone's role of the scientific research institutes and universities in independent innovation.

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Table1. The R & D input of large and medium-sized industrial enterprises (2002-2005)

Indicator	Year			
	2002	2003	2004	2005
R & D personnel (ten thousand people)	60.0	66.3	65.4	76.0
R & D expenditure (million)	560.2	720.8	954.4	1250.3
The percent of R & D personnel in the total R & D staff (%)	57.97	60.56	56.74	55.67
The ratio of R & D funding and the country's total investment in R & D (%)	43.51	46.82	48.54	51.03

Source: National Statistical Bureau, statistical data

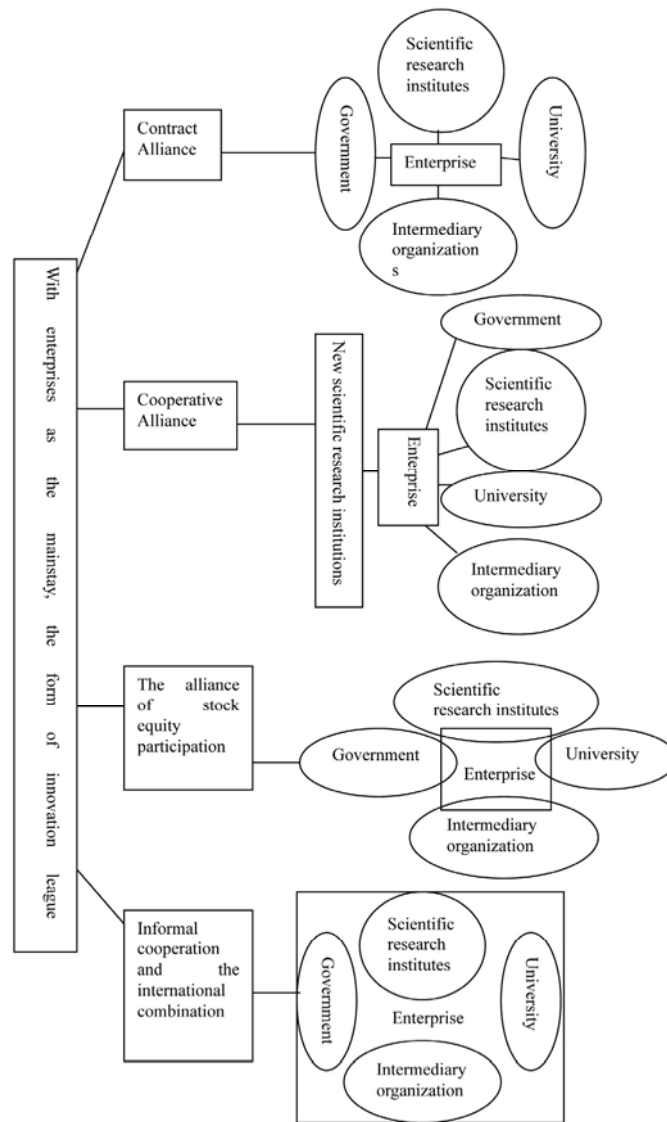


Figure 1. the icon form of Innovation Alliance

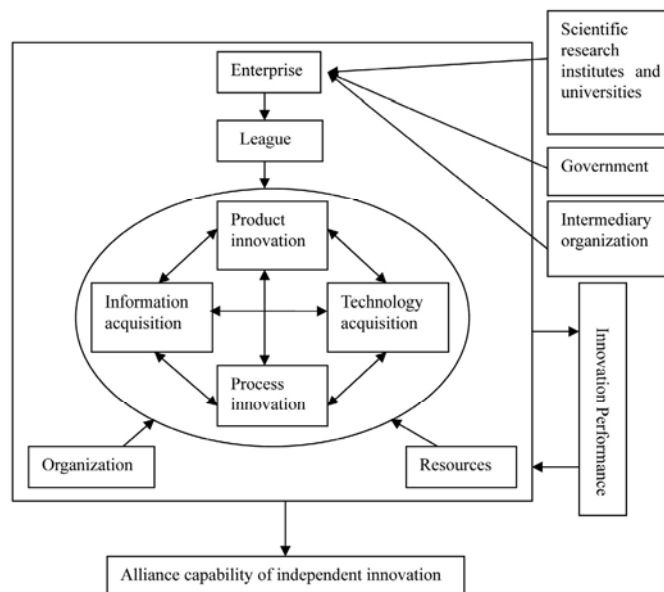


Figure 2. the positioning capability of enterprise's independent innovation theoretical model





## Malaysian and Tiger Market Linkages: An Analysis on the Long Run Relationship and Risk Diversification

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### Abstract

The fundamental argument in the Capital Asset Pricing Model (CAPM) is that the market risk is impossible to be eliminated. Investors tend to look into the possibility of diversifying their investment activities in various countries in the same region, hence, regional of equity markets. This study makes an attempt to re-examine the dynamic relationship among the Malaysian, and the Tiger markets (Hong Kong, South Korea, Singapore and Taiwan). This study adopts the Johansen multivariate cointegration test and VECM using a five-variable model and followed by the Granger causality test. The results indicate that there is a long run relationship among the five markets, and that the Hong Kong and Taiwan markets appear to be the most influential markets in this region.

**Keywords:** Malaysia, Tiger markets, Causality, Long run relationship, Risk diversification

### 1. Introduction

Studies on regional market linkages have become increasingly important for most investors. Undoubtedly, the Asian region is vulnerable to 'shocks' (i.e. financial crisis) and where the crisis is contagious, it can affect the entire region. Accordingly then, the countries in the region should become more concerned about their interdependency in the event of any occurrences of any financial turmoil. The Asian financial crisis began with the collapse of Thai baht in July 1997 and its stock market, and the subsequent erosion in Hong Kong and other Asian markets in October 1997 and as a result, the co-movement among the Asian financial markets increased.

Besides that, Ghosh, Saidi, and Johnson (1999) found that the volatility and co-movement of financial markets increased several months after the financial crisis happened. Choudhry (2001) indicated that stock returns of Asian stock markets could be predicted in the long run. Poon (2001) in his extensive work on twelve stock markets, noted that stock markets' downturn could reduce the benefits of international diversification. Chatterjee (2003) argued significant correlation among the Asian markets may not be felt especially in the presence of economic shocks due to their own returns behaviour. However, others argue that the Asian markets tend to converge towards the long term linkages. Nonetheless, it should be understood that despite its vulnerability to economic environment, the Asian region could be a major source of returns for investors if its markets linkages are clearly understood. Hence, knowledge of the Asian market linkages has to be incorporated into the international investment strategies.

Capital Asset Pricing Model (CAPM) suggested that the systematic risk, (or 'market risk'), is impossible to be eliminated. As investors become more risk averse, further risk diversification continues to be their main concern. The best step taken by investors is to invest in different countries under the concept of international diversification, where the general argument is that foreign investments offer additional profit potential while concurrently reducing the total risk of the investment portfolio. However, recent co-movements among financial markets around the world have reduced the diversification benefit. Further, world financial markets are rapidly integrating into a single global marketplace as investors are driven to developing countries in the search for higher returns and opportunities for risk diversification. To some extent, portfolio investments have been redesigned e.g. mutual funds, to cater for the risk adverse investors (Ng, 2002) and this helps to diversify the risk of investment.

## **2. Rationale of the study**

Researchers have only been interested to investigate the effect of the crisis on the market linkages and individual country's dependency on other stock markets. However, a more contemporary model is required to understand the Asian market linkages in the short run and also long run. Besides this, a few reasons may be put forward as to why this study should be carried out. First, the sample period of 1997 – 2007, in particular the aftermath of the 1997 financial crisis, may be able to offer more insightful information on both short and long run relationships between the Malaysian, Hong Kong, South Korea, Singapore and Taiwan markets (Note 1). In addition, the withdrawal of the fixed exchange rates (capital control) regime by Malaysia in 2006 (and China in 2006, effectively affecting the Tiger markets, particularly the Hong Kong market) is expected to dictate the short run relationship among the regional markets. Second, this study also paves a way for us to relate to the significance of the monetary policy, fiscal policy, political turmoil and other economic practices of each of the Asian Tigers, including effects on the Malaysian market as they can create a strong impact on the Asian markets as a whole. Third, the findings of this study could be very useful for regional and global investors for risk diversification purposes.

Investigations on direction of causality between markets may also provide fund managers and individual investors insights as to which markets to follow or avoid once certain markets start to move. If certain financial markets are seen to be on the uptrend and investment opportunities are missed in certain markets, knowledge of other markets that are correlated and especially, the direction of causality may provide similar investment opportunities elsewhere. Perhaps then, it might allow for better investment decisions to be made, with the ultimate goal being to maximize returns for a given level of risk or to minimize risk for a given level of returns.

## **3. Objective**

This study continues the work and effort of other researchers in understanding regional market linkages in particular. Hence, our objective is to re-examine the dynamic relationship and dependency among the Malaysian, Hong Kong, South Korea, Singapore and Taiwan markets.

## **4. Literature Review**

Janakiramanan et al. (1998) studied on the linkages among the stock markets of Australia, Hong Kong, Indonesia, Japan, Malaysia, New Zealand, Singapore, Thailand and the United States markets and subsequently, Cheung and Mak (1992) added Taiwan and the Philippines. Gorenzen and Franses (2000) used a graphing technique to investigate stock market correlations and their evolution over time. They did not observe a world market portfolio but rather three clusters of markets that break down along geographical lines, namely Europe, Asia and the USA. The ASEAN stock markets might be inter-related because of co-movements in the expected cash flows. This is because ASEAN economies experience aggregate economic shocks that affect all of them similarly. Masson (1998) terms this as 'monsoonal effects', where economic shocks in the developed economies can result in effect on the emerging markets. An example of a common shock that could affect all the ASEAN stock markets would be a slowdown in the US economy that causes slower economic growth in the region. Chung and Liu (1994) found that the stock markets of the USA and five Asian countries shared four common stochastic trends.

Sheng and Tu (2000) used cointegration and variance decomposition analysis to examine the linkages among the stock markets of 12 Asia-Pacific countries, before and during the period of the Asian financial crisis. The tests showed that there was no cointegration before the period of the financial crisis, and one cointegration relationship among the national stock indices during the period of the financial crisis. In addition, Granger causality test suggested that US still Granger-causes some Asian countries during the period of crisis, reflecting the US market's persisting dominant role. Masih and Masih (1999, 2002) found cointegration in the pre-financial crisis period of October 1987 among the stock markets of Thailand, Malaysia, the US, UK, Japan, Hong Kong and Singapore. But there were no long-run relationships between these markets for the period after the global stock market crash of 1987. Arshanapalli et al. (1993) noted an increase in stock market interdependence after the 1987 crisis for the emerging markets of Malaysia, the Philippines, Thailand, and the developed markets of Hong Kong and Singapore. Najand (1996), using linear state space models, detected stronger interactions among the stock markets of Japan, Hong Kong, and Singapore after the 1987 stock market crash.

Weber (2007) revealed various causality-in-variance effects between the volatilities in the national financial markets in the Asian-Pacific region (Australia, Hong Kong, Indonesia, India, Japan, South Korea, New Zealand, Philippines, Singapore, Taiwan and Thailand) for the post-crisis period 1999–2006. Cheung (1995) observed a long-run relationship among five emerging stock markets: Hong Kong, Korea, Malaysia, Singapore, and Thailand. Sharma and Wongbangpo (2002) investigated the long-term trends and cycles of stock markets in Indonesia, Malaysia, Singapore, and Thailand. They observed that the stock markets of Indonesia and Thailand are cycle dominated, and those of Malaysia and Singapore are trend dominated. Masih and Masih (1997) conclude that the markets of Japan, US, UK, and Germany drive the fluctuations in the markets of Taiwan, South Korea, Singapore, and Hong Kong. Kwan, Sim, and Cotsomit

(1995) noted that the markets of Hong Kong, Singapore, Korea, and Taiwan are not cointegrated among themselves but they are cointegrated with G-7 countries. Tan (1998) and Baig and Goldfajn (1999) investigated Southeast Asian stock markets during the period 1995 to 1998 and verifies the contagion effect during the Asian financial crisis. Moon (2001) examined and compared the behaviour of Asian stock markets after the 1997 Asian currency crisis with the behaviour of European stock markets after the 1992–93 Exchange Rate Mechanism (ERM) crises. Ratanapakorn and Sharma (2002) investigated the short-run and long-run relationships among stock indices of the US, Europe, Asia, Latin America, and Eastern Europe and Middle East for the pre-Asian crisis and for the crisis period. No long-run relationship was observed among these indices during the pre-Asian crisis period. They also inferred that only the European markets directly affected the US market, while the other regional markets indirectly influenced the US market through the European market.

Yang, Kolari, and Min (2003) examined long-run relationships and short-run dynamic causal linkages among the US, the Japanese, and ten Asian emerging stock markets, with particular attention to the 1997–1998 Asian financial crisis. In general, the results showed that both long-run cointegration relationships and short-run causal linkages among these markets were strengthened during the crisis, and that these markets have generally been more integrated after the crisis than before it. Lai et al. (1993), Richards (1995) Solnik et al. (1996), Darbar and Deb (1997), Yuhn (1997) and Francis and Leachman (1998) only incorporated Japan in their studies of international stock market linkages, Ramchand and Susmel (1998) added Singapore and Hong Kong, while Kwan et al. (1995) also included Taiwan and Korea. Cha and Oh (2000) investigated the relationship between the 2 largest equity markets in the world – the USA and Japan – and the Hong Kong, Korea, Singapore and Taiwan of the Asian emerging equity markets. They found that the links between developed markets and the Asian emerging markets began to increase after the stock markets crash in October 1987, and have significantly intensified since the outbreak of Asian financial crisis in July 1997. Sheng and Tu (2000) also examined the linkages among the stock markets of twelve Asia-Pacific countries, before and during the period of the Asian financial crisis, and found evidence in support of the existence of cointegration relationship among the national stock indices.

Divecha et al. (1992) investigated ten emerging Asian stock markets and found that they were homogenous with a dominating strong market force and less correlated with each other and with developed markets. Masih and Masih (1997) applied co-integration tests to South Korea, Taiwan, Hong Kong, and Singapore and test whether these are co-integrated with four developed stock markets (the US, UK, German, and Japanese markets). An interesting study by Ghosh et al. (1999) indicated that some of the Asian stock markets are closer to the Japanese market, while others are more linked to the US market. Chan et al. (1992) studied the inter-relationship among the stock markets of Hong Kong, South Korea, Singapore, Taiwan, Japan and the US and found that these markets are all weak form efficient but not co integrated with each other. Cheung and Ho (1993) reported the unstable correlations between the developed markets and the Asian emerging markets. By taking the exchange rate fluctuation into account, Hung and Cheung (1995) found evidence of co integration among Asian stock indices. Corhay et al. (1995) investigated the long-run relationship between major Pacific-Basin stock markets and conclude that they are co-integrated. Bailey and Stulz (1990) examined portfolio diversification across Pacific-Basin stock markets during 1977-1985 and found a high degree of correlation between US and Asian equity markets. Garret and Spyrou (1997) showed that Asia Pacific stock markets (Indonesia, Malaysia, Thailand and Philippines) had a small inter-market dependency with two exceptions, South Korea and Taiwan. Roca et al. (1998) reported that with an exception of India, ASEAN-5 markets were closely linked in the short-run but not in the long-run, and two markets (Singapore and Thailand) had strong linkages with other markets.

Ghosh et al. (1999) found that there were three types of stock markets with distinctive features during the Asian financial crisis (1997-1998): the first group (Hong Kong, South Korea and Malaysia) was mostly influenced by the US stock market; the second group (Indonesia, Philippines and Singapore) influenced by Japanese stock market, and the third group (Thailand and Taiwan) influenced by neither stock markets. Cheung and Mak (1992), Liu and Pan (1997) and Wu and Su (1998) have shown that both US and Japanese stock markets affect the stock markets of the Asian countries. Cha and Oh (200) showed that the US and Japanese markets affect Hong Kong, Korea, Singapore, and Taiwan. Another study is that of Rogers (1994), which investigated the price interactions between the equity markets of the US, Japan, Germany, UK, Taiwan, South Korea, Thailand, Mexico and Chile based on daily price data in US dollars also for the period 1986 to 1988. For East Asia, Park (2002) uses a co-integration test for six East Asian national stock markets, but did not find any meaningful evidence of integration. Roca (1999) investigated the price linkages between the equity markets of Australia and that of the U.S., U.K., Japan, Hong Kong, Singapore, Taiwan and Korea using weekly stock market data. He uses Johansen cointegration technique to determine the long run relationship between the price levels of the above countries and employed Granger causality tests to determine the short run relationships. His results indicated no cointegration between Australia and other markets. However, the Granger causality tests revealed that Australia is significantly linked with the U.S. and the U.K. Roca et al. (1998) reported that with an exception of India, ASEAN-5 markets are closely linked in the short run but not in the long run, and two (Singapore and Thailand) markets had strong linkages with other markets.

Linkages among national stock markets before and during the period of the Asian financial crisis in 1997/98 were also explored by Sheng and Tu (2000). In particular, adopting multivariate cointegration and error-correction tests, these authors focused on 11 major stock markets in the Asian-Pacific region (Australia, China, Hong Kong, Indonesia, Japan, Malaysia, Philippines, Singapore, South Korea, Taiwan and Thailand) and the US. Using daily closing prices, they found empirical evidence that cointegration relationships among the national stock indices has increased during, but not before, the period of the financial crisis.

## 5. Research Methodology

Engle and Granger (1987) introduced cointegration approaches to investigate the nature of long run equilibrium relationships. In the case of time series analysis, cointegration test is useful when two or more non-stationary series are combined for a linear relationship. Hence, they are integrated of order one (1). The main argument under the cointegration proposition is that data series may drift apart in a short run but they eventually tend to form a long run equilibrium. The details of the stock exchanges and indices considered for the study are shown in Table 1 below.

Model:

$$KLCI_t = \beta_0 + \beta_1 HSI_t + \beta_2 KOSPI_t + \beta_3 STI_t + \beta_4 TAIEX_t + u_t$$

In view of performing the cointegration tests, first, each of the five data series were tested for stationarity using the unit root test. Three techniques were used for the unit root test; Augmented Dickey-Fuller (ADF), Phillips-Perron (PP) and Kwiatkowski-Phillips-Schmialt-Shin (KPSS). All the data series must be non-stationary and integrated at I(1) for cointegration test. The details are as follows:

*Model of ADF (1981) test was used.*

$$\Delta Y_t = \alpha + \phi Y_{t-1} + \delta T + \sum_{i=2}^p \beta_i \Delta y_{t-i-1} + \varepsilon_i$$

$$\Delta Y_t = \alpha + \phi Y_{t-1} + \sum_{i=2}^p \beta_i \Delta y_{t-i-1} + \varepsilon_i$$

Where  $Y_t$  = variable in period  $t$ ,  $t$  = time trend,  $\varepsilon_t$  = i.i.d. disturbance with mean 0 and variance  $\sigma^2$ ; that is,  $[\varepsilon_t - NI(0, \sigma^2)]$ .

Another form of unit root hypothesis was PP test. PP test allowed us to estimate serial correlation and error variance.

$$\frac{1}{N} \sum_{t=1}^N \hat{\varepsilon}_t^2 + \frac{2}{N} \sum_{t=1}^N \varpi(s, l) \sum_{t=s+1}^N \hat{\varepsilon}_t \hat{\varepsilon}_{t-s}$$

Where  $\hat{\varepsilon}$  is truncation lag parameter; and  $w(s, l)$  is a window that is equal to  $1 - s/(l + 1)$ .

As for KPSS test could be illustrated as follows;

To obtained the residual test for unit root, the model below was applied.

$$X_t = \beta_0 + \beta_1 Y_t + \varepsilon_{x,t}$$

$$Y_t = \beta_0 + \beta_1 Y_t + \varepsilon_{y,t}$$

ADF test without drift and time trend was applied as follows:

$$\Delta \hat{\varepsilon}_t = a_1 \hat{\varepsilon}_{t-1} + \sum_{i=1}^k a_{i+1} \Delta \hat{\varepsilon}_{t-i-1} + \varepsilon_t$$

Where  $\Delta \hat{\varepsilon}$  was include the  $\varepsilon_{x,t}$  or  $\varepsilon_{y,t}$  and the  $H_0 : a_1 = 0$

After determining the non-stationarity of data, the cointegration test was then initiated. The cointegration test in this study followed the means and method as developed by Johansen and Juselius (1990). Finally, we applied Granger's [1969] causality test to identify the interdependency among the financial market under investigation. There were also some past studies that adopted this test for the same purpose such as Arshanpalli and Doukas (1993), Malliaris and Urrutia (1992) and Mathur and Subrahmanyam (1990).

*Error correction model (ECM) from Engle and Granger (1987)*

$$\Delta \chi_t = \beta_1 + \sum_{i=1}^{n1} \beta_{11}(i) \Delta \chi_{t-i} + \sum_{j=1}^{n2} \beta_{12}(j) \Delta y_{t-j} + \beta_s(\varepsilon_{t-1}) + \eta_t$$

$$\Delta y_t = \beta_2 + \sum_{i=1}^{n3} \beta_{21}(i) \Delta \chi_{t-i} + \sum_{j=1}^{n4} \beta_{22}(j) \Delta \chi_{t-j} + \beta_f(\varepsilon_{t-1}) + \eta_t$$

$\varepsilon_{t-1}$  =  $n \times t$  vectors of error correction terms represents the previous period's disequilibrium ( $y_{t-1} - \alpha_1 X_{t-1}$ ),  $\eta_t$  =  $n \times t$  vectors of residuals.

#### *Granger Causality Test and Vector Error Correction Model (VECM)*

Causality test should incorporate co-integration test involving two or more data series and error correction term (ECT) in order to avoid the misspecification (Granger, 1981) and hence, co-integration testing by Engle and Granger (1987), Johansen and Juselius (1990) is significantly important in performing granger causality test.

#### *Impulse Responses Functions (IRF) and Variance Decomposition (VDC)*

While VECM provides causality outcome within the sample period, variance decomposition (VDC) is used to describe the causality outside of the sample estimation. It offers information about the relative importance of each random shock to the variable in the VAR. Meaning, it tends to show the percentage of forecast error variance for each of the index selected that may attribute to its own shocks and to fluctuations in other indices. IRF measures the predictable response to a one –standard deviation shock to one of the indices in the model. Indirectly, it shows the future path of these indices' changes in response to the shock. Choleski approach was used to orthogonalize all innovations or shocks. The Generalized Impulse Response Functions (GIRFs) were used as the literature, to some extent, did not offer a clear ordering of indices used in the model.

#### *Data Collection*

This study adopted daily data of composite indices for the five countries selected for this study. Some researchers had applied daily data to better keep track of the dynamic of international transmission (Hamao et al., 1990; Koutmos and Tucker, 1996; Dwyer and Hafer, 1988). Daily data is better than weekly or monthly data because the intervals of daily data allow the underpinning of interrelations that conclude within one or only a few days (Stivaktakis et al., 2006). This study covered the period of 1997 to 2007 and thus, data were collected accordingly.

### **6. Empirical Findings**

Figure 1 below shows the pattern of the movements of the five indices over the period 1997 to 2007 and Table 2 presents the descriptive statistics of the five data series. Three types of stationarity test were used; Augmented Dicky-Fuller (ADF), Phillips-Perron (PP) and Kwiatkowski-Phillips-Schmialt-Shin (KPSS). The results of the tests are shown in Table 3 below. In the case of ADF and PP, we failed to reject the null hypothesis of non-stationarity at level involving intercept and intercept and trend. KPSS test showed consistent results as we rejected the null hypothesis of stationarity at level under intercept and intercept and trend. Very importantly, the stationarity test on residual will be another significant step in moving forward for cointegration testing. The results were very consistent between ADF and PP, thus, the residual was stationary or  $I(0)$  as given in Table 3. This allowed us to proceed for cointegration test.

#### *Cointegration Test*

As for multivariate analysis, two tests have been suggested in determining cointegration rank;  $\lambda_{\max}$  and  $\lambda_{\text{trace}}$  (Johansen, 1988; Johansen and Juselius, 1990) with the details of the results given in Table 5 below. The results, indicate that there is evidence that two cointegrations exist among the stock exchanges (under both techniques) as the null hypothesis of no cointegration vector hypothesis ( $r=0$ ) is rejected at 5 per cent significance level involving all the lags.

The results in Table 5 are consistent with our general expectation where the Malaysian and Tiger markets will have a long run relationship. The cointegrating indices should have an error correction representation. By furthering the analysis using the VECM approach, we would be able to detect the direction of the Granger causality relationship as shown in Table 6. The adoption of the right VECM is dependent on the AIC or BIC criteria in line with the number of lags being considered here. As this study involved daily data, obviously there was a need to incorporate more lags in the analysis. Misspecification resulting from this model must also be taken into consideration for other test (Masih and Masih, 1997a and 1997b).

#### *Granger causality test*

Table 6 confirms that there is a short run relationship among the equity markets before they converge into the long run equilibrium relationship. Based on Table 6, over the period 1997-2007, Hong Kong, South Korea and Taiwan did granger cause Malaysia at the lag model (lag 5, with the lowest AIC). These findings seemed to be almost similar at lag 6 and 7. In the case of Singapore, it was the Malaysian market that affected the Singapore market. Additionally, there was a two-way granger causality between Malaysia and Taiwan.

As to further our analysis on GIRF and VDC, a stability test was considered to check on the best VECM sample (lag 5) using the CUSUM test which statistically supports the linear stability on transformed data as given in Figure 2 below. This can be accomplished by taking Malaysia as a dependant variable and the Tiger markets as independent variables, coupled with the use of the OLS approach. As it enhances the robustness of the findings in VECM, we can conclude that our forecast via GIRF and VDC would offer more insights.

*GIRF and VDC*

An analysis of GIRF is presented in Figure 3 below with a consideration of 150 days to check on the shocks. It seems shocks in Hong Kong will give impact on the Malaysian market for at least 100 days before it becomes stable. Surprisingly, impact of shocks in Singapore on Malaysia is perceived to be quite serious as it leads to negative returns though Singapore does not granger cause Malaysia. Both South Korea and Taiwan share the same magnitude in terms of the impact of their instability on the Malaysian market. However, shocks in the Malaysian market will have a serious impact on the Singapore market, but the Tiger markets do not see Malaysia as a major threat.

The results of VDC are presented in Table 7. An extended 'ten to one hundred-fifty days' period was employed to convey a sense of dynamics of the system. Malaysia seems to be somewhat endogenous as only 64 per cent explained by itself at period 50 and reduced to 43 per cent at period 150. Hong Kong remains very strong on its exogeneity as 90 per cent of the variation is explained by itself and probably about 4 per cent is explained by Taiwan. South Korea is also said to be exogenous as even at period 150, 83 per cent is explained by itself and about 8 per cent explained by Taiwan. Singapore is an endogenous market as only 9 per cent explained by itself, thus regional performance is essentially important for the Singapore market. Taiwan seems to be exogenous as the earlier discussions show that there were two-way granger causality between Taiwan and other Tiger markets.

## 7. Conclusion and Implications

This study encompasses co-integration test in the VAR framework, granger causality to determine the direction of the relationship of the stock indices on a bivariate basis, followed by GIRF and VDC. Evidence from co-integration reiterates the fact that there is a long-run relationship among the regional stock markets though such relationships appear to be weak in the short-run. Specifically, we may conclude that there appears to be some linkages between the Malaysian market and the Tiger markets. In particular, we found that the Hong Kong, South Korea and Taiwan markets influenced the Malaysian stock market. Conversely, the Malaysian market affected the Singaporean market. Also, our findings demonstrate that for all of the five stock markets sampled, the Hong Kong and Taiwanese stock markets demonstrated strong exogenous characteristics. Hence, fund managers and individual investors are advised to take Hong Kong and Taiwanese stock markets as the main reference point, and if there shall exist any abnormal or 'shock' effects in these markets, the other markets are likely to follow thereafter. Fund managers and individual investors henceforth may use this result to assist in their investment decision-making process.

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## Notes

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Table 1. Stock Indices under investigation

Country	Stock Exchange	Index
Malaysia	Bursa Malaysia (Kuala Lumpur Stock Exchange)	KLCI
Hong Kong	Hang Seng Index	HSI
South Korea	Korea Composite Stock Price Index	KOSPI
Singapore	Straight Time Index	STI
Taiwan	Taiwan Capitalization Weighted Stock Index	TAIEX

Table 2. Descriptive Statistics

Details	Malaysia	Hong Kong	South Korea	Singapore	Taiwan
Mean	6.662242	9.492830	6.691905	7.543534	8.781363
Median	6.668559	9.498870	6.669726	7.549459	8.768409
Maximum	7.272669	10.36212	7.632813	8.259911	9.230359
Minimum	5.571013	8.803938	5.634790	6.690892	8.145045
Std. Dev.	0.268477	0.269904	0.419914	0.279799	0.224725
Skewness	-0.237911	0.370564	0.051353	0.076588	-0.167481
Kurtosis	3.880228	3.125489	2.790912	3.263737	2.419216
Jarque-Bera	107.4629	60.64532	5.824587	9.984119	48.24738
Probability	0.000000	0.000000	0.054351	0.006792	0.000000

Table 3. Stationary test on Indices at level

Markets/Tests	Intercept			Intercept and trend		
	ADF	PP	KPSS	ADF	PP	KPSS
Malaysia	-1.309964	-1.267148	2.322857*	-2.800323	-2.720693	0.50727*
Kong Kong	-0.7463	-0.5085	2.2040*	-1.7166	-1.4848	0.7443*
South Korea	-0.5507	-0.5446	4.1066*	-2.7815	-2.6328	0.4948*
Singapore	-0.7368	-0.6786	2.7158*	-2.0817	-2.0337	0.7537*
Taiwan	-1.9115	-1.9470	1.2060*	-1.7641	-1.8326	1.0904*

Notes: For ADF and PP, (\*) Rejection of the null hypothesis at 5% and therefore all indices are stationary at I(1). KPSS indicates rejection of the null hypothesis of stationarity. Thus, the results are very consistent.

Table 4. Stationary test on residual at level

	None (No intercept, No intercept and trend)
	ADF
Residual	-5.412557*
	PP
	-5.412557*

Notes :(\*) Rejection of the null hypothesis at 5% and therefore the residual is stationary.

Table 5. Johansen and Juselius Cointegration test

Null Hypothesis	$\lambda_{\max}$	5%	$\lambda_{\text{trace}}$	5%
Lag Length = 1				
r = 0	133.7862*	33.87687	200.026*	69.81889
r < 1	42.19605*	27.58434	66.23978*	47.85613
r < 2	18.35974	21.13162	24.04373	29.79707
r < 3	5.090959	14.2646	5.683991	15.49471
r < 4	0.593032	3.841466	0.593032	3.841466
Lag Length = 2				
r = 0	131.5209*	33.87687	191.2152*	69.81889
r < 1	38.06762*	27.58434	59.70427*	47.85613
r < 2	15.65694	21.13162	21.63665	29.79707
r < 3	5.33512	14.2646	5.979707	15.49471
r < 4	0.644588	3.841466	0.644588	3.841466
Lag Length = 3				
r = 0	100.5004*	33.87687	160.1363*	69.81889
r < 1	36.74961*	27.58434	59.63589*	47.85613
r < 2	16.3838	21.13162	22.88627	29.79707
r < 3	5.716924	14.2646	6.50247	15.49471
r < 4	0.785546	3.841466	0.785546	3.841466
Lag Length = 4				
r = 0	85.86317*	33.87687	138.1229*	69.81889
r < 1	31.72035*	27.58434	52.25938*	47.85613
r < 2	14.37939	21.13162	20.53938	29.79707
r < 3	5.396575	14.2646	6.159989	15.49471
r < 4	0.763414	3.841466	0.763414	3.841466
Lag Length = 5				
r = 0	82.65687*	33.87687	136.1704*	69.81889
r < 1	33.11441*	27.58434	53.51357*	47.85613
r < 2	14.20983	21.13162	20.39915	29.79707
r < 3	5.480772	14.2646	6.189321	15.49471
r < 4	0.708549	3.841466	0.708549	3.841466
Lag Length = 6				
r = 0	77.76276*	33.87687	128.9746*	69.81889
r < 1	30.77154*	27.58434	51.21185*	47.85613
r < 2	13.98134	21.13162	20.44031	29.79707
r < 3	5.930268	14.2646	6.458972	15.49471
r < 4	0.528704	3.841466	0.528704	3.841466
Lag Length = 7				
r = 0	76.52705*	33.87687	126.6405*	69.81889
r < 1	30.00385*	27.58434	50.11349*	47.85613
r < 2	13.42551	21.13162	20.10963	29.79707
r < 3	6.111787	14.2646	6.684127	15.49471
r < 4	0.57234	3.841466	0.57234	3.841466
Lag Length = 8				
r = 0	74.70305*	33.87687	124.6094*	69.81889
r < 1	31.14699*	27.58434	49.90632*	47.85613
r < 2	11.96669	21.13162	18.75933	29.79707
r < 3	6.290106	14.2646	6.792635	15.49471
r < 4	0.502529	3.841466	0.502529	3.841466

\* significance level at 5%.



Table 6. Granger Causality test in VECM

Dependent Variables	Malaysia	Hong Kong	South Korea	Singapore	Taiwan
Lag Length = 1 AIC = -26.63937					
Malaysia		1.822922	3.816135	16.97532*	0.627335
Hong Kong	1.936825	1.043655	0.000169	3.202102	5.058663*
South Korea	0.506968	0.288751	0.270442	0.416726	9.997825*
Singapore	0.293876	1.889241	10.83382*	1.63937	3.033397
Taiwan	0.473585				
Lag Length = 2 AIC = -26.67638					
Malaysia		2.304355	13.65316*	89.88269*	0.954146
Hong Kong	3.747051	2.472186	6.26886*	20.24973*	5.088646
South Korea	3.393829	0.86981	0.707421	1.127462	9.327409*
Singapore	2.049785	7.615695*	13.15565*	1.06008	7.299749*
Taiwan	5.164818				
Lag Length = 3 AIC = -26.70062					
Malaysia		5.352858	12.64281*	85.42876*	4.70194
Hong Kong	23.6563*	7.550722	11.02374*	32.69738*	8.256392*
South Korea	11.85257*	0.374906	4.240115	2.289461	12.62815*
Singapore	2.438316	10.33146*	17.03563*	3.644616	10.13064*
Taiwan	8.134086*				
Lag Length = 4 AIC = -26.73424					
Malaysia		6.675597	10.63469*	83.30373*	4.77408
Hong Kong	41.55576*	8.108227	15.21423*	43.8357*	12.18906*
South Korea	14.16427*	0.485488	5.902871	3.665783	13.41971*
Singapore	1.452398	17.75633*	33.36109*	3.089001	10.42745*
Taiwan	9.345346				
Lag Length = 5 AIC = -26.73497					
Malaysia		7.469272	10.11101	88.83888*	11.76015*
Hong Kong	39.92697*	8.436799	19.26291*	42.50663*	14.898*
South Korea	13.0743*	1.267872	11.92913*	4.460457	14.25682*
Singapore	1.525132	17.55972*	43.40528*	3.095599	6.970059
Taiwan	10.42115*				
Lag Length = 6 AIC = -26.72888					
Malaysia		7.873938	10.99687	85.31846*	13.99181*
Hong Kong	40.59751*	11.25546	22.08787*	46.74536*	16.67932*
South Korea	14.70119*	3.504841	13.31619*	5.718437	14.81939*
Singapore	1.70851	20.37151*	45.13153*	4.21186	10.98481
Taiwan	13.64847*				
Lag Length = 7 AIC = -26.72241					
Malaysia		9.511444	10.63786	86.17011*	14.05916
Hong Kong	39.17962*	12.24855	22.92453*	46.99063*	16.75503*
South Korea	14.57845*	12.30377	13.84804	6.737552	16.42205*
Singapore	1.645406	22.95167*	49.61575*	4.992936	13.2276
Taiwan	19.4593*				
Lag Length = 8 AIC = -26.71822					
Malaysia		10.59417	11.81015	86.77005*	13.47206
Hong Kong	38.31336*	15.52487*	22.42934*	48.67633*	16.64605*
South Korea	15.47629	14.29116	13.68947	12.1501	16.57307*
Singapore	2.280444	36.24997*	49.18756*	6.017084	13.14278
Taiwan	23.03117*				

\* significance level at 5%

Table 7. Variance Decomposition of various countries – Malaysia (MAL), Hong Kong (HK), South Korea (SK), Singapore (SING), Taiwan (TAIW)

MAL Period	S.E.	MAL	HK	SKOR	SING	TAIW
1	0.016387	100.0000	0.000000	0.000000	0.000000	0.000000
2	0.023520	99.91229	0.055415	0.000925	0.003330	0.028045
3	0.029144	99.52135	0.289187	0.014178	0.027747	0.147535
4	0.033953	98.41099	1.085749	0.078382	0.061251	0.363623
5	0.037460	96.51432	2.515696	0.233309	0.168727	0.567945
6	0.041018	95.02949	3.406181	0.413687	0.289035	0.861610
7	0.044285	93.71248	4.151267	0.609427	0.407692	1.119130
8	0.047339	92.55160	4.774243	0.765468	0.539149	1.369539
9	0.050311	91.55217	5.237141	0.903226	0.681854	1.625605
10	0.053069	90.55661	5.724707	1.033787	0.844805	1.840089
50	0.125882	63.61568	16.92690	5.666291	9.124227	4.666899
80	0.165488	53.40373	20.50503	7.631689	13.19062	5.268928
100	0.188421	49.24541	21.90540	8.444842	14.91943	5.484919
150	0.237404	43.33254	23.85606	9.609963	17.42951	5.771922
HK Period	S.E.	MAL	HK	SKOR	SING	TAIW
1	0.016939	0.077123	99.92288	0.000000	0.000000	0.000000
2	0.024197	0.216491	99.73671	0.019336	0.000949	0.026511
3	0.029110	0.293334	99.33540	0.139301	0.003193	0.228775
4	0.034235	0.238393	98.91699	0.387195	0.013822	0.443596
5	0.038478	0.192259	98.24429	0.665013	0.024517	0.873921
6	0.041923	0.173112	97.52016	0.942704	0.055132	1.308890
7	0.045251	0.157439	97.01400	1.120638	0.083643	1.624281
8	0.048413	0.149141	96.63708	1.213358	0.106266	1.894158
9	0.051376	0.146852	96.33786	1.273341	0.131170	2.110776
10	0.054260	0.142794	96.11573	1.318259	0.157423	2.265794
50	0.129225	0.040569	92.75652	2.497653	1.197146	3.508115
80	0.167501	0.049092	91.65953	2.906836	1.718900	3.665640
100	0.189257	0.058432	91.18769	3.079465	1.953123	3.721289
150	0.235504	0.076591	90.48254	3.334606	2.309570	3.796694
SKOR Period	S.E.	MAL	HK	SKOR	SING	TAIW
1	0.021204	0.056291	0.002094	99.94162	0.000000	0.000000
2	0.030799	0.165355	0.001742	99.63476	0.000166	0.197975
3	0.037302	0.495635	0.067634	99.05655	0.019226	0.360958
4	0.042606	0.746377	0.290946	98.22212	0.016297	0.724255
5	0.047226	0.997898	0.697497	96.61756	0.016171	1.670870
6	0.051322	1.254979	1.295865	94.56773	0.081212	2.800211
7	0.055203	1.382680	1.788408	93.06591	0.133007	3.629995
8	0.058918	1.446010	2.162090	91.95415	0.162791	4.274958
9	0.062464	1.493270	2.446017	91.13079	0.188326	4.741601
10	0.065840	1.530252	2.651973	90.53311	0.208795	5.075873
50	0.150844	1.462242	4.965898	85.06343	0.812491	7.695940
80	0.193172	1.295974	5.475333	84.19501	1.088751	7.944928
100	0.217154	1.223086	5.681279	83.85667	1.213079	8.025890
150	0.268184	1.113396	5.982604	83.36852	1.404238	8.131238
SING Period	S.E.	MAL	HK	SKOR	SING	TAIW
1	0.013496	0.110052	0.057821	0.003902	99.82822	0.000000
2	0.019710	0.582899	0.092928	0.002268	99.31265	0.009255
3	0.024249	2.459086	0.276802	0.007331	97.22498	0.031802
4	0.027994	3.642114	0.213312	0.008059	96.11002	0.026493
5	0.031219	4.712718	0.520505	0.006945	94.72076	0.039068
6	0.033973	5.840297	0.893696	0.044732	93.16739	0.053887
7	0.036354	6.444011	1.415479	0.141580	91.91923	0.079700
8	0.038500	6.823357	2.054952	0.290401	90.70020	0.131087
9	0.040435	7.027776	2.677849	0.501944	89.59096	0.201465

10	0.042196	7.128418	3.307984	0.753402	88.52333	0.286861
50	0.086689	2.861031	35.82353	18.14055	38.53052	4.644364
80	0.118541	2.016125	46.21050	25.01316	20.78824	5.971976
100	0.138307	1.926677	49.23474	27.19495	15.29008	6.353550
150	0.181193	1.964204	52.51287	29.70943	9.050237	6.763252
TAIW						
Period	S.E.	MAL	HK	SKOR	SING	TAIW
1	0.015958	0.237740	0.029081	0.279529	0.012830	99.44082
2	0.022922	0.337871	0.036235	0.670315	0.006750	98.94883
3	0.028429	0.319482	0.035924	0.786815	0.035190	98.82259
4	0.033370	0.480896	0.040820	0.658629	0.135360	98.68429
5	0.037353	0.638107	0.108084	0.542127	0.223032	98.48865
6	0.040963	1.005515	0.277140	0.460053	0.264992	97.99230
7	0.044332	1.306362	0.456487	0.403654	0.282302	97.55119
8	0.047457	1.497485	0.620641	0.370548	0.283456	97.22787
9	0.050423	1.640186	0.759219	0.361837	0.278347	96.96041
10	0.053243	1.715199	0.872289	0.366130	0.269625	96.77676
50	0.123065	1.652231	2.556664	0.790057	0.107967	94.89308
80	0.157262	1.420217	3.121771	1.034498	0.183846	94.23967
100	0.176612	1.318488	3.366638	1.146717	0.234866	93.93329
150	0.217790	1.165295	3.737265	1.320955	0.326196	93.45029

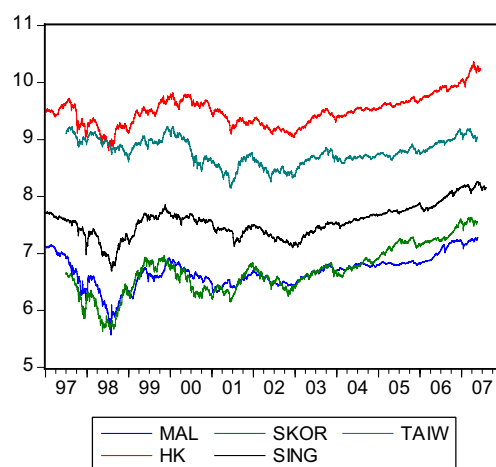


Figure 1. Line Graph of the Malaysian

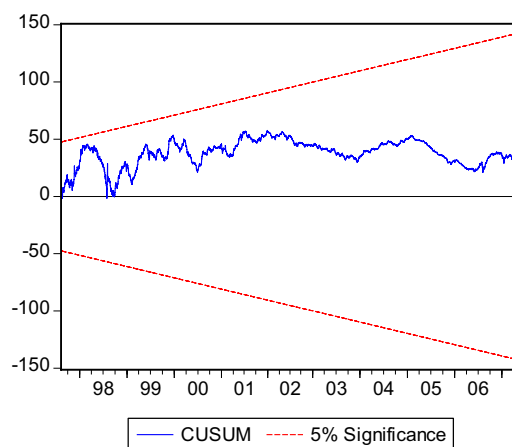


Figure 2. CUSUM Test

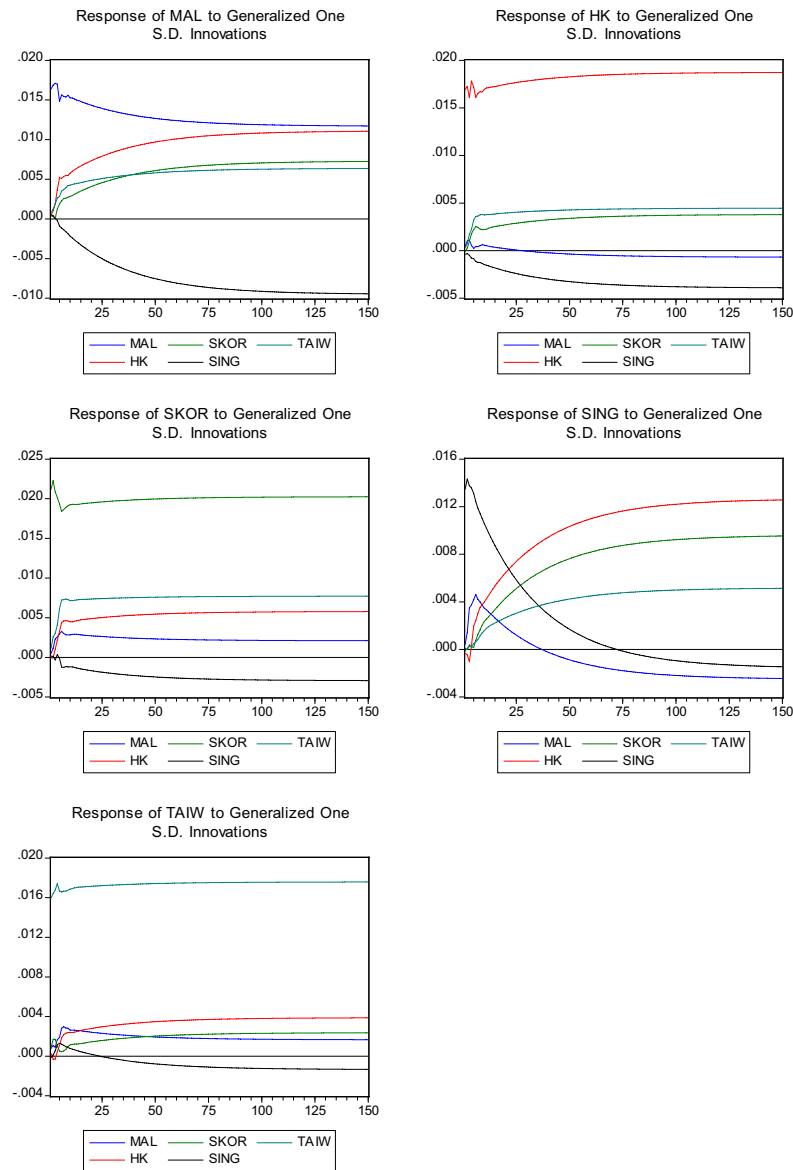


Figure 3. Generalized Impulse Response Functions of One Standard deviation Shocks/Innovations



## The Relationship between Regional Trading Blocs and Globalization

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### Abstract

Over the years, countries throughout the world have formed many regional trading blocs, and there is no doubt that they play an important role in the world economy and trade. Since trading blocs came into being, there has been much discussion on their effects on globalization, which is the other important trend in the world economy development apart from regionalization. In this thesis, this issue will be reviewed and analyzed and finally a conclusion will be reached.

**Keywords:** Trading blocs, Globalization, Regionalization

### 1. The motivation to establish regional trading blocs: competing with the outside world

Looking through the world since the 1960s, we can see that an important motivation of the formation and development of regional trading blocs is to compete with the outside world.

After the World War II, the Western European countries had once been very dependent on the United States (the U.S.), which charged something else from them. Therefore, since their economy recovery after the 1960s, they began to search for economic and political independence. Another important fact that stimulated the process of their cooperation is Japan's fast economic development. In order to compete with the U.S. and Japan and some other developed countries, the Western European countries started to search for ways of cooperation in many fields in the early 1960s.

Since the 1980s, there have been plenty of changes of the strengths of the main economically strong countries. These changes, especially Japan's fast development, made some other developed countries search for the protection of regional trading blocs, which could preserve their economic interest and prevent the loss of their competitive edge. At the same time, more and more developing countries also had to do the same thing out of their dissatisfaction with the unfair and unbalanced economic situation.

On 12 April 1989, "The Delors Committee presented the report on the economic and monetary union." (The History of the European Union 2008) On 2 October 1997, "The Ministers for Foreign Affairs of the Member States of the European Union signed the Treaty of Amsterdam" (The History of the European Union 2008), which cleared away the last obstacle to the euro and provided it with a legal guarantee.

The fast development of the European Union (EU) and Japan reminded the U.S. of its relative falling position in the world economy. According to Mason and Turay, "business and political leaders saw that the USA was becoming less and less competitive with Japan and the EC.... in the 1970s and 1980s US manufacturers lost their strong market positions in several key sectors, including consumer electronics, commercial aircraft, apparel, machine tools, semi-conductors and automobiles." (Mason and Turay, 1994, p. 17) Finding that its role in the multilateral talks in the General Agreement on Tariffs and Trade (the GATT) less important than before, the U.S. began to think about Canada and Mexico, two of its closest countries. At the same time, Canada and Mexico also hoped that their products could enter the American market and that they could attract more of the American investment. "Both Canada and Mexico have had difficult economic and political relations with the USA, but each wants NAFTA more than the USA itself." (Mason and Turay, 1994, p.18) Therefore, in 1992, the three countries formed the North American Free Trade Agreement (the NAFTA). This was the first time a regional trading bloc made up of countries with a considerable disparity between them came into being.

On 8 August, 1967, Thailand, Indonesia, Malaysia, Singapore and the Philippines formed an organization called the Association of Southeast Asian Nations (the ASEAN). Later, other states Brunei, Vietnam, Laos, Myanmar and Cambodia joined. Being faced with the keen competition among the U.S., Japan, China and some other big countries, these relative small countries found that the only way to ensure their security and competitiveness is to unite and cooperate.

### 2. Regional trading blocs' effect on globalization

#### 2.1 Regionalization is changing the pattern of world economy

In recent years, regionalization has been more and more popular and common in the world. For America, the NAFTA

has achieved a positive result. For Europe, “one in eight numbers of the United Nations (UN) is the member of the EU. Europe is an equal partner to the United States in trade negotiations.” (the Foreign & Commonwealth Office, 2005, p. 15) And the launching of euro has an epoch-making significance to the world economy. For Asia-Pacific region, the Asia-Pacific Economic cooperation has become one of the most influential forums. In Southeast Asia, the ASEAN member countries have obviously strengthened their cooperation in economic fields.

The formation of the NAFTA, the EU, the Asia-Pacific Economic Cooperation (the APEC), the ASEAN and other regional trading blocs have to some extent changed the pattern of world economy and trade. There is no doubt that the increase of the dependence of the member countries on the regional trade blocs and their negotiating abilities towards the outside world will bring keener competition to the world, which proves to be harmful to globalization.

### *2.2 Regionalization has created new trade barriers*

One of the purposes of the establishment of trading blocs is to arrange easier trade within the regions, and to increase the economic efficiency and the competitiveness of their productions. The free trade or relative free trade among the member states will surely increase their dependence on each other, which will promote regionalization. For example, since the establishment of the NAFTA, the trade among the U.S., Canada and Mexico has been more than doubled, and the economic cooperation in this region will be increased in the future.

While the World Trade Organization (the WTO) is trying to eliminate trade barriers throughout the world, trading blocs are maintaining and even increasing them under the name of regional cooperation. While trading blocs are giving their member states more interest, they are building trade barriers to the outside world and preventing other countries' and regions' productions from importing. When they have satisfied their member states, they have also damaged the foundation of global cooperation and increased the difficulties of negotiations between countries, thus blocking the real “globalization”.

Certainly, there are other effects of trading blocs on globalization except the above two, such as causing international political confrontation, speeding the readjustment of each country's industrial setup, promoting direct investment and arranging keener competitiveness in international trade. Regional trading blocs do have a wide and far-reaching influence.

### **3. The definitions of “trading blocs” and “globalization”**

According to what is stated above, it seems that regional trading blocs are bound to be a barrier to globalization. However, there are other things which have not been viewed.

What was talked above was all temporary fact. Now it is necessary to look at some intrinsic and basic things. First of all, the relationship between trading blocs and globalization will be looked into from their definitions. “A trade bloc is a large free trade zone or near-free trade zone formed by one or more tax, tariff and trade agreements.” (Trade bloc, 2008) “Globalization describes the changes in societies and the world economy that result from dramatically increased international trade and cultural exchange. It describes the increase of trade and investing due to the falling of barriers and the interdependence of countries. In specifically economic contexts, the term refers almost exclusively to the effects of trade, particularly trade liberalization or “free trade”.” (Globalization, 2008) From their definitions, there seems no difference in their natures. Both of them pursue “free trade” between countries while the main difference lies in their scopes. To be more precise, the former one is regional and the latter is global.

Virtually, as what is discussed above, “free trade” is much more practiced in regional trading blocs than on the global level. e.g. The EU as the most famous regional trading bloc has not only formed a market in which essential factors of production can be traded freely, but also launched a common currency called euro, which is of great significance to regionalization. But the WTO has only reduced tariffs and restricted some non tariff barriers. Obviously, the global free trade is not as developed as the regional free trade.

However, it cannot be deduced that trading blocs are a barrier to globalization from the above facts. Because the trading blocs which first appeared as early as fifty years ago did not stop or even slow the process of globalization. The multilateral talks of the WTO and its predecessor, the GATT, constantly reached many agreements. Though there were difficulties and contradictions in these talks, the results proved to be good. The GATT has become the WTO and the world free trade has been achieved better than ever in many fields. Since the 1990s, the world market which based upon market mechanism has been formed as well as a global financial market.

### **4. The interest of countries**

Generally, when the relationship between trading blocs and globalization is discussed, countries are the very basic members and factors of international trade organizations and are of great importance. No matter what a country does, should it be joining regional trading blocs or multilateral talks, its ultimate purpose is to get as much economic interest as possible from it. This purpose is beyond all others, e.g. the so-called regional economic interest and global economic interest.

A country joins a regional trading bloc not because of the abstract supranational “regional interest”, but because it wants to reach its economic, political and other purposes with the power of the bloc. It cannot be denied that in order to compete with the EU and Japan, the U.S. formed the NAFTA with Canada and Mexico. Under the pressure brought by the EU and the NAFTA, Japan also strongly promotes the economic cooperation among the East Asian countries. Another good example is the ASEAN, which consists of smaller countries, because each of them does not have sufficient strength to compete with big countries, they hope that they will have it by getting together. On the contrary, if the regional trading blocs cannot give what their member countries want, there would most probably be problems that will slow the process of regionalization. For instance, the reason why Germany and France compete for the regional economic leadership and the UK is out of the euro system, is that the above three countries’ interests conflict with the whole region’s interest.

Many countries join regional trading blocs with the hope that the power of the blocs would help them to speak louder in multilateral talks. They want the blocs to be their “speakers”. To achieve this, all the member states in one trading bloc have to speak in “one voice”, which represents their common economic interest. And if one of the member countries’ interests are out of the whole, it will surely speak in a different voice. And what the country would do next is probably to seek other cooperation, such as bilateral and other multilateral talks, which could help them with their economic development. Again a good example of this is the formation of NATFA. Why does the U.S. need NAFTA? One of the important reasons is that it found “the GATT was unable to eliminate the competitive advantage that Japan’s industrial structure and distribution system and the EC’s agricultural and high-technology subsidies provided.” (Mason and Turay, 1994, p. 17) In other words, no matter what means a country uses, it is always oriented by its interest, especially the economic interest.

## 5. Conclusion

By looking at the direct motivation to form a regional trading bloc, namely, competing with other regions and countries, one conclusion that can be framed is that trading blocs do hamper globalization to some extent. Also the fact that they have divided the world into trading areas and changed the pattern of the world economy proves this conclusion.

However, we cannot say that trading blocs and globalization are completely contradictory as there is no contradiction or difference in their natures. Both of them pursue “free trade”. For a single nation, its purpose to join a regional trading bloc and the WTO is to get more interest from them. Both trading blocs and globalization require their member countries to overstep their boundaries and transfer some of their economic sovereignties. The difference is that the former one is within a region while the latter one is on global level. Therefore, their contradiction lies in their scopes but not their natures. It is natural and reasonable that trading blocs and globalization coexist in the same period. In the future, regional trade will expand the global level, which means, trading blocs are a necessary stage of globalization.

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## The Savings-Investment Relationship: Cointegration and Causality Evidence from Uemoa Countries

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### Abstract

The relationship between saving and investment has been sharply debated in the empirical literature following the pioneering work of Feldstein and Horioka (1980). This paper contributes to this literature. As opposed to most previous studies, which have used panel estimation methods, we test for cointegration and causality between saving and investment in time-series settings for the UEMOA member countries by using the bounds test for cointegration proposed by Pesaran *et al.* (2001) and the Granger causality test of Toda and Yamamoto (1995). The results show that domestic saving plays an active role in financing investment in only three countries. For the other four countries, the domestic savings rate and investment rate are not related.

**Keywords:** Investment, Saving, Cointegration, Causality

### 1. Introduction

Savings and investment are key requirements for growth and development. However, lack of savings and investment are common in developing countries. To overcome the lack of adequate domestic savings, foreign savings via unrestricted capital flows are encouraged. The issue of low levels of domestic savings is a major problem in small developing states because of high unemployment, low wages, engagement of a large proportion of the population in the informal sector, and poor performance of the economy. The interaction between saving and investment has become a subject of great interest and debate among macroeconomists. The debate has traditionally revolved around two issues. The first relates to whether domestic investment results in domestic savings, and the second relates to how domestic investment affects savings. A growing body of literature has emerged, both at the theoretical and empirical level, attempting to answer these issues. Conventional thinking holds that savings is an essential element in promoting investment and therefore economic growth. According to this view, low levels of domestic savings in some developing countries condemn them to an uncomfortable choice between low investment and growth, or excessive reliance upon foreign capital which makes them vulnerable to financial crises. Empirical research, however, does not conclusively support this conventional belief. Empirical findings are mixed and controversial across countries, data and methodologies. Most empirical works are based on panel or cross-country regressions and may be criticised since they impose cross-sectional homogeneity on coefficients that in reality may vary across countries because of differences in institutional, social and economic structures. The overall result obtained from panel or cross-section regressions represents only an average relationship, which may or may not apply to individual countries in the sample. To enhance our understanding of the causal relationship between saving and investment it is essential to perform studies on individual countries using time series data.

This paper makes an empirical contribution to the literature on the saving-investment relationship for the member countries of the West African Economic and Monetary Union (UEMOA), namely Benin, Burkina Faso, Côte d'Ivoire, Mali, Niger, Senegal and Togo. We aim to investigate two broad objectives. The first is to determine whether saving and investment rates are cointegrated, and the other is to identify the direction of causality between the two variables.



Presence of cointegration suggests that capital is at least somewhat immobile internationally, while lack of cointegration suggests perfect capital mobility (Miller, 1988). Understanding the causal relationship between saving and investment is relevant for its policy implications, specifically for countries of a common monetary area. Indeed, budget deficits reduction within monetary unions is commonly based on the belief that deficits affect negatively domestic savings, and therefore domestic investment. Behind this interpretation there is the idea that domestic saving systematically causes domestic investment. If this saving causes investment in all countries, then promoting domestic savings should be a high priority to boost investment and economic growth. In this case, the deficit target within UEMOA is absolutely relevant. Alternatively, if causality runs from investment to saving, saving-promoting policies are likely to be unsuccessful and may involve economic inefficiencies. Policy emphasis should be shifted away from saving and concentrated in removing the impediments to investment. In the presence of heterogeneity in the causal relationship between saving and investment, the fiscal rule becomes similar to an asymmetric shock striking the member countries. As it increases the domestic savings, it will be beneficial only for countries where causality runs from saving to investment. Given these arguments the issue regarding the causality between savings and investment is of great interest for UEMOA member countries. By examining this relation this paper will offer a guideline to help the policymakers in formulating their policies in terms of encouraging domestic saving and investment.

Unlike most empirical studies, this work uses innovative econometric methodologies to examine the relationship between saving and investment. Specifically, existing empirical work on cointegration and causality uses standard Engle and Granger (1987) and Johansen (1988) cointegration tests and the Granger-causality-type tests to investigate the long-run relationship and the direction of causality. Our paper adopts different methodological approaches, namely the bounds test to cointegration proposed by Pesaran *et al.* (2001) and the Toda and Yamamoto (1995) test for non-causality. These tests are relatively more efficient in small sample data sizes as is the case in most empirical studies on African countries, and are particularly appropriate for series for which the order of integration is not known or may not be necessarily the same for all variables of interest.

The remainder of this paper is organized as follows. Section 2 briefly reviews some of the theoretical and empirical literature regarding the dynamic relationships between saving and investment. Section 3 highlights the econometric framework. Section 4 presents the data and empirical results. Finally, section 5 offers a brief summary and gives some concluding remarks.

## 2. Literature Review

Investment is a central macroeconomic variable. Its fluctuations account for a large fraction of cyclical volatility of output and income, and most economists link high rates of investment to long run economic growth. Many works have attempted to investigate the theoretical and empirical relationship between investment and saving. Theoretically, for classical and neoclassical economists, the interest of the capital market is determined regarding investment and saving. Following Goldsmith (1969), McKinnon (1973), and Gurley and Shaw (1955), economic development creates demand for particular types of financial arrangements, and the financial system responds automatically to these demands. According to this view, the financial system of a country mobilizes saving and improves the allocation of saving to investment. According to Bencivenga and Smith (1991), the financial system allows altering the composition of saving in a way that is favourable to capital accumulation. Influential economists such as Robinson (1952) and Kuznets (1955), however, contend that the role of financial development is overstated or that financial development follows expansion of the real economy. This would indicate, in contrast to McKinnon-Shaw and the endogenous growth theorists that causality, if it exists, runs from growth to financial development.

This study is linked to the endogenous growth literature which stresses the significance of financial development for long-run economic growth through the impact of financial sector services on capital accumulation and technological innovation. These services include mobilizing savings, acquiring information about investments and allocating resources, monitoring managers and exerting corporate control, and facilitating risk amelioration. As shown by Romer (1986), Lucas (1988), and Rebelo (1991) – and subsequent endogenous growth studies, finance tends to promote capital investment.

Baxter and Crucini (1993) build a theoretical framework to explain the correlation between investment and saving. Their analysis is carried out within the context of a two-country, one-sector, stochastic growth model driven by exogenous shocks to productivity. Although Caprio and Howard (1984), Roubini (1988), Summers (1988), for instance, have suggested that policy reactions are the explanation for observed saving-investment correlations, Baxter and Crucini's (1993) model generates plausible correlations in the presence of completely passive fiscal policy. In their analysis, country size is an important determinant of saving-investment correlations.

To the empirical point of view, one of the most stable regularities observed in data is the fact that national saving rates are highly correlated with national investment rates, both in time series analyses of individual countries and in cross-sections in which each country is treated as a single point data. The debate over the relationship between saving and investment has been initiated by the work of Feldstein and Horioka (1980). According to Feldstein and Horioka, if

capital is perfectly mobile, investors care only about the rate of return on their investments and not about which country they invest in. This means that domestic saving need not be related to domestic investment under perfect international capital mobility. On the basis of this idea, Feldstein and Horioka (1980) regressed domestic investment ratio on domestic saving ratio for cross-sectional samples of 16 OECD countries over the period 1960-1974 in order to assess how mobile capital was among them. They found that the estimated regression coefficients, which they termed "saving-retention coefficients", were all close to one, indicating that most incremental saving tends to remain in the country of origin. This finding was surprising since it suggested that capital was closer to being completely immobile than perfectly mobile internationally. Their results also supported crowding out and implied that a country's growth prospects are closely tied to its saving effort. Accordingly, policies that promoted saving would impact favourably on growth.

The traditional view is that the level of domestic saving determines the domestic investment. Indeed, the level of saving determines the interest rate and thus the cost of investment, which in turn influences the demand for new capital. In this sense, low investment rate is related to low saving rate. The positive relationship between domestic saving and domestic investment is often viewed as evidence of imperfect international capital flows and various country-specific institutional and non-institutional rigidities. The widespread view that the saving-investment coefficient is simply associated with the degree of capital mobility has been heavily criticized. Alternative interpretations are commonly found in the literature. The first is the long-run current account targeting which is likely to produce a high saving-investment coefficient and, most notably, the intertemporal budget constraint which implies that saving and investment are cointegrated with a unit coefficient regardless of the degree of capital mobility. The second approach to interpret the saving-investment coefficient is related to the country size. Georgopoulos and Hejazi (2005) argue that the Feldstein and Horioka's result simply reflects the fact that a large country is more reliant on domestic sources of financing. Consistent with this interpretation, Murphy (1984), Baxter and Crucini (1993) and Mamingi (1994) find that smaller OECD or developing countries exhibit higher capital mobility than larger ones. This finding is attributed to the fact that smaller countries cannot influence world interest rates, and thus their saving-investment correlation is not biased upwards. The third interpretation is related to the existence of a home bias due to the association of high costs with foreign markets which reduce the international diversification of portfolios (Georgopoulos and Hejazi, 2005; Hericourt and Maurel, 2005). The fourth interpretation suggests that the saving-investment correlation coefficient reflects the substitutability between domestic and external savings (Sachsida and Caetano, 2000). The last interpretation represents a special case and refers to highly integrated regions and currency unions, such as the European Union. Blanchard and Giavazzi (2002) argue that a weaker saving-investment association may simply reflect higher financial and trade integration.

Feldstein and Horioka finding stimulated a large body of empirical works where more of such works have focused on the developed countries with little performed on developing countries. Empirical works vary significantly in terms of the methodology employed, as well as the data set and sample periods covered. The Feldstein and Horioka result has been mainly replicated using cross-section regressions (see among others, Feldstein, 1983; Obstfeld, 1995), and panel estimation techniques (Chakrabarty, 2006; Georgopoulos and Hejazi, 2005; Nell and Santos, 2008; Fouquau, Hurlin and Rabaud, 2008; Kollias, Mylonidis and Paleologou, 2008, Coakley and Kulasi, 1997; Oh et al. 1999). Time-series analysis has provided a wider dispersion of saving-investment coefficients (see among others, Kim, 2001; Kim, Kim and Wang, 2007).

Kollias, Mylonidis, and Paleologou (2008) analyse the saving-investment correlation for 15 European Union member countries, using the ARDL approach and panel regressions. Their study validates the Feldstein-Horioka interpretation of the saving-investment correlation, but the evidence from the ARDL approach does not point to any particular direction in terms of country size, or level of development, or economic and capital market structure. Panel regressions yield a saving-investment coefficient in the range of 0.148-0.157. This finding is attributed to higher capital mobility, lower transaction costs in the international capital markets, and the declining status of long-run current account targeting as a primary government objective. Telatar, Telatar, and Bolatoglu (2007) re-examine the savings-investment nexus using data for some European countries. Applying a Markov-switching model with heteroskedastic disturbances, they find that the correlation coefficients are unstable due to the policy regime changes consistent with the Lucas critique. Fouquau, Hurlin and Rabaud (2008) propose an original framework to study the influence of factors such as degree of openness, country size and current account on the saving-investment relationship originated by Feldstein and Horioka. Using panel threshold regression models, they establish country-specific and time-specific saving retention coefficients for 24 OECD countries over the period 1960-2000. These coefficients are importantly influenced by degree of openness, country size and current account to GDP ratios.

There is a further set of papers which consider more technical issues in studies of the Feldstein-Horioka puzzle. The empirical estimates are generally sensitive to the estimation method used. For example, Krol (1996) establishes that improvements in the estimating procedure can be obtained by the use of a more general approach than OLS, such as a

fixed effects panel regression procedure. These estimating techniques result in a reduction in the Feldstein-Horioka correlation, thus reducing the estimated home bias.

### 3. Econometric Methodology

Econometric literature proposes different methodological alternatives to empirically analyse the long-run relationships and dynamics interactions between two or more time-series variables. The most widely used methods include the two-step procedure of Engle and Granger (1987) and the full information maximum likelihood-based approach due to Johansen (1988) and Johansen and Juselius (1990). All these methods require that the variables under investigation are integrated of order one. This inevitably involves a step of stationarity pre-testing, thus introducing a certain degree of uncertainty into the analysis. In addition, these tests suffer from low power and do not have good small sample properties (Cheung and Lai, 1993; Harris, 1995). Due to these problems, this study makes use of two newly developed approaches to cointegration and causality that have become popular in recent years.

#### 3.1 The Bounds testing approach to cointegration

The bounds testing approach to cointegration was introduced by Pesaran *et al.* (2001). The main advantage of the bounds testing approach is that it can be applied irrespective of whether the regressors are purely I(0), I(1) or mutually cointegrated. Another advantage is that the test is relatively more efficient in small sample data sizes as is the case in most empirical studies on African countries. This test is particularly appropriate for small samples in which the order of integration is not known or may not be necessarily the same for all variables of interest.

The bounds test involves estimating by ordinary least squares the following unrestricted error correction model (UECM) considering each variable in turn as a dependent variable:

$$\Delta I_t = \beta_0 + \sum_{i=1}^p \beta_{1i} \Delta I_{t-i} + \sum_{i=0}^p \gamma_{1i} \Delta S_{t-i} + \eta_1 I_{t-1} + \eta_2 S_{t-1} + e_{1t} \quad (1)$$

where  $I_t$  and  $S_t$  denote domestic investment and savings as share of GDP. The structural lags are determined by using minimum Akaike's information criteria (AIC). To depict the presence of cointegration the estimated coefficients of lagged level variables are restricted equal to zero. Thus the null hypothesis for no cointegration is:

$$H_0 : \eta_1 = \eta_2 = 0 \quad (2)$$

The null hypothesis is tested by the mean of the  $F$ -test which has an asymptotic non-standard distribution. Thus, the calculated  $F$ -statistic is compared with two asymptotic critical values tabulated by Pesaran *et al.* (2001). The lower critical value assumes that all the regressors are I(0), while the upper critical value assumes that they are I(1). Therefore, if the computed  $F$ -statistic is greater than the upper critical value, the null of no cointegration is rejected and we conclude that saving and investment share a long-run level relationship. If the calculated  $F$ -statistic is below the lower critical value, then the null hypothesis of no cointegration cannot be rejected regardless of the orders of integration of the variables. On the other hand, if it falls inside the critical value band, the test is inconclusive unless we know the order of integration of the underlying variables.

If a cointegration relationship is observed between the series, Bardsen's (1989) method will be used to compute the short and long run coefficients. From the estimation of (1), the long-run coefficient is computed as the coefficient of the one lagged level explanatory variable divided by the coefficient of the one lagged level dependent variable and then multiplies with a negative sign. Thus, under the alternative of interest  $\eta_1 \neq 0$  and  $\eta_2 \neq 0$ , the long-run level relationship between investment and saving is described by:

$$I_t = \theta_0 + \theta_1 S_t + v_t \quad (3)$$

where  $\theta_0 = -\beta_0 / \eta_1$  and  $\theta_1 = -\eta_2 / \eta_1$ , and  $v_t$  is a zero-mean stationary process.

#### 3.2 The Toda-Yamamoto approach to Granger causality test

The bounds test assumes the dependent variable to be I(1) and the regressors to be either I(0) or I(1). The procedure cannot be applied if the dependent variable of interest is I(0) and would crash in the presence of I(2) variable. To complement the bounds test approach and derive inference regarding the direction of causality between saving and investment, we use the methodology proposed by Toda and Yamamoto (1995). This procedure has the advantage of not requiring pretesting for cointegration properties of the system. Thus it overcomes the pre-test biased associated with unit root and cointegration tests. More importantly, the Granger causality tests can be implemented regardless of the orders of integration of the underlying variables. Performed directly on the coefficients of the levels VAR, Toda and Yamamoto methodology minimizes the risk associated with possibly wrongly identifying the orders of integration of the series, or the presence of cointegration relationship (Giles, 1997; Mavrotas and Kelly, 2001). The basic idea is to artificially augment the correct

VAR order,  $k$ , with  $d_{\max}$  extra lags, where  $d_{\max}$  is the maximum likely order of integration of the series in the system. The empirical model to be estimated is specified as follows:

$$I_t = \alpha_0 + \sum_{i=1}^k \alpha_{1i} I_{t-i} + \sum_{j=k+1}^{k+d_{\max}} \alpha_{2j} I_{t-j} + \sum_{i=1}^k \beta_{1i} S_{t-i} + \sum_{j=k+1}^{k+d_{\max}} \beta_{2j} S_{t-j} + e_{1t} \quad (4)$$

$$S_t = \phi_0 + \sum_{i=1}^k \phi_{1i} S_{t-i} + \sum_{j=k+1}^{k+d_{\max}} \phi_{2j} S_{t-j} + \sum_{i=1}^k \delta_{1i} I_{t-i} + \sum_{j=k+1}^{k+d_{\max}} \delta_{2j} I_{t-j} + e_{2t} \quad (5)$$

The null hypothesis that saving does not cause investment is formulated as follows:

$$\beta_{11} = \beta_{12} = \dots = \beta_{1k} = 0 \quad (6)$$

The system given by equations (4) and (5) is estimated using the Seemingly Unrelated Regression technique (Rambaldi and Doran, 1996). A Wald test is then carried out to test the hypothesis (6). The computed Wald-statistic has an asymptotic chi-square distribution with  $k$  degrees of freedom.

#### 4. Data and Empirical results

This study uses time series annual data on gross domestic saving and gross domestic investment as share of GDP for the UEMOA member countries. Except Guinea-Bissau, countries under investigation include Benin, Burkina Faso, Côte d'Ivoire, Mali, Niger, Senegal and Togo. All the data are extracted from the 2007 world development indicators tapes of the World Bank (2007).

Before we proceed with the bounds test, we perform the Augmented Dickey-Fuller (1979) and Phillips-Perron (1988) unit-root tests (ADF and PP hereafter, respectively) to determine the order of integration of each variable. This is to ensure that none of the variables is I(2) so as to avoid spurious results in bounds test. The results reported in Table 1 reveal that saving and investment have unit root for all countries except for Mali and Togo, for which investment is stationary, and Niger for which saving is stationary. However, after taking the first difference, the series appear to be stationary in all countries.

[Table 1 about here]

We can now confidently apply the bound test procedure to examine the presence of long-run relationships between saving and investment. We use the Akaike Information Criterion to determine the appropriate lag structure. Table 2 reports the results of the F-statistic test when each variable is considered as a dependent variable. As can be seen from Table 2, the computed F-statistic appears to be lower than the upper critical values at 5% of significance for all countries except for Benin and Niger.

[Table 2 about here]

For these two countries there is evidence of cointegration when investment is the dependent variable. The long-run coefficient estimates suggest imperfect capital mobility in the case of Benin and complete capital immobility in Niger. For the rest of the countries results indicate capital mobility, that is, investment is independent of domestic saving.

To complement the above findings, we proceed to causality tests using the Toda and Yamamoto procedure. As the maximum order of integration of the series under investigation is one, the Toda and Yamamoto test involves the addition of one extra lag of each of the variables to control for potential cointegration. Results of the causality tests are presented in Table 3. As can be learned from the  $p$ -values of the Wald statistic, there is evidence of unidirectional causality running from saving to investment in Benin, Côte d'Ivoire and Niger. For the remaining countries, no evidence of causality is detected between saving and investment.

[Table 3 about here]

To sum up, the empirical findings suggest that Benin, Côte d'Ivoire and Niger are characterized by a degree of capital immobility. Therefore all increase in domestic savings will not flow out of these countries to other countries, but will induce an increase in domestic investment rate. This gives rise to the importance of saving-promoting policies. On the contrary, in the rest of the countries domestic saving does not play an active role in financing domestic investment. This shows capital mobility with domestic investment being financed by foreign saving rather than domestic saving.

#### 5. Conclusion

The objective of this paper is to empirically investigate the relationship between saving and investment for UEMOA countries. To this end, we used time series data on saving and investment rates. Since it is recognized that inferences based on standard approaches of unit root and cointegration tests may yield misleading results, we followed the bounds testing approach to cointegration proposed by Pesaran *et al.* (2001) and the Granger-causality test of Toda and Yamamoto (1995). Empirical findings are mixed across countries. The results from these tests provided support to the

view that investment is positively related to domestic savings in only three countries out of seven, namely Benin, Côte d'Ivoire and Niger. For the other four countries, investment is not related to domestic savings. This implies that the bulk of the investment in these countries is not being financed by domestic saving but by foreign saving. Hence, economic policies may be focused on the incitation of investment and the reduction of capital outflows for Burkina Faso, Mali, Senegal and Togo. However, Benin, Côte d'Ivoire and Niger are characterized by imperfectly mobile capital, corroborating some degrees of imperfections mainly in political risk (Côte d'Ivoire), human capital (Niger), and infrastructures (Benin).

The findings of this paper accord with the view of other empirical studies that the relationship between saving and investment cannot be generalized across countries because these results are country-specific.

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Table 1. Results of Unit-root tests

Country	ADF test				PP test			
	$S_t$	$I_t$	$\Delta S_t$	$\Delta I_t$	$S_t$	$I_t$	$\Delta S_t$	$\Delta I_t$
Benin (1982-2005)	-1.895 (-2.992)	-1.799 (-3.004)	-6.057* (-1.955)	-5.988* (-1.957)	-2.389 (-2.991)	-1.204 (-1.956)	-8.339* (-1.955)	-7.186* (-1.957)
Burkina Faso (1979-2005)	-0.657 (-1.955)	-1.805 (-2.981)	-3.772* (-1.955)	-5.398* (-1.955)	-0.776 (-1.955)	-1.805 (-2.981)	-3.801* (-1.955)	-5.398* (-1.955)
Côte d'Ivoire (1965-2005)	-2.459 (-2.925)	-1.123 (-1.949)	-6.988* (-1.949)	-5.334* (-1.949)	-2.488 (-2.935)	-1.081 (-1.949)	-7.158* (-1.949)	-5.375* (-1.949)
Mali (1967-2005)	-2.586 (-2.941)	-4.270* (-3.533)	-7.231* (-1.950)	-9.433* (-1.950)	-2.531 (-2.941)	-4.270* (-3.533)	-11.190* (-1.950)	-11.321* (-1.950)
Niger (1980-2005)	-3.572* (-2.981)	-2.425 (-3.603)	-5.384* (-1.954)	-4.677* (-3.673)	-3.583* (-2.981)	-2.439 (-3.603)	-5.418* (-1.954)	-4.369* (-3.612)
Senegal (1965-2005)	-2.260 (-2.935)	3.222 (-1.950)	-8.392* (-1.949)	-2.612* (-2.948)	-2.205 (-2.935)	2.897 (-1.949)	-8.392* (-1.949)	-10.241* (-2.938)
Togo (1980-2005)	-3.373 (-3.595)	-3.634* (-2.986)	-7.227* (-2.981)	-6.573* (-1.955)	-3.161 (-3.595)	-3.646* (-2.986)	-8.032* (-1.954)	-6.573* (-1.955)

Notes: The ADF statistics are compared with the critical values from MacKinnon (1996) that are in parenthesis. \* denotes the rejection of the null hypothesis at the 5% significance level.

Table 2. Bounds Test Results

Country	Dependent variable	$F$ -statistic	5% Lower Bound Value	5% Upper Bound Value	Cointegration	$\hat{\theta}_1$ (s.e.)
Benin	$I_t$	27.766*	4.94	5.73	Yes	0.776* (0.094)
	$S_t$	3.268	3.15	4.11	No	
Burkina Faso	$I_t$	2.372	4.94	5.73	No	
	$S_t$	1.128	3.15	4.11	No	
Côte d'Ivoire	$I_t$	3.416	3.15	4.11	No	
	$S_t$	3.273	4.94	5.73	No	
Mali	$I_t$	5.100	4.94	5.73	No	
	$S_t$	9.679*	4.68	5.15	Yes	1.224* (0.338)
Senegal	$I_t$	4.180	4.68	5.15	No	
	$S_t$	2.788	3.15	4.11	No	
Togo	$I_t$	4.884	4.68	5.15	No	
	$S_t$					

Notes: \* denotes the rejection of the null hypothesis at 5% significance level. Critical values for F-statistics are from Pesaran *et al.* (2001, p. 300). The last column contains the estimates and standard errors (figures in parenthesis) of the parameters of the long-run relationship computed following Bardsen (1989).

Table 3. Results of Toda and Yamamoto Granger non-causality tests

Country	Lag length (k)	$S_t$ causes $I_t$		$I_t$ causes $S_t$		Direction of causality
		Wald Stat	p-value	Wald Stat	p-value	
Benin	3	8.394*	0.038	5.823	0.120	$S \rightarrow I$
Burkina Faso	1	0.488	0.484	2.104	0.146	No
Côte d'Ivoire	1	3.666**	0.055	0.152	0.695	$S \rightarrow I$
Mali	1	0.067	0.795	0.001	0.997	No
Niger	1	5.247*	0.022	0.159	0.689	$S \rightarrow I$
Senegal	1	0.000	0.993	0.625	0.429	No
Togo	1	1.113	0.291	0.295	0.586	No

Notes: \* and \*\* denote statistical significance at the 5% and 10% levels, respectively.



## Research on Pushing Effect of Urbanization on China Western Investment

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### Abstract

This paper introduces the basic connotation of urbanization and its relationship with economic growth. By analyzing the urbanization conditions in China western area, this paper summarizes the pushing effects of urbanization on investment in western area. Besides, this paper points out the specific ways for western area applying the new harmonious urbanization development strategy, offering a theoretical basis for investing in China western area.

**Keywords:** Urbanization, Investment, Pushing effect

### 1. Introduction

Urbanization is an important symbol reflecting social development and civilization of one country or region. It is a history process in which cities become more important in state economy and social life along with the transfer of economy and population toward cities and the fast rise of cities and populations due to industrialization. Urbanization is not only a process in which material civilization and spiritual civilization develop at the same time, and also a reflection of the integrated development of social politics, economy, culture, science and technology. Compared with rural areas, cities have rich and colorful life, better industrial base, complete structure, and more job opportunities, and develop fast. Therefore, cities can exert a strong attraction for investments, driving efficiency and effectiveness of investment, and pushing the development of economy.

### 2. Theory of urbanization

#### 2.1 Connotation of urbanization

In a wide aspect, urbanization refers to a process in which the proportion of people living in cities and towns to total population is rising. In this process, the number of cities is increasing and the size of cities is larger, what are caused by the development of social productivity. Population is centering toward cities. Urban material civilization and spiritual civilization are growing. Regional industrial structure keeps in changing. In an economic aspect, urbanization is a transfer from rural economy toward urban economy. It emphasizes on the re-combination of urban industry. The move of rural population toward cities is merely a superficial phenomenon. The nature of urbanization is the transformation and the re-combination of urban spatial structure and urban economic structure, and the creation and the spread of urban factors and urban economic relationship. In other words, it is the value creation process that takes non-agricultural production as the form, and the creation and spread process of life style.

#### 2.2 The relationship between urbanization and economic growth

To study the relationship between urbanization and economic growth, we can use the urbanization rate to evaluate the level of urbanization, and use the GDP per capita to evaluate the level of economic development. Figure 1 shows the change of urbanization rate and GDP per capita from 1991 to 2007 in China.

From this figure, urbanization has a prominent effect on economic growth. Along with the stable rise of urbanization rate, GDP per capita rises gradually. Especially after 2000, the effect of urbanization on economic growth tends to be more significant. The process of urbanization is always driving the economic development. The emergence of cities enlarges the scope of social division, and drives the further evolvement of social division. And the evolving process of division is a process of economic growth. The higher the level of social division is, the higher the level of economic development is. Urbanization makes separate and disordered population and capitals turn into a highly-intensive and ordered state. Productivity is improved greatly. The wealth created and accumulated in cities is far more than that in rural areas. Therefore, as cities where the industrial and service industries center in develop well, it greatly improves the level of local economic development.

### 3. The condition of urbanization in the west of China

In a macro aspect, not only the west of China, for the whole economic filed, urbanization and economic development are one organic body. The level of urbanization is an important index for evaluating a country's level of modernization. In the west of China, the urbanization is deepened further. But there is still certain problem.

#### 3.1 The urbanization rate is low.

In 2007, the urbanization rate in the west of China is merely 37.83%. The rate in the east is 60.47%. And the average of



China is 44.94%. The low urbanization rate barriers the improvement of national urbanization rate and restrains the development of economy in the west of China. Among 12 provinces and regions in the west of China, only Inner Mongolia and Chongqing has the urbanization rate that is higher than the average of China. Thereinto, in Guizhou and Tibet the urbanization rate is the lowest.

### *3.2 Cities are few and density of cities is low.*

Data show that China has 651 cities in 2007. 260 of them locate in the east of China, accounting for 40% of the total. However, there are 165 cities in the west of China, accounting for 25% of the total. By calculating the number of cities per 10,000 square kilometer, the density of cities in the east is 1.99 cities per 10,000 square kilometer, the middle 0.79 cities per 10,000 square kilometer, and the west 0.3 cities per 10,000 square kilometer. From this index, the east is 6.54 times of the west.

### *3.3 The size of cities is small and cities' functions can not be exerted completely.*

In China, among the cities with more than 1 million people, about 54% of them locate in the east, and only 18% in the west. The east has the absolute advantage. Cities in the east have large sizes and that in the west is small. This condition can not benefit the development of market economy or the integration of rural and urban economy. According to the function of cities, the service function of cities in the west, concerning the fields of trade, information, finance, education, science & technology, and culture, is weak. Therefore, the size and structure of cities in the west have evident defects. Functions of cities can not be exerted completely.

### *3.4 The quality of urbanization is worse.*

All indexes of west cities are lower than that of eastern and middle cities and the average of China. In 2007, statistical data show that the per capita income in cities is 14908.61 RMB, per capita disposal income is 14908.61 RMB, and per capita expenditure on consumption is 14908.61 RMB. In west cities, the numbers are respectively 12130.66 RMB, 11309.45 RMB, and 8177.49 RMB. These numbers show that the economy of west area is low, the infrastructure is lagged behind, the transportation is undeveloped, the environment is bad, and people's daily life is at a low level. Besides, most cities in west area are industrial cities. The comprehensive quality of cities is low. All these facts lead to the weak agglomeration function and weak reflection function of cities in west area. Western cities can not exert the economic coherence effect and the spread effect. The quality of urbanization is worse.

## **4. The pushing effect of urbanization on western investment**

Urbanization is an investment activity. It serves as an important power driving western economic growth and fixed asset investment. The three effects of urbanization are influential, including agglomeration effect, industrial correlation effect, and upgrade of economic structure.

### *4.1 The pushing effect of urbanization's agglomeration effect on investment*

Urban economy dominates regional economy. The process, speed, and level of urbanization stand for the level of regional economic modernization. The agglomeration effect means that economic activities happen together in a spatial aspect, which can realize lower costs, highly effective resource allocation, and rising economic benefits. Urban economy's fundamental features and basis associate closely with agglomeration. Agglomeration economic effect is a systematic power that aims at improving economic efficiency and decreasing economic costs by economy of scale and economy of scope, increasing the efficiency of investment.

Firstly, urbanization indicates the aggregation of people. It is a process of people moving and centering at a large scale. It happens naturally along with economic development and social progress. It is an objective process that is not under the effect of human will. It is resulted from rural area's powerful pushing power and cities' powerful pulling power. It not only transfers the great production factor ----- land resource, but also attracts rural surplus laborers to move in cities.

Secondly, urbanization is a process of agglomerating economic activities and resource factors together. As a large of population moves in cities, economic activities center in cities either. The agglomeration of economic activities include the agglomeration of factors, production, exchange, and exchange, which can benefit the rise of investment scale, the improvement of investment's technological efficiency, and production benefit, making the diversification of investment structure more rational.

### *4.2 The pulling effect of urbanization's industrial correlation effect on investment*

The industrial correlation effect means that one industry's development can cause related industries' development. The industrial correlation is the technological structure and products' needs structure of different departments and industries in production. It is a spatial structure of social productivity development.

The process of urbanization needs amounts of capital flow and material flow in production, circulation, and consumption, greatly enhancing the industrial correlation. It can drive the development of relevant energy industries and

the extension of relevant industries. For example, the real estate industry in urbanization can inspire more investment, concerning the development of construction material industry, metallurgy industry, machine industry, and finance industry, decorative draft, household appliance industry, textile industry, garden industry, travel industry, finance, and insurance industry. Urbanization pushes the close relationship of all industries and drives the activities of investment.

#### *4.3 The pushing effect of urbanization's economic structural upgrade effect on investment*

The nature of urbanization is to change social economic structure and people's production style, life style by pursuing the agglomeration effect, and finally actualize urban modernization and improve people's life quality.

Firstly, urbanization benefits the development of agricultural production. The process of urbanization makes amounts of rural laborers enter cities, and drives the agglomeration of rural lands. The scale of rural production is enlarging. Production technologies and labor tools are progressing. Agricultural productivity will be improved. On the other hand, the expansion of cities, the rise of urban residents, and the improvement of urban life will stimulate the rise of needs for agricultural products. Therefore, urbanization has a driving effect on agricultural production.

Secondly, urbanization will bring about the development of industrialization inevitably. The agglomeration of population toward cities enlarges the needs for industrial products, which stimulates the production of daily industrial products and enduring products. Meanwhile, the development of agriculture and the improvement of agricultural productivity supply laborers for industrial development. Lots of urban residents possess different production skills, what offers multiple choices for different enterprises recruiting managers and workers.

Thirdly, urbanization drives the upsurge of the third industry. Cities, as centers of agglomeration, have more advantages in capitals, transportation, labor technologies, communication equipments, labor resources, and living conditions, which makes production activities center toward cities, generating a scale effect and economic effect. The agglomeration of people offers a possibility of developing the third industry. The scale production caused by agglomeration of economic activities has demands for basic service facilities concerning electric, water, railway, roads, and communication, offering necessary conditions for the upsurge of the third industry.

Fourthly, the process of urbanization can form a consumption model effect and an income increase effect. The change of people's consumption mode and the improvement of general consumption level can stimulate domestic needs, driving the improvement of investment level. Meanwhile, it optimizes present products' needs structure, further optimizing the industrial structure, and making the investment structure more rational.

### **5. The west of China applies the new strategy for harmonious urbanization development**

In order to allocate resources reasonably and exert the function of investment to a great degree, and make urbanization exert the positive effect on investment, the west of China can apply the new strategy for harmonious urbanization development from these aspects.

#### *5.1 Take large cities as centers and apply the city cluster strategy*

In order to deepen the process of urbanization, the west of China must give priorities to large cities with better conditions in development, enhance the division and coordination between cities and the degree of economic integration, and improve the spatial agglomeration ability of cities. Take city cluster, city band, and city circle as the main forms to develop large cities firstly. Then develop medium cities. Develop some special small towns. Realize the coordinative development of large, medium, and small cities.

By external needs generated by key areas and the radiate spread of industries, capitals, and technologies, transfer the impacts of industrialization and urbanization to small towns. Make small towns and center cities and large cities form reasonable function division, and form an integrated urban spatial structure system, driving the urbanization of the west of China. City cluster development can promote the coordinative development of large, medium, and small cities and small towns, forming a city group with high creative ability. It is the urgent and best choice for western cities following the trend of knowledge economy and economic globalization.

#### *5.2 Match with the new industrialization*

New industrialization stimulates cities' agglomeration function by creation. The industrialization requires for the agglomeration advantage of cities as spatial carriers. For different cities with special functions and resources, the agglomeration and the extension are different. Therefore, cities must position themselves clearly based on self conditions and the needs for new industrialization.

New industrialization drives urban geological spatial optimization and resources' intensive use. To reduce consumption of resources by scientific and technological innovation, technological change, industrial structure adjustment, and circular economy is the way supporting new urbanization. Therefore, new harmonious urbanization must use land resources collectively, pay attention to reducing pollutions, and focus on ecological balance.

### 5.3 Perfect cities' functions and improve cities' quality

In order to improve the effect of urbanization in west area, we must focus on cities' functions, guide urban construction, and improve cities' quality. Firstly, improve the level of infrastructure, drive the construction of modern integrated system, speed up the modernization of science, education, and culture, enhance public service function, and improve people's life quality. Secondly, improve the inheritance function of culture and dig out the excellent traditional culture of west area. Integrate history culture and modern civilization into cities' construction. Thirdly, improve the ecological carrier function, speed up the construction of city drainage works and the construction of greening work, and perfect the cities' environment. Meanwhile, develop the ecology industry, especially ecological agriculture, ecological industry, and ecological tourism industry, founding strong material base for harmonious urbanization.

## 6. Conclusion

The west of China is one of key investment areas in China. The process of urbanization pushes the investments in western area to a great degree. Analyze theories of urbanization reasonably, study its pushing effects on investments, strengthen the urbanization development strategy, and achieving a pushing effect on economic development in the west of China.

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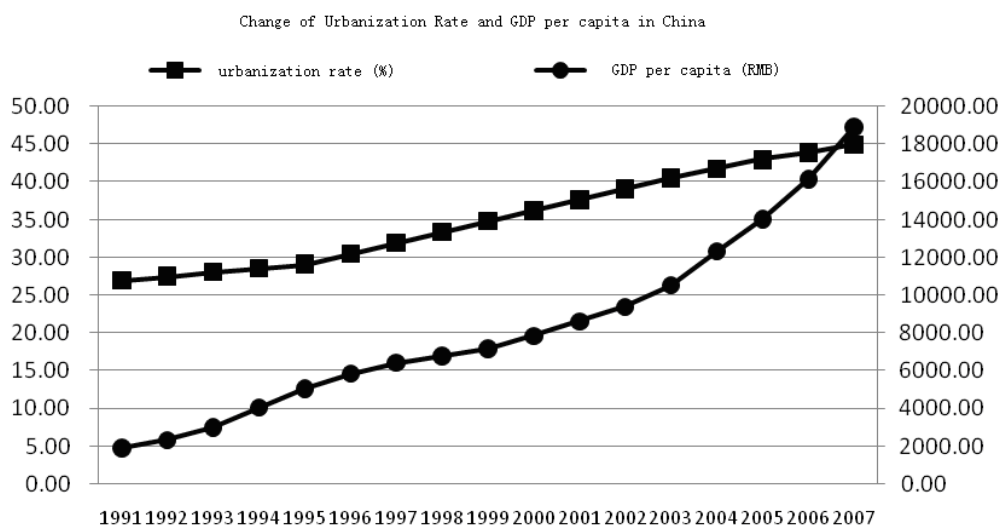


Figure 1. Change of Urbanization Rate and GDP per capita in China.



## Cost and Profit Efficiency of the Malaysian Commercial Banks: A Comparison between Domestic and Foreign Banks

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### Abstract

This study examines the relative efficiency levels of domestic and foreign commercial banks in Malaysia between 2000 and 2006, using accounting-based ratio, stochastic cost and profit frontier approach. Using accounting-based ratio, the results suggest that interest margin and operating cost are slightly higher for domestic banks than for foreign banks. Further, the results also suggest that profit ratios are slightly higher for foreign banks relative to domestic banks. Using the stochastic frontier approach, the results indicate that domestic banks are found to be more cost-efficient but less profit - efficient relative to foreign banks.

**Keywords:** Efficiency, Accounting-based ratios, Stochastic cost and profit frontier approach, Malaysia

### 1. Introduction

The purpose of this paper is to investigate the efficiency levels of commercial banks in Malaysia by comparing the use of basic accounting ratios and the stochastic frontier analysis (SFA): cost and profit frontier approach. The estimates of the level of efficiency were performed using basic accounting ratios and the stochastic cost and profit frontier approach. The results of the study suggest that foreign banks are more cost and profit efficient than domestic banks. Consistent with previous studies, we find that the managerial inefficiencies for the Malaysian commercial banks are found to be significant with the average cost efficiency level of 80.6 percent. The cost efficiency level for domestic banks is 88.2 percent and 75.5 percent for foreign banks, therefore, domestic banks are found to be more cost efficient relative to their foreign counterparts. The results of our study also indicate that the overall profit efficiency level for the commercial banks is 71.7 percent. The profit efficiency level for domestic banks is 63.8 percent and 76.9 percent for foreign banks. Thus, foreign banks are more profit efficient than domestic banks.

This study differs from previous studies in that it covers more recent data, from 2000 to 2006 compared to the study undertaken by Sufian (2004) where he focussed on the period from 1998 to 2003. Second, it examines both the efficiency of domestic and foreign banks. Third, three different measures were used to measure efficiency, accounting-based ratios, and stochastic frontier approach: cost and profit frontier approach.

The structure of the Malaysian financial institutions has changed dramatically over the last twenty years. The global trend towards liberalization in banking has led to the blurring of demarcation lines separating activities of the different groups of financial institutions and the removal of artificial barriers to competition. Similarly, deposit taking, credit

granting, investment, insurance and financial advisory services are being bundled into one financial conglomerate of financial supermarkets. The integration of financial markets within and across borders as well as mergers among banks, reflect attempts to increase financial industry efficiency. The Malaysian experience on the merger exercise is a good example. From 58 financial institutions, the number has to reduce to 10 anchor banks, this was completed in December 2000. This was the result of the financial crisis which weakened the domestic banking sector and the move towards consolidation is hoped to improve the efficiency of the banking sector.

The commercial banks have undergone a tremendous development with the merger exercise. Theoretically, bank mergers could broaden the product mix and reduce cost. Definitely, large size capital and assets are crucial for a bank to become an efficient, competitive and powerful bank. These elements with good quality service will enable banks to compete with foreign banks at the local as well as at the international levels.

This article is organized as follows: Section 2 overviews the efficiency measurement in banking followed by data and methodology. Section 4 discusses the results and followed by conclusion.

## **2. Efficiency Measurement in Banking**

In the previous literature on banking studies both parametric and non-parametric approach has been used. There is no consensus of which method is superior to the other. Accounting-based ratios, though is a crude measure, is easy to use. However, results obtained by this method must be interpreted with caution.

### *2.1 Accounting-based Ratios*

Early research in the banking industry was mainly concerned with estimating the average productivity, using some sort of indices and with cost comparison (Farrell, 1957). Subsequently, researchers tended to proxy efficiency by market share, the assumption being that banks with large market shares may be expected to earn higher profits because they have lower unit costs than banks with smaller market shares (See for example, Smirlock 1985 and Evanoff & Fortier 1988). In other words, banks with lower cost structures could maximize profits either by maintaining the current level of prices and size or reducing the price levels and expanding, a positive relationship between firms' profits and market structures being attributed to the gains made by more efficient firms.

Accounting ratios are a crude measure used by bank analysts to measure efficiency and performance of banks. These ratios are easy to use since they are provided in the financial statements of each bank under consideration. Despite its contradictory issues, the use of simple financial indicators of operating performance, such as operating costs divided by total assets or the return on equity or assets, have also been used to compare efficiencies, as in studies of bank efficiency before and after mergers by Rhoades (1986), Cornett & Tehranian (1992) and Srinivisan & Wall (1992).

However, the use of financial ratios has its limitations. According to Berger, Hunter & Timme (1993), the first problem is that financial ratios are regarded as misleading indicators of efficiency because they do not control for product mix or input prices. Secondly, using the cost-to-asset ratio assumes that all assets are equally costly to produce and all locations have equal costs of doing business. Finally, the use of simple ratios cannot distinguish between X-efficiency gains and scale and scope efficiency gains.

### *2.2 Stochastic Frontier Approach*

The stochastic frontier approach (SFA), sometimes also referred to as the econometric frontier approach (EFA), was developed by Aigner, Lovell & Schmidt (1977), and Meeusen & Van den Broeck (1977). In this approach, the SFA specifies a functional form for the cost, profit or the production frontier and allows for random error. The SFA modifies a standard cost (production) function to allow inefficiencies to be included in the error term. The predicted standard cost function is assumed to characterize the frontier while any inefficiency is captured in the error term, which is by construction orthogonal to the predicted frontier. This assumption forces any measured inefficiencies to be uncorrelated with the regressors and any scale or product mix economies derived linearly from these explanatory variables (Ferrier & Lovell, 1990).

Another assumption needed in the SFA is to distinguish the inefficiencies from random components of the error terms. The random components include short term luck which place individual banks in relatively high or low cost positions and measurement error from excluded explanatory variables, misspecification etc. These two components are separated by assuming that inefficiencies are drawn from asymmetric half-normal distribution, and that random errors are drawn from a symmetric normal distribution. However, it is not possible to decompose individuals' residuals into inefficiency or random variation; therefore, estimating technical inefficiency by observation is impossible. Okuda, Hashimoto & Murakami (2003) used SFA to estimate the cost function of the Malaysian commercial banks from 1991-1997 and its impact on bank restructuring. The study observed economies of scale but not economies of scope and suggested that Malaysian domestic banks were making unproductive capital investments. Yildirim & Philippatos (2007) used both SFA and DFA to examine the cost and profit efficiency of banking sectors in twelve countries in Europe and found that the average cost efficiency level was 72 percent by DFA and 77 percent by SFA.

### 3. Data and Methodology

The banks in our sample include all 9 domestic and 13 foreign commercial banks in Malaysia over the period 2000-2006. The list of banks is presented in Table 1. Income and Balance Sheet data taken was obtained from IBCA's BANKSCOPE data set. Altogether there were 147 observations but due to the log-linear specification in the estimated model, observations that had negative values were dropped from the sample. The selection process yielded an unbalanced panel with 147 for the cost function and 142 samples for the alternative profit function. This study will use the intermediation approach. Under the intermediation approach, banks are treated as financial intermediaries that combine deposits, labour and capital to produce loans and investments. The values of loans and investments are treated as output measures; labour, deposits and capital are inputs; and operating costs and financial expenses comprise total cost.

#### 3.1 Accounting Ratios

In this study, three main accounting ratios will be used (See Table 2).

For each ratio, a comparison is made. For both interest margin ratios and operating cost ratios, the smaller the margin the more efficient the bank, the smaller the cost the more efficient the bank. For the profit ratios, the larger the profit the more efficient the bank is. Table 3 presents the mean accounting ratios for 2000 to 2006.

#### 3.2 A Stochastic Cost Frontier (SCF)

Cost efficiency measures the performance of banks relative to the best-practice banks that produces the same output under the same exogenous conditions. The stochastic cost frontier (SCF) approach is based on a cost equation that relates a bank's cost to variables that incur those expenses, such as output levels and input prices.

The SCF cost equation contains a composite error structure that distinguishes random cost fluctuations from cost inefficiencies. To put it simply, the cost function describes the relationship between the cost with quantities of output and input variables plus the inefficiency and random error. The following cost equation:

$$C = f(y, w, z) + u + v \quad (1)$$

where  $C$  measures the total costs of a bank, including both operating and financial costs;  $y$  is a vector of outputs;  $w$  is a vector of input prices;  $z$  represents the quantities of fixed bank parameters;  $u$  is the inefficiency term that captures the difference between the efficient level of cost for given output levels and input prices and the actual level of cost; and  $v$  is the random error term.

The cost efficiency of the bank can be written in a natural logarithm form as follows:

$$\ln TC = f(y, w, z) + \ln u_i - \ln v_i \quad (2)$$

where  $f$  denotes a functional form. After estimating a particular cost function, the cost efficiency for bank  $i$  is measured as the ratio between the minimum cost ( $C_{\min}$ ) necessary to produce that bank's output and the actual cost ( $C_i$ ):

$$COSTEFF_i = \frac{C_{\min}}{C_i} = \frac{\exp[f(y, w, z)] \times \exp(\ln u_{\min})}{\exp[f(y, w, z)] \times \exp(\ln u_i)} = \frac{u_{\min}}{u_i} \quad (3)$$

where  $u_{\min}$  is the minimum  $u_i$  across all banks in the sample. Under this formulation, an efficiency score of 0.95 for example, implies that the bank would have incurred only 95 percent of its actual costs had it operated in the frontier.

#### 3.3 A Stochastic Profit Frontier (SPF)

Profit efficiency on the other hand measures how close a bank is to attaining the maximum possible profit as a best-practice bank on the frontier for a given level of inputs and output prices (quantities) and other exogenous variables. In this study we use the alternative profit specification thus avoiding the problems of having to measure output prices which are basically not available in our study.

The alternative profit specification employs the same set of exogenous variables as the cost function in Equation (1) but the profit replaces total cost as the dependent variable. Therefore the profit frontier is derived as follows:

$$P = f(y, w, z) + u + v \quad (4)$$

where  $P$  measures the profits of a bank, including both interest and fee income, less total costs  $C$  used in the cost function.

The profit function of the bank can be written in a natural logarithm form as follows:

$$\ln P = f(y, w, z) + \ln u_i - \ln v_i \quad (5)$$

Profit efficiency is measured by the ratio between the actual profit of a bank and the maximum possible profit that is achievable by the most efficient bank.

$$PROEFF_i = \frac{P_i}{P_{\max}} = \frac{\exp[f(y, w, z)]x \exp(\ln u_i)}{\exp[f(y, w, z)]x \exp(\ln u_{\max})} \quad (6)$$

where  $u_{\max}$  is the maximum  $u_i$  across all banks in the sample. For example, if the profit efficiency score of a bank is 90 percent, it means that the bank is losing about 10 percent of its potential profits to managerial failure in choosing optimum output quantities and input prices.

The variables used in this study and the descriptive statistics are presented in Tables 4 and 5.

These two models are simultaneously estimated using the maximum likelihood parameter estimation (Battese & Coelli, 1995). The computer programme, FRONTIER Version 4.1 developed by Coelli (1995) has been used to obtain the maximum likelihood estimates of parameters in estimating the technical efficiency. The programme can accommodate cross sectional and panel data; cost and production function; half-normal and truncated normal distributions; time-varying and invariant efficiency; and functional forms which have a dependent variable in logged or original units.

## 4. Empirical Findings

### 4.1 Accounting ratios

Table 6 shows the findings using accounting ratios. Operating asset ratios indicate that interest margin and operating costs on average are slightly higher for domestic banks compared to foreign banks. Similar findings are shown with operating income ratios and operating equity ratios. These ratios indicate that foreign banks are more cost efficient than their domestic counterparts. The opposite is the case with the profit ratios; they are on average slightly higher for foreign banks compared to domestic banks. This indicates that foreign banks are more profit efficient than the domestic banks.

For individual bank, it is found that PUB and HLB have the lowest operating costs. For profit ratios, PUB has the highest profit ratio followed by HLB and MBB, while CIMB has the lowest profit efficiency followed by RHB and ALB. AFB on the other hand experienced negative efficiency because this bank was making losses during these periods. For foreign banks, RBS has the lowest interest margin followed by DB and BNS. BOT and MCB have the highest profit efficiency. Overall, the results indicate that foreign banks are more cost and profit efficient than domestic banks.

However, accounting ratios are crude measures of bank performance and they need to be interpreted with caution (De Young, 1997). For example, higher operating costs would mean higher costs to support extensive branches, technology and better service quality to customers.

### 4.2 Stochastic Cost Frontier Analysis

The results using cost frontier approach are presented in Table 9. According to the results, the average cost efficiency level for 9 domestic banks under examination is 88.2 percent. This suggests that, on average, about 12.8 percent of bank resources are wasted during the provision of banking services. Whereas the average cost efficiency level for 13 foreign banks is 75.5 percent. This implies that on average 24.5 percent of the resources are wasted.

Overall, the results show that the cost efficiency level for all commercial banks in Malaysia is 80.6 percent. This means that 19.4 percent of the resources are wasted during the period. The results of this study are much lower than found in the previous studies of developed banking markets, in the range of 20 percent to 30 percent. Cost efficiency level has increased over the period for both domestic and foreign banks.

Based on the results, AMB has the highest average efficiency level (98.8 percent) and AFB has the lowest (83 percent) for domestic banks. For foreign banks, UOB has the highest efficiency level (89.4 percent) while BBB has the lowest cost efficiency level (54.4 percent). However, all these banks have improved their cost efficiency since 2000.

Fig. 1 depicts the mean cost efficiency levels for both domestic and foreign banks.

### 4.3 Stochastic Profit Frontier Analysis

The results of the alternative profit efficiency estimation are presented in Table 10. As in many previous studies, the alternative profit estimates are lower than those of cost efficiency levels (Berger & Mester, 1997 for US banks). Based on the results, the alternative profit estimates for domestic banks are lower than foreign banks (63.8 percent against 76.9 percent). From the results we can conclude that approximately one-third of banks' profits were lost to inefficiency during the period under study. All banks however, have increased their profit efficiency levels significantly since 2000.

The most profit efficient domestic banks are MBB (88.4 percent) and PUB (87.9 percent) whilst AFB, CIMB and RHB are the least profit efficient (19.9 percent, 40.4 percent and 47.3 percent respectively). The most profit efficient foreign banks are MCB (91.7 percent followed by CTB (91.6 percent) and HSBS (88.8 percent). The least efficient banks are RBS (52.4 percent), SCB (54.8 percent) and BOC (57.1 percent).

Overall, all banks have improved their profit efficiency over the seven-year period. Fig. 2 depicts the mean profit

efficiency levels for domestic and foreign banks.

The maximum likelihood parameter estimates for both the cost and profit efficiency are presented in Appendix 1 and Appendix 2.

## 5. Conclusions

The Malaysian financial system has undergone a tremendous change during the last decade. Globalisation and technological advancement has changed the way banks are operating; emphasising the importance of minimising costs and maximising profits. This study examines the efficiency of Malaysian commercial banks using accounting-based ratios and the stochastic frontier approach: cost and profit frontier approach.

Our results suggest that interest margin and operating costs on average are slightly higher for domestic banks compared to foreign banks. These indicate that foreign banks are more cost efficient than domestic banks. This is perhaps due to the fact that domestic banks have numerous branches all over the country. In the case with the profit ratios; they are on average slightly higher for foreign banks compared to domestic banks. This indicate that foreign banks are more profit efficient than the domestic banks.

The cost and alternative profit efficiency is estimated using the stochastic cost and profit frontier approach. As in most previous studies on bank efficiency, we find that the average bank deviates substantially from the best-practice frontier. The managerial inefficiencies for the Malaysian commercial banks were found to be significant, with the average cost efficiency level for 22 banks at 80.6 percent. This suggests that an average bank would have incurred 19.4 percent less actual costs had it matched its performance with the best-practice bank. According to our results, domestic banks are more cost efficient relative to their foreign counterparts (80.6 percent against 75.5 percent).

The alternative profit efficiency levels are found to be significantly lower relative to cost efficiency. According to the profit efficiency estimation, the alternative profit estimates for domestic banks are lower than foreign banks. From the results we can conclude that approximately one-third of banks' profits were lost to inefficiency during the period under study. All banks however, have increased their profit efficiency levels significantly since 2000.

As a caveat, the results should be interpreted with great caution since previous research differs substantially across different estimation procedures. Further studies should use different estimation approaches allowing results to be compared.

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Table 1. List of Malaysian Commercial Banks

Domestic banks	Foreign Banks
Affin Bank Berhad (AFB)	The Royal Bank of Scotland (RBS)
Alliance Bank Malaysia Berhad (ALB)	Bangkok Bank Berhad (BBB)
AmBank Malaysia Berhad (AMB)	Bank of America (BOA)
CIMB Bank Berhad (CIMB)	The Bank of Nova Scotia (BNS)
EON Bank Berhad (EON)	Bank of China (Malaysia) Berhad (BOC)
Hong Leong Bank Berhad (HLB)	Bank of Tokyo-Mitsubishi UFJ (Malaysia) Berhad (BOT)
Malayan Banking Berhad (MBB)	Citibank Berhad (CTB)
RHB Bank Berhad (RHB)	HSBC Bank Malaysia Berhad HSBC)
Public Bank Berhad (PUB)	United Overseas Bank (Malaysia) Bhd (UOB).
	Standard Chartered Bank Malaysia Berhad (SCB)
	JP Morgan Chase Bank Berhad (MCB)
	OCBC Bank (Malaysia) Berhad (OCBC)
	Deutsch Bank (DB)
Note: Abbreviations in parentheses	
Source: Bank Negara Malaysia	

Table 2. Accounting Ratios

1. Operating asset ratios	i) Interest margin to assets (interest received – interest expenses)/asset
	ii) Operating cost to assets
	iii) Pre-tax profit to assets
2. Operating income ratios	i) Interest margin to income
	ii) Operating cost to income
	iii) Pre-tax profit to income
3. Operating equity ratios	i) Interest margin to equity
	ii) Operating cost to equity
	iii) Pre-tax profit to equity

Table 3. Accounting Ratios Mean Values (RM MILLION), 2000-2006

	Total Assets	Equity	Gross Income	Interest Margin	Overheads	PBT
<b><u>Domestic Banks</u></b>						
AFB	20988.40	1561.47	1272.90	462.23	391.50	-26.13
ALB	18328.47	1571.85	1127.72	477.15	264.40	133.67
AMB	39344.78	2554.20	2559.28	1077.40	607.30	390.20
CIMB	76412.23	5330.23	4344.96	1814.87	1201.60	510.90
EON	24233.10	2223.86	1310.10	710.23	353.06	407.19
HLB	35418.59	3271.84	1921.34	889.84	379.03	718.03
MBB	138524.34	11668.04	7056.86	3925.23	1860.44	2699.79
RHB	62658.81	5109.67	3493.19	1412.36	917.19	441.93
PUB	72583.54	6287.60	3386.00	1927.23	743.56	1501.00
<b><u>Foreign Banks</u></b>						
RBS	3314.11	350.87	190.09	41.94	69.76	34.36
BB	844.26	227.47	52.17	20.14	9.44	21.36
BOA	1351.71	327.99	60.89	25.24	16.07	21.09
BNS	2649.00	358.54	129.10	45.47	15.39	37.70
BOC	837.82	319.78	37.10	18.28	10.16	12.46
BOT	3721.97	764.64	187.19	74.96	38.43	87.87
CTB	29728.01	1664.39	1932.09	820.10	555.51	572.90
HSBC	30346.16	1883.59	1954.96	725.14	646.24	602.53
UOB	23061.73	1769.53	1351.97	501.13	258.93	419.90
SCB	28164.77	1482.42	1714.27	710.60	476.73	412.68
MCB	1654.56	371.03	93.94	34.76	20.76	45.33
OCBC	26332.90	1887.77	1477.16	601.36	283.80	396.34
DB	4708.84	417.84	353.10	67.26	72.10	77.26

Note: PBT=Profit before tax

Source: Author's own estimates. Data taken from Bankscope.

Table 4. Variables Used in the Measurement for Cost and Profit Equations

<b><u>Dependent Variables</u></b>		
TC	Total cost	Operating + interest + personnel + overheads
$\pi$	Profit	Pre tax profits
<b><u>Independent variables</u></b>		
Q	Total Earning Assets	Loans, investment and other earning assets
$X_1$	Price of Labour and Capital	personnel and other overhead expenses divided by the total assets
$X_2$	Price of Deposits	income paid to depositors divided by total deposits

Table 5. Descriptive Statistics for Input and Output Variables, 2000-2006 (In RM Million)

	Variable	N	Mean	Median	Minimum	Maximum	Std. Dev.
<b>All</b>	TC	147	1073.91	825.20	13.20	6632.70	1212.98
	$\pi$	142	465.2092	267.80	6.60	5318.20	728.181
	Q	147	28300.14	19669.00	508.90	189518.10	34256.54
	X <sub>1</sub>	147	24477.63	17172.50	190.10	164392.60	29819.88
	X <sub>2</sub>	147	420.11	291.60	6.60	2784.00	490.79
<b>Domestic banks</b>	TC	59	1973.378	1552.10	342.20	6632.70	1390.863
	$\pi$	56	843.258	472.00	13.40	5318.20	1014.115
	Q	59	53196.17	38644.60	8826.00	189518.10	40747.25
	X <sub>1</sub>	59	46037.12	33733.30	6955.90	164392.60	35478.75
	X <sub>2</sub>	59	761.70	571.90	124.20	2784.00	572.60
<b>Foreign Banks</b>	TC	88	470.855	158.85	13.20	1648.40	512.785
	$\pi$	86	219.037	78.60	6.60	949.10	242.199
	Q	88	11608.48	3124.30	508.90	39324.00	12660.97
	X <sub>1</sub>	88	10022.98	2614.20	190.10	35417.30	11249.28
	X <sub>2</sub>	88	191.09	63.25	6.60	875.10	231.24

Note: TC = Total costs,  $\pi$  = profits, Q = Total earning assets, X<sub>1</sub> = Price of labour and capital, X<sub>2</sub> = Price of deposits

Table 6. Operating Ratios (Average of 2000-2006 in %)

	Operating asset ratios			Operating income ratios			Operating equity ratios		
	IMA	OCA	PA	IMI	OCI	PI	IME	OCE	PE
<b>Domestic banks</b>									
Affin Bank Berhad	2.2	1.9	-0.2	36.6	30.9	-1.5	30.5	27.0	-6.3
Alliance Bank Malaysia Berhad	2.7	1.4	0.8	42.3	23.3	12.2	32.1	17.2	9.7
AmBank Malaysia Berhad	2.8	1.6	1.1	42.5	23.5	15.7	43.1	23.6	15.9
CIMB Bank Berhad	2.4	1.6	0.6	41.6	27.5	10.9	35.5	23.4	9.1
EON Bank	2.8	1.5	1.5	55.1	26.5	31.4	29.7	15.6	15.9
Hong Leong Bank Berhad	2.8	1.1	2.1	51.0	20.4	37.5	28.2	11.6	21.6
Malayan Banking Berhad	2.8	1.3	1.9	54.5	26.1	36.5	33.3	15.7	22.0
RHB Bank	2.3	1.5	0.7	40.5	25.9	12.6	27.5	17.7	8.6
Public Bank	2.7	1.1	2.0	57.0	23.4	43.6	29.1	11.7	22.5
<b>Mean</b>	<b>2.6</b>	<b>1.4</b>	<b>1.2</b>	<b>46.8</b>	<b>25.3</b>	<b>22.1</b>	<b>32.1</b>	<b>18.2</b>	<b>13.2</b>
<b>Foreign Banks</b>									
The Royal Bank of Scotland	1.3	2.1	1.0	22.8	36.9	19.0	12.7	21.1	9.1
Bangkok Bank Berhad	2.4	1.2	2.7	39.0	18.6	38.6	13.1	6.5	13.2
Bank of America	1.9	1.3	1.5	47.1	29.4	37.1	7.7	5.0	6.4
The Bank of Nova Scotia	1.7	0.6	1.4	35.6	11.9	29.5	13.0	4.3	10.9
Bank of China	2.2	1.3	1.4	52.2	30.7	31.4	5.7	3.2	3.8
Bank of Tokyo-Mitsubishi UFJ	2.1	1.1	2.4	41.2	21.6	46.0	9.8	5.0	11.3
Citibank Berhad	2.8	1.9	2.0	42.4	28.7	29.7	50.3	33.9	35.7
HSBC Bank	2.4	2.1	2.0	37.2	33.0	30.4	39.0	34.3	31.6
United Overseas Bank	2.2	1.2	1.9	37.2	19.3	30.9	27.9	14.5	23.4
Standard Chartered Bank	2.6	1.8	1.4	42.0	28.3	23.8	48	32.3	27.5
JP Morgan Chase Bank	2.2	1.4	2.8	42.1	25.8	48.3	9.5	5.7	12.3
OCBC Bank	2.3	1.1	1.5	41.2	18.9	26.2	32.0	14.9	20.8
Deutsch Bank	1.5	1.7	1.9	19.4	20.8	21.6	16.5	18.4	18.5
<b>Mean</b>	<b>2.1</b>	<b>1.4</b>	<b>1.8</b>	<b>38.4</b>	<b>24.9</b>	<b>31.7</b>	<b>21.9</b>	<b>15.3</b>	<b>17.3</b>

Table 7. Cost Efficiency Measures, 2000-2006

<b>Banks</b>	<b>2000</b>	<b>2001</b>	<b>2002</b>	<b>2003</b>	<b>2004</b>	<b>2005</b>	<b>2006</b>	<b>Average</b>
<b><i>Domestic banks</i></b>								
Affin Bank Berhad	0.802	0.812	0.822	0.831	0.84	0.848	0.856	0.830
Alliance Bank Malaysia Berhad	NA	0.812	0.821	0.83	0.839	0.847	0.855	0.834
AmBank Malaysia Berhad	NA	NA	NA	0.988	0.988	0.989	0.989	0.988
CIMB Bank Berhad	0.862	0.869	0.875	0.881	0.887	0.893	0.898	0.881
EON Bank	0.807	0.817	0.827	0.835	0.844	0.852	0.859	0.834
Hong Leong Bank Berhad	0.859	0.866	0.872	0.879	0.885	0.891	0.896	0.878
Malayan Banking Berhad	0.909	0.914	0.918	0.922	0.926	0.930	0.933	0.922
RHB Bank	0.901	0.906	0.911	0.915	0.919	0.923	0.927	0.915
Public Bank	0.874	0.88	0.886	0.892	0.897	0.902	0.907	0.891
<b><i>Mean</i></b>	<b><i>0.859</i></b>	<b><i>0.859</i></b>	<b><i>0.867</i></b>	<b><i>0.886</i></b>	<b><i>0.892</i></b>	<b><i>0.897</i></b>	<b><i>0.902</i></b>	<b><i>0.882</i></b>
<b><i>Foreign Banks</i></b>								
The Royal Bank of Scotland	0.597	0.619	0.640	0.660	0.678	0.696	0.712	0.657
Bangkok Bank Berhad	0.460	0.491	0.521	0.548	0.573	0.597	0.620	0.544
Bank of America	0.613	0.634	0.654	0.673	0.691	0.707	0.723	0.671
The Bank of Nova Scotia	0.529	0.556	0.581	0.604	0.626	0.647	0.666	0.601
Bank of China	NA	NA	0.750	0.764	0.776	0.788	0.799	0.775
Bank of Tokyo-Mitsubishi UFJ	0.819	0.828	0.837	0.845	0.853	0.860	0.868	0.844
Citibank Berhad	0.846	0.854	0.861	0.868	0.875	0.881	0.887	0.868
HSBC Bank	0.800	0.811	0.820	0.830	0.838	0.847	0.854	0.829
United Overseas Bank	0.877	0.883	0.889	0.894	0.900	0.905	0.909	0.894
Standard Chartered Bank	NA	0.825	0.834	0.842	0.85	0.858	0.865	0.846
JP Morgan Chase Bank	0.661	0.68	0.697	0.713	0.729	0.743	0.757	0.711
OCBC Bank	0.871	0.878	0.884	0.890	0.895	0.900	0.905	0.889
Deutch Bank	0.647	0.666	0.684	0.701	0.717	0.733	0.747	0.699
<b><i>Overall Mean</i></b>	<b><i>0.702</i></b>	<b><i>0.727</i></b>	<b><i>0.743</i></b>	<b><i>0.756</i></b>	<b><i>0.769</i></b>	<b><i>0.782</i></b>	<b><i>0.793</i></b>	<b><i>0.755</i></b>
<b><i>Overall N = 147</i></b>	<b><i>0.763</i></b>	<b><i>0.780</i></b>	<b><i>0.790</i></b>	<b><i>0.809</i></b>	<b><i>0.819</i></b>	<b><i>0.829</i></b>	<b><i>0.838</i></b>	<b><i>0.806</i></b>
Note: NA, Data was not available from Bankscope								

Table 8. Profit Efficiency Measures, 2000-2006

Banks	2000	2001	2002	2003	2004	2005	2006	Average
<b><i>Domestic banks</i></b>								
Affin Bank Berhad	NA	NA	0.113	0.151	0.195	0.242	0.293	0.199
Alliance Bank Malaysia Berhad	NA	0.578	0.620	0.660	0.696	0.730	NA	0.657
AmBank Malaysia Berhad	NA	NA	NA	0.631	0.669	0.705	0.738	0.686
CIMB Bank Berhad	0.250	0.300	0.352	0.405	0.457	0.507	0.556	0.404
EON Bank	0.456	0.505	0.552	0.597	0.640	0.679	0.715	0.592
Hong Leong Bank Berhad	0.811	0.833	0.853	0.871	0.887	0.901	0.913	0.867
Malayan Banking Berhad	0.834	0.854	0.871	0.887	0.901	0.914	0.925	0.884
RHB Bank	0.321	0.373	0.425	0.476	0.526	0.573	0.617	0.473
Public Bank	0.827	0.848	0.866	0.883	0.897	0.910	0.921	0.879
<b>Overall Mean</b>	<b>0.583</b>	<b>0.613</b>	<b>0.582</b>	<b>0.618</b>	<b>0.652</b>	<b>0.685</b>	<b>0.710</b>	<b>0.638</b>
<b><i>Foreign Banks</i></b>								
The Royal Bank of Scotland	NA	0.402	0.453	0.503	0.550	0.596	0.638	0.524
Bangkok Bank Berhad	0.730	0.760	0.787	0.812	0.834	0.855	0.872	0.807
Bank of America	0.518	0.565	0.608	0.649	0.687	0.722	0.754	0.644
The Bank of Nova Scotia	0.626	0.665	0.701	0.734	0.765	0.792	0.817	0.729
Bank of China	NA	NA	0.480	0.528	0.574	0.617	0.658	0.571
Bank of Tokyo-Mitsubishi UFJ	0.820	0.841	0.860	0.877	0.892	0.906	0.918	0.873
Citibank Berhad	0.879	0.894	0.907	0.919	0.929	0.938	0.946	0.916
HSBC Bank	0.839	0.859	0.876	0.891	0.905	0.917	0.927	0.888
United Overseas Bank	0.815	0.837	0.856	0.874	0.889	0.903	0.915	0.870
Standard Chartered Bank	NA	0.429	0.479	0.528	0.574	0.618	0.659	0.548
JP Morgan Chase Bank	0.880	0.895	0.908	0.920	0.930	0.939	0.947	0.917
OCBC Bank	0.675	0.710	0.742	0.771	0.798	0.822	0.843	0.766
Deutch Bank	0.773	0.799	0.822	NA	0.862	0.879	0.894	0.838
<b>Overall Mean</b>	<b>0.755</b>	<b>0.721</b>	<b>0.729</b>	<b>0.750</b>	<b>0.784</b>	<b>0.808</b>	<b>0.830</b>	<b>0.769</b>
<b>Overall N = 142</b>	<b>0.691</b>	<b>0.681</b>	<b>0.673</b>	<b>0.694</b>	<b>0.730</b>	<b>0.757</b>	<b>0.784</b>	<b>0.717</b>
Note: NA, Data was not available from Bankscope								

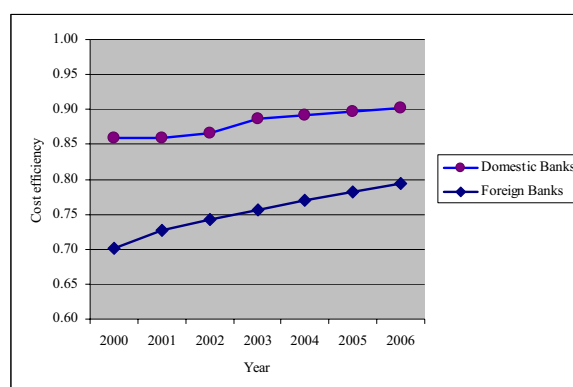


Figure 1. Cost Efficiency for Domestic and Foreign Banks

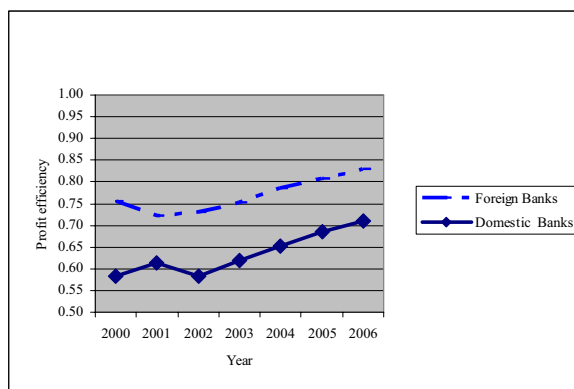


Figure 2. Profit Efficiency for Domestic and Foreign Banks

**Appendix 1: Cost Function Maximum Likelihood Parameter Estimates***Dependent Variable :  $\ln(\pi)^*$* 

Parameter	Variable	Coefficient	Standard Error	T-Ratio
$\beta_0$	Constant	-1.947	0.922	-2.111
$\beta_1$	Total Earning Assets	1.273	0.113	11.236
$\beta_2$	Price of Labour and Capital	0.522	0.319	1.635
$\beta_3$	Price of Deposits	0.064	0.122	0.525
$\beta_4$	(T. Earning Assets) <sup>2</sup>	-0.013	0.005	-2.427
$\beta_5$	T. E. Assets X P. Labour and Capital	-0.020	0.013	-1.511
$\beta_6$	T. E. Assets X P. Of Deposits	0.012	0.008	1.423
$\beta_7$	(P. of Deposits) <sup>2</sup>	0.101	0.035	2.842
$\beta_8$	P. Labour and Capital X P. of Deposits	-0.251	0.035	-7.125
$\beta_9$	(Price of Deposits) <sup>2</sup>	0.093	0.014	6.566
Sigma-square	$\sigma^2 = \sigma_v^2 + \sigma_u^2$	1.106	0.317	3.481
Gamma	$\gamma = \sigma_u^2 / (\sigma_v^2 + \sigma_u^2)$	0.999	0.0002	4142.701
Mu		-2.102	0.358	5.863
Eta		0.048	0.009	5.515
Log likelihood Function			237.664	

Note: N = 147

**Appendix 2: Profit Function Maximum Likelihood Parameter Estimates**

<b><i>Dependent Variable : <math>\ln(\pi)^*</math></i></b>				
<b>Parameter</b>	<b>Variable</b>	<b>Coefficient</b>	<b>Standard Error</b>	<b>T-Ratio</b>
$\beta_0$	Constant	-2.4687	2.0193	-1.2225
$\beta_1$	Total Earning Assets	-0.2780	0.5793	-0.4799
$\beta_2$	Price of Labour and Capital	-4.0892	1.6165	-2.5296
$\beta_3$	Price of Deposits	2.4393	1.3964	1.7468
$\beta_4$	(T. Earning Assets) <sup>2</sup>	-0.0145	0.0296	-0.4906
$\beta_5$	T. E. Assets X P. Labour and Capital	-0.0530	0.0943	-0.5618
$\beta_6$	T. E. Assets X P. Of Deposits	-0.3358	0.1080	-3.1093
$\beta_7$	(P. of Deposits) <sup>2</sup>	-0.3422	0.2627	-1.3025
$\beta_8$	P. Labour and Capital X P. of Deposits	-0.4309	0.4115	-1.0473
$\beta_9$	(Price of Deposits) <sup>2</sup>	0.2086	0.1673	1.2469
Sigma-square	$\sigma^2 = \sigma_v^2 + \sigma_u^2$	0.8132	0.3913	2.0782
Gamma	$\gamma = \sigma_u^2 / (\sigma_v^2 + \sigma_u^2)$	0.7432	0.1465	5.0723
Mu		-1.5548	1.0553	-1.4734
Eta		0.1451	0.0496	2.9277
Log likelihood Function			-109.5221	
Note: N = 142				



## Global Financial Tsunami Impacts Russian Economy

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### Abstract

Russian economy depends on energy resources highly. Due to impacts of the financial crisis and the sharp decrease of oil price, Russian economy driven by “Petro-dollar” tends to develop slowly. The overwhelming financial tsunami not only impacts Russian financial system but also influences Russian substantial economy. Russian government adopts relevant financial policies in time, keeping the stability of domestic currency, depressing the inflation, and enhancing the support for SMEs and substantial economy. In 2009, Russian economy recovers its vitality, stepping forward steadily.

**Keywords:** Financial tsunami, Russian economy

As American sub-prime mortgage crisis make western countries in panic, Russia is like a silent port. Nobody believes there is certain relationship between the sub-prime mortgage crisis and Russia. However, American financial crisis come Russia overnight, which not only impacts Russian financial system but also influences Russian substantial economy.

### 1. The present situation of Russian economy is not optimistic

Russian economy depends on energy resources highly. Due to the financial crisis, the crude oil price goes down sharply from 147 US dollars per barrel to about 40 US dollars per barrel in 2008. Russian economy driven by “Petro-dollar” tends to develop slowly. Although Russian economy has developed fast during past ten years, it slows down now. In Dec. 2008, Russian economy shrunk by 1.1%. Surely, the slow down of economy is popular in the world, but this phenomenon is especially surprising in Russia.

Statistical data show that in Nov. 2008 Russian industrial enterprises’ production shrunk quickly. In this month the domestic industrial added value decreases by 10.8% compared with that of Oct, and decreases by 8.7% compared with that of the same period in 2007. This decrease almost covers Russian all industrial production filed. And in Dec. the industrial production shrunk further. According to a report issued by an international grading institution, it is predicted that in 2009 the export of Russia will shrink by 25% and the GDP will decrease by 2.2%. Besides, the house price that has kept rising before Oct. 2008 tends to decline. The house price in Moscow decreases by 25%. Similar to the house market, the stock indexes decrease by more than 70%. According to Russian official data, during the recent months, more than 300 thousand people lost jobs and total unemployment number exceeds 5 million. In addition, the outflow of Russian capitals tends to be faster, which will continue in 2009. It is predicted that in 2009 the net outflow of Russian capitals will reach 100-110 billion US dollars.

Declining industry, house market and stock market, serious unemployment, and outflow of capitals have already turned into a vivid description of Russian economy. Russian economy is “extremely weak” in facing the global financial crisis. The situation is not optimistic.

### 2. Serious shock of financial market

In Russian, the exchange fluctuates freely. Therefore, American financial crisis exerts a significant impact on Russian financial system.

#### 2.1 Stock market slumps seriously

Since American sub-prime mortgage crisis, global stock markets have slumped seriously. Russian has even turned into the “safely island” of world economy. Amounts of foreign capitals rush in and the stock market rises quickly. On June 3<sup>rd</sup>, 2008, the index “Russian trading system” rises to the historical top 2451 point. Afterwards, it declines slowly. On Aug. 8<sup>th</sup>, a military conflict happens between Russia and Georgia. The geopolitical contradiction between Russia and America is intensified. Russian stock index slumps from 1839 to 1722. On Sep. 15<sup>th</sup>, Lehman Brothers Holdings goes bankruptcy. Russian stock market slumps sharply. On Sep. 16<sup>th</sup>, the index Russian trading system (RTS) slumps by 11.47%. Moscow Inter-bank Currency Exchange Index (MICEX) slumps by 17.75%. On Sep. 17<sup>th</sup>, RTS and MICEX stop normal trade. Index MICEX falls by 10% above. Russian savings bank stock falls by 26% on the same day. On Oct. 6<sup>th</sup>, Russia PTC pay system stock slumps by 19.1%, reaching at 866.39 point, the largest decline since Sep. 1<sup>st</sup>, 1995. On the same day, MICEX index slumps by 18.66%, reaching at 752 point. Due to the sharp decline, PTC stops two times and MICEX stops three times on the same day. Although Russian government inputs capitals in banking system



for many times in order to save the stock market, it can not strengthen investors' confidence.

### *2.2 Banks operates at loss*

Along with the spread of world financial crisis, it tests the stability and adaptability of Russian banking system. Statistical data show that about one third of Russian banks are in business risks. They are confronted with an unprecedented risk for ten years. The loss of Russian banking system reaches 40 billion RUB till Oct. 31<sup>st</sup>, 2008. Russian professionals say that since 1999 all Russian banks are profitable. According to statistical materials from Central Bank of Russia, the total profits of Russian banking industry reaches 508 billion RUB in 2007. The number is 371.5 billion RUB in 2006, 262.1 billion RUB in 2005, and 177.9 billion RUB in 2004. From Jan. to Aug. 2008, Russian banking industry's average total profits per month reaches 44 billion RUB. However, this condition is sharply changed in two months due to the world financial crisis. In Sep. the total profits of Russian banking industry is 1.3 billion RUB. From Oct. the operation of Russian banking industry turns into "loss" from "profit" in general.

Due to Russian financial industry faces severe crisis. On Oct. 7<sup>th</sup>, the President Medvedev holds an urgent economic conference. He declares that the state offers a favorable loan 950 billion RUB and the term is no less than five years. Some Russian professionals agree that this measure is not for supporting the liquidity but help banks to pay for debts in case of banks' bankruptcy causing panic among citizens. On Oct. 13<sup>th</sup>, the President signs an act of Complement Measures for Supporting Financial System and amends relevant laws. Russian government invests in banks by all means in order to solve the liquidity risk. The issue of Russian Act of Complement Measures for Supporting Financial System signals the government saving the market comprehensively. At present, 122 large and medium banks get investments from the government. However, Russia has 1126 banks. Most small banks can not get allowance from the government. Therefore, the government amends the Law of Natural Person Deposit Insurance. The former law regulates that the top limit for a full compensation is 200,000 RUB (about 7565 US dollars) as banks are in bankruptcy. And for a deposit between 200,000 RUB and 700,000 RUB (about 26,457 US dollars), the compensation is 90%. Now the amended law regulates that the top limit for a full compensation rises to 700,000 RUB. By this way, it can ensure small banks' deposits. 98% of depositors can get a full compensation. The government plans to further perfect this law and endows deposit insurance companies with a right of saving banks at the very beginning instead of at bankruptcy.

### *2.3 RUB keeps in depreciation*

Since the year 2003, the crazy rise of world crude oil further stabilizes the advantage position of RUB. The exchange rate from RUB to US dollar rises from 1: 28.5810 (Mar. 22<sup>nd</sup>, 2005) to 1: 23.4456 (July June 31<sup>st</sup>, 2008). The appreciation is about 21.93%. However, since American financial crisis, especially the conflict between Russia and Georgia, RUB depreciates sharply. The exchange rate from RUB to US dollars decreases from 1:23.4456 (end of July) to 1:32.9 (Jan. 20<sup>th</sup>, 2009), being the lowest since 1998. The depreciation surpasses 40%.

Due to the pessimistic economic future, RUB keeps in depreciation recently. In order to support the RUB, Russia sales lots of US dollars. According to news from Reuters Reuters, Russia has already spent 200 billion US dollars in order to control the depreciation of RUB, which is equal to one third of Russia's foreign exchange reserve. However, under the double pressures from world financial crisis and decline of world crude oil price, Russian government fails. In order to save RUB, Russia sets the bottom limit for the depreciating RUB. Unfortunately, it makes RUB turn into a striking target. RUB exchange is a sensitive issue in Russia. The memory of a sharp depreciation of RUB in 1998 is still clear. Oil is the main export product of Russia. The sharp decrease of crude oil price and the world financial crisis make amounts of capitals exit from Russia, which makes RUB depreciate seriously in last several months. Russian government has to save the RUB exchange.

According to Russian official statistical data, since 2009, RUB depreciates by 23.1%. From early 2008 to now, the accumulated depreciation of RUB is 50%. Although in Feb. 2009 the Central Bank of Russia continues to increase the repurchase rate and a series of mortgage rates and RUB tends to stop depreciating, the RUB exchange starts a new decrease after five trading days. Apparently, Russian government's exchange interference and rising rates can not stop the depreciation of RUB. As a matter of fact, the real reason for global investors depreciating RUB is the worry of unstable political situation and the uncertainty of high crude oil price.

## **3. Substantial economy suffers serious damages**

American financial crisis brings about significant negative effects on Russian substantial economy by finance, investments, and trade.

In 2008, Russian enterprises and organizations' net profits (subtract losses from profits) calculated by current prices are 3998.6 billion RUB, being equal to 171.9 billion US dollars, decreasing by 30.4%. Presently about 300,000 enterprises submit taxation reports in Moscow. Therein, nearly 59,000 enterprises are in losses and about 60,000 enterprises report zero tax. Along with the development of financial crisis, more and more enterprises will suffer from losses, which will causes a sharp decrease of budget income.

Since the financial crisis, Russian stock market suffers a series of continuous strikes. Two main stock indexes decrease by 70% from the top in May. Because of credit deflation, amounts of SMEs can not get loans, what makes their operations more difficult. Russian small and medium trading net has been ruined seriously. Therein, most are merged or in bankruptcy. Lots of retailers face problems of short-term loans, rising rates, and decreasing demands. Besides, the financial crisis exerts negative effects on credit loans for agricultural production. Today it is more difficult for farmers getting a new loan or increase present loans. In order to further extend the output, Russia must invest more in the agriculture. Unfortunately, it is hard now getting loans from banks in financial crisis.

As the crisis spreads over the financial market, the oil and gas industry, the greatest backbone of Russian economy, feels threats. After Aug. 2008, the slumping world crude oil price and the shrinking stock prices make Russia's main oil and gas enterprises face debts crisis and reduce of production. According to a report from Russian Business Men, Russian oil and gas enterprises admit the severe problems originated from the financial crisis for the first time. They hope the government to offer helps. On Sep. 24<sup>th</sup>, the chiefs from Russian Joint-Stock Company Gazprom, OAO Lukoil Holdings, Russian Rosneft Company, and THK-BP Company please Premier Putin to offer official loans for paying off western banks. These companies hope the Premier Putin to ask the Ministry of Finance and the Central Bank of Russia to set up a mechanism of investing in strategic industries. 70% of oils and 91% of gases are from these four companies. Therefore, the four companies are vital for Russian economy. Now Putin promises to offer 50 billion US dollars.

Due to the difficulty of applying for loans and the high expenses, Russian construction enterprises face financial problems now. Some Russian real estate developers fail to get necessary capitals. Certain large developers may stop some new projects or refuse to purchase more lands. Even some developers try to pay loans by selling the projects in construction. Now it is reported that Moscow city government plans to take 2 billion US dollars budget capitals to help the real estate developers in difficulty.

Impacted by the financial crisis, Russian automobile production enterprises and metal manufacturing enterprises have to reduce the output to manage the crisis. An automobile group declares to apply a four-work-day system in order to reduce the output. Another group even stops the production of trucks. Because of the decrease of orders, on Oct. 8<sup>th</sup> 2008 one of Russia's largest steel companies declares to reduce the production by 15% and employees by 10%. Russia steel pipe company will reduce the investment plan by half in next year. Market analysts agree that by late 2008 all Russian steel companies will reduce the production by 20%-25%. And this state will continue for one or two years because the large consumer of steels, construction industry and oil and gas industry change their production and investment plans.

In order to weaken the impacts of financial crisis on the substantial economy, Russia constitutes and starts to apply a saving plan for some backbone industries, such as agriculture, energy, automobile, aircraft, military, and construction. For example, the government offers loans for large agricultural projects. The national purchase should target at the domestic products firstly. For enterprises that produce for the government's orders, the government should offer national guaranties. The government supplies official allowances for military enterprises paying off loans. Russian government will support 1500 enterprises that are meaningful for the national economy.

#### **4. The future of Russia ----- goes forward difficultly**

Russia's vice<sup>[voice]</sup> Premier Kudelin has ever said that the year 2009 will be the most difficult one since the World War Two. The budget deficit may reach 3% or 5% of GDP. At the first half of 2009, the RUB exchange will decrease by 10% at least compared with that of last year. Although the effects of financial crisis should not be neglected by all means, it is predicted that the tight supply of energy in the global market will contribute to the sharp rise of crude oil price. OPEC's reduce of production may benefit the rise of crude oil price. Meanwhile, Russian government adopts relevant financial policies, maintains the stability of national currency, and depresses the inflation. As enhancing the supports for SMEs and the substantial economy, the government supervises the use of financial allocation, ensuring that the substantial economy gets funds. To release the liquidity deflation caused by the financial crisis can protect the financial system to certain degree, which can also guarantee the recovery of Russian economy. Russia has ever experienced the most difficult stage in late 90s in last century. Russian now can resist the world financial crisis effectively. In 2009, Russian economy restores former confidence gradually. Although the future is till difficult, Russia will go forward.

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## E-Banking in Emerging Economy: Empirical Evidence of Iran

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### Abstract

Now a day's due to emerging global economy, e-commerce and e-business have increasingly become a necessary component of business strategy and a strong catalyst for economic development. The integration of information and communications technology in business has revolutionized relationships within organizations and those between and among organizations and individuals. The new information technology is becoming an important factor in the future development of financial services industry, and especially banking industry. The results of this study shows that e-banking serves several advantages to Iranian banking sector, however, the study also shows that the Iranian customers have not enough knowledge regarding e-banking which is rendering by banking sector in Iran.

**Keywords:** Banking sector, E-banking, Iran

### Introduction

Financial services industry has recently been open to historic transformation, it can call e-developments are emerging and advancing rapidly in all areas of financial intermediation and financial markets: e-finance, e-money, electronic banking (e-banking), e-brokering, e-insurance, e-exchanges, and even e-supervision. The new information technology (IT) is turning into the most important factor in the future development of banking, influencing banks' marketing and business strategies. In recent years, the adoption of e-banking began to occur quite extensively as a channel of distribution for financial services due to rapid advances in IT and intensive competitive banking markets. The driving forces behind the rapid transformation of banks are influential changes in the economic environment: innovations in information technology, innovations in financial products, liberalization and consolidation of financial markets, deregulation of financial inter-mediation etc. These and other factors make it complicated to design a bank's strategy, which process is threatened by unforeseen developments and changes in the economic environment and therefore, strategies must be flexible to adjust to these changes. The financial services market is continuing to change rapidly, which brings into question whether traditional banks, as they are now structured, will actually continue to exist by the end of the decade or even survive through the next five years. Competition has been increasing for some years within traditional financial centers, amongst the banks themselves. A significant challenge comes from international banks offering technology-based financial services across geographical boundaries and thereby competing with traditional banks for their best business within their own back yard.

Indeed, there is a growing concern that e-banking is not yielding the anticipated results, creating a gap between the actual returns and the proposed objectives and thereby losing a large amount of investment. This especially concerns the interaction with clients and thereby increased and more rapid access to new markets. This has thrown the spotlight onto the problem of change from one particular delivery channel to another. This is highly important since the implementation of e-banking may have radical implications on a bank's structures, business processes, products and services and value flows with clients and other parties.

A strong banking industry is important in every country and can have a significant affect in supporting economic development through efficient financial services. In Iran the role of the banking industry needs to change to keep up with the globalization movement, both at the procedural level and at the informational level. This change will include moving from traditional distribution channel banking to electronic distribution channel banking. Given the almost complete adoption of e-banking in developed countries, the reason for the lack of such adoption in developing countries like Iran is an important research that will be addressed by this paper. In other words, despite this growth of IT worldwide, Iranian banks continue to conduct most of their banking transactions using traditional methods. Understanding the reasons for the lack of such technological innovation in developing countries such as Iran will

develop a fruitful research. The aim of the paper is to look at the emergence, advantages and acceptance of e-banking in Iran.

### **Definition of e-banking**

E-banking is the newest delivery channel for banking services. Banks have used electronic channels for years to communicate and transact business with both domestic and international corporate customers. With the development of the Internet and the World Wide Web (WWW) in the latter half of the 1990s, banks are increasingly using electronic channels for receiving instructions and delivering their products and services to their customers. This form of banking is generally referred to as e-banking or Internet banking, although the range of products and services provided by banks over the electronic channel vary widely in content, capability and sophistication. E-banking is defined as the automated delivery of new and traditional banking products and services directly to customers through electronic, interactive communication channels. The definition of e-banking varies amongst researches partially because electronic banking refers to several types of services through which bank customers can request information and carry out most retail banking services via computer, television or mobile phone (Daniel, 1999; Mols, 1998; Sathye, 1999). Burr (1996), for example, describes it as an electronic connection between bank and customer in order to prepare, manage and control financial transactions. Electronic banking can also be defined as a variety of following platforms:

(a) Internet banking (or online banking), (b) telephone banking, (c) TV-based banking, (d) mobile phone banking, and e-banking (or offline banking).

As online Internet banking and mobile phone banking are the fastest developing areas, in the present paper the focus is mainly on the development and the future of these platforms.

E-banking includes the systems that enable financial institution customers, individuals or businesses, to access accounts, transact business, or obtain information on financial products and services through a public or private network, including the Internet or mobile phone. Customers access e-banking services using an intelligent electronic device, such as a personal computer (PC), personal digital assistant (PDA), automated teller machine (ATM), kiosk, or Touch Tone telephone. While some literature restricts the use of the term to internet banking (i.e. Daniel 1999), elsewhere the term is limited to retail banking (Aladwani 2001) or both retail and corporate banking (Simpson 2002). The common definition for e-banking, and the one used in this paper, comes from the Basel Committee Report on Banking Supervision (1998, 3), 'e-banking refers to the provision of retail and small value banking products and services through electronic channels. Such products and services can include deposit-taking, lending, account management, the provision of financial advice, electronic bill payment, and the provision of other electronic payment products and services such as electronic money.'

### **E-banking benefits**

E-banking serves several benefits to any societies which are summarized as below:

#### **Benefits from the banks' point of view**

From the banks' view point, the first benefits for the banks offering e-banking services is better branding and better responsiveness to the market. Those banks that would offer such services would be perceived as leaders in technology implementation. Therefore, they would enjoy a better brand image.

The other benefits are possible to measure in monetary terms. The main goal of every company is to maximize profits for its owners and banks are not any exception. Automated e-banking services offer a perfect opportunity for maximizing profits.

According to a survey an estimated cost providing the routine business of a full service branch in USA is \$1.07 per transaction, as compared to 54 cents for telephone banking, 27 cents for ATM (Automatic Teller Machine) banking and 1.5 cents for Internet banking (Nathan 1999; Pyun *et al.*, 2002).

#### **Benefits from the customers' point of view**

The main benefit from the bank customers' point of view is significant saving of time by the automation of banking services processing and introduction of an easy maintenance tools for managing customer's money. The main advantages of e-banking for corporate customers are as follows (Gurău, 2002). Reduced costs in accessing and using the banking services. According to their idea the main benefits of e-banking are as flow:

- 1) Increased comfort and timesaving — transactions can be made 24 hours a day, without requiring the physical interaction with the bank, without requiring the physical interaction with the bank.
- 2) Quick and continuous access to information. Corporations will have easier access to information as, they can check on multiple accounts at the click of a button.
- 3) Better cash management. E-banking facilities speed up cash cycle and increases efficiency of business processes as large variety of cash management instruments is available on Internet sites of banks.

4) Private customers seek slightly different kind of benefits from e-banking. In the study on online banking drivers Aladwani (2001) has found, that providing faster, easier and more reliable services to customers were amongst the top drivers of e-banking development. The main benefits from e-banking for private customers are as follows (BankAway, 2001):

- 1) Reduced costs: This is in terms of the cost of availing and using the various banking products and services.
- 2) Convenience: All the banking transactions can be performed from the comfort of the home or office or from the place a customer wants to.
- 3) Speed. The response of the medium is very fast; therefore customers can actually wait till the last minute before concluding a fund transfer.
- 4) Funds management. Customers can download their history of different accounts and do a “what-if” analysis on their own PC before affecting any transaction on the web. This will lead to better funds management.

### **Economical benefits**

The impact of the New Economy on the entire economic growth has been studied in several research projects. For example Pohjola (2002) shows, that the contribution of the use of information communication technology to growth of output in the Finnish market sector has increased from 0.3 percentage points in early 1990s to 0.7 points in late 1990s. However, unlike the US, there has been no acceleration in the trend rate of labor productivity in Finland.

According to the recent research conducted in Estonia (Aarma and Vensel, 2001), bank customers use bank office services on average 1.235 times per month, and wait in queue in bank office on average for 0.134 hours.

In nutshell, E-banking serves so many benefits not only to the bank it self, but also to the society at whole. Accordingly From bank's side, e-banking makes finance economically possible:

- (1) Lower operational costs of banks
  - . Automated process
  - . Accelerated credit decisions
  - . Lowered minimum loan size to be profitable
- (2) Potentially lower margins
  - . Lower cost of entry
  - . Expanded financing reach
  - . Increased transparency
- (3) Expand reach through self-service
  - . Lower transaction cost
  - . Make some corporate services economically feasible for society
  - . Make anytime access to accounts and loan information possible

- From society perspective

E-banking business makes access to finance from banks attractive. Society have benefited from the development of E-finance and gradually stepped out of the informal sector. In particular, E-finance offers the following attractive benefits for society:

- . Ease of use
- . Lower costs of financing
- . Convenience
- . Time savings
- . Operational efficiency

### **History of banking in Iran**

La Porta et al., (2002) documents that government ownership of banks is pervasive worldwide. In 1995 state ownership in the banking industry around the world averaged about 41.6% percent (38.5% if we exclude former socialist countries). Mayer (1990) shows that bank financing is the main source of outside financing in all countries. Yet despite the prevalence of government-owned banks in many countries, the prominent role of bank financing, and the importance of efficient financial markets for growth, there is very little evidence on how government ownership affects bank lending.

Banking operations had been carried out in Iran by temples and princes before the advent of Achaemenid dynasty by government. In that period, trade boomed in the country, thus giving a boost to banking. Before a bank in its present form was established in the country, banking operations had been carried out in traditional forms in the form of money changing. Money changing began to decline with the establishment of New East Bank, an originally British owned bank in the country in 1850. Bank Sepah was the first bank to be established with Iranian capitals in 1925 under the name of Bank Pahlavi Qoshun, in order to handle the financial affairs of the military personnel and set up their retirement fund. The primary capital of the bank was 388,395 Tomans. In the spring of 1979, all Iranian banks were nationalized and banking laws changed with the approval of the new interest free Islamic banking regulations. Before a bank in its present form was established in Iran, banking operations had been carried out in traditional form, or in other words in the form of money changing. Simultaneous with promotion of trade and business in the country, more people chose money changing as their occupation.

Following a boost in trade and use of bank notes and coins in trade during the Parthian and Sassanian eras, exchange of coins and hard currencies began in the country. Some people also managed to specialize in determining the purity of coins. Bank notes and gold coins were first used in the country following the conquest of Lidi by Achaemenid king Darius in 516 B.C. At that time, a gold coin called Derick was minted as the Iranian currency. During the Parthian and Sassanian eras, both Iranian and foreign coins were used in trade in the country. However, with the advent of Islam in Iran, money changing and use of bank notes and coins in trade faced stagnation because the new religion forbade interest in dealing. In the course of Mongol rule over Iran, a bank note which was an imitation of Chinese bank notes was put in circulation. The bank notes, called Chav bore the picture and name of Keikhathu. On one side of the bank notes there was the following sentence: "Anybody who does not Besides Chav, other bank notes were used for a certain period of time in other Iranian cities and then got out of circulation. Before the printing of first bank notes by the Bank Shahanshahi (Imperial Bank), a kind of credit card called Bijak had been issued by money dealers. As mentioned before, money changing got out of fashion with the advent of Islam under which usury is strictly forbidden.

The New East Bank establishment 1850 and it was in fact the first banking institute in its present form established in Iran. It laid the foundation of banking operations in the country. It was a British bank whose headquarters was in London. The bank was established by the British without receiving any concession from the Iranian government. The New East Bank allowed individuals to open accounts, deposit their money with the bank and draw checks. It was at this time that people began to draw checks in their dealings. In order to compete with money dealers, the bank paid interest on the fixed deposits and current accounts of its clients. The head office of the bank in Tehran issued five 'qeran' bank notes in the form of drafts. According to a concession granted by the Iranian government to Baron Julius De Reuter in 1885, Bank Shahanshahi (Imperial Bank) was established. This bank purchased the properties and assets of the New East Bank, thus putting an end to the banking operations of the former. The activities of Bank Shahanshahi ranged from trade transactions, printing bank notes, and serving as the treasurer of the Iranian government at home and abroad in return for piecework wage. In return for receiving this concession, Reuter obliged to pay six percent of the annual net income of the bank, providing that the sum should not be less than 4,000 pounds, and 16 percent of incomes from other concessions to the Iranian government. The legal center of the bank was in London and it was subject to the British laws but its activities were centered in Tehran.

In 1209 (lunar hejira), the right of printing bank notes was purchased from Bank Shahanshahi for a sum of 200,000 pounds and ceded to the Bank Melli of Iran. Bank Shahanshahi continued its activities until 1948 when its name was changed into Bank of Britain in Iran and Middle East. The activities of the bank continued until 1952. In 1269 (l.h.), a Russian national by the name of Jacquet Polyakov, received a concession from the then government of Iran for establishment of Bank Esteqrazi for 75 year. Besides, banking and mortgage operations, the bank had an exclusive right of public auction. In 1898 the Tzarist government of Russia bought all shares of the bank for its political ends. Under a contract signed with Iran, the bank was transferred to the Iranian government in 1920. The bank continued its activities under the name of Bank Iran until 1933 when it was incorporated into the Bank Keshavarzi (Agriculture Bank).

Bank Sepah was the first bank to be established with Iranian capitals in 1925 under the name of Bank Pahlavi Qoshun, in order to handle the financial affairs of the military personnel and set up their retirement fund. With Bank Sepah opening its branches in major Iranian cities, the bank began carrying financial operations such as opening of current accounts and transfer of money across the country. The Iran-Russia Bank was formed by the government of the former Soviet Union in 1926 with an aim of facilitating trade exchanges between the two countries.

The headquarters of the bank was in Tehran with some branches being inaugurated in northern parts of the country. The bank dealt with financial affairs of institutes affiliated to the government of the former Soviet Union and trade exchanges between the two countries. The activities of this bank, which were subject to Iranian banking regulations, continued until 1979. In that year, this bank along with 27 other state-owned or private banks was nationalized under a decision approved by the Revolutionary Council of the Islamic Republic of Iran.

The proposal to establish a national Iranian bank was first offered by a big money dealer to Qajar king Nasereddin Shah before the Constitutional Revolution. But the Qajar king did not pay much attention to the proposal. However, with the establishment of constitutional rule in the country, the idea of setting up a national Iranian bank in order to reduce political and economic influence of foreigners gained strength and at last in December 1906 the establishment of the bank was announced and its articles of association compiled.

In April 1927, the Iranian Parliament gave final approval to the law allowing the establishment of Bank Melli of Iran. But, due to some problems the Cabinet ministers and the parliament's financial commission approved the articles of association of the bank in the spring of 1928. The Central Bank of Iran was established in 1928, tasked with trade activities and other operations (acting as the treasurer of the government, printing bank notes, enforcing monetary and financial policies and so on). The duties of the CBI included making transactions on behalf of the government, controlling trade banks, determining supply of money, foreign exchange protective measures and so on.

In June 1979, Iranian banks were nationalized and banking regulations changed with the approval of the Islamic banking law (interest free), and the role of banks in accelerating trade deals, rendering services to clients, collecting deposits, offering credits to applicants on the basis of the CBI's policies and so on was strengthened. In short now days there are currently around seventeen commercial banks in Iran, of which eleven are state-owned and six are privately owned which all the banks must follow Islamic banking principles whereby usury is forbidden and, rather than AIRs, profit rates are set on deposits and expected rates of profit on facilities are set on loans. In terms of both assets and capital, the banking sector is dominated by Bank Melli Iran (National Bank of Iran). In recent years, six privately owned banks, Bank Kafarin, Bank Parsian, Bank Eqtesad-e-Novin Bank Saman, Bank Pasargad and Bank Sarmaye have commenced operations in Iran for the first time since the nationalization of the Iranian banking sector in 1952.

### **Review of literature**

Costs of transactions in e-banking can be as low as a tenth of the cost of banking through conventional means. A further very telling factor is that Internet banking clients generate twice the revenue of a bank's traditional customers and we already know that the cost of their transactions is one-tenth of the cost of transactions through conventional banking; and access to e-banking is becoming easier all the time.

Banking industry, locally as much as internationally, is becoming a tougher business to run and grow, given the increasing competition in a shrinking globe. Bankers are looking more and more into solutions to better reach out to their customers, improve customer's loyalty, gain competitive advantage, and provide better services, while reducing their running cost and generating more revenues.

Daniel (1999) described e-banking as the provision of banking services to customers through new technology. Other researches (Daniel, 1999; Karjaluoto et al., 2002) indicated that banks have the choice to offer their banking services through various electronic distribution channels technologies such as Internet technology, video banking technology, telephone banking technology, and WAP technology. Karjaluoto et al. (2002) also indicated that Internet technology is the main electronic distribution channel in the banking industry. In other words, e-banking as an online banking that involves the provision of banking services such as accessing accounts, transferring funds between accounts, and offering an online financial service.

Wang et al. (2003) claim that in the 1990s e-banking was under-utilised as business organisations used it only to market their products and services. Thornton and White (2001), who examined customer orientations and usage of financial distribution channels in the Australian financial industry, found that more recently most financial institutions, faced with competitive pressure after the introduction of deregulation in 1983, have rethought their strategies to take full advantage of Internet technology. Tan and Teo (2000) note that the challenge to expand and maintain banking market share has influenced many banks to invest more in making better use of the Internet. The emergence of e-banking had made many banks rethink their Information Technology (IT) strategies in competitive markets.

They suggest that the banks that fail to respond to the emergence of e-banking in the market are likely to lose customers and that the cost of offering e-banking services is less than the cost of keeping branch banking. This notion was also confirmed in a study conducted by Jasimuddin (2004) who examined the role of e-banking in Saudi Arabia. He indicated that the majority of Saudi banks had taken advantage of Internet technology to establish web sites but few offered e-banking services. He suggested that if the Saudi Arabian banking industry wished to be successful in the global economy it would need to integrate Internet technology into its banking strategy.

Chiemeke et al. (2006) conducted an empirical investigation on adoption of e-banking in Nigeria. The study identified the major inhibiting factors to Internet banking adoption in Nigeria such as, insecurity, inadequate operational facilities including telecommunications facilities and electricity supply, and made recommendations on how Nigeria banks can narrow the digital divide. Also, the report revealed that Internet banking is being offered at the basic level of interactivity with most of the banks having mainly information sites and providing little Internet transactional services.

Similarly, Agboola (2006) investigated electronic payment systems and tele-banking services in Nigeria. The findings revealed that there has been a very modest move away from cash. Payments are now being automated and absolute volumes of cash transactions have declined. The result of the study revealed that tele-banking is capable of broadening the customer relationship, retain customer's loyalty and enable banks to gain commanding height of market share if their attendant problems such as, ineffectiveness of telecommunications services, epileptic supply of power, high cost, fear of fraudulent practices and lack of facilities necessary for their operation were taken care of.

Ayo (2006) investigated the prospects of e-commerce based on ability, motivation and opportunities (AMO) model and observed that virtually all companies have online presence. The paper reported the motivation and opportunities for e-commerce as low based on lack of e-Payment infrastructure and access to ICT facilities.

Also, in an empirical assessment of customer acceptance of m-Commerce carried out in Germany, and reported by Buse and Tiwari (2006) as follows:

- 1) The highest mobile users are top management, followed by self employed, salaried class, students and others. Government employees were found not to patronize mobile banking.
- 2) The most favored reason for carrying out mobile banking is ubiquity, next is overview of bank account, followed by immediacy.
- 3) The highest fear of customers about mobile banking is that of insecurity, next is cost, and uncomfortably.

### **Research questions and hypotheses**

According to the above literature e-banking caused so many advantages, so the research questions are as below:

Q1: does e-banking cause advantages to Iranian banks?

Q2: are there some barriers for using e-banking in Iran?

According to the above research questions the hypotheses of the study as follow:

H1: from the view points of customers, e-banking cause higher advantages to Iran;

H2: e-banking leads to increase of volume of transactions in Iran;

H3: e-banking leads to increase in using ATM among the banks' customers in Iran; and

H4: non-existing of enough knowledge have led to decrease in using e-banking in Iran.

### **Research Methodology**

Two research tools were employed. The first is an exploratory research based on secondary data obtained through the Net, books and related journals.

Secondly, Survey questionnaire was administered to empirically assess the level of adoption of e-banking in Iran. A survey questionnaire was completed by the banks customers, at the end of 2008. The questionnaire contains two parts namely (A) bio-data and (B) this section includes several questions regarding to the e-banking services which rendering in Iran. Five-Point Likert Scale questionnaire was employed in this research. The Five-Point Likert's scale having the ratings of "strongly disagree" (1) and "strongly agree" (5) were used. For analyzing data X2 is employed which is the most relevant test to this kind of study.

A total of eight hundred (800) questionnaires were randomly administered to business men and customers in the general public. Six hundred (600) were returned, which represents 75% of the total respondents. The bio data of participants is summarized in Table. 1

Insert Table 1 Here

As Table 1 shows, out of 600 participants 325 (54.17%) are female and 275 are male. It means that the majority of participants are female. Majority of the respondents were between ages 31 to 50 years, which represent 51.5% followed by ages 41 to 50 years with 16.50%. Regarding to educational background, out of 600 respondents 281 had bachelor degree which represent 46.83% followed by master degree of 201 participants in percentage 33.50%. The least number of participants had PhD degree (1.17%).

Related to job position, majority of the respondents were clerk, which represent 34.50% followed by Businessman with 20.33%. Out of 600 participants 189 were self employed in percentage 31.50%. The least number of participants fall in the category of others (teacher, student and housewife).

### **Analysis and interpretation of data**

In order to analyzing data, as it is mentioned before, X2 test is employed. The results of testing hypotheses is summarized in Table.2

The first hypothesis postulated in this study is:



H1: from the view points of customers, e-banking cause higher advantages to Iran.

According to table 2 the first hypothesis is accepted and null hypothesis is rejected. In other words, Iranian banks enjoy highly from e-banking in Iran. In this condition Jayawardhena and Foley (2000) explore the e-banking as a new delivery channel arguing that e-banking may help to overcome the inherent disadvantages of traditional banks.

Insert Table 2 Here

The second hypothesis is:

H2: e-banking leads to increase of volume of transactions in Iran.

Table 2 shows that this hypothesis is also accepted and a null hypothesis is rejected.

It is very clear that if e-banking conducted successfully it leads to big volume of transactions, further Birch and Young (1997) argue that the internet may be exploited as a new delivery channel by the financial services industry to completely reorganize the structure of banks.

The third hypothesis is:

H3: e-banking leads to increase in using ATM among the banks' customers in Iran.

With reference to table 2 this hypothesis also accepted. It means that conducting e-banking in Iran leads more usage of ATM in Iran. The authors came to conclusion that the active ATM in banking sectors will cause cash circulation decreases, the efficiency of banking sector will increase, as:

- a. client banking costs decreases (less cash fees to pay),
- b. shop keeper / service provider costs will decrease, and
- c. bank costs decrease (cash storage, less checking and processing costs)

The fourth hypothesis is:

H4: non-existing of enough knowledge have led to decrease in using e-banking in Iran.

With regard to table 2 the results of this study show that this hypothesis is also accepted, in other words, the Iranian costumers have not enough knowledge related to e-banking in Iran. Accordingly the null hypothesis is rejected also. The authors believe that the lack of enough information on e-banking in Iran may cause less efficiency of Iranian banks.

To achieving high efficiency both bankers as well as Iranian legislators should introduce e-banking services at mass level. By the way, improving society knowledge through out TV, bulletin, etc will improve the knowledge of society at whole.

## Conclusion

A strong banking industry is important in every country and can have a significant affect in supporting economic development through efficient financial services (Salehi and Azary, 2008, Salehi et al. 2008). Iranian banks have rapidly introduced innovative banking technologies and e-banking services in recent years. Almost all banks have invested in expanding and improving the IT systems and a number of new e-banking services have been developed.

All major banks have declared e-business as one of the core strategies for the future developments. At the same time, e-banking acceptance depends probably on bank service quality, customer preferences and satisfaction. One of the main reasons for the growth of e-banking is that, if handled correctly, it can significantly lower the cost of delivering products and services. The results of this study showed that the customers also strongly agree with e-banking in Iran.

However, with banking customers growing increasingly comfortable with the digital lifestyle, their expectations from financial service providers have undergone a significant transformation but Iranian customers are not aware about e-banking in Iran. They are not fully understand the power of technology and seek to leverage it to enjoy better control over their banking operations. According to this condition we are at on the middle of the way. Bankers and practitioners should try to introduce e-banking very well in Iran. To conclude that e-banking may also provide other benefits. For instance, creating new markets, and reducing operational costs, administrative costs and workforce are increasingly important aspects for the banks' competitiveness, and e-banking may improve these aspects as well. So, Iranian banks should take these advantages of e-banking in Iranian economics as early as possible.

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Table 1. Bio data of participants

Variable	Category	Frequency	Percentage
Gender	Male	275	45.83
	Female	325	54.17
Age	20-30	98	16.34
	31-40	309	51.50
	41-50	99	16.50
	50 and upper	94	15.66
Education	Diploma	111	18.50
	B.S	281	46.83
	M.S/M.A	201	33.50
	PhD	7	1.17
Job position	Businessman	122	20.33
	Clerk	207	34.50
	Self employed	189	31.50
	Others	82	13.67

Table 2. The results of testing hypotheses

Hypotheses	X2 Table amount	Mono-sample X2 amount	D.f	Alpha P-value	Results
Hyp. No. 1	7.814	8.162	3	0.043	Accepted
Hyp. No. 2	5.991	17.10	2	0.002	Accepted
Hyp. No. 3	3.841	6.00	1	0.014	Accepted
Hyp. No. 4	6.002	18.08	3	0.001	Accepted



## On the Design Method of Economically Optimal Size of Projects

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### Abstract

This paper analyzed the most disputed issue on the economically optimal size design of the size-variable projects. The paper confirms that the concept that the size at which the NPV of the size-variable project getting its maximum value is the economically optimal size is incorrect and that the size is the maximum size rather than the economically optimal one. The economically optimal size can be only restricted within the range in which NPV & NPVR get their maximum value respectively as its upper and lower limits, and the economically optimal size within the range can only be worked out according to the concrete case. Two kinds of different models optimizing the size of the size-variable projects are set up in the paper.

**Keywords:** Economically optimal Size, NPV (net present value), NPVR (rate of net present value)

### 1. Introduction

One kind of projects such as dams, buildings, roads and so on the size (such as their height, width, etc.) of which can be varied are called size-variable projects. The others are called size-fixed projects, just as its name implying, the size of size-fixed project is fixed, they cannot be segmented, either the whole or nothing. On the other hand, the sizes of the size-variable projects are variable, and then how large the size of the project should be? How to determine the suitable size of a size-variable project? Most of the sizes of the size-variable projects can be determined by their economical efficiency criterion. But how to design a veritable optimum size of a size-variable project still remains a much disputable topic in engineering economics.

Generally, when an optimum size of a size-variable project is designed, the NPV of the size-variable project is often used as the objective function, such as the famous Weingartner Optimal Model. It means that the size of the project will be the optimum one when its NPV gets the maximum value.

Is it always the case no matter what the conditions may be? In other words, is the maximum value of NPV of the size-variable project the sufficient and necessary condition for it to get its economical optimum size? If so, what is the reason? If not, why? And how to work out the economical optimum size of a size-variable project?

### 2. Optimization-model development

A common production function can be expressed as follows:

$$Q=f(C, L, \dots)$$

Where C, the capital

L, the labors

... ..

Q stands for the maximum output of a certain amount of production factors such as capital, labors etc. combined together.

In order to make the problem much simpler, it is assumed that the capital, C, is the only variable factor among the production factors which makes the output, Q, changed. That means Q is the function of the only variable C, the capital, i.e.,  $Q=f(C)$ .

Generally, with the capital increasing, the production will increase rapidly at the beginning. When the capital is increased to some degree, the production will increase slowly, and even will decrease when the investment capital comes to a certain amount (Figure 1).

Insert Figure 1 Here

#### 2.1 The defining of the three different regions and the maximum NPV

The relationship between NPV and C behaves in the same way as that between Q and C, it was studied previously both

in textbook(Fu, 1996, pp.59-62) and in magazine(Hu,1995,pp.92-96), and therefore the curve of NPV-C can be drawn as Figure 2.

Just as shown in Figure 2, NPV will be increased fleetly at the beginning and the acceleration is becoming smaller and smaller with the capital increase, and even decreases after the capital is increased up to some degree.

NPVR (the Rate of Net Present Value) is the NPV of per unit investment capital, consequently, it can be calculated as follows:

$$NPVR=NPV/C$$

Where NPVR, the rate of NPV.

C, the capital invested in the project.

The difference between NPV and NPVR is that NPVR emphasizes the importance on the efficiency of capital used, and it shows how much NPV the project can gain per unit capital used. It is a relative criterion and represents the efficiency of capital. While NPV is an absolute one on the other hand, it just shows how much NPV the project may get without mentioning any amount of capital involved. Therefore, the same quantity of NPV with quite different quantity of capital involved may have quite different meaning, but it will make no difference if only judged by NPV.

Based on the above reasons, many textbooks and papers concerning the comparison among mutual exclusive projects make it clear that the project with higher NPV will be the better one under the condition that the capital of investment is the same amount, otherwise they should be further evaluated with criterion NPVR. Hu(1995, pp 32-37) made comparison analysis about the evaluation criterion.

Insert Figure 2 Here

The curve of NPVR-C can also be drawn based on the curve of NPV-C (Figure 2), for NPVR is NPV divided by the capital, C. Figure 2 shows that NPVR and NPV get their maximum values where the amount of capital used is  $P_a$  and  $P_b$  respectively. In this way, there are three different zones divided by the two maximum values. In zone I, with the capital increasing, both NPV and NPVR are increased, therefore the increase of investment capital should not stop in this zone and should keep on increasing until it comes into zone II. In zone III, both NPV and NPVR are decreased with the capital increasing. It shows that the capital is a bit too great, and should be reduced in order to make NPV & NPVR much greater. From the above analysis, it can be seen that it is the range of zone II that the optimum size of the size-variable project must reside, for both the increase in capital from zone I and the decrease from zone III will all fall into zone II. In zone II, with the capital increasing, the NPV is keeping on increasing while the NPVR is going down all the way through. At point  $P_b$ , the NPV of the size-variable project gets its maximum value, but its NPVR is the smallest within the zone in the meantime.

Is the point,  $P_b$ , where NPV gets its maximum value, the optimum size?

Above all, it is necessary to make clear what characteristics point  $P_b$  has. Firstly, its NPV reaches the maximum value, in other words, the marginal increment of NPV is equal to zero at this point, i.e.,  $dNPV/dC=0$ . Secondly, its NPVR is the smallest within zone II, and it is really much small in practice.

In order to prove the statement whether the size where the NPV of the size-variable project get its maximum value is the economically optimal size or not, another size of investment capital,  $P_d$ , is chosen randomly within zone II (Figure 2). Which size is better, size  $P_b$  or size  $P_d$  (to be convenient, the project with a size of  $P_b$  is called size- $P_b$ -project, so is the size-  $P_d$ -project)?

On the one hand, there is:

$$NPV_{P_b} > NPV_{P_d}$$

While, on the other hand, there is:

$$NPVR_{P_b} < NPVR_{P_d}$$

From the above comparison, the conclusion that size- $P_b$ -project is absolutely better than size-  $P_d$ -project can not be drawn, because the investment capital involved is quite different between the two projects. The following example can also confirm the above statement.

Hu(1995, p.95) quoted such an example as following. Suppose there are two projects, namely A and B. Project A needs the capital of about 208,000 Yuan, and will get a net income of about 31,000 Yuan annually for 20 years; at the end of the project remains will be valued at 53,900 Yuan. While project B may yield the net income of 11,000 Yuan annually for 20 years and the remaining value will be 1,000 Yuan, the capital needed is 30,000 Yuan at the beginning of the project. Which is the better one (the supposed discount rate is 10%)?

Project A:

$$NPV_A = -208,000 + 31,000(P/A, 10\%, 20) + 53,900(P/F, 10\%, 20) = 63,943 \text{ (Yuan)}$$

$$NPVR_A = NPV_A / C_A = 63,943 / 208,000 = 0.307$$

Project B:

$$NPV_B = -30,000 + 11,000(P/A, 10\%, 20) + 1,000(P/F, 10\%, 20) = 63,803 \text{ (Yuan)}$$

$$NPVR_B = NPV_B / C_B = 63,803 / 30,000 = 2.127$$

$$NPV_A > NPV_B$$

$$NPVR_A < NPVR_B$$

The example shows that even though project A's NPV is larger than that of project B, but the difference is only 140 Yuan, which is too little compared with the difference of their investments, 178,000 Yuan. Suppose there is a project with an investment of 178,000 Yuan just gets a NPV of 140 Yuan in return after 20 years. The project is feasible for its NPV is 140 Yuan, which is greater than zero, but it is by no means a better one compared with the existing projects, A and B. In other words, it means that project A is not better than project B even though its NPV is a bit greater.

From the above example, it can be seen that the size- $P_b$ -project will not be always better than the size- $P_d$ -project if the concrete conditions concerned is taken into account. Besides, if the capital margin,  $P_c$  ( $P_c = P_b - P_d$ ), is invested in a new project instead of leaving it alone as the above example, the project portfolio composing of the size- $P_d$ -project and the newly invested project which is invested by the capital margin,  $P_c$ , will be better than the size- $P_b$ -project itself with the same amount of capital being consumed. As it is shown in Figure 2, the NPVR at size  $P_b$  is the smallest one within zone II, its actual value is quite small, so it is not difficult to find out potential projects with a higher NPVR than that of the size- $P_b$ -project (a fact meeting in practice will give a detail explanation about it in the following part "Model two"). If so, the project portfolio composing of one of the new potential projects and the size- $P_d$ -project is proved to be better than the size- $P_b$ -project (Refer to the appendix for demonstration). For size- $P_d$ -project is chosen randomly, it confirms that the case occurs universally.

## 2.2 The project portfolio

In the above demonstration, it is assumed that the amount of investment capital of the new project  $P_c$  whose NPVR is larger than that of the size- $P_b$ -project is the capital margin between size  $P_b$  and  $P_d$  (Figure 2), therefore the amount of investment capital needed for the new project should not larger than the difference between size  $P_b$  and size  $P_d$ . But according to the un-segmentation theory of the size-fixed project, the amount of investment need for size-fixed project cannot be changed at will. That means the investment capital required for the new project may not always equal to the capital margin between size  $P_b$  and  $P_d$ , in other words, the spare capital  $P_c$  may not always be made full use of. In fact, it is unnecessary for the size-fixed projects to be segmented for the above project portfolio, for the different size-fixed projects can be accommodated (instead of being segmented) by different size of size- $P_d$ -project to form a project portfolio, because the size- $P_d$ -project is just a size-variable project, whose size is just needed to be fixed.

Just as it is said above, the size of size-fixed project can not be changed, but the size of size-variable project that seeks for the economically optimal size is variable, and the size- $P_d$ -project is the very size- $P_b$ -project by reducing its size from size  $P_b$  to size  $P_d$  (Figure 2). Therefore, the project portfolio can be formed in this way that by adjusting the size of size-variable project to accommodate one of the size-fixed potential projects under the condition of a certain amount of capital involved. Because the efficiency of capital of the size- $P_b$ -project is the lowest one within zone II, therefore, there may be many potential projects that are economically feasible available, they may be size-variable projects or size-fixed ones. Combining one of these potential projects with the size-variable project to form a series of the project portfolios whose investment capital are limited to the amount  $P_b$ . All of these project portfolios formed in this way can be compared with one another only by the criterion NPV, for they all have the same amount of investment capital involved, and the best one selected in this way will surely have a greater NPV than the maximum NPV of the size-variable project itself for the former projects have higher NPVR than the latter one.

In fact, the size where NPV gets its maximum value is not the optimum size but the maximum size, because it is just at the point where NPV gets its maximum value that the marginal increment of NPV comes to zero, it means that the size is the largest, it should not be increased any more, otherwise its NPV will decrease instead of increase.

## 2.3 The economically optimal size

Where is the optimum size of a size-variable project then? And how to get the optimum size of a given size-variable project?

From the analysis made above, it shows that the reason why the size where the NPV of a size-variable project gets its maximum value is not the optimum size is that the efficiency of capital, NPVR, is so low at the very size that there may be many potential projects of which the efficiency of capital, NPVR, will be greater than it, if a new investment is made

with the reduced capital by reducing the size of the size- $P_b$ -project to some degree, the two projects combined with each other to form a new project portfolio will yield a much greater NPV, for the efficiency of the capital of the two new projects are both greater than that of the size- $P_b$ -project itself.

The paper will provide two kinds of methods to set up the optimum models based on the above analysis according to the different conditions.

#### 2.4 Model one

In order to get the veriest maximum value of NPV, it is recommended that when the size of size-variable projects is need to be designed, both the size-variable project and the potential projects which are feasible in that condition should be taken into account. In other words, it is the project portfolio consisting of both the size-variable project and the other potential projects not the only size-variable project itself should be taken as the objective function when an optimization model for economically optimal size is set in order to get the veriest maximum NPV value.

If a size-variable project needs to be optimized its economical size, the NPV made by the given amount of capital is taken as the objective function. To be simple, supposed that there may be  $n+1$  projects, one of them is the size-variable project whose size needed to be determined, the other  $n$  projects are all supposed to be size-fixed ones, which means their  $NPVR_j$  ( $j=1, 2, n$ ) are fixed. The total amount of capital can be used is  $C_p$ .

Therefore, the model can be expressed as following (fig 3).

Objective function:

$$\text{MAX}[\text{NPV}(C_p)] = \int_0^{X_1} [\text{NPV}_1(X)/X] dx + \sum_{j=1}^n \text{NPVR}_j \times X_j$$

Constraint condition:

$$X_1 + \sum_{j=1}^n X_j \leq C_p$$

$$P_a \leq X_1 \leq P_b$$

$$0 \leq X_j \leq C_p$$

Insert Figure 3 Here

The optimum model has such features as followings:

Both the size-variable project and the potential projects are taken into account in the model, in this way, the efficiency of the investment capital can be made as high as possible.

Both NPV and NPVR made in this way will be at least equal to, if not larger than, that one obtained from the model in which only the NPV of the size-variable project itself is taken as the objective function.

#### 2.5 Model two

##### 2.5.1 Introduction to Model two

The second model will be set up upon a practical case. In this case, the NPV of the size-variable project is taken as the objective function as it is done usually, but the difference is that the constraint of the efficient use of resource such as capital, land, etc. should be applied to the objective function in order to make full use of resource. A practical example of well-drilling projects during oil-field development in oil industry will be introduced to explain the principle of this kind of model.

During oil-field development in oil industry, there are two kinds of well-drilling technology used widely, i.e.: vertical well drilling and horizontal well drilling. Generally, the oil reservoirs lie underground horizontally, a traditional vertical well is to drill a vertical well hole and hit the oil reservoir vertically, only a certain part of oil reservoir can be covered and a certain amount of oil is taken out in this way. On the contrary, a horizontal well can drill a horizontal well hole within the oil reservoir, therefore a horizontal well can get more oil out of the hole than a vertical well. Besides, the longer a horizontal well bore drilled within the oil reservoir, the more oil will be taken out. In the meantime, the longer a horizontal well bore is drilled, the more cost will be spent on it, besides cost, there are lots of factors affect the oil production. The amount of oil produced by a horizontal well is not proportional to the length of horizontal well section being drilled, and their relationship is just as that of  $Q$  vs.  $C$  (fig. 1), which is explained above. In general, with the horizontal well bore being drilled on, the NPV of this horizontal well will be increased fleetly at the beginning, later on, the rate of increase will become a bit slower, when the length of horizontal well bore is increased to a certain distance, the NPV of this horizontal well will come to the maximum value, from then on, if the length of horizontal well bore keeps on drilling, the NPV of this horizontal well will begin to drop.

##### 2.5.2 The Relationship among NPV, NPVR & $d\text{NPV}/dL$

According to the above analysis, the curve between the horizontal well bore length and the NPV of the horizontal well can be drawn as Figure 4. It is quite similar to the curve of  $\text{NPV}-C$ , the only difference is the horizontal axis, it is the

reservoir length a horizontal well covers rather than the capital it takes, in this case, the capital invested in this kind of projects is supposed to be limitless, the only variable is the length of the horizontal well within the reservoir. In Figure 4, the curve of NPV—L is the above one, the others below it are the curves of NPVR—L and dNPV/dL—L of horizontal well respectively, and the straight line is the curve of NPVR—L & dNPV/dL—L of a vertical well. As it is said above that a vertical well is a well drilled vertically through the oil reservoir, and covers a certain area however it is drilled. It means that a vertical well consumes a certain amount of oil reservoir and products a certain amount of oil. In other words, a vertical well has a fixed value of NPV, besides, the capital and the reservoir it taking is also fixed, therefore, the NPVR and dNPV/dL of a vertical well are equal to each other and unchangeable, it can therefore be drawn as a straight line, VV (Figure 4). Contrary to the nature of a vertical well, a horizontal well is quite changeable, both its NPV & NPVR will be quite different with the different horizontal well bore length. At the beginning, when the horizontal well has not drilled its horizontal section long enough, the cost it take is much more than that of a vertical well, but the production it get is not great enough to make up for the cost it takes compared with a vertical well, therefore, the NPV and NPVR of horizontal well are both smaller than those of a vertical well at the very beginning. With the horizontal section being drilled longer and longer, its advantage appears, the oil-production increase rapidly compared with that of cost. Figure 4 shows that the curve NPV and NPVR of the horizontal well increase very fast at the beginning and its dNPV/dL is therefore much higher then. With the horizontal well bore being drilled on, its dNPV/dL first come to the maximum value, and then followed by the curve of NPVR, while the NPV of the horizontal well is still increasing but at a low rate. In year 2000, Hu(2000,pp,81-82) published his study on the relationship among NPV, NPVR & dNPV/dL between the horizontal well and vertical well.

Insert Figure 4 Here

With the horizontal well bore prolonging, the curve of dNPV/dL—L of the horizontal well comes across the straight line, the curve of dNPV/dL—L of the vertical well, at point B. From then on, keeping on drilling the horizontal well bore will get less NPV than stopping to drill a vertical well even though the NPV of the horizontal well is still increasing, for the value of dNPV/dL of the horizontal well falls below that of the vertical well after the point B (Figure 4). Therefore, it is at the point B that an optimal horizontal well bore should be stopped in order to get the veriest maximum value of NPV of the project portfolio. If the horizontal well bore continue to drill to the point F, where NPV of the horizontal well itself gets its maximum value. The size of the project or the length of the horizontal well bore at the point F is not the optimum size but the maximum one, because it is just at the point where NPV gets its maximum value that the marginal increment of NPV comes to zero, it means that the size is the largest, it should not be increased any more, otherwise its NPV will decrease instead of increase. Although the marginal NPV of the horizontal well is below that of the vertical well, NPVR of the horizontal well is still larger than that of the vertical well before the point ,C, therefore the whole NPV of the horizontal well is greater than that of the vertical wells with the same amount of resource being consumed (Figure 4), It means that the oil-field developed by horizontal well can still get a greater NPV than developed by vertical wells as long as the length of the horizontal well is not drilled to exceed the point ,C, eventhough its length overpass the point, F. If the horizontal well bore keep on drilling overpass point C, it is not only the marginal increment of NPV but also the NPVR of the horizontal well are both smaller than those of the vertical well. It means that if the length of horizontal well bore is drilled surpass the point C, a oilfield developed by drilling vertical wells will get more NPV than by the horizontal well.

### 2.5.3 The Optimal Length of a Horizontal Well

As it is said above, in order to get more NPV from a certain amount of resource, the length of the horizontal well bore should be stopped at the point B (Figure 4), where the marginal increment of NPV of the horizontal well is equal to that of the vertical well, rather than keep on drilling till the point F, where the NPV of the horizontal well comes to its maximum value, let alone the point C.

The above analysis shows a very important conclusion that the size where the NPV of the size-variable project gets its maximum value is by no means the economically optimal size but an upper limit. Because the marginal increment of NPV of the size-variable project is equal to zero when its maximum value of NPV arrives, if the length is keeping on increasing from that point on, the value of NPV will decrease rather than increase, therefore, that point is an upper limit, the maximum size would never surpass it.

Because the point at which the NPV of the size-variable project get its maximum value is the upper limit point, the point at which the marginal increment of NPV of the horizontal well is equal to that of the vertical well is the interesting point for the optimal horizontal well bore length design. The dNPV/dL of the vertical well must be used as the special constraint when the model for optimal horizontal well bore length is set up, without which the horizontal well bore length may be designed much too long to be the optimal length any more.

### 2.5.4 Model two

Supposed the length of resource covered by one vertical well is  $\Delta L$ , the horizontal well bore length of a horizontal well



should be at least  $L_{\min}$ , otherwise the income gained from a horizontal well could not make up for the cost spent on a horizontal well, the largest length is named as  $L_{\max}$  which may be limited by the size of oil reservoir, the capacity of the rig used, the technology of drilling, etc.. In order to enlarge the NPV of the project with a certain amount of resource, the drilling of this horizontal well bore should be stopped as soon as its  $dNPV/dL$  is no more greater than that of a vertical one, i.e.:

$$NPV_H(L+\Delta L) - NPV_H(L) \geq NPV_V$$

Here,  $NPV_H$  &  $NPV_V$  ( $NPV_V$  is a constant) stands for the NPV of a horizontal well and that of a vertical well respectively.

Therefore, the model can be expressed as following:

Objective function:

$$\text{MAX}[NPV(L)] = \text{MAX}\{\sum_{t=1}^m [CI(L) - CO(L)] / (1+i)^t\}$$

Constraint condition:

$$NPV_H(L+\Delta L) - NPV_H(L) \geq NPV_V \quad (\text{while, } d^2\{NPV_H(L)\}/dL^2 < 0)$$

$$L_{\max} \geq L \geq L_{\min}$$

Here,  $CI(L)$ ,  $CO(L)$  stands for the input & output of the cash flow of a horizontal well with  $L$  meters horizontal well bore length every year respectively, and  $m$  is the economic life of a horizontal well.

### 2.5.5 Example

There is an oilfield of which length is about 4000 meters, and its width is wide enough to place one row of wells only. A vertical well covers about 400 meters in length, and yields the value of NPV about  $23 \times 10^5$  dollars, therefore, the NPV per meter of a vertical well can be calculated as  $23 \times 10^5 \div 400 = 5750$  dollars per meters. If it is developed by horizontal wells, how long will the horizontal well bore be drilled?

If an optimal model is set by taking NPV of a horizontal well as an objective function, the length of a horizontal well can be worked out, it is about 3280 meters, and the NPV of that length is about  $240 \times 10^5$  dollars. Is it the optimal length for a horizontal well in this region? For the NPV per meter of a vertical well is 5750 dollars per meters. If the  $dNPV/dL$  of the vertical well is imposed on the design model, another result can be made, the optimal length is about 2806 meters, and the NPV of that length is about  $222 \times 10^5$  dollars.

Which is the better one then? It is the one that can gain more NPV with the same amount of resource being consumed. For the total amount of resource is about 4000 meters, a horizontal well with 3280 meters takes 3280 meters, and there are about  $4000 - 3280 = 720$  meters left. For a vertical well covers about 400 meters in length and yields the value of NPV about  $23 \times 10^5$  dollars, there are fewer than two vertical wells can be placed for the spare space left by the horizontal well with a horizontal well bore length of 3280 meters. Therefore, the total NPV gained by this project portfolio (project B) is not larger than  $286 \times 10^5 (240 \times 10^5 + 2 \times 23 \times 10^5 = 286 \times 10^5)$  dollars. The average NPV per meter is 7264.1\$/m. While the other project portfolio (project A) consists one horizontal well with a 2806 meters horizontal well bore length and three vertical wells. because the spare length left by the horizontal well with a 2806 meters horizontal well bore length may allow three (i.e.  $(4000 - 2806) / 400 = 2.98$ ) vertical wells to be placed, and it can yield a total NPV of  $291 \times 10^5 (222 \times 10^5 + 3 \times 23 \times 10^5 = 291 \times 10^5)$  dollars. The average NPV per meter is 7009.8\$/m. The results are listed in the following table:

Insert Table 1 Here

From the example, it shows that if the length of a horizontal well bore is designed just by taking the NPV of the horizontal well as the objective function without the any constraint on the efficient use of resource, the length of a horizontal well bore will be designed too long to be the optimal one any more. Therefore, the constraint on the efficient use of resource should be imposed in order to get the veriest optimal size if the NPV of the size-variable project is taken as the objective function.

### 3. Conclusion

The size at which the NPV of the size-variable project gets its maximum value is not the economically optimal size but the maximum one, for the size can not be increased any longer.

If NPV of the size-variable project is taken as the objective function when an optimization model is set up, the efficiency of resource consumed should be imposed as the constraint upon the objective function. Otherwise, the size made in this way will yield too large a size to be the optimal one any more.

The economically optimal size is the size at which the NPV of the project portfolio comprising both the size-variable project and the potential projects get the maximum value not the size at which the NPV of the size-variable project itself gets the maximum value, for the former NPV is always greater than the latter one under the condition of the same

amount of resource being consumed.

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## Appendix

There are two projects, size- $P_b$ -project and size- $P_d$ -project, the capital invested on them are  $P_b$  and  $P_d$  respectively (Figure 2), the NPVR of size- $P_d$ -project is greater than that of size- $P_b$ -project, i.e.:  $NPVR_{p_d} > NPVR_{p_b}$ .

Supposed another new size- $P_c$ -project, of which capital is  $P_c$  ( $P_c = P_b - P_d$ ), has higher capital efficiency than that of size- $P_b$ -project (for the capital efficiency of size- $P_b$ -project is so low that it is easy to find projects of which capital efficiency is higher than that of size- $P_b$ -project), i.e.:  $NPVR_{p_c} > NPVR_{p_b}$ .

Project O is a project portfolio comprising of size- $P_d$ -project and size- $P_c$ -project, and it consuming the same amount capital as project  $P_b$ .

$$\because NPVR_{p_d} > NPVR_{p_b}$$

$$NPVR_{p_c} > NPVR_{p_b}$$

$$\therefore NPV_{p_o} = NPV_{p_d} + NPV_{p_c}$$

$$= NPVR_{p_d} \times P_d + NPVR_{p_c} \times P_c$$

$$> NPVR_{p_b} \times P_d + NPVR_{p_b} \times P_c$$

$$= NPVR_{p_b} \times (P_d + P_c)$$

$$= NPVR_{p_b} \times P_b$$

$$= NPV_{p_b}$$

And,

$$NPVR_{p_o} = NPV_{p_o} / (P_d + P_c)$$

$$> NPV_{p_b} / (P_d + P_c)$$

$$= NPV_{p_b} / P_b$$

$$= NPVR_{p_b}$$

$$\text{i.e.: } NPV_{p_o} > NPV_{p_b}$$

$$NPVR_{p_o} > NPVR_{p_b}$$

Conclusion:

Project portfolio O is better than size- $P_b$ -project with the same amount resource being consumed.

Table 1. Results of the Example

The objective function	Special constraint	horizontal well bore length (m)	well numbers*	Consumed resource (m)	Total NPV (\$)	NPV per meter (\$/m)
(Vertical well)	--	--	10V.	4000	$230 \times 10^5$	5750
Project A MAX{NPV(L)}	$dNPV/dL \geq 5750$	2806	1H+3V	4006	$291 \times 10^5$	7264.1
Project B MAX{NPV(L)}	--	3280	1H+2V	4080	$286 \times 10^5$	7009.8

\*Note: "well numbers" here means the number of well being drilled within a certain area. For example, "1H+2V" means one horizontal well and two vertical wells being drilled within 4080 meters in length.

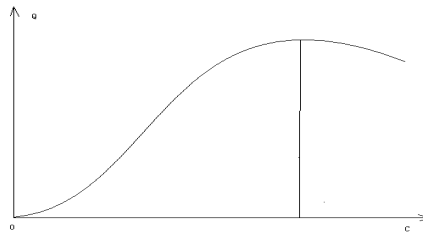


Figure 1. Output (Q) vs. Capital (C)

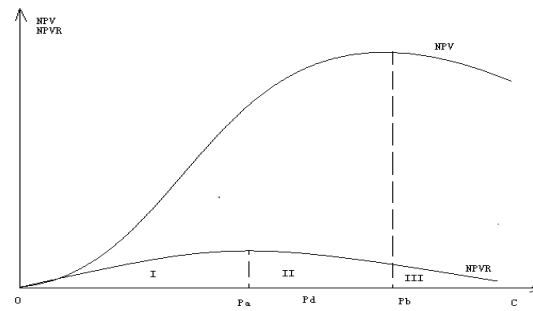


Figure 2. NPV/NPVR vs. Capital (C)

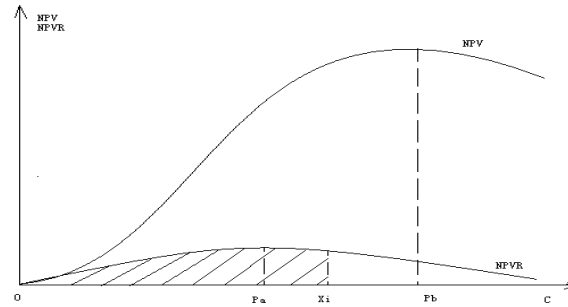


Figure 3. Curve of Size-Variable Project for Model One

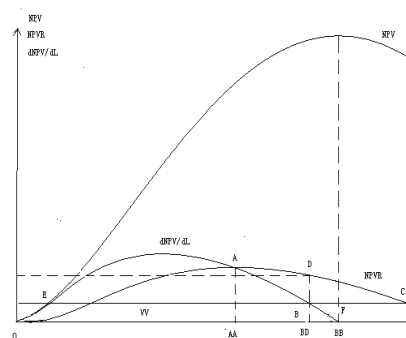


Figure 4. Relationship among NPV, NPVR &  $dNPV/dL$  between a Horizontal Well & a Vertical Well



## Tax Literacy among Employees: Sabah and Sarawak's Perspective

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### Abstract

The main intent of this paper is to gauge the level of tax literacy among taxpayers in Sabah and Sarawak. It is vital to shed light on our preparation to face the challenge posed by the implementation of Self -Assessment System (SAS) in 2004 whereby the taxpayers are expected to be functionally tax-literate in computing their own tax liabilities accurately. Methodologically, the subjects were randomly sampled from taxpayers working in a few selected towns in Sarawak and Sabah. Statistical tests like t-tests and chi-square were applied onto the means of tax literacy scores by each state and the taxpayers' respective workplaces. The taxpayers in Sarawak were found to be more tax-literate as compared to their counterparts in Sabah. Nonetheless, the taxpayers in both states were not eventually prepared for SAS. More aggressive efforts were recommended to raise the level of tax literacy among the taxpayers.

**Keywords:** Tax literacy, Self-Assessment System (SAS), Taxpayers

### 1. Introduction

Self-Assessment System (SAS) for taxpayers in Malaysia for 2004 began in 2005. This was a move in line with the shifting of Preceding Year Assessment (PYA) to the Current Year Assessment (CYA) proposed under budget 2000. It was to replace the Official Assessment System (OAS). The implementation of SAS was carried out in stages. It was first imposed on companies in 2001 and implemented to partnerships and individuals in 2004. It was intended to enhance efficiency by improving compliance, speeding up assessment process and facilitating collection of taxes. The important element of SAS is that the onus for computing tax liability lies with the taxpayers. A taxpayer is expected to be "functionally literate" to determine his own taxable income and income tax payable; and to furnish correct returns to Inland revenue Board (IRB) which may be a daunting task for some taxpayers. IRB, on the other hands, will conduct a

desk audit to verify the correctness and accuracy of the taxpayers' computation. Shanmugam (2003) stated that countries which have applied SAS managed to reduce the tax administration cost and improved their efficiency.

The central issue of this paper is to gauge the general level of tax literacy among employees in public and private sectors in the event of Self-Assessment System Implementation on taxable individuals in 2004. The question posed was, "Are the individual taxpayers ready for such a change in 2005 for income earned in 2004?" The success of this new system relies on the attitudes and willingness of taxpayers to upgrade their tax knowledge (Sabri, 1993; Robert et al., 1994 and Kasipillai, 1996). Previous studies by Bardai (1992); Kasipillai and Baldry (1995) and Razman and Ariffin (2000) showed that the composition of our tax-paying society who could have been classified as literate was still unsatisfactory. Nero and Amrizah (2003; 2005) indicated that only 13 % of the taxable individuals in Sarawak can be classified as "very literate". The same study reflected that the level of awareness of taxpayers on matters relevant to SAS was very low.

Previous tax literacy studies in Malaysia were just describing the tax literacy scenario at Klang Valley and northern part of West Malaysia. This study not only extended the tax literacy to Sabah and Sarawak, but also discussed the implication of tax literacy scores in detail. This study also employs the more accurate and current research instrument in determining the tax functional literacy where literacy items were actually taken and adapted from the actual tax return form and not based on the percentage of 'Ability to fill the tax form' and 'Seeking professional help to fill the tax form' as being done by prior tax literacy studies. The contribution of this paper is not only extending the coverage of tax literacy study but also providing a more accurate tax literacy score hence useful for policy-making decisions. It is specifically focused on employment and not mixing it up with general issues on business taxation as what some prior studies did.

Tax literacy is the ability to fill in the tax form and calculate their tax liabilities independently (Bardai, 1992; Razman and Ariffin, (2000). Nero and Amrizah (2003; 2005) and Amrizah and Nero (2005) emphasize that respondents should know how to determine tax liability if they know what constitutes taxable income, deductible deductions, claimable tax reliefs and rebates. The only aspect that has not been explored in this tax literacy paper is the application of tax rate against the taxable income before claiming tax rebates to arrive at tax payable.

In Pryor and Schaffer (1997: 6), they define functional literacy as: ...the ability to use skills in reading, interpreting documents, and carrying out quantitative calculations in real-life situations...

A person can therefore be said to be functionally literate if he/she can read, write and calculate for his/her own self. The tax literacy definition is not only practical, but also meets the commonly-believed notion of literacy requirement as described above.

## 2. Methods

The data were collected via questionnaires. The population of taxable individuals was obtained from the IRB Kota Kinabalu, Sabah (Table 1) and from the various Section Heads of IRB Kuching, Sarawak. For the total population of 77, 596 in Sabah and 134, 555 in Sarawak, according to Krejcie and Morgan (1970), it is sufficient to have a sample size of 400 to 500 respondents respectively. Hence the sample size for each town (Table 1) was derived based on a pro-rata basis. To ensure that the validity and reliability of data collected were maintained, a full list of private companies and government offices was obtained from the Registrar of Companies and telephone directory (Yellow pages) respectively. The respondents were selected randomly from the list.

## 3. Results and Discussions

### 3.1 Reliability analysis using Cronbach Alpha

The Cronbach Alpha coefficients for tax literacy and awareness were quite reliable as shown in Table 2. The alpha value of understanding tax jargons and tax vehicles were also within an acceptable range.

### 3.2 Literacy score

Tax literacy, which is the central issue of the paper, was captured via Section C of the questionnaire. A total of 40 questions relevant to issues under taxation for employment were asked. One mark was awarded for a correct answer and none was given for a wrong one. The main objective of this paper is to determine the level of functional tax literacy among the employees working in public and private sectors in Sabah and Sarawak. It is disheartened to report that the overall mean score for the two states is about 60% which is within the 'literate' category (see Table 3). By category, about six (6) percent of the respondents were very literate whereas three-quarter of them were just literate and 18.6% were illiterate.

### 3.3 Tax literacy: Sabah versus Sarawak Employees

The hypothesis for this comparison between Sabah and Sarawak employees is:

H<sub>01</sub>: There is no significant difference in the mean score of tax literacy among taxable individuals in Sabah and Sarawak.

To investigate the difference in the mean scores, an independent sample t-test was conducted. The results of the t-test are shown in Table 4. As reported in that Table 4, the taxpayers in Sarawak obtained a higher mean score as compared to their counterparts in Sabah. As such, taxpayers in Sarawak are more tax-literate. H<sub>01</sub> is therefore rejected due to the results.

Being more tax-literate implies that their tax liability computations are more accurate in which they are able to anticipate year end tax expenses in their personal cash flows management. Tax illiteracy, on the contrary, has a few adverse implications on the taxpayers. Firstly, their own tax calculations though guided by e-filing system, may not be the correct figure as there could be some unclaimed tax reliefs and rebates or income have been unreported. Under SAS, the unclaimed tax reliefs and rebates are self-imposed penalties for not computing their tax liabilities correctly. Secondly, inaccurate tax computation means that some sources of income are unreported. This will attract tax desk audits and can therefore be subjected to additional assessment. Thirdly, a penalty will be imposed on any late payment of tax. Such financial burdens are avoidable if they have known some avenues for updating their own tax knowledge. Goody (1996; 1997) as cited by Walter (1997) states that functional literacy has a profound economic impact on individuals. Another researcher agreed that functional literacy did help a person to escape from the prison of ignorance (Fraze, 1996) and this ignorance cannot be defended in court of law while Stokes (1993) further elaborated that functional literacy in business would have a competitive advantage over their competitors. High tax literacy rate is commendable because if appropriately exploited, it can actually enhance and improve compliance by allowing taxpayers to legally and commercially plan every transaction in order to avoid paying more tax. Tax literacy is crucial in order to tap on tax loopholes in reducing tax obligation which is legal in nature. This will obviously help to keep taxpayers being informed about SAS development.

#### *3.4 Independent t-test on tax awareness by state*

Independent sample t-test was applied to gauge whether or not, there was a significant means of value difference of taxpayers' level of tax awareness. The results indicated that there were strong significant differences in the means value of some variables, as revealed in Table 5.

The results show that taxable individuals in Sarawak are confirmed to be more knowledgeable in tax matters pertaining to personal taxation within the context of Malaysian income tax laws in which the findings are actually good for taxpayers as they would be more aware of tax administration. They are not ignorant to the penalties imposed for not reporting all income and providing incorrect information to the tax authority. Nevertheless, this awareness does not eventually guarantee a total of compliance as argued in Mottiakavandar et al (2003) when they asserted that it was the taxpayer's perception towards the fairness of the tax system that influenced one's tax compliance and not tax knowledge as previously claimed by Sabri (1993), Robert et al. (1996) and Kasipillai (1996). The finding from Mottiakavandar et al (2003) was also supported by earlier study by Fallan and Eriksen (1996).

#### *3.5 Utilization of tax vehicles*

The data for this section was captured via Section D of the questionnaire. In this section, the respondents were required to indicate whether or not they have applied the identified tax vehicles or avenues in enhancing their tax knowledge. The respondents were also required to indicate the level of effectiveness of the tax vehicles used. The most popular method used by taxpayers in updating themselves with tax information was reading tax pamphlets and other printed tax materials. About 68% of the respondents utilized this avenue. The next popular tax vehicle was a commentary on our national budgets followed by TV talks which accounted for 56.3% and 50.3% utilization rate respectively. The tax vehicles which were not widely used were: taxpayers' service week, TPSW (49%), press release (49%), tax seminar/workshop (30.3%), radio talks (35.2%) and the least popular was IRB's webpage (28.8%). Tax avenues utilization by state revealed that taxpayers in Sarawak outperformed their counterparts in Sabah for majority of the avenues. This observation is presented in Figure 1.

The chi-square analysis of respondents' tax vehicles utilization revealed that those who found to be tax literate and very literate were mostly respondents utilizing budget commentaries and pamphlets and printed tax materials. 60% (391 out of 651) respondents of 'literate' and 70% (38 of 54) respondents of 'very literate' categories from Sabah and Sarawak clearly explained this finding. They read the budget commentary to improve their tax knowledge (Table 6). In addition to this observation, there is a strong association between these variables which indicates that tax literacy is dependent on the reading of budget commentaries made by interested parties such as professionals and local politicians.

Table 7 depicts literacy category by pamphlets and printed materials. It could be observed that about 68.6% (593 of 865) respondents of Sabah and Sarawak utilized pamphlets and printed materials. Majority of 593 respondents who made use of this tax vehicle were literate and very literate. Those using this avenue accounted for more than double of those who did not use this vehicle which were categorized as literate and very literate. Only 22.7% of those who did not make use

of this avenue were literate and very literate as compared to 58.6% of those utilizing this avenue in acquiring the necessary tax knowledge.

Further analysis using One-Way ANOVA on tax vehicles used by the respondents indicated that there were significant differences in the mean scores with respect to those who utilized vehicles such as tax seminars, press release, commentaries on national budget and pamphlets, and other printed tax materials, as compared to their counterparts who did not use such avenues to update themselves with tax information. The results are reported in Table 8.

IRB, to some extent, has satisfactorily educated the taxpayers on basic rules and regulation of tax administration, specifically the responsibilities of taxpayers and offences and penalties of tax violations. Providing information using pamphlets and printed tax materials can be enhanced as this approach is positively identified to be related to tax literacy. The taxing authority, however, cannot assume every taxpayer is informed about tax matters by having published the tax information over the IRB's webpage. Taxpayers at different places of work might require different approaches in updating their tax knowledge. The access to the IRB's webpage is very much hindered by poor internet access and network coverage. This could be the main reason why the utilization rate for webpage is very low (28.8%). The IRB webpage is comprehensive but not quite practical at the moment as our network coverage and internet infrastructure are still not properly sufficient and conducive.

#### 4. Conclusion

As noted earlier in the introductory paragraph, the main objective of the paper is to determine the level of tax literacy in Sabah and Sarawak. Based on the overall mean score, it can thus be concluded that the tax literacy level in the two states is not quite satisfactory. Judging from the literacy scores reported, it can be generalized that majority of taxpayers in East Malaysia are barely literate. This means that income earners have an average understanding of basic tax knowledge. Hence their computation of tax liabilities might not be accurate. They may require assistance in determining the correct amount of tax to be paid. The taxpayers in Sarawak are eventually more tax-literate as compared to their counterparts in Sabah as indicated by significantly higher tax literacy mean score. It is also concluded that higher tax literacy score is attributed to a wider and greater utilization of tax vehicles by way of reading tax pamphlets and printed tax materials. The contribution of this paper is that the overall literacy rate using percentage of correct responses is more accurate as it detailed out the respondents into their functional literacy categories: illiterate, literate and very literate based on the scores obtained. This research is therefore unique in its contribution as compared to prior studies where tax literacy levels were determined based on percentage of 'ability to fill tax form' and 'seeking professional help to fill the tax form' instead of functional literacy scores described above.

To address the issues related to tax literacy among taxpayers in East Malaysia, several recommendations are suggested in this paper. Firstly, more aggressive approaches should be adopted to educate taxpayers. Taxation knowledge can be taught at upper secondary school level to inculcate tax responsibilities among potential revenue contributors. Secondly, awareness of Self Assessment System (SAS) requires tax education in the form of providing brochures and tax updates which can be distributed to taxable employees through their employers or sent to their residential addresses. For future research, it would further provide useful insight if another study can be conducted to probe the actual level of functional tax literacy of taxpayers by conducting pre- and post-workshop and seminar on personal tax liability computation.

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Table 1. Population and sample size of respondents

City / Town	Population	Sample Size
Kota Kinabalu	51,569*	243
Sandakan	12,428*	102
Tawau	13,599*	84
<b>Sub-total</b>	<b>77,596</b>	<b>429</b>
Kuching	45,000*	181
Sibu	40,000*	134
Bintulu	16,741*	59
Miri	32,815*	155
<b>Sub-total</b>	<b>134,555*</b>	<b>535</b>

\*Source: Section Heads in Inland Revenue Board

Table 2. Cronbach Alpha for literacy variables

Variables	No of Items	Cronbach Alpha
Tax literacy items	34	0.809
Tax awareness	12	0.872
Utilization of tax vehicles	8	0.698

Table 3. Tax literacy description

Category	Scores	Description
Illiterate	24 – 49%	Taxpayer with very poor skills, unable to understand tax terminologies used in the tax form.
Literate	50 – 74%	Having average understanding of the basic tax knowledge. However, they require assistance in determining tax liability.
Very literate	75 – 100%	Very much aware of tax issues. Possess high understanding of tax term and should be able to determine their own tax liabilities.

(Adopted from Nero and Amrizah, 2003)

Table 4. Tax literacy by state

Literacy item	State	N	Mean scores	Std. Dev	F-value	Sig.
Literacy score	Sabah	429	59.23	13.63	6.11	0.014
	Sarawak	539	61.06	12.54		

\* significant at the 0.05 level



Table 5. Independent t-test on tax awareness by state

Variables	State	N	Mean	Std Dev.	Sig. (2-tailed)
Informing new address	Sabah	424	2.61	0.646	0.009*
	Sarawak	534	2.72	0.563	
Penalty not reporting all income	Sabah	424	2.5	0.660	0.004*
	Sarawak	537	2.62	0.644	
Penalty for incorrect information	Sabah	423	2.54	0.658	0.004*
	Sarawak	537	2.66	0.602	
Tax rate based on residence status	Sabah	423	1.85	0.783	0.042*
	Sarawak	536	1.95	0.778	

\*significant at 0.05 (equal variance assumed)

Table 6. Literacy category by budget commentary

Literacy Category	Did not read Budget Commentaries		Read Budget Commentaries		Total	
	No.	%	No.	%	No.	%
Illiterate	102	11.8	59	6.8	161	18.6
Literate	260	30.0	391	45.2	651	75.2
Very Literate	16	1.8	38	4.4	54	6.2
	378	43.6	488	56.4	866	100.0

Chi-Square value = 33.375 ; Asymp. Sig. = 0.000

Table 7. Literacy category by pamphlets and printed materials

Literacy Category	Did not read Pamphlet and printed materials		Read Pamphlet and printed materials		Total	
	No.	%	No.	%	No.	%
Illiterate	75	8.7	86	9.9	161	18.6
Literate	182	21.0	468	54.1	650	75.1
Very Literate	15	1.7	39	4.5	54	6.2
	272	31.4	593	68.6	865	100.0

Chi-Square value = 21.032; Asymp. Sig. = 0.000

Table 8. Respondents' mean scores by utilization of tax vehicles

Tax Vehicle	Mean Score 'Utilized Tax Vehicle'	Mean Score 'Not Utilizing Tax Vehicle'	F-Value	Sig. value
Tax Seminar	62.55	60.05	6.994	0.008
Press Release	62.56	59.31	14.663	0.000
Budget Commentaries	63.13	57.83	37.936	0.000
Pamphlets	62.42	57.28	31.031	0.000

Significant at the level of 0.05

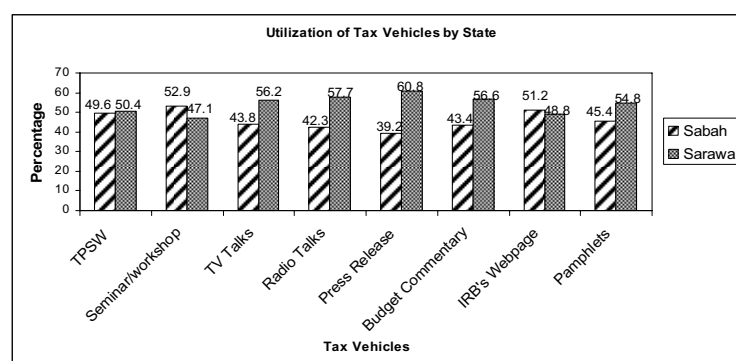


Figure 1. Utilization of tax vehicles by state

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