# Based on ECM Modelling for Daily Turnover and Close Index of Chinese Stock Markets

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## Abstract

By making use of test for stationary, Granger, co-integration, we study the daily turnover and daily close index of Chinese stock markets from 1991 to 2011. We strive to find how Shanghai and Shenzhen stock markets interact each other, there really exist a long-run equilibrium equation among the daily close index,daily turnover of Shanghai (Shenzhen) market and daily close index of Shenzhen (Shanghai) market, to establish the two-order bivariate error correction model(ECM)for two Chinese stock markets respectively. We also further analyze the act of the fluctuation of daily close index of the two markets in short-term.

**Keywords:** turnover, close index, ECM, co-integration, Granger cause

## 1. Introduction

Shanghai stock market and Shenzhen stock market, both established in the early l990s, sometimes are affected by the western stock markets.Due to Chinese special financial policy, however the development tendency of two Chinese markets has its own character every day, that is when the index of one market goes up, the index of another market not necessarily goes up even goes down in their early period of development.The phenomena of "Shanghai market gets strong and Shenzhen market becomes weak",or vice versa occurred from time to time, one market's development change is often different from another one's every day, two stock markets are almost independent of each other.However,as time passes, the interaction between Shanghai stock market and Shenzhen stock market has been becoming more and more obvious. The phenomena of "Shanghai (Shenzhen) market strong and Shenzhen(Shanghai) market weak" is no longer the case nowadays. Two Chinese stock markets seemingly rise up or drop down almost at the same time,

The relation between business volume and price in stock market is of interests to the professional people.In general, increase in business amount causes index climing up, decline in business amount causes index down. There are a lot of literatures that research the relation between the close index and the turnover in the same market. For example,in the recent papers, ZHOU Xiao-yan(2012) studied the volume-price relation in Shenzhen Stock Market by using impulse response function and variance decomposition from 2003 to 2006. ZHAI Ai-mei&ZHOU Tong(2011) analyzed the volume-price relation in stockmarket from 2006 to 2010 by using Behavioral Finance. GUO Liang & ZHOU Weixing (2010) performed an empirical analysis of the volume-price relation in the Chinese stock market at microscopic level using high-frequency data from January to June 2006. TONG Menghua& WU Chengming (2009) studied the dynamic relation between volume and price in Shanghai stock market based on the CARR model from 1999 to 2007 etc.

These papers all have focused on the single stcoket market, they have not considered the interaction between two markets. Moreover, Sample data used in their research is limited, and the time range of sample data is finite. In this paper,we expand the time range of sample data from 1991 to 2011,and consider the interaction between two markets, by the use of mainly bivariate ECM to study the volume- price relation.We noticed that In Chinese stock markets, the index of one market is affected not only by its own turnover but also by another market index, but the index of one market is irrelevant with the turnover of another market, although the close index and turnover appears occurring in a random way every day. There likely exists a long-run equilibrium relation among the daily close index, daily turnover in same market and daily close index of another market. The question

arising is What is their relation in long-term? Furthermore, what does cause the fluctuation of the close index in one market in short-term? These problems are what we are concerned and what we intend to study in this paper, the answer to these problems are very important for investors in the stock markets. Hopefully the findings from this study provide investors some helpful advices to lower risk and improve return.

The reminder paper is organized as follows. Section 2 presents the method used in this paper. Section 3 presents the empirical analysis and modelling. The final section presents conclusions.

## 2. Methodology

There are lots of papers to introduce how to test the stationary of the variables using the Augmented Dickey-Fuller (ADF), how to test for causality from variable A to variable B (and variable B to variable A) using the Granger and how to test, provided the co-integration has been found, co-integration between variables using the Johansen (or others) technique. In this paper, we mainly introduce bivariate ECM.

Suppose that there is a long-run equilibrium relation among variables $Y_t$, $X_t$ and $Z_t$ as below

$$Y_t = \alpha_0 + \alpha_1 X_t + \alpha_2 Z_t + u_t \tag{1}$$

However, actually variable $Y_t$, $X_t$ and $Z_t$ seldom exist the long-run equilibrium relation at $t$ moment. Let $ecm_t = \mu_t = Y_t - \alpha_0 - \alpha_1 X_t - \alpha_2 Z_t$, we then can establish multiple variables two-order error correction model (ECM) as below.

$$\Delta Y_t = \lambda evm_{t-1} + \beta_1 \Delta X_t + \beta_2 \Delta X_{t-1} + \gamma_1 \Delta Z_t + \gamma_2 \Delta Z_{t-1} + \varepsilon_t \tag{2}$$

Where $\varepsilon_t$ is white-noise series, and $\alpha_0, \alpha_1, \alpha_2, \lambda, \beta_1, \beta_2, \gamma_1, \gamma_2$ are parameters to be estimated.

## 3. Empirical Analysis and Modelling

### 3.1 Data and Variables

The time range of sample data is from 3/4/1991 to 28/11/2011, hence the total size of sample data is 5043, Let $x_{1t}, x_{2t} (t = 1,2,...,5042)$ represent the daily close index, daily turnover of Shanghai market at the $t-th$ day respectively, whilist $y_{1t}, y_{2t} (t = 1,2,...,5042)$ be the daily close index, daily turnover of Shenzhen market at the $t-th$ day respectively. We also set $lx_{1t} = \ln x_{1t}, lx_{2t} = \ln x_{2t}, ly_{1t} = \ln y_{1t}, ly_{2t} = \ln y_{2t}$.

### 3.2 Test for Stationary and Granger

We find $lx_{it}, ly_{it} (i = 1,2)$ are not stationary by test for unit root, though they are stationary by one-difference, or, $lx_{it}, ly_{it} (i = 1,2)$ are $I(1)$, For $lx_{it}, ly_{it} (i = 1,2)$, according to "AIC", we take lags to include $k = 1$, then we tabulate the test for Granger in table 1 below.

Table 1. Test for Granger

| Null | Hypothesis | | Obs | F-Statistic | Prob. |
|---|---|---|---|---|---|
| $\Delta lx_{2t}$ | does not Granger Cause | $\Delta lx_{1t}$ | 5040 | 1.64919 | 0.1991 |
| $\Delta lx_{1t}$ | does not Granger Cause | $\Delta lx_{2t}$ | | 194.471 | 2.00E-43 |
| $\Delta ly_{2t}$ | does not Granger Cause | $\Delta ly_{1t}$ | | 1.03545 | 0.3089 |
| $\Delta ly_{1t}$ | does not Granger Cause | $\Delta ly_{2t}$ | | 257.246 | 2.00E-56 |
| $\Delta ly_{1t}$ | does not Granger Cause | $\Delta lx_{1t}$ | | 0.54933 | 0.4586 |
| $\Delta lx_{1t}$ | does not Granger Cause | $\Delta ly_{1t}$ | | 0.10067 | 0.751 |

Whether the significance level is 1%,5% or 10%, we accept $\Delta lx_{2t}$ Granger causes $\Delta lx_{1t}$, $\Delta ly_{2t}$ Granger causes $\Delta ly_{1t}$, $\Delta lx_{1t}$ Granger causes $\Delta ly_{1t}$, $\Delta ly_{1t}$ Granger causes $\Delta lx_{1t}$.

*3.3 Test for Co-integration*

We establish the regression equations as below

$$lx_{1t} = 0.11431 lx_{2t} + 0.562769 ly_{1t} + u_t \tag{3}$$

$$ly_{1t} = 0.060579 ly_{2t} + 0.955076 lx_{1t} + v_t \tag{4}$$

Where $u_t, v_t$ are random errors, note in (3) $R^2$=0.917, D.W=0.047, in (4) $R^2$=0.871, D.W=0.010. We perform unit root test for $u_t$, then generate some results given in table 2 below

Table 2. Augmented Dickey-Fuller (ADF) test for $u_t$

| ADF | | | t-Statistic | Prob. |
|---|---|---|---|---|
| | | | -5.13745 | 0.000 |
| | 1% level | Test critical values | -2.56542 | |
| significance level | 5% | | -1.94089 | |
| | 10% | | -1.61666 | |

In same way, we can perform unit root test for $v_t$, and obtain t-Statistic=-5.388414. It is not hard to see $u_t \square I(0)$, $v_t \square I(0)$. These observations show that there exists an co-integration relation among $lx_{1t}, lx_{2t}$ and $ly_{1t}$, an co-integration relation among $ly_{1t}, ly_{2t}$ and $lx_{1t}$, from 3/4/1991 to 28/11/2011, where the co-integration vector are (1,-0.114310, -0.562769),(1,-0.060579, -0.955076), respectively.

*3.4 Modeling for ECM*

Now in turn, we consider the long-run equilibrium equation among the daily close index $lx_{1t}$, daily turnover $lx_{2t}$ of Shanghai market and daily close index $ly_{1t}$ of Shenzheng market. Firstly let's establish the equations as below

$$lx_{1t} = 0.54296 + 0.1179761 lx_{2t} + 0.4873571 ly_{1t} + u_t \tag{5}$$

$$ly_{1t} = 0.678149 + 0.064201 ly_{2t} + 0.850619 lx_{1t} + v_t \tag{6}$$

Notice that In (5), $R^2$=0.92, D.W=0.053, in (6), $R^2$=0.90, D.W=0.02, we take the residual series $u_t$, $v_t$ to be the error correction term. Accordingly, we establish two-order Error Correction Model (ECM) for $lx_{1t}$ and $ly_{1t}$, respectively.

$$\Delta lx_{1t} = -0.00761 ecm_{t-1} + 0.0085 \Delta lx_{2t} + 0.0023 \Delta lx_{2t-1} + 0.691 \Delta ly_{1t} - 0.0282 \Delta ly_{1t-1} + \varepsilon_t \tag{7}$$

$$\Delta ly_{1t} = -0.0038 ecm_{t-1} + 0.01 \Delta ly_{2t} + 0.0023 \Delta ly_{2t-1} + 0.551 \Delta lx_{1t} + \varepsilon_t \tag{8}$$

Note In (7), $R^2$=0.43, D.W=1.983, but In (8), $R^2$=0.436, D.W=1.98, (7) and (8) show $\varepsilon_t$ doesn't exist one-order autocorrelation, coefficient of Autocorrelation and Partial Correlation further show $\varepsilon_t$ don't exist high-order autocorrelation..But it shows that the significance test for coefficients in (7), (8) and regression equation (7), (8) can pass whether the significance level is 1%,5% or10%.

**4. Conclusion**

By Test for stationary,Granger,co-integration, we find that there really exist the long-run equilibrium equation among the daily close index,daily turnover of Shanghai (Shenzhen) market and daily close index of Shenzhen (Shanghai) market.

In the long run, by (5), we noticed that $x_{1t}$ will change 0.1179761% when $x_{2t}$ changes 1% but $y_{1t}$ keeps unchanged, while $x_{1t}$ will change 0.4873571% when $y_{1t}$ changes 1% but $x_{2t}$ keeps unchanged; Similarly by

(6), $y_{1t}$ will change 0.064201% when $y_{2t}$ changes 1% but $x_{1t}$ keeps unchanged, $y_{1t}$ will change 0.850619% when $x_{1t}$ changes 1% but $y_{2t}$ keeps unchanged.

In the short run,by (7) and (8), the fluctuation of the close index of Shanghai(Shenzhen) stock market was caused by two factors.The first one was the effect of the close index deviating from long-run equilibrium.In particular the size of coefficient of term $ecm_{t-1}$ reflects adjusting strength of deviating from long-run equilibrium, the estimation value of coefficient -0.00761(-0.0038) shows that when the short-run fluctuation deviates from the long-run equilibrium,the close index of Shanghai (Shenzhen) market will be pulled back to equilibrium state by adjusting strength 0.00761(0.0038). It is obvious to see the adjusting strength of Shanghai market is more bigger than that of Shenzhen market; the second factor was the total effect of the four (three) term short-run fluctuation, in (7),they include the current, lag-one fluctuation of the turnover of Shanghai; the current, lag-one fluctuation of close index of Shenzhen. Four term coefficients: 0.0085, 0.0023, 0.691,-0.0282 respectively reflect the effect strength size of short-run fluctuation. In (8), they include the current, lag-one fluctuation of the turnover of Shenzhen; the current fluctuation of close index of Shenzhen. Three term coefficients: 0.01, 0.0023, 0.551 respectively reflect the strength size of the effect of short-run fluctuation. In (7), it is obvious to see that the lag-one fluctuation of the close index of Shenzhen, $\Delta ly_{1t-1}$ affects the fluctuation of the close index of Shanghai, coefficient -0.0282 shows the effect is the reverse,however, In (8),on the contrary,the lag-one fluctuation of the close index of Shanghai, $\Delta lx_{1t-1}$ doesn't affect the fluctuation of the close index of Shenzhen.

In (7) and (8), $\Delta lx_{1t}$, $\Delta ly_{1t}$ also represent the daily return rate of Shanghai, Shenzhen stock market respectively, $\Delta lx_{2t}, \Delta ly_{2t}$ stand for the corresponding daily turnover variation rate of two karkets. In (7), $\Delta lx_{1t}$ will change 0.0085(0.691) unit when $\Delta lx_{2t}(\Delta ly_{1t})$ changes 1 unit but another three factors keep unchanged. $\Delta lx_{1t}$ will change 0.0023 unit when $\Delta lx_{2t-1}$ changes 1 unit but another three factors keep unchanged. $\Delta lx_{1t}$ will decrease(increase ) 0.0282 unit when $\Delta ly_{1t-1}$ increases(decreases) 1 unit but another three factors keep unchanged. In (8), $\Delta ly_{1t}$ will change 0.01(0.551) unit when $\Delta ly_{2t}(\Delta lx_{1t})$ changes 1 unit but another two factors keep unchanged. $\Delta ly_{1t}$ will change 0.0023 unit when $\Delta ly_{2t-1}$ changes 1 unit but another two factors keep unchanged.

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