Financial Instability, Banking Crisis, and Growth Volatility In Thailand: An Investigation of Bi-Directional Relationship

Piriya Pholphirul
School of Development Economics
The National Institute of Development Administration (NIDA)
Serithai Road, Bangkapi, Bangkok 10240, Thailand
Tel: 66-2727-3636 E-mail: piriya.p@nida.ac.th

Abstract

Thailand has undergone several economic shocks transmitted from outside the country. A reasonable degree of macroeconomic stability in many critical aspects was implemented during that period. A time-series econometrics is examined to investigate the causal links of financial instability and different sources of volatility to macroeconomic instability and probability of economic downturn. The estimated results show that financial instability and probability of banking crisis are relatively more determined from the volatility in trade openness, and less determined from the price related volatility. In addition, variables related to financial system development seem to be crucial factors in maintaining the stability of the financial sector. The estimated coefficients also indicate that better financial system development should also help stabilize growth volatility and decrease the probability of economic downturn. In addition, we also conclude that price variability does not have strong effects on growth volatility and economic downturn.

Keywords: Financial Instability, Growth Volatility, Banking Crisis, Thailand

1. Introduction

In the second half of the 1990s, financial markets around the world captured strong attention because financial stability started to tremble in several countries as a result of formidable macroeconomic imbalance, which had been liberalized a few years earlier. Thailand experienced a severe economic crisis in 1997, which had the combined effects of a currency crisis which was indeed the most severe one since the Second World War. Key elements of Thailand's financial crisis reflected its cumulative balance of payment problems, particularly persistently large current account benefits. The Bank of Thailand (BOT) was depleted for most of its international reserves in defending the baht currency, therefore had to float the currency on July 2, 1997, ending long decades of the fixed exchange rate regime. The banking crises in Thailand wsd particularly painful and costly, as the government was often caught unprepared and had to rescue ailing units without many options. Public debts therefore surged to a large extent. Meanwhile, corporate debt restructuring did not proceed at a satisfactory pace, making many parties question whether a clear-cut economic recovery was forthcoming, and if so, how long it would take and whether it would be sustainable. These strong and negative consequences of banking crises demonstrate that it is worth examining their fundamental conceptual framework and some actual experiences in the past.

On the external front, three variables deserved immediate attention of current account shock in Thailand: terms of trade or the extent of foreign demand, world interest rates, prevailing degree of confidence and its primary determinants. Terms of trade or foreign demand ordinarily affect performance on the current account, while interest rate differentials, exchange rate volatility, and confidence motivate capital flows. These current account shocks and capital flows represent one crucial source of liquidity change, which has a strong impact upon financial institutions' positions or potential. For instance, deterioration of terms of trade can impair debt-servicing capacity of banks' customers. Furthermore, such an unlucky incident may weaken foreign investors' confidence, leading to capital outflows, exchange rate depreciation, and substantial losses to financial institutions' cash flow positions. In this context, another important item is the degree of globalization or how much the local economy is allowed to interact with the rest of the world with respect to trade and capital flows.

On the internal account, confidence affects behavior of both lenders and borrowers, therefore the extent and pace of credit expansion. Meanwhile, there is also influence on capital flows, which can stimulate or slow down credit expansion via market competition and changes in exchange rates. The pace of credit expansion is an important determinant of not only economic growth and inflation but also the extent of non-performing loans (NPL), depending upon the quality of credit management. In any case, though NPL will impair both financial stability and confidence, the central authority can help preserve stability of the whole financial system via prudent examination

and supervision. Finally, politics is also another significant domestic factor that has strong psychological impact on investor confidence.

However, regardless of the 1997 economic crisis, we can observe how well the Thai economy performed in the past if one concentrates on lists of macroeconomics indicators, for example the real growth of national income, inflation or changes of price level, and rates of employment. Thailand's average growth rate between 1970 and 1990 was fairly high at 6.7 percentage points per annum if compared to those of other emerging countries. Actually, it is widely agreed that Thai economy also enjoyed considerable expansion as early as the 1950s. Nonetheless, among high and steady growth, instabilities did occur, like other countries, Thailand, in the past, has undergone several economic shocks, most of them were transmitted from outside the country but some emerged internally. However, since macroeconomic variables show how well the country could adjust themselves to those shocks, questions that might be addressed are, firstly, how could the Thai economy perform quite well during the periods of 1970-1990 even though there were a number of external shocks that affected the country's current account? Secondly, what were the major factors of shocks that caused the Thai economy more struggle since 1990 and, at the end, led the country to the most turbulent period in to financial market and severe economic crisis at the end of 1990s?

In this occasion, the relationship between economics financial instability and financial development to economic growth has received a lot of attention in economic literature in the last ten years. Undoubtedly, financial stability/instability and macroeconomic stability/instability are intricately related. Applied to the case of Thailand, relationships between weak financial institutions and macroeconomic condition should be addressed to analyze how the financial volatility determines macroeconomic imbalances. In addition, there are a number of shocks, especially from external factors, that causes institution weakening, for example the financial liberalization that mounted to excessive capital inflows in the early 1990s, and macroeconomic volatility, for example two oil shocks in the 1970s.

Should we follow the econometrics reasoning by estimating lists of regressions, the volatility occurrences in the periods before 1990 is believed to be less affected to macroeconomic variables, e.g. GDP growth, inflation, and government budget. However, the relationship might be changed since the beginning of the 1990s when capital inflows surged. Beyond this hypothesis, some questions need to be answered to confirm the result which are (i) Do economies with higher levels of financial intermediary development experience more or less volatility in economic growth rates? and (ii) Do intermediaries dampen the impact of external shocks on the economy or do they amplify them through the credit channel? Many literatures have empirically investigated a positive impact of financial sector development on economic growth. Specifically, a series of empirical articles by King and Levine (1993a, 1993b, 1993c) brought the discussion to the forefront of economic literatures in the 1990s. Some empirical work in this vein includes Gelb (1989), Roubini and Sala-i-Martin (1992), Pagano (1993), Levine (1997, 1998), Beck, Levine, and Loayza (2000), and Rioja and Valev (2004). However, the potential links between financial development and the volatility of economic growth have not been studied thoroughly yet. Previous papers have found that financial development reduces macroeconomic volatility (Easterly, Islam, and Stiglitz, 2000; Hausmann and Gavin, 1996). Nevertheless, many literatures adopt the cross-country studies to determine the causal relationship between those two variables. Further, none of these papers have tried to identify the channels through which financial development potentially affects growth volatility.

The imbalances of financial institutions, or financial instability in Thailand exist in a sense of prosperity during the expansion path giving rise to over optimism, complacency, and over confidence. As soon as overvaluation of asset prices has been realized, a loss of confidence, pessimism, and over-reaction set in. Rising bankruptcies, non-performing assets, and bank runs are the order of the day in a debt-deflation economy. The greater the amount of debt accumulated over the expansion phase of the cycle, the deeper the trough and the longer the duration of the recession. Financial instability therefore leads to macroeconomic instability and vice versa.

Section II constructs the model specification of the simultaneous econometrics time series capturing the relationship of financial instability and growth volatility. Variables measuring economic volatility, financial instability, and various sources of volatility will be announced in this section. Section III investigates the determinants of financial instability and banking crisis from different sources of volatility by using bivariated regression. Section IV also investigates the determinants of growth volatility and probability of economic downturn from different sources of volatility. Section V adopts the method of instrumental variable (IV) to treat the effect of simultaneity of financial instability and growth volatility. It also includes both general level of volatility, which is measured by standard deviation of variables, and excess volatility, which was determined during the period of economic turbulence in 1997-1998. And, Section VI concludes.

2. Model Specification and Variables.

The detailed explanation of this section was lead us to implement the econometrics framework to capture volatility. For the purposes of this section, time series econometrics framework attempts to investigate how the stability of

Thailand's financial institution incorporated by a macroeconomic volatility and its downturn. On the other hand, how the instability of Thailand's macroeconomics variability affects financial instability. Since the financial crisis erupted in Thailand in 1997, the key elements of Thailand's economic crisis, which follow the banking crisis, reflected its cumulative balance of payment problem, particularly and persistently large current account deficits, and unsustainable financing through short-term borrowing. Crockett (1996) defines financial instability as a situation when economic performance is adversely affected by fluctuations in prices of financial assets and when financial intermediaries have difficulty in meeting their contractual obligations. The volatility of financial institutions should also be simultaneously determined by the economic volatility.

Since the bi-directional causal relationship is applied in this study, the system equations capturing simultaneous between those two variables: macroeconomics volatility and financial institution; should be investigated. The important form of endogeneity of explanatory variables is simultaneity.

The most important point to remember in using simultaneous equations models (SEMs) is that each equation in the system should have a ceteris paribus in causal interpretation. Therefore, to observe bi-directional relationship between institution volatility and growth volatility, the method of ordinary least square (OLS) is biased and inconsistent when applied to a structural equation in a simultaneous equation system. Thus, two equations are suffering from simultaneous bias performance as the following structural equations:

$$Y_t = \alpha_1.I_t + \beta_1 X_t \quad + \varepsilon_{1t} \tag{1}$$

$$I_t = \alpha_2 Y_t + \beta_2 X_t + \varepsilon_{2t} \tag{2}$$

For simplicity, the intercept for each equation is suppressed. To show that the economic volatility (Y) is generally correlated with the error term ε_2., two equations can be solved for Y in terms of the exogenous variables (X) and the error term by plugging Equation (2) into the Equation (1), we get

$$Y_t = \quad \alpha_1.(\alpha_2 Y_t + \beta_2 X_t + \varepsilon_{2t}) + \beta_1 X_t + \varepsilon_{1t}$$

Or,

$$(1- \alpha_1.\alpha_2) Y_t = (\alpha_1.\beta_2 + \beta_2).X_t + \varepsilon_{1t} + \alpha_1.\varepsilon_{2t} \tag{3}$$

The assumption of $\alpha_1.\alpha_2 \neq 1$ must hold in order to solve for Y. Dividing Equation (3) by $(1- \alpha_1.\alpha_2)$, Y can be rewritten as

$$Y_t = \Pi_1.X_t + v_{1t} \tag{4}$$

Where, $\Pi_1 = (\alpha_1.\beta_2 + \beta_2)/(1- \alpha_1.\alpha_2)$ and $v_{1t} = (\varepsilon_{1t} + \alpha_1.\varepsilon_{2t})/ (1- \alpha_1.\alpha_2)$. The Equation (4) expresses *Y* in terms of the exogenous variables and the error terms, is the reduced form for *Y*. The parameter Π is therefore called reduced form parameters.

Also, Π as itself is simultaneously determined from Y, a reduced form also exists for *I* by plugging Equation (1) into the Equation (2) and getting,

$$I_t = \quad \alpha_2.(\alpha_1 I_t + \beta_1 X_t + \varepsilon_{1t}) + \beta_2 X_t + \varepsilon_{2t}$$

Or,

$$(1- \alpha_1.\alpha_2) I_t = (\alpha_2.\beta_1 + \beta_2).X_t + \varepsilon_{2t} + \alpha_2.\varepsilon_{1t} \tag{5}$$

The assumption of $\alpha_1.\alpha_2 \neq 1$ must also hold to solve for *I*. Dividing Equation (5) by $(1- \alpha_1.\alpha_2)$, I can be rewritten as the reduced form function shown in the Equation (6) below:

$$I_t = \Pi_2.X_t + v_{2t} \tag{6}$$

Where, $\Pi_2 = (\alpha_2.\beta_1 + \beta_1)/(1- \alpha_1.\alpha_2)$ and $v_{2t} = (\varepsilon_{2t} + \alpha_2.\varepsilon_{1t})/ (1- \alpha_1.\alpha_2)$. The endogenous variable (*Y*) is the macroeconomic volatility measured by:

Y_1: Standard deviation of changes in real GDP per capita, and

Y_2: Probability of economic downturn

The endogenous variable (I) measures the volatility and fragility of the financial institution. In general, performances of banks are measured in term of size, activity, and efficiency as explained in a number of literatures. Since the domestic financial architecture framework in Thailand is performing on a bank-based system, banks play a leading role in mobilizing savings, allocating capital, overseeing the investment decision of corporate managers, and providing risk management vehicles. Even though, lists of variables might be considerably adopted to measure the degree of volatility in the banking sector, this study points out the following two potential variables:

I_1: Standard deviation of liquidity asset/deposit ratio, and

I_2: Standard deviation of capital account/risk asset ratio

The first variable I_1 measures how the liquidity status of commercial bank might fluctuate. Since commercial banks regularly borrow in the financial markets, liquidity takes on the added dimension of the ability to borrow funds at minimum cost. Bank liquidity thus refers to a bank's capacity to acquire immediately available funds at a reasonable price. The lower the ratio indicates less liquidity channel of the deposit, which thereafter causes less performance in financial institutions. The second variable I_2, the standard deviation of capital account/risk asset ratio, determines the volatility of the banking sector that holds high proportion of risky asset. The higher the ratio implies more volatility of the financial institution. Both variables were found to be highly volatized during the periods of severe economic crisis 1997-1999.

Vector X denotes a set of exogenous variables, which are the variables measuring different sources of volatility. Since the volatility from different sources determine both endogenous variables Y and I, the set of X variables in this case are mutually overlapping and therefore there is no rule of exclusion restriction on the variables X. The measurement used in general both in terms of level and in term of standard deviation of the variables are under study. They are defined as the following categories:

(2) Trade and Financial Openness (X_1)

Standard deviation of change in term of trade;

(export + import)/GDP;

Standard deviation of (export + import)/GDP;

Private capital inflow/ GDP;

Standard deviation of (Private capital inflow/ GDP);

(3) Financial System Development(X_2)

M3/GDP;

Standard deviation of M3/GDP;

Stock market capitalization/GDP;

Standard deviation of stock market capitalization/GDP;

Credit to private sector/ GDP;

Standard deviation of credit to private sector/ GDP;

Standard deviation of change in private credit/ GDP;

(4) Price Variability (X_3)

Standard deviation of oil price index;

Standard deviation of changes in oil price index;

Standard deviation of agriculture price index;

Standard deviation of changes in agriculture price;

Standard deviation of manufacturing price index;

(5) Policy Volatility (X_4)

Standard deviation of fiscal balance/GDP;

Net foreign asset/GDP;

Standard deviation of net foreign asset/GDP;

Central bank asset/ GDP;

Standard deviation of central bank asset/ GDP;

Some literatures within the theoretical consideration suggest that greater openness to trade and finance may expose the country to more external shocks. Especially, in the case of Thailand, greater openness of the capital account might expose to greater dependence of credit that might at the end make the country more vulnerable. More trade opening might create acute portfolio problems since the relative prices change. Hence weak firms and business practices become insolent, and thereafter reflect to economic volatility. Financial openness is applied in the case of Thailand where excessive short-term capital inflow was the major cause of the country to acute external debt, which thereafter was the major cause of the financial and economic crisis.

Table 1. Summarized Table of Statistics classified by Sub-Periods.

Variables	*Ranges of Variables*		*Mean*	*Mean*	*Mean*	*Mean*	*Maximum*	*Minimum*
	From	To	1970-2004	1970-1985	1986-1996	1997-Present		
Trade and Financial Openness (X1)								
S.D.(Change in term of trade)	1970 Q1	2004 Q4	4.07	5.31	2.97	3.10	12.08	1.13
(Export + Import)/GDP	1970 Q1	2004 Q4	0.59	0.40	0.62	0.94	1.21	0.28
S.D.(Export + import)/GDP	1970 Q3	2004 Q4	0.04	0.03	0.03	0.08	0.14	0.01
Private capital inflows/GDP	1993 Q1	2004 Q4	2.11	n.a.	2.56	1.89	7.01	0.59
S.D. (Private capital inflows/GDP)	1993 Q3	2004 Q4	0.75	n.a.	0.63	0.81	1.82	0.11
Financial System Development (X2)								
M3/GDP	1980 Q4	2004 Q4	3.36	2.06	3.32	4.42	5.21	1.67
S.D.(M3/GDP)	1981 Q2	2004 Q4	0.14	0.14	0.12	0.17	0.38	0.07
Stock market capitalization/ GDP	1988 Q3	2004 Q4	1.54	0.15	2.00	1.50	4.01	0.07
S.D.(stock market capitalization/ GDP)	1989 Q1	2004 Q4	0.40	n.a.	0.38	0.42	0.88	0.05
Credit to private sector/GDP	1970 Q1	2004 Q3	2.12	1.10	2.59	3.55	4.87	0.72
S.D. (Credit to private sector/GDP)	1970 Q3	2004 Q3	0.13	0.06	0.14	0.26	0.52	0.01
S.D. (Charge of private credit/GDP)	1970 Q3	2004 Q3	4.24	4.06	3.90	5.05	7.92	1.82
Price Variability (X3)								
S.D. (Oil price index)	1970 Q1	2002 Q2	21.43	17.82	22.94	28.27	84.08	0.67
S.D. (Charge in oil price index)	1970 Q1	2002 Q2	17.19	20.38	15.03	12.79	104.57	1.93
S.D. (Agriculture price index)	1970 Q3	2002 Q2	5.67	5.54	5.81	5.74	13.63	0.35
S.D. (Charge in agriculture price index)	1970 Q4	2002 Q2	4.98	5.93	4.60	3.10	14.46	1.23
S.D. (Manufacturing price index)	1987 Q3	2004 Q4	6.36	n.a.	5.79	7.03	13.28	2.70
Policy Volatility (X4)								
S.D. (Fiscal balance /GDP)	1970 Q3	2004 Q3	0.03	0.03	0.02	0.03	0.05	0.01
Net foreign assets /GDP	1980 Q4	2004 Q4	0.31	0.11	0.27	0.51	1.21	-0.71
S.D. (Net foreign assets /GDP)	1981 Q2	2004 Q4	0.10	0.03	0.08	0.17	0.39	0.02
Central bank assets/GDP	1975 Q4	2004 Q4	1.10	0.78	0.87	1.88	2.14	0.68
S.D. (Central bank assets/GDP)	1976 Q2	2004 Q4	0.07	0.04	0.04	0.15	0.44	0.01
Financial Institution (I)								
Capital accounts as % of risk assets	1970 Q1	2004 Q3	0.11	0.11	0.09	0.13	0.15	0.08
S.D. (Capital accounts/risk assets)	1970 Q4	2004 Q4	0.53	0.42	0.42	0.90	1.70	0.14
Liquid assets/total deposits	1970 Q1	2004 Q2	0.11	0.07	0.07	0.20	0.28	0.06
S.D. (Liquid assets/total deposits)	1970 Q4	2004 Q3	0.01	0.00	0.00	0.02	0.05	0.00

Source : Bank of Thailand.

Financial system development experienced both more and less volatility in economic growth rate. Different literatures produce different answers. It is possible that financial development might alleviate the agency costs and cash flow constraints, and thereafter dampen the impact of real shocks to the economy. On the other hand, there is the dampening effect of financial intermediaries on the propagation of real shock and a magnifying effect of the propagation of monetary shock. In this case, financial development might have an overall dampening or amplifying impact of growth volatility.

Reasonable price volatility is possibly a crucial prerequisite for effective and efficient domestic resource mobilization and allocation through the financial sector. High price volatility implies unpredictability. Economic activity, including banking activities, therefore, takes place in an increasingly uncertain world. Uncertainty causes economic inefficiency.

The macroeconomic policies, which are related to fiscal policy or to monetary policy, no doubt have an effect on the economic growth and economic volatility. Expansionary fiscal policy has medium and long-run effects on economic volatility. A series of expansionary fiscal policy shocks raise the ratio of net government credit to total domestic credit. Monetary policy, on the other hand, produces exogenous shock, in the same way as the variance of money growth shock. Monetary policy implementation determines many of the constraints under which financial institutions must operate. Thereafter, compared to the fiscal policy, monetary policy is more assessing to activities and performances of financial institutions.

3. Determinants of Financial Instability and Banking Crisis

This section aims to investigate the financial volatility from the different sources of volatility in the Thai economy. Volatility and crises deteriorate the quality of financial institutions. Thailand is no exception; banking volatility has no meaning except the variability of financial performance, which is determined from different characteristics of volatility. The measurement of banking volatility is as of denoted in the previous section. To investigate the impacts of financial stability to economic volatility, the bivariated regression of financial volatility (I_1 and I_2) is individually estimated with numbers of volatility (X) as given by the Equation (6), which is the reduced form equation for I. Also, estimating with time trend, Table 2 shows the bivariated estimation of trans-log function of I_1: standard deviation (capital account/risk asset) and Table 3 shows the estimated results trans-log function of I_2: standard deviation (liquidity asset/ deposit).

From the above estimated results, both tables indicate that term of trade volatility and openness to trade volatility is individually associated with increased financial volatility. Even though, the volatility of financial openness is not found to be statistically associated to the financial volatility I_1, it is observed to decrease financial volatility I_2. Mostly, the indicators of financial system development are found to decrease financial volatility. Some of the most influential variables are, for example, the size of financial market (M2/GDP), capital market development and its volatility, and the financial depth and its volatility (credit to private sector/GDP). These results can be explained as that the better development of financial system and capital market, the more encouraging it is for financial institutions to manage their domestic resource mobilization and thereafter helping in stabilizing the institutions.

Nevertheless, by observing the estimated coefficients, the variables related to price variability are less likely to cause financial institution more volatility. Both standard deviation of agriculture price and oil price is found to increase venerability of financial institution. It might be argued that the impacts of oil price and agriculture price should not be direct determinants of the financial sector, but rather to be passed-through to the real sector. Nevertheless, more flexibility of price index in both agriculture sector and manufacturing sector is observed to decrease financial volatility.

Policy variability in fiscal related and net foreign asset are also associated with decreased financial volatility. However, the variability in net foreign asset to GDP is associated with increased financial volatility. In addition, central bank asset and its volatility are also associated with increased volatility in financial institutions. Nonetheless, compared with other significant variables; the volatility of trade openness seems to generate the highest determinant to the financial volatility, followed by the volatility in the related policy. Compared to other sources of volatility, the volatility in price seems likely to generate the least impact to financial institution's volatility in Thailand. This therefore leads to the conclusion that the volatility in Thailand's financial institutions is largely influenced by the external factors. Throughout the periods studied, international openness in trade and capital inflow has caused Thailand's financial institution to be more volatized. Nonetheless, the variables related to financial development are important to help in the stabilization of this sector.

Table 2. Estimation of Financial Volatility: I_1 = S.D. (capital account/risk asset)

Variables	*Coefficient*	*t-statistics*	*P-Value*
Trade and Financial Openness (X1)			
S.D.(Change in term of trade)	0.525***	6.009	0.001
(Export + Import)/GDP	0.715**	2.347	0.020
S.D.(Export + Import)/GDP	0.294***	3.723	0.001
Private capital inflows/GDP	-0.158*	-1.712	0.094
S.D. Private capital inflows/GDP	-0.205**	-2.276	0.028
Financial System Development (X2)			
M3/GDP	-0.415	-0.930	0.355
S.D.(M3/GDP)	0.174	1.272	0.207
Stock market capitalization/ GDP	-0.238***	-3.260	0.002
S.D.(stock market capitalization/ GDP)	0.030	0.312	0.756
Credit to private sector/GDP	-0.269	-1.249	0.214
S.D. (Credit to private sector/GDP)	0.104	1.189	0.237
S.D. (Change of private credit/GDP)	0.121	1.006	0.316
Price Variability (X3)			
S.D. (Oil price index)	-0.059	-1.312	0.192
S.D. (Change in oil price index)	0.038	0.805	0.422
S.D. (Agriculture price index)	0.022	0.325	0.746
S.D. (Change in agriculture price index)	0.194**	1.939	0.055
S.D. (Manufacturing price index)	-0.415***	-2.700	0.009
Policy Volatility (X4)			
S.D. (Fiscal balance /GDP)	0.057	0.365	0.716
Net foreign assets /GDP	-0.161**	-2.586	0.012
S.D. (Net foreign assets /GDP)	0.428***	5.861	0.001
Central bank assets/GDP	0.810***	4.665	0.001
S.D. (Central bank assets/GDP)	0.058	0.768	0.444

Note: *** 0.01, ** 0.05, and *0.10 significant level.

Table 3. Estimation of Financial Volatility: I_2 = S.D. (liquidity asset/deposit)

Variables	*Coefficient*	*t-statistics*	*P-Value*
Trade and Financial Openness (X1)			
S.D.(Change in term of trade)	1.112***	5.569	0.001
(Export + Import)/GDP	0.412	0.445	0.657
S.D.(Export + Import)/GDP	1.322***	9.427	0.000
Private capital inflows/GDP	0.191	0.950	0.347
S.D. Private capital inflows/GDP	0.285	1.434	0.159
Financial System Development (X2)			
M3/GDP	-2.952***	-3.095	0.003
S.D.(M3/GDP)	0.206	0.731	0.467
Stock market capitalization/ GDP	-1.020***	-8.795	0.001

S.D.(stock market capitalization/ GDP)	-0.839***	-4.627	0.001
Credit to private sector/GDP	-1.318***	-3.198	0.002
S.D. (Credit to private sector/GDP)	0.010	0.044	0.965
S.D. (Change of private credit/GDP)	0.899***	3.387	0.001
Price Variability (X3)			
S.D. (Oil price index)	0.312*	1.815	0.073
S.D. (Change in oil price index)	-0.027	-0.152	0.880
S.D. (Agriculture price index)	0.067	0.331	0.741
S.D. (Change in agriculture price index)	-0.905**	-2.380	0.020
S.D. (Manufacturing price index)	-0.993***	-2.840	0.006
Policy Volatility (X4)			
S.D. (Fiscal balance /GDP)	-1.204***	-3.514	0.001
Net foreign assets /GDP	-0.002	-0.013	0.989
S.D. (Net foreign assets /GDP)	0.085	0.513	0.609
Central bank assets/GDP	2.947***	6.915	0.001
S.D. (Central bank assets/GDP)	0.693***	4.365	0.001

Note: *** 0.01, ** 0.05, and *0.10 significant level.

However, banking volatility has no meaning except the variability of financial performance. Banking crisis firstly erupted in Thailand in 1997 and it was the most severe one since the Second World War. Although the crisis began on a certain date, elements of Thailand's financial crisis became evident well before the flotation of the baht in July 2, 1997. Those elements reflected hidden problems in a number of unsound financial institutions. During the first quarter of 1997, capital inadequacy and liquidity shortage in finance companies and small banks existed. Adopting probit framework to estimate the probability of Thailand's banking crisis resulted from various sources of volatility. Therefore, to adopt it in this study, the volatility of the financial sector should be set with a possible threshold for taking action in terms of type I error (failure to identify the crisis) and type II error (false alarm). Thus the analysis of bivariate probit can be used as a simple warning system for the authorities to take drastic policy actions to prevent for an impending volatility. Called the probability analysis, this is the starting point of an econometric model of the probability of a systemic banking crisis.

The word "banking crisis" may be used to cover many specific variables. Such a situation can occur as a result of crises occurring in the financial institution. The definition of banking crisis used in this study follows the argument when banking is highly volatized until it exceeds a certain threshold. In regards to Wolf (2004), distinguishing between normal volatility of financial institution (I) and extreme volatility or crisis is necessary to be identified. Nevertheless, to determine a certain threshold can be a rather subjective matter. Let's consider when the variable of financial volatility I, measured by I_1 is greater than 1.5 standard deviation above its mean as the periods of banking crisis (I = 1 defined a period of banking crisis), and I = 0 otherwise. Even though this threshold is not observable but if it is normally and identically distributed, it is possible to estimate the parameters. Given the assumption of normality, the probability can be computed from the standardized normal cumulative distribution function.

The probabilistic estimation of banking crisis is reported in Table 4. The estimated results show different volatilities, which determined the probability of banking crisis in Thailand. The variables that are found to be quite a small determinant to banking crisis are term of trade volatility, trade openness volatility, larger size of financial system (M3/GDP), volatility of financial depth (s.d. of credit to private sector/GDP), and the volatility of foreign asset to GDP. By estimation, those variables caused about 0.01 percent of the banking crisis in the Thai economy. However, it is doubtful to observe the negative causality of the volatility of private capital inflow to GDP and volatility of capital market to the banking crisis. It implies less volatility of both variables caused to the banking crisis. Possibly, the volatility of both variables is quite high during the sub-period II, which was followed by banking crisis. There might be a lead time of both variables that might cause the existing banking crisis. The negative relationship of stock market capitalization and banking crisis also lead to an interesting suggestion that better development of capital market might be an effective tool to banking stability.

For the price variability, the volatility of oil price is a major determinant to the banking crisis. From the probabilistic estimation, it implies that a percentage of oil price volatility is associated to increase about 9.3 percent of the

banking crisis. However, it is also found that more price flexibility of both agricultural sector and manufacturing sector is individually associated to decrease the probability of the banking crisis.

The bivariated analysis of banking crisis helps to determine the factors that might be contributing to banking fragility, or in each particular episode. Nevertheless, the factors that explain the level of financial volatility may not be necessarily the same factors that can be used to justify the probability of the banking crisis. Financial volatility in such a period of time may not imply banking crisis in the same period. Therefore, variables that are sufficient indicators to the financial volatility might not be the necessary factors for the banking crisis. For example, as what we found from the estimated results above, price volatility seems to be a small determinant to financial volatility, however, oil price is found to be largely associated to the banking crisis. The most critical task of this study is choosing the optimal threshold of the banking crisis. Even, nowadays, there is no appropriated rule adopted to select the optimal threshold of the banking crisis variable.

Table 4. Probabilistic Estimation of the Banking Crisis.

Variables	*Probability*	*t-statistics*	*P-Value*
Trade and Financial Openness (X1)			
S.D.(Change in term of trade)	0.001***	3.470	0.001
(Export + Import)/GDP	0.005	0.510	0.613
S.D.(Export + Import)/GDP	0.001***	2.870	0.004
Private capital inflows/GDP	-0.144	-1.120	0.264
S.D. Private capital inflows/GDP	-0.358***	-2.780	0.006
Financial System Development (X2)			
M3/GDP	0.001***	3.070	0.002
S.D.(M3/GDP)	0.057	1.290	0.199
Stock market capitalization/ GDP	-0.132**	-2.330	0.020
S.D.(stock market capitalization/ GDP)	-0.249**	-2.540	0.011
Credit to private sector/GDP	0.001	0.910	0.362
S.D. (Credit to private sector/GDP)	0.001***	3.130	0.002
S.D. (Change of private credit/GDP)	0.019**	2.450	0.014
Price Variability (X3)			
S.D. (Oil price index)	0.093***	2.870	0.004
S.D. (Change in oil price index)	0.043	1.360	0.172
S.D. (Agriculture price index)	-0.017	-0.360	0.718
S.D. (Change in agriculture price index)	-0.002**	-2.360	0.019
S.D. (Manufacturing price index)	-0.317***	-2.920	0.003
Policy Volatility (X4)			
S.D. (Fiscal balance /GDP)	-0.004	-0.910	0.361
Net foreign assets /GDP	-0.034*	-1.820	0.069
S.D. (Net foreign assets /GDP)	0.001**	2.360	0.018
Central bank assets/GDP	0.082**	2.350	0.019
S.D. (Central bank assets/GDP)	0.004	0.770	0.440

Note: *** 0.01, ** 0.05, and *0.10 significant level.

By comparing between two estimated dependent variable: financial volatility and the extreme volatility measuring probability of the banking crisis; financial volatility and the extreme banking crisis are relatively determined from the volatility in trade openness and variability of development in the domestic financial sector. By each variable, the volatility causing to the instability of the financial sector and the banking crisis are trade openness volatility, volatility of financial depth, and volatility of net foreign asset. Financial system development and enlarging capital market capitalization is found to help decrease financial volatility and reduce the probability of the banking crisis.

Even the price related volatility is found to be the causality of financial volatility. However, its impacts are not that strong compared to other sources of volatility, such as trade and financial openness and financial system development. Oil price is quite a significant factor to the banking crisis. Nevertheless, estimating those independent variables with non-linear estimation and imposing time-lag of some variables might help to improve the results.

4. Determinants of Growth Volatility and Economic Downturn

In regards to the reduced form equations shown in Equation (3), we estimate the bivariated translog regression of growth volatility (Y_1) and different sources of volatility during the entire period studied. Shown in Table 5, all indicators in trade and financial openness volatility, except private capital inflow/ GDP, are associated to increased macro volatility. Thus, more openness of Thailand is a major factor to economic variability. In addition, better financial system development, in term of enlarging stock market capitalization and volatility of credit to private sector/GDP, helps to reduce growth volatility. Private capital inflow does not affect growth, but its volatility does increase the growth volatility. In term of price variability, there is only the standard deviation in the change of oil price that has an impact on greater growth volatility. The flexibility of agriculture price is however not associated with growth volatility. All indicators in the policy volatility, except standard deviation of fiscal balance/GDP, are associated with increased volatility. Net foreign asset/GDP and its volatility is observed to cause more venerability to the economic. Nonetheless, asset of the central bank and its volatility seems to be another important variable determining the volatility in Thailand's economic growth.

Table 5. Bivariate Estimation of Growth Volatility.

Variables	*Coefficients*	*t-statistics*	*P-Value*
Trade and Financial Openness (X1)			
S.D.(Change in term of trade)	1.203***	6.015	0.001
(Export + Import)/GDP	3.481***	5.303	0.001
S.D.(Export + Import)/GDP	1.294***	8.334	0.001
Private capital inflows/GDP	0.239	0.880	0.384
S.D. Private capital inflows/GDP	0.917***	4.272	0.001
Financial System Development (X2)			
M3/GDP	0.320	0.301	0.764
S.D.(M3/GDP)	-0.036	-0.117	0.907
Stock market capitalization/ GDP	-0.600***	-3.951	0.001
S.D.(stock market capitalization/ GDP)	-0.119	-0.524	0.602
Credit to private sector/GDP	0.366	0.678	0.499
S.D. (Credit to private sector/GDP)	-0.311	-1.446	0.151
S.D. (Change of private credit/GDP)	-0.917***	-3.422	0.001
Price Variability (X3)			
S.D. (Oil price index)	0.131	1.269	0.207
S.D. (Change in oil price index)	0.433***	4.255	0.001
S.D. (Agriculture price index)	0.094	0.610	0.543
S.D. (Change in agriculture price index)	-0.065	-0.262	0.794
S.D. (Manufacturing price index)	-0.031	-0.077	0.939
Policy Volatility (X4)			
S.D. (Fiscal balance /GDP)	-0.259	-0.718	0.474
Net foreign assets /GDP	0.367***	3.205	0.002
S.D. (Net foreign assets /GDP)	0.348*	1.756	0.083
Central bank assets/GDP	2.630***	7.284	0.001
S.D. (Central bank assets/GDP)	0.766***	5.003	0.001

Note: *** 0.01, ** 0.05, and *0.10 significant level.

Nevertheless, the economic downturn, which is defined as negative per capital GDP growth takes on a value $I = 1$ of the negative growth and $I = 0$ of the positive growth. During the period studied, Thailand experienced an economic downturn of 9.6 percent throughout the periods studied, which is about the same when compared to the OECD countries reported by Easterly, Islam, and Stiglitz (2000). This is not surprising since Thailand experienced only a severe economic downturn during 1997.

From adopting a probit regression to estimate the probability of economic downturn, more volatility of trade openness: standard deviation of (export + import)/ GDP; increases the probability of economic downturn by approximately 12.1 percent. Private capital inflow/GDP and its volatility also increase the probability of economic downturn by 27.3 percent and 38.5 percent respectively. However, when we take into account in term of financial development, larger size of financial system, more volatility of capital market utilization, and especially the financial depth (credit to private sector/GDP) we find out that these factors also make the country more vulnerable by increasing the probability of downturn about 4.3 percent, 24.3 percent, and 46 percent respectively. Interestingly, in term of price variability, oil price does not have the effect to probability of economic downturn, but the volatility of agriculture price slightly decreases the likelihood of a downturn by about 2.6 percent. It can also be observed that size of the central bank and its volatility also has an affect causing a higher probability of the country's economic downturn.

Therefore, the bivariated studies above indicate that both growth volatility and economic downturn in Thailand are mainly determined from the variables in trade openness volatility, financial openness volatility, and volatility from the central bank asset. Better financial system development, represented by some variables such as financial depth volatility and net foreign asset, are associated to stabilize growth and decrease probability of economic downturn. Nevertheless, those variables are also, individually, significant variables in determining the volatility in financial institutions. However, since the evidence from financial volatility and the banking crisis that caused the 1997 economic crisis was observed, the bi-directional relationship between those two variables should be identified within the effects of some exogenous variables. The model implemented for this analysis will be presented in the next section.

This result therefore leads to the basic conclusion that trade and financial liberalization might be one of the most important factors causing instability of financial institutions as well as leading the economy to be more volatile. Nevertheless, the estimated coefficients also indicate that better financial system development should also help to stabilize growth volatility and decrease the probability of economic downturn. Nevertheless when price-related volatility is concerned, we find that price variability does not have much effect on growth volatility and probability of economic downturn.

Table 6. Probabilistic Estimation of Economic Downturn.

Variables	*Probability*	*t-statistics*	*P-Value*
Trade and Financial Openness (X1)			
S.D.(Change in term of trade)	0.021	0.340	0.736
(Export + Import)/GDP	0.274	1.400	0.162
S.D.(Export + Import)/GDP	0.121**	2.480	0.013
Private capital inflows/GDP	0.273**	2.260	0.024
S.D. Private capital inflows/GDP	0.385***	3.300	0.001
Financial System Development (X2)			
M3/GDP	0.043***	2.800	0.005
S.D.(M3/GDP)	-0.059	-0.780	0.433
Stock market capitalization/ GDP	-0.058	-1.010	0.313
S.D.(stock market capitalization/ GDP)	0.243***	3.140	0.002
Credit to private sector/GDP	0.460***	3.070	0.002
S.D. (Credit to private sector/GDP)	0.073	1.220	0.224
S.D. (Change of private credit/GDP)	-0.202***	-2.890	0.004
Price Variability (X3)			
S.D. (Oil price index)	-0.002	-1.060	0.288

S.D. (Change in oil price index)	0.001	0.770	0.438
S.D. (Agriculture price index)	0.007	0.880	0.380
S.D. (Change in agriculture price index)	-0.026*	-1.710	0.087
S.D. (Manufacturing price index)	-0.035	-0.250	0.800
Policy Volatility (X4)			
S.D. (Fiscal balance /GDP)	0.134	1.360	0.175
Net foreign assets /GDP	0.001	0.120	0.901
S.D. (Net foreign assets /GDP)	0.072	1.420	0.156
Central bank assets/GDP	0.199**	2.110	0.035
S.D. (Central bank assets/GDP)	0.121***	3.750	0.001

Note: *** 0.01, ** 0.05, and *0.10 significant level.

5. Simultaneous Estimation of Growth Volatility and Financial Instability

Once the structural equation is identified from the different sources of volatility (X), we can estimate the simultaneous equation model (SEM) by using two state least squares. To identify the instrumental variables from the X variables and in order of capture simultaneous relationship of those two variables: Y and I, two conditions must hold: 1) instrumental variables (X) are uncorrelated with the error term ε (Cov (X, ε) = 0), and 2) instrumental variables (X) are correlated with I (Cov (X, I) $\neq$ 0).

Given that the Equation (1) is estimated to analyze the impacts of the financial instability (I) and other sources of volatility (X) to the growth volatility (Y), the financial instability (I_1 and I_2) is observed to be endogenously determined by (i) standard deviation of (stock market capitalization/ GDP) and (ii) standard deviation of (change of private credit/ GDP). The former measures the volatility in the capital market development, and the later measures the volatility in financial depth. Using the Hausman Test, confirms that the instrumental variables are valid and sufficient. The estimated equation and lists of exogenous variables are presented as Equation 7:

$$Log(Y_t) = \alpha + \delta log(I_t) + \beta_1.logS.D(X+M/GDP) + \beta_2.logS.D.(Private\ capital\ inflow/GDP) + \beta_3.logS.D.(M3/GDP) + \beta_4.logS.D.(Change\ in\ oil\ price\ index) + \beta_5\ log.S.D.(Net\ foreign\ asset/\ GDP) + \beta_6.log(Central\ bank\ asset/\ GDP) + \varepsilon \quad (7)$$

Lists of exogenous variables measuring different sources of volatility: in terms of trade and financial openness, financial system development, price variability, and policy volatility, are selected to estimate the growth volatility. Estimated coefficients shown in ordinary least square and two-stage least square are presented in Table 7

Table 7. Volatility of Financial Institutions and the Determinants of Growth Volatility.

Variables	*OLS*		*2SLS*	
Constant	-1.004	-0.42	-0.835	3.693
	(-0.71)	(0.30)	(0.25)	(1.51)
I1: S.D.(Capital account/Risk asset)	0.281	-	1.804**	-
	(1.13)	-	(1.96)	-
I2: S.D.(Liquidity asset/Deposit)	-	0.305***		0.358***
	-	(2.19)		(2.11)
S.D. (Export + Import/GDP)	0.541***	0.190	0.672*	0.528
	(2.53)	(0.71)	(1.65)	(0.85)
S.D.(M3/GDP)	-0.303	-0.295	0.010	-0.109
	(-1.09)	(-1.08)	(0.02)	(0.30)
S.D.(Credit to private sector/GDP	0.600***	0.658***	0.367	0.413*
	(4.18)	(4.88)	(1.11)	(1.64)
S.D. (Net foreign asset/GDP)	-0.004	-0.026	0.487	-0.007

	(-0.02)	(-0.13)	(1.23)	(-0.03)
S.D.(Central bank asset/GDP)	1.792***	1.174**	2.537**	2.691***
	(2.79)	(1.83)	(1.90)	(2.61)
Time-Trend	-0.003	-0.003	-0.004	-0.039**
	(-0.38)	(0.37)	(0.89)	(1.93)
Adjusted R-Square	0.61	0.63	0.28	0.57
F-Statistics	0.001	0.001	0.001	0.001

Note: *** 0.01, ** 0.05, and *0.10 significant level.

Volatility in financial institution of both variables I1 and I2 are found to be a major cause of Thailand's economic volatility. However, the volatility of financial institutions are not the only cause that makes Thailand's economy more volatile. Volatility of trade openness is also associated to increased growth volatility of the country. In the case of Thailand, greater openness of trade might expose her to greater dependence of credit that might at the end make the country more vulnerable. In addition, volatility in trade opening might create acute portfolio problems since the relative price change is caused by exchange rate fluctuation. Hence weak firms and business practices might become insolence, and thereafter reflect economic volatility.

The volatility of financial depth (S.D. private credit/GDP) is also associated with increased growth volatility. Since financial system development in Thailand should cause economy to be less volatile and decrease the probability of crisis, its volatility might magnify the impact of real shocks to the economy, and thereafter amplify the impact on growth volatility.

In addition, we also observe that volatility related to the monetary authority is significantly associated to higher growth volatility. Fluctuation of Bank of Thailand's asset might indicate the constraint under which the financial authority must operate. It is more assessing to activities and performances of the economic well-being.

6. Conclusion

Even though Thailand faced a number of past shocks, e.g. the hikes of oil price and commodity price, she was able to achieve a positive growth of 4.5-5 percent during 1970-1990. Like other countries, Thailand has undergone several economic shocks transmitted from outside the country. A reasonable degree of macroeconomic stability in many critical aspects was implemented during that period. Macroeconomic stability can be attributed to sound macroeconomic management in both fiscal and monetary policies. However, some shocks also benefited the country's economic well being because brought about tremendous change to the economic structure.

A time-series econometrics is examined to investigate the causal links of financial instability and different sources of volatility to macroeconomic instability and probability of economic downturn. The estimated results show that financial instability and probability of banking crisis are relatively more determined from the volatility in trade openness, and less determined from the price related volatility. In addition, variables related to financial system development seem to be crucial factors in maintaining the stability of the financial sector. However, the banking crisis is relatively more determined from the volatility in trade openness and variability of development in the domestic financial sector. The volatility causing instability to the financial sector and the banking crisis are trade openness volatility, volatility of financial depth, and volatility of net foreign asset. Financial system development and enlarging capital market capitalization also help reduce the probability of the crisis.

In regards to growth volatility, the method of two-stage least square (2SLS) is adopted to treat the effect of simultaneously relationship between financial volatility, growth volatility, and other sources of volatility. To estimate growth volatility, volatility in financial institution is found to be a factor that causes the economy to be more venerable. Nevertheless, the estimated coefficients also indicate that better financial system development should also help stabilize growth volatility and decrease the probability of economic downturn. In addition, we also conclude that price variability does not have strong effects on growth volatility and economic downturn.

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