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A QUANTITATIVE MODEL OF STABILIZATION POLICIES FOR BANKING CRISIS IN A SMALL OPEN ECONOMY

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Abstract

This study constructs a framework that can account for banking crisis for a small open economy. It then explores how the stabilization policies consisting of 1) tight monetary policy, which was guided by the International Monetary Fund during the Asian Financial Crisis and 2) unconventional monetary policy, which was implemented by the Federal Reserve, find the way out of this unfavorable financial turmoil. This observation also applies to Thailand's economic conditions during 1997-1998 as an example of banking crisis characteristics. The result of this study is consistent to Stigliz (2002) that the tight monetary policy increases borrowing cost and even deteriorates the economy. It also points out that the policymaker is supposed to pacify the banking distress through the unconventional monetary policy rather than the tight monetary policy because it can pacify the severity of the financial crisis.

Key Words : Quantitative Model, Stabilization Policy, Banking Crisis

1. Introduction

A bank is an institution whose current operations consist of granting loans and receiving deposits from the public. (Freixas and Rochel, 1997) In other words, a bank has a role in financial intermediation. An agent who needs funds borrows from a bank, while an agent who wants to save to insure for consumption tomorrow makes deposits to a bank. This channel allows these 3 agents better off: The borrower gets funds to make investment on his project; the depositor can get more returns from making deposits at the bank; the bank also acquires benefits from operating through this procedure. For the case of emerging economies, a source of external finance is not just only domestic deposit, but it also includes international capital

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flows from foreign lenders. Fluctuations in foreign lenders' decision result dramatically in bank's decisions on sources of financing.

Reinhart and Rogoff (2009) define the term "Banking Crises" as bank runs or the closure, merging, takeover, or large-scale government assistance of an important financial institution. This model is consistent to the definition in an aspect of the existence of financial support from the central bank when financial distress starts. In particular, financial turmoil in a small open economy is characterized as the rise of panic of lenders. During the crisis period, lenders feel anxious and force banks to reduce their loans. Therefore, the borrowers cannot get funds to finance their projects. This unsatisfying consequence transmits from financial intermediary sector to real sector. As a result, the entire economy incurs the shortage of liquidity and the financial crisis.

Thailand featuring a characteristic of a small open economy encountered banking crisis. Fifteen years ago, a dramatic financial turmoil led to significant contraction in economic activity. In 1997, the source of contagion first originated in Thailand. Deterioration of macroeconomic conditions, such as current account deficits, and bad financial status, such as bank failure, resulted in the rising anxiety of the foreign investor. Although most well-known event is Currency Crisis according to the relinquishment of the pegged exchange rate subsequently led to capital outflows, the many closures in financial institutions were commonly recognized characteristics as well. Such bad financial conditions can be considered as a type of banking crises.

Stabilization policies are important keys that possibly lead the economy out of the financial turmoil. Regarding Thailand financial crisis in 1997, the International Monetary Fund or IMF offered the Thai government loans by trading for a so-called austerity program, which consists of fiscal spending cut, financial reform and tight monetary policy. In particular, the tight monetary policy was announced to entice more capital inflows. Nevertheless, in doing so, several economists argue that the tight monetary policy might not be an appropriate stabilization policy for financial insolvency in banking industry. Stiglitz (2002) criticizes about the IMF policy that it is too strict and can worsen the crisis through higher borrowing cost for distressed financial institutions. As for efficiency of exchange stability, Ohno, Shirono and Sisli (1999) argue that the high interest rate can help to stabilize the exchange rate just in the beginning of the crisis. If the situation worsens, this tight monetary policy immediately loses its

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power to pacify the crisis. Moreover, they also draw the conclusion that the subsequent recovery of stability is a regional phenomenon. However, of course, IMF proponents do not seem to agree with those opponents' results. Basurto and Ghosh (2000) argue that the tight monetary policy helps to appreciate the exchange rate during the distressed period.

Ten years later, the world once again faced a tremendous threat. Financial distress in financial intermediaries harmed US economy and the rest of the world. The US policymaker had to relieve this effect by coming up with the special resolution, which is so-called unconventional monetary policy. The Federal Reserve or the Fed acted as a major role to support the financial intermediaries through buying a lot of assets. One advantage of this support is that the Fed was not subject to the financial constraint. Finally, this policy can help recover the economy without urging for external supports.

As mentioned, it is obvious that some characteristics of two past economic disasters were somewhat different. Because of different conditions of rising crisis and different natures of the economies, the outcomes were slightly distinguished. Nevertheless, both of them shared an essential component of banking crises that was a process of depreciation of asset prices consistent to financial intermediary's net worth. In US crisis, the Fed implemented the unconventional policy in order to moderate the decline in asset prices. After implementing, the Fed's resolutions yielded satisfied outcomes. In other words, it was able to suppress the unstable economic indicators back to favorable status. While, for Thailand, although sudden capital outflows is the reason that the IMF encouraged the monetary authorities in trouble Asian countries, including Thailand, to increase interest rate to attract capital inflows and increase deposits in financial intermediaries, the tight monetary policy begets financial distress in banking industry.

Because of similarity to the US economy in an important characteristic which is the distress in financial intermediaries or Banking Crisis, the instability of the Thai economy should be at least moderated or at most back to the normal conditions if the authority implemented the unconventional monetary policy. In other words, here comes to the question "What was the best resolution that the monetary authority should respond to?" In other words, if a created model conforms to economic conditions as in the Asian crisis, either the tight monetary policy or the unconventional monetary policy, what is the policy that provides the most satisfying outcomes to the economy?

Most of all, the ordinary objective of this research is to construct a macroeconomic crisis framework that not only possibly accounts for the banking crisis for a small open economy but also test two stabilization policies on banking crisis conditions. Particularly, testing with the case of Thai financial crisis during 1997 to 1998 is the cascaded objective on the purpose of testing the macroeconomic indicators whether they are consistent to the realistic conditions and how the stabilization policies can subside the economic turbulence.

Basically, the amplification of the effect originates in financial intermediaries. After that, it generally transmits to the real sector and then pervades a whole country and adjacent regions. However, the latest US financial crisis framework can be partially applied to the Thai financial crisis by applying Gertler and Karadi (2011) in terms of the unconventional monetary policy during the crisis. This paper also adapts Steffen (2011), which contains the basic real business cycle framework of small open economy with financial intermediaries. The artificial economy is able to be constructed and calibrated under different resolutions as mentioned earlier.

2. Literature Review

Realization of the past banking crises involves with many losses not just only in the financial intermediary sector, but also covers the real sector. In particular, it is monstrous to let unfavorable outcomes happen. To cross over prejudicial results, many papers have been created to ransack the optimal way to response to them. A lot of studies of crises have been conducted for many years regarding either theoretical or empirical research. Most of the research concentrates on the financial crisis rather than the banking crisis. Such works bring about research extensively in both horizontal and vertical aspects. Some of them try to account for historical patterns of the crisis. In particular, predictable sequences of essential events after the crises start highly call for. Also, many studies experiment on various stabilization policies in defending against undesirable fortune.

In order to create a model to capture the behavior of financial institutions during the crisis in a small open economy, many literature provide a lot of useful information and insightful concepts to build such an artificial economy. Additionally, related literature in the Thai financial crisis and the U.S. government policy after the Subprime mortgage crisis is very helpful to provide concepts and facts to create the stabilization policies for the banking crisis. In

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particular, they share necessary features to establish a Thailand-based crisis model, which consists of 1) a small open economy, 2) unconventional monetary policy and 3) the Asian financial crisis. Nevertheless, the arguments about the tight monetary policy are highly important to be revised first because it utmost lays the research questions on this study.

2.1 Dispute in Tight Monetary Policy

Tobin (1998) criticizes about IMF's bailout on the Asian countries. The austere fiscal and monetary policy could not retrieve market confidence and also result in deep recession. Ohno, Shirono and Sisli (1999) argue that the high interest rate can help the exchange rate stabilize just in the beginning of the crisis. If the situation worsens, this tight monetary policy immediately loses its power to pacify the crisis. Moreover, they also draw conclusion that the subsequent recovery of stability is a regional phenomenon. Stiglitz (2002) also disagree with the tight monetary policy. He claims that the IMF policy is too strict and can worsen the crisis through the higher borrowing cost. Nonetheless, of course, IMF proponents do not seem to agree with those opponents' opinions. Basurto and Ghosh (2000) argue that the tight monetary policy helps the exchange rate appreciate during the distress period and then can attract more capital inflows.

2.2 A Small Open Economy

A small open economy is another essential characteristic of Thai economy. Because of being such an economy, a macroeconomic model for Thailand is necessary to not only account for domestic activities but also covers international features as well. To study impacts of distress of financial institutions in a small open economy, a structure needs to be consistent to the original purpose.

Mendoza (1991) provides a baseline model to study real business cycles under a small open economy. This model is able to account for Canadian stylized facts properly. Schmitt-Grohe and Uribe (2003) applies Mendoza (1991) to establish a small open economy with incomplete assets. This setting is very useful to help induce stationarity in order to close a small open economy. Another recent paper is Steffen (2011). This paper is rather interesting in terms of incorporating financial intermediaries into the feature of a small open economy. This arrangement aids the study to capture the relationship between the government policy and the

role of financial institution. Additionally, it assumes a shock to trigger the crisis, namely, the anxiety of the foreign investor. According to Fostel and Geanakoplos (2008), the realization of an anxious investor is sensitive to the global distress. If the investor receives the unfavorable information about the crisis, the investor will need the bank to reduce its leverage ratio. In other words, the bank is supposed to increase its net worth or reduces liabilities or assets.

2.3 U.S. Financial Crisis in 2007

During the U.S. financial crisis, many papers engineer the turmoil in many different situations. As for banking crisis, one of many reasons leading to the distrusted behavior amongst banks was financial health. In particular, during the crisis, the interbank market which was considerably large in U.S. was under distress. A bank which lacked of financial funds had to find sources of finance. But in a period of turmoil, none dared to supply funds because of many existences of uncertainties. Therefore, banks with scantiness cannot get enough required funds. Lost trustiness between banks resulted in banking crisis.

Gertler and Kiyotaki (2010) create a Dynamic Stochastic General Equilibrium model (DSGE) in order to account for the trouble in the interbank market. Specifically, there are two types of banks which consist of 1) banks with excessive funds and 2) banks with lag funds. As in the real situation, banks with abundant funds hesitated to lend to trouble banks with insufficient funds. Moreover, the authors also integrate unconventional policies that the Fed and Department of the Treasury worked together during that time to mitigate unfavorable consequences. Another attempt to create a model with financial frictions during 2007 financial crisis is belonged to Brunnermeier and Sannikov (2011). Instead of formulating a conventional DSGE in theoretical work, they generate a nonlinear model with a full equilibrium dynamics with a continuous time method.

2.4 Unconventional Monetary Policy

Unconventional monetary policy was on spot after the Fed's announcement in order to relieve credit crunch distress. The Fed bought some trouble assets from the trouble banks. Banks exchanged these assets with the equivalent banks' reserves in the central bank. Banks still held these reserves in the central bank because banks can get the interest rate from holding without doing anything and the Fed will not default certainly. Banks will use these

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reserves to increase amount of loans in the future. Increasing loans will induce increasing deposits since the household borrowers must deposit loans that they received into the bank's account. This process will increase money supply indirectly.

Related papers that clarify for the unconventional monetary policy are Gertler and Karadi (2011), and Gertler, Kiyotaki and Queralto (2011). Gertler and Karadi (2011) provide the canonical model for the unconventional policy and calibrate the model to verify the effectiveness of the policy. Also, the zero-lower-bound interest is taken into account to capture the Fed fund rate monetary policy at this time. Both papers yield remarkable results that the unconventional monetary policy helps the economy stabilize during the crisis period.

2.5 Asian Financial Crisis and Thai Economy

A lot of literature provides insightful models in terms of clarification of the Asian financial Crisis, which is also known as the Currency crisis. In particular, the main problem of this crisis results from the exchange rate volatility. The rapid depreciation of the exchange rate led to the unexpected increase in foreign debts. As a result, balance sheets of firms and financial institutions carried larger amount of debts became susceptible to unsatisfied economic conditions. Gertler, Gichrist and Natalucci (2007) develop a model to analyze the role of exchange rate regime by focusing on quantitative results. In particular, their experiment examines how well the model fits to the real data during the crisis period.

Most DSGE-type models to account for Thai economy are widely used in the Bank of Thailand. Especially, a paper provides a small open economy with financial frictions is Tanboon, Piamchol, Ruenbanterng and Pongpaichet (2009). It integrates price stickiness, which is the key attribute of the New Keynesian, with the balance sheet relationship. Especially, this DSGE model adds the balance sheet constraint into firm sector. This characteristic distinguishes this study from the most well-known paper in the balance sheet effect, Bernanke, Gertler and Gilchrist (1999). The latter allows the balance sheet effect on just an agent namely "Entrepreneur", who has roles to manage production and obtain funds for financing in the production process. This entrepreneur's idea can be considered as a firm-bank combination. However, the former separates this integration to help us understand behaviors of each agent even better.

2.6 Summary

This paper sets up a similar model to Steffen (2011). The reason of this setting is to concentrate on a role of financial intermediation on banking crisis in a small open economy. Furthermore, this model follows Fostel and Geanakoplos (2008) that the crisis is triggered by the rise of lenders' anxiety. In terms of stabilization policies, this study applies 2 remarkable resolutions to find out what policies are appropriate to response to this kind of crisis and stabilize the economy. The tight monetary policy is the first one that was suggested by IMF in 1997. The tight monetary policy is defined as the increasing high interest rate by the monetary authority. Although there has been existing arguments about its effectiveness, this model still adopts this policy to test on conditions of banking crisis. Moreover, another advantage of this study is an ability to integrate the unconventional monetary policy, which is mostly based on Gertler and Karadi (2011). To help banks increase credit demand, the central bank issues the central bank's bond to get funds, and then uses such funds to buy firm's equities. In doing so, the central bank is not subject to balance sheet constraint while banks are. This policy can be considered as an alternative way to deal with the banking turmoil.

3. Theoretical Framework

In order to establish a quantitative model to be consistent to banking crisis in the case of Thailand, significant characteristics should be taken in account. In particular, a fundamental structure of Thai economy or so-called "Small Open Economy" is available in this model. Also, vital attribute is the role of financial intermediary during the financial crisis. Additionally, the indispensable attributes in this work are stabilization policies for the crisis. In comparison between the IMF's tight monetary policy and the unconventional policy, the policymaker's instrument constraints should be added in the policymaker' decision functions.

Regarding the first stabilization policy, on the one hand, the tight monetary policy that this paper wants to capture is the increase in the domestic interest rate during that time as a purpose of attracting foreign capital inflows to boost up financial confidence. On the other hand, the increase in interest rate helps the financial intermediaries accumulate deposits rapidly. Furthermore, the purpose to integrate the second stabilization policy; the unconventional monetary policy; is to observe an effect of this extraordinary implementation whether it works significantly to mitigate the turbulence of the economy.

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In order to establish a model that is satisfied the objective of the study, this model gathers such aforementioned necessary characteristics from previous works. Mostly, it relates to Steffen (2011) in terms of a small open economy model with a financial intermediary sector. It is very helpful to build a model based on Thailand's economy. Also, settings of the unconventional monetary policy follow Gertler and Karadi (2011), which the central bank supports the firms by increasing demand for assets.[2]

3.1 Households

In this model, a continuum of identical households lives in measure unity. Each of them can consume, save, borrow foreign debts, and work. As for saving, it is like that households lend to financial intermediaries, and the central bank in the case that the authority issues riskless bonds. As in a standard model, households gain more utility from consumption c_t and less from work l_t. Let γ be a degree of risk aversion; ω be an elasticity of labor supply. So, household preferences are given by following equation.

$$u(c_t, l_t) = \frac{(c_t - \omega^{-1} l_t^{\omega})^{1-\gamma} - 1}{1-\gamma} \tag{3.1}$$

Households consist of 2 types of agents: workers and bankers as fractions $1-f$ and f respectively. Workers supply labor and return wages to households. They also save as a form of risk-free bonds, which consist of saving bonds and central bank bonds, and borrow foreign debts from foreign lenders in the international financial market. A friction of foreign borrowing represents as a portfolio adjustment cost, as in Schmitt-Grohe and Uribe (2002). For saving, households will hold the central bank bonds if the central bank decides to implement the unconventional monetary policy. Bankers operate financial intermediaries.

Every period bankers face a probability $1-\theta$ to become workers. If bankers become workers, they will transfer their current wealth to their belonged households. In the meantime, workers also turn into bankers simultaneously. Also, workers transfer a fraction of their wealth to be start-up funds for new bankers. The purpose of this setup is to enforce bankers not to arrive the point that they can finance themselves through their own net worth.

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[2] The final results can be acquired through numerical method. I construct a system of linear rational expectation equations and then apply Christopher A. Sims' algorithm GENSYS to solve for policy functions.

I let w_t be the real wage, R_t^f be the gross domestic risk-free interest rate from $t-1$ to t, R_t be the gross foreign interest rate at the same duration as R_t^f, d_{t+1}^H be the foreign debts that were borrowed by households by period t and will be paid back foreign investors at the gross level by period $t+1$, b_{t+1} be the risk-free bonds that households save at period t and will get as incomes by period $t+1$, and Π_t be the transfers. The household budget constraint is shown as the following equation.

$$d_{t+1}^H + R_t^f b_t + w_t l_t + \Pi_t + T_t = R_t d_t^H + b_{t+1} + c_t + \Psi(d_{t+1}^H - \bar{d}^H) \tag{3.2}$$

Meaning of this constraint is that each period households select to consume c_t, save at the total quantity b_{t+1}, borrow foreign debts at the amount d_{t+1}^H and work l_t hours under their net current wealth, which consists of the labor incomes $w_t l_t$, the net distributions from ownership of banks and capital producers Π_t, transfers from the central bank in operating bond market T_t, the total return from savings $R_t^f b_t$ from holding bonds, net the total debts from the foreign borrowing $R_t d_t^H$ and cost from adjusting level of debts $\Psi(d_{t+1}^H - \bar{d}^H) = \frac{\psi^d}{2}(d_{t+1}^H - \bar{d}^H)^2$, where ψ^d is the coefficient of the adjustment.

A representative household problem is to maximize his expected lifetime utility (3.1) under his budget constraint (3.2).

$$\max \sum_{t=0}^{\infty} \beta^t [\frac{(c_t - \omega^{-1} l_t^{\omega})^{1-\gamma} - 1}{1-\gamma}]$$

subject to $d_{t+1}^H + R_t^f b_t + w_t l_t + \Pi_t + T_t = R_t d_t^H + b_{t+1} + c_t + \Psi(d_{t+1}^H - \bar{d}^H)$.

Therefore, the Lagrangian for this maximization problem is given by

$$L = \sum_{t=0}^{\infty} \beta^t \{[\frac{(c_t - \omega^{-1} l_t^{\omega})^{1-\gamma} - 1}{1-\gamma}] + \lambda_{Lt}(d_{t+1}^H + R_t^f b_t + w_t l_t + \Pi_t + T_t - R_t d_t^H - b_{t+1} - c_t - \Psi(d_{t+1}^H - \bar{d}^H))\} \tag{3.3}$$

where λ_{Lt} is the shadow price and β is the discount factor.

First order conditions are shown as consumption decision, labor supply decision, savings decision and foreign debts decision.

A representative household chooses a level of consumption to maximize his utility $(\partial L / \partial c_t = 0)$ as the following equation.

$$(c_t - \omega^{-1} l_t^{\omega})^{-\gamma} = \lambda_t \tag{3.4}$$

The interpretation of both equations (3.4) is the cost-benefit relationship. That is, the marginal cost from reducing expected utility of consuming one unit of consumption is equal to the marginal benefit from gaining more utility of income.

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He also chooses to work and trade off between consumption and labor to maximize his utility $(\partial L / \partial l_t = 0)$ as the following equation.

$$(c_t - \omega^{-1} l_t^{\omega})^{-\gamma} (l_t^{\omega-1}) = \lambda_t w_t \quad (3.5)$$

The marginal cost from reducing consumption today to supply more hours worked is equal to the marginal benefit from increasing wealth to consume more.

He chooses to save as risk-free bonds maximize his utility $(\partial L / \partial b_{t+1} = 0)$ as the following equation.

$$\lambda_t = \beta E_t \lambda_{t+1} (R_{t+1}^f) \quad (3.6)$$

The marginal cost from reducing consumption and making deposits today is equal to the marginal benefit from getting more the gross bank savings to consume more in the next period.

He chooses to borrow foreign debts maximize his utility $(\partial L / \partial d_{t+1}^H = 0)$ as the following equation.

$$\lambda_t (1 - \Psi'(d_{t+1}^H - \bar{d}^H)) = \beta \lambda_{t+1} (R_{t+1}) \quad (3.7)$$

The marginal benefit from borrowing more foreign debts, which is deducted by the deviation of debts from steady state, to consume today is equal to the marginal cost from repaying gross foreign debts tomorrow.

After combining (3.4) and (3.5), the new equation shows a relationship between real wage and labor. It can be illustrated as the following equation.

$$l_t^{\omega-1} = w_t \quad (3.8)$$

The above equation represents the labor supply curve. The marginal substitution of leisure for consumption is equal to the real wage.

After combining (3.4) and (3.7), the new equation can be shown as

$$1 - \Psi'(d_{t+1}^H - \bar{d}^H) = \beta E[\Lambda_{t,t+1} (R_{t+1})] \quad (3.9)$$

where $$\Lambda_{t,t+1} = \frac{(c_{t+1} - \omega^{-1} l_{t+1}^{\omega})^{-\gamma}}{(c_t - \omega^{-1} l_t^{\omega})^{-\gamma}}. \quad (3.10)$$

From the equation (3.9), if household chooses to borrow an additional unit of foreign debt, then the marginal benefit of a unit foreign debt is equal to marginal cost to pay it back in the future. The variable $\Lambda_{t,t+1}$ is the marginal rate of substitution of consumption or so-called the stochastic discount factor.

After combining (3.4) and (3.6), the new equation can be shown as the following

$$1 = \beta E_t [\Lambda_{t,t+1} R_{t+1}^f]. \quad (3.11)$$

Equation (3.11) implies that if household chooses to reduce consumption today and save in a form of a unit of risk-free bond, then he receives gross return to increase consumption tomorrow.

3.2 Banks

Banks which are operated by bankers act as financial intermediaries. They acquire funds from foreign borrowing and households' deposits, and purchase firms' equities. Such purchasing can be considered as a form of financing. This setting is somewhat different from Steffen (2011) and Gertler and Karadi (2011). For the former, a model allows banks to borrow foreign debts as liabilities. The latter permits banks to obtain deposits from households. In this model, banks can either borrow foreign debts or get saving bonds to purchase firms' equities. The reason of this combination is to observe behaviors of financial intermediaries in regard of relationship between the unconventional monetary policy and foreign behavior.

The term j represents bank j. For simplicity, bank j is separated as 2 subunits: liability unit and operating unit. Liability unit acquires two sources of funding from deposits and foreign lender and then sells them as liabilities to the operating unit. The operating unit acts as a role of general bank. It uses liabilities to expand its balance sheet through obtaining firms' equities.

Regarding the liability unit, it obtains deposits b_{jt+1} with risk-free interest rate R_t^f and foreign debt d_{jt}^B with foreign interest rate R_{jt}. It then sells liabilities L_{jt} with return on liabilities R_{Lt} to the operating unit. However, in obtaining deposits and foreign debt, the liability unit faces the convex adjustment cost $\frac{\psi^l}{2}(\frac{d_{jt}^B}{L_{jt}}-\nu^l)^2$. ν^l is the desired level of ratio of foreign debt to liabilities. If the liability unit restructures levels of deposits or foreign debt, it costs at the adjustment cost. Purposes of introducing of this friction are to set different 1) wedge between return on liabilities and foreign interest rate and 2) wedge between return on liabilities and risk-free interest rate.

The liability unit maximizes profit as the following

$$\max_{d_{t+1}^B, b_{jt+1}} E_t \sum_{i=0}^{\infty} \beta^i \Lambda_{t,t+i}(R_{Lt}L_{jt} - R_t d_{jt}^B - R_t^f b_{jt} + b_{jt+1} + d_{jt+1}^B - L_{jt+1} - \frac{\psi^l}{2}(\frac{d_{jt}^B}{L_{jt}}-\nu^l)^2) \quad (3.12)$$

subject to $L_{jt} = b_{jt} + d_{jt}^B$. (3.13)

First order conditions are shown as foreign debts decision and saving bonds decision.

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Liability unit chooses to borrow foreign debts to maximize his objective. It can be shown as the following equation.

$$R_{Lt+1} - R_{t+1} = \psi^{l}\left(\frac{d^{B}_{jt+1}}{L_{jt+1}} - \nu\right)\frac{b_{jt+1}}{(L_{jt+1})^{2}} \tag{3.14}$$

In addition, liability unit also chooses to obtain saving bonds to maximize his objective. It can be shown as the following equation.

$$R_{Lt+1} - R^{f}_{t+1} = -\psi^{l}\left(\frac{d^{B}_{jt+1}}{L_{jt+1}} - \nu\right)\frac{d^{B}_{jt+1}}{(L_{jt+1})^{2}} \tag{3.15}$$

I rearrange equations. The equation (3.14) is divided by the equation (3.15). The result can be shown as the following equation.

$$\frac{R_{Lt+1} - R_{t+1}}{R_{Lt+1} - R^{f}_{t+1}} = \frac{b_{jt+1}}{-d^{B}_{jt+1}} \tag{3.16}$$

Second I rearrange the equation (3.16). Then the result can be shown as the following equation.

$$R_{Lt+1} = R_{t+1}\frac{d^{B}_{jt+1}}{L_{jt+1}} + R^{f}_{t+1}\frac{b_{jt+1}}{L_{jt+1}} \tag{3.17}$$

The implication of the above equation is that the return on liabilities is the combination of weighted average of interest rates.

Domestic interest rate relates to borrowing cost. On the one hand, increased interest rate attracts households to hold more saving bonds. On the other hand, banks have to bear the burden from increase in cost of funding saving bonds. This model allows banks can decide the amount of how much saving bonds bank can take. Additionally, if cost of saving bonds is higher than cost of borrowing foreign debts, banks would rather borrow foreign debts. This implies the negative relationship between risk-free interest rate and saving bonds. This condition can be set through Proposition 1.

Proposition 1*: Risk-free interest rate* R^{f}_{t+1} *increases and saving bonds* b_{jt+1} *decreases if and only if* $\frac{\nu^{l}}{2} - \frac{d^{B}_{t+1}}{L_{t+1}} < 0$.

Operating unit receives liabilities from the liability unit. It uses liability as source of funding to purchase firms' equities, which are considered as assets. Let q_t be the equity price; s_t be the amount of equities that the operating unit chooses to invest. Liabilities L_{jt+1}, which

comprise of foreign debts d^{B}_{jt+1} and saving bonds b_{jt+1}, are obtained from the liability unit. The rest is the net assets of the bank or so-called net worth n_{jt}. This relationship is shown as equation (3.18).

$$q_t s_{jt} = n_{jt} + L_{jt+1} \tag{3.18}$$

Balance sheet relationship in the equation (3.18) is a constraint for the bank at time t. However, from period $t-1$ to period t, there is a dynamic relationship due to the banker's operation in this enterprise. I let R_{kt} be the gross rate of return on a unit of firm's equities, so net worth in period $t+1$ is equal to the last-period difference between the gross earnings from holding assets net gross liabilities, which is given by

$$n_{jt+1} = R_{kt+1} q_t s_{jt} - R_{Lt+1} L_{t+1}. \tag{3.19}$$

After combining (3.18) and (3.19), the new equation is shown as following

$$n_{jt+1} = (R_{kt+1} - R_{Lt+1}) q_t s_{jt} + R_{Lt+1} n_{jt}. \tag{3.20}$$

Implication of (3.20) is that growth of net worth depends on lending premium $R_{kt+1} - R_{Lt+1}$ and total value of assets $q_t s_{jt}$. This is similar to the situation if the operating unit receives payment on its shares ($R_{kt+1} q_t s_{jt}$), then it repays on its liabilities ($R_{Lt+1} L_{jt+1}$). In other words, the operating unit obtains liabilities to finance a firm if lending premium is greater than or equal to zero all the time. $\beta^i \Lambda_{t,t+i}$ is a discount for a banker at period t applies to earnings at period $t+i$ where $i \geq 0$, so the relationship can be shown as the following equation.

$$E_{t+i} \beta^i \Lambda_{t,t+1+i} (R_{kt+1+i} - R_{Lt+1+i}) \geq 0 \tag{3.21}$$

As mentioned in households, at the end of each period, a banker retires from working at the bank and turning into a worker with probability $1-\theta$. Therefore, the objective of a banker is to maximize the lifetime value of the bank, which is given by the following equation.

$$V_{jt} = \max_{\{s_{jt}\}} E_t \sum_{i=0}^{\infty} (1-\theta) \theta^i \beta^{i+1} \Lambda_{t,t+1+i} n_{jt+1+i} \tag{3.22}$$

Intuitively, the net worth of a bank can be considered as the wealth of a banker. The net present value or the value of the banker's wealth at period t is equal to the sum of the discount banker's wealth from period $t+1, t+2, \ldots$ until the last period that the banker retires.

To feature a trigger of crisis in the model, a problem between foreign lenders and bankers is attached as a constraint. At the beginning of period t, a banker has an incentive to divert (e.g. pay out a large bonus and dividend) a fraction λ_t of assets $q_t s_{jt}$, and transfer them back to households of which he is a member. If they extend this fraction of asset over a bank's

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present value, foreign lenders will force a bank into bankruptcy. A banker will certainly lose his ownership on this bank as well.

Therefore, $\lambda_t q_t s_{jt}$ can be considered as a total benefit from extending a level of holding firms' equities. Cost in doing so is the bank's present value V_{jt} that foreign lenders can force a bank into bankruptcy if he does not follow the cost benefit relationship constraint $V_{jt} \geq \lambda_t q_t s_{jt}$.[3] However, a banker decides a level of benefit from holding firms' equities until the constraint above is binding as the following equation.

$$V_{jt} = \lambda_t q_t s_{jt} \tag{3.23}$$

Regarding a crisis generator, in the model foreign investors do not trust in banker's behavior. During the crisis period, anxiety of foreign investors rises and they want a banker to reduce a level of holding firms' equities. Such a setting can be represented by increasing λ_t. If λ_t increases, a banker holds a lower level of firm's equities and also satisfies cost-benefit condition as the equation (3.23).

In contrast, if the foreign investors feel optimistic on the economy, anxiety of foreign investors, which is also represented by λ_t, decreases. A banker holds a higher level of firm's equities.

To solve for bank's maximization problem, this model applies a guess and verify method. The solution of this method can be shown as Proposition 2.

Proposition 2*: The solution of the banks can be determined by*

$$V_{jt} = \upsilon_t q_t s_{jt} + \eta_t n_{jt} \tag{3.24}$$

where

$$\upsilon_t = (1-\theta)\beta\Lambda_{t,t+1}(R_{kt+1} - R_{Lt+1}) + \beta\Lambda_{t,t+1}\theta\frac{q_{t+1}s_{t+1}}{q_t s_t}\upsilon_{t+1} \tag{3.25}$$

$$\eta_t = (1-\theta)\beta\Lambda_{t,t+1}R_{Lt+1} + \beta\Lambda_{t,t+1}\theta\frac{n_{t+1}}{n_t}\eta_{t+1}. \tag{3.26}$$

The term υ_t is the marginal gain of holding firms' equities. The term η_{t+1} is the marginal return from adding additional unit of n_{jt}.

After combining between (3.23) and (3.24), the new equation can be shown as the following

$$\upsilon_t q_t s_{jt} + \eta_t n_{jt} = \lambda_t q_t s_{jt}.$$

---

[3] If a bank does not commit to this constraint, foreign investors will not lend funds earlier.

The above equation can be aggregated for all j firms, which then can be determined by the following arrangement.

$$\upsilon_t q_t s_t + \eta_t n_t = \lambda_t q_t s_t$$

$$\upsilon_t \frac{q_t s_t}{n_t} + \eta_t = \lambda_t \frac{q_t s_t}{n_t}$$

$$\upsilon_t \frac{q_t s_t}{n_t} + \eta_t = \lambda_t \frac{q_t s_t}{n_t}$$

$$\eta_t = (\lambda_t - \upsilon_t) \frac{q_t s_t}{n_t}$$

$$(\lambda_t - \upsilon_t) \frac{q_t s_t}{n_t} = \eta_t$$

$$\frac{q_t s_t}{n_t} = \frac{\eta_t}{\lambda_t - \upsilon_t} \tag{3.37}$$

I let ϕ_t be a leverage ratio. Then the equation (3.27) turns into the following equation.

$$\phi_t = \frac{q_t s_t}{n_t} \tag{3.28}$$

The total net worth of banks in period t consists of the existing banks' net worth and the entering banks' net worth. The value of existing banks' net worth is equal to the following equation.

$$n_{et} = \theta[(R_{kt} - R_{Lt}) q_{t-1} s_{t-1} + R_{Lt} n_{t-1}] \tag{3.29}$$

Regarding entering banks, households transfer a fraction of their wealth for new bankers, which is equal to $\xi/(1-\theta)$ of value of assets $(1-\theta) q_{t-1} s_{t-1}$ that exiting bankers had intermediated in their final operating period. Therefore, the value of entering banks' net worth is equal to the following equation.

$$n_{nt} = \xi q_{t-1} s_{t-1} \tag{3.30}$$

Total banks' net worth is the sum of both types, which is equal to the following equation.

$$n_t = \theta[(R_{kt} - R_{Lt}) q_{t-1} s_{t-1} + R_{Lt} n_{t-1}] + \xi q_{t-1} s_{t-1} \tag{3.31}$$

3.3 Firms

There are a lot of firms in the competitive economy. They produce the final output by using capital, labor and production technology as inputs. The firm's constant return to scale production function can be shown as following

$$y_t = z_t k_t^{\alpha} l_t^{1-\alpha} \tag{3.32}$$

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where y_t is the output, z_t is a technology factor, k_t is the capital, and l_t is the worked hours. α represents a share of capital on output.

As for capital acquisition, firms have to plan one period ahead. Firms obtain capital k_{t+1} at the end of period t and use it to produce output for the next period. In doing so, firms issue equities and trade with banks. Banks get s_t equities and pay as a form of funds. Firms use such funds to purchase capital k_{t+1} from the capital producers. For the next period, since banks hold equities, firms are obliged to pay gross return R_{kt} from holding last period equities to banks. The price of a unit of capital is given by q_t. Therefore, the relationship between capital and equities is given by the following equation.

$$q_t s_{jt} = q_t k_{t+1} \tag{3.33}$$

Apart from purchasing capital from capital producers, firms also sells capital after depreciation to them at the same price of a unit $(1-\delta)k_t$ of capital.

Therefore, the firm's profit maximization problem is given by

$$\max_{l_t,k_t} E_t \sum_{i=0}^{\infty} \beta^i \Lambda_{t,t+i}[y_t - R_{kt} q_{t-1} s_{jt-1} - w_t l_t + q_t(1-\delta)k_t] \tag{3.34}$$

subject to (3.32).

First order conditions are given by labor decision and capital decision.

The first decision is that firms choose to hire labor to maximize their objective. It can be shown as the following equation.

$$(1-\alpha)\frac{y_t}{l_t} = w_t \tag{3.35}$$

This equation can be considered as labor demand. Firms will hire labor at the real wage that provides an equivalent marginal product of labor.

The second decision is that firms choose to acquire capital to maximize their objective. It can be shown as the following equation.

$$R_{kt} = \frac{\alpha \frac{y_t}{k_t} + (1-\delta)q_t}{q_{t-1}} \tag{3.36}$$

Return on equity that firms pay to banks is equal to a ratio of gross revenue at period t to period $t-1$. Gross revenue at period t consists of marginal product of capital and capital after depreciation and the value of capital after depreciation, while gross revenue at period $t-1$ is the value of capital at period $t-1$.

3.4 Capital Producers

As in Bernanke, Gertler and Gilchrist (1999) and Carlstrom and Fuerst (1999), introduction of capital producers is on the purpose of matching price of capital to investment. Mendoza (1991) raises that the capital adjustment costs are typically needed for small open economy model to reduce excessive investment volatility. Therefore, for this model, change in investment level, which is endogenously determined in capital adjustment costs, affects price of capital, vice versa.

At the end of period t, capital producers buy capital after depreciation from firms at price q_t and quantities $(1-\delta)k_t$. They use such quantity and invest at the amount i_t to get capital k_{t+1}. Also, cost to adjust level of investment is equal to $\Phi(\frac{i_t}{k_t})k_t$, which has a form $\Phi(\frac{i_t}{k_t})k_t = [\frac{i_t}{k_t} - \frac{\psi^i}{2}(\frac{i_t}{k_t} - \delta)^2]k_t$. After that, capital producers sell this capital k_{t+1} to firms. As described in firms sector, firms use this capital to produce output in the next period. So, the law of motion of the capital stock is shown as the following equation.

$$k_{t+1} = (1-\delta)k_t + \Phi(\frac{i_t}{k_t})k_t \tag{3.37}$$

Therefore, capital producers' profit maximization problem can be determined through the following

$$\max_{i_t} E_t \sum_{i=0}^{\infty} \beta^i \Lambda_{t,t+i}[q_t k_{t+1} - q_t(1-\delta)k_t - i_t]$$

subject to (3.37).

First order condition is given by investment decision. Capital producers choose to level of investment to maximize their objective. It can be shown as the following equation.

$$q_t = [1 - \psi^i(\frac{i_t}{k_t} - \delta)]^{-1} \tag{3.38}$$

The meaning of equation above is that capital producers will sell capital at price that is equal to cost of adjustment. If investment increases, then price of capital increases, vice versa.

3.5 Central Bank's Stabilization Policies

The central bank can apply two monetary policies. First, this model follows Gertler and Karadi (2011) by allowing the central bank helps banks buy firms' equities to increase asset demand. The central bank will buy firms' equities $q_t s_{gt}$ by issuing the central bank bonds b_{gt} to households. Households obtain these bonds as savings and get risk-free return R^f_{t+1}. I let s_{pt} be the amount of firms' equities held by banks. Therefore, the total amount of firms'

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equities is equal to the sum of equities held by banks and the central bank, which can be shown as the following equation.

$$q_t s_t = q_t s_{pt} + q_t s_{gt} \tag{3.39}$$

However, the central bank intermediates equities as a fraction of total amount of firms' equities. It can be shown as the following

$$q_t s_{gt} = \iota_t q_t s_t \tag{3.40}$$

where $$\iota_t = \iota + \nu_g E_t[(R_{kt+1} - R^f_{t+1}) - (R_k - R^f)]. \tag{3.41}$$

From equation above, in most of the financial distresses especially in the financial institution, an obvious fact is that the gap or the spread of the returns on capital or the return on equity R_{kt+1} and the risk-free rate R^f_{t+1} is wider because of shortage of demand of firms' equities. Therefore, if the spread increases too high, there might signal to the policymaker to take some actions. In such a providing more credit availabilities, the amount of the central bank's support should proportionate to this spread. In this model a criterion that the central supports the stocks of capital bases on the difference between interest rate spread $E_t(R_{kt+1} - R^f_{t+1})$ and its steady state value.

The equation (3.39) can be modified as the following

$$\frac{q_t s_t}{n_t} = \frac{q_t s_{pt}}{n_t} + \frac{q_t s_{gt}}{n_t}. \tag{3.42}$$

The equation (3.42) can be rearranged by plugging (3.40) into it. It turns into the following equation.

$$\frac{q_t s_t}{n_t} = \frac{q_t s_{pt}}{n_t} + \iota_t \frac{q_t s_t}{n_t} \tag{3.43}$$

The term $\frac{q_t s_t}{n_t}$ is defined as the ratio of aggregate assets to the banks' net worth ϕ_{ct}, while $\frac{q_t s_{pt}}{n_t}$ is the ratio of banks' intermediated assets to banks' net worth ϕ_t. So, the equation (3.43) can be also written as the following equation.

$$\phi_{ct} = \phi_t + \iota_t \phi_{ct} \tag{3.44}$$

Second, for the conventional monetary policy, the central bank adjusts interest rate to stabilize inflation. However, for this case of tight monetary policy, as guided by the IMF, the central bank increases interest rate at a high level. Therefore, real risk-free interest rate is adjusted through feedback rule as the following equation.

$$R^f_t = (1 - \rho_{R^f}) R^f + \rho_{R^f} R^f_{t-1} + \varepsilon^{R^f}_t \tag{3.45}$$

3.6 Closing the Model

Exogenous processes for this model consist of 4 variables. The first one is the technology process, follows AR(1).

$$\ln z_t = \rho_z \ln z_{t-1} + \varepsilon_t^z \tag{3.46}$$

Next, as described in the equation (3.23) , the foreign investor shock represents the crisis generator. For this model, this unpredictable event is an AR(1) exogenous variable as well. Let λ be a steady state value of divertible asset. Therefore, a crisis generator follows by

$$\lambda_t = \bar{\lambda}\varpi_t \tag{3.47}$$

where $\ln \varpi_t = \rho_\varpi \ln \varpi_{t-1} + \varepsilon_t^\varpi$. (3.48)

The third exogenous variable is the foreign interest rate. According to being the small open economy, Thailand is likely affected by the world interest rate, which is determined exogenously as following

$$R_t = R\kappa_t \tag{3.49}$$

where $\ln \kappa_t = \rho_\kappa \ln \kappa_{t-1} + \varepsilon_t^\kappa$. (3.50)

The last one is the risk-free interest rate, as in equation (3.40).

$$R_t^f = (1-\rho_{R^f})R^f + \rho_{R^f} R_{t-1}^f + \varepsilon_t^{R^f}$$

Market clearing conditions consists of 2 constraints. The one is an aggregate resource constraint, which can be shown as the following equation.

$$y_t = c_t + \Phi(\cdot)k_t + R_t d_t^H - d_{t+1}^H + R_t d_{jt}^B - d_{jt+1}^B + \Psi(d_{t+1}^H - \bar{d}^H) \tag{3.51}$$

The output for the economy is necessary to be equal to aggregate demand.

The other is the trade balance relationship. For this model, trade balance is similar to the residual from the aggregate demand, which can be shown as the following equation.

$$tb_t = y_t - c_t - \Psi(\cdot) - \Phi(\cdot)k_t \tag{3.52}$$

The central bank has to issue the central bank bond to finance firms' equities. Constraint for the unconventional monetary policy can be determined by the following equation.

$$R_{kt} q_{t-1} s_{gt-1} + b_{gt+1} + T_t = R_t^f b_{gt} + q_t s_{gt} \tag{3.53}$$

At period t, the central bank issues the central bank bonds b_{gt+1} to finance firms' equities $q_t s_{gt}$. In the meantime, the central bank receives gross return from holding firms' equities from last period $R_{kt} q_{t-1} s_{gt-1}$, and commits to pay gross return from holding the central bank bonds $R_t^f b_{gt}$ to households.

Risk-free bond market consists of saving bonds and the central bank bond.

$$b_{t+1} = b_{jt+1} + b_{gt+1} \tag{3.54}$$

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3.7 Equilibrium

This model is defined as a stochastic sequence of 19 allocations, which consist of $[c_t, l_t, d_{t+1}^H, L_{t+1}, s_t, n_t, \eta_t, \upsilon_t, \phi_t, d_{t+1}^B, k_{t+1}, i_t, y_t, tb_t, \lambda_t, \Lambda_{t,t+1}, b_{jt+1}, \phi_{ct}, \iota_t]_{t=0}^{\infty}$, and 5 prices, which consist of $[q_t, w_t, R_{kt}, R_{Lt}, R_t]_{t=0}^{\infty}$. 5 initial conditions given at the beginning consist of $k_0, d_0^H, d_0^B, b_{j0}, L_0$. 4 exogenous processes generating shocks in the model consist of $[z_t, \varpi_t, \kappa_t, R_t^f]_{t=0}^{\infty}$.

Additionally, the amount of allocations and prices need to match with all agents' decisions, which consist of optimal conditions and market clearing conditions. They are summarized as 24 conditions. Each set of them is grouped separately.

3.8 Parameterization

Most of the parameters used in this model are based on Thailand economy during 1997-1998. Most of these parameters follow Queralto (2011) because such paper studies Thailand financial crisis at the same period. Several parameters can be from Steffen (2011).

The first group of parameters is about the preference and production. The capital share of output α is 0.32. The quarterly discount factor β is equal to 0.9690, which is estimated from 13 percent of real interest rate during 1997-1998. The depreciation rate of capital δ is equal to 0.0103, which is calculated from the annual rate of depreciation 4.1 percent during 1997-1998. Risk aversion γ is equal to 2. Elasticity of labor supply ω is equal to 1.455.

The second group is about the real sector. The ratio of households' foreign debt to GDP is set to 0.1 set to force the model be a convergent level. Also, real foreign interest rate is equal to 2.03 percent, which is an approximate value of US interest rate. Frictions in capital adjustment and portfolio adjustment, ψ^i and ψ^d, are equal to 0.028 and 0.00042. These two values are assumed to be very small in order to affect much in the model.

The third group relates to the banks sector. Probability of survival of bankers θ is equal to 0.869. Start-up capital of banks is equal to 0.00016. During the period of the study, the ratio of banks' foreign debts to net worth is equal to 3 for technical reason for an acceptable level of volatility of net worth during the shock.

The last group of parameters relates to the unconventional monetary policy response. The parameter ν_g represents implicit fractions of central intermediation assets for the financial institutions. They vary from 0 to 100. Value 0 represents no credit policy response, while 100 refers to full support from the government.

Table 3.1

Parameters

Parameter	Description	Value
α	Capital share	0.32
β	Discount factor	0.9690
δ	Depreciation rate of capital	0.0103
γ	Risk aversion	2
ω	Elasticity of labor supply	1.455
$\frac{d^H}{y}$	Ratio of households' foreign debt to GDP	0.1
R	Foreign interest rate	1.0203
ψ^i	Capital adjustment coefficient	0.028
ψ^d	Portfolio adjustment coefficient	0.00042
θ	Probability of survival of bankers	0.869
ξ	Start-up capital of banks	0.00016
$\frac{d^B}{n}$	Ratio of banks' foreign debts to net worth	3
ν_g	Fractions of central intermediation assets for the financial institutions	0 to 100

Source: Author's Designation

4. RESULTS

This chapter provides details about crisis experimentation. The beginning is to introduce how the economic indicators respond to the banking crisis generator, which is triggered by the foreign anxiety. It can be also considered as a baseline model to compare to the two stabilization policies. This study explores the effect of the IMF's tight monetary policy. Next, the results of the unconventional monetary policy are shown. Finally, the consequences of the actual and the optional stabilization policies are compared and concluded as the implications of this study.

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4.1 Baseline Model (Crisis Generator)

Regarding a crisis generator of banking crisis or a foreign investors shock, this paper follows Steffen (2011). Anxious investors panic about news and they need banks to increase their current leverage ratios. The mechanism can be explained stepwise. In particular, it can be modeled as an increasing bankers' ability to divert assets. Foreign investors realized that the bankers' incentive to divert assets increases when the crisis occurs. Foreign investors will force bankers to sell the assets or increase net worth.

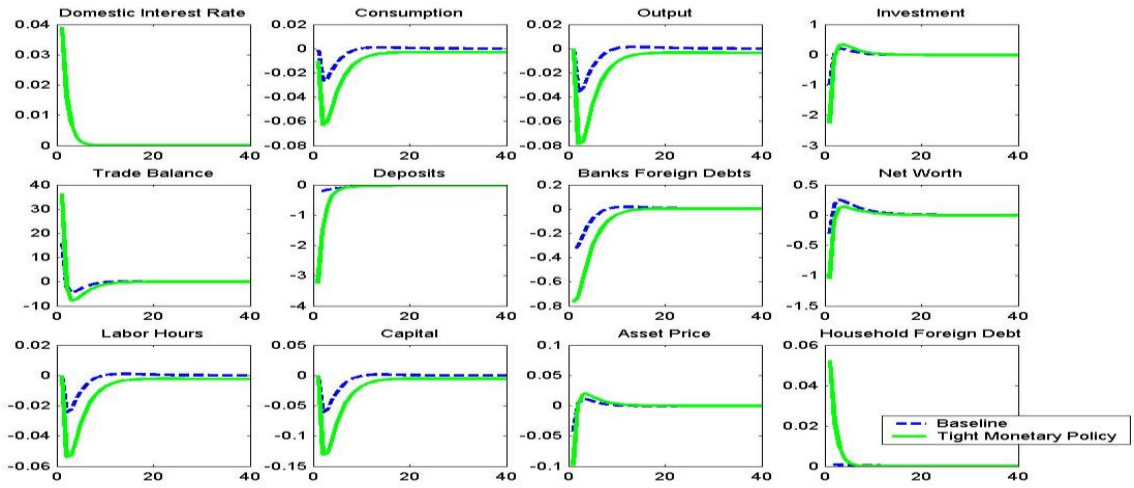
In Figure 4.1, dashed lines show the impulse responses to foreign investors shock. This model allows the rise of foreign investors' panic about 15 percent to grasp the fact that during 1997-1998 Thailand's GDP contracted by about 7.7 percent. At the beginning, after the panic rises, foreign investors force bankers to sell assets and net worth declines immediately. If banks reduce assets, they have to reduce their liabilities as well. Since liability unit encounters adjustment cost for obtaining foreign debts, liability producer makes decision to reduce more foreign debts than deposits. Therefore, foreign debts reduce by 30 percent while deposits decrease just by 20 percent. Since only one source that buys firm's equities is the bank sector, selling assets leads to reduction of demand for assets. In this case, the capital, which also represents for amount of firms' equities, reduces to 6 percent. Also, this reduction of demand for assets puts pressure downward on the asset prices and the return for holding firm's equity. The asset prices decrease by about 4.5 percent. As a result, the capital producers lose incentive to invest, so investment reduces a lot. Therefore, because of a lot of reduction in aggregate demand, the residual, which is the trade balance or the net export, rises up.

For subsequent period, according to the reduction of demand for assets, the return on capital shoots up because of low asset prices in the previous period. The amount of capital that a firm uses for production also reduces. This results in the decline on output and hours worked. Likewise, households foresee that their future incomes reduce according to the reduction of hours worked, so they reduce their consumption.

As for recovery period, the net worth gradually increases. This implies that banks build their net worth to match with leverage ratios that foreign investors require by obtaining deposits. As a result, the demand for assets starts growing and asset prices recover immediately. Investment also increases and back to the steady state. Firms can use capital and hire more labor to produce the output. Household gets more income from working, so they start to consume more.

Figure 4.1

Baseline Model and Tight Monetary Policy



Source: Author's Illustration

4.2 Stabilization Policy 1: Tight Monetary Policy

Also, for Figure 4.1 solid lines illustrate the impulse responses for the case of the tight monetary policy. As for this case, there will be 2 sources to generate shocks to the economy. The first is the degree of panic or the crisis generator. It is configured similarly to the case of baseline model. The second shock is from the domestic interest rate. To match the tight monetary policy for the case of Thailand, the exogenous variable for this fact is under the assumption that the central bank adjusts the interest rate based on feedback rule. In other words, this can be considered as a riskless interest rate shock. In this model, the central bank adjusts the riskless interest rate higher by 3.9%, which is derived from the average change of interest adjustment during June 1997 to March 1998.

According to the crisis shock, the bank is forced to sell the assets and their net worth declines. Also, the reduction of demand for assets leads to decline in asset price. Investment declines as capital producers lose incentive to invest. Trade balance starts shooting up again. Lack of capital lets the firm cannot produce output and hours worked reduce.

However, this case is very special. The tight monetary policy is very helpful in attracting capital inflows because of the difference between the international rate of return and the domestic rate of return. Since the domestic interest rate becomes exogenous and greater

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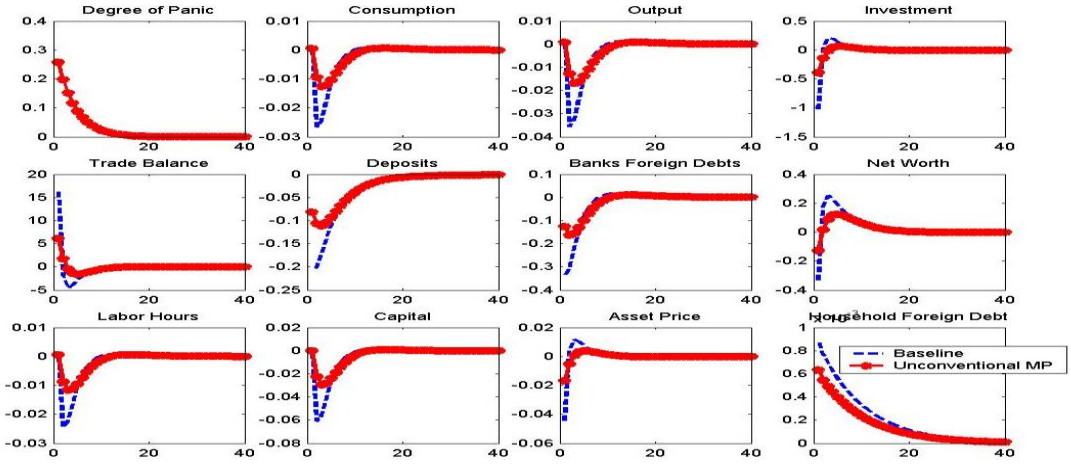
than the foreign interest rate, households make decision to borrow from international capital market to make deposits in the banks.

Nevertheless, domestic interest rate is generally a cost of borrowing for banks. If it is higher, banks have to bear more burdens. Therefore, banks use deposits less than foreign debts for financing their assets. That answers why deposits declines much greater than foreign debts in Figure 5.1 for this case of the tight monetary policy. This stabilization policy even deteriorates liabilities financing. Plunging into low levels of both deposits and foreign debts leads to shrink of banks' assets. Demand for assets and asset prices reduce much lower than in the baseline case. Firms obtain fewer funds to produce output. Moreover, decline in asset prices decreases incentive of capital producers to invest. Because of lower output, firms hire less labor. Households realize that their incomes reduce, so they reduce their consumption.

Figure 4.2

Baseline Model and Unconventional Monetary Policy



Source: Author's Illustration

4.3 Stabilization Policy 2: Unconventional Monetary Policy

The next case is the effect of the unconventional monetary policy. From Figure 4.2, the effects of the unconventional monetary policy are shown in the line with the asterisk. By comparing to the case of the baseline model, the unconventional monetary policy pacifies the deterioration of most indicators. The central bank helps demand for assets increase by issuing

bonds to finance firms' equities. By comparing to the baseline model, decline of asset prices improves for this stabilization policy. Since the demand for assets improves from the baseline case, banks reduce lower liabilities than the baseline case as well.

According to the central bank's intermediation, the capital declines less and the asset prices also improve. Capital producers invest relatively more. Additionally, the trade balance reduces since the aggregate demand increases. Support from the central bank help firms get capital rapidly. Firms hire more labor to produce more output faster. Therefore, the decline in the output in this case is not as much as the baseline case.

Therefore, the unconventional monetary policy can help the economy stabilize.

4.4 Comparison between 2 Stabilization Policies: Tight Monetary Policy and Unconventional Monetary Policy

The purpose of this analysis is to compare the outcome of 2 stabilization policies. Figure 4.3 shows the impulse responses of foreign investors shock and subdue the turmoil by 1) the tight monetary policy and 2) the unconventional monetary policy.

In terms of unsatisfied magnitudes of macroeconomic indicators, the unconventional monetary policy yields lower declines in most variables. Plausibility behind this is that the unconventional monetary policy increases demand for assets directly while the tight monetary policy does not. The tight monetary policy even deteriorates the economy by amplifying the effect of financial crisis through higher borrowing cost. Financial institutions encounter a hard time to buy firms' equities. Therefore, the decline of output for the case of the tight monetary policy is worse than the case of unconventional monetary policy. One interesting point is that the trade balance for the case of the tight monetary policy improves significantly. The reason behind this improvement is the reduction in the aggregate demand.

This implies that if the policymaker chooses to implement the tight monetary policy, the worst event e.g. recession, increase in unemployment, will be more severe than she does the other way. It creates the higher borrowing cost of banking sector. On the other hand, if the policymaker chooses to implement the unconventional monetary policy, this central bank tool is powerful enough to impede the severity of banking crisis.

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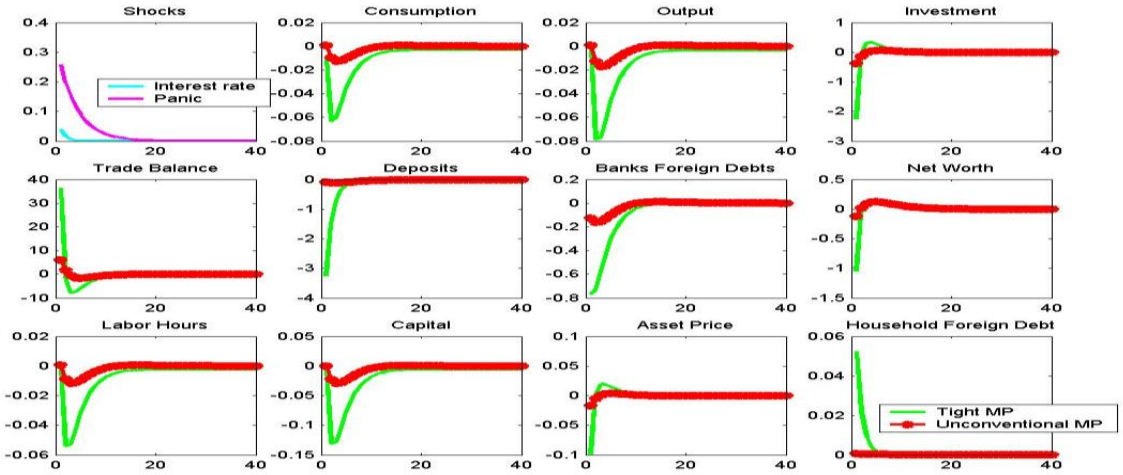
Figure 4.3

Baseline Model and Unconventional Monetary Policy



Source: Author's Illustration

5. Conclusion and Recommendation

This study constructs a framework that can account for banking crisis for a small open economy. It then explores how the example policies so-called "Stabilization Policies", which consist of 1) tight monetary policy and 2) unconventional monetary policy, find the way out of the unfavorable financial turmoil. This observation also applies Thailand's economic conditions during 1997-1998 as an example because it is suitable for focused characteristics: banking crisis or small open economy.

The definition of banking crisis in this study follows Reinhart and Rogoff (2009) as a large-scale government assistance of an important financial institution. Banking crisis are started by the unexpected increase in panic of banks' lenders and then will be observed the resolution through the central bank's two aforementioned policies. According to the rise of anxiety of lenders, banks are forced to reduce their assets immediately. This channel consequently transmits through the reduction of demand for assets. Because of the lack of credit, the output of the economy decreases and the crisis starts.

To find out the resolutions for counteracting the effect of banking crisis, the past policies are introduced to test whether they can actually help the economy stabilize. As guided by IMF to set the interest rate at a high level, the tight monetary policy is adopted by the Thai

authority because it is able to support the exchange rate appreciation. Basurto and Ghosh (2000) conduct research and obtain convincing results the same as IMF claims. However, there are several arguments about this policy. The most important reason is that the higher interest rate pushes more burdens to financial intermediaries. Higher borrowing cost leads to financial distress in the bank sector. Stiglitz (2002) gives the reason that the tight monetary policy even worsens the economic conditions downward to a lower level. Therefore, it has been doubtful whether the tight monetary policy is good for restoring the Thailand's economic conditions at that time.

Once again, the rise of the banking crisis in 2007 started originally in U.S.'s financial intermediaries sector had a major role in amplifying the severity of the crisis. The Fed intermediated credit availabilities through increasing in asset demand. Then, the asset prices recover back to the steady level. The output of the economy ameliorates remarkably.

Two stabilization policies represent examples of many resolutions among financial turmoils. Comparison their efficiencies is another target of this study. This model adopts Steffen (2011) which incorporates the real business cycle framework with small open economy. Structures of decentralization economy in this study are established on this paper. Moreover, integration of banking sector is helpful in terms of accounting for the banking crisis. Another outstanding characteristic is sources of financing. This model allows banks can make decision on external financing, which comprises of obtaining deposits from households and borrowing from foreign lenders. Introducing this features benefits in observing banks' decisions on choosing sources of funds during the crisis period. Last but not least, the unconventional monetary policy is a vital characteristic that this study needs to capture. This model follows Gertler and Karadi (2011) by allowing the central bank issues bonds to finance the firm assets. According to this mechanism, the demand for assets improves significantly. Increasing in demand eases the decline of asset price and other macroeconomic variables.

Methodology applied to solve this study is based on Sims (2002). All of decision equations are arranged in the form of linearization. Most parameters are set for the case of Thailand when it experienced the financial crisis during 1997-1998. The rest of them follow Queralto (2011).

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Several key findings in this study infer from the path of impulse response functions. First, increasing interest rate leads to higher borrowing cost of the financial intermediaries, so they reduce credit availabilities to the real sector. The primary transmission to the real sector for this mechanism is under asset pricing channel. Reduction in demand for capital leads to the decline of asset prices and so on. Therefore, the tight monetary policy worsens the economy as in Stiglitz (2002). Second, the increasing in the central bank's asset intermediation helps the asset demand increase remarkably. The monetary authority can issue bonds to get funds and use such funds to inject the credit availabilities. In this policy, the role of the central bank is similar to the bank. The central bank generates more loans to the firms than the banks do because the central bank is not constrained by financial conditions.

The rise of degree of panic can generate the economic fluctuations. In particular, banks face tough time to intermediate loans can be considered as banking crisis. Two stabilization policies are chosen to test whether it can be resolutions for such a crisis in small open economy. The results of this study point out that the policymaker is supposed to pacify the banking distress through the unconventional monetary policy rather than the tight monetary policy because it can pacify the severity of the financial crisis.

This research is conducted based on the assumption of the crisis generator. The rise of lender's panic is the origin of the crisis. In particular, this assumption follows Fostel and Geanakoplos (2008) on the aspect that the lenders feel anxious and force the bank to reduce the level of assets. However, this model applies the real business cycle model, which focuses on banking crisis and neglects the exchange rate. The central bank's interest rate rule is a feedback rule.

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