Vulnerability Indicators to the Twin Crises:

Evidence from Thailand

Abstract

This paper aims to construct the composite index of vulnerability that represents the susceptibility to a currency and financial crisis (twin crisis) in Thailand. This index is the combination of four key early warning indicators that tend to demonstrate an abnormal behavior in the lead-up to a crisis. The four indicators include the real exchange rate misalignment, reserve adequacy ratio, financial fragility and fiscal position. RER misalignment is estimated according to the time series econometric procedure and the composite index of vulnerability is calculated by geometric average method. The advantage of this index for policymakers is the signaling and monitoring the underlying fundamentals of a country. After the 1997 crisis, the composite index shows that the state of vulnerability to a currency and financial crisis of Thailand is still at a favorable position. However, because of the contagion effect that could arise from the current global financial crisis, the government needs to monitor the state of the country's vulnerability closely, especially in terms of financial fragility and fiscal position.

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I. Introduction

After the wake of the Asian currency turmoil in 1997-98, the subject of currency and financial crises has become the forefront of policy discussion. A number of theoretical studies have been developed to explain causes of the crisis and to foretell a possible future crisis. The sizeable literature on currency/financial crises could be grouped into two different notions. The first notion emphasized the inconsistency between fiscal , monetary and exchange rate policies as well as an unsustainable deterioration in macroeconomic within a country (e.g. Krugman, 1979; Goldstein, 1998; Athukorola and Warr, 2002). The second notion stresses self-fulfilling expectations and herding behavior in international capital market and has paid much attention to multiple equilibria in financial markets (Obstfeld, 1995; Calvo, 1995). In contrast to the former, the latter sees the currency crisis as an unforeseeable financial panic reflecting inherent instabilities in international capital markets and financial panic instead of a deterioration of economic fundamentals. This second notion implies that there is no defensive policy at the national level other than limiting short-term capital inflows in order to deter speculation (Athukorala and Warr, 2002).

However, based on empirical evidence, crises are typically preceded by a multitude of weak and deteriorating economic fundamentals, including financial system (Kaminsky and Reinhart, 1999). While speculative attacks can occur as market sentiment shifts and possibly, herding behavior takes over, the incidence of crises where the economic fundamentals were sound are rare. In other words, self-fulfilling expectations could emerge and make economic collapse more severe but the genesis of the crisis is likely to come primarily from the inconsistency of domestic policies and weak economic fundamentals.

Since economic fundamentals provide insight about the underlying causes of the crises, this study aims to determine useful indicators affecting the state of a country's economic vulnerability and likelihood to crisis. This issue has become even more important in recent years since the global financial crisis, which first occurred in the United States and spread into Europe and Japan, could have severe impacts on developing Asian countries when their economic fundamentals are weak. Examining such indicators could provide useful information to policy makers in ensuring healthy of an economy.

Thailand provides an excellent case study of the subject at hand for two reasons. Firstly, there was policy inconsistency in Thailand before the 1997 crisis. Thailand pursued a pegged exchange rate regime as well as accelerated capital account opening in the lead-up to the 1997 currency crisis. The exchange rate during the period 1987–96 averaged out at around 25 baht to the US dollar. In addition, Thailand began liberalizing controls of capital and financial account in the late 1980s. The controls were progressively liberalized during the early 1990s. As a result, Thailand experienced massive (net) private capital inflows, with a noticeable shift in the composition towards short-term capital flows. Compared with other emerging-market recipients, Thailand was among the ten largest emerging-market recipients of net capital inflows (Lopez-Mejia, 1999). These two aspects of macroeconomic policy are widely cited as the main causes of the currency crisis in Thailand (Alba *et al.*, 1999; Lópex-Mejia, 1999; Warr, 1999; Rajan, 2001). Second, Thailand has been castigated as the starting point for the recent Asian financial crisis and weak economic fundamentals has been hypothesized as a major factor behind Thailand's vulnerability to the crisis. There are, however, limited systematic empirical studies to identify the appropriate economic fundamentals that could provide insight about the underlying causes of the crises. In addition, whether such economic fundamentals have been improved after the crisis remains an unanswered issue.

II. Scope of Study

There are seven sections in this study. The following section (Section III) develops the analytical framework of key economic fundamentals that can provide insight about the state of economic vulnerability. In short, based on the analytical framework, we can group key economic fundamentals into four areas, namely (1) misalignment of real exchange rate; (2) reserve adequacy; (3) financial fragility; and (4) fiscal position. In contrast to (2), (3) and (4), where indicators can be computed directly by using macroeconomic time-series data, the estimation of (long-run) equilibrium real exchange rate needs to be done to determine real exchange rate misalignment. Thus, a theoretical model of (long-run) equilibrium real exchange rate is also reviewed in this section.

Section IV undertakes a survey of the macroeconomic policy and performance of Thailand over the two past decades to better understand factors influencing the movement of key economic indicators. Particularly, this section emphasizes on exchange rate policy, and capital and financial liberalization policies undertaken from the late 1980s to the early 1990s in order to address its impact on macroeconomic development. Macroeconomic performance, including economic growth, inflation, and external balance component, is reviewed in this subsection.

Data and econometric procedure are discussed in Section V. A quarterly time-series data during the period 1995-2008 are used to conduct the vulnerability indicators and error correction model (General to Specific Modeling (GSM) approach) is applied to estimate the (long-run) equilibrium real exchange rate.

Movements of vulnerability indicators are shown in Section VI. Indicators in the four areas are first shown separately. In particular, the estimation of (long-run) equilibrium real exchange rate is provided along with the misalignment of real exchange rate. Then, we apply the geometric average method to combine these four areas of vulnerability indicators into a composite index in order to conclude the overall state of economic vulnerability in Thailand.

The final section (Section VII) provides conclusion and policy inferences. This chapter sheds light on forming macroeconomic policy conducive to sustainable economic development.

III. Analytical Framework

The balance of payment approach is applied here in identifying indicators that can reflect the state of a country's vulnerability to currency and financial crisis. The balance of payment can be defined as following;

$$BA = CA + CAP = \Delta Reserve \quad (1)$$

where BA is the balance of payment; CA is current account; CAP is the capital account and ΔReserve is changes in foreign exchange reserves.

To understand how vulnerability indicator can be derived from the balance of payment approach (equation 1), we suppose that a country is in a situation of successive current account deficit but high level of net capital inflows, thereby accumulating foreign exchange reserves. Suppose further that at some point in time, there are huge capital outflows from the country, resulting in a decline in foreign exchange reserves and losing investors' confidence. Under the managed floating exchange rate regime, including pegged exchange rate regime, there are three key ways that policy makers can manage to restore investors' confidence and to avoid the currency crisis.

First, real exchange rate has to depreciate to switch demand from tradables to nontradables, and supply from nontradables to tradables, in order to reduce the successive current account deficit. The depreciation of real exchange rate increases international competitiveness of the bilateral trade condition of a country. Exports of goods and services would be enlarged while demand for imports decline due to a rise in import prices. This results in the abridgement in the current account deficit. Nonetheless, the disadvantage of this policy is that the real depreciation implies the actual wealth reduction and thus the economic recession of a country. Excessive depreciation of the real exchange rate will lead to economic deterioration according to the higher level of foreign debts. Therefore, this policy would be effective in cushioning current account deficit and restring investors' confidence when real exchange rate is not significantly misaligned from its equilibrium level.

Second, policy markers could use foreign exchange reserves to defend its currency until the confidence is restored. In a situation of currency crisis, it is likely to have a sudden reversal of capital flows that cause a significant depreciation/devaluation of the currency. The government could use foreign exchange reserves to slowdown the path of currency depreciation or to maintain the currency at the pegged level. However, this policy is appropriate when a country has a high level of international reserves, especially compared to the stock of mobile capital (e.g. port-folio investment) or external short-term debts. The reserve level reflects a country's potentiality to buffer against shocks in the currency crisis. If reserves are not sufficient to meet an abrupt reversal, then the government will be weakened the credibility and may lead to the more and sudden exchange rate volatility. Therefore, the higher the foreign exchange reserves level is, the higher the ability to defend the currencies.

Third, policy markers could increase domestic interest rate to reduce domestic absorption (consumption and investment) to rebalance current account and to compensate the loss of investor's return emerging from the (expected) exchange rate depreciation. Nevertheless, this policy is suitable when the country has a healthy financial system. This strategy affects the solvency of business and makes the operating of investors more difficult as the interest burden is increasing especially in the high leverage company. If the financial institutions have been operating under the well-behaved regulating and good corporate governance, the banking system of the country would acquire the high quality of credit. Otherwise, the high interest rate can lead to a significant increase in non-performing loans because of credit squeeze and economic deterioration. Consequently, the more vigorous the financial system is, the greater the possibility to use increasing interest rate policy to defend the currency.

All in all, from the balance of payment approach, there are three indicators that can reflect the country's vulnerability to crisis, namely real exchange rate misalignment, reserve adequacy and financial fragility.

III.1 Real exchange rate (RER) misalignment

A. Definition of RER

The real exchange rate (RER) is a broad summary measure of the prices of one country relative to the prices of another country or group of countries, both expressed in a common currency.[1] It can generally be expressed as:

$$\text{RER} = \frac{\prod_{i=1}^{m} \left[E_i P_i^w\right]^{\omega_i}}{P^d} \tag{2}$$

where

E is the nominal exchange rates (domestic currency / foreign currency)

P^w is an index of foreign prices

P^d is an index of domestic prices

m is number of trading partner countries

ω is the appropriate weight for each i-th foreign country using geometric averaging method (the sum of weight must equal one)

Since the RER in equation (2) measures relative prices between countries, it is referred to as *external* RER. An increase in the value of RER indicates that foreign goods become more expensive relative to domestic goods so that international competitiveness improves. An increase (decrease) in RER is referred to as depreciation (appreciation).

In fact, there is another definition of RER, i.e. internal RER. Internal RER is the relative prices of domestic tradable to non-tradable goods and could reflect the changes in domestic incentive structure between tradable and non-tradable goods (Jongwanich, 2006). Because of the unavailable data of both tradable and non-tradable prices, it is imperative to determine the real exchange rate according to the first definition, which define the real

[1] Most people are acquainted with the nominal exchange rate, which is defined as the price of one currency in terms of another. The nominal exchange rate reflects the cost of translation, however, people, who translate for other currencies, are more interested in what can be translated and are better off with those currencies taking price level of objective countries into consideration. Consequently, the real exchange rate plays a more important role in the International financial market.

exchange rate as a summary measure of the price of one country's goods relative to the price of competitor countries, as following

In this study, foreign and domestic price indices are represented by the consumer price index (CPI). This has the advantage of being timely, similarly constructed across countries, and available for a wide range of countries over a long time span. Because it captures the relative costs of a broad basket of goods and services across countries, CPI-based RER measures provide a good reflection of the purchasing power of the domestic currency. However, the fact that CPI baskets contain a significant nontraded component makes CPI-based RER less than ideal for assessing a country's international competitiveness. A measure based on the price of traded goods or a measure of business costs would be more appropriate in assessing competitiveness. Producer price index, which relatively contains a high proportion of traded goods, and unit labor cost are used to reflect this matter. Nevertheless, it is often difficult to obtain data on these alternative price indices on a comparable basis across countries over a reasonable length of time. The empirical work is, therefore, heavily reliant on CPI-based measures.

The choice of weighting scheme (ω_i) depends crucially on the purpose for which the RER is being constructed. For countries without substantial unrecorded or misreported trade, actual trade weights can be used for assessing changes in competitiveness. However, when the inter-country pattern of trade is significantly different for imports and exports, it may be preferable for some analytical purposes to use either export or import weights rather than averaging these together. In addition, the weights should reflect reasonably well the structure of trade in the period being analyzed. Using current weight schemes could mitigate the problem of changing trade structure and should be used for current policy analysis (Hinkle and Nsengiyumva 1999). In the case of Thailand, the inter-country pattern of trade is not dramatically different between exports and imports so that trade weight, averaging between 2000-05, is applied in this study.[2]

[2] The weight applied in this study is as follows: Japan (24%); US (16%); PRC (12%); Malaysia (8%); Singapore (8%); Hong Kong, China (5%); Indonesia (4%); Korea (4%); Germany (3%);

B. Real exchange rate misalignment

The real exchange rate misalignment is a sustained deviation of the actual real exchange rate from its long-run equilibrium level (Edwards, 1989). The real exchange rate overvaluation or undervaluation is a persistent decrease or increase in the value of the real exchange rate from its steady-state equilibrium level accordingly. The long-run equilibrium real exchange rate is the value of the real exchange rate that emerges from the economy' s macroeconomic equilibrium when policy and exogenous variables are at sustainable "permanent" levels and when the operationally relevant subset of the economy' s predetermined variables have settled into their steady-state configurations (Montiel, 1999). This equilibrium represents the ideal real exchange rate that mirrors the macroeconomic fundamentals of a country. The long-run equilibrium real exchange rate can be settled by investigating the permanent changes in the various macroeconomic determinants that normally significant influence on the real exchange rate.

Therefore, there are two steps to determine RER misalignment. The first step is to estimate the determinants of real exchange rate to get the long-run coefficients of real exchange rate determinants (i.e. fundamental factors). The second step is to get permanent components of fundamental factors, and then apply their corresponding coefficients to calculate long-run equilibrium real exchange rate. The actual real exchange rate is compared with its long-run equilibrium real exchange rate to reveal the RER misalignment.

C. The empirical model of (long-run) RER determinants

The empirical model applied in this study is based on empirical study of Jongwanich (2008). According to the model, the dependent variable can be estimated by the meaningful macroeconomic variables. The following independent variables affect the real exchange rate on the different directions, which could be positive or negative relationship, and cause the long-run equilibrium real exchange rate to depreciate or appreciate to restore both internal and external balance. The model is identify as follows:

Saudi Arabia (3%); United Kingdom (3%); Philippines (2%); Netherlands (2%); Viet Nam (2%); France (2%); India (2%); Italy (2%); Belgium (2%)

$$RER = f(GSPEND, NFA, TOT, HBS, OPEN) \quad (3)$$

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where

RER	=	Real exchange rate
GSPEND	=	Total government spending
NFA	=	Net Foreign Assets
TOT	=	Terms of trade
HBS	=	Productivity differential toward tradable goods
OPEN	=	Trade openness

There are four exogenous variables that cause the real exchange rate to appreciate. They are total government spending (GSPEND), net foreign assets (NFA), term of trade (TOT), and productivity differential (HBS).

GSPEND is mostly spent for nontrabable products, nontradable prices increase in response to a rise in domestic demand. Thus, the negative relationship (appreciation) between *GSPEND* and *RER* is expected. While an increase in *NFA* tends to improve a country's wealth. The nontradable prices increase in response to a rise in domestic demand. The equilibrium RER appreciates.

The *TOT*, defined as the ratio of export to import prices, is included to capture exogenous changes in world prices. Term of trade improvement, which is a relatively increase of export to import prices, creates an income effect and increases domestic demand of a country so that non-tradable prices have to increase relative to tradable prices with the purpose of switching the demand from non-tradable to tradable goods. These cause RER to appreciate and restore the equilibrium.

Differences in the rate of productivity growth in tradable-good production of a country compared to that of the main trading partner countries (*HBS*) are potential factors that affect the *RER**. An increase in HBS will raise the demand for labor employed in the tradable sector. Under full employment condition, labor must be drawn from the nontradable sector toward the

tradable one and this puts pressure on wage rate in the nontradable sector. This causes the *RER* to appreciate to restore the equilibrium.

In the model, there is an exogenous variable, namely trade openness, that put pressure on RER to depreciate to maintain the equilibrium. Trade liberalization is generally more intensive in tradable goods. To preserve the equilibrium, the RER is forced to depreciate so that the demand from tradable goods would switch toward non-tradable goods and then hold the equilibrium position.

III.2 Reserve adequacy

In this study, reserve adequacy is measured as follows:

$$\text{Reserve adequacy ratio} = \frac{\text{total foreign exchange reserve}}{\text{stock of short-term mobile capital}} \quad (4)$$

Alternatively, reserve adequacy ratio can measured in terms of total foreign exchange reserves to short-term debt. However, because of the insufficient data of short-term external debts, we use stock of short-term mobile capital as denominator. In some empirical studies, M2 is used as the denominator. However, in our point of view, M2 is too broad and inappropriate because a large portion of M2 does not include speculative mobile capital.

III.3 Financial fragility

The healthy of banking system is measured here by the ratio of private domestic credit to GDP. That is

$$\text{Financial fragility} = \frac{\text{total domestic credit to the private sector}}{\text{GDP}} \quad (5)$$

The underlying hypothesis is that the rapid growth in bank credit leads to a greater opportunity for banks to have unfavorable loans (Radelet and Sachs, 1998; Sachs et al., 1996; Mishkin, 1996; and Backstrom, 1997). This situation indicates the fragility of the banking system and represents a vulnerability to a financial crisis. In case of Thailand, the main contributed factor to reflect the credit of bank loans is the domestic credit. Therefore, we use the domestic private sector credit ratio as an indicator of the vulnerability to a financial crisis.

We also look at the other two alternative indicators, namely the ration of non-performing loans to total loans and capital adequacy ratio[3], to reflect the fragility of financial sector. Non-performing loan (NPL) is a loan that is nonperforming when payments of interest and principal are past due by 90 days or more, or at least 90 days of interest payments have been capitalized, refinanced or delayed by agreement, or payments are less than 90 days overdue, but there are other good reasons to doubt that payments will be made in full (IMF). The domestic private sector credit ratio indicates the probability of the bank to have bad debt, however, it will not represent the managerial quality of the banking system of a country. If the financial institutions of each country provide the same amount of credit to the private sector, the higher quality of the banking system management will produce a lower amount of non-performing loans. Consequently, we use NPLs as another indicator to support the hypothesis of the health of a country's financial system that vulnerable to a financial crisis.

Capital adequacy ratio is the ratio which determines the capacity of the bank in terms of meeting the time liabilities and other risk such as credit risk, operational risk, etc. In the simplest formulation, a bank's capital is the "cushion" for potential losses, which protect the bank's depositors or other lenders. As a result, the capital adequacy for bank is a fender to a bankruptcy possibility when the financial crisis probably occurs in the future. The more capital adequacy ratio is, the lower vulnerability to a financial crisis.

It is noteworthy that because of limited data on non-performing loans and capital adequacy ratio, the ratio of private domestic credit over GDP is used to conduct composite index of the country's vulnerability.

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[3] Capital adequacy ratio $= \frac{\text{Capital}}{\text{Risk}} = \frac{\text{Tier one capital + Tier two capital}}{\text{Risk weighted credit}}$

where Tier one capital: Actual contributed equity plus retained earnings
Tier two capital: Preferred shares plus 50% of subordinated debt
Risk weighted credit: since different types of assets have different risk profiles, CAR primarily adjusts for assets that are less risky by allowing banks to "discount" lower-risk assets.
The 8% threshold use as a common requirement for regulators is set by the national banking regulator.

III.4 Fiscal Position

In addition to the above three indicators, fiscal position is another factor that can reflect the state of a country's vulnerability. The fiscal policy is the taxing and spending decisions of the government with the intention of dealing with the economic conditions of a country. Typically, the government takes an action to raise taxation and lessen government spending during inflationary periods and vice versa during recessionary periods to stabilize the economy. These decision makings have the objective to diminish or augment the money supply in the system in order to slow down or boost the economics respectively. Government balance refers to tax revenues subtract government expenditure. The positive government balance, budget surplus, represents government saving and the negative government balance, budget deficit, leading to accumulation of government debt. The large amount of government debt could denote the unsound of the government position. In contrast, when a country is facing the crisis or economic slowdown, if the country has good fiscal position, it would become easy to use expansion fiscal policy. Consequently, in this study, we use government debt as another key indicator to represent the vulnerability of a country. That is

$$\text{Fiscal Position} = \frac{\text{Government Debts}}{\text{GDP}} \tag{6}$$

IV. Macroeconomic Policy and Performance in Thailand

From the period of 1960 to the financial crisis in 1997, Thailand maintained a fairly stable nominal exchange rate and was officially described as a basket-pegged regime dominated by the US dollar in the basket (Jongwanich 2006 and 2008). During the period 1961-80, the nominal exchange rate remained around 20 baht per US dollar. However, the macroeconomic imbalance emanated from a huge and successive government deficit and a domestic demand expansion during the early 1980s drove the country to devalue the nominal exchange rate to 27 baht per US dollar at the end of 1984 before slightly appreciating to 25 bah per US dollar in 1988-1996.

[Figure1 is here]

In the late 1980s and the early 1990s, financial and capital accounts were progressively liberalized. The financial account liberalization began with dismantling of interest rate controls and reducing the existing market distortion. The milestone of capital and financial liberalization was an achievement of Article VIII of the International Monetary Fund (IMF) in May 1990. The capital control measures were progressively removed. For example, all controls on foreign exchange transactions on the current account were removed. In April 1991, the general public was allowed to conduct foreign exchange transactions directly with commercial banks with no limit on amount. In addition, the Bangkok International Banking Facility (BIBF) was established in March 1993. BIBF was an offshore financial market, which offered tax and regulatory advantages to investors in order to encourage foreign financial institutions to set up operations in Thailand. These financial institutions were to make loans both to domestic borrowers (out-in BIBF) and to borrowers in other countries (out-out BIBF) in the region.

The short-term capital, especially port-folio investment, increased noticeably during 1993-96. Especially in 1993, there was a massive amount of short-term capital inflows around 138,151 millions baht, from the deficit of 179,840 millions baht in 1990-92 (average), into Thailand. From 1993 to the 1997 crisis, the hot-money capital inflows maintained the high level with fluctuating trend and had the highest value in the early 1997, the summation of the second

and the third quarter of port-folio investment in 1997 account for 118,436 millions baht. As well, before the 1997 Asian crisis, there were massive foreign currency borrowings with no guaranteed lending and under-regulating conditions by foreign banks. Moreover, the increasing domestic credit with defectively regulated banking system produces deterioration in the quality of credit that creates non-performing loan. These represent a weak corporate governance and erroneous managing policy of the banking system. The current account deficit as a percentage of GDP also rose continuously. Beginning in the early 1980s, according to the available statistical data, Thailand maintained the current account deficit, exception for 1986, until the Asian crisis in 1997. The movement of the current account deficit as a percentage of GDP was volatile and had an increasing trend starting from 1993 to the highest value, around 8%, in both 1995 and 1996.

[Figure 2, 3, 4 and 5 are here]

The basket pegged-exchange rate regime, together with financial and capital account liberalization, tended to induce excessive short-term capital inflows. The non-tradable prices tended to increase and Jongwanich (2006 and 2008) found the overvaluation of real exchange rate in the pre-1997 period. To slowdown the path of economic overheating, the domestic interest rate was increased in mid-1990 to sterilize excessive capital inflows. However, the existing exchange rate regime and capital account policy induced even more short-term capital. Real exchange rate appreciated further, undermining the country's international competitiveness. Export declined significantly[4], which triggered the speculation on Thai baht (Jongwanich, 2008). This resulted in a persistent loss of international reserves, which ultimately force the authorities to abandon the parity (Krugman, 1979).

On 2 July 1997, the BOT announced a float of the currency that allows nominal exchange rate to freely adjust according to market forces. Following the onset of crisis, the nominal exchange rate depreciated from around 25 baht per U.S. dollar in June 1997 to almost 50 baht per U.S. dollar in January and returned to around 37–38 baht per U.S. dollar in July

[4] Export value declined from over 20 percent in 1995 to around zero percent in 1996, while export volume dropped from 15 percent in 1995 to -5.5 percent in 1996

1998. After mid–1998, the nominal exchange rate tended to stabilize. However, the trend of nominal exchange rate is still more volatile compared to the former because a managed float framework forces a currency value to reflect the change in underlying fundamentals of a country. After the Asian crisis, the nominal exchange rate of Thai Baht depreciated to the lowest value around 45.35 baht per U.S. dollar in mid-2001 and then gradually appreciated to around 34.80 baht per U.S. dollar at the end of 2008.

Real GDP contracted by -1.4 per cent in 1997 and -10.5 per cent in 1998. The 1997–98 negative growth rates were the greatest economic contraction in Thailand over the past three decades. The negative growth rate was mainly due to the huge reduction in private domestic investment, registered -30.4 and -52.3 per cent in 1997 and 1998, respectively.

[Figure 6 is here]

After the crisis, there was a massive amount of a capital reversal and it generated a balance of payment deficit for the two following years. Until mid-2004, port-folio investment and capital account turned to be net capital inflows again. The current account deficit as a share of nominal GDP decreased from 8.1 per cent in 1996 to 0.8 per cent in 1997, followed by the surplus of 12.7 per cent in 1998. In 2008, the current account registered as a negative 0.11% of GDP. Besides, the real GDP growth reported as 2.94%, which had a decreasing trend from 2004 due to the world's economic recession and political uncertainty in 2008.

After Asian crisis, there are mainly four areas that tend to indicate a significant improvement of the banking system in Thailand. Bank profitability has tended to rise while the overall capital adequacy has been improving. Non-performing loans have been reduced and bank's performance indicators have led to significant recent credit ratings upgrades (Jones and Gottschalk, 2006). Private domestic credit has exhibited a downward trend since the onset of the crisis (Siamwalla, 2004).

In terms of fiscal position, in the early 1980s, the government of Thailand tends to employ budget deficit policy to expand the economy. Government spending was mostly financed by domestic borrowing (i.e. commercial banks and the government saving bank) rather than through the Thai central bank, the Bank of Thailand (BOT), and foreign borrowing

(Warr and Nidhiprabha, 1996). However, after 1984 devaluation, Thailand experienced fiscal surplus throughout the period before the 1997 Asian crisis. This fiscal surplus was the outcome of the economic boom that enlarged taxation of Thailand. Consequently, the government had low level of debt and quite strong position to repay the obligation. The government applied the budget deficit policy during the recovery period. It is quite easy to employ the expansionary fiscal policy because of a good fiscal position of the government. The domestic government debt increased sharply from 32 billion baht in 1997 to 427 billion baht in 1998, account for.9.2% of GDP in 1998 and the total debt had the increasing trend after that period. In 2008, the total government debt as a percentage of GDP was around 23%. The high level of government debt leads the policymaker to concern about the fiscal position of the government to cope with the financial crisis that may occur in the future.

V. Data and Econometric Procedure

V.1 Data

We employ quarterly data for conducting four areas of vulnerability indicators. This was an exception of non-performing loans and capital adequacy ration that we employ annual data because of data limitation. We use quarterly data for the period of 1995 to 2008. Data are collected from *International Financial Statistics*, International Monetary Organization (IMF); Bank of Thailand (BOT); *National Income Accounts*, National Economic and Social Development Board (NESDB) in Thailand.

The exogenous variables are established by following procedure: Total government spending (GSPEND) is measured as total government expenditure over GDP; Net foreign assets (NFA) is determined as the ratio of net foreign assets to GDP; Terms of trade (TOT) is calculated as the deflator of exports to imports, the current prices to constant prices of exports to imports; Productivity differential toward tradable goods (HBS) is the ratio of real value added per worker in Thailand to that in the major trading partner country; and Trade openness (OPEN) is settled as the ratio of the trade balance of goods to GDP.

V.2 Econometric procedure

First, we estimate the RER equation to identify RER misalignment. In line with standard practice in time-series econometrics, the time series property of data was tested at the outset using the Augmented Dickey-Fuller (ADF) test. Test results are reported in Table1. For testing results, only HBS is stationary I(0) while the other variables (RER, GSPEND, NFA, TOT, OPEN) are non-stationary I(1). Consequently, the general cointegration techniques that are proper when all exogenous are I(1) is not appropriate in this case under the consideration of the same order of integration. The differencing method also ignores the long-run relationship of the variables. To estimate the model with difference order of integration taking long-run relationship into consideration, the General to Specific Modeling (GSM) approach is applied (See Appendix I for GSM approach).

[Table I is here]

Second, we apply the geometric average method to combine all vulnerability indicators, which are the real exchange rate misalignment, reserve adequacy ratio (total foreign exchange reserve to stock of mobile capital), financial fragility (domestic private sector credit) and fiscal position (government debt), into a composite index and conclude the state of the vulnerability of Thailand in the lead-up to a possible future currency crisis.

VI. Results

VI.1 Vulnerability indicators

A. Real exchange misalignment

According to the theoretical framework, the explanatory variable (OPEN) is expected to have positive relationship and other independent variables (GSPEND, NFA, TOT and HBS) are expected to have negative relationship with RER and cause the long-run equilibrium real exchange rate to depreciate or appreciate, respectively, to restore both internal and external balance. Table 2 reports the result of the estimation. There are three long-run parameters (GSPEND, NFA and HBS) that the estimating results are consistent with the theoretical framework. The coefficient of GSPEND, NFA and HBS are negative and statistically significant and the coefficient of NFA is the smallest value. A 10% increase in GSPEND, NCF and HBS cause the equilibrium RER to appreciate by 5.7%, 0.2% and 8.0% respectively

The negative sign of GSPEND supports the hypothesis that the government spending is more intensive in non-tradable goods. Net resource transfer to Thailand causes the RER appreciation. The productivity differential increase the demand for labour in tradable sector has an effect on wage rate in non-tradable sector and causes the negative value of the coefficient. However, the independent variable OPEN is statistically significant in the short-run relationship. The positive coefficient can be concluded that a 10% increase in OPEN will affect the RER depreciation by 0.7%. TOT is statistically significant only in the short-run. A 10% increase in TOT leads to an appreciation of real exchange rate by 0.8%. This result implies that income effect tends to dominate substitution effect from TOT rise in the case of Thailand. The RER appreciation from income effect, which the demand from non-tradable goods have to move towards tradable goods to restore the equilibrium from domestic demand increasing, and the RER depreciation from substitution effect, which the demand for tradable goods increase from relatively lower import prices.

[Table II is here]

A.1 Real exchange rate misalignment

The real exchange rate misalignment is the different value of the actual RER and the RER equilibrium. For the long-run equilibrium RER, the coefficients are based on the results of estimated equation above. The permanent values of all statistically significant variables (GSPEND, NCF and HBS) are generated by the Hodrick-Prescott filter (HP filter).[5] The positive value of misalignment implies real exchange rate undervaluation. The negative value of misalignment implies real exchange rate overvaluation and precursor to financial crisis.

[Figure 7 and 8 are here]

Before the 1997 Asian crisis, there was a significant RER overvaluation in Thailand that caused the financial collapse in the middle of 1997. According to figure 8, RER overvaluation had a dramatic increasing trend in the lead up to the crisis and had the highest value at the second quarter of 1997, the period of Asian crisis. The RER was misaligned around 13.80% from its equilibrium value in the second quarter of 1997. In that period, Thailand changed the exchange rate regime to floating rate system that cause the nominal exchange rate of Thai Baht depreciated about 100% from around 25 baht to 50 baht per US dollar within a half year and return to around 37 to 38 baht per US dollar, which was the equilibrium value in the middle of year 1998. Figure 8 apparently depicts the misalignment of Thai baht in that period and we can see that the RER suddenly depreciated to the equilibrium. The trend of depreciation was rapidly increasing and the RER was undervalued to the highest value around 20.25% from its equilibrium value during the recovery period in the beginning of 1998 and then return to the equilibrium value again in mid-1998. After Asian crisis, the value of Thai baht is line around the equilibrium value because the floating exchange rate system adjusts the value of

[5] Technically, the Hodrick-Prescott (HP) filter is a two-sided linear filter that computes the smoothed series *s* of *y* by minimizing the variance of *y* around *s*, subject to a penalty that constrains the second difference of *s*. That is, the HP filter chooses to minimize:

$$\sum_{t=1}^{T}\left(Y_t - S_t\right)^2 + \lambda\sum_{t=2}^{T-1}\left(\left(S_{t+1} - S_t\right) - \left(S_t - S_{t-1}\right)\right)^2$$

The penalty parameter λ controls the smoothness of the series σ. The larger the λ, the smoother the . As $\lambda=\infty$, approaches a linear trend.

Thai baht to reflect the true value according to market forces. The condition of RER misalignment in 2008 is not far from the equilibrium value and has a little bit overvaluation. Consequently, we can infer that there has been no any significant misalignment of real exchange rate after 2000 signal in the lead-up to the financial crisis in the future.

B. Reserve adequacy

[Figure 9, 10 and 11 are here]

The total foreign exchange reserve of Thailand, from 1995 to 2008, has a quite smooth increasing trend, which implies a growing capacity of a country to defend its currency value. After the Asian crisis, the level of reserve decreased to the lowest value around 25,355 millions U.S. dollars in the mid-1998 and then gradually increased to the highest value around 108,317 millions U.S. dollars at the end of 2008. However, the increasing foreign exchange reserve is insufficient to determine the state of vulnerability to a financial crisis due to the unknown flows of short-term capital in each period. The hot-money capital flow of Thailand has a fluctuant trend throughout the period. There were a huge amount of portfolio investment capital inflows and the stock of short-term mobile capital was sharply increasing during the Asian crisis. Subsequently, the portfolio investment was quite stabilized and has a little bit decreasing trend until 2004. It is important to consider that the short-term capital was rapidly increasing and had a highest value around 26,126 millions U.S. dollar at the end of 2006. Reserve adequacy ratio is a proper indicator by combining these two factors together. From figure 9, we can see that the trend of reserve adequacy ratio is speedily decreasing to the lowest value around 1.5 during Asian crisis. This represents the early warning indicator to a financial crisis in Thailand. After the Asian crisis to 2004, the reserve adequacy ratio had an increasing trend due to the improvement of both level of foreign exchange reserve and stock of short-term mobile capital. After 2004, a swift rising of stock of mobile capital that overwhelms the growing of foreign exchange reserve level deteriorates the reserve adequacy of Thailand. This ratio had the lowest value around 2.2, which indicate the vulnerability to a crisis. However, reserve adequacy ratio swiftly recovers to a good position around 5.67 in 2008.

C. Financial Fragility

[Figure 12 is here]

The ratio of private domestic credit over GDP had increased substantially in the lead up to the 1997 crisis. It rose to almost 70% in the third quarter of 1997. The trend of private domestic credit to GDP was still increasing after the crisis because of the expansionary policy to offsetting the slowdown of the economy and the expeditious growth in capital financing market. The ratio had a highest value at 0.73% in the third quarter of 1998. The circumstance is the outcome of the bubble economy that stimulates investors to expand the business by using leverage from financial institutions. After that period, this ratio has a decreasing trend to the lowest value around 0.40% in 2008. The lower bank credit implies the lower opportunity to have bad debts that signify the soundness of the financial system of a country. Consequently, this low level of this financial fragility ratio indicates the good position of the vulnerability to a financial crisis. In addition, the capital adequacy ratio and level of non-performing loans after the crisis confirm the healthier of financial system in Thailand.

D. Fiscal position

[Figure 13 is here]

The budget surplus policy that was likely utilized by the government of Thailand leaded to the low level of debt and therefore a good fiscal position of the government in the period before the Asian crisis. At the mid-1997, the government debt to GDP merely reported for 16.20% in terms of quarterly GDP. Annually, total government debts in 1997 registered at 6.9% of GDP. After the Asian crisis, the government changed the fiscal policy toward budget deficit to expand the economy that deteriorates the fiscal position of a country. The government debt to GDP had an increasing trend from 1997 to the highest value around 31% in 2002. The government debts slightly declined after 2002 but still be maintained at the high level at around 25% of GDP, especially compared to the pre-crisis level.

VI. 2 Composite index of vulnerability

Since these four indicators reflect different aspects of the vulnerability to a currency and financial crisis, the composite index of vulnerability is constructed to provide a single index in measuring the degree of a country' s vulnerability to a currency crisis.

In order to obtain a vulnerability (composite) index, the four constructed indicators are first converted into index (1995=100) to unify their measurement difference. The absolute value of RER misalignment and reverted reserve adequacy ratio are adjusted to ensure to solve the directional problem in explaining the composite index. The next step is to standardize the averaged value to create a composite index. The standardization method, which is used in this study, is based on the following formula (Briguglio L., 1995, Small island developing states and their economic vulnerabilities, World development, Vol.23, No.9, 1615-32). Finally, we apply the geometric average with equal weight to combine them together.

$$X_{i,t}^{*} = \frac{X_{i,t} - \min(x_i)}{\max(x_i) - \min(x_i)} \quad (7)$$

where

$X_{i,t}^{*}$ = Re-scaling indicator i at time t

$X_{i,t}$ = Actual indicator i at time t

$\max(x_i)$ = Minimum value of X_i for all t

$\min(x_i)$ = Maximum value of X_i for all t

Note that $X_{i,t}^{*}$ will lie between 0 and 1. The higher the value of $X_{i,t}^{*}$ the higher the vulnerability to a currency crisis that Thailand is facing.

[Figure 14 is here]

This composite index of vulnerability represents the susceptible position resulting from the combination of four areas of indicators in this study. Figure 15 demonstrates the state of the vulnerability to a financial crisis in Thailand from 1995 to 2008. The composite index rose substantially in mid 1990, from 0.2 in 1995 to almost 0.5 in the third quarter of 1997. The

vulnerability index continued to increase and has the highest value around 0.70 at the beginning of 1998, the year where GDP growth reached the bottom at -10.5%. The main contributed factors are the accumulation problems of the RER misalignment (standardized RER misalignment index =1 in the first quarter of 1998), the low level of foreign exchange reserve (standardized reserve adequacy ratio index = 1 in the second quarter of 1998) and the high level of private domestic credit (standardized financial fragility =1 in the second quarter of 1998). Nevertheless, the composite index of vulnerability has an improvement trend after the Asian crisis through 2008. In summary, the early warning indicators in this study have a good position in the compound consideration of the vulnerability to a financial crisis.
In 2008, the real exchange rate is not significantly misaligned, slight undervaluation, from the equilibrium value. The reserve adequacy ratio is at a quite high position due to the high level of foreign exchange reserve. The private domestic credit has a decreasing trend and has the lowest value at the current time. However, the fiscal position is the only indicator that represents the terrible index in this study resulting from the budget policy to expand the economy of Thailand. All in all, the constructed composite index has an improvement trend and good position, which demonstrates a good state of vulnerability to a financial crisis of Thailand, especially compared to the mid 1990s.

[Figure 15 is here]

In this study, we also calculate the composite index of vulnerability with unequal weight to consider the sensitivity of each early warning indicator. We employ the geometric average given more weight about 20% to the testing sensitivity indicator and equal weight to the others. The four pre-warning indicators are taken into consideration. The results specify that there is an insignificant sensitivity given more weight for each indicator.

VII. Conclusion and Policy Inferences

The currency and financial crisis was typically the outcome of the vulnerability that caused from the delicate underlying fundamentals of the economy. This study presents four key early warning indicators that can potentially signal the state of vulnerability to a crisis. Firstly, the real exchange rate misalignment is one of the most effective indicator and generally major concern of the policy-markers. The results of this study support the hypothesis that there were significant values of the real exchange rate overvaluation that leaded to the 1997-99 Asian crisis. Secondly, the low level of foreign exchange reserve with the accelerated increasing in the stock of short-term mobile capital deteriorated the capital adequacy resulting in the lower capability of Thailand to defend the currency value. Thirdly, the liberalization of the domestic credit under weak financial management system amplified the existing non-performing loans in that period, which created the financial fragility of banking sector of Thailand. However, the low level of government debts due to the budget surplus policy resulting from the economic boom signified a good fiscal position of Thailand. This is the only indicator that represented a good direction of Thailand before 1997.

After the Asian crisis, the three pre-warning indicators that stand for the unfavorable condition have the improvement trend to the gratifying position. In 2008, the transition from fixed to managed floating foreign exchange rate regime restrains the values of real exchange rate, which are not considerably apart from the equilibrium value. Besides, the increasing trend of the reserve adequacy implies the powerful ability to buffer against hot-money capital flows. Additionally, the development of domestic capital markets that strengthen regulation and supervision of management improve the financial fragility condition of the banking sector. Nevertheless, the fiscal position is dissolved because of budget deficit policy after the Asian crisis with the intention to boost up the economy.

As a result of the identical and invert direction of early warning indicators at each point of time. The composite index of vulnerability is constructed to represent an effective key early warning indicator to a financial crisis. This composite index combines all four areas of interest

together to signal the simultaneous symptom that underlies the likelihood to a crisis. The highlight utility of this index is utilized as a tool for policymakers for signaling and monitoring an unusual behavior of macroeconomic variables to cope with the problem that will happen in time.

The vulnerability composite indices illustrate that the state of vulnerability increased substantially in the lead up to the 1997 crisis and at the highest value in 1998, where the real GDP had reached the lowest value over the past four decades. The state of vulnerability, however, has improved gradually after the crisis. In 2008, Thailand was still at the favorable position to cushion the financial and currency shocks. However, due to the contagion effect that could arise from the current global financial crisis, the government needs to monitor the state of the country's vulnerability closely, especially in terms of financial fragility and fiscal position, because this is the area that tends to be more vulnerable to the country from this study. Meanwhile, financial sector, including equity and bond market needs to improve further to ensure the stability of the country's financial system and the ability to weather the global financial crisis.

Appendix I

General to Specific Modeling (GSM) Procedure

The fashionable cointegration econometric procedures, such as the two-step residual-based procedure adopted by Engle-Granger (1987), and the system-based reduced rank regression approach due to Johansen (1991, 1995), that are appropriate for the variables in the system being of equal order of integration are not applicable in our case. The econometric analysis in this study is based on the general-to-specific modeling (GSM) procedure (Hendry, 1995). The GSM procedure is applicable when set of variables includes series that are non-stationary or a mixture of non-stationary and stationary. Therefore, GSM procedure is chosen for estimating the behavioral equations in this paper.

The GSM approach embodies the relationship being investigated within a sufficiently complex dynamic specification, including lagged dependent and independent variables, so that a parsimonious specification of the model can be uncovered. Under this procedure, estimation begins with an autoregressive distribution lag (ADLs) specification of an appropriate lag order:

$$Y_t = \alpha + \sum_{i=1}^{m} A_i Y_{t-i} + \sum_{j=1}^{k} \sum_{i=0}^{m} B_{ij} X_{j,t-i} + \mu_t \qquad \text{(A1)}$$

where α is a constant, Y_t is the endogenous variable, $X_{j,t}$ is the j^{th} explanatory variable and A_i and B_{ij} are the parameters.

Equation (A1) can be rearranged by subtracting Y_{t-1} on both sides and turns the set of explanatory variables into terms of differences representing the short-run dynamics. The lagged levels of both dependent and explanatory variables remain in the rearranged functional form on the right-hand-side and capture the long-run (cointegrating) relationship in the system.

$$\Delta Y_t = \alpha + \sum_{i=1}^{m-1} A_i^* \Delta Y_{t-i} + \sum_{j=1}^{k} \sum_{i=0}^{m-1} B_{ij}^* \Delta X_{j,t-i} + C_0 Y_{t-m} + \sum_{j=1}^{k} C_1 X_{j,t-m} + \mu_t \qquad \text{(A2)}$$

where $A_i^* = -\left[I - \sum_{i=1}^{m-1} A_i \right]$, $B_{ij}^* = \left[\sum_{i=0}^{m-1} B_{ij} \right]$, $C_0 = -\left[I - \sum_{i=1}^{m} A_i \right]$, $C_1 = \left[\sum_{i=0}^{m} B_{ij} \right]$, the long-run multiplier of the system is given by $C_0^{-1} C_1$.

Equation (A2) is known as the error correction mechanism (ECM) representation of the model and can be rewritten as equation (A3) to capture well the error correction mechanism of the model (C_o).

$$\Delta Y_t = \alpha + \sum_{i=1}^{m-1} A_i^* \Delta Y_{t-i} + \sum_{j=1}^{k} \sum_{i=0}^{m-1} B_{ij}^* \Delta X_{j,t-i} + C_0 \left[Y_{t-m} + \left(\sum_{j=1}^{k} C_1 \Big/ C_0 \right) X_{j,t-m} \right] + \mu_t \qquad \text{(A3)}$$

Equation (A2) is the particular formulation generally used as the 'maintained hypothesis' of the specification search. The estimation procedure involves first estimating the unrestricted equation (A2), and then progressively simplifying it by restricting statistically insignificant coefficients to zero and reformulating the lag patterns where appropriate in terms of levels and differences to achieve orthogonality. As part of the specification search, it is necessary to check rigorously at every stage even the more general of models for possible misspecification. Such checks will involve both a visual examination of the residual from the fitted version of the model and the use of tests for serial correlation, heteroskedasticity and normality in the residual, and the appropriateness of the particular functional form used. In particular, any suggestion of autocorrelation in the residual should lead to a rethink about the form of the general model. Above all, theoretical consistency must be born in mind throughout the testing down procedure.

To closely look at how the estimated coefficients of real exchange rate change through time, recursive estimates are performed after equation (A2) is appropriately estimated. In recursive estimates, the equation is estimated repeatedly, using ever larger subsets of the sample data. The first observations are used to form the first estimated coefficients and then the

next observations are added to the dataset and are used to compute the second estimated coefficients. This process is repeated until all the sample points have been used.

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Table I

Dickey-Fuller Test for Unit Roots

Variables	**t-statistic for level**	**t-statistic for first difference**
Real exchange rate log (RER)	-1.51 (9)	-2.30 (7)**
Total government spending log (GSPEND)	-2.43 (9)	-4.45 (3)*
Net foreign assets (NFA)	-2.89 (2)	-3.05 (5)*
Terms of trade log (TOT)	-2.00 (2)	-7.91 (1)*
Productivity differential toward tradable goods log (HBS)	-5.14 (10)*	-2.23 (8)**
Trade openness log (OPEN)	-3.48 (4)	-4.74 (5)*

Note: '*' and '**' denote the rejection of the null hypothesis 5 and 10 per cent level of significance, respectively. Figures in parentheses indicate the order of augmentation selected on the basis of the Akaike Information Criterion (AIC).

Table II

Determinants of the real exchange rate in Thailand, 1995–2008

Variables	Equation Parameter (t-ratio)	
Constant	+0.60	+2.88*
Dlog(gspend)	-0.08	-2.78*
Dlog(nfa),t-2	-0.06	-2.68*
Dlog(tot)	-0.08	-1.58***
Dlog(hbs)	-0.33	-10.87*
Dlog(hbs),t-1	-0.11	-3.24*
Dlog(open),t-2	+0.07	+1.90**
D97Q3	-0.19	-9.60*
D98Q2	-0.05	-3.54*
D08Q2	+0.06	+3.61*
LR relationship		
Log(RER),t-1	-0.35	-5.14*
Log(gspend),t-1	-0.20	-4.73*
Log(nfa),t-1	-0.006	-1.14 ***
Log(hbs),t-1	-0.28	-6.16*
LR coefficients		
Log(gspend),t-1	-0.57	
Log(nfa),t-1	-0.02	
Log(hbs),t-1	-0.80	
Diagnostic tests		
No. of observations (after adjustment)	51	
Adjusted R2	0.94	
SE of regression	0.012	
LM – X2	0.61 (p-value=0.55)	
RESET – F version	1.11 (p-value=0.30)	
JBN – X2	1.61 (p-value=0.45)	
ARCH – X2	2.51 (p-value=0.09)	

Notes: (1) The equation adds three dummy variables, which are dummy = 1 for 1997Q3, 1998Q2, 2008Q2 and 0 for otherwise, with the purpose of interpretation for abnormal situation during those period. 1997Q3 and 1998Q2 for Asian crisis, and 2008Q2 for the contagion of the financial disaster and world economic contraction in 2008.

(2) * = 5% ** = 10% and *** = 15% statistical significance level accordingly.

(3) LM = Lagrange multiplier test of residual serial correlation
RESET = Ramsey test for functional form misspecification
JBN = Jarque-Bera test for the normality of residuals
ARCH = Engle's autoregressive conditional heteroscedasticity test
DF = the corresponding t-statistics of lagged residual from testing DF unit roots on residual

Figure 1

Nominal Exchange Rate

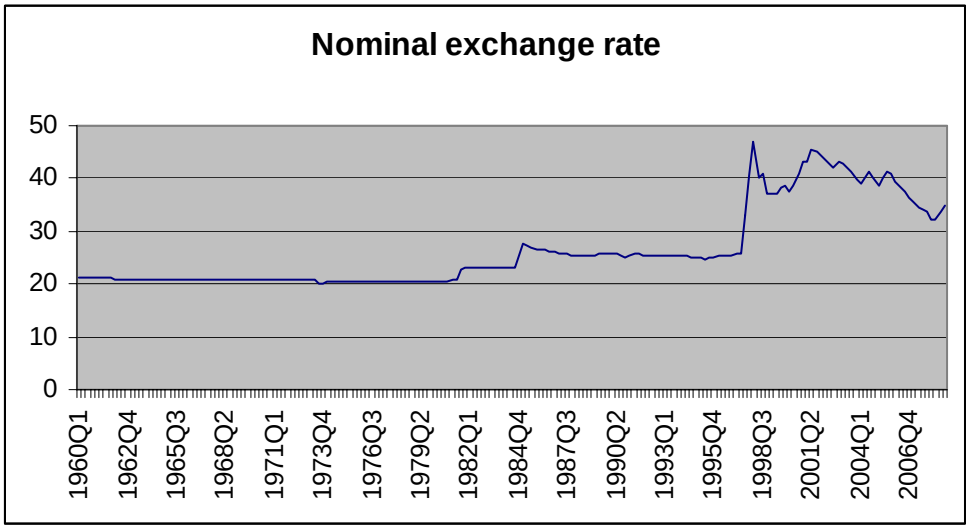

Figure1: Nominal exchange rate (Baht per U.S. dollar), 1960-present (Quarterly)

Figure 2

Current Account (% of GDP)

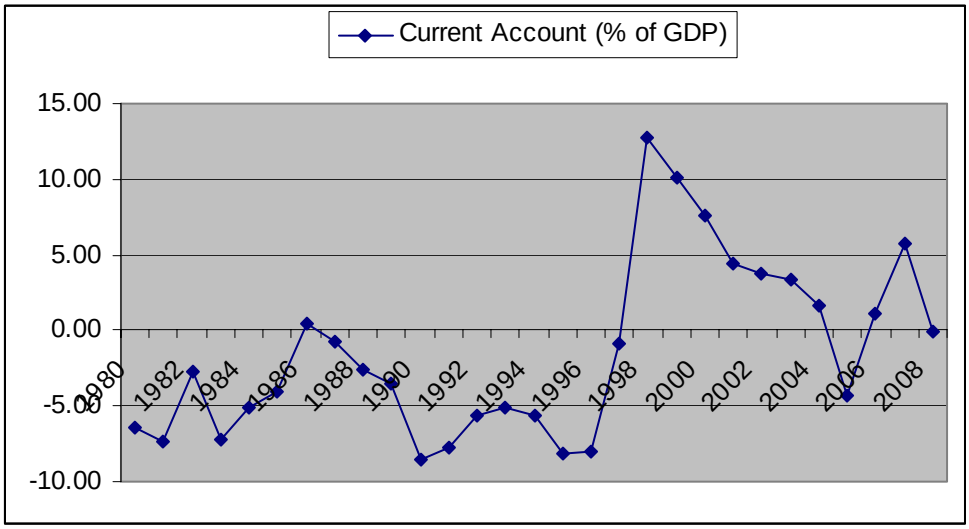

Figure2: Current account (% of GDP), 1980-present (Annual)

Figure 3

Capital Account

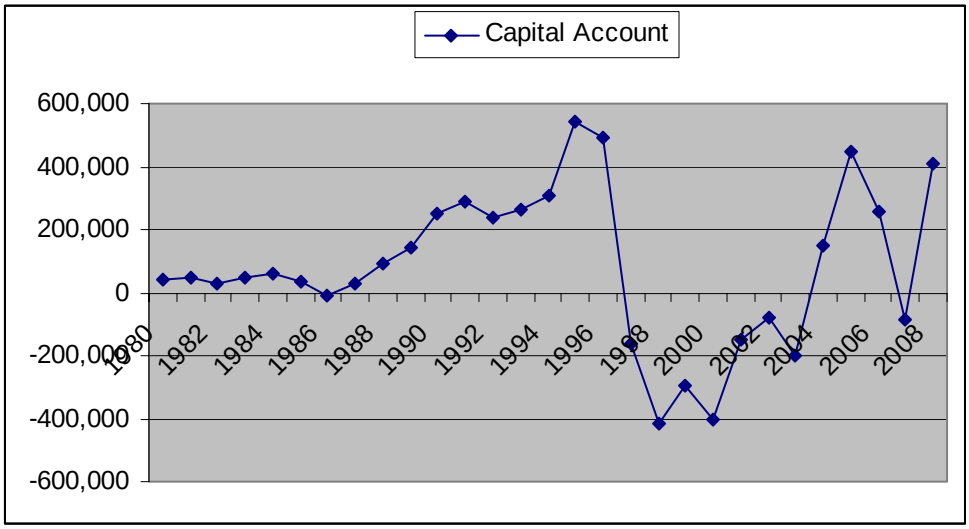

Figure3: Capital account (million baht), 1980-present (Annual)

Figure 4

Short-term Capital

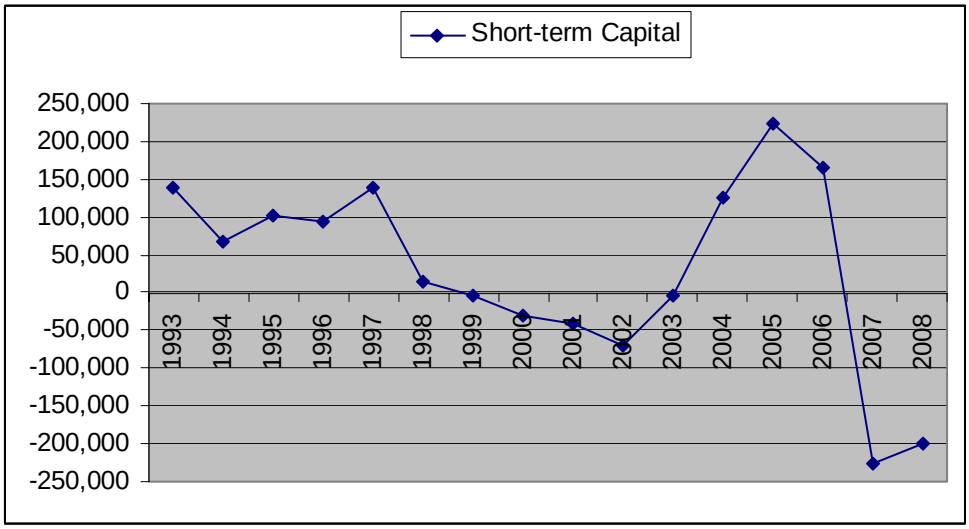

Figure4: Short-term capital (million baht), 1993-present (Annual)

Figure 5

Capital Account and Short-term Capital

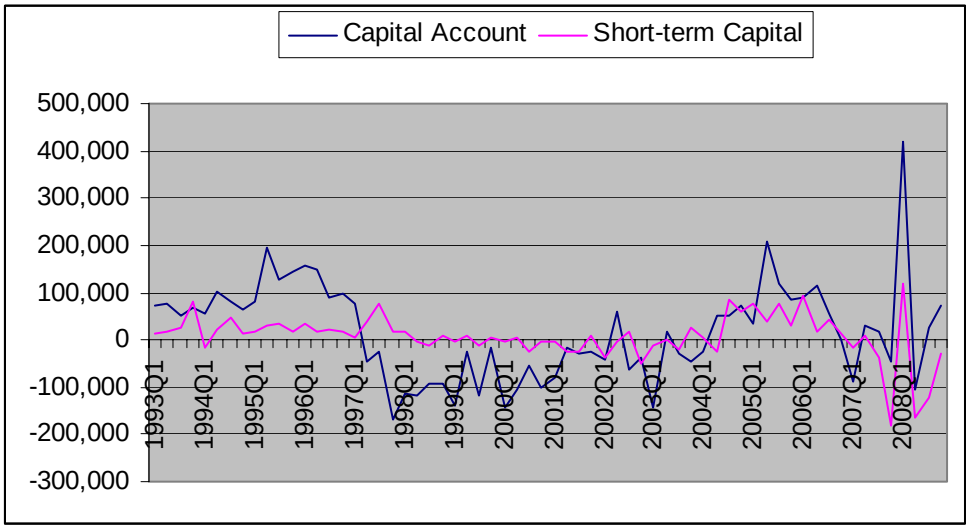

Figure5: Capital account and short-term capital (million baht), 1993-present (Annual)

Figure 6

Real GDP Growth

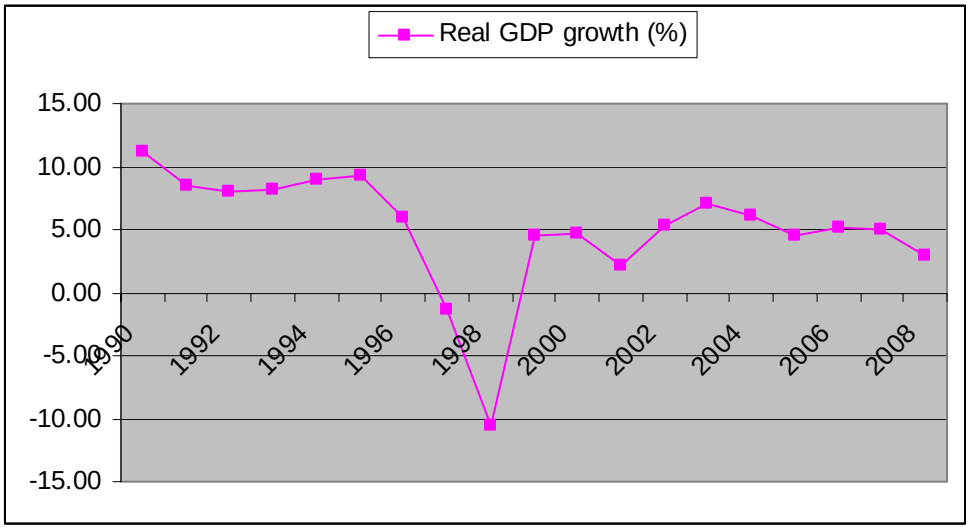

Figure6: Real GDP growth (percentage), 1990-present (annual)

Figure 7

Actual RER and RER Equilibrium

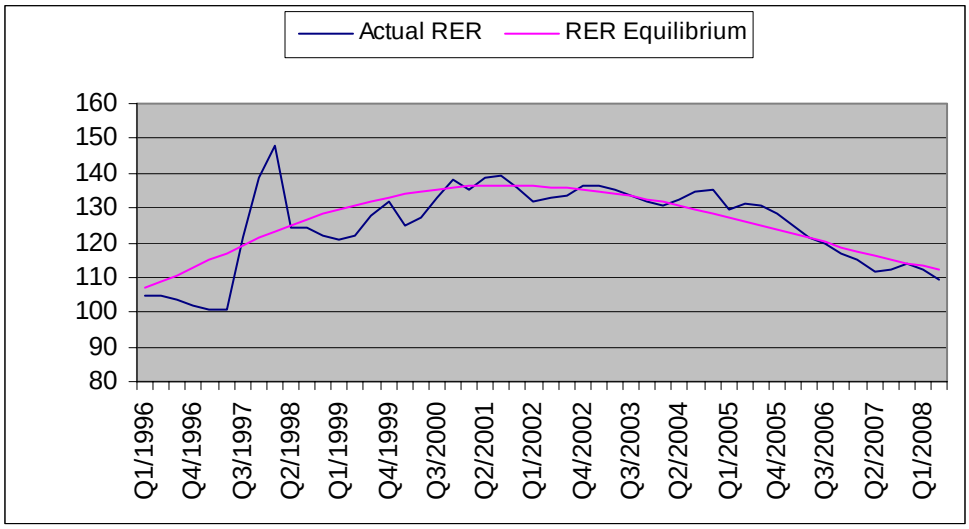

Figure7: Actual RER and RER equilibrium, 1996-present (Quarterly)

Figure 8

RER Misalignment

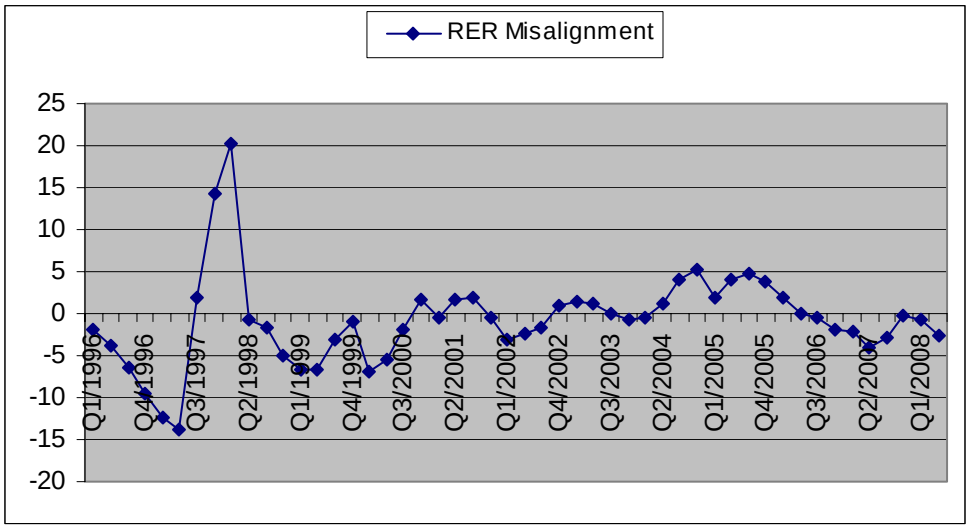

Figure8: RER misalignment (percentage), 1996-present (Quarterly)

Figure 9

Reserve Adequacy Ratio

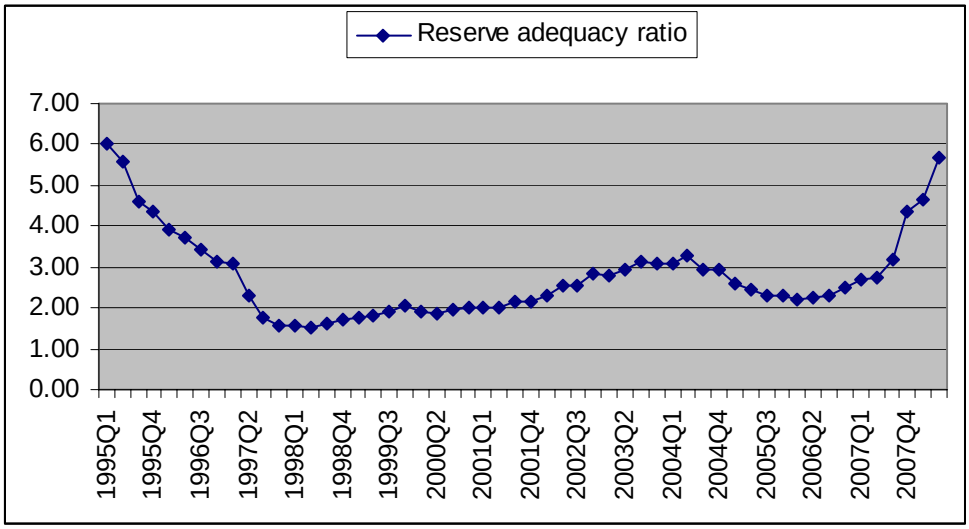

Figure9: Reserve adequacy ratio, 1995-present (Quarterly)

Figure 10

Foreign Exchange Reserve

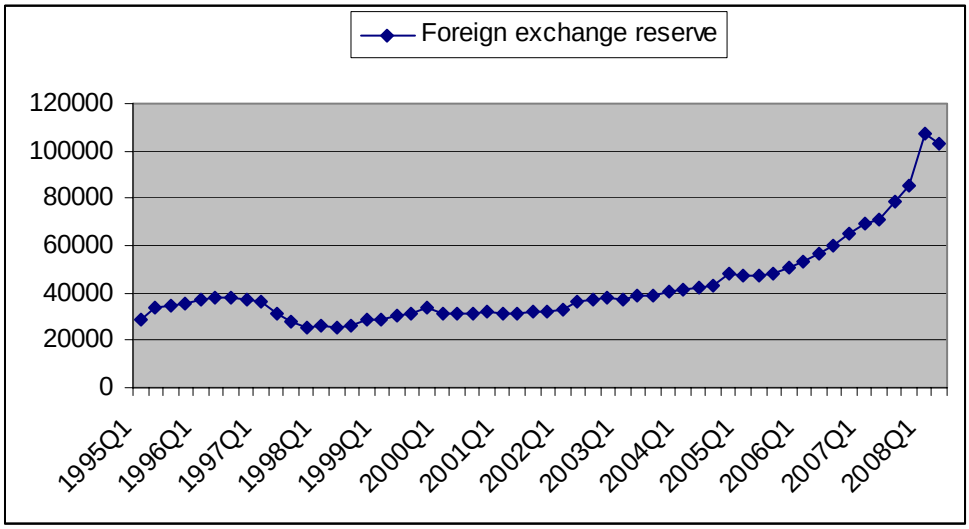

Figure10: Foreign exchange reserve (million baht), 1995-present (Quarterly)

Figure 11

Stock of Mobile Capital

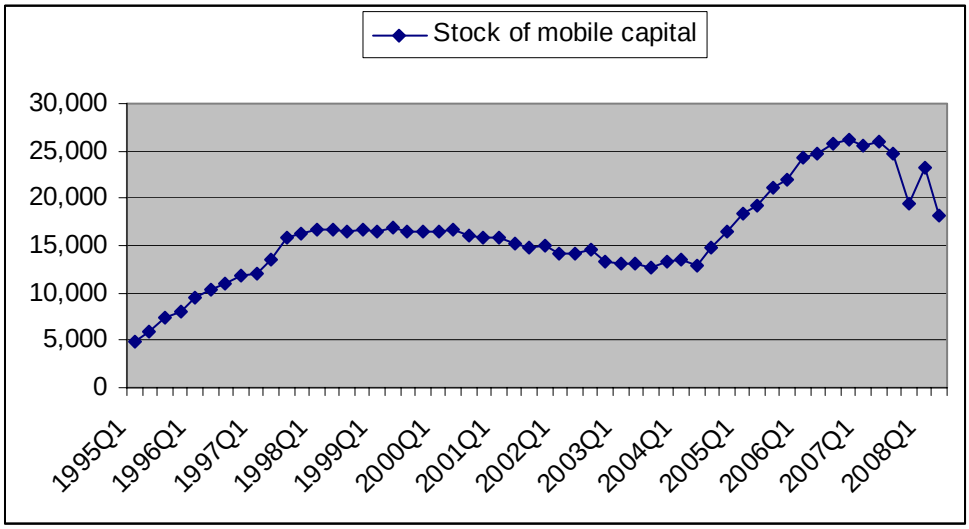

Figure11: Stock of mobile capital (million baht), 1995-present (Quarterly)

Figure 12

Financial Fragility

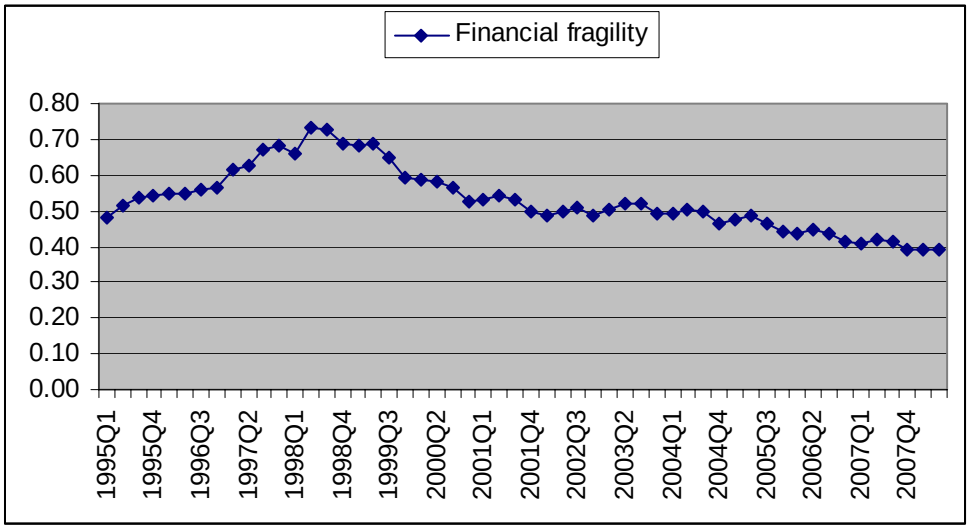

Figure12: Private domestic credit (% of GDP), 1995-present (Quarterly)

Figure 13

Fiscal Position

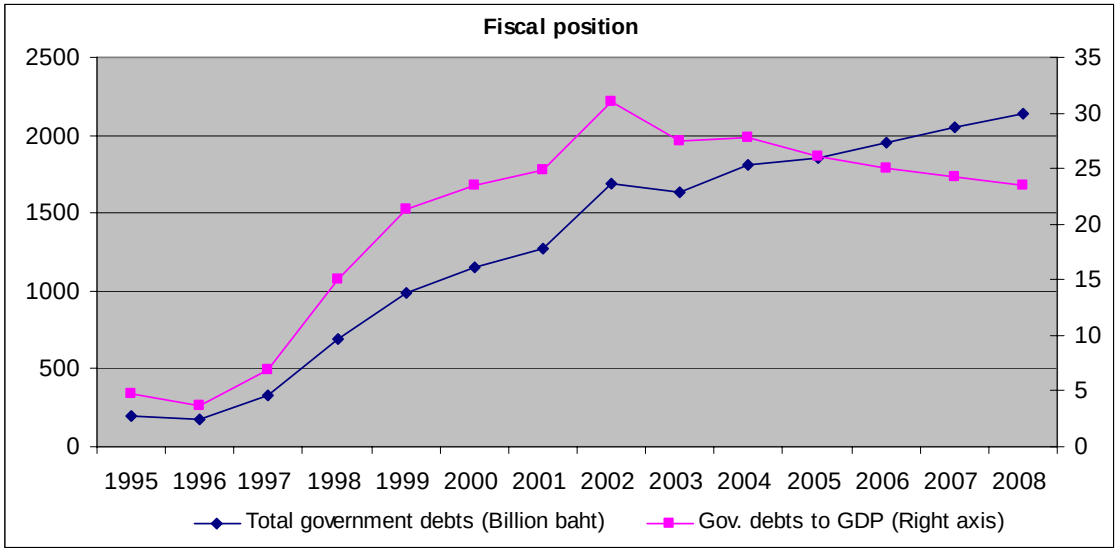

Figure13: Government debt (billion baht and % of GDP), 1997-present (Annual)

Figure 14

Composite Index

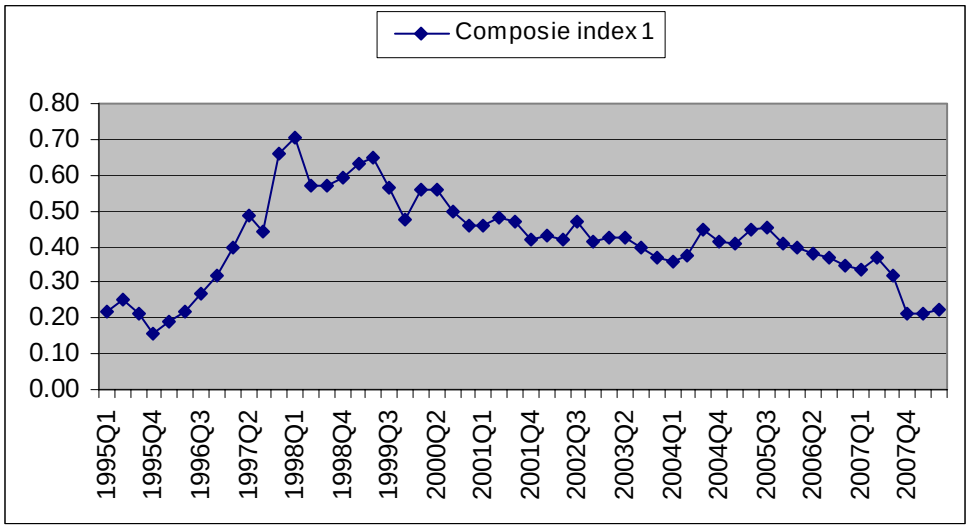

Figure14: Composite index of vulnerability with equal weight, 1995-present (Quarterly)

Figure 15

Sensitivity Analysis of Composite Index

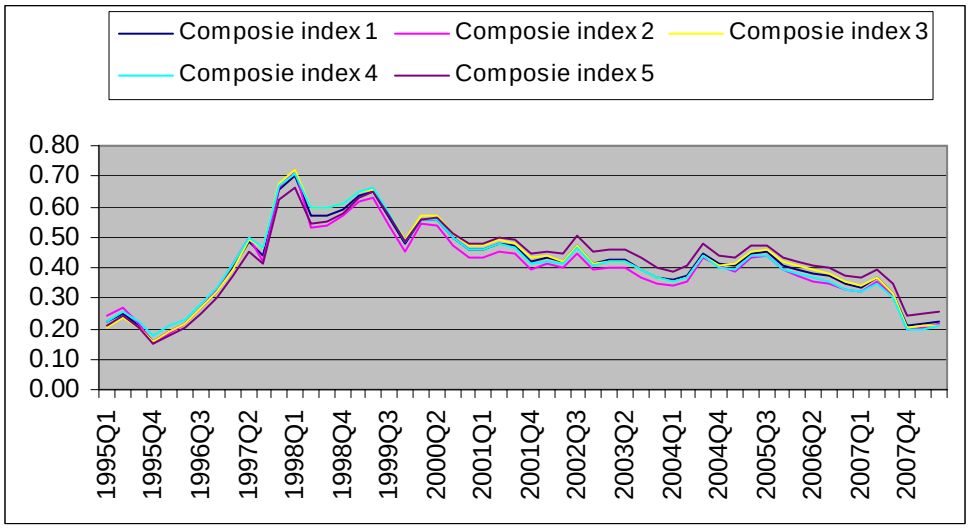

Figure15: Composite index of vulnerability, 1995-present (Quarterly)

Note: More weight 20% for RER misalignment (index 2), reserve adequacy ratio (index 3), financial fragility (index 4) and fiscal position (index5)