Analysis of Real Exchange Rate (RER): A Case Study of Thailand

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Abstract

This paper examines the explanatory variables that can affect the real exchange rate (RER). It aims at investigating the way in which RER (real exchange rate) misalignment relates to the Thai economy in regarding the financial crisis, capital control policy imposed by the central Bank of Thailand (BOT), and import/export. The RER (real exchange rate) at the equilibrium level will be estimated using the behavioral effective exchange rate model (BEER model). RER (real exchange rate) misalignment is observed through comparing the calculated RER (real exchange rate) and the estimated RER (real exchange rate) in the long run equilibrium. Using data from year 1993Q1 to 2010Q4, it can be observed the direction in which each main economic factors affecting RER (real exchange rate). The result reveals the RER (real exchange rate) misalignment; overvaluation in the period before 1997 Asian financial crisis and before US subprime crisis in 2008. These misalignments of RER (real exchange rate) correspond to the intervention from BOT. With RER (real exchange rate) misalignment, the impact on import/export sector plays vital role towards criteria of policy selection.
## Contents

Introduction .................................................................................................................. 3

Literature Review ........................................................................................................ 6

Theoretical Framework ............................................................................................ 9

Conceptual Framework .............................................................................................. 13

Research Method ...................................................................................................... 14

Data ............................................................................................................................. 14

Econometrics Model ................................................................................................... 21

Estimated Results ....................................................................................................... 22

  Unit Root Test ......................................................................................................... 22

  Granger Causality Test ............................................................................................ 23

  Cointegration Analysis ............................................................................................ 24

  OLS estimation of short run and long run RER (real exchange rate) Equilibrium ......... 25

Analysis ...................................................................................................................... 28

  Analysis of factors affecting RER (real exchange rate) ........................................... 28

  Analysis of RER (real exchange rate) Misalignment with crisis, export/import and capital control ........................................................................................................... 29

Conclusion .................................................................................................................. 37

Limitation .................................................................................................................... 37

Suggestion ................................................................................................................... 38

References .................................................................................................................. 39

Appendix I ................................................................................................................... 41

Appendix II .................................................................................................................. 43
Introduction

In macroeconomic perspectives, especially in open economies, exchange rate is rather significant. The exchange rate is defined as “the price of one currency in terms of another” (Mishkin, 2004). The real exchange rate (RER) is the nominal exchange rate adjusted for the inflation differential among countries. It could be interpreted as the purchasing power of two currencies relative to one another. The RER (real exchange rate) is used to represent a country’s competitiveness in international trade.

Thailand is a developing country with an open economy. The majority of its income comes from the manufacturing sector, in which mostly for export since manufacturing products are in the first rank of export product. As a result, Thailand mainly derives its income from export, and in the year 2010, it is ranked the 19th biggest exporter of the world\(^i\). However, most of Thai laborers are in agricultural sector which contributes to a smaller share of GDP than the manufacturing sector. Moreover, the Thai economy also gains a lot of income from tourism. Thus, the variations in exchange rates can have a great effect on the Thai economy, since it is all about competitiveness in exporting products and tourism.

The Thai exchange rate was pegged to the U.S. Dollar after World War II and was subsequently pegged to a weighted basket currency of its major trading partners later on. Eventually, Thai economy encountered a currency crisis in 1997 known as the “Tom-yum-kung crisis”, and the Thai government could not continue buying baht to maintain fixed exchange rate anymore. It had to adopt a managed-floating exchange rate regime where the central Bank of Thailand (BOT) would intervene in the system if necessary. In a normal situation, the central bank will let the currency float according to the demand and supply of currencies. The introduction of the managed floating system of exchange rate rised the exchange rate from around 20 baht per U.S. Dollar (pegging regime) to around 50 baht per U.S. Dollar. This is believed to be caused by speculative attacks\(^{ii}\). In addition, BOT used monetary targeting regime between the year 1997 and year 2000, after which it changed to the present inflation targeting regime.

\(^i\) Information and Communication Technology Center with Cooperation of the Customs Department

\(^{ii}\) Speculative attack is the situation in which there is expectation of devaluation of national currency, so the speculators sell national currency held and buy foreign reserves. Then, they sell it afterwards at higher rate after depreciation of national currency.
At the present time, compared to US dollars, Thai baht tends to appreciate in the future due to the US financial and economic crisis in 2008. Through various policy packages aimed to stimulate the US economy, the money injected into the economy caused the interest rates within the USA to be low. Excess money supply flowed into other countries with higher return. Thailand is one of those capital recipient countries, which lead to appreciation of the Thai baht.

Underlining the role of the central bank (Bank of Thailand), it should be very precise in analyzing what is going on with the RER (real exchange rate) in each time period, due to the capital control policy imposed to prevent drastic fluctuations in currency price, since appreciation of the Thai baht could have an adverse effect on the Thai export sector, and unfortunately makes Thai export products seem relatively expensive in foreigners’ view. Thus, it is a duty to protect exporters and maintain stability by intervening to prevent Thai baht appreciation. The situation illustrated shows how RER (real exchange rate) can’t be naturally adjusted to truly reflect the actual economic fundamentals of the country with the central bank intervention.

Furthermore, one has to keep in mind that changes in the RER (real exchange rate) would affect short term capital flows and thus, affect the liquidity in the economy. As a result, the RER (real exchange rate) is always brought up as one of the possible causes of the currency crisis. For example, when the Baht declined in value while employing a fixed exchange rate regime, making BOT had to use foreign reserve to buy back Baht. However, investors is not so comfortable with the instability of Baht, as they were aware that devaluing the Baht could downside the economy, as BOT cannot keep on buying Baht forever. So they send their money out of the country before it was too late. This is called “capital flight”, and further worsened the exchange rate, leading to the final decision to adopt a floating exchange rate which caused the crisis in the Thai economy.

RER (real exchange rate) misalignment, the deviation of the RER (real exchange rate) from what it should be at the equilibrium level in the steady state, could possibly be used as a signal to detect a coming crisis. If the actual RER (real exchange rate) is higher than the “should be equilibrium”, it is called undervaluation while a relatively lower actual RER (real exchange rate) is called overvaluation. According to previous research, persistent appreciation of the RER (real exchange rate) has been identified as major factor in setting scene for crisis because it implies that the country may have less ability to defend its currency in speculative
attacks leading to currency crises and the misalignment also makes the country vulnerable to exogenous effects. On the contrary, some findings show that there is no overvaluation of the RER (real exchange rate) in the pre-crisis period. (Juthatip J., 2009) However, there are many other views on its relation with the overall performance of a country’s economy.

The RER (real exchange rate) can have a relation with many more aspects of the economy, but in this paper, only three aspects mentioned above (crisis, central bank capital control policy intervention, and export/import) will be analyzed in relation to the situation of the RER (real exchange rate) that is estimated at each period of time in the Thai economy.

This paper’s main objective is to examine the explanatory variables that may have an impact on the RER (real exchange rate). It also aims at investigating the way in which RER (real exchange rate) misalignment relates to the Thai economy in the aspects of financial crises, import/export, and capital control policy imposed by the central Bank of Thailand (BOT).

To conduct an analysis, this paper focuses on the situation in Thailand with the use of time series data during the period 1993Q1 to 2010Q4. (Quarterly secondary data)

The method used in this paper is based on a quantitative approach in order to estimate a RER (real exchange rate) equilibrium that reflects economic fundamentals. Cointegration analysis of a time series regression model is used to see the relationship of the studied economic variables as determinants of RER (real exchange rate). A descriptive approach is used along with the quantiative model mention above to analyze and compare the calculated RER (real exchange rate) with the RER (real exchange rate) equilibrium computed with econometric model.

At the final part of the paper, after research summary and a result interpretation has been made, further suggestions for possible future research in this or relevant topic is provided.
Literature Review

There are many definitions of the RER (real exchange rate). Chinn (2006) mentioned that the most common definition is the nominal exchange rate adjusted for price levels, based on the purchasing power parity model, as he explored the RER (real exchange rate) in his paper, stating that it plays a crucial role in models of open economy on how it is defined, how it behaves over time, and what determines its variation over various time horizons.

As a result of its importance, a lot of research had attempted to identify the determinants of RER (real exchange rate), as well as Faruqee (1995), he described the long-run determinants of RER (real exchange rate) as net foreign assets and other factors affecting trade flows, in his paper of determining long run RER (real exchange rate). Its determinants vary according to different economy conditions and different factors affecting trade flows. For example, in South African economy, oscillation in the terms of trade, arising chiefly from fluctuation in the gold price, and recurrent political shocks that cause outflows of freeing capital, are the important determinants, according to Gerson and Kahn (2006).

Many researches had investigated on determinants of RER (real exchange rate). Gross (2008) took a close look on relationship between capital control and RER (real exchange rate), using propensity score matching, a statistic technique, in analyzing the treatment effect of capital control policy on real exchange rate volatility. The result is that treatment effect in adopting relatively liberal capital controls, do decrease the RER (real exchange rate) volatility.

One important determinant of RER (real exchange rate) is export sector. Sackey (2001) studied the relationship among RER (real exchange rate), foreign aids and impact on export performance in Ghana. The author found out that aid inflows have a depreciating effect on the RER (real exchange rate) and so have positive impact on export performance, as mentioned and confirmed in the study that appreciation of RER (real exchange rate) has negative effect on export performance by his estimated export performance model.

As well as Jongwanich’s paper in 2009, she studied relationship among equilibrium RER (real exchange rate), RER (real exchange rate) misalignment, and export performance in eight Asian economies during 1995-2008. The author found that there is a RER (real exchange rate) persistent overvaluation before crisis in the crisis-affected countries and RER (real exchange rate) undervaluation after the crisis. She also found the positive relationship
between RER (real exchange rate) and export performance in all sample countries, which means if RER (real exchange rate) depreciate, export volume will increase. Moreover, RER (real exchange rate) misalignment could have negative impact on export performance in those economies in long run. But the level of impacts varies among countries. Thus, negative impact of RER (real exchange rate) appreciation on export would be more significant when it is associated with RER (real exchange rate) misalignment. She suggested that RER (real exchange rate) misalignment could be regarded as one of the keys indicators of level of vulnerability of economy to currency speculation and crisis.

Another work of Jongwanich (2008), she studied the relationship between Thai RER (real exchange rate) and its currency crisis during 1997-1998. She found that there is RER (real exchange rate) misalignment before the crisis; the RER (real exchange rate) overvaluation from 1991 up to 1997 yielded too much short-term inflows. Then RER (real exchange rate) depreciated in huge amount during the crisis and returned to its equilibrium level. As well as Naseem, Tan and Hamizah (2009), they also have the parallel result of relationship between crisis and RER (real exchange rate) misalignment. The RER (real exchange rate) misalignment in Malaysia was overvalued during 1993:Q2 to mid 1997 and after the Asian financial crisis in July 1997, undervalued RER (real exchange rate) was presented from 1997:Q3 till 2003:Q4. Again, Kemme and Roy (2005) found the same pattern of RER (real exchange rate) misalignment in Russia; pro-long overvaluation in the pre-crisis and the devaluation and undervaluation during and after the crisis, it was approaching equilibrium in year 2001.

Moving on to estimation of RER (real exchange rate) misalignment, there are many approaches to choose from, but the most suitable one is behavioral effective exchange rate model. Clark and MacDonald (1998) mentioned in their research on comparing behavioral effective exchange rate model and fundamental effective exchange rate model, that behavioral effective exchange rate model’s basic equilibrium concept is the systematic relationship between real effective exchange rate and its economic determinants, which are economic fundamentals. They believe that behavioral effective exchange rate model has desirable properties; stock-flow consistent, systematic estimator model, which would be useful in future more sophisticate application.

Furthermore, MacDonald and Dias (2007) used Behavioral equilibrium exchange rate estimates in implying exchange rate adjustments in their paper. They mentioned that
behavioral effective exchange rate model has been widely used for the main industrial countries and also transition countries. For reasons it is chosen, it is considered to replace the ordinary purchasing power parity measures, as Purchasing power parity has high RER (real exchange rate) volatility and slow mean reversion of RER (real exchange rate) making it’s not a useful measure. Behavioral effective exchange rate model is argued to be more advantage than other internal external balance approach, especially fundamental effective exchange rate model. It can capture all the systematic and fundamental movement of exchange rates and can be subject to rigorous statistic testing. Moreover, it is tractable approach to gauging an equilibrium exchange rate, usually single equation approach using time series or pane data.

In line with Robinson (2010), he estimated the equilibrium RER (real exchange rate) in Jamaica over three time horizons; short run, medium run, and long run. The author selected the different model for each time horizon;

“The capital enhance equilibrium exchange rate model (CHEER) was selected for the short run model with sufficient variables to capture effects of uncovered interest rate parity, purchasing power parity and risk premium. The behavioral effective exchange rate model method was used for both short run and medium run analysis on the grounds of being wholly determined by fundamental variables. The permanent equilibrium exchange rate model, which is a decomposition of the behavioral effective exchange rate model, was also selected on the basis of being a more positive approach than the alternative models.”

He also recommended the medium run and long run equilibrium model in the process of actively monitoring impact of structural change and misalignment in foreign exchange market, which behavioral effective exchange rate model: Medium run analysis is used in this research.
Theoretical Framework

Theory of Exchange Rate

Exchange rate is relative price of two currencies. It is the price of one currency in terms of another. (Mishkin, 2004)

Nominal Exchange Rate

Nominal exchange rate is the price of one currency in terms of another. It’s usually expressed as the domestic price of the foreign currency. (Luis A.V. Catão, 2007) For example, 35 TH/US can be interpreted as 35 Thai baht must be used in order to buy 1 US dollar, or to get 1 Thai baht, 0.029 US dollar is needed. However, relying on only nominal exchange rate can’t tell purchasing power since each country has different living expense. Prices of goods and services in each country differ. RER (real exchange rate) should come to play a role.

Real Exchange Rate

RER (real exchange rate) is the product of nominal exchange rate and the ratio of domestic and foreign price indices. It helps measure the value of a country’s goods against those of another country, or a group of countries. It can be used to compare purchasing power between countries. RER (real exchange rate) is always measured as purchasing power benchmark in terms of basket of goods such as the consumer price index (CPI), which includes both goods and services. (Luis A.V. Catão, 2007)

\[ RER = e \cdot \frac{P^*}{P} \]

\( e = \text{nominal exchange rate} \)

\( P^* = \text{price index of goods in foreign country} \)

\( P = \text{price index of the goods in domestic country} \)
Theory of BEER (Behavioral Equilibrium Exchange Rate) Simulation

According to approach proposed by Clark and Macdonald (1998), BEER approach is used to estimate relationship between long run equilibrium RER (real exchange rate) and economic variables with following equation.

\[ q_t = \beta'Z_t + \gamma'T_t + \mu_t \]

- \( q_t \) = long run equilibrium of RER (real exchange rate)
- \( Z \) = economic variables affecting RER (real exchange rate) equilibrium in long run
- \( T \) = economic variables affecting RER (real exchange rate) equilibrium in short run
- \( \beta', \gamma' \) = coefficient
- \( \mu \) = error terms

To estimate long run equilibrium, let \( T \) and \( \mu \) be zero.

\[ q_t' = \beta'Z_t \]

Thus, deviation from RER (real exchange rate) long run equilibrium is denoted as follow.

\[ q_t - q_t' = \gamma'T + \mu \] ; Deviation due to effect of short term economic variable

\[ q_t - q_t' = q_t - \beta'\bar{Z}_t \] ; Deviation due to effect of long term economic variable

Where \( \bar{Z}_t \) = the estimated economic variables affecting RER (real exchange rate) equilibrium in long run

Deviation of RER (real exchange rate) from long run equilibrium is resulting from short run economic variable, deviation from actual economic fundamentals and error term.
Theory of Foreign Exchange Market and Determinants of Real Exchange Rate

In this paper, based on previous literatures observed, major economic variables that can have impact on RER (real exchange rate) are selected.

\[ \text{RER} = f(NFA, TOT, GS, TO, INT, DMCC) \]

NFA = Net Foreign Asset

TOT = Terms of Trade

GS = Government Spending

TO = Trade Openness

INT= TH/US interest rate

DMCC=Dummy variable of Capital Control (policy imposed by central bank)

Foreign exchange market is the market in which national currencies are traded for one another. There is linkage between foreign currency’s demand/supply and Thai baht. Demand for foreign currency implies supply of Thai baht as people will trade Thai baht in order to get foreign currency. Supply of foreign currency implies demand for Thai baht as people want to give out foreign currency to get Thai baht. (Froyen, 2008)

Assume no intervention, foreign exchange market can be illustrated in the following diagram.

Determinants of exchange rate can be any factors having potential to shift up or down the demand-supply curve shown such as export, import, or capital inflow. If any factor causes demand and supply to shift downward, lowering exchange rate, then Thai baht is said to be appreciated. On the contrary, if factors shift any of the 2 curves upward, exchange rate is higher and Thai baht is said to be devalued.
Selected variables in this paper as factors determining RER (real exchange rate) can have an impact on the demand-supply curve which will be studied further.

To be more precise on definitions of determinants of RER (real exchange rate) see next section for descriptions. Also, explanation on relationships between variables according to theory will be clarified.
To explore relationship between economic environments and RER (real exchange rate), it is challenging. With estimation of long run equilibrium of RER (real exchange rate), RER (real exchange rate) misalignment can be observed by comparing it to actual RER (real exchange rate). RER (real exchange rate) misalignment can be seen as related to crisis, capital control policy and export/import.

**Variables**
- Independent Variables
  - GS, INT, NFA, TOT, TO, DMCC
- Dependent Variables
  - RER

**Method of Analysis**
- **BEER Approach**
  (To estimate LR-RER equilibrium and to see relationship of factors affecting RER)
- **Unit Root Test using ADF**
  (To test stationarity of the data)
- **Cointegration Analysis by Unit root test of residuals**
  (To determine co-movement in LR-equilibrium and to see relationship between set of time series variables)
Research Method

I. Definition, Sampling and Source of Data

This paper uses time series data quarterly collected from year 1993-2010. Domestic country in the analysis is Thailand. Even though, U.S. is the third major trade partner of Thailand, following the first and second trade partners like Japan and China respectively, this paper chooses the USA as the only major trading partner in analysis for the ease of calculation, finding data and interpretation. Since data available usually come in form of U.S. Dollars and Thailand usually uses the Baht per U.S. Dollar for unit in explaining exchange rate situation.

Real exchange rate

In this paper, RER (real exchange rate) is defined as the relative price of tradable to non-tradable goods in domestic country corresponding to foreign country. (Menzie D. Chinn, 2006) Foreign country stated in this paper is scoped to be major trading partner of Thailand which is the USA.

After observing empirical studies in previous literatures, commonly used model as a measure of RER (real exchange rate) is defined as followed. To make domestic currency value comparable for all other foreign currencies, weight is assigned by considering trade balance with each foreign country.

\[ RER = \frac{\prod_{i=1}^{n} \left[ s_{TH} \cdot p_i \right] w_i}{p_{TH}}, \text{where} \sum_{i=1}^{n} w_i = 1 \]

\( n \) = numbers of major trading partners (foreign country i)
\( s_{TH} = \text{nominal exchange rate (TH/US dollar)} \)
\( p_{TH} = \text{Price Index in Thailand} \)
\( p_i = \text{Price Index for i foreign country} \)

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$w_i = \text{appropriate weight assigned for each i-th foreign country}$

In this study, foreign and domestic price indices are represented by the producer price index (PPI) and consumer price index (CPI), respectively. PPI is dominated by the price of tradable goods and CPI is dominated by price of non tradable goods. Furthermore, the geometric average outperforms the simple average in mitigating the problem of changing export structure as well as enabling one to capture both current policy analysis and representative ones from the past (Hinkle & Montiel, 1999; Juthatip, 2009).

**Net Foreign Asset**

Net foreign asset is the value of the assets that a country owns abroad, minus the value of the domestic assets owned by foreigners.$iv$ Net foreign asset used in this paper is net portfolio investment (value of investment abroad by Thai investors less value of investment in Thailand by foreign investors) expressed as a ratio to nominal GDP.

$$NFA = \frac{\text{Net Foreign Asset}}{\text{Nominal GDP}}$$

For net foreign asset variable (NFA), from Portfolio Balance Model, net foreign asset can be changed as a result of the change in current account in the part of income gained from investment abroad (interest, dividend, transfer payment). If there is a reduction in foreign assets held in the hand of domestic people, income gained from these foreign assets declines. When the trade balance is set constant, current account will be deficit. Under (managed) floating exchange rate system, current account deficit leads to the depreciation of RER (real exchange rate).

*Therefore, the hypothesis is that the NFA will have a negative effect on RER (real exchange rate).*

**Terms of Trade**

Terms of trade is the relative price of exports compared to its imports. Terms of trade is most commonly used in economics referring to relative price, on world markets, of a country's exports compared to its imports. (Marshall, 1923)

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$iv$ http://www-personal.umich.edu/~alandear/glossary
\[
TOT = \frac{\text{Export Index}}{\text{Import Index}}
\]

, where \( \text{Export Index} = \frac{\text{Export Value}}{\text{Export Price Index}} \)

\( \text{Import Index} = \frac{\text{Import Value}}{\text{Import Price Index}} \)

For terms of trade (TOT), it is the ratio of export relative to import prices to see how world price effect RER (real exchange rate). Theoretically, when trade ratio increases, price of country’s export goods rises due to higher world demand. The country will be more affluent and more influx of foreign currency will occur leading to appreciation of RER (real exchange rate).

\textit{Therefore, the hypothesis is that the TOT will have a negative relationship with RER (real exchange rate).}

\textbf{Government Spending}

Thai government spending collected to use in this paper includes the all expenses for compensation of employees, use of goods & services, consumption of fixed capital, interest, subsidies, grants, social benefits, and other expense.

\[
GS = \frac{\text{Government Spending}}{\text{GDP}}
\]

For government spending (GS), the increase in government spending tends to decrease RER (real exchange rate), although there is no clear relationship. It is assumed that most of the government spending is non tradable goods within country increasing demand for non tradable goods causing an increase in price. Since RER (real exchange rate) is the price of tradable to non- tradable goods, RER (real exchange rate) decreases when denominator increases with government spending.\(^v\)

\textit{Therefore, the hypothesis is that the GS will have a negative relationship with RER (real exchange rate).}

\textbf{Trade Openness}

\(^v\) Yearly Report Article from BOT
Trade openness shows the degree of trade that one country have with others. Trade can be defined as import, export, foreign direct investment, borrowing and lending, and repatriation of fund abroad.\(^{vi}\)

Trade would enable development as it creates greater market opportunities and funds from other countries, on the other hand, it can lead to the more competition too.

For methods in measuring trade openness, H. Yanikkaya divided in to 5 categories. In this paper, the most common one will be used by expressing trade in terms of trade share of income for a given country, that is, export plus import divided by GDP. (H. Yanikkaya, 2003)

\[
TO = \frac{Export + Import}{GDP}
\]

For trade openness (TO), if the country is more opened for trade, it can be implied that the domestic produced substitutes for imported goods are less enhanced. Import tends to increase, then demand for foreign currency increases. With this Thai baht is devalued.

*Therefore, the hypothesis is that the TO will have a positive relationship with RER* (real exchange rate).

**TH/US Interest Rate**

TH/US interest rate is expressed in ratio of discount rate in Thailand over the USA.

\[
INT = \frac{i_{TH}}{i_{US}}
\]

For TH/US interest rate (INT), if Thai rate of interest is higher than rate in US, there will be influx of foreign capital to the country making the country’s currency appreciate in value.

*Therefore, the hypothesis is that INT will have negative relationship with RER* (real exchange rate).

**Dummy Variable of Capital Control**

Capital control is the restriction imposed on capital flows to protect the economy from vulnerability to speculative currency crisis. (Pariyate, 2007) In this paper, the capital control

\(^{vi}\) http://www.enotes.com/business/q-and-a/what-trade-openness-87695
policy is focused on the one implemented during the period prior to the crisis. The main restriction is that the capital flowing into the country must have been kept as national reserve at the central bank of Thailand, the rest of 70% can then be used for investment. This reduces the money circulation in the economy with intention to prevent the appreciation of Thai baht. Dummy variable for the year in which there is the capital control policy imposed by central bank of Thailand is assigned the value to be 1 which is during 2006Q4-2008Q1. The rest is assigned 0.

For dummy variable of capital control (DMCC), if there is the capital control policy imposed, it means that there will be less amount of foreign currencies circulating in Thai economy than amount flowing in. The less inflow of capital leads to the depreciation of Thai baht.

Therefore, the hypothesis is that DMCC will positive relationship with RER (real exchange rate).

To make it easier for interpretation, log form of the data is used in this paper, except for NFA since log form can’t take function on negative value.

Overall, the hypothesized relationship among dependent and independent variables can be illustrated as following functions.

\[
\begin{align*}
RER &= -f(NFA) & RER &= +f(TO) \\
RER &= -f(TOT) & RER &= -f(INT) \\
RER &= -f(GS) & RER &= +f(DMCC)
\end{align*}
\]

Source :

Nominal Exchange Rate (TH/US) is extracted from International Financial Statistics Online Database of the International Monetary Fund (IMF).

\(P^{TH}\) is collected from Central Bank of Thailand (BOT)

\(P^i\) is from Australian Bureau of Statistics, Bureau of Labour Statistics, United States Department of Labour and Organization for Economic Cooperation and Development (OECD).

NFA is obtained from Central Bank of Thailand.
CPI, WPI, Export/Import Value, Export/Import Price Index is also extracted from International Financial Statistics Online Database of the International Monetary Fund (IMF) and Bureau of Trade and Economic Indices (BTEI), Ministry of Commerce.

RER (real exchange rate) and economic fundamentals from 1993Q1 – 2010Q4

And its first difference
II. Econometrics Model

\[ \text{RER} = f^{(NFA, TOT, GS, TO, INT, DMCC)} \]

\[ \text{RER} = c + \beta_1 NFA + \beta_2 TOT + \beta_3 GS + \beta_4 TO + \beta_5 INT + \beta_6 DMCC + \sum_{i=1}^{P} \beta_i \text{RER}_{t-1} + \hat{U} \]

In this paper, the econometric methods used here are granger causality test (Granger, 1969) to estimate equation above and to verify the hypothesis set. Before that, it is necessary to test for presence of unit roots in the time series to avoid spurious regression, otherwise, \( R^2 \) may be abnormally high. The time series property of data is tested using the Augmented Dickey-Fuller (ADF) test to determine whether the variables of equation above are stationary in first difference.

Unit root test with ADF is used to solve the autocorrelation by adding first difference lagged value in the variable (Gujarati, 2008).

Granger Causality Test which is technique for determining whether one time series data is useful in forecasting another (Granger, 1969) is being employed in order to observe if set of selected economic variables, including NFA, TOT, GS, TO, INT, DMCC granger-cause RER (real exchange rate).

When the variables contain unit roots and are non-stationary, cointegration analysis is applied to determine co-movement in long-run equilibrium RER (real exchange rate). This paper formulates model with OLS method and then test the residuals for unit root. While the residuals contain no unit root, it is stationary and so is cointegrated. (Gujarati, 2008)

Cointegration analysis can help examine long-term co movements between a set of time-series variables. Cointegrated variables may be drift apart temporarily, but must converge systematically over time. Hence, any model that imposes a deterministic long-run relationship between a set of integrated economic variables, which allow those variables to deviate over the short term, will show cointegration. (Juthatip, 2009)

Then, the OLS estimation method is used to form regression model in order to forecast the long run equilibrium of RER (real exchange rate). The level of RER (real exchange
rate) that should have been taken place at the steady state in long run equilibrium is forecasted and short run model is formulated also to see the misalignment from what it should be.

III. Estimated Results (Completed Test Results are shown in Appendix II)

A. Unit Root Test

Table 1

<table>
<thead>
<tr>
<th>Variables</th>
<th>ADF Test Statistics</th>
<th>Probability</th>
<th>1% critical value</th>
<th>5% critical Value</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>LEVEL Form</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>LNRER</td>
<td>-1.9866</td>
<td>0.2929</td>
<td>-3.5270</td>
<td>-2.9036</td>
</tr>
<tr>
<td>NFA</td>
<td>-0.4789</td>
<td>0.8866</td>
<td>-3.5285</td>
<td>-2.9042</td>
</tr>
<tr>
<td>LNTOT</td>
<td>-2.2788</td>
<td>0.1816</td>
<td>-3.5256</td>
<td>-2.9020</td>
</tr>
<tr>
<td>LNGS</td>
<td>-7.0252</td>
<td>0.0000</td>
<td>-3.5206</td>
<td>-2.9020</td>
</tr>
<tr>
<td>LNTO</td>
<td>-0.8323</td>
<td>0.8034</td>
<td>-3.5285</td>
<td>-2.9042</td>
</tr>
<tr>
<td>LNINT</td>
<td>-3.6590</td>
<td>0.0069</td>
<td>-3.5300</td>
<td>-2.9048</td>
</tr>
<tr>
<td>DMCC</td>
<td>-2.1652</td>
<td>0.2207</td>
<td>-3.5256</td>
<td>-2.9030</td>
</tr>
<tr>
<td><strong>1st Difference Form</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>△LNRER</td>
<td>-6.0509</td>
<td>0.0000</td>
<td>-3.5349</td>
<td>-2.9069</td>
</tr>
<tr>
<td>△NFA</td>
<td>-9.1158</td>
<td>0.0000</td>
<td>-3.5300</td>
<td>-2.9048</td>
</tr>
<tr>
<td>△LNTOT</td>
<td>-8.7335</td>
<td>0.0000</td>
<td>-3.5270</td>
<td>-2.9036</td>
</tr>
<tr>
<td>△LNGS</td>
<td>-5.6021</td>
<td>0.0000</td>
<td>-3.5366</td>
<td>-2.9077</td>
</tr>
<tr>
<td>△LNTO</td>
<td>-7.6448</td>
<td>0.0000</td>
<td>-3.5285</td>
<td>-2.9042</td>
</tr>
<tr>
<td>△LNINT</td>
<td>-4.2328</td>
<td>0.0012</td>
<td>-3.5332</td>
<td>-2.9062</td>
</tr>
<tr>
<td>△DMCC</td>
<td>-4.1633</td>
<td>0.0016</td>
<td>-3.5402</td>
<td>-2.9092</td>
</tr>
</tbody>
</table>

*NOTE: Δ represents first difference. ADF test is based on Akaike Information Criterion (AIC) to ensure residual whiteness.

To test stationarity of the time series data of each variable with the avoidance of spurious regression, ADF is used. Normally, every times series can occur 3 situations in ADF test, which are random process with intercept(c) and trend(t), random process with constant but without trend, and random process without constant and trend.
For the graph without obvious steep trend of each variable over time, time series should be best fitted with the second type, the random process with constant and without trend.

In this paper, quarterly data with small samples (72 observations) is used, lag value is automatically determined by lag length criteria of Akaike Information Criterion (AIC).

\[ \Delta RER = c + \beta_1 \Delta NFA + \beta_2 \Delta TOT + \beta_3 \Delta GS + \beta_4 \Delta TO + \beta_5 \Delta INT + \beta_6 \Delta DMCC + \sum_{i=1}^{p} \beta_i \Delta RER_{t-i} + \bar{u} \]

where \( p \) = lagged value

Null Hypothesis is that

\[ H_0 : \text{There is unit root in first difference for each variable. (Non stationary)} \]

\[ H_1 : \text{There is no unit root in first difference for each variable. (Stationary)} \]

The results of unit root test (Table 1) shows that relevant economic variables contain no unit root and are non stationary, the null hypothesis is rejected. RER (real exchange rate), net foreign asset, terms of trade, government spending, trade openness, TH/US interest rate, and dummy variable of capital control are stationary in first difference. These variables are said to be I(1). 5% significance level is used.

**B. Granger Causality Test**

**Table 2**

<table>
<thead>
<tr>
<th>At level data</th>
<th>Null Hypothesis</th>
<th>F Statistics</th>
<th>Probability</th>
</tr>
</thead>
<tbody>
<tr>
<td>NFA does not Granger Cause LNRER</td>
<td>2.9969</td>
<td>0.0569</td>
<td></td>
</tr>
<tr>
<td>LNTOT does not Granger Cause LNRER</td>
<td>2.4084</td>
<td>0.0979</td>
<td></td>
</tr>
<tr>
<td>LNGS does not Granger Cause LNRER</td>
<td>2.1650</td>
<td>0.1230</td>
<td></td>
</tr>
<tr>
<td>LNTO does not Granger Cause LNRER</td>
<td>1.0890</td>
<td>0.3453</td>
<td></td>
</tr>
<tr>
<td>LNINT does not Granger cause LNRER</td>
<td>0.7666</td>
<td>0.4688</td>
<td></td>
</tr>
<tr>
<td>DMCC does not Granger cause LNRER</td>
<td>0.1745</td>
<td>0.8402</td>
<td></td>
</tr>
</tbody>
</table>
Granger causality test is used to test the explanatory variables at level using 15% level of significance here. According to Table 3 testing granger causality at first difference form, at 15% significance level, all variables (NFA, TOT, TO, INT, DMCC) can be used to explain dependent variable (real exchange rate) except GS. Null hypothesis is rejected except the one stating that LNGS doesn’t granger cause LNRER. Thus, in this paper, GS will be excluded from model.

### C. Cointegration Analysis

#### Table 4

<table>
<thead>
<tr>
<th>Variables</th>
<th>ADF test statistic</th>
<th>Prob.</th>
<th>1% level</th>
<th>5% level</th>
</tr>
</thead>
<tbody>
<tr>
<td>Residuals</td>
<td>-3.7970</td>
<td>0.0003</td>
<td>-2.5994</td>
<td>-1.9457</td>
</tr>
</tbody>
</table>

To test for cointegration relationship and number of cointegrating vectors according to the way proposed by Johansen, 2 tests, trace test and maximum Eigen value, are usually used.

Here, in this paper, just simple unit root test of residuals after model formulation will be used.

The results in Table 4 show that residuals series tested contain no unit root since the null hypothesis ($H_0$: Residual has unit root.), is rejected at 1% level of significance. When the
residual series has no unit root, it is stationary and the times series of these economic variables are said to have cointegration relationship in the long run except GS.

This paper will exclude variable GS since from it is not significance and cannot help explain dependent variable (real exchange rate) from granger causality test.

D. OLS estimation for Short Run and Long Run Equilibrium

Table 5

<table>
<thead>
<tr>
<th>Variable</th>
<th>Coefficient</th>
<th>T-statistics</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Short Run Model</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>C</td>
<td>0.2383</td>
<td>0.8976</td>
</tr>
<tr>
<td>ΔRER</td>
<td>0.3363</td>
<td>0.0723</td>
</tr>
<tr>
<td>ΔNFA</td>
<td>-5.2372</td>
<td>-1.6972</td>
</tr>
<tr>
<td>ΔTOT</td>
<td>-10.9187</td>
<td>-3.2710*</td>
</tr>
<tr>
<td>ΔTO</td>
<td>1.3319</td>
<td>0.4728</td>
</tr>
<tr>
<td>ΔINT</td>
<td>-1.3317</td>
<td>-1.4923</td>
</tr>
<tr>
<td>ΔDMCC</td>
<td>-3.4134</td>
<td>-2.2194*</td>
</tr>
<tr>
<td>U_HAT</td>
<td>15.53</td>
<td>4.2048*</td>
</tr>
<tr>
<td>R-squared</td>
<td>38.4783%</td>
<td></td>
</tr>
<tr>
<td>Adjusted R-squared</td>
<td>31.5323%</td>
<td></td>
</tr>
<tr>
<td><strong>Long Run Model</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>C</td>
<td>4.0949</td>
<td>39.7539*</td>
</tr>
<tr>
<td>TOT</td>
<td>-0.6629</td>
<td>-19.2443*</td>
</tr>
<tr>
<td>TO</td>
<td>0.2049</td>
<td>3.7439*</td>
</tr>
<tr>
<td>INT</td>
<td>0.0330</td>
<td>1.5280</td>
</tr>
<tr>
<td>DMCC</td>
<td>-0.0251</td>
<td>-0.7830</td>
</tr>
<tr>
<td>R-squared</td>
<td>87.0450%</td>
<td></td>
</tr>
<tr>
<td>Adjusted R-squared</td>
<td>86.2716%</td>
<td></td>
</tr>
</tbody>
</table>

Note: The level of statistical significance denote as follows; *=1%. U_HAT is the corresponding t-statistics of lagged residual from testing ADF unit roots on residuals. This is developed by Mackinnon (1991).

From results in Table 5, in long run equilibrium RER (real exchange rate), adjusted R-squared tells that this model can be used for these independent variables (TOT, TO, INT,
DMCC) to explain the dependent variables (real exchange rate) with 86.27% accurate which is quite high.

The relationship of variables can be concluded as follow. (Given effect of other variables constant)

The increase in terms of trade by 1% can lead to the decrease in RER (real exchange rate) by 0.66%. (Thai baht appreciated since relative price of export improves, increasing the supply of foreign exchange.)

The increase in trade openness by 1% can lead to increase in RER (real exchange rate) by 0.20%. (Thai baht depreciated since more import causes demand for foreign exchange to rise.)

The increase in TH/US interest rate by 1% leads to the increase in RER (real exchange rate) by 0.03% (Thai baht depreciated since not much influx of foreign capital investment occurs due to political instability.)

The capital control policy to restrict the flow of foreign investment leads to the decrease in RER (real exchange rate) by 0.02%. (Thai baht appreciated in the period during capital control implementation since supply of foreign currency increases.)

The relationship among each dependent (RER) and independent variables (TOT, TO) are all consistent with the hypothesis at first. But GS and NFA are excluded in the model since they reveal insignificance and also show relationship in contrast with hypothesis set. Besides, INT and DMCC are inconsistent with the set hypothesis, further explanation will be clarified in analysis part.

In short run equilibrium RER (real exchange rate), adjusted R-squared tells that his model can be used for these independent variables (NFA, TOT, TO, INT, DMCC and residuals) to explain the dependent variables with 31.53% accurate.

The relationship of variables can be concluded as follow. (Given affect of other variables constant)

The increase in net foreign asset by 1% can lead to decrease in RER (real exchange rate) by 5.23%
The increase in terms of trade by 1% can lead to the decrease in RER (real exchange rate) by 10.91%.

The increase in trade openness by 1% can lead to increase in RER (real exchange rate) by 1.33%.

The increase in TH/US interest rate by 1% leads to decrease in RER (real exchange rate) by 1.33% (Thai Baht appreciated since more influx of foreign capital investment occurs.)

The capital control policy to restrict the outflow of foreign investment leads to the decrease in RER (real exchange rate) by 3.41%.

U_HAT is residuals obtained from long run equilibrium estimation model. It tells the rate at which RER (real exchange rate) is deviated from equilibrium.

The relationship among each dependent and independent variables are all consistent with the hypothesis at first except GS which is excluded in the model and except INT in long run model as prior explained.
IV. Analysis

Analysis of factors affecting RER (real exchange rate)

First finding obtained from the results of test conducted and model formulated in the previous section is the direction in which each selected economic variables determines RER (real exchange rate).

From model constructed, the relationship of each variables and RER (real exchange rate) is hypothesized and shows in this following equation.

\[ RER = c + \beta_1 NFA + \beta_2 TOT + \beta_3 GS + \beta_4 TO + \beta_5 INT + \beta_6 DMCC \sum_{i=1}^{p} \beta_7 RER_{t-1} + \hat{\epsilon} \]

From Granger Causality Test, GS is insignificant and cannot explain RER (real exchange rate) so it is excluded in the model estimation.

For net foreign asset (NFA), it’s hypothesized that it is negatively related to RER (real exchange rate) \((\beta_1 < 0)\). According to Table 5, in short run model, coefficient of RER (real exchange rate) supports the hypothesis but in the long run, the results show that NFA is positively related and insignificant. Thus, NFA is excluded to estimate RER (real exchange rate) equilibrium in the long run model. This implies that NFA can be one main factor affecting RER (real exchange rate) in short run but may not be adequately powerful in affecting RER (real exchange rate) in the longer term. Possible explanation for this is that in the long run only real variables such in the long run as GDP matters, not the financial capital flows. Net financial flows will eventually be cleared. Since the capital owners have to take money back for their own consumption. The flow can’t continue forever. Thus this provides reasonable reasons for NFA to have insignificant effect on RER (real exchange rate) in the long run. However, there is previous research on this kind of topic of RER (real exchange rate) misalignment done by Thai researcher with more advanced and complicated econometrics model, but what she found is quite contradictory to the results obtained in this paper. Her results turns out that NFA (together with TOT) can be major contributory factors determining RER (real exchange rate) in both long run and short run. (Juthatip, 2009) This is probably because of the difference in data source, amount of data sampling or even different in data definition. The increase in NFA leads to decrease in RER (real exchange rate) or leads to Thai baht appreciation, ceteris paribus, but the relationship lasts only in short run.

For terms of trade (TOT) it is hypothesized that it has negative relationship with RER (real exchange rate) \((\beta_2 < 0)\). The coefficient from both short run and long run model
supports these hypotheses. Since TOT is the relative price of tradable to non-tradable goods, the improvement in TOT (given others constant) leads to an increase in supply of foreign exchange decreasing RER (real exchange rate) leading to Thai baht appreciation.

For trade openness (TO), it is hypothesized to be positively related to RER (real exchange rate). \((\beta_4 > 0)\) The coefficients from the results support the hypothesis. The increase in trade openness enhances more import and raises demand for foreign currency increasing RER (real exchange rate) causing Thai baht devaluation.

For TH/US interest rate (INT), it is hypothesized to be negatively related to RER (real exchange rate). The coefficient in short run model confirms the hypothesis. In the long run model, it shows positive relationship between INT and RER (real exchange rate). This may be caused by the intervention of BOT that distorts the market together with the unstable political problem in Thailand there is not that much foreign investment flowing into the country despite of higher interest rate, so Thai baht is not appreciated so much.

For dummy variable of capital control (DMCC), it’s hypothesized that it should be positively related to RER (real exchange rate). But the result shows that they are negatively related. This may be because during the implementation of capital control, a lot of capital flowing in for speculative purpose makes Thai baht appreciation dominates. Without capital control policy, Thai baht might have been more appreciated.

**Analysis of RER (real exchange rate) Misalignment in relation to crisis, export/import and capital control**

**Figure 1: Forecast of real exchange rate from E-view**

- **Forecast: RERF**
- **Actual: RER**
- **Forecast sample: 1 72**
- **Included observations: 72**
- **Root Mean Squared Error**: 3.034166
- **Mean Absolute Error**: 2.270104
- **Mean Abs. Percent Error**: 6.098730
- **Theil Inequality Coefficient**: 0.039774
- **Bias Proportion**: 0.000000
- **Variance Proportion**: 0.044408
- **Covariance Proportion**: 0.955592
Figure 2: Real Exchange Rate Misalignment

Figure 3: Residual of real exchange rate

residuals
After formulating economic model to estimate long run equilibrium, we can obtain the graph showing forecast of long run RER (real exchange rate) equilibrium shown in figure 1. This is based on long run equilibrium of RER (real exchange rate) that is estimated in this paper using TOT, TO, INT, and DMCC as independent variables (real exchange rate determinants).

Figure 2 shows the comparison between actual calculated RER (real exchange rate) and RER (real exchange rate) equilibrium (RERF) that is forecasted to occur at equilibrium. When comparing estimated RER (real exchange rate) equilibrium to actual calculated RER (real exchange rate), we can notice that RER (real exchange rate) misalignment continuously occurs. RER (real exchange rate) misalignment is the deviation from what it should be at equilibrium. Red line denotes actual calculated RER (real exchange rate) while blue one denotes RER (real exchange rate) forecasted in long run equilibrium. When actual calculated RER (real exchange rate) lies below equilibrium level, Thai baht is said to be overvalued since at the equilibrium, its currency value should have been more devalued. RER (real exchange rate) should have been higher. In contrast, if actual calculated RER (real exchange rate) lies above RER (real exchange rate) equilibrium, Thai baht is said to be undervalued since at the equilibrium, its currency value should have been more appreciated. RER (real exchange rate) should have been lower. Both situations can be seen during 1993-2010, scoped period of study.

Figure 3 shows residuals or shows how much it deviates from long run equilibrium. There can be many explanation or economic situation related to RER (real exchange rate) misalignment during each time period. Here, in this paper, we will make an analysis of RER (real exchange rate) misalignment in relation to 3 aspects of Thai economy. These 3 aspects referred to are financial crisis, capital control policy intervened by central bank of BOT, and export/import sector. These 3 aspects can be linked and combined to be best fit description for what happen to RER (real exchange rate) movement at each period of time in the overall picture in economy.

**Real exchange rate Misalignment and Financial Crisis**

Tracing back in time historically, there are 2 periods that Thailand faces relatively large financial crisis which are during 1997 and 2008.
In 1997, severe Asian Financial Crisis occurred or so called, Tom Yum Kung Crisis. During that time, there was speculative investment in financial sector, commodity, and real estate. Level of indebtedness was highly created. At the time of financial crisis 1997, due to speculative attack, Thai baht depreciated so much that it’s beyond the ability of central bank of Thailand to remain it at target level in the fix exchange rate regime. Thai currency is floated after having been pegged to US dollars for a long time. Thai baht is drastically depreciated in year 1997 due to manage float exchange rate regime adopted. This is consistent with what the graph Figure 4 shows. Also, RER (real exchange rate) at equilibrium should actually be lower as blue line due to influx of foreign capital for currency speculation during crisis.

In 2008, Sub Prime crisis starts to have global impact. During 2008Q3, it’s the period at which Thai economy is affected. RER (real exchange rate) is undervalued.

**Figure 4: Drastic Depreciation of Thai Baht**

It can be observed that during or a bit later the year Thailand facing crisis in 1997 and 2008Q3, Thai baht is always undervalued, illustrated in Figure 5.

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vii It is named Tom Yum Kung Crisis since this crisis is believed to be initiated in Thailand then has domino effect to other countries in the region.

viii It is global economic crisis originated due to the non performing loan problem in the US real estate market. It has adversely strong effect on US economy in the beginning of 2008. Stock exchanges, large financial institution and economic sectors around the world have been affected as the USA is largest economy of the world.
In Figure 6, it also shows an overvaluation of RER (real exchange rate) every time before the crisis to occur both before 1997 and 2008 crisis, RER (real exchange rate) lies under what it should be at equilibrium level. Therefore, it can be considered as a signal before crisis. When currency is overvalued the speculators may trade currency according to their expectation that can be negatively affect balance sheet of Thai economy later on. The economy is said to be weak if RER (real exchange rate) doesn’t reflect real value of what it should be. It will leave the relevant organization in charge of monetary and economic state with the misleading indicators leading to improper policy action.

Another interesting point to consider RER (real exchange rate) misalignment relating to crisis contributes to what is called here, psychological effect. As seen from the magnitudes of RER (real exchange rate) misalignment, the overvaluation of RER (real exchange rate) in Thailand prior to crisis is not very large, just 10-15%. Many countries face with this situation without any crisis occurs afterwards. Psychological effect mentioned here is in the sense that, for example, in 1997 the period of Asian financial crisis, Thailand may just a little bit mistakenly behave or wrongly respond some way, but it’s exposed to large speculative attack. Therefore, there is possibility that the overvaluation of RER (real exchange rate) may not necessarily lead to speculative attack and financial crisis within the country but probably occurred because the effect from psychology moves. In this paper, more regional information has been searched and it is found that virtually, the country that is severely attacked at the same time is Indonesia and less severely in South Korea. At that time, Indonesia was facing serious economic problem and political tension. Its financial confidence level in the eyes of investors collapses showing the sign of fixed exchange rate system failure. From foreign investors’ viewpoint, this failure possibility is opportunity for speculative attack to get currency at better price. In reality, there is no perfect information about real situation in each country, foreign investors especially those in western don’t know in details the real economic fundamentals of country within the region, so they base on what they think, from the data they have, they may consider that this country, let’s say Indonesia, having risk of fixed exchange rate regime failure and without knowing much information about Thailand, they will infer that Thailand might have similar situation and so other countries in the region and they will react the same. They will see the countries as a whole region having similar risk and performance. This enhances the severity of speculative attack causing financial and economic situation within region getting worse. Hence, this RER (real exchange rate) misalignment can partly explain the signal situation for crisis, it may not the only key problem, still, there are some
others reasons that can contribute and explain for the occurrence of the crisis, such as psychological effect discussed,

**Real Exchange Rate Misalignment and Capital Control**

Before 1997, Thailand pursues Washington Consensus believing in financial and capital liberalization, capital control policy is firstly adopted in Thailand during 1997 financial crisis. At that time the policy is not obvious or formally announced, so we mainly explain the relation of capital control to RER (real exchange rate) movement based on policy in 2006. The explanation based on 2006 capital control policy explains similar outcome and situation of what did actually happen in Asian financial crisis in the past. The detail of capital control policy imposed recently is shown in section of Appendix I.

**Figure 5: Devaluation of Thai baht during the crisis, capital control imposed**

**Figure 6: Overvaluation of Thai Baht Prior to Crisis**
At the time of global financial crisis 2008, it creates large inflow of capital into Thailand, since the investment inside of western seems less profitable and credential. This can lead Thai baht to be appreciated which will adversely affect Thai export sector. Central bank of Thailand has a role to stabilize economy through various policies with the intention to reduce the foreign currencies circulating in economy. Policy of capital control to restrict the inflow of foreign capital for prevention of too much Thai baht appreciation is implemented. With capital control policy adoption, from 2006Q1-2008Q3, Thai baht is overvalued, still, despite of the capital inflow restriction in this capital control policy, which is consistent with the figure 5. If there is no capital control policy, Thai baht has probably been more appreciated or more overvalued. After that Thai baht starts to gradually appreciates. This appreciation not just in Thai baht but almost all currencies around the world corresponds to continuous stimulus packages stimulating economy of the USA.

Real Exchange Rate Misalignment and Export/Import

**Figure 7:** Real exchange rate misalignment and link to import and export
Another aspect that can be related to movement of RER (real exchange rate) is export/import.

From Figure 7 shown, RER (real exchange rate) can be related to export/import sector in the country. Obviously seen, during the time of RER (real exchange rate) overvalued in 1995Q1-1997Q3, RER (real exchange rate) seems too low implying too much appreciation of Thai baht. Appreciation of Thai baht is favorable to import as imported goods denoted in foreign currency tends to be relatively cheaper. Import volume during the time of RER (real exchange rate) overvaluation increases higher than export.

As seen from the relation between RER (real exchange rate) and export/import, it comes to conflict that if BOT intervenes to keep Thai baht not to drastically devalue, it seems to have adverse effect on trade balance leading to the possibility of trade deficit. To estimate the effectiveness of capital control policy, gain and loss occurred due to export/import is taken into account.
Conclusion

This paper aims at examining the explanatory variables that can have impact on RER (real exchange rate). It also aims at investigating the way in which RER (real exchange rate) misalignment relates to Thai economy in the aspects of financial crisis, import/export, and capital control policy imposed by central bank of Thailand (BOT).

Method used is based on quantitative approach in order to estimate RER (real exchange rate) equilibrium that reflects economic fundamentals. Cointegration analysis of times series regression model is used to see the relationship of studied economic variables as determinants of RER (real exchange rate). Descriptive approach is used along with this stated quantitative model to analyze and compare the calculated RER (real exchange rate) with the RER (real exchange rate) equilibrium obtained from computable outcome from econometric model.

From the analysis, there is RER (real exchange rate) misalignment over time and before crisis period (before 1997 and before 2007), there’s always overvaluation of RER (real exchange rate).

During the time of capital control policy, there exists overvalued or appreciated value of Thai baht since the inflow of foreign currency for speculation dominates.

RER (real exchange rate) provides direct relationship to export/import sector and also can have implication for the effectiveness of capital control policy by BOT.

Limitation

This paper bases only on RER (real exchange rate) of TH/US as major trading partner of Thailand. Even though, U.S. is the third major trade partner of Thailand, following the first and second trade partners like Japan and China respectively, this paper chooses the USA as the only major trading partner in analysis for the ease of calculation, finding data and interpretation. Since data available usually come in form of U.S. Dollars and Thailand usually raises the Baht per U.S. Dollar for unit in explaining exchange rate situation.

The purchasing power, impact on import/export and the gain or loss in export/import due to capital control imposed by BOT can be just roughly measured for analytical basic
framework by RER (real exchange rate) but to be more précised concept of real effective exchange rate should be used since it can tell value of domestic currency compared to groups of currency basket not just compared to only one currency. But the real effective exchange rate is very complicated in calculation and estimation as it deals with trade weight to each trading partner.

**Suggestion**

For new researchers employing more advanced knowledge in econometrics, the Johansen cointegration method should be applied to determine cointegration relationships among variables since it will provide more strong results.

Other important trading partners of Thailand, such as Japan and China may be taken into account in further researches.
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**Website**


http://www-personal.umich.edu/~alandear/glossary

Appendix I

(Capital Control Policy)

1. The policy to collect 30 percent of capital flow in for reservation on 19th December 2006

   It is the policy that forces the financial institution that involving in selling or buying international currency to keep 30% of the in-flow foreign currency in reservation. Then make use of the rest 70%. Exception is for the foreign currency that is earned by Thais from investing abroad. Descriptive regulations for this policy are listed below;

   1. Clients of financial institutions can refund the 30% deposit reserved after one year since the date that it is reserved. Clients have to show the evidence that ones have moved the fund to invest in Thailand no less than one year.

   2. After financial institution approved that ones have invested in the country for no less than one year, Bank of Thailand will step in to the next process of returning the reserved deposit to clients.

   3. If any of the clients move the fund out of country, investing less than one year in the country, ones will only get 2 of 3 of the money reserved.

   4. Any transaction that is dealt before 19th December 2006 doesn’t have to follow this policy of 30% reservation.

   5. Any foreign fund that is considered as foreign direct investment will be refunded the deposit directly after request is submitted through financial institution and approved on the agreement of Bank of Thailand

   6. The deposit reserved must be transferred to Bank of Thailand on the 7th of each month.

   7. The benefit from this policy will be used to benefit State and people of the country.

   This Policy is cancelled on 3rd of March 2008, via 9/2008 announcement of Bank of Thailand on 29th of February 2008. Because Thai currency was more stable during the time and move in the more harmony path with other currencies in Asia Pacific.

2. Relaxation of regulations in investing abroad, regulation of futures exchange to manage the risk, and regulations for running cash management business on 2nd of February 2010.

   This policy is employed in order to alleviate the appreciation of Baht that leads to excess supply in economy, which will continue the appreciation of baht in the future, also, to solve the foreign currency liquidity problem, under Abhisit Vejjajiva government on 2nd of February 2008. The conclusion is listed below;
1. Increase the financial amount that ones can invest abroad, such legal entity can invest unlimitedly abroad. Securities and Exchange Commission (SEC) is allowed to invest in securities abroad 50,000 million U.S. Dollars, increased from 30,000 million U.S. Dollars, in order for the balance of flows of funds, give an alternative to the investors, and increase the competitiveness of Thai business.

2. Futures Exchange is dealt to reduce the risk, this policy give right to exporters and importers to be able to cancel the future contract made to reduce the risk of exchange rate in every case.

3. Easing the qualifications in forming new cash management business, for example, legal entity can form new cash management business without forming new organization, allowing it to transfer foreign currency among companies that it owns within the country more effectively, etc. This would increase the competitive ability of Thailand.

4. Relaxing other regulations, enhance the financial amount that ones can invest in properties abroad from 5 million U.S. dollars to 10 million U.S. dollars, and give permission for companies in Thailand to be able to give loans to other companies abroad that is not their branches no more than 50 million U.S. dollars. Including, increasing the financial amount that ones can exchange baht in to foreign currency in order to deposit in commercial bank in Thailand.

Source: Central Bank of Thailand
Appendix II

(Complete Test Results)

Augmented Dickey Fuller for Unit Root Test

**Variable: RER**

Null Hypothesis: LOG(RER) has a unit root
Exogenous: Constant
Lag Length: 1 (Automatic - based on AIC, maxlag=11)

<table>
<thead>
<tr>
<th>Augmented Dickey-Fuller test statistic</th>
<th>t-Statistic</th>
<th>Prob.*</th>
</tr>
</thead>
<tbody>
<tr>
<td>-1.986608</td>
<td>0.2920</td>
<td></td>
</tr>
</tbody>
</table>

Test critical values:
- 1% level: -3.527045
- 5% level: -2.903566
- 10% level: -2.589227


**Variable: D(RER); D denotes first difference**

Null Hypothesis: D(RER,2) has a unit root
Exogenous: Constant
Lag Length: 4 (Automatic - based on AIC, maxlag=11)

<table>
<thead>
<tr>
<th>Augmented Dickey-Fuller test statistic</th>
<th>t-Statistic</th>
<th>Prob.*</th>
</tr>
</thead>
<tbody>
<tr>
<td>-6.050920</td>
<td>0.0000</td>
<td></td>
</tr>
</tbody>
</table>

Test critical values:
- 1% level: -3.534868
- 5% level: -2.906923
- 10% level: -2.591006


**Variable: NFA**

Null Hypothesis: NFA has a unit root
Exogenous: Constant
Lag Length: 2 (Automatic - based on AIC, maxlag=11)

<table>
<thead>
<tr>
<th>Augmented Dickey-Fuller test statistic</th>
<th>t-Statistic</th>
<th>Prob.*</th>
</tr>
</thead>
<tbody>
<tr>
<td>-0.487869</td>
<td>0.8866</td>
<td></td>
</tr>
</tbody>
</table>

Test critical values:
- 1% level: -3.528515
- 5% level: -2.904198
- 10% level: -2.589562


**Variable: D(NFA)**

Null Hypothesis: D(NFA,2) has a unit root
Exogenous: Constant
Lag Length: 1 (Automatic - based on AIC, maxlag=11)

<table>
<thead>
<tr>
<th>Augmented Dickey-Fuller test statistic</th>
<th>t-Statistic</th>
<th>Prob.*</th>
</tr>
</thead>
<tbody>
<tr>
<td>-9.115801</td>
<td>0.0000</td>
<td></td>
</tr>
</tbody>
</table>
Variable : TOT
Null Hypothesis: LOG(TOT) has a unit root
Exogenous: Constant
Lag Length: 0 (Automatic - based on AIC, maxlag=11)

<table>
<thead>
<tr>
<th>Augmented Dickey-Fuller test statistic</th>
<th>t-Statistic</th>
<th>Prob.*</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>-2.278760</td>
<td>0.1816</td>
</tr>
</tbody>
</table>

Test critical values:
- 1% level: -3.525618
- 5% level: -2.902953
- 10% level: -2.588902


Variable : D(TOT)
Null Hypothesis: D(LOG(TOT)) has a unit root
Exogenous: Constant
Lag Length: 0 (Automatic - based on AIC, maxlag=11)

<table>
<thead>
<tr>
<th>Augmented Dickey-Fuller test statistic</th>
<th>t-Statistic</th>
<th>Prob.*</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>-8.733499</td>
<td>0.0000</td>
</tr>
</tbody>
</table>

Test critical values:
- 1% level: -3.527045
- 5% level: -2.903566
- 10% level: -2.589227


Variable : GS
Null Hypothesis: LOG(GS) has a unit root
Exogenous: Constant
Lag Length: 0 (Automatic - based on AIC, maxlag=11)

<table>
<thead>
<tr>
<th>Augmented Dickey-Fuller test statistic</th>
<th>t-Statistic</th>
<th>Prob.*</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>-7.025171</td>
<td>0.0000</td>
</tr>
</tbody>
</table>

Test critical values:
- 1% level: -3.525618
- 5% level: -2.902953
- 10% level: -2.588902


Variable : D(GS)
Null Hypothesis: D(LOG(GS)) has a unit root
Exogenous: Constant
Lag Length: 6 (Automatic - based on AIC, maxlag=11)
## Variable: TO

Null Hypothesis: LOG(TO) has a unit root  
Exogenous: Constant  
Lag Length: 2 (Automatic - based on AIC, maxlag=11)

<table>
<thead>
<tr>
<th>Test Critical Values</th>
<th>t-Statistic</th>
<th>Prob.*</th>
</tr>
</thead>
<tbody>
<tr>
<td>1% level</td>
<td>-3.536587</td>
<td></td>
</tr>
<tr>
<td>5% level</td>
<td>-2.907660</td>
<td></td>
</tr>
<tr>
<td>10% level</td>
<td>-2.591396</td>
<td></td>
</tr>
</tbody>
</table>


## Variable: D(TO)

Null Hypothesis: D(LOG(TO)) has a unit root  
Exogenous: Constant  
Lag Length: 1 (Automatic - based on AIC, maxlag=11)

<table>
<thead>
<tr>
<th>Test Critical Values</th>
<th>t-Statistic</th>
<th>Prob.*</th>
</tr>
</thead>
<tbody>
<tr>
<td>1% level</td>
<td>-3.528515</td>
<td></td>
</tr>
<tr>
<td>5% level</td>
<td>-2.904198</td>
<td></td>
</tr>
<tr>
<td>10% level</td>
<td>-2.589562</td>
<td></td>
</tr>
</tbody>
</table>


## Variable: INT

Null Hypothesis: LOG(INT) has a unit root  
Exogenous: Constant  
Lag Length: 3 (Automatic - based on AIC, maxlag=11)

<table>
<thead>
<tr>
<th>Test Critical Values</th>
<th>t-Statistic</th>
<th>Prob.*</th>
</tr>
</thead>
<tbody>
<tr>
<td>1% level</td>
<td>-3.530030</td>
<td></td>
</tr>
<tr>
<td>5% level</td>
<td>-2.904848</td>
<td></td>
</tr>
<tr>
<td>10% level</td>
<td>-2.589907</td>
<td></td>
</tr>
</tbody>
</table>


## Variable: D(INT)

Null Hypothesis: D(LOG(INT)) has a unit root
Exogenous: Constant
Lag Length: 4 (Automatic - based on AIC, maxlag=11)

<table>
<thead>
<tr>
<th></th>
<th>t-Statistic</th>
<th>Prob.*</th>
</tr>
</thead>
<tbody>
<tr>
<td>Augmented Dickey-Fuller test statistic</td>
<td>-4.232802</td>
<td>0.0012</td>
</tr>
</tbody>
</table>

Test critical values:
- 1% level: -3.533204
- 5% level: -2.906210
- 10% level: -2.590628


**Variable : DMCC**

Null Hypothesis: DMCC has a unit root
Exogenous: Constant
Lag Length: 0 (Automatic - based on AIC, maxlag=11)

<table>
<thead>
<tr>
<th></th>
<th>t-Statistic</th>
<th>Prob.*</th>
</tr>
</thead>
<tbody>
<tr>
<td>Augmented Dickey-Fuller test statistic</td>
<td>-2.165188</td>
<td>0.2207</td>
</tr>
</tbody>
</table>

Test critical values:
- 1% level: -3.525618
- 5% level: -2.902953
- 10% level: -2.588902


**Variable : D(DMCC)**

Null Hypothesis: D(DMCC) has a unit root
Exogenous: Constant
Lag Length: 8 (Automatic - based on AIC, maxlag=11)

<table>
<thead>
<tr>
<th></th>
<th>t-Statistic</th>
<th>Prob.*</th>
</tr>
</thead>
<tbody>
<tr>
<td>Augmented Dickey-Fuller test statistic</td>
<td>-4.163332</td>
<td>0.0016</td>
</tr>
</tbody>
</table>

Test critical values:
- 1% level: -3.540198
- 5% level: -2.909206
- 10% level: -2.592215


**Granger Causality Test using at level data**

Granger Causality Test using at level data

Pairwise Granger Causality Tests
Date: 05/06/11   Time: 22:28
Sample: 1 72
Lags: 2

<table>
<thead>
<tr>
<th>Null Hypothesis</th>
<th>Obs</th>
<th>F-Statistic</th>
<th>Prob.</th>
</tr>
</thead>
<tbody>
<tr>
<td>NFA does not Granger Cause LNRER</td>
<td>70</td>
<td>2.99691</td>
<td>0.0569</td>
</tr>
<tr>
<td>LNRER does not Granger Cause NFA</td>
<td>14.1866</td>
<td>8.E-06</td>
<td></td>
</tr>
<tr>
<td>LNTOT does not Granger Cause LNRER</td>
<td>70</td>
<td>2.40843</td>
<td>0.0979</td>
</tr>
<tr>
<td>LNRER does not Granger Cause LNTOT</td>
<td>7.57308</td>
<td>0.0011</td>
<td></td>
</tr>
<tr>
<td>LNTOT does not Granger Cause LNRER</td>
<td>70</td>
<td>1.08097</td>
<td>0.3453</td>
</tr>
</tbody>
</table>
LNRER does not Granger Cause LNTO
LNRER does not Granger Cause LNGS
LNGS does not Granger Cause LNRER
LNINT does not Granger Cause LNINT
DMCC does not Granger Cause LNRE
LNRER does not Granger Cause DMCC
LNTOT does not Granger Cause NFA
NFA does not Granger Cause LNTOT
LNTOT does not Granger Cause NFA
NFA does not Granger Cause LNTO
LNGS does not Granger Cause NFA
NFA does not Granger Cause LNGS
LNINT does not Granger Cause NFA
NFA does not Granger Cause LNINT
DMCC does not Granger Cause NFA
NFA does not Granger Cause DMCC
LNTOT does not Granger Cause LNTOT
LNTOT does not Granger Cause LNTO
LNGS does not Granger Cause LNTOT
LNTOT does not Granger Cause LNGS
LNINT does not Granger Cause LNTOT
LNTOT does not Granger Cause LNINT
DMCC does not Granger Cause LNTOT
LNTOT does not Granger Cause DMCC
LNGS does not Granger Cause LNINT
LNINT does not Granger Cause LNGS
LNTOT does not Granger Cause LNTO
LNINT does not Granger Cause LNTO
LNGS does not Granger Cause LNTO
LNINT does not Granger Cause LNGS
LNTOT does not Granger Cause DMCC
LNGS does not Granger Cause DMCC
LNINT does not Granger Cause DMCC
LNTOT does not Granger Cause DMCC

At first difference

Pairwise Granger Causality Tests
<table>
<thead>
<tr>
<th>Null Hypothesis</th>
<th>Obs</th>
<th>F-Statistic</th>
<th>Prob.</th>
</tr>
</thead>
<tbody>
<tr>
<td>NFA-NFA(-1) does not Granger Cause LNRER-LNRER(-1)</td>
<td>69</td>
<td>5.99971</td>
<td>0.0041</td>
</tr>
<tr>
<td>LNRER-LNRER(-1) does not Granger Cause NFA-NFA(-1)</td>
<td></td>
<td>2.68382</td>
<td>0.0760</td>
</tr>
<tr>
<td>LNTOT-LNTOT(-1) does not Granger Cause LNRER-LNRER(-1)</td>
<td>69</td>
<td>3.46627</td>
<td>0.0372</td>
</tr>
<tr>
<td>LNRER-LNRER(-1) does not Granger Cause LNTOT-LNTOT(-1)</td>
<td></td>
<td>9.40381</td>
<td>0.0003</td>
</tr>
<tr>
<td>LNTO-LNTO(-1) does not Granger Cause LNRER-LNRER(-1)</td>
<td>69</td>
<td>2.26045</td>
<td>0.1139</td>
</tr>
<tr>
<td>LNRER-LNRER(-1) does not Granger Cause LNTO-LNTO(-1)</td>
<td></td>
<td>1.00949</td>
<td>0.3701</td>
</tr>
<tr>
<td>LNGS-LNGS(-1) does not Granger Cause LNRER-LNRER(-1)</td>
<td>69</td>
<td>0.21719</td>
<td>0.8054</td>
</tr>
<tr>
<td>LNRER-LNRER(-1) does not Granger Cause LNGS-LNGS(-1)</td>
<td></td>
<td>3.45950</td>
<td>0.0374</td>
</tr>
<tr>
<td>LNINT-LNINT(-1) does not Granger Cause LNRER-LNRER(-1)</td>
<td>69</td>
<td>2.69477</td>
<td>0.0763</td>
</tr>
<tr>
<td>LNRER-LNRER(-1) does not Granger Cause LNINT-LNINT(-1)</td>
<td></td>
<td>2.32725</td>
<td>0.1058</td>
</tr>
<tr>
<td>DMCC-DMCC(-1) does not Granger Cause LNRER-LNRER(-1)</td>
<td>69</td>
<td>2.31233</td>
<td>0.1086</td>
</tr>
<tr>
<td>LNRER-LNRER(-1) does not Granger Cause DMCC-DMCC(-1)</td>
<td></td>
<td>0.02719</td>
<td>0.9732</td>
</tr>
<tr>
<td>LNTOT-LNTOT(-1) does not Granger Cause NFA-NFA(-1)</td>
<td>69</td>
<td>2.11289</td>
<td>0.1292</td>
</tr>
<tr>
<td>NFA-NFA(-1) does not Granger Cause LNTOT-LNTOT(-1)</td>
<td></td>
<td>5.48030</td>
<td>0.0064</td>
</tr>
<tr>
<td>LNGS-LNGS(-1) does not Granger Cause NFA-NFA(-1)</td>
<td>69</td>
<td>1.95096</td>
<td>0.1505</td>
</tr>
<tr>
<td>NFA-NFA(-1) does not Granger Cause LNGS-LNGS(-1)</td>
<td></td>
<td>1.18915</td>
<td>0.3111</td>
</tr>
<tr>
<td>LNINT-LNINT(-1) does not Granger Cause NFA-NFA(-1)</td>
<td>69</td>
<td>1.32619</td>
<td>0.2727</td>
</tr>
<tr>
<td>NFA-NFA(-1) does not Granger Cause LNINT-LNINT(-1)</td>
<td></td>
<td>6.10794</td>
<td>0.0037</td>
</tr>
<tr>
<td>DMCC-DMCC(-1) does not Granger Cause NFA-NFA(-1)</td>
<td>69</td>
<td>4.46385</td>
<td>0.0153</td>
</tr>
<tr>
<td>NFA-NFA(-1) does not Granger Cause DMCC-DMCC(-1)</td>
<td></td>
<td>0.45073</td>
<td>0.6392</td>
</tr>
<tr>
<td>LNTO-LNTO(-1) does not Granger Cause LNTOT-LNTOT(-1)</td>
<td>69</td>
<td>2.28175</td>
<td>0.1104</td>
</tr>
<tr>
<td>LNTOT-LNTOT(-1) does not Granger Cause LNTO-LNTO(-1)</td>
<td></td>
<td>0.60335</td>
<td>0.5501</td>
</tr>
<tr>
<td>LNGS-LNGS(-1) does not Granger Cause LNTOT-LNTOT(-1)</td>
<td>69</td>
<td>0.08535</td>
<td>0.9183</td>
</tr>
<tr>
<td>LNTOT-LNTO(-1) does not Granger Cause LNGS-LNGS(-1)</td>
<td></td>
<td>4.09113</td>
<td>0.0213</td>
</tr>
<tr>
<td>LNINT-LNINT(-1) does not Granger Cause LNTOT-LNTOT(-1)</td>
<td>69</td>
<td>0.05509</td>
<td>0.9464</td>
</tr>
<tr>
<td>LNTOT-LNTO(-1) does not Granger Cause LNINT-LNINT(-1)</td>
<td></td>
<td>2.74939</td>
<td>0.0715</td>
</tr>
<tr>
<td>DMCC-DMCC(-1) does not Granger Cause LNTOT-LNTOT(-1)</td>
<td>69</td>
<td>2.49050</td>
<td>0.0909</td>
</tr>
<tr>
<td>LNTOT-LNTO(-1) does not Granger Cause DMCC-DMCC(-1)</td>
<td></td>
<td>0.87687</td>
<td>0.4210</td>
</tr>
<tr>
<td>LNGS-LNGS(-1) does not Granger Cause LNTO-LNTO(-1)</td>
<td>69</td>
<td>1.06482</td>
<td>0.3508</td>
</tr>
<tr>
<td>LNTO-LNTO(-1) does not Granger Cause LNGS-LNGS(-1)</td>
<td></td>
<td>0.47335</td>
<td>0.6251</td>
</tr>
<tr>
<td>LNINT-LNINT(-1) does not Granger Cause LNTO-LNTO(-1)</td>
<td>69</td>
<td>6.05022</td>
<td>0.0039</td>
</tr>
<tr>
<td>LNTO-LNTO(-1) does not Granger Cause LNINT-LNINT(-1)</td>
<td></td>
<td>4.64464</td>
<td>0.0131</td>
</tr>
<tr>
<td>DMCC-DMCC(-1) does not Granger Cause LNTO-LNTO(-1)</td>
<td>69</td>
<td>19.6015</td>
<td>2.E-07</td>
</tr>
<tr>
<td>LNTO-LNTO(-1) does not Granger Cause DMCC-DMCC(-1)</td>
<td></td>
<td>0.14175</td>
<td>0.8681</td>
</tr>
<tr>
<td>LNINT-LNINT(-1) does not Granger Cause LNGS-LNGS(-1)</td>
<td>69</td>
<td>0.81224</td>
<td>0.4484</td>
</tr>
<tr>
<td>LNGS-LNGS(-1) does not Granger Cause LNINT-LNINT(-1)</td>
<td></td>
<td>0.76734</td>
<td>0.4685</td>
</tr>
</tbody>
</table>
### Unit Root Test for Residuals

Null Hypothesis: RESID02 has a unit root  
Exogenous: None  
Lag Length: 3 (Automatic - based on AIC, maxlag=11)

<table>
<thead>
<tr>
<th></th>
<th>t-Statistic</th>
<th>Prob.*</th>
</tr>
</thead>
<tbody>
<tr>
<td>Augmented Dickey-Fuller test statistic</td>
<td>-3.797049</td>
<td>0.0003</td>
</tr>
</tbody>
</table>

Test critical values:
- 1% level: -2.599413
- 5% level: -1.945669
- 10% level: -1.613677


### Augmented Dickey-Fuller Test Equation

Dependent Variable: D(RESID02)  
Method: Least Squares  
Date: 05/06/11 Time: 22:44  
Sample (adjusted): 5 72  
Included observations: 68 after adjustments

<table>
<thead>
<tr>
<th>Variable</th>
<th>Coefficient</th>
<th>Std. Error</th>
<th>t-Statistic</th>
<th>Prob.</th>
</tr>
</thead>
<tbody>
<tr>
<td>RESID02(-1)</td>
<td>-0.524051</td>
<td>0.138015</td>
<td>-3.797049</td>
<td>0.0003</td>
</tr>
<tr>
<td>D(RESID02(-1))</td>
<td>0.012770</td>
<td>0.141688</td>
<td>0.090131</td>
<td>0.9285</td>
</tr>
<tr>
<td>D(RESID02(-2))</td>
<td>0.261399</td>
<td>0.136643</td>
<td>1.913006</td>
<td>0.0602</td>
</tr>
<tr>
<td>D(RESID02(-3))</td>
<td>0.127096</td>
<td>0.123288</td>
<td>1.030886</td>
<td>0.3065</td>
</tr>
</tbody>
</table>

R-squared: 0.270034  
Adjusted R-squared: 0.235817  
S.E. of regression: 0.066580  
Sum squared resid: 0.283709  
Log likelihood: 89.80888  
Durbin-Watson stat: 1.978340

### Short Run Determinants of Real Exchange Rate in Thailand

Dependent Variable: GR  
Method: Least Squares  
Date: 05/06/11 Time: 22:59  
Sample (adjusted): 3 72  
Included observations: 70 after adjustments
<table>
<thead>
<tr>
<th>Variable</th>
<th>Coefficient</th>
<th>Std. Error</th>
<th>t-Statistic</th>
<th>Prob.</th>
</tr>
</thead>
<tbody>
<tr>
<td>C</td>
<td>0.238348</td>
<td>0.265543</td>
<td>0.897588</td>
<td>0.3729</td>
</tr>
<tr>
<td>LNRER(-1)-LNRER(-2)</td>
<td>0.336305</td>
<td>4.651652</td>
<td>0.072298</td>
<td>0.9426</td>
</tr>
<tr>
<td>LNTOT-LNTOT(-1)</td>
<td>1.331860</td>
<td>2.816760</td>
<td>0.472834</td>
<td>0.6380</td>
</tr>
<tr>
<td>LNINT-LNTOT(-1)</td>
<td>-10.91873</td>
<td>3.337965</td>
<td>-3.271075</td>
<td>0.0018</td>
</tr>
<tr>
<td>NFA-NFA(-1)</td>
<td>-5.237240</td>
<td>3.085793</td>
<td>-1.697211</td>
<td>0.0947</td>
</tr>
<tr>
<td>LNINT-LNINT(-1)</td>
<td>0.336305</td>
<td>0.892415</td>
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<td>0.102513</td>
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<td>4.204782</td>
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R-squared: 0.384783
Mean dependent var: 0.209249
S.D. dependent var: 2.534383
S.D. of regression: 2.097081
Akaike info criterion: 4.426180
Schwarz criterion: 4.683151
Hannan-Quinn criter.: 4.528252

**Long Run Determinants of Real Exchange Rate in Thailand**

Dependent Variable: LNRER
Method: Least Squares
Date: 05/06/11   Time: 22:52
Sample: 1 72
Included observations: 72

<table>
<thead>
<tr>
<th>Variable</th>
<th>Coefficient</th>
<th>Std. Error</th>
<th>t-Statistic</th>
<th>Prob.</th>
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<tr>
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<td>0.103005</td>
<td>39.75391</td>
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<td>LNTOT</td>
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<td>LNINT</td>
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<td>0.021612</td>
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<td>DMCC</td>
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<td>-0.782979</td>
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</tbody>
</table>

R-squared: 0.870450
Mean dependent var: 3.600329
S.D. dependent var: 2.22126
S.D. of regression: 2.089928
Akaike info criterion: 4.22126
Schwarz criterion: -1.931827
Hannan-Quinn criter.: -2.026988

Durbin-Watson stat: 1.834280
Prob(Durbin-Watson stat): 0.000055

Sum squared resid: 272.6604
Akaike info criterion: 4.426180
Schwarz criterion: 4.683151
Hannan-Quinn criter.: 4.528252

F-statistic: 5.539633
Prob(F-statistic): 0.000000
Linnaeus University – a firm focus on quality and competence

On 1 January 2010 Växjö University and the University of Kalmar merged to form Linnaeus University. This new university is the product of a will to improve the quality, enhance the appeal and boost the development potential of teaching and research, at the same time as it plays a prominent role in working closely together with local society. Linnaeus University offers an attractive knowledge environment characterised by high quality and a competitive portfolio of skills.

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