EXCHANGE MARKET PRESSURE
IN THAILAND:
AN APPLICATION OF
THE GIRTON-ROPER MONETARY MODEL

Master Thesis

INTERDEPARTMENTAL PROGRAMM

OF POSTGRADUATE STUDIES IN ECONOMICS

University of Macedonia

Tzika Paraskevi

Supervisor: Karfakis Costas

THESSALONIKI 2014

ACKNOWLEDGMENTS

I wish to dedicate this thesis to every single person who has mentally supported me.

I would like to express my most sincere gratitude to my supervisor, Professor Karfakis Costas. His guidance and his felicitous comments were vital for the completion of the present research.

In addition, I would like to thank all the professors that have contributed to my post-graduate education.

Moreover, the completion of this paper would not have been successful, if I did not have the precious support of my parents and sister. I want to thank them for having done the best they could for my education.

Last but not least, I also wish to dedicate my thesis to Yannis, the person who has mentally supported and encouraged me in the best way, throughout my pre- and post- graduate years.

“Η ολοκλήρωση της εργασίας αυτής έγινε στο πλαίσια της υλοποίησης του μεταπτυχιακού προγράμματος το οποίο συγχρηματοδοτήθηκε μέσω της Πράξης «Πρόγραμμα χορήγησης υποτροφιών ΙΚΥ με διαδικασία εξατομικευμένης αξιολόγησης ακαδ. Έτους 2012-2013» από πόρους του Ε.Π. «Εκπαίδευση και δια βίου μάθηση» του Ευρωπαϊκού Κοινωνικού Ταμείου (ΕΚΤ) και του ΕΣΠΑ(2007-2013)”

CONTENTS

ABSTRACT

This thesis deals with Exchange Market Pressure (EMP) in Thailand, through an application of the Girton and Roper monetary model. The reason for conducting such a research was the fact that EMP can be used as a measure for identifying the existence of currency crises. The resent world economic crisis that has hit almost every part of the globe was the inspiration which created the thought of dealing with such an issue. EMP is a useful index for measuring currency crises and it is the only one suitable for every exchange rate regime. At first, a theoretical analysis of the definition of EMP and its relation with currency crises is presented. The Girton and Roper monetary model is analyzed and explained. Then, the time series of the EMP index for Thailand is created and it is examined if its behavior provides any signs of the onset of a currency crisis. In addition, we try to identify if the macroeconomic variables are supposed to influence the value of the index according to Girton-Roper model (GR model) are confirmed. Moreover, we examine whether the distribution of EMP between exchange rate changes and changes in international reserves influences the value of the index, and which of the two components (exchange rate change or international reserve change) better absorbs foreign exchange market pressure. The results are very close to the GR model.

1. INTRODUCTION

Since 2008 many countries have been facing currency crises which have puzzled governments and monetary authorities. This is not a phenomenon of the last five years; many countries faced currency crises during the 1990's. The fact that the last decades, almost every country of the world has gone under such a crisis, has provided researchers with the motive to conduct research on crisis determinants and to find indexes that are useful for an early warning of a currency crisis.

Under a fixed or managed floating exchange rate regime, the foreign exchange pressure cannot be fully observed through the changes in the exchange rate. Thus, researchers have tried to identify other ways of measuring this pressure. The first attempt is due to the work of Girton and Roper (1976), who have measured EMP by considering changes in the exchange rate and the foreign reserves. Thus, they defined EMP as the sum of the exchange rate change and the change in the international reserves.

The idea behind EMP is that there are three policies, which can be used by governments, in order to face foreign exchange market speculation. The first one is to let exchange rate depreciate. Secondly, they can sell international reserves. Last but not least, interest rate can be increased, so that capital inflows are attracted (Ankinand et al., 2006). The above three policies are the cornerstone of the demonstration of the EMP index. Consequently, EMP is calculated by many authors as a weighted average of the exchange rate depreciation, the international reserves and the interest rate.

This paper aims to identify the determinants of EMP. More specifically, this thesis aims to estimate the EMP index for Thailand according to the model of Girton and Roper, test for evidence of currency crisis on Thai Baht at the beginning of the current crisis and observe which are the determinants of EMP, so that monetary authorities have a clue of what should be done in order to reduce forex pressure on the currency. The identification of the variables that influence EMP is done based on the GR model. Moreover, we test whether the distribution of EMP between exchange rate and international reserves influences the measure of EMP and whether exchange rate or international reserves better absorb forex pressure.

The remainder of the paper is organized as follows: Section 2 contains the bibliography review which discusses the definition of EMP and gives the different versions of EMP. Section 3 contains the analysis of the Girton and Roper model. Section 4 includes the stylized facts of the Thai economy, calculates EMP and examines any signs of a currency crisis. The econometric procedure and interpretation of the results are included in section 5. Section 6 concludes the paper.

2. LITERATURE REVIEW ON EXCHANGE MARKET PRESSURE

- Defining EMP

EMP can be described as the currency's excess supply in the foreign exchange market, under the condition that monetary authorities do not try to influence the exchange rate. Therefore, EMP refers to changes in two variables: international reserves and nominal exchange rate. Some economists also include changes in interest rate. A question that arises is why EMP should be used to measure forex pressure and not just the exchange rate change. EMP is a better measure because it can be applied to any kind of exchange rate regime. Another reason is that the EMP index can be used to determine other phenomena as well. Additionally, this index is a better indicator of forex tensions and can help monetary authorities to early encounter crisis contagion from other countries and avoid any potential domino effects (Jager and Klaasen, 2010).

As mentioned above, EMP covers the whole spectrum of exchange rate regimes. In the specific case of a floating regime, policy makers do nothing in order to change the exchange rate. As a result, in such a case, the pressure in the forex market will be equal to the actual depreciation of the currency. On the other hand, in any other regime authorities take on policy actions to face the depreciation. Such actions may be a change in the interest rate, or purchasing domestic currency in the forex markets. Thus, EMP differs significantly from the simple exchange rate change, because it takes policy measures into account. So, in a country with a managed floating exchange rate regime, it would be misleading to test for forex pressure only via exchange rate changes and totally leave reserves out of research (Tanner, 2001).

A problem that appears is that EMP is not directly observable. The only factor that can easily be observed, apart from the exchange rate change, is the policy responses to this pressure. These responses might be active, like purchasing or selling foreign assets, or passive, for example changes in the exchange rate, which happen due to forex pressure (Heriqbaldi, 2012). These responses give us the chance to indirectly quantify EMP. The variables included in calculating EMP are the exchange rate, the interest rate and the international reserves. Some economists do not include the interest rate, either because it does not change the value of EMP significantly or because there are not reliable data on interest rates (Jager and Klaasen , 2010), while some others choose to leave international reserves out of the estimation of EMP, as they claim that reserve data are noisy (Angkinand et al, 2006). Although the basic idea behind EMP's formula remains the same between different authors and throughout the years, the fact is that every author uses a different version of the formula.

Generally, the models of EMP estimation that have been analyzed so far can be divided into two categories, as it is proposed by Klaasen (2011). The first one contains Girton-Roper's and Weymark's model. It's the group of the "model-dependent weighting methods, where the weights are set by a model. In Girton and Roper there are unit weights while Weymark, using a more general model, supports that weights are defined by unknown parameters. On the other hand, the second category includes theories which claim that it is really difficult to connect exchange rates with macroeconomic fundamentals, hence the use of a model is wrong. Eichengreen et al belong to this category. They estimate the weights as the ratio of two sample standard deviations. The reason they do so is to ensure that none of the parameters dominates the rest. The problem with this approach is that this way of estimating EMP does not only reflect the effectiveness of the parameter, but also the intensity that each variable is used by the monetary authorities; this could cause a bias in the research.

In the following paragraphs, different versions of EMP estimation will be apposed in chronological order.

As it has already been mentioned, the first economists who dealt with EMP were Girton and Roper (1976). In their paper they try to explain EMP by incorporating changes of exchange rate and official intervention. They used the EMP index to refer to the disequilibrium of the money market and its magnitude, which has to be and is removed through changes in the exchange rate or the reserves. More explicitly, according to Girton and Roper, if the market equilibrium of a country is disturbed, this disequilibrium will be restored through a depreciation(appreciation) of the domestic currency and an outflow(inflow) of the international reserves. Thus, they calculate EMP as the simple sum of the changes in international reserves and the changes in the exchange rate: $EMP_t = e_t - r_t$ [1]; where EMP_t is the exchange market pressure at time t, e_t is the change in the spot exchange rate at time t (domestic currency over foreign currency) and r_t is the change in international reserves at time t. They actually derive this measure from the monetary model of the balance of payments, which will be presented in detail in section 3. If EMP is defined by the previous equation, an index is created that can be universally and easily applicable regardless of the exchange rate regime that a country follows -fixed, floating or managed floating exchange rate regime. There are three assumptions in the Girton and Roper model: 1) Purchasing Power Parity (PPP) holds, 2) interest rate differential is constant and 3) flow equilibrium in both domestic and foreign money market.

Many economists afterwards followed the GR monetary model for the EMP index, as they were the pioneers of their era on this research area. A characteristic example was I. Kim (1985), who has made a research on the

[1] Variables in levels are expressed in capital-case letters.
Variables in first differences are expressed in small-case letters.

South Korea economy. Kim states that the approach of Girton and Roper combines the monetary approach of the balance of payments and the monetary approach of the exchange rate determination. He examines whether their model can be applied to a managed floating exchange rate regime. Moreover, E. Ziramba (2007) also follows the model of Girton and Roper in his paper and he applies it to the South Africa economy. The same model is used in the present thesis as well.

Another paper with important contribution in the field of EMP was written by Eichengreen et al. (1994). They claimed that if researchers limited their attention only on speculative attacks which are successful, this would cause a selectivity bias, because some attacks have been warded off by monetary authorities of the country. In his paper it is supported that an index which takes both successful and unsuccessful attacks into account should be used. Taking the Girton and Roper theory as granted, Eichengreen takes their EMP formula and by using PPP, ends up to the following equation:

$$le + (i - i^*) - (r - r^*) = (d - d^*) - \beta(y - y^*) - (1 + a)(i - i^*)$$

where le: log of the exchange rate

i: interest rate change

r: ER/H (where R: international reserves, E: the domestic price of a unit of foreign exchange)

d: D/H (where D: domestic credit)

y: real income change

As Eichengreen says, the left-hand side is “an index of speculative pressure”, or as it is known the EMP index. Theory proposes that EMP should be a parametric function of macroeconomic fundamentals; which in the above equation are the growth of domestic credit, the level of income and the interest rate differential. Eichengreen identifies some problems on this approach:

– The weights of the three parameters used in the calculation of EMP are arbitrary, as terms can simply be added to both sides of the equation. Hence, even if assumptions are imposed for the use of the formula, the weights are not appropriately determined.

– Measuring EMP with the use of a linear combination of the exchange rate, the reserves and the interest rate is also a problem. The conditional volatility of the change in reserves is much higher than the conditional volatility of the exchange rate which is much higher than the conditional volatility of the interest rate differential. This means that an unweighted average of the three variables would be driven mainly by the reserve changes, and this would not be a correct measure of EMP.

Karticioglu and Feridun followed Eichengreen’s steps, in their relevant research about EMP in Turkey. More specifically, they calculated EMP using the following formula:

$$EMP_t = \alpha \Delta E_t + \beta \Delta (I_t - I_t^*) - \gamma \Delta (R_t - R_t^*)$$

where weights are the inverse of the standard deviation of each component.

The next one who made a significant contribution in the evaluation of EMP index was Weymark (1995), who defined EMP as follows: “Exchange market pressure measures the excess demand for a currency in international markets as the exchange rate change that would have been required to remove this excess demand in the absence of exchange market intervention, given the expectations generated by the exchange rate policy actually implemented”. Her model was based on a more general framework than the previous theories did. The formula she used for the estimation of EMP index is:

$$EMP_t = e_t - \eta r_t \qquad \text{where } \eta = -\frac{\partial e_t}{\partial r_t}$$

This formula is more general than the ones that had been used until then. Weymark in her article also derives an intervention index, which is related to EMP.

$$\omega_t = \frac{\eta r_t}{EMP_t} = \frac{r_t}{\frac{1}{\eta} e_t + r_t}$$

The type of intervention of a country can be seen by the value and the sign of ω_t.

Another author with vital contribution in the field of EMP is Tanner (2001). He claimed that it is wrong to focus only on either the exchange rate or the reserve changes, thus it would be better to have an index combining these two. EMP is the most appropriate way to measure the forex pressure, especially in managed floating regimes, says Tanner. Based on a monetary model, he derives the following estimation for the EMP index:

$$EMP_t = E_t - R_t = \delta_t - m_t$$

which shows that the sum of the exchange rate depreciation and the reserve outflows is equal to the growth rate of domestic component of the monetary base (δ_t) minus the growth rate of money demand (m_t). Tanner noticed that EMP and δ-which actually reflects monetary policy- move closely together for most of the countries he examined, especially in periods of crises. For example, according to his findings, when Mexico faced a severe crisis in 1994-95, EMP and δ increased sharply.

Jager and Klaasen (2010) define EMP as the excess supply in the forex market, which is expressed as the depreciation that is required to remove this excess supply. The formula for the calculation of EMP, according to Jager and Klaasen, is the following:

$$EMP_{i,t} = e_{i,t} + ai_{i,t} - br_{i,t}$$

where EMP $_{i,t}$ is the exchange market pressure index of currency i at time t, $e_{i,t}$ the change in the spot exchange rate of currency i at time t, $i_{i,t}$ is the change in the interest rate, $r_{i,t}$ is the change in the international reserves and a, b are positive coefficients.

The reason of the use of coefficients is simple. The variables used in the formula have different values; coefficients are needed in order to set all variables in the same base. These coefficients also play the role of weights; they show how effectively each component removes pressure away and how intensively each variable is used as a means to reduce pressure. (Jager and Klaasen, 2010).

When EMP index has a positive value it means that the currency is under pressure. It actually indicates a depreciation pressure, which is due to currency's depreciation, a widening of the interest rates spread or/and a loss of foreign reserves. The higher (in real value) EMP index is, the higher is the forex pressure the currency faces (Katirciaglu and Feridun, 2010).

EMP is a very useful means for two main reasons. Its first advantage is that EMP index is a helpful instrument for central banks, as it is related to exchange rate management. Thus, it can prevent a country from being affected by contagion effects. If a neighboring country is facing severe currency pressure, EMP could offer a measure of how much this will affect the domestic currency, through contagion. The Asian crisis of the late 1990's can offer a great example. Secondly, EMP index can measure how effectively monetary authorities of a country can reduce forex pressure, in times it is needed (Heriqbaldi, 2012).

As reported by Heriqbaldi (2012), EMP is connected with factors that show the internal and external situation of an economy and are usually reflected on the exchange rate changes, the interest rate and the international reserves of a country. These are the key factors that are affected in the onset of a currency crisis.

- Exchange Market Pressure and currency crisis

A currency crisis is defined as pressure on the currency, which happens due to speculative attacks in the foreign exchange markets. Currencies can be under severe pressure in the forex market, but in a fixed or managed exchange rate regime this is not fully visible via the change in the exchange rate. Thus, this pressure, though not obvious, can be estimated through EMP.

Currency depreciation can be thought of as a measure of currency crisis, but it can take into account only the successful speculative attacks. By saying "successful" we mean attacks that make the monetary authorities of a country depreciate the domestic currency, even though it has been pegged. But speculation on a currency can be successful or unsuccessful (Li et al., 2006). This happens because monetary authorities of the country have some ways to face speculation, and these ways may or may not be effective. Potential policy actions are: depreciation of the domestic currency, selling international reserves in the forex markets, increasing interest rate or a combination of the three (Angkinand et al, 2006). This leads to the use of EMP as a currency crisis measure.

Although Girton and Roper where the first to mention EMP, Eichengreen, Rose and Wyplosz (1994) where the first who used EMP as a currency crisis indicator. When EMP has a large value during a period, then this period can be described as a currency crisis. More specifically, a period of currency crisis is said to begin when EMP exceeds some specific thresholds, for instance two or three standard deviations above its mean. Over the last years, this approach is the most commonly used to identify currency crisis (Angkinand et al, 2006).

In terms of a mathematical formula:

$$crisis_{i,t} = 1 \quad \text{if} \quad EMP > \alpha\sigma_{EMP} + \mu$$

which means that a currency crisis begins when EMP index is higher than α standard deviations above its mean; where α usually takes value between 2 and 3.

As it is concluded from the above, a time period is characterized by currency crisis when EMP index has its higher levels. Hence, the question raised is, which is the lower boundary for EMP that identifies currency crises. In simple words, what is the appropriate value for α, in the above formula. In most cases, the researcher is the one how decides what threshold to use. Nevertheless, different levels of thresholds reflect the severity of each crisis. High α reflects only severe crises while a lower α indicates milder crises as well. Even if α is set equal to 2, it seems to be too strict for a mild crisis, in the eyes of some authors.

As a concluding remark for this section, it is worth mentioning that although EMP is supposed to be the best currency crisis indicator, it is not always effective. This failure might be due to the crisis threshold, the variables and the way of calculating the weights of each variable in the estimation of EMP.

3. THE GIRTON-ROPER MONETARY MODEL OF EXCHANGE MARKET PRESSURE

The monetary approach of the balance of payments proposes that, under a fixed exchange rate regime, the excess money supply leads to a loss of international reserves and consequently to balance of payments deficits. On the other hand, in the case of a flexible exchange rate regime, the pressure on the balance of payments can be absorbed by a depreciation of the currency. EMP is derived by the disequilibrium between domestic money supply and demand. An excess money supply results to an increase of the demand for goods and services, which means that people will increase the demand for foreign goods and services as well and consequently, money reserves will flow out of the domestic market.

Girton and Roper's innovation on this field was that they tried to create an EMP index that would be applicable on managed floating exchange rate systems. Their model is based on two conditions:

- Equilibrium in the money market
- Purchasing Power Parity (PPP) holds

The Girton-Roper model is the following:

$$M^s = m(R+D) \quad (1)$$

$$M^d = kPY \quad (2)$$

$$E = \frac{P}{P*} \quad (3)$$

$$M^s = M^d \quad (4)$$

where:

M^s = money supply

m = money multiplier

R = central bank's holdings of foreign assets

D = central bank's holdings of domestic assets

M^d = money demand

k = fraction of nominal income people hold in the form of cash (constant)

P = domestic price level

Y = real domestic income

E = nominal exchange rate

P* = foreign inflation

The first equation is for the money supply and the second one for the money demand. Equation 3 is the PPP condition. Finally, equation 4 is the monetary equilibrium condition. From the above equations and by taking the changes of the logarithms of the variables, they conclude to the formula of EMP:

$$e - r = d - p^* - y + a \quad (5)$$

where:

r = change in the international reserve component of the base money

e = change in the nominal exchange rate (where exchange rate is defined as domestic over foreign currency)

d = change in the domestic credit as a portion of the base money

p* = change in foreign prices

y = change in real income

a = change in the money multiplier

Equation 5 is the formula for the calculation of the EMP index (Ziramba, 2007). Many authors have based their research on the Girton-Roper monetary model. One of them was I. Kim (1985) who applied this model on the economy of Korea. The results of his research agreed with the Girton-Roper model. All of the explanatory variables had the expected signs and most of them, except for the foreign inflation, had statistically significant coefficients. Moreover, E. Ziramba (2007) applied the same model as well. His research for South Africa gave also important findings. The signs of all variables agreed with the model and the coefficients of domestic credit and money multiplier were statistically significant. The present thesis aims to follow the same method as the above two papers, based on the Girton-Roper model.

4. EMPIRICAL EVIDENCE FROM THAILAND

- Thailand’s economy and currency

Thailand’s economy has made one of the most significant success stories in world economic history. The World Bank announced in 2011 that Thailand changed income category. Until 2011 it belonged to the low-middle income category. But since then it has been included in the countries with upper-middle income. Although Thailand has been facing political issues for many years, they managed to achieve great development, sustain a significant growth rate and reduce poverty impressively. In the end of 80’s and beginning of 90’s Thailand economy was growing at the remarkable rate of almost 9%. Then, the Asian crisis occurred, thus its growth slowed down, to boost again after 2000, when the crisis was over. After a period of great development the current world crisis as well as some extreme weather events (like devastating floods), slowed down Thailand’s prosperity again.

The cornerstone of the steady growth that Thailand has achieved, are the industrial and agricultural exports. The authorities try to maintain growth by encouraging domestic consumption and public investment. Industries that are of great importance for Thailand economy are tourism, agriculture, textiles, cement, electronics and computers, beverages, plastics and automobiles and automotive parts. It should be noticed that Thailand is the second largest tungsten producer and the third largest tin producer in the world. From the goods that they produce, the ones which are mainly exported are textiles, rubber, jewelry, fishery goods, rice, electronics and automobiles. However, the exports sector was hit by the world crisis in the end of 2008 and beginning of 2009, hence exports were dramatically reduced.

Thailand has made great steps in the reduction of poverty as well, since 1980. In 2000 poverty was 42.6%, while in 2011 it had fallen at the rate of 13.2%, though poverty still remains a phenomenon that mostly affects rural areas, especially Northern and Northeast Thailand. This inequality is apparent by the Gini coefficient which equals 0,45.

Another field in which Thailand economy shows very positive signs is unemployment. Unemployment rate is less than 1%, a fact which makes the country really attractive to economic immigrants. In numbers, Thailand attracts approximately 2.5 million migrant workers from neighboring countries.

Moreover, Thailand's monetary authorities do not rest on what they have succeeded until now, but they do their best in order to meet the Millennium Development Goals (MDGs). In terms of general development, Thailand has achieved to reduce maternal and under five-year mortality and more than 97% of the population has access to clean water.

Thailand's currency is the Thai Baht (known as tical until 1925). Until 1902 baht was fixed on a silver basis. In 1902 baht began increasing in value and in 1908 it was pegged to the British pound (with the exchange rate of Thai Baht over British Pound being equal to 13). Baht was pegged to the U.S. Dollar during the period 1956-1973, at the exchange rate of 20,8. Baht was re-pegged to 25 U.S. Dollars until 1997, when the country was hit by the well known Asian crisis[2]. In 1998 baht was left to float and its value was reduced to half, with one baht equaling 56 U.S. Dollars. Today, Thailand has a managed floating exchange rate regime and Baht's exchange rate over dollar is close to 30. To visualize the exchange rate of Thai Baht over US Dollar (xr_us) and its changes, figure 1 is provided.

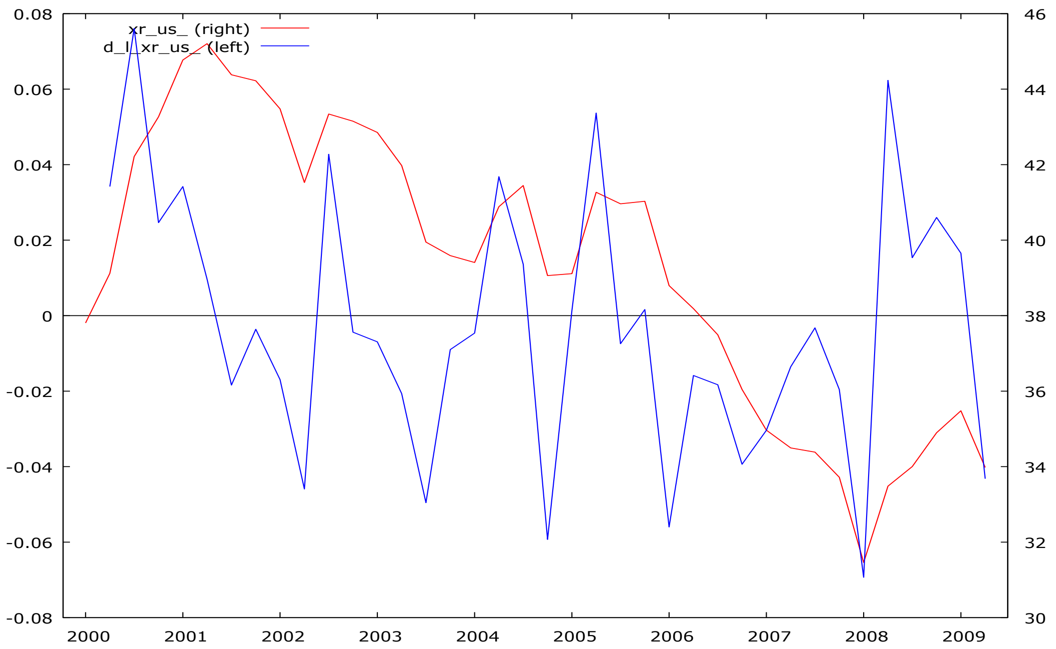

figure 1

Another figure which will be very informative is the one that combines the exchange rate and the international reserves into a single diagram. As it is obvious, when the exchange rate is high international reserves are low and

[2] Data for this part, about Thailand's economy have been retrieved from the following sites:
http://www.heritage.org
http://www.worldbank.org
http://www.indexmundi.com
http://www.tradingeconomics.com

vice versa. This fact is also illustrated in the corresponding figure that shows the changes of the two variables. This negative relation between these variables can also be confirmed by the correlation coefficient matrix, which gives a statistically significant coefficient, equal to -0,8683 (table 1).

Correlation coefficients, using the observations 2000:1 - 2009:2
5% critical value (two-tailed) = 0.3202 for n = 38

res_us_	xr_us_	
1.0000	-0.8683	res_us_
	1.0000	xr_us_

table 1

In the following figure (2) the time series graph of the international reserves of Thailand measured in US dollars (res_us) and the exchange rate of thai baht over US dollar is illustrated. It can easily be seen that there is a negative relation between the two variables. Throughout the period examined (2000-2009) the exchange rate had a proclivity to fall while reserves were increasing.

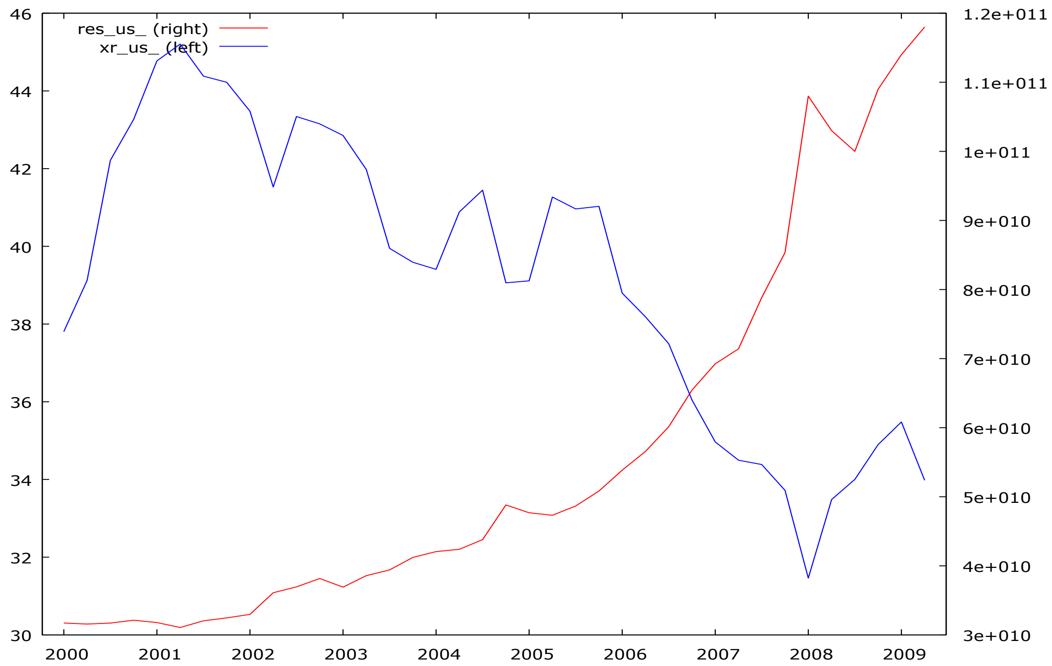

figure 2

➢ Thailand's monetary policy

The economic crisis of 1997 influenced many aspects of Thailand's economy. After the recovery of that crisis, Thailand restored its economic policy, in order to avoid the same mistakes in the future. In the sector of monetary policy, the aim changed. Until 1997 the monetary policy had focused on maintaining exchange rate stability, but after the crisis ended, they tried to focus on promoting exports, in order to achieve price stability and sustain the economy.

The evolution of the monetary policy of the Bank of Thailand (BOT) can be divided into three periods, which are explained below:

- Pegged exchange rate regime (Second World War – June 1997): The thai baht was pegged to a major currency, to gold or to a basket of currencies. The Exchange Equilization Fund used to announce the value of thai baht against the US dollar and every monetary or financial policy actions were based on this value. The pegged exchange rate regime collapsed in 1997, when Thailand faced its most severe crisis of its modern history, which happened due to policy inconsistency and some underlying systematic vulnerabilities.
- Monetary targeting regime (July 1997 – May 2000): With the assistance of the IMF Thailand tried to reestablish its macroeconomic stability. The BOT targeted domestic money supply, in order to gain macroeconomic consistency, price and growth stability. The BOT would set the monetary base targets, in daily and quarterly base.
- Inflation targeting regime (May 2000 – present): The BOT decided to change the target from money supply to inflation. The Bank's monetary policy formulation is stated as follows: "The Monetary Policy Committee (MPC) sets monetary policy in order to attain price stability conducive to sustainable economic growth. The MPC also monitors factors contributing to external stability and financial imbalances." (according to the Bank of Thailand's inflation report).The main objective of this inflation targeting regime is price stability (Nakornthab, 2009).

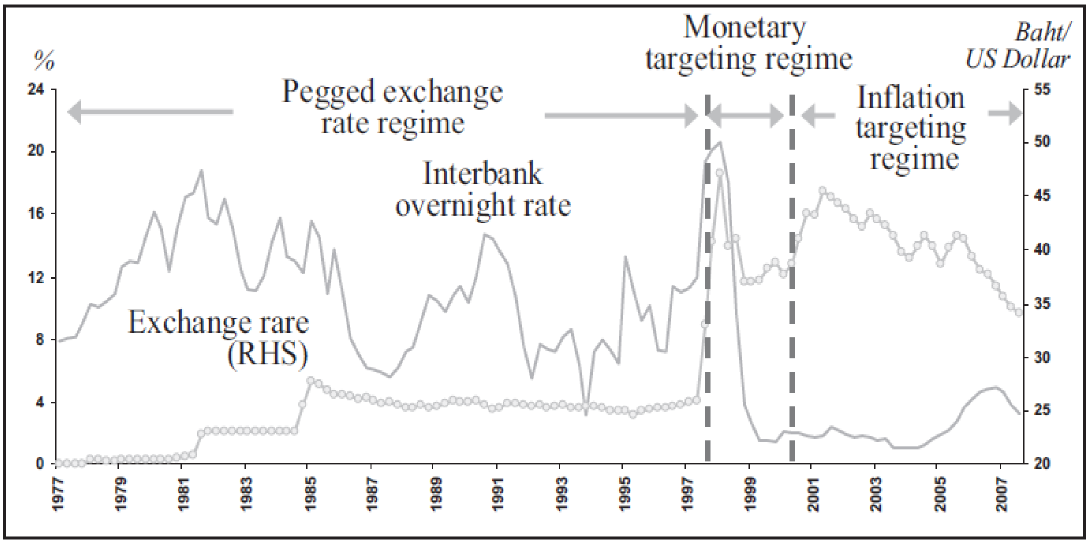

figure 3 (**Thailand's monetary policy frameworks across time**)[3]

[3] source : Nakornthab D., (2009) Thailand's monetary policy since the 1997 crisis.

The BOT uses several means in order to accomplish MPC's decisions. These instruments can be classified into three categories: (a) reserve requirements, (b) open market operations and (c) standing facilities.

- Data

Thailand is a good example to apply the Girton-Roper monetary model of EMP for two essential reasons. Firstly, because it follows a managed floating exchange rate regime. To be exact, Thailand has a "managed floating exchange rate regime with no pre-determined path for the exchange rate" (according to the IMF). This means that the central bank tries to affect the exchange rate of Thai Baht, but without having a specific target. Intervention may occur through direct or indirect policies and adjustments are not always automatic. The second reason is that Thailand can be treated as a small open economy, which means that world monetary conditions and world prices are considered as given and Thailand economy cannot influence them.

Thailand is a country which had been hit by the Asian currency crisis in the late 1990's. Much research has been conducted on that crisis. Those related to EMP have shown that EMP index for Thailand rose in 1997 and fell by the end of the Asian crisis (Tanner, 2001). For this reason, this research leaves out the 1990's decade.

The initial purpose of the survey was to include the current world crisis, but unfortunately there were no data available on domestic credit and money supply after the second quarter of 2009. Hence, the period examined here is from the first quarter of 2000 until the second quarter of 2009. Data used are quarterly and were retrieved from International Financial Statistics IMF and from the database OECD-StatExtracts. Data used are for the exchange rate of the thai baht over the US dollar and the reverse exchange rate of US dollar over thai baht, international reserves of Thailand, domestic credit of the Thailand economy, money supply (M1), Thailand's GDP, price level of Thailand and price lever of the USA.

- Estimating EMP

As it has already been mentioned, this thesis uses the monetary model of Girton and Roper, following the footsteps of I. Kim (1985) and E. Ziramba (2007). The model has been presented earlier in section 3. The formula for the estimation of EMP is the following:

$$EMPi=e-r \quad (6)$$

where EMPi is the EMP index, r is the change of international reserve component of the base money (R+D) and e is the change of the exchange rate of US dollar over thai baht (measured as the volume of thai baht that can be purchased with 1 US dollar). The graph of the time series of Thailand's EMP is shown below.

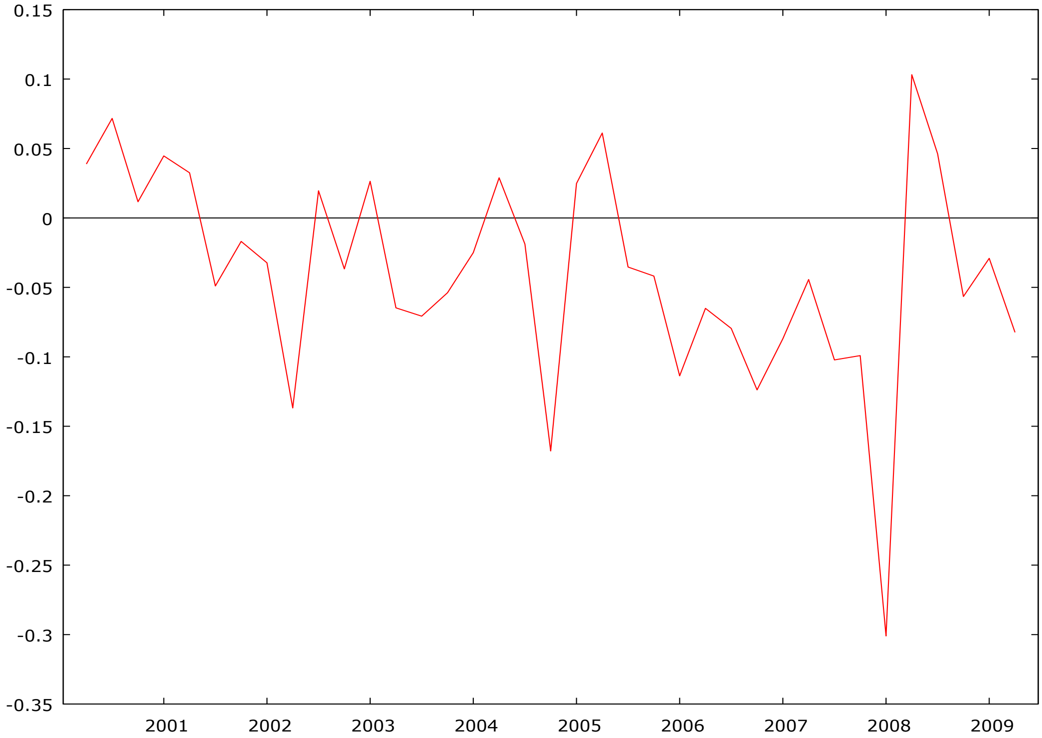

figure 4

In Figure 5 somebody can see the time series plot of EMP index for Thailand, over the period on which this research is conducted. For identifying any possible currency crisis, the mean and standard deviation of the series is needed. The mean is equal to -0.038493 and the standard deviation is equal to 0.076761. According to the formula in the second part of this paper:

$$crisis_{i,t} = 1 \quad \text{if} \quad EMP > \alpha\sigma_{EMP} + \mu$$

If α is set equal to 2, then $\alpha\sigma_{EMP} + \mu$ =0,115029. The highest deviation of EMP from its mean is for the second quarter of 2008, when EMP= 0,1031, which is lower than 0,115029. This means that a mild currency crisis is not observed at the beginning of the current world crisis, though the values are close, so the situation was close to a mild currency crisis.

If α is set equal to 3, then $\alpha\sigma_{EMP} + \mu$ =0,19179. As already mentioned, the highest deviation of EMP from its mean is for the second quarter of 2008, when EMP= 0,1031 , which is again lower than 0,19179. This means that a severe currency crisis is not also observed at the beginning of the current world crisis.

The following Figure shows, in terms of a diagram, the time series of EMP and the exchange rate of US dollar over thai baht. It is obvious that EMP moves together with the changes of the exchange rate of baht during the period examined.

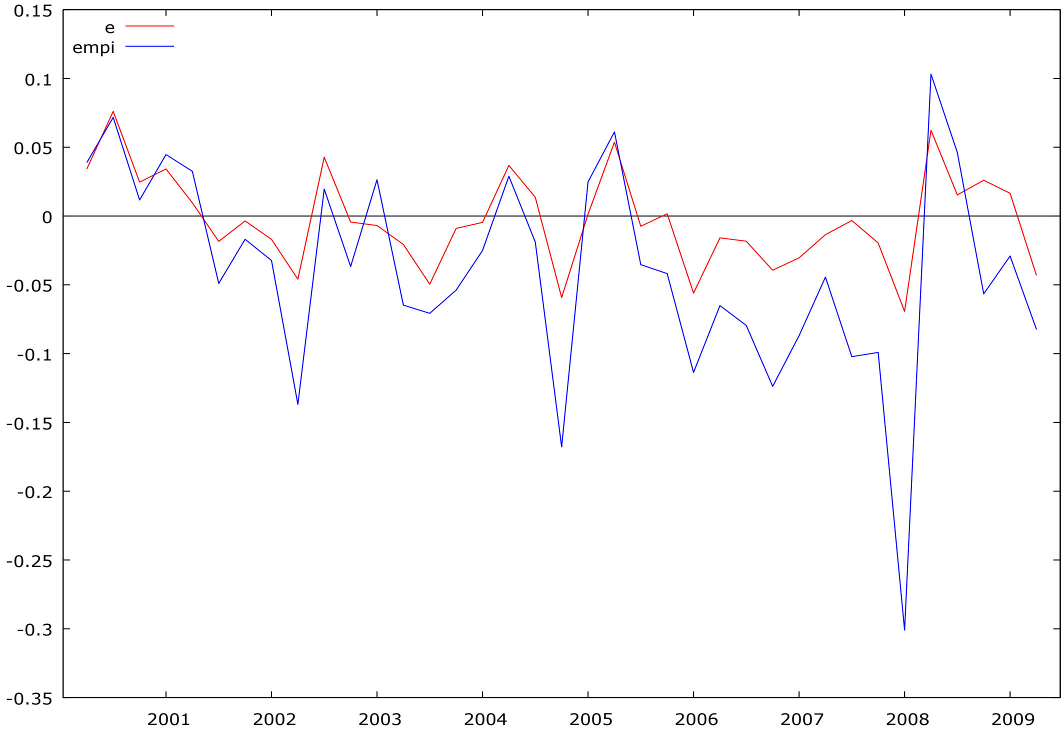

figure 5

Their relation is also apparent from the correlation matrix (table 2), which shows that there is a high positive relation between EMP and the exchange rate, because their correlation coefficient is equal to 0,4176 and statistically significant.

Correlation coefficients, using the observations 2000:1 - 2009:2
(missing values were skipped)
5% critical value (two-tailed) = 0.3202 for n = 38

e	EMPi	
1.0000	0.8617	e
	1.0000	EMPi

table 2

Similarly, figure 6 shows the time series of EMP and the international reserves of Thailand, expressed in terms of US dollar.

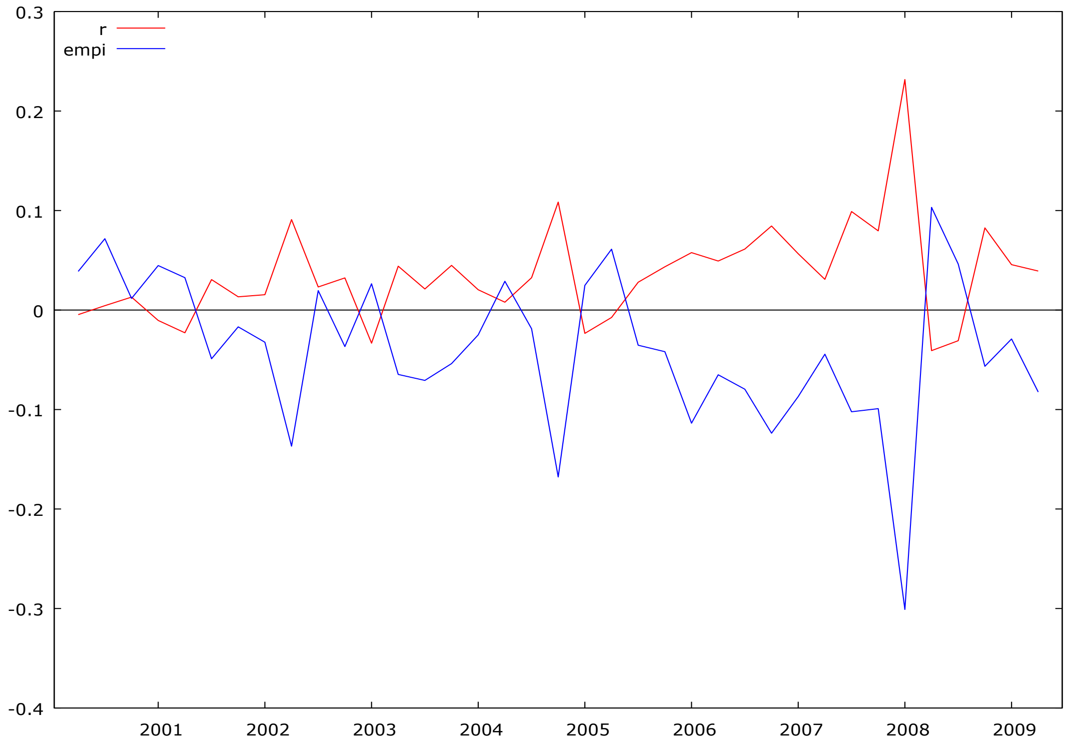

figure 6

It is obvious that EMP moves in opposite directions with the international reserves during the examined period. Their relation is also apparent from the correlation matrix (table 3). There is a high negative relation between EMP and the exchange rate, because their correlation coefficient is equal to -0.9376 and statistically significant.

Correlation coefficients, using the observations 2000:1 - 2009:2
(missing values were skipped)
5% critical value (two-tailed) = 0.3202 for n = 38

r	EMPi	
1.0000	-0.9376	r
	1.0000	EMPi

table 3

5. THE MODEL AND THE EMPIRICAL PROCEDURE

- The model

The model which is used in this thesis is the Girton-Roper monetary model. This model has been analyzed in section 3 and it concludes to the following equation:

$$e\text{-}r = d - p^* - y + a \qquad (5)$$

where:

r = change in the international reserve component of the base money

e = change in the nominal exchange rate
d = change in the domestic credit as a portion of the base money
p* = change in foreign prices
y = change in real income
a = change in the money multiplier

On the left hand side we have the EMP, which is the dependent variable. The independent variables are on the right hand side. The purpose of this part of the paper is to examine which of these variables affect EMP of Thailand and how. According to the above equation of the GR model, three propositions will be tested: (a) an increase in y will result in appreciation of the thai baht and an inflow of reserves, (b) an increase in d will result in a depreciation of the thai baht and an outflow of reserves and (c) an increase in p* will result in appreciation of the thai baht and an inflow of reserves. If the above propositions are proven to be satisfied, then the thesis will conclude that the results agree with the GR model.

- Stationarity test

The first econometric procedure that has to be done is a stationarity test, in order to examine if all series that will be included in the regression, are stationary in levels. As it is known, the parameters that are included in the OLS must be stationary. If they are then we include them in the regression in levels. On the other hand, if they have unit root, I(1), we use their first differences in the following procedures; but only if the first differences series are stationary. Otherwise, the regression will be spurious; this means that we might conclude incorrectly to a significant relationship between two parameters, which are in fact not related. The regression might seem to be good, but has no rational economic interpretation.

This study employs the Augmented Dickey-Fuller test for unit root. It is a test whose null hypothesis is I(1). The results show that both the dependent and the independent variables are I(0). The test below is an example of the results of the test for the EMP:

```
Dickey-Fuller test for EMPi
sample size 36
unit-root null hypothesis: a = 1

   test with constant
   model: (1-L)y = b0 + (a-1)*y(-1) + e
   1st-order autocorrelation coeff. for e: -0.037
   estimated value of (a - 1): -0.909749
   test statistic: tau_c(1) = -5.38044
   p-value 7.849e-005
```

table 4

- OLS with robust standard errors

Firstly, an OLS procedure is used, where the OLS estimates use robust standard errors. On the left-hand side of the regression (the dependent variable) we have the EMP index of Thailand. The independent variables are the ones proposed by the Girton-Roper model. In this specific case, a dummy for the 1st quarter of 2008 is added as an independent variable, because it's the quarter in which there are signs of currency crisis. The reason for doing this is that running the regression without the dummy, we result in non-normal residuals. By including the dummy variable, the hypothesis of normality is accepted and the coefficient of the dummy is statistically significant. Hence, we realize that it is fair to include the dummy in the left hand side of the regression.

The OLS was applied by taking two lags for each independent variable. Then, by omitting one insignificant variable at a time and using the three indexes: the Schwartz Bayesian Criterion, the Akaike Information Criterion and the Hannan-Quinn, the procedure concluded to the following results for the regression:

Model 5: OLS, using observations 2000:4-2009:2 (T = 35)
Dependent variable: emp
HAC standard errors, bandwidth 2 (Bartlett kernel)

	Coefficient	*Std. Error*	*t-ratio*	*p-value*	
const	-0.0516789	0.00967274	-5.3427	0.00002	***
d	2.53931	0.677129	3.7501	0.00094	***
d_1	-1.01267	0.526377	-1.9238	0.06583	*
y	-0.0230409	0.00494728	-4.6573	0.00009	***
y_1	-0.0186094	0.00356977	-5.2131	0.00002	***
a	1.24477	0.603265	2.0634	0.04960	**
d_l_prices_usa	7.25913	1.20198	6.0393	<0.00001	***
d_l_prices__1	2.20876	1.01863	2.1684	0.03985	**
d_l_prices__2	1.69199	0.560324	3.0197	0.00576	***
dum0801	-0.235432	0.0178015	-13.2254	<0.00001	***

Mean dependent var	-0.043850	S.D. dependent var	0.075343
Sum squared resid	0.055485	S.E. of regression	0.047111
R-squared	0.712515	Adjusted R-squared	0.609021
F(9, 25)	623.3215	P-value(F)	4.02e-27
Log-likelihood	63.15944	Akaike criterion	-106.3189
Schwarz criterion	-90.76541	Hannan-Quinn	-100.9498
rho	0.132340	Durbin-Watson	1.703999

table 5

*	90% confidence level
**	95% confidence level
***	99% confidence level

Note for Table 5

The OLS results provide some important information relevant to the GR model. The variables are statistically significant and their signs are the expected ones, apart from the sign of the foreign inflation. More specifically, the sum of coefficients for the change of domestic credit is positive. This means that if the growth rate of domestic credit increases, there will be a depreciation of the currency (e increases) or an outflow of reserves, thus EMP will increase and this result agrees with the GR model. The sum of real income's coefficients is negative, which is also the expected sign. When real income increases exchange rate of thai baht over US dollar will fall (appreciation) and reserves will increase, leading EMP downwards. Variable a (change of money multiplier) has a positive coefficient, which is also in support of the GR model. An increase in a will lead to depreciation and reserve outflow and consequently to an increase of EMP. The result which is not congruous with the GR model is the sign of the coefficient of foreign inflation. This coefficient is positive for Thailand. This means that if foreign inflation increases, there will be a depreciation of the currency and an outflow of the reserves. This is opposite than what theory implies. We would expect that when international inflation increases, products and services of the foreign country would be more expensive, thus demand for domestic products and services will be increased, because they would be relatively cheaper, and the resultant increase in exports would bring more reserves and decline EMP.

We can see that there is a high R-squared, approximately equal to 0,61. This means that the independent variables used in this OLS explain at a rate of 61% any changes in the EMP index of Thailand Baht. This can be also observed in figure 7 below, which shows the actual and the fitted series of EMP in a common diagram. It is obvious that the values predicted by the independent variables of the regression are very close to the actual values of the exchange market pressure index, during the whole width of the examined period. So, the independent variables which were used are able to offer a good prediction of the value of EMP.

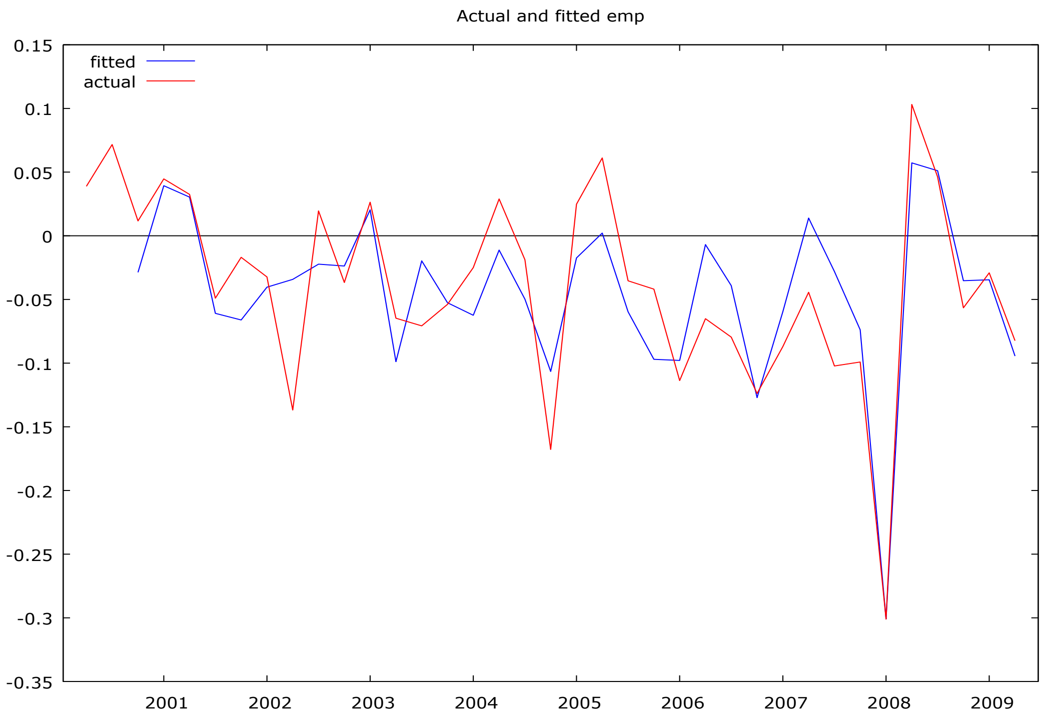

figure 7

There are some necessary tests that need to be done in order to test for heteroskedasticity and autocorrelation. The White's test for heteroskedasticity and the Breusch–Godfrey serial correlation LM test were applied. The results prove that nor heteroskedasticity neither autocorrelation are present in the OLS estimation.

White's test for heteroskedasticity - Null hypothesis: heteroskedasticity not present Test statistic: LM = 8.65117 with p-value = P(Chi-square(17) > 8.65117) = 0.950574

table 6

LM test for autocorrelation up to order 4 - Null hypothesis: no autocorrelation Test statistic: LMF = 0.277893 with p-value = P(F(4,21) > 0.277893) = 0.888948

table 7

Moreover, another important test that should be done is for the normality of the residuals. In this test, the hypothesis of normally distributed residuals is not rejected, as it can be concluded by table 8.

Test for normality of residual - Null hypothesis: error is normally distributed Test statistic: Chi-square(2) = 3.74352 with p-value = 0.153853

table 8

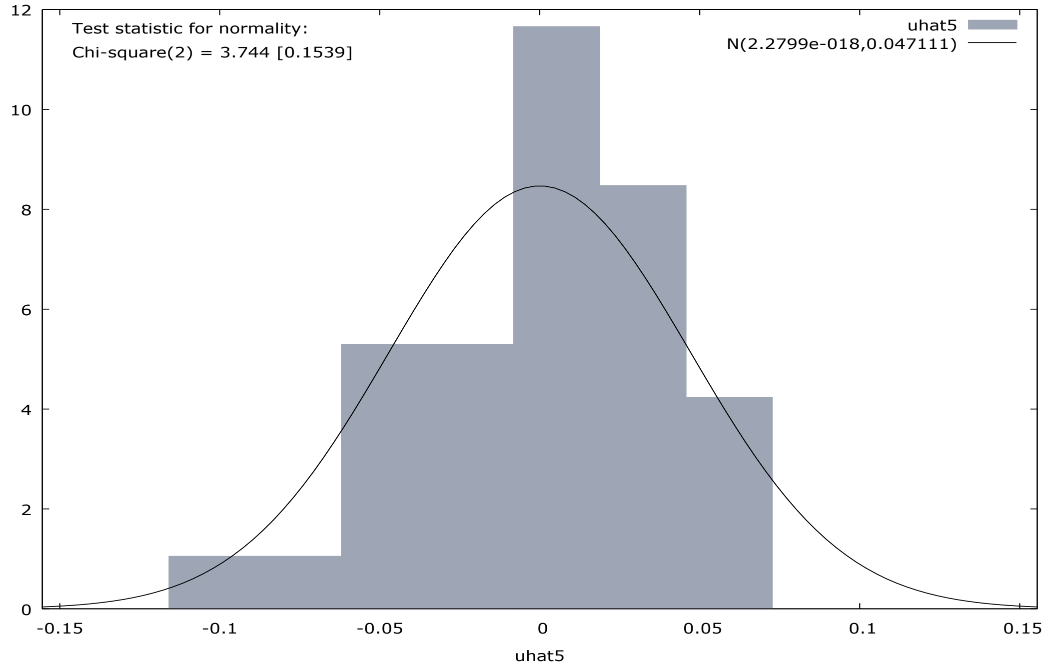

figure 8

Additionally, a QLR test was run, to test whether there is a structural break or not. The result is that there is no structural break.

QLR test for structural break - Null hypothesis: no structural break Test statistic: chi-square(6) = 1.79769 at observation 2001:4

table 9

Last but not least, the hypothesis of a stable regression should be accepted. As it is obvious from the graphs below, the CUSUM and CUSUM-square tests confirm that there is stability in the regression.

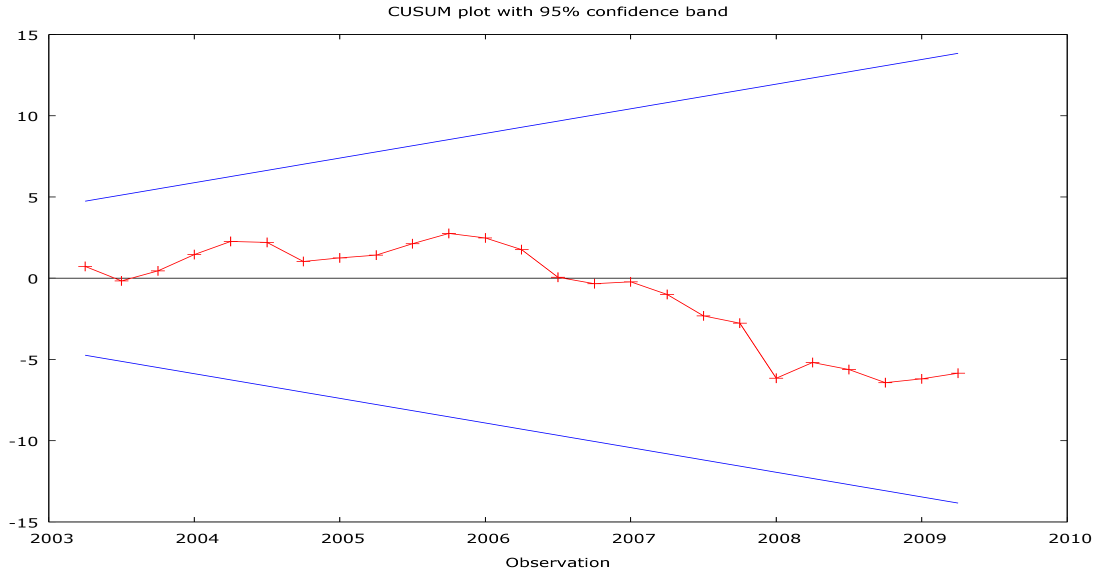

figure 9

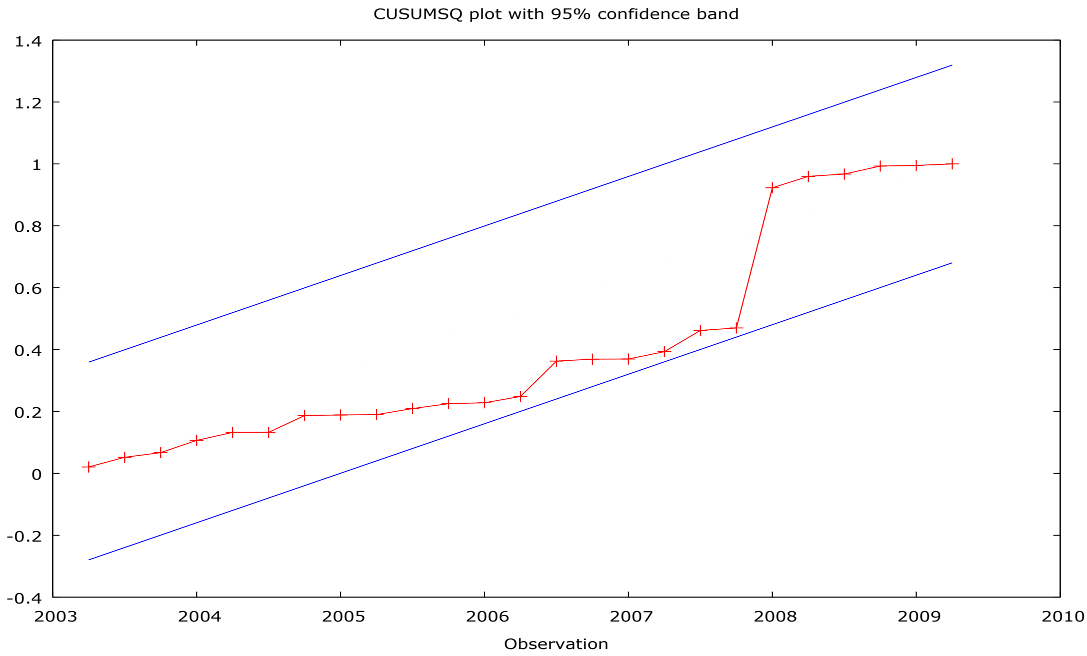

figure 10

➢ Additional tests

Dependent variable	d	p*	y	a	Q	R^2-adj.	D.W.
EMPi (1)	1.52665	11.1599	-0.04165	1,24477	-	0,61	1,7
EMPi (2)	1.48384	10.27451	-0.036	1.78442	Not significant	0,62	1,46
r (3)	-0.88769	-4.65766	0.02356	0.167458	-	0,99	0,59
e (4)	0.562834	3.80179	-0.01830	Not significant	-	0,40	1,94

table 10[4]

This paper, apart from detecting the parameters that influence Thailand's EMP has two more objectives. In other words, two propositions which are examined. The first is about whether the distribution of EMP between exchange rate and international reserves influences the measure of the EMP, while the second test is for whether or not and in what proportion absorbing exchange market pressure, results from changes in the international reserves or from changes in the exchange rate.

The first test is to examine whether the value of the EMP index is independent of the choice of monetary authorities to absorb forex pressure

[4] The rows of this table represent the 4 different regressions which are run for this research.
The columns contain the sum of the statistically significant coefficients of each explanatory variable.

through the exchange rate or the international reserves. For this reason a new parameter is added in the regression. This is symbolized as Q and is actually the ratio of the spot exchange rate of thai baht minus unit over Thailand's international reserves minus unit, in mathematical terms: $Q = \frac{e-1}{r-1}$. The higher Q is, the more the monetary authorities allow the pressure to be reduced by a depreciation of the currency relative to reserve loses. Running the regression again, including this time Q on the right-hand side, as an independent variable, we get the following results.

Model 6: OLS, using observations 2000:4-2009:2 (T = 35)
Dependent variable: emp
HAC standard errors, bandwidth 2 (Bartlett kernel)

	Coefficient	*Std. Error*	*t-ratio*	*p-value*	
const	0.238412	0.187888	1.2689	0.21664	
d	2.52975	0.638299	3.9633	0.00058	***
d_1	-1.04591	0.56223	-1.8603	0.07514	*
y	-0.0217686	0.00495905	-4.3897	0.00020	***
y_1	-0.0142407	0.00304666	-4.6742	0.00010	***
d_l_prices_usa	6.96744	1.04511	6.6667	<0.00001	***
d_l_prices__1	1.51074	0.81937	1.8438	0.07760	*
d_l_prices__2	1.79633	0.420036	4.2766	0.00026	***
a	1.78442	0.690555	2.5840	0.01628	**
dum0801	-0.232356	0.0177819	-13.0670	<0.00001	***
Q	2.90364	1.86975	1.5530	0.13352	

Mean dependent var	-0.043850	S.D. dependent var	0.075343
Sum squared resid	0.051645	S.E. of regression	0.046389
R-squared	0.732410	Adjusted R-squared	0.620914
F(10, 24)	379.8729	P-value(F)	6.67e-24
Log-likelihood	64.41443	Akaike criterion	-106.8289
Schwarz criterion	-89.72003	Hannan-Quinn	-100.9229
rho	0.251409	Durbin-Watson	1.459460

table 11

The purpose of running this regression is to test whether variable Q is significant or not. The result is that Q is not statistically significant for any level of confidence. This means that the value of EMP is not affected by the composition between exchange rate and reserves. This result is the same as in past papers, such as the ones of Girton-Roper, Kim and Ziramba. The coefficients of the other independent variables do not differ much between regressions (1) and (2) (table 10). The only parameter which faced a worth-mentioning change is a, the rate of change of the money multiplier. In the second regression, it is not statistically significant. As for the other variables, they have the same sign as in the 1st regression and do not differ much in value. In this second regression, adjusted R^2 is a bit higher, 0,62, which means that the independent variables used, are able to explain bigger percentage of the EMP changes than before. We can observe this by the following diagram, in which someone can see the time series plot of the actual and fitted values for EMP. It is apparent that the two time series move very close together.

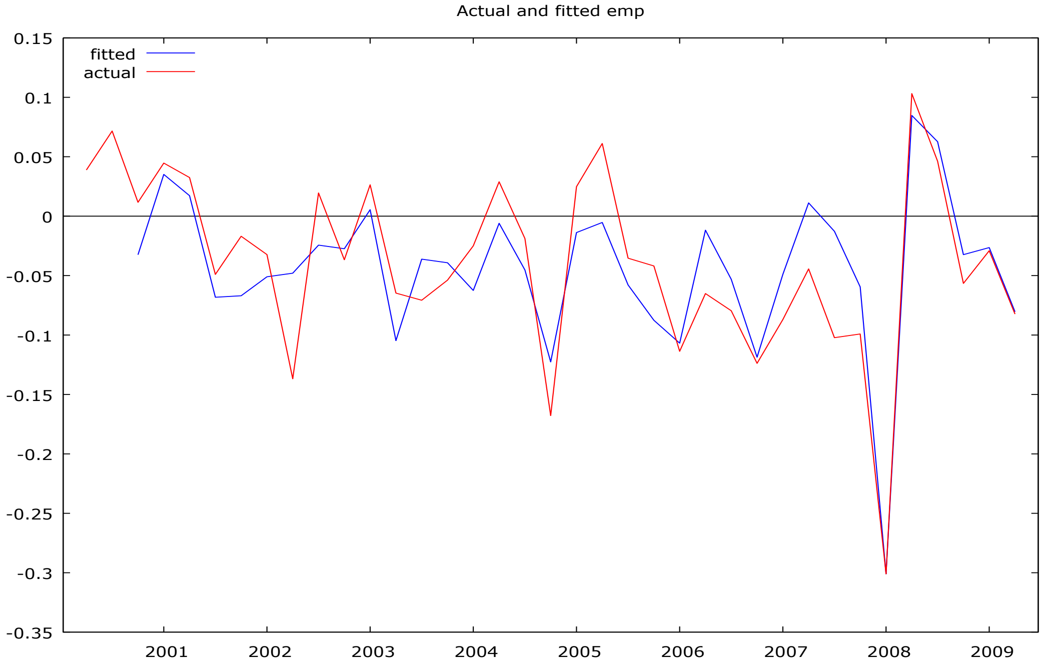

figure 11

It is necessary to run the same tests as we did for the 1st regression. Beginning with the White's test for heteroskedasticity, it is concluded that heteroskedasticity is not present.

White's test for heteroskedasticity -
Null hypothesis: heteroskedasticity not present
Test statistic: LM = 9.06749
with p-value = P(Chi-square(19) > 9.06749) = 0.972342

table 12

Next is the test for autocorrelation, which results in accepting the null hypothesis, thus there is no autocorrelation.

LM test for autocorrelation up to order 4 -
Null hypothesis: no autocorrelation
Test statistic: LMF = 0.834284
with p-value = P(F(4,20) > 0.834284) = 0.519308

table 13

Moreover, another important test that needs to be done is for the normality of the residuals. The hypothesis of normality is accepted.

Test for normality of residual -
Null hypothesis: error is normally distributed
Test statistic: Chi-square(2) = 2.70406

with p-value = 0.258714

table 14

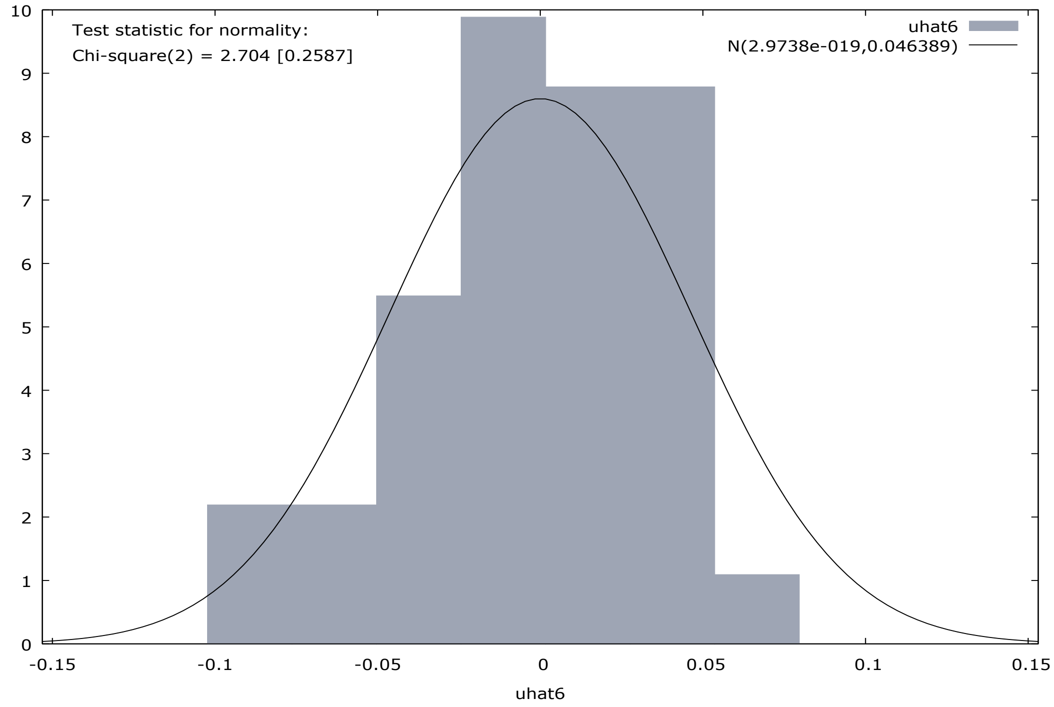

figure 12

Additionally, a QLR test was run, to test whether there is a structural break or not. The result is that there is no structural break.

QLR test for structural break -
Null hypothesis: no structural break
Test statistic: chi-square(6) = 1.79769 at observation 2001:4

table 15

The second test is to examine whether the exchange rate or the international reserves better absorb EMP. The procedure for this test is the following. We run exactly the same regression as in the beginning, but the dependent variable will not be EMP, but it will be just the international reserves of Thailand in regression 3 and the exchange rate in regression 4. The results of these regressions are given below. The following regression is number (3) and the dependent variable is r.

Model 9: OLS, using observations 2000:4-2009:2 (T = 35) Dependent variable: r HAC standard errors, bandwidth 2 (Bartlett kernel)					
	Coefficient	*Std. Error*	*t-ratio*	*p-value*	
const	-0.495943	0.240915	-2.0586	0.05055	*
d	-1.54695	0.439933	-3.5163	0.00177	***
d_1	0.659255	0.332171	1.9847	0.05872	*
y	0.0157302	0.00357925	4.3948	0.00019	***
y_1	0.00782968	0.00121206	6.4598	<0.00001	***
d_l_prices_usa	-4.65766	0.975817	-4.7731	0.00007	***
a	-0.823876	0.419397	-1.9644	0.06116	*
a_1	0.295362	0.336533	0.8777	0.38883	
a_2	0.991334	0.468236	2.1172	0.04480	**
dum0801	0.145704	0.0211546	6.8876	<0.00001	***
r_1	1.0481	0.021804	48.0693	<0.00001	***

Mean dependent var	10.87146	S.D. dependent var	0.426149
Sum squared resid	0.020694	S.E. of regression	0.029364
R-squared	0.996648	Adjusted R-squared	0.995252
F(10, 24)	16020.56	P-value(F)	2.32e-43
Log-likelihood	80.41900	Akaike criterion	-138.8380
Schwarz criterion	-121.7292	Hannan-Quinn	-132.9320
rho	0.100498	Durbin's h	0.590796

table 16

We can see that all of the coefficients are again statistically significant and they have the expected signs. But their value has been reduced. The important fact here is that the adjusted R^2 is higher than before. In this regression 99% of the changes in r can be explained by the explanatory variables of the model. We will compare this result later with regression (4).

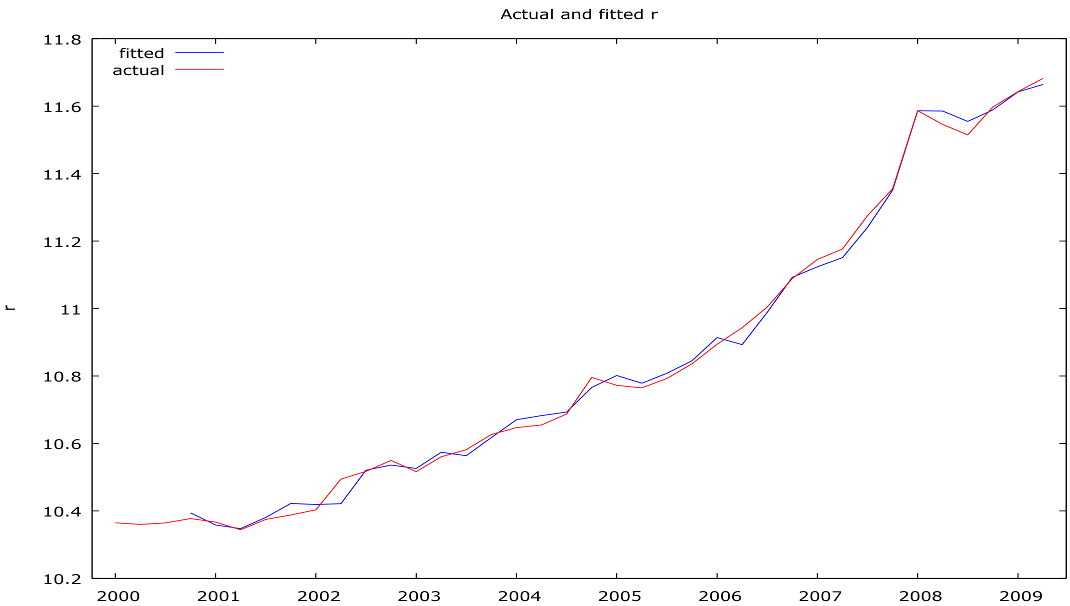

figure 13

It is necessary to run the same tests as we did for the 1st regression. Beginning with the White's test for heteroskedasticity, it is concluded that heteroskedasticity is not present.

White's test for heteroskedasticity -
Null hypothesis: heteroskedasticity not present
Test statistic: LM = 11.1665
with p-value = P(Chi-square(19) > 11.1665) = 0.91811

table 17

Next is the test for autocorrelation, which results in accepting the null hypothesis.

LM test for autocorrelation up to order 4 -
Null hypothesis: no autocorrelation
Test statistic: LMF = 0.336424
with p-value = P(F(4,20) > 0.336424) = 0.850157

table 18

Moreover, another important test that needs to be done is for the normality of the residuals. In this test we accept the null hypothesis for ones more.

Test for normality of residual -
Null hypothesis: error is normally distributed
Test statistic: Chi-square(2) = 3.88479
with p-value = 0.14336

table 19

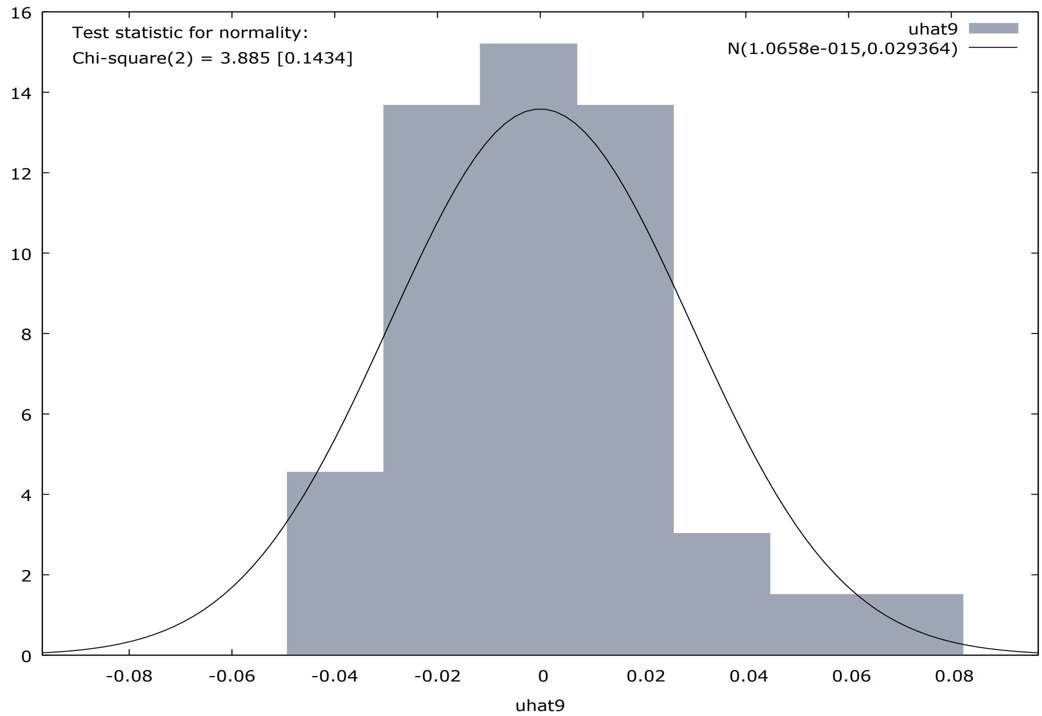

figure 14

Additionally, a QLR test was run, to test whether there is a structural break or not. The result is that there is no structural break.

```
QLR test for structural break -
  Null hypothesis: no structural break
  Test statistic: chi-square(6) = 1.79769 at observation 2001:4
```

table 20

Next, the results of regression (4) are presented, where e is the dependent variable.

Model 13: OLS, using observations 2000:4-2009:2 (T = 35)
Dependent variable: e
HAC standard errors, bandwidth 2 (Bartlett kernel)

	Coefficient	*Std. Error*	*t-ratio*	*p-value*	
const	-0.000511878	0.00351386	-0.1457	0.88522	
d	0.562834	0.273514	2.0578	0.04903	**
y	-0.00781054	0.00165907	-4.7078	0.00006	***
y_1	-0.0104908	0.00177979	-5.8944	<0.00001	***
d_l_prices_usa	1.90906	0.523087	3.6496	0.00107	***
d_l_prices__1	1.89273	0.482292	3.9244	0.00051	***
dum0801	-0.0576784	0.00537453	-10.7318	<0.00001	***

Mean dependent var	-0.006200	S.D. dependent var	0.031928
Sum squared resid	0.017013	S.E. of regression	0.024649
R-squared	0.509142	Adjusted R-squared	0.403958
F(6, 28)	109.9342	P-value(F)	3.83e-18
Log-likelihood	83.84726	Akaike criterion	-153.6945
Schwarz criterion	-142.8071	Hannan-Quinn	-149.9362
rho	-0.020350	Durbin-Watson	1.938028

table 21

The results of the 4th regression differ even more from the original regression, than the results of regression (3) did. Here, variable a is statistically insignificant, in contradiction to the 1st and 3rd regression. Although the signs of the coefficients remain the same, their value is lower, compared with regression (1). But, the most important fact is that adjusted R^2 is much lower. It is 0,42 meaning that only 42% of the changes in the dependent variable (e) can be explained by the right hand side variables.

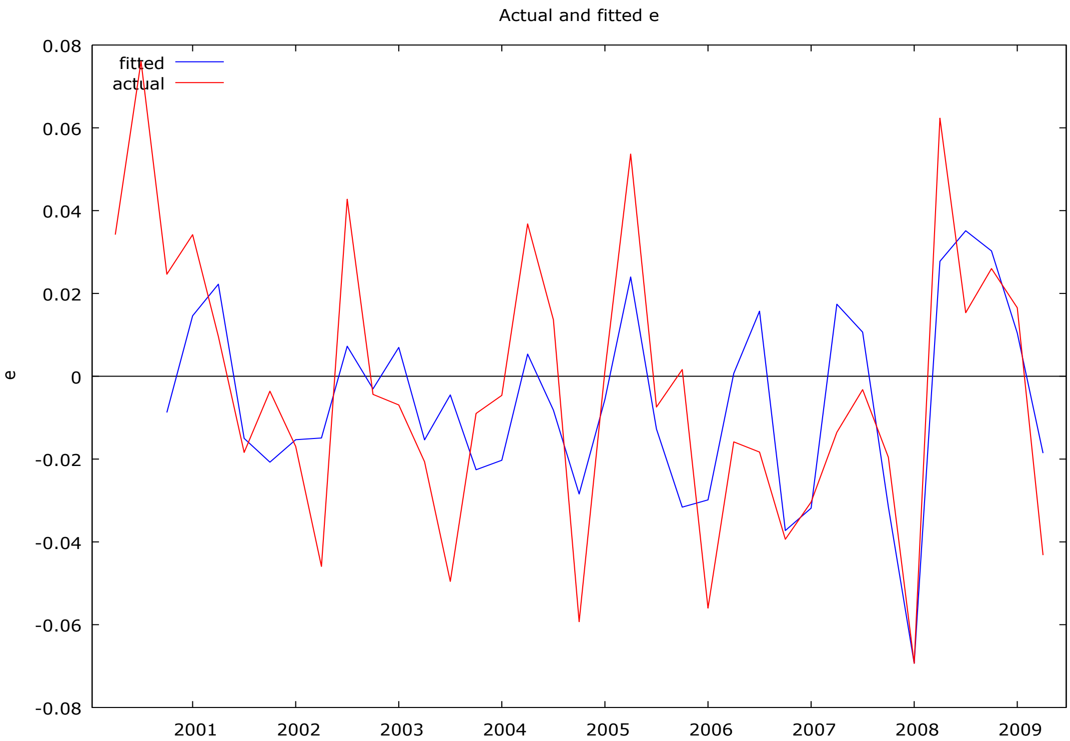

figure 15

It is necessary to run the same tests as we did for the 1st regression. Beginning with the White's test for heteroskedasticity, it is concluded that heteroskedasticity is not present.

White's test for heteroskedasticity - Null hypothesis: heteroskedasticity not present Test statistic: LM = 16.662 with p-value = P(Chi-square(21) > 16.662) = 0.731379

table 22

Next is the test for autocorrelation, which results in accepting the null hypothesis.

LM test for autocorrelation up to order 4 - Null hypothesis: no autocorrelation Test statistic: LMF = 0.584208 with p-value = P(F(4,24) > 0.584208) = 0.677078

table 23

Moreover, another important test that needs to be done is for the normality of the residuals. In this test, it is concluded that the residuals are normally distributed.

Test for normality of residual - Null hypothesis: error is normally distributed Test statistic: Chi-square(2) = 1.04427 with p-value = 0.593253

table 24

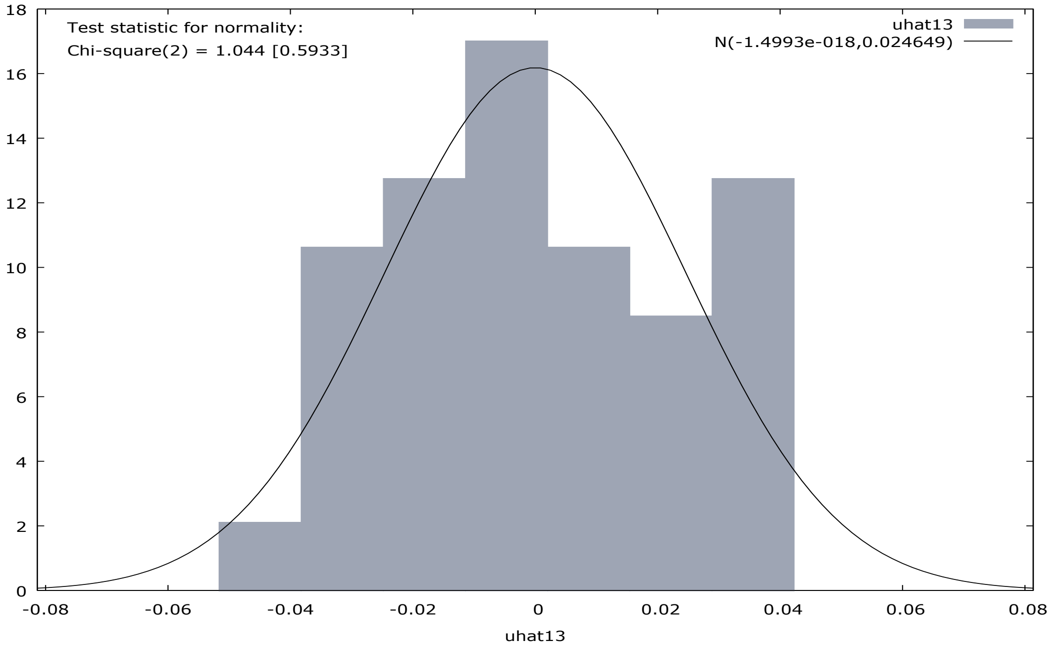

figure 16

Additionally, a QLR test was run, to test whether there is a structural break or not. The result is that there is no structural break.

QLR test for structural break -
Null hypothesis: no structural break
Test statistic: chi-square(6) = 1.79769 at observation 2001:4

table 25

Comparing regressions (1), (3) and (4) (see table 10 for help) we are led to the conclusion that most of the changes in Thailand's EMP happens due to changes in the growth of international reserves of the country rather than changes in the exchange rate. This can be seen through adjusted R^2. In the 3rd regression, adj-R^2=0,99 which means that the determinants of EMP can explain almost completely the any changes in the international reserves. But, the same determinants do not explain more than 40% of the changes in the exchange rate of thai baht. Consequently, the Thailand data show that most EMP is absorbed by changes in the international reserves.

This result comes as support to those who claim that exchange rate alone in not a good measure of the forex pressure. As it has been mentioned in the second part of this paper, in any exchange rate regime (except for the floating one) authorities take on policy actions in order to face depreciation. Thus, EMP differs significantly from the simple exchange rate change, because it takes policy measures into account. So, in a country with a managed floating exchange rate regime it would be misleading to test for forex pressure only via exchange rate changes and totally leave reserves out of research (Tanner, 2001). The results of this test for Thailand, which is a country that follows a managed floating exchange rate regime, support the above theory, which not only Tanner, but almost every author contends.

Before concluding the paper, there should be a discussion over the determinants of EMP. Beginning with the growth of domestic credit, the results show that when it increases currency depreciates and reserves flow out of the country, thus EMP increases. This result agrees with the GR monetary model, which proposes that there is positive relation between EMP and the growth of domestic credit. As it is known from the economic theory a currency crisis occurs when the speculation on the domestic currency in the forex market will lead to a collapse of the currency. According to the first generation model of currency crisis, the time of the collapse of the exchange rate regime of a country is given by the following formula:

$$T = \frac{\ln\left[1 + \frac{R}{D}\right]}{\mu} - \alpha$$

According to the crisis theory and the above model, if the ratio R/D increases then the time of the collapse of the regime is postponed. In the above formula the ratio R/D, the ratio of reserves over domestic credit, is the inverse of the monetary base domestic credit. Therefore, if monetary base domestic credit increases, the time of the collapse of the fixed exchange rate regime will be minimized, which is compatible to the econometric results of the present thesis.

Additionally, the results for the growth of real income also support the GR model. When income increases, there is an appreciation of the currency and an inflow of reserves, which means EMP falls. This can be interpreted by the fact that when GDP increases, the domestic currency gets stronger and thus it is less vulnerable to forex speculations. The pressure the currency is under diminishes, thus the EMP index is expected to fall.

The results for the money multiplier seem to be a little confusing, because it causes a positive relation to both EMP and reserves, leaving exchange rate unaffected. However, the positive relation between a and EMP is correct according to the model of Girton and Roper.

Finally, as it has been explained above, the coefficient of foreign inflation does not agree with the GR model. The evidence from Thailand show that if foreign inflation increases there will be a depreciation of the currency and an outflow of the reserves. This is opposite than what theory implies. We would expect that when international inflation increases, products and services of the foreign country would be more expensive, thus demand for domestic products and services will be increased, because they would be relatively cheaper, and the resultant increase in exports would bring more reserves and decline EMP.

6. CONCLUSION

The main purpose of this thesis was to examine if the propositions of the monetary model of Girton and Roper are supported. In this way the determinants of EMP were identified. The empirical analysis was based on the GR model and especially on two more resent papers, one by I. Kim (1985) and one by E. Ziramba (2007).

Firstly, the GR model was presented and then the time series of Thailand's EMP index was created. At first, it was examined if these data provide any evidence of currency crisis, at the beginning of the current world crisis. According to the approach proposed by Tanner (2001), signs of a currency crisis are identified, in the first quarter of 2008, which can be described, not only as mild, but also as severe crisis. An additional finding is that the time series of Thailand's EMP and of the growth of nominal spot exchange rate move very close together. These series also have a high and statistically significant correlation.

In order to detect which variables influence EMP, the econometric procedure of OLS was followed and the regression was created according to the GR model. The results agree with the model, except for the sign of foreign inflation. More specifically, there is a positive relation between EMP and growth of domestic credit, positive relation between EMP and money multiplier and negative with real income. These results agree with the GR model. The one that does not agree is the positive relation between EMP and foreign inflation.

The two additional tests that were conducted, also gave some interesting results. The first test concludes that the distribution of EMP between exchange rate and international reserves does not influence the value of Thailand's EMP index, because variable Q was statistically insignificant. Moreover, the second test shows that most Thailand's EMP is absorbed by changes in the international reserves rather than changes in the exchange rate. This result comes as support to those who claim that exchange rate alone in not a good measure of the forex pressure.

Somebody may claim that EMP index may be affected by the explanatory variables, but it may also influence some of them. For example, some authors support that a change in EMP would cause a change in the growth of domestic credit as well. In such a case, a VAR approach would be helpful to draw some conclusions. But, this specific research is based on papers that follow the GR model and focuses on the unidirectional effect from the other variables towards the EMP index of Thailand. However, a similar survey with a VAR econometric approach could be an idea for further research on thai baht's EMP and its determinants.

Concluding this paper, it should be mentioned that it has given some important results for the case of the Thai economy. It has been proved that EMP can give us a hint about the outburst of a currency crisis, which could help monetary authorities take on efficient policy actions. Moreover, it is observed by the econometric analysis that EMP is affected by several macroeconomic variables. The GR model is supported by this research, but not absolutely. These results may be only for Thailand, but they agree in a high extent with the results of former papers in the same field and with further research it can be proven if the same facts hold for other economies and currencies as well.

REFERENCES

Angkinand, A. et al., (2006). Measures of Currency Crises: A Survey. Available through: Claremont Graduate University website http://www.cgu.edu [Accessed 11 March 2013]

Bertoli, S. et al., (2008). Exchange Market Pressure: some caveats in empirical applications. *Applied economics*, 42(19)

Chen, S.S. and Taketa, K., (2006). An Assessment of Weymark's Measures of Exchange Market Intervention: The Case of Japan. IMES[5] Discussion Paper Series, Discussion Paper No. 2006-E-3. Available through: IMES website http://www.imes.boj.or.jp [Accessed 1 March 2013]

Eichengreen, B. et al., (1994). Speculative attacks on pegged exchange rates: an empirical exploration with special reference to the European monetary system. *National Bureau of economic research* (working paper 4898)

Eichengreen, B. et al., (1994). Speculative attacks on pegged exchange rates: an empirical exploration with special reference to the European monetary system. *NBER[6] Working Paper Series*, Working Paper No 4898. Available through: http://www.nber.org [Accessed 15 November 2013]

Ziramba, E., (2007). Measuring Exchange Market Pressure in South Africa: An Application of the Girton-Roper Monetary Model. *South African Journal of Economic and Management Sciences.* 10(1), pp.89-98

Girton, L. and Roper, D., (1976). A Monetary Model of Exchange Market Pressure Applied to the Post-War Canadian Experience. The American Economic Review, 67(4), pp. 537-547

Heriqbaldi, U., (2012). Exchange Market Pressure In Indonesia: A Univariate Markov Switching Analysis. *Asian Economic and Financial Review*. 2(5), pp. 603-616. Available through: http://www.aessweb.com [Accessed 10 September 2013]

Jager, H. and Klaasen, F., (2010). Exchange Market Pressure. Available through: Universiteit Van Amsterdam website http://www1.fee.uva.nl [Accessed 26 February 2013]

Kamaly, A. and Erbil, N., (2000). A VAR analysis of exchange market pressure: a case study for the Mena region. Economic Research Forum. Available through: http://www.erf.org.eg [Accessed 9 September 2013]

[5] Institute of Monetary and Economic Studies, Bank of Japan
[6] National Bureau of Economic Research

Karfakis, C. and Moschos, D., 1999. Searching for Indicators of Foreign Exchange Market Pressure: Evidence from Greece. *International Journal of Finance and Economics*, 4, pp.63-73.

Katircioglou, S.T. and Feridum, M., 2010. Do macroeconomic fundamentals affect exchange market pressure? Evidence from bounds testing approach for Turkey. Applied Economics Letters, 18(3), pp. 295-300. Available through: http://www.tandfonline.com [Accessed 12 March 2013]

Khawaja, M.I., (2007). Exchange Market Pressure and Monetary Policy: Evidence from Pakistan. Pakistan Institute of Development Economics. 2007(31). Available through: http://www.pide.org.pk [Accessed 12 March 2013]

Kim, I., 1985. Exchange Market Pressure in Korea: An Application of the Girton-Roper Monetary Model: Note. *Journal of Money, Credit and Banking*, 17(2), pp. 258-263. Available through: http://www.jstore.org [Accessed 11 September 2013]

Klaasen, F., (2011). Identifying the Weights in Exchange Market Pressure. Tinbergen Institute Discussion Paper, Discussion Paper No 030/2. Available through: http://www.tinbergen.nl [Accessed 17 November 2013]

Li, J. et al., (2006). Measuring currency crisis using exchange market pressure indices: the impression of precision weights. Available through: Claremont Graduate University website http://www.cgu.edu [Accessed 11 March 2013]

Nakornthab, N., (2009). Thailand's monetary policy since the 1997 crisis. Kobe University Economic Review 55. Available through: http://www.econ.kobe-u.ac.jp [Accessed 10 February 2014]

Stavarek, D., (2009). Exchange Market Pressure in Central Europe: An Application of the Girton-Roper Mode*l. Munich Personal RePEc Archive,* Paper No 15744. Available through: http://mpra.ub.uni-muenchen.de/15744 [Accessed 15 November 2013]

Stavarek, D., (2010). Exchange Market Pressure and de facto Exchange Rate Regime in the Euro-Candidates. *Romanian Journal of Economic Forecasting.* 2/2010, pp. 119-139

Tanner, E., (2001). Exchange Market Pressure and Monetary Policy: Asian and Latin America in the 1990's. IMF Staff Press. 17(3), pp. 311-333. Available through: http://www.papers.ssrn.com [Accessed 10 September 2013]

Tanner, E., (2002). Exchange Market Pressure, Currency Crises, and Monetary Policy: Additional Evidence from Emerging Markets. *IMF Institute*

Weymark, D.N., (1995). Estimating exchange market pressure and the degree of exchange market intervention for Canada. *Journal of International Economics*, 39, Available through: http://www.sciencedirect.com [Accessed 15 November 2013]