THE EFFECT OF CHANGE IN OUTPUT AND INFLATION ON
NOMINAL INTEREST RATE DURING THE GLOBAL
FINANCIAL CRISIS IN THE EUROZONE,
THE UNITED STATES, AND THAILAND
AND THEIR DIFFERENCES

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A Thesis Submitted in Partial

Fulfillment of the Requirements for the Degree of

Master of Management

International College

National Institute of Development Administration

2015

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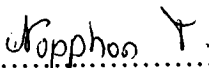
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August 2015

ABSTRACT

Title of Thesis	The Effect of Change in Output and Inflation on Nominal Interest Rate during the Global Financial Crisis in the Eurozone, the United States, and Thailand and Their Differences
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Degree	Master of Management
Year	2015

This study focuses on the consequences of the global financial crisis as changes in output and inflation. By researching the effects of these changes, which are the main factors influencing monetary policy, on nominal interest rate, it is important to find out which of these two factors are more important when it comes to the Eurozone and to compare it with the Unites States' and Thailand's monetary policy. The paper will focus on comparing the effects of these two variables on nominal interest rate before the crisis and during the global financial crisis. Subsequently, the important part in the paper is the impact of the global financial crisis on changes in the intra-regional and extra-regional trade and FDI flow in ASEAN. According to the results, I will try to prove that the effect of the global financial crisis on Thailand's monetary policy and the economy of the ASEAN countries is much different and lower compared to the Eurozone and the U.S.

ACKNOWLEDGEMENTS

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ABBREVIATIONS AND SYMBOLS

Abbreviations	**Equivalence**
ASEAN	Association of Southeast Asian Nations
BOT	Bank of Thailand
BRIBOR	Bratislava Interbank Offered Rate
CDO	Collateralized Debt Obligation
CPI	Customer Price Index
ECB	European Central Bank
EU	European Union
FDI	Foreign Direct Investment
FED	Federal Reserve System
GDP	Gross Domestic Product
MBS	Mortgage-Backed Security
U.S.	United States of America

SYMBOLS

i	Nominal Interest Rate
r	Real Interest Rate
π	Inflation
P	P-Value

CHAPTER 1

INTRODUCTION

The global financial crisis, which began between 2007 and 2008, resulted in the sharp reduction in global growth, trade and increased the unemployment rate, not just in the Europe or the U.S., but globally. "A classic explanation of recent financial crises is that they are caused by excesses, frequently monetary excesses, which lead to a boom on the market and after that, the boom leads to an inevitable bust", for example, the housing boom and bust which started the global financial crisis in 2007 (Taylor, 2009). There are many reasons why housing boom happened. One of them is that after the dotcom crisis investors stopped investing their money into the IT industry and they were instead looking for another branch to invest. Later on, this caused an increase of investments into a real estate. A housing boom was probably also an effect of irresponsible commercial banks' policy. Banks were offering loans to a high risk clients and after the decrease of real estate prices increased a percentage of non-performing loans. It is also responsibility of the monetary authority, specifically FED, because they kept nominal interest rate on very low level. So the result was that the housing boom was caused by a huge amount of money on the market because of low interest rates by FED. FED actually did not continue in the same policy as was done before, mapping the Taylor curve and setting the interest rate in its merits, but between years 2001 and 2006 interest rates went much lower as they supposed to according to Taylor rule, because of the change in FED's monetary policy which could be caused by the dotcom crisis. This shows us a very important shortcoming in using monetary policies of central banks, which caused a monetary excess in the market. Central banks should be careful with using conventional and unconventional tools of their monetary policy, otherwise their use which was meant to get the economy back on track after the crisis could end up in another financial crisis in the future. However, when financial crisis occurs, central banks have to be careful again,

to use these tools properly so that they can help to get rid of the crisis not just as soon but also as effectively as possible.

This paper researches the effect of output and inflation on nominal interest rates in the Eurozone and in the U.S. before and during the financial crisis and compares their differences. Subsequently, it examines the effect of these two variables on nominal interest rate in Thailand and looks at how the crisis, which mostly occurred in the U.S. and EU, affected the economies in the ASEAN community by researching the change in FDI and trade. The second chapter briefly describes the monetary policy, and open-market operations and effects of the financial crisis on the monetary policy of the Eurozone, the U.S., and Thailand. The first part of the third chapter will provide the reader with the methodology of the research, the data used, and the estimation technique. The research part is quantitative. The first part researches how big the effect of inflation and output is on nominal interest rate set by the ECB, FED, and BOT. The second part of the research is comprised of the chronological development of intra-regional and extra-regional trade and FDI flow. The discussion section summarizes the differences between the effect of inflation and output on nominal interest rate in the Eurozone, the U.S., and Thailand, compares its differences, and describe the effect of the crisis on ASEAN in the conclusion part.

This paper shows us how monetary policy decisions, according to inflation and output, differ among the Eurozone, the U.S., and Thailand. The paper also explores the idea whether the predictions for faster intra-regional FDI flow and trade growth compared with extra-regional growth in ASEAN after the global financial crisis really took place and if these predictions were correct.
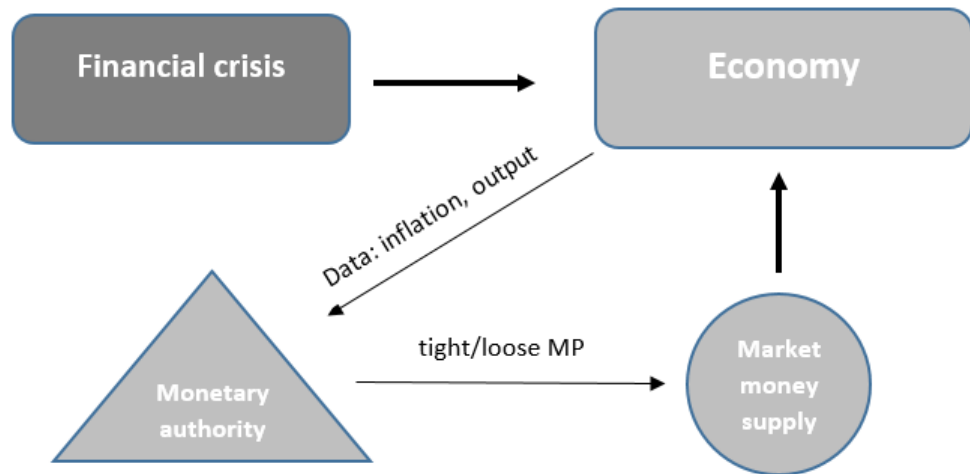
Figure 1.1 The Impact of the Financial Crisis on the Monetary Policy

Figure 1.1 shows us what monetary authority does, when the financial crisis strikes the economy in order to prevent its adverse effects. Simply said, when the financial crisis occurs, it has a huge effect on the economy, but in this paper, more important is the effect of inflation and output. Financial crisis in one perspective is a significant change in output and inflation that are the indicators of the financial crisis for a central bank. A central bank is trying to adjust its monetary policy according to the change in these indicators. By the monetary policy tools, the central bank is influencing the market money supply to get inflation and output back on a track.

CHAPTER 2

LITERATURE REVIEW

2.1 Monetary Policy

The monetary policy is one of two most important economic policies. This policy is performed by the monetary authority of a country or a block of countries and its usual goals are a price stability, a full employment and a high rate of economic growth (Monetary policy, 2014). The monetary policy controls the amount of money on the market and influences this amount by monetary policy tools to reach its goals. Those tools are open-market operations, discount rates and reserve requirements. However, we cannot forget about unconventional tools of monetary policy, which are a credit easing, signaling and a quantitative easing (Taylor, 1999). The main principle which the monetary policy uses is a relation between the price of money (interest rates) and a total supply of money on the market.

For some time now, monetary economists have been in a consensus on the principles of monetary policy design. One of those principles is the belief that central banks should be independent and that they should clearly define their policy objectives and use their monetary tools to meet those objectives. Another common principle is that the monetary authority's number one operational instrument should be an interest rate and these policymakers need to be transparent about their actions (what and why are they doing) (Woodford, & Walsh, 2005).

Speaking of tools of the monetary policy, economists distinguish between two main groups, conventional and unconventional. Nowadays, the monetary policy mainly acts by setting a target for the overnight interest rate in the interbank money market and adjusting the supply of central bank money to that target through open-market operations. The central bank is not involved in lending to the private sector or the government. The use of open-market operations is the most important tool used to manipulate monetary policy. The monetary authority's goal in trading securities is to affect nominal interest rate, the rate at which banks borrow reserves from each other.

The monetary authority sets a target for this rate but not the actual rate itself because it is determined by the open market (Investopedia). "By steering the level of the key interest rates, the central bank effectively manages the liquidity conditions in the money markets and pursues its primary objective of maintaining price stability over the medium term. These tools are used to provide stimulus to the economy during downturns and to decrease inflationary pressures during upturns" (Smaghi, 2009).

The other type of monetary policy tools, unconventional monetary tools, is used when the interest rates are close to the 0% level and it is really hard for the central bank to boost economy by using the conventional tools. Monetary authority starts to use unconventional monetary tools, when conventional tools are ineffective. Let's have a look at specific unconventional monetary tools used, when conventional are not enough.

The first one is credit easing. Credit easing is a combination of three important parts: lending to financial institutions, providing a liquidity to the key credit markets and buying of a long term securities. This policy is used in a situation when banks doesn't have enough liquidity, which happened during the global financial crisis. There was a fire sale of securities which drove down their prices. Banks are holding many of securities in their balance sheet to borrow money in the capital markets and they use them as a collateral. Banks also securitize the loans and then sell those securities to the private sector. When fire sale started equity of banks was wiped out as they seek to maintain their holdings and that's why they couldn't borrow more in private sector. This situation can be solved by the government security purchases to raise the security prices so the real investment can start (Shleifer, & Vishny, 2010).

The second important tool is the monetary policy signaling. It's a way how the policy makers indicate their intentions through a policy reports, speeches and other communication channels. This policy is effective because the exchange rates and the long term interest rates reflect the expectations of the monetary policy in the future. This means that the orientation of the monetary policy should be seen while looking at the expected intentions of the monetary authority more than looking at the current setting of the central banks instrument (Svensson, 2003).

The third, but most discussed unconventional tool these days is the quantitative easing. It is purchasing public and private sector assets using the central

bank money (Benford, Berry, Nikolov, Young, & Robson, 2009). This is the way how to increase the amount of money on the market and increase inflation. On the other hand, issuing additional money and putting them on the market by buying public and private assets has also effect on the value of your currency. This increasing of the money on the market will depreciate your currency against other currencies, which means that imports are more expensive for you. On the other hand, it can kick start your export, because your goods and services are cheaper for other countries. It helps to increase current account in the balance of payments of the country.

2.2 Financial Crisis and Its Effect on Output and Inflation

It was the global financial crisis which caused the huge decrease in output in many world economies, which is one of most important factors determining the monetary policy of the central bank. Inflation is also very important because goal number one of most monetary authorities nowadays is the price stability kept by inflation targeting policy, which is actually the heritage of the 1970's Great Inflation period (Faia, 2008). Output and inflation were used in the research of this paper also because of the Taylor rule, which estimates what level of nominal interest rate the monetary authority should set according to these two variables. One way to view the crisis is as a series of policy events proceeding through various periods and in those periods, the policy responses differ (Fender, & Gyntelberg, 2008). According to Jacson (2010) the global financial crisis can be divided to four phases. The first one is "Early build-up" to the crisis when policy makers assist individually troubled banks and financial institutions. In the second phase, the governments (through the central banks) address the issue of liquidity that arises from concerns over the viability of the financial system. In the third phase, the government adopts policies to address the issues of solvency when financial institutions and banks are getting rid of troubled assets. Last, fourth phase, is described as government's shift to address growing concerns over the economic downturn that worsened the financial crisis.

According to Chailloux, Gray, Kluh, Shimizu, and Stella (2008) one of the biggest issues central banks are facing during the financial crisis is to distinguish between troubled institutions on to market and troubled markets. According to the

paper, it is easier to deal with institutions because you can go case-by-case, but when you deal with troubled markets there is a need of more coordinated approach because the effects of dealing with them can affect wide range of countries and financial markets. This is more the subject of fiscal policy, but in this paper, focus will be more on the monetary policy.

Economists nowadays have different opinions about the appropriate monetary policy, which should be used to get rid of the aftermath of the financial crisis. Usually, there are two different opinions when speaking about the domestic interest rates of a country. There is the option to cut interest rates to increase borrowing and spending, which should decrease unemployment. The other option is to raise the interest rates to defend the currency and to halt the flight of the capital from the economy. However, when a financial crisis occurs, it is more important to defend the economy and to accept a short currency value decrease in order to increase the aggregate demand. According to Christiano, Gust, and Roldos (2004) there should be a framework with two building blocks. To increase a production, firms need a domestic working capital to hire a labor and an international working capital to finance an imported intermediate input. The second block means an expansive monetary policy including the decrease of nominal interest rates, which brings more liquidity to the banking sector and allows firms to hire more labor. The additional feature of their model is a collateralized physical asset such as a land or a capital that mostly has to be present when borrowing through the crisis. Application of binding collateral constraints in the model cause the economy to have a current account surplus and decrease its debt to state when the collateral constraint is non-binding. The amount of this collateral limits the borrowing that firms can do. This leads to the reduction in output and the employment. Another effect is that asset values fall, as well because of slowdown in activity and real and nominal exchange rates depreciation. These findings correspond with what was observed in the Asian crisis that began in late 1997.

Speaking about an interest rate cut, it results in the exchange rate depreciation. This effect decreases a value of domestic assets (which can be used as the collateral) but on the other hand is not affecting a value of international liabilities. This is more likely to happen when there are limitations on how flexible can the economy exploit

an increase in a quantity of the intermediate good. On the other hand, the interest rate cut can also decrease the need for collateral by pushing up the value of assets. This situation is more likely to happen when there are no such limitations as in the first case (Christiano et al., 2004).

Few economists argue that expansive monetary policy is ineffective during the crisis and monetary authorities should not use their tools to recover from the crisis. This brings us back to Keynesians and their view on the monetary policy during the crisis. They argue that a credit market is strongly influenced by the financial crisis and the monetary policy cannot entice consumers into spending more money or investing more in the economy, even when monetary authority is increasing the amount of money on the market. This situation is called "pushing on a string". Mishkin (2009), argues that this view is incorrect. He says that if the monetary policy should offset the contractionary effects of the financial crisis, than it need to pursue more expansive monetary policy than normal.

2.3 Nominal Interest Rate and Inflation

Inflation, as one of the main macroeconomic indicators, reflects the rate of the increase in price level, which is actually the depreciation rate of the purchasing power of money. Talking about the relationship between nominal interest rate and inflation, it is important to mention the economist Irving Fisher and his equation known as the Fisher equation:

$$i = r + \pi$$

This approximated equation shows, that two important factors determining the change of nominal interest rate are the real interest rate and the inflation rate. "The quantity theory and the Fisher equation together tell us how money growth affects nominal interest rate. According to the quantity theory, and increase in the rate of money growth of 1 percent causes a 1-percent increase in the rate of inflation. According to the Fisher equation, a 1-percent increase in the rate of inflation in turn causes a 1-percent increase in nominal interest rate (Mankiw, 2002)." We can also see

it in the Figure 2.1. When inflation is high, nominal interest rates are high and vice versa. This relationship is called the Fisher effect and according to this effect, low levels of the inflation, which are present these last years in the Eurozone, can lead to a liquidity trap which makes the monetary policy ineffective. This is because when the interest rates are almost at a zero level or even under it, people will decide to simply hold the cash. Even when the monetary authority raises the supply of the money in the market, the extra liquidity might not have any effect because the interest rates cannot fall any further. This happened in Japan in the 1990's and the United States in the 1930's (Mankiw, 2002). As important is the effect of nominal interest rate on inflation, the effect of inflation has the same importance in setting the future nominal interest rate target.

This paper investigates the relation between inflation and nominal interest rate according to Taylor (1999), who suggests an important relation between inflation and nominal interest rate and recommends a "tight" monetary policy (relatively high-interest rate), which should be set when inflation is above its target in order to reduce inflationary pressure. He recommends an "easy" monetary policy (relatively low-interest rate) in the opposite situation, in order to stimulate output.

According to "Analysis of shocks of inflation expectations and ex-ante real interest rates impact on development of interbank interest rates BRIBOR" by Mirdala (2008), interest rates were affected dominantly by changes in inflation expectations and barely by ex-ante real interest rates.

Also, according to Mankiw (2002), who compared data on nominal interest rate of three-month Treasury bills and the inflation rate measured by the CPI in the United States between 1954 and 2000 (Figure 2.1), we can see a strong relation between those two variables.

Effect of inflation on nominal interest rate (US)
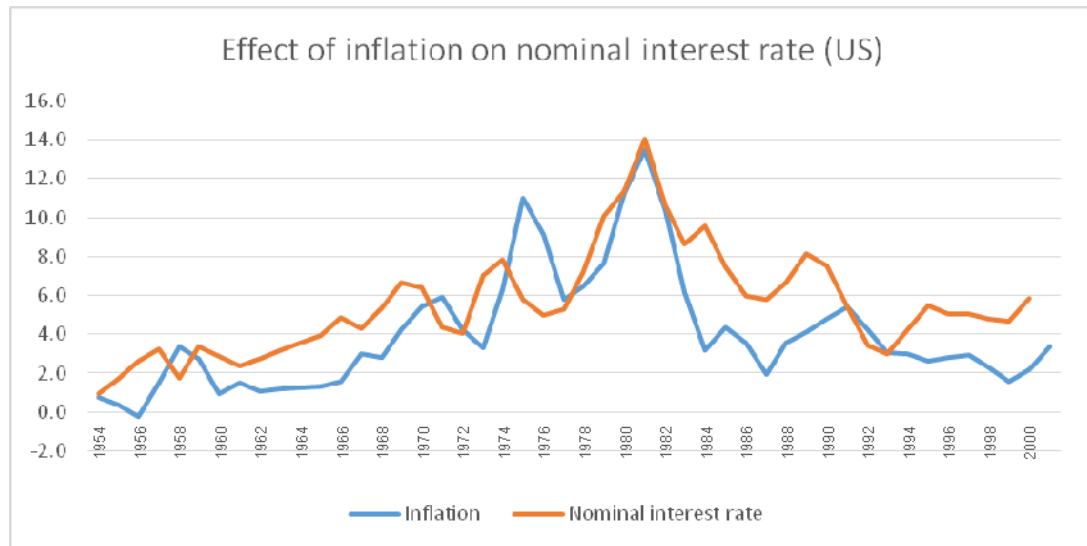
Figure 2.1 Relation between Inflation and Nominal Interest Rate
Source: Graphed from Dataset of the Federal Reserve Bank of St. Louis.

Mankiw (2002), is also describing an evidence from late nineteenth and early twentieth century when high interest rates are not present while high inflation, that is why it cannot be considered as the Fisher effect. According to a recent research, this period has little to tell us about a validity of the Fisher effect because it relates nominal interest rate to expected inflation, but in this period, inflation was really unexpected and that is why there is no Fisher effect.

Paper by Booth (2001) is characterizing the changes in a nominal short-term Eurocurrency interest rates. Author used the short-term nominal Eurocurrency interest rates and inflation rates for 10 countries (9 European countries and the U.S.). The analyses indicates that with one exception, each European country is cointegrated with its inflation rate. Crowder and Hoffman (1996), found in their study a support for a tax-adjusted Fisher equation, specifically that a 1% increase in the inflation brings 1.34% increase in nominal interest rate. They documented that a 3-month U.S. T-bill rate and the U.S. inflation rate are cointegrated. This shows that inflation has a huge and positive effect on nominal interest rate.

According to these facts, three hypothesis were formed about the relationship between inflation and the target nominal interest rate.

H1: Inflation has a positive effect on the interest rate for the main refinancing operations of the European Central Bank.

H2: Inflation has a positive effect on the Effective Federal Funds Rate of the FED.

H3: Inflation has a positive effect on the nominal interest rate set by the Bank of Thailand.

2.4 Nominal Interest Rate and Output

The monetary policy is very important and effective in stabilizing a business cycle fluctuations and relations between monetary policies and the real output are crucial in the monetary policy research. It is also important to know how the monetary policy decisions are affecting the long term equilibrium real output (Aksoy, & León-Ledesma, 2005). This paper investigates how big and how significant is the effect of output on Eurozone's, U.S.'s and Thailand's monetary policy.

The simple rule is that the higher the output, the tighter should the monetary policy be. When it comes to open-market operations, it essentially means selling securities by the monetary authority. This means lowering the amount of money on the market. When output is lower than the expectations, the monetary policy should be easier (i.e. decreasing nominal interest rate and putting more money into the market to ensure higher output). Many economists say that in the long run, this does not create higher output, only higher inflation.

When dealing with an expected output, the higher the expected output is, the lower should the interest rate be set in order to get to that point and meet the expectations of the market. The Taylor rule uses a deviation of real GDP from the target so the higher it is, the higher should be nominal interest rate (Taylor, 1993).

According to previous research, the following three hypotheses were formed concerning the relationship between output and the target nominal interest rate.

H4: Output has a positive effect on interest rate for the main refinancing operations of the European Central Bank.

H5: Output has a positive effect on the Effective Federal Funds Rate of the FED.

H6: Output has a positive effect on the nominal interest rate of the Bank of Thailand.

2.5 Monetary Policy and Taylor Rule

In the past, before the Taylor rule was formulated, there were different econometric models formulated by IMF, FED, Department of finance in Canada and others, which were measuring the performance of different monetary policy rules. There were many differences between those models. Later they came to one consensus and that was a fact that the exchange rate oriented policy rules that focus on the money supply don't perform as well as models which focus directly on the price level and the real output. According to this fact, Taylor (1993) assumed that in flexible exchange-rate regime, the central bank adjusts the short-term interest rate target in response to changes in the price level and the real output from the target. But in fixed exchange rate regime, countries cannot set their interest rates without looking at the interest rates of other countries. According to these and other facts, Taylor formed his own equation for his own rule:

$$r = p + 0.5y + 0.5(p - 2) + 2$$

Where:

      r   is the federal funds rate

      p   is the rate of inflation over the previous four quarters

      y   is the percent deviation of real GDP from a target

Taylor rule is actually an analysis of FED's monetary policy between 1987 and 1992. Simply formulated, it says that the short term interest rate is equal to the average short term real interest rate and terms which reflect deviations from the inflation target of the monetary authority and the difference of GDP.

Gerlach, and Schnabel (2000), found two main reason why Taylor rule can be attractive for the ECB to use. First one, according to Peersman and Smets (1998) in framework of small econometric model for EMU area, Taylor rule provides a degree of macroeconomic stabilization which is very close to one offered by an optimal rule.

Second one is simply a fact, that if the monetary authority will use a rule, which is well known to public, public can predict course of the monetary policy which wipes out uncertainty about it. They measured how the interest rate in EMU would look like, if Taylor rule would be used in period from 1990 until 1998. They found out that using Taylor rule, the interest rate would not deviate much from weighted interest rate setting behavior in EMU countries.

2.6 The Effect of the Financial Crisis on ASEAN Economy

As already mentioned in the introduction, the global financial crisis did not affected only the U.S. and the Europe but also other countries. Although many economists think that the effect of the global financial crisis was only partial and that it did not affect the Asian economy that much, some would argue, that when the crisis escalated, the ASEAN countries switched their target markets to Asia. However, searching for new markets to succeed there also takes time. On the other hand, according to Thangavelu (2008), "intra-regional trade in ASEAN and Asia will be one of the key factors for export growth as the key export markets in the U.S. and EU flattens. Intra-regional trade in Asia accounts for nearly 50% of the total trade in Asia in 2006. In ASEAN, the share of intra-ASEAN trade increased from 17% in 1990 to nearly 26% in 2005. Also, foreign investment in ASEAN countries is still very important for this region.

According to Kawai, Adams, Anatha-Nageswaran, Hu, Rana, and Chin, (2008), there are three main reasons why the global financial crisis should not affect ASEAN countries as much as expected. First is the fact that ASEAN's financial institutions are still not that developed as their U.S. or European counterparts, so there are not that many highly-complex financial innovations present. Another important fact is that the Asian financial crisis in 1997 was still in the minds of investors, so they were not investing in many high-risk instruments such as MBSs and CDOs. Another reason is also somehow connected with the financial crisis which occurred in 1997, and that is the strengthening of prudential supervision and regulation in the financial sectors introduced by the authorities in the ASEAN countries.

International monetary fund also did some projections on how would the global financial crisis affect ASEAN countries and they were expecting decrease in the output growth from 6.5% in 2007 to below 5% in 2009.

To conclude, the global financial crisis could be also a big opportunity for ASEAN countries to cooperate more in the region in a field of monetary and economic policy coordination (Thangavelu, 2008). With its population of over 500 million, ASEAN region plays an important role in the stabilization and growth of South-east Asian countries.

According to previous research, the following three hypotheses were formed concerning the relationship between the global financial crisis and change in intra-regional and extra-regional FDI flow, and intra-regional and extra-regional trade.

H7: The global financial crisis will cause faster after-crisis growth in intra-regional ASEAN FDI than extra-regional ASEAN FDI.

H8: The global financial crisis will cause faster after-crisis growth in intra-regional ASEAN trade than extra-regional ASEAN trade.

CHAPTER 3

METHODOLOGY

3.1 Measures

The main dependent variable, nominal interest rate, is in fact European central banks (ECB's) main refinancing operations interest rate, the U.S.'s effective federal funds rate, and the BOT's policy interest rate, which are the most suitable for seeing the effect of inflation and output. The specific inflation and output used for the European example were the percentage growth of the GDP and the lag harmonised index of consumer prices (lag HICP) overall inflation in the Euro area. For the U.S. example an output gap in the percentage of the potential GDP and lag GDP implicit price deflator were used. For the Thailand example it is the percentage growth of the GDP and lag inflation measured by the GDP deflator. The reasons why lag inflation was used and not lag but the current GDP are the following: first of all, inflation is calculated at the end of the period, so while determining a new nominal interest rate target, monetary authorities look at the rate of inflation already calculated, which is the rate from the previous period. When it comes to GDP growth, its expected rate does not deviate from the exactly-calculated rate at the end of the period that much. That is why it could be easily substituted by the current period GDP growth in the present data. For all of these indicators, quarterly data were used. For the second part of the research, annual the intra-regional and extra-regional FDI and trade data in ASEAN countries were used.

3.2 Nominal Interest Rate

When it comes to a role of interest rates in the economy, economists distinguish between nominal interest rate and the real interest rate. Nominal interest rate monetary authorities are setting is a target rate, so not actual nominal interest rate on the market set by the monetary authority in order to control the amount of money

on the market. On the other hand, the real interest rate is actually the nominal interest rate corrected for inflation (Mankiw, 2002). For example, when nominal interest rate is 5% and inflation rate is 2%, then the real interest rate is 3%. This gives us a simple equation for nominal interest rate called Fisher equation:

$$i \approx r + \pi$$

Where:

i = nominal interest rate

r = real interest rate

π = inflation

This equation shows that there are two important variables which can change nominal interest rate and those are change in the real interest rate or change in inflation. It is important to realise that this is not research about the actual nominal interest rate on the market, but about the target rate.

"The quantity theory and the Fisher equation together tell us how money growth affects nominal interest rate. According to the quantity theory, an increase in the rate of money growth of 1-percent causes a 1-percent increase in the rate of inflation. According to the Fisher equation, a 1-percent increase in the rate of inflation in turn causes a 1-percent increase in nominal interest rate. The one-for-one relation between the inflation rate and nominal interest rate in called the Fisher effect" (Mankiw, 2002).

3.3 Inflation

Inflation is a change in overall level of prices over a specific period of time and it is one of the primary concerns of economists and policy makers (Mankiw, 2002). For example same amount of the money you have today does not buy as much as it did 10 years ago. Inflation is measured by the inflation rate and there are two most frequently used ways how to measure it, which are consumer price index (CPI)

and implicit price deflator for GDP also known as GDP deflator. These two have some key differences.

GDP deflator uses domestically produced goods and reflects the price of all goods and services. CPI takes into account the prices of specific goods and the prices which are part of so called "basket" where the goods and the services are fixed and it compares prices of a current period to a previous period. CPI also considers imported goods which GDP deflator does not. Another important thing is, that one quarter delayed inflation was used in paper analyses. It is due to the fact that monetary authority sets nominal interest rate during the year and that is why they are counting on last calculated inflation, so it is the one calculated previous quarter.

3.4 Output

Output is expressed by GDP, which is considered the best measure of how well the economy is performing. The goal of GDP is summarizing, in single number, the money value of economic activity in a given period of time (Mankiw, 2002). Because GDP is so important, it is one of the main factors determining nominal interest rate set by the monetary authority. The equation for output is:

$$Y = C + I + G + NX$$

Where:

Y = output

C = consumption

I = investments

G = government spending

NX = net export (export - import)

This paper examines the effect of output on nominal interest rate also from Taylors rule perspective. Taylors rule was used for the U.S. and that is why, in the regression for the U.S., the output gap (GDP gap) was used to see the change in GDP during time and use this data to see the significance of its effect on nominal interest

rate set by the monetary authority. An output gap is actually a difference between actual GDP and potential GDP. The equation how to get it expressed in percentage is:

$$\frac{(GDP_{actual} - GDP_{potential})}{GDP_{potential}} * 100$$

For the Eurozone and Thailand, instead of GDP gap, the percentage growth of GDP was used.

3.5 Foreign Direct Investment Flow

If one wants to invest in a foreign country, there are two common ways how to do it, namely it's a foreign direct investment and a portfolio investment. Difference between these two types is that by the foreign direct investment one controls (owns) at least 10% of a company (defined by the OECD) and one's goal is to have a word in the company and to participate in a strategic planning of the company. If one goes by a way of the portfolio investment, one invests less than 10% and a main goal is not to "steer the wheel of the company". According to Investopedia, FDI is the direct investment after which one gains a "significant degree of influence and control over the company into which the investment is made. Open economies with skilled workforces and good growth prospects attract larger amounts of FDI than closed, highly regulated economies" (Investopedia, 2015b).

The following part will distinguish between an intra-regional and extra-regional FDI flow. For the intra-regional, an annual total number of FDI flow within the ASEAN and the extra-regional flow is flow of FDI from non-ASEAN countries to ASEAN were used.

3.6 Intra/Extra-Regional Trade

International trade is an exchange of goods and services between countries around the world. Same as with FDI, paper examines intra and extra-regional trade. For this research, an annual data of a total trade (export and import together) between

ASEAN countries (intra-regional) and between ASEAN and the rest of the world (extra-regional) were used.

3.7 Sample and Data Collection

For the research part of this paper, secondary data from the databases of the European Central Bank, the International Monetary Fund, the World Bank, the Federal Reserve Bank of St. Louis, the ASEAN database, the ieconomics online database, and the CEIC database were used.

Table 3.1 Data Used for Regression and Effect of the Global Financial Crisis on ASEAN

Variable	United States (quarterly)	Eurozone (quarterly)	Thailand (quarterly)	ASEAN (annual)
Nominal interest rate	Effective federal funds rate	Main refinancing operations	Policy interest rate	-
Inflation	GDP deflator (lag)	HICP (lag)	GDP deflator (lag)	-
Output	GDP gap/GDP growth	%GDP growth	%GDP growth	
FDI	-	-	-	Intra/extra-regional FDI
Trade	-	-	-	Intra/extra-regional trade

For the dependent variable, the target nominal interest rate was used. For two independent variables, inflation and output were used.

In order to see how important these variables were, 6 regressions were made, 4 for the U.S. and Thailand for periods between 1999 and 2006 as the pre-crisis period, and 2008 and 2014 as the crisis period. The two regressions for the Eurozone for the same first period and the second period were from 2008 to 2015.

3.8 Estimation Technique

For the first part of the research, ordinary least squares (OLS) regression was used to analyse the data. It was used to estimate the relationship between the two independent variables and the dependent variable. The analysis was performed using IBM SPSS Statistics 14.0. The second part contains graphs of the chronological development of the FDI and total trade in ASEAN.

CHAPTER 4

RESULTS

4.1 The Effect of Inflation and Output on Target Nominal Interest Rate

The correlations among the variables were analysed using Pearson correlation coefficients. Table 4.1 represents the correlations among the variables in the Eurozone during the pre-crisis and crisis period. Tables 4.2 and 4.3 represents the correlations among the variables in the U.S. during the pre-crisis and crisis period both for GDP gap and GDP growth, and Table 4.4 shows the same correlations for Thailand. This correlation analysis was performed in order to explore the one-on-one relationships between key variables.

Table 4.1 Correlations among the Variables for the Eurozone

Variables	1a	2a	3a	1b	2b	3b
1a. MRO (99-06)	1	0.352*	0.090			
2a.GDP growth (99-06)		1	-0.209			
3a. Inflation (99-06)			1			
1b. MRO (08-15)				1	0.048	0.759**
2b.GDP growth (08-15)					1	0.261
3b.Inflation (08-15)						1

Note: *p<0.05, **p<0.01

Table 4.2 Correlations among the Variables for the U.S. (GDP Gap as Output Indicator)

Variables	1a	2a	3a	1b	2b	3b
1a. EFFR (99-06)	1	0.870**	0.068			
2a.GDP gap (99-06)		1	-0.169			
3a.Inflation (99-06)			1			
1b. EFFR (08-14)				1	0.616**	0.599**
2b.GDP gap (08-14)					1	0.428*
3b.Inflation (08-14)						1

Note: *p<0.05, **p<0.01

Table 4.3 Correlations among the Variables for the U.S. (GDP Growth as Output Indicator)

Variables	1a	2a	3a	1b	2b	3b
1a. EFFR (99-06)	1	-0.143	0.068			
2a. GDP growth (99-06)		1	-0.274			
3a. Inflation (99-06)			1			
1b. EFFR (08-14)				1	-0.248	0.599**
2b. GDP growth (08-14)					1	-0.175
3b. Inflation (08-14)						1

Note: *p<0.05, **p<0.01

Table 4.4 Correlations among the Variables for Thailand

Variables	1a	2a	3a	1b	2b	3b
1a. Policy rate (99-06)	1	0.023	0.583**			
2a. GDP gap (99-06)		1	-0.033			
3a. Inflation (99-06)			1			
1b. Policy rate (08-14)				1	-0.067	0.554**
2b. GDP gap (08-14)					1	-0.087
3b. Inflation (08-14)						1

Note: *p<0.05, **p<0.01

The results from the OLS regressions analyses are presented in tables 3.1 to 3.8 The unstandardized beta coefficients for all regressions are reported as *** p <0.001, ** p<0.01, *p<0.05.

Table 4.5 Regression Results for the Eurozone (1996-2006)

	Dependent variable
	Interest rate for Main refinancing operations
(Constant)	1.643*
HICP inflation	0.275
GDP gap	0.287*
R-squared	0.152
Adjusted R-squared	0.093

Note: *** p <0.001, ** p<0.01, *p<0.05

Table 4.6 Regression Results for the Eurozone (2008-2015)

	Dependent variable
	Interest rate for Main refinancing operations
(Constant)	-0.346
HICP inflation	0.931***
GDP gap	-0.111
R-squared	0.581
Adjusted R-squared	0.547

Note: *** p <0.001, ** p<0.01, *p<0.05

Hypothesis 1 predicts a positive relationship between inflation and nominal interest rate for main refinancing operations in the Eurozone. From the data before the crisis and during the crisis, research discovered that the relationship between inflation and nominal interest rate was positive in the pre-crisis period (β=0.275) and positive during the crisis (β=0.931). Important fact is that in the pre-crisis period, findings were statistically not significant, but in the crisis period they were significant (p_1=0.337; p_2<0.001). Therefore, hypothesis 1 is supported in the crisis period and not supported in the pre-crisis period.

Hypothesis 4 predicts a positive relationship between output and nominal interest rate for main refinancing operations in the Eurozone. In this example, research discovered that in the pre-crisis period, relationship between output and nominal interest rate was positive and statistically significant (β=0.287; p=0.035). This relationship was negative, but not statistically significant in the crisis period (β=-0.111; p=0.252). Therefore, hypothesis 3 is supported for the pre-crisis period but not for the crisis period.

Table 4.7 Regression Results for the U.S. (1999-2006) (GDP Gap as Output Indicator)

	Dependent variable
	Effective federal funds rate
(Constant)	2.334***
GDP def. inflation	0.443*
GDP gap	0.992***
R-squared	0.804
Adjusted R-squared	0.791

Note: *** $p < 0.001$, ** $p < 0.01$, * $p < 0.05$

Table 4.8 Regression Results for the U.S. (2008-2014) (GDP Gap as Output Indicator)

	Dependent variable
	Effective federal funds rate
(Constant)	0.987
GDP def. inflation	0.397*
GDP gap	0.275*
R-squared	0.511
Adjusted R-squared	0.470

Note: *** $p < 0.001$, ** $p < 0.01$, * $p < 0.05$

Table 4.9 Regression Results for the U.S. (1999-2006) (GDP Growth as Output
     Indicator)

	Dependent variable
	Effective federal funds rate
(Constant)	3.527**
GDP def. inflation	0.063
GDP growth	-0.462
R-square	0.022
Adjusted R-square	-0.046

Note: *** p <0.001, ** p<0.01, *p<0.05

Table 4.10 Regression Results for the U.S. (2008-2014) (GDP Growth as Output
     Indicator)

	Dependent variable
	Effective federal funds rate
(Constant)	-0.424
GDP def. inflation	0.565**
GDP growth	-0.178
R-squared	0.380
Adjusted R-squared	0.332

Note: *** p <0.001, ** p<0.01, *p<0.05

In regressions for the U.S., there is a significant difference between the use of
GDP growth and GDP gap as the indicator of output. Regression with GDP growth
with annual data showed results which were almost the same as for GDP gap.

However, using quarterly data, results changed significantly. That's why looking at the regression with GDP growth as the output indicator, only hypothesis 2 is supported and only for one period. For the regressions where GDP gap is the indicator of output, both hypothesis 2 and 5 were supported in both periods. The main reason why this phenomenon occurred is probably the fact that Taylor rule is still an important factor while setting FED's monetary policy. Taylor rule counts with GDP gap, which is actual GDP minus potential GDP divided by potential GDP. Point here is that potential GDP is calculated by FED itself and that is why GDP gap can be more appropriate to look at while determining FED's monetary policy. Another reason why these two regression results are so different could be also fact that GDP growth is still just an estimation, that's why data doesn't have to be significant. According to these results and facts, it is proper to use GDP gap as more important indicator of GDP for the U.S. According to it, both of the hypothesis for the U.S. were supported.

Hypothesis 2 predicts a positive relationship between inflation and The Effective Federal Funds Rate in the U.S. In this regression, it was found that in the pre-crisis period, relationship between inflation and nominal interest rate was positive and statistically significant ($\beta=0.443$; $p=0.013$). This relationship was also positive and statistically significant in the crisis period ($\beta=0.397$; $p=0.018$). Therefore, hypothesis 2 is supported.

Hypothesis 5 predicts a positive relationship between output and The Effective Federal Funds Rate in the U.S. In this regression, it was found that in the pre-crisis period, relationship between output and nominal interest rate was positive and statistically significant ($\beta=0.992$; $p<0.001$). This relationship was also positive and statistically significant in the crisis period ($\beta=0.275$; $p=0.010$). Therefore, hypothesis 5 is supported. Results from all the regressions are also simply summarized in Figures 4.1, 4.2 and 4.3.

Table 4.11 Regression Results for Thailand (1999-2006)

	Dependent variable
	Policy interest rate
(Constant)	1.907***
GDP def. inflation	0.218*
GDP gap	0.016
R-squared	0.342
Adjusted R-squared	0.296

Note: *** $p < 0.001$, ** $p < 0.01$, * $p < 0.05$

Table 4.12 Regression Results for Thailand (2008-2014)

	Dependent variable
	Policy interest rate
(Constant)	1.806***
GDP def. inflation	0.240*
GDP gap	-0.003
R-squared	0.308
Adjusted R-squared	0.255

Note: *** $p < 0.001$, ** $p < 0.01$, * $p < 0.05$

Hypothesis 3 predicts a positive relationship between inflation and The Policy interest rate in Thailand. In this regression, it was found that in the pre-crisis period, relationship between inflation and nominal interest rate was positive and statistically significant ($\beta = 0.218$; $p = 0.001$). This relationship was also positive and statistically

significant in the crisis period (β=0.240; p=0.002). Therefore, hypothesis 3 is supported.

Hypothesis 6 predicts a positive relationship between output and The Policy interest rate in Thailand. In this regression, it was found that in the pre-crisis period, relationship between output and nominal interest rate was positive, but not statistically significant (β=0.016; p=0.783). This relationship was slightly negative and not statistically significant in the crisis period (β=-0.003; p=0.909). Therefore, hypothesis 6 is not supported.

When it comes to possible problem of multicollinearity among variables in each regression, the Variance Inflation Factor (VIF) statistics was evaluated. It's value was between 1.001 and 1.224, which was significantly below critical value of 10 which was suggested by Hair, Anderson, Tatham, and William (1995). This implies no serious multicollinearity issue in the analysis.
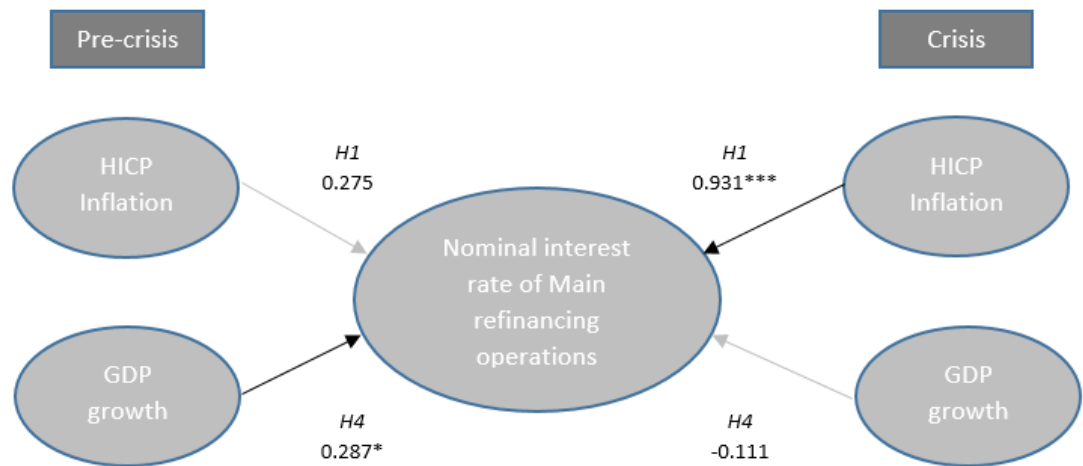

Figure 4.1 Regression Results Eurozone

Note: Unstandardized beta coefficients are reported;

*** p <0.001, ** p<0.01, *p<0.05;

Black lines represent significant coefficients

Figure 4.2 Regression Results United States (GDP Gap)

Note: Unstandardized beta coefficients are reported;

   *** p <0.001, ** p<0.01, *p<0.05;

   Black lines represent significant coefficients

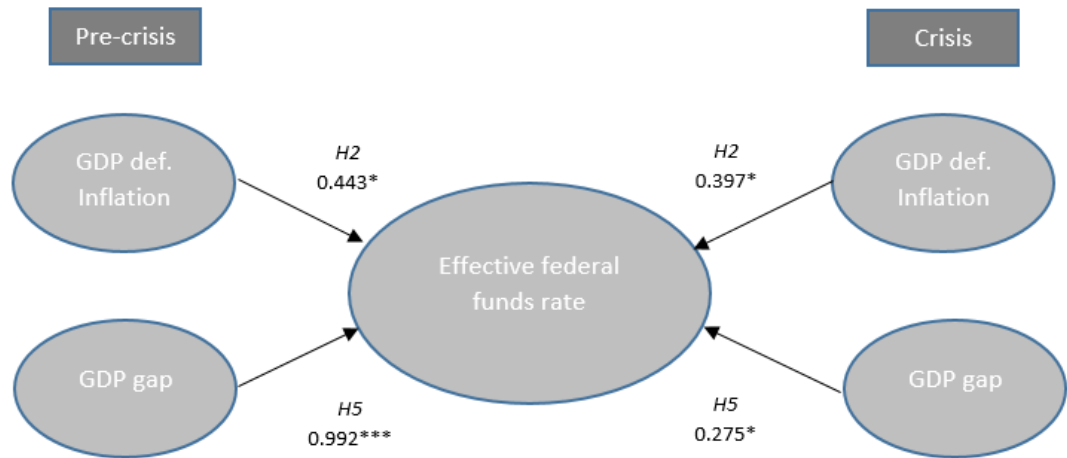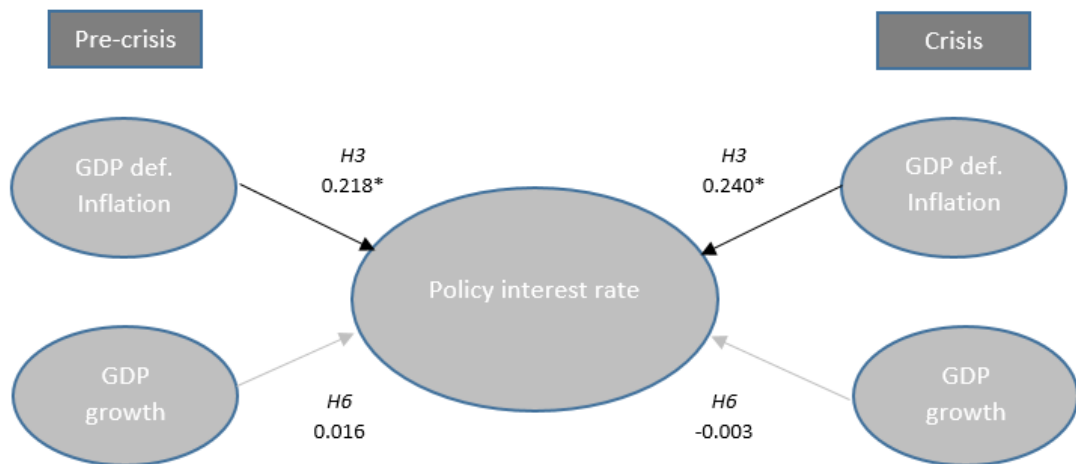**Figure 4.3** Regression Results Thailand

Note: Unstandardized beta coefficients are reported;

   *** p <0.001, ** p<0.01, *p<0.05;

   Black lines represent significant coefficients

4.2 The Change in FDI and Trade in ASEAN after the Global Financial Crisis

Figure 4.4 shows a graph of the chronological change of intra-regional and extra-regional FDI flow for ASEAN countries and Figure 4.5 shows the total intra-regional and extra-regional trade.

Hypothesis 7 predicts faster after-crisis growth in the intra-regional ASEAN FDI flow than in the extra-regional ASEAN FDI flow. It is important to look at this rise of the FDI flow after the crisis from two views: the first one is the percentage rise in the FDI when the year 2009 was used as a base year, because there was a huge decrease in FDI flow between 2008 and 2009. Looking at the percentage change from this perspective, then, it can be seen that the intra-regional FDI flow rose by 304.5% and the extra-regional FDI flow rose by 204.9%, which supports this hypothesis. Another way was to use the data from the one year period before the crisis started and spread as a base year, but then a different year has to be used for ASEAN (we used year 2008) and a different year for the biggest trade partners that were affected by the crisis sooner (we used year 2007). Therefore, by comparing these years, the intra-regional FDI rose by 125.6% and the extra-regional FDI rose by 52.4%, which also supported the hypothesis.

Hypothesis 8 predicted faster after-crisis growth in intra-regional ASEAN trade than extra-regional ASEAN trade. As with the FDI, also looking at the change of trade, two different base years were used. Using 2009 as the base year, intra-regional trade rose by 59.8% and extra-regional trade rose by 61.4%, which rejects the hypothesis despite the fact that the difference was very small. Then, using the year 2008 as the base year for both intra-regional and extra-regional trade, intra-regional rose by 27.8% and extra-regional rose by 31.3% which did not support the hypothesis either.
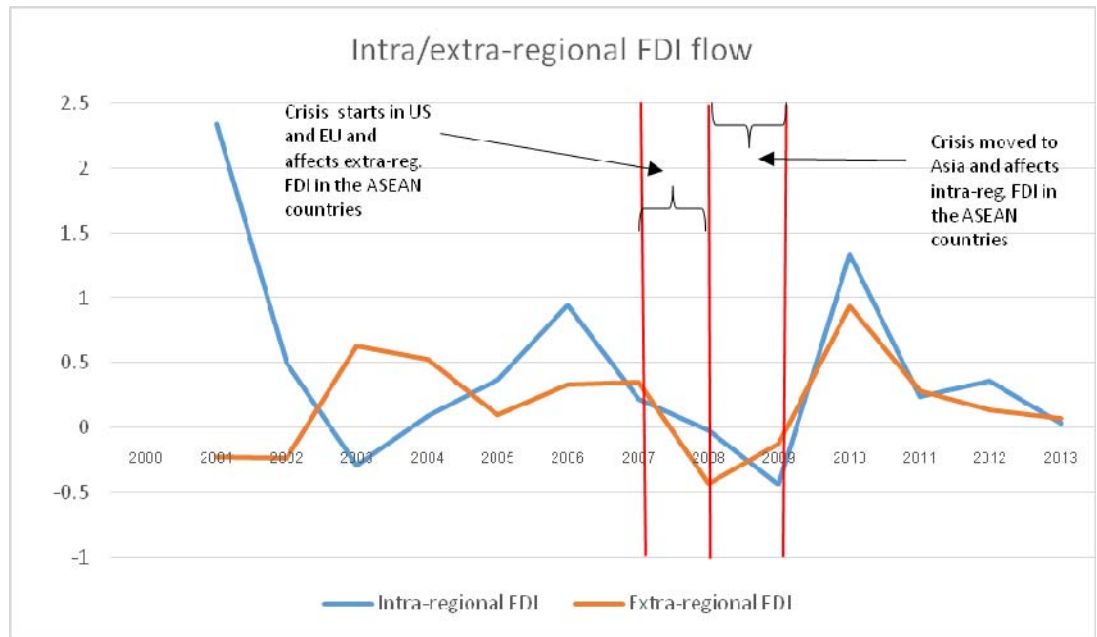
Figure 4.4 Flow of Intra/Extra-Regional FDI (Percentage Change)

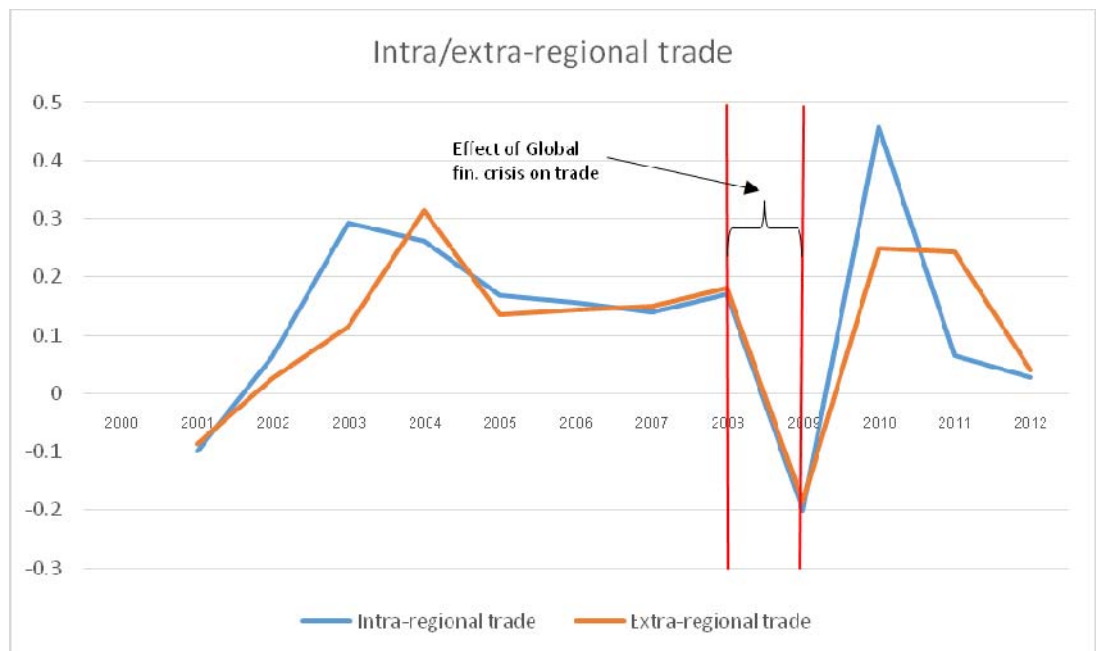**Source**: Graphed from dataset of the ASEAN org. database.

Figure 4.5 Intra/Extra-Regional Trade for ASEAN (Percentage Change)

Source: Graphed from dataset of the ASEAN org. database

4.3 Limitation of the Research

Limitation of this research is that quarterly data for the GDP gap for Eurozone and Thailand are not available. Also the quarterly data for the potential GDP were not available and that is why it was not possible to calculate GDP gap either. If these data would be available, the difference between the effect of GDP gap and GDP growth on the target nominal interest rate also in the Eurozone and Thailand could be seen.

CHAPTER 5

DISCUSSION

5.1 The Effect of Inflation and Output on the Target Nominal Interest Rate

The first part of this study tries to find a relationship between one of the most important variables in macroeconomics which are nominal interest rate, inflation and output. In the results from the six regressions, there was supporting evidence for the positive effect of output on the nominal interest rate in the Eurozone's pre-crisis period and in the U.S. during both periods. In Thailand, the relation of output and nominal interest rate in both periods was not statistically significant. In the Eurozone and the U.S. cases, the effect of the change in the output on the change in nominal interest rates was much higher during the pre-crisis period. To explain this phenomenon, it is important to look at the fact that the percentage fall in output during the crisis was much higher than the fall in nominal interest rate. That is because nominal interest rates were already at low levels even before the crisis. More importantly according to Economics-Online (2013), the nominal interest rates should not "go negative" because banks will always charge for lending while on the other hand there can be a huge fall of output into negative numbers, which happened during the crisis period. This could happen because nominal interest rate during the crisis period was more affected also by inflation. In the U.S., during the pre-crisis period, output had a much higher impact on nominal interest rate than inflation, but during the crisis, the impact of inflation on the nominal interest rate was higher than the impact of output.

This situation does not account for Thailand. The reason could be that Thailand's output was not affected by the global financial crisis that much—there was a sharp decrease only in 2009, so the BOT did not have to manoeuvre its policy rate according to sharp changes in output. On the other hand, inflation in Thailand was

significant during both periods. That is probably because continuing the inflation targeting policy by the BOT and no need for another manoeuvring of the nominal interest rate target according to relatively stable GDP growth.

The second important finding was that inflation in the Eurozone was not significant in either period. On contrary it is not like the example from the late nineteenth and early twentieth centuries when high interest rates were not present while high inflation was. In the research part is prove of positive relationship between inflation and nominal interest rate in the pre-crisis period and positive relationship between those two variables in the crisis period. Important finding is that the relationship in the pre-crisis period is not significant. One of the reasons could be "Milton Friedman's Thermostat." Let's remind ourselves a quantity equation of change (M*V=P*Y). Even when it is more connected with the effect of the nominal interest rate on price level, according to Friedman (2003), who says that decline in V (velocity) causes the monetary authority to react by increasing M (amount of money in the market) so that P (price level) would not change. According to the problem of not significant inflation in the Eurozone in both periods, it basically means that because the ECB uses the policy of inflation targeting, it manipulates nominal interest rate in order to hold the inflation at a constant level. That is why the relationship between these two variables is in some cases not significant and an increase in nominal interest rate will cause only a decline in V, and have no effect on inflation when the economy is stable.

5.2 How the Results Correspond with Actual Monetary Policies of ECB, FED and BOT

BOT's monetary policy changed according to the global financial crisis to the lowest extent. In both periods the most important factor for setting its policy was inflation. That is because of effective pursuing of the inflation targeting.

In the U.S., two indicators of output and one indicator of inflation were used in order to analyse U.S.'s monetary policy. Important finding was that Taylor rule, even after 15 years still plays a big role in setting FED's policy because the

relationship between the variables was positive and significant when GDP gap was uses, which is the variable from the Taylor rule equation.

Main factor for steering the monetary policy of the Eurozone is output in the pre-crisis period and inflation in the crisis period. It is probably because ECB sets the policy for a many countries with different economic challenges. That is why ECB's monetary policy is more focused on changes on its whole market then reacting to changes in economic indicators in concrete member states of Eurozone. Out of these three different monetary policies, ECB's monetary policy is considered as the one which changed to the greatest extent because of the global financial crisis and its effect on main macroeconomic indicators.

5.3 Change in FDI and Trade in ASEAN after the Global Financial Crisis

The second part of the research concerned the effect of the crisis on the FDI flow and trade in the ASEAN. Economists expected that the intra-regional FDI flow would grow faster than the extra-regional after the crisis and data used in the research of this paper proved this prediction. This happened mostly because when the crisis occurred, investments from abroad decreased and the gap was a little bit substituted by the FDI within ASEAN. This was possible also because of the cooperation of ASEAN countries in dealing with the crisis. In a few years, we will see if this trend will continue or if it was just a short-time, after-crisis effect. However, prediction about faster growth in intra-trade than extra-trade was not supported. By seeing almost the same speed of growth in both indicators, it is obvious that the financial crisis did not have a big influence on the change of their mutual positions. The crisis had an effect on their fall between 2008 and 2009 by 20% (intra-regional) and 18.6% (extra-regional).

CHAPTER 6

CONCLUSION

Although this study fully supported four out of eight hypotheses and two other hypotheses were supported partially, there still could be other reasons than the ones mentioned why the inflation in the Eurozone was not significant during the pre-crisis period. Why was the effect of output on BOT's policy interest rate not significant during the post-crisis period? Also why the after crisis intra-regional trade is not more enhanced than the extra-regional one. Future studies should focus also on other variables which affect the nominal interest rate and on what should be the monetary authority policy in case nominal interest rate is already very close to the 0 level.

This study supported the theory that the role of output in determining nominal interest rate was much higher during the pre-crisis period and that is mostly because central banks could maneuverer in a wider range with their nominal interest rate than during the crisis period. When nominal interest rate is too low, and output is still rising very slowly or even decreasing, the best solution in this situation is probably to use unconventional monetary tools to put the economy back on track. Another finding was that the effect of the inflation rate on nominal interest rate in the Eurozone and Thailand was not as big as in the U.S. In the U.S., the FED's decisions about the Effective Federal Funds Rate are probably more affected by the Taylor rule than the ECB's or BOT's policy making. However, this could also have happened because for the U.S., GDP gap data were used, as stated in the Taylor equation, but for Thailand and the Eurozone, GDP growth data were used. Even when economists before the crisis were expecting a change in the proportion of growth in intra-regional and extra-regional trade in the ASEAN, both of these were rising almost in the same way. This change might still come in the future after the crisis years.

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