INVESTIGATING THE FACTORS THAT AFFECT THE SURGE OF THAILAND'S INTERNATIONAL RESERVES

SAMACH SOOKSAI

MASTER OF ECONOMICS IN APPLIED ECONOMICS

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APPROVED BY   Advisory Committee

Chair ┈┈┈┈┈┈┈┈┈┈┈┈┈┈┈┈┈┈┈┈┈┈┈

(Assistant Professor Dr. Jorge Fidel Barahona Caceres)

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Committee ┈┈┈┈┈┈┈┈┈┈┈┈┈┈┈┈┈┈┈┈

(Assistant Professor Dr. Wanvilai Chulaphan)

………………/………………/ ……………

Committee ┈┈┈┈┈┈┈┈┈┈┈┈┈┈┈┈┈┈┈┈

(Dr. Kantaporn Chuangchid)

………………/………………/ ……………

Program Chair, Master of Economics ┈┈┈┈┈┈┈┈┈┈┈┈┈┈┈┈┈┈

in Applied Economics   (Assistant Professor Dr. Ke Nunthasen)

………………/………………/ ……………

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ACADEMIC ADMINISTRATION   (Associate Professor Dr. Yanin Opatpatanakit)

AND DEVELOPMENT   Vice President

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ชื่อเรื่อง   การศึกษาปัจจัยที่ส่งผลต่อการเพิ่มขึ้นอย่างสูงของเงินสำรองระหว่าง
                      ประเทศในประเทศไทย
ชื่อผู้เขียน   นายสมัชญ์ สุขใส
ชื่อปริญญา   เศรษฐศาสตรมหาบัณฑิต สาขาวิชาเศรษฐศาสตร์ประยุกต์
อาจารย์ที่ปรึกษาหลัก   Assistant Professor Dr.Jorge Fidel Barahona Caceres

บทคัดย่อ

      งานวิจัยครั้งนี้มีจุดประสงค์เพื่อศึกษาปัจจัยทางเศรษฐกิจที่ส่งผลต่อการเพิ่มขึ้นอย่างสูง
ของเงินทุนสำรองระหว่างประเทศในประเทศไทยโดยใช้แบบจำลอง Autoregressive Distribution
Lag (ARDL) ข้อมูลที่ใช้ในการศึกษาครั้งนี้เป็นข้อมูลรายไตรมาสตั้งแต่ปี พ.ศ.2536 ถึง 2562 การ
เลือกตัวแปรอธิบายขึ้นอยู่กับแรงจูงใจในการสะสมทุนสำรองระหว่างประเทศเพื่อป้องกันเสถียรภาพ
ทางการเงินและส่งเสริมการค้าขายของประเทศ ผลการศึกษาในครั้งนี้ยืนยันว่าการเปิดกว้างทาง
การค้า การเปิดกว้างทางการเงิน อัตราแลกเปลี่ยน ผลิตภัณฑ์มวลรวมในประเทศต่อหัว มี
ความสัมพันธ์เชิงบวกกับเงินสำรองระหว่างประเทศของไทยในระยะยาว อย่างไรก็ตาม งานวิจัยนี้พบ
ความกังวลเกี่ยวกับอัตราเงินเฟ้อต่อความต้องถือเงินสำรองระหว่างประเทศ เนื่องจากผลการศึกษา
พบว่าอัตราเงินเฟ้อส่งผลกระทบเชิงลบอย่างมากต่อเงินสำรองระหว่างประเทศของประเทศไทย
ดังนั้นเพื่อให้ทุนสำรองระหว่างประเทศอยู่ในระดับที่เหมาะสม ผู้กำหนดนโยบายควรติดตามภาวะเงิน
ฝืดและการแข็งค่าของค่าเงินในประเทศ เนื่องจากจะทำให้เงินทุนสำรองระหว่างประเทศของไทย
เพิ่มขึ้นอย่างต่อเนื่อง

คำสำคัญ : เงินสำรองระหว่างประเทศ, เงินสำรอง, การเพิ่มขึ้นอย่างมาก, ประเทศไทย

Title	INVESTIGATING THE FACTORS THAT AFFECT THE SURGE OF THAILAND'S INTERNATIONAL RESERVES
Author	Mr. Samach Sooksai
Degree	Master of Economics in Applied Economics
Advisory Committee Chairperson	Assistant Professor Dr. Jorge Fidel Barahona Caceres

ABSTRACT

The aim of this paper was to investigate economic factors contributing to the large increase in Thailand's international reserves by using an Autoregressive Distribution Lag (ARDL) model. The data used in this study is quarterly data from 1993 to 2019. The selection of explanatory variables was based on the country's precautionary and mercantilist motives to accumulation international reserves. Our result confirms that trade openness, financial openness, exchange rate, real GDP per capita are positive relationship with Thailand's international reserves in the long-run period. However, inflation is concerned to demand international reserves because we found an extremely negative effect on international reserves in Thailand. Therefore, to keep international reserves at an adequacy level. The policymaker should monitor the deflation and domestic currency appreciation because it leads to continuously increase of international reserves in Thailand.

Keywords : International Reserves, Reserves, Surge, Thailand

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TABLE OF CONTENTS

Page

LIST OF TABLES

LIST OF FIGURES

CHAPTER 1

INTRODUCTION

The beginning of international reserves from the world history in the century of 1990, many countries change the fixed Exchange rate systems to float Exchange rate systems. In addition, the frequency of float Exchange rate need to have the reserves for reduce the fluctuation (Archibald and Richmond, 1971). Therefore, after the 1990s, there was a massive accumulation of international reserves in the global massive accumulation because there was a popular trend around the world at that time (Benecká and Komarek, 2018), as shown in Figure 1.
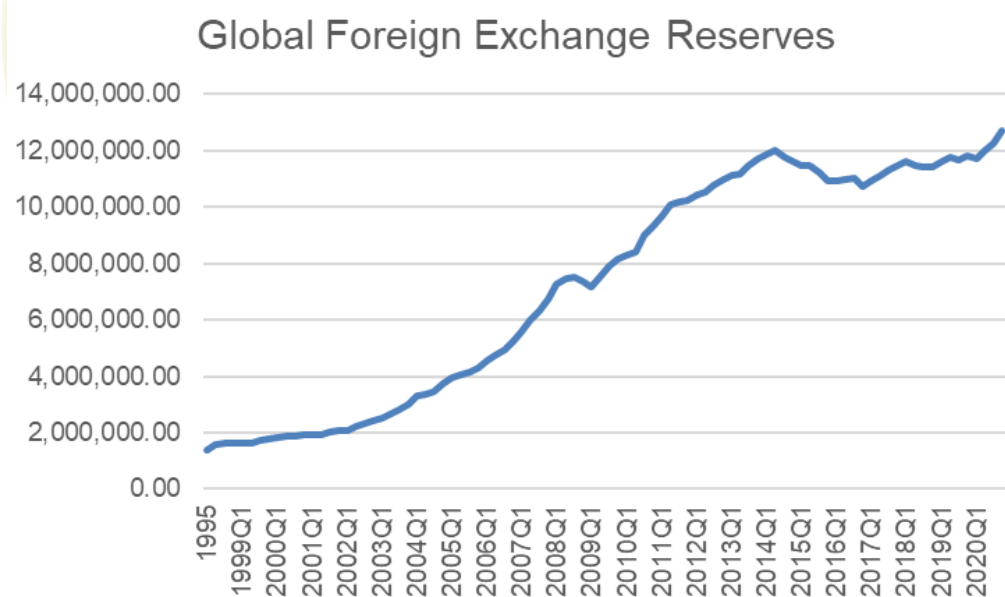
Figure 1 *Global Foreign Exchange Reserves.*

Source: (Currency Composition of Official Foreign Exchange Reserves (COFER), 2022)

In the case of Thailand's international reserve accumulation, Thailand has more accumulated international reserves after facing the Asian financial crisis in 1997, which extremely negatively affected Thailand's economy. Therefore, the Bank of Thailand, which is the central bank of Thailand had determined the objective of Thailand's official reserves acting as a 'buffer' to protect the volatility of the Thai economy. In addition, Thailand's official reserves must therefore be sufficient and ready to use, when there need to use foreign currency for the trade and investment of Thai and foreign people which can be seen from the changing inflow/outflows of trade and investment (Thailand, 2022).

Moreover, the Bank of Thailand is also responsible for managing the official reserves by the management principles as specified by the objective law, as three aspects, first, maintaining the value of official reserves in foreign currency like the security of the Thai financial system. Second, there is sufficient liquidity for the implementation of monetary policy and exchange rate policy like the liquidity of the Thai financial system. Third, get the highest return within an acceptable level of risk as to the risk-adjusted return of the Thai financial system (Bank of Thailand).

Recently, the Bank of Thailand (BOT) reports on the status of international reserves in 2020, that international reserves adjust up to 227 billion dollars considered a new high record and increased almost 10 times from the year 1997.

This value of international reserves makes Thailand is ranked 12th in the world and second large in ASEAN (Bank of Thailand, May 2020).

In addition, there were various empirical studies identified the reason why many countries accumulate and hoard international reserves. In general, the general reasons related to a country's motivation consist of first, after there were the financial crises in the late of the 1990s, the country will accumulate reserves with precautionary motive because it as a self-insurance or buffer of the economic output contraction from the sudden stop capital flow (Aizenman and Lee, 2007).

The second aspect, the country accumulates the international reserves for a promote policy, therefore, a policy may advantageous externalities than other trading partners. For export growth promotion and growth economic (mercantilist motive) (Lane and Burke, 2001).

Finally, the reserve policies may be aimed at protecting domestic credit markets (financial stability), moreover, reserve holdings may reflect attempts to overcome constraints related to monetary policy and/or financial openness (Benecká and Komarek, 2018).

However, in the case of Thailand, it seems like Thailand hoarding international reserves too much according to the measuring adequacy of the international reserve level in Thailand from 1995-2019 have found that Thailand

holds international reserve over the adequacy level of international reserves which calculate from the International Monetary Fund (IMF) as shown in figure 2.
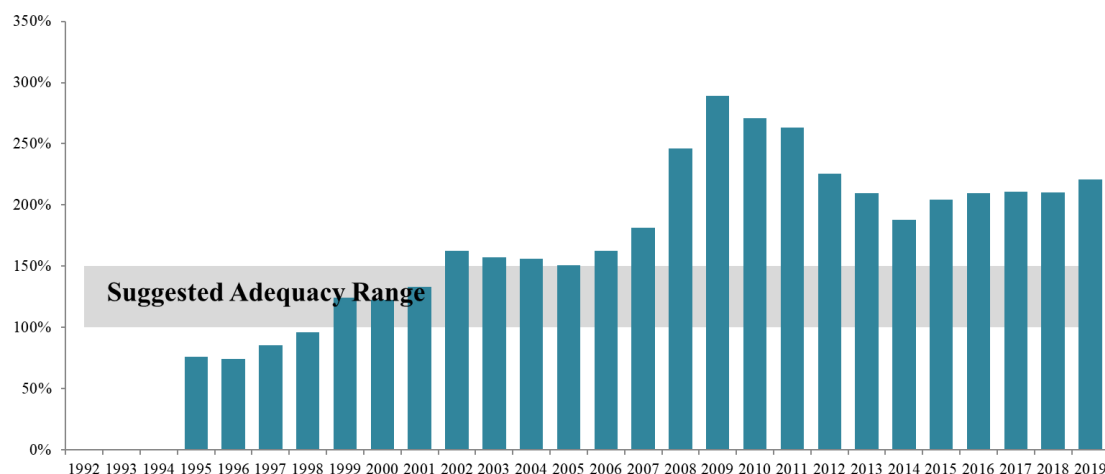
Figure 2 *The international reserves adequacy in Thailand.*

Source: International Monetary Fund (IMF)

In addition, there is the opportunity cost to holding a large amount of international reserves or excess international reserves and there is empirical evidence about the impact of excess international reserves. According to critics' analysis, holding a lot of reserves is costly because the held reserves have low return. More worthy if using the reserve to be investing for potential return on real investments in the economy (Aizenman and Marion, 2003).

Moreover, the support evidence of the impact of the excess international reserve as mentioned before, there was the estimation of the reserve's opportunity cost in 1999, based on the calculation following Rodrik (2006) Firstly, the excess of import value is the cost of maintaining the capital account. Second, the spread

between the yield on foreign reserves and (the US Treasury bill rate) is used. as a proxy of the marginal cost of domestic funds and is taken to be 6 percentage." The result show Thailand has annual opportunity cost of reserves around 1 percent of GDP and is the highest expenditure when compared with five countries in East Asia (Bird and Rajan, 2003). The opportunity cost of reserves as significant in the context where emerging economies are most in need of capital for development.

Moreover, there is some evidence to states that the purchasing foreign reserves to manage exchange rate in Thailand. It effects to increasing of contingent liability. The central bank suffered from the appreciation of domestic currency due to the surplus current account causing a large amount of foreign money to flow into country (Nguyen and Boateng, 2015). Many developed and developing countries increasing rely on borrowing in international financial markets for accumulating reserves (Lizondo and Mathieson, 1987).

Consequently, Bank of Thailand (BOT) must intervene in the market by buying some dollars more than market demand. To reduce pressure to make the baht appreciation. US dollars in the hands of Bank of Thailand (BOT) or reserves increasing (Monetary Policy Line Bank of Thailand, 2012).

In addition, an in-depth study of determinants of international reserves which IMF calculate by the EM ARA metric is analytical on four specifics essentially sources of determining the international reserves needed for precautionary purposes in figure

3 (IMF staff, 2013). However, measurement by ARA metric Thailand has a wide gap between the four main factors and international reserves level which this gap shows there are other factors relating to the increasing international reserves in Thailand while This metric doesn't evaluate mercantilist purposes and opportunity cost (International Monetary Fund).
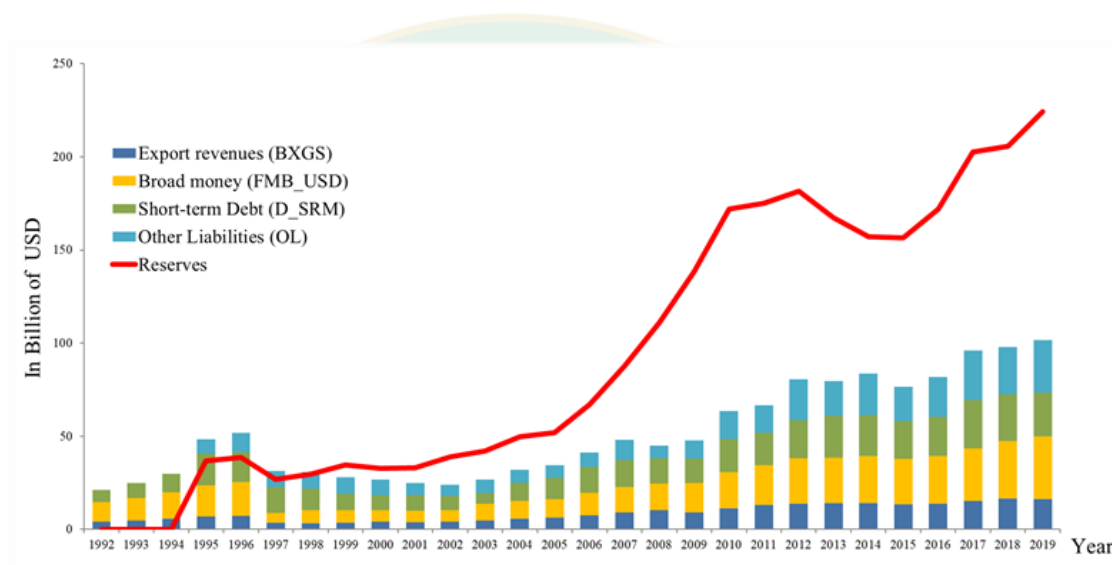
Figure 3 IMF calculates the decomposition of international reserves in Thailand.
Source: International Monetary Fund (IMF)

This leads us to the question about "What economic factors affect increasing international reserves in Thailand?". Because the previous studies have not been examined the economic factors affecting international reserves specifically in Thailand.

So, this study aims to examine the economic factors that impact on the increasing in Thailand's international reserves. Then, this study analyzes time series data using quarterly data from 1993 quarter 1 to 2019 quarter 2 in Thailand. This

study has policy recommendations to reduce Thailand's international reserves at the adequacy level and avoid excess international reserves which reduce the ability of international reserves and disadvantage to the country such as costly, debt, and financial crisis.

1.1 IMPORTANCE OF THIS STUDY

The benefit of this study is that builds understanding of the role and importance of economic factors which affect to increase in Thailand's international reserves. Furthermore, the result of this study can be a guideline for consideration, planning, and formulating strategies to manage international reserves of monetary authorities.

1.2 ADVANTAGE OF THIS STUDY

To find the important economic factor that affects the large increase of Thailand's international reserves. Then suggest the decision from the estimation result and find the way to reduce Thailand's international reserves at the adequacy level. At this moment Thailand has an excess of international reserves. Its effect to less benefit and ability of international reserves. Moreover, excess of Thailand's international reserves will be a financial problem for the future because the bank of Thailand or the ministry of finance must bear the cost from the opportunity cost of international reserves and increase of external debt from purchasing foreign reserves.

1.3 OBJECTIVES OF THIS STUDY

This study aims to investigate economic factors contributing to the large increase in Thailand's international reserves. For this, the objectives of this study are to (1) build a model based on Precautionary and Mercantilism motives to study the factors that impact international reserves. Then (2) to estimate a model with the autoregressive distributed lag (ARDL) model to analyzing the impact of the volatility economic factors that relate to international reserves adjustment in the short run and study the relationship between international reserves and economic factors in the long run.
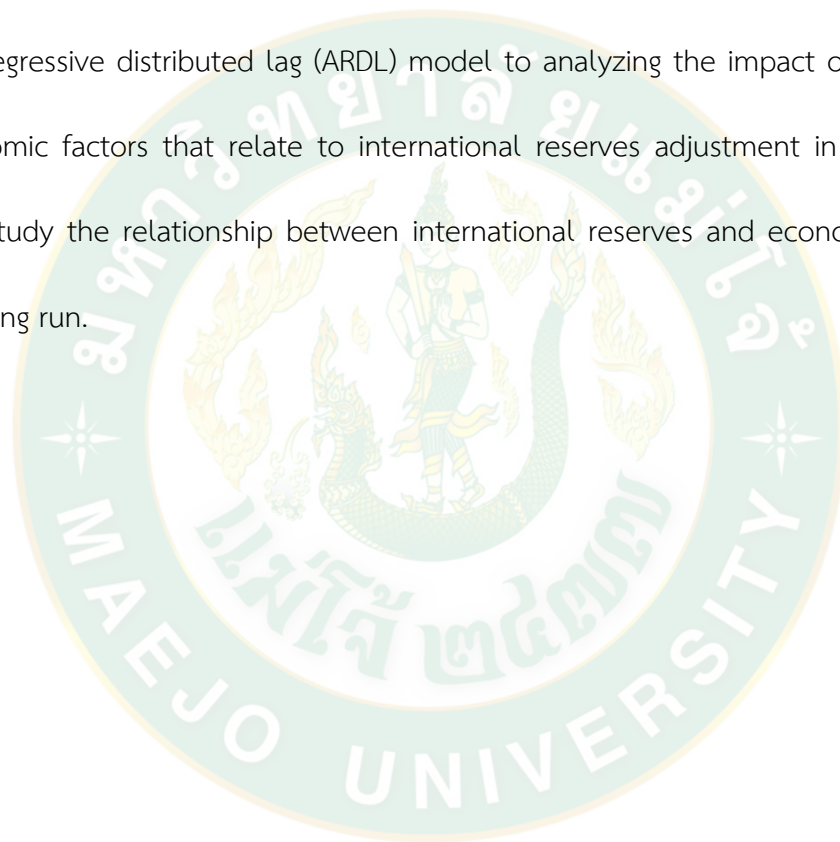
CHAPTER 2

LITERATURE REVIEW

2.1 REVIEW OF THE EMPIRICAL STUDIES OF DEMAND FOR INTERNATIONAL RESERVES

In the past, study of Barth and Bennett (1975) was concerns about amount of international reserves in many countries because haven't the main condition to determine international reserves. In each country holds the different currency, assets and international liquidity. It is difficult to identify which many different types of assets can be international reserves. Then Heller (1966) mention to divides three types of assets that have international transaction qualify which can be international reserves of country. It composes of official holdings of gold, convertible foreign exchange, and the I.M.F. gold tranche position.

Follow the notion of Heller (1966) and develop by Hamada and Ueda (1977) the level of international reserves for countries should hold depend on three variables as first the propensity to import second the opportunity cost of holding international reserves and third the instability of international accounts.

Because an increase of propensity import, it will make country's balance of payment deficit which central bank against trade deficit by accumulate international reserves and the increase of instability of international accounts given the level of reserves rising because it wants more reserves available. Whereas increase of

opportunity cost, it will decrease the international reserves because less income from trading and invest with foreign countries it will lower the benefit of reserves.

Further, the important discovery of Flood et al. (2001) is the exchange rate system have an influence in country's international reserves. It associates with the transaction of domestic and foreign currency in terms of trading, borrowing, with abroad which obtain cost of currency adjustment.

2.1.1 Demand for international reserves under fixed exchange rate

Pre-1973 have many studies about the demand for reserves under fixed exchange rate regime. Courchene and Youssef (1967) mention that the Central bank has a demand for reserves to cover the potential disturbances between foreign receive and payment along with balance of payment of the country. There is important because financial agency use international reserves as a contract of foreign payments and buy international reserves to exchange the domestic currency into foreign currency on demand.

Then Flanders (1971) investigated the balance of payment and willingness to "use" reserves. In terms of net payments imbalances when countries need to hold more international reserves and use them to support finance transaction which the number of reserves can be measuring the ability of the country's import while payments are stuck. So, the purpose of international reserves around 1973 is support to finance trade by it is money supply to import goods into the country.

Consistent with the study of Kelly (1970), the regime of pegged exchange rate or fixed exchange rate government have a demand for international reserves as a money supplier that is ready to offer foreign currency. While the domestic currency is not a problem because the government can be printing itself, foreign currency is limited with a yield of net surpluses in the country's balance of payments.

And also Clark, Peter Barton (1970) said the demand on international reserves depends on the cost of international reserves source. If considering the cost of international reserves sources, hoarding international reserves will loss domestic capital formation. And international reserves can be invested in assets that given positive yield, instead of paying opportunity cost to hold international reserves in terms of saving is the interest rate.

2.1.2 Demand for international reserves under float exchange rate

Post-1973 many countries change the exchange system from a fixed-rate system to a managed floating rate regime. We find the initial study on the demand for international reserves under the floating exchange rate. Kenen and Yudin (1965) talks about the government had many reasons for hoarding international reserves the one reason is the requirements of domestic monetary legislation before changing the exchange rate regime.

Later the floating exchange rate has a frequency of currency adjustments, there produce the main reason is for maintaining stable exchange rates when facing

payments disturbances. The study flexible exchange rate regime by Levy (1983) mentions that the net money inflow will be changing in the exchange rates. If the domestic currency was perfectly appreciated, the intervention from the central bank will change in official international reserves and official liabilities to maintain an equilibrium of the exchange rates.

Bahmani-Oskooee and Brown (2002) show many developing countries have experienced changing three-factor affected by float exchange regime including exchange rate, international reserves, and external debt. The characteristic of the floating exchange rate is frequent change in the exchange rate. According to the money market mechanism, to manage the equilibrium of the balance of payment. So, it leads to the world's massive accumulation of international reserves. Aizenman and Marion (2003) mention that the effective return on holding reserves will be falling, when the country has experienced political instability and political corruption. Then, next time demand for international reserves will acquire more to stock up.

The accumulation of international reserves becomes competitive in each country, this trend makes a demand on international reserves higher around the world. The large volume of international reserves is likely to encourage external transactions, economic openness, and scale of the economy (Lane and Milesi-Ferretti, 2007).

Support with the result of Lizondo and Mathieson (1987) found the long-run demand for international reserves is determinant of the size of the country's international transactions (proxied by the real income), the average propensity to Import (to represent economic openness), the variability of external transactions (proxied by gross national product), and sometimes effort to incorporate the opportunity cost of holding reserves too.

Moreover, Badinger (2004) refer to investigation demand for international reserves in Austria. It appears to have the scale of foreign trade, the net opportunity cost of holding reserves, and reserves uncertainty as three main variables that optimize reserves demand. Mishra and Sharma (2011) show demand for international reserves in India depend on credit confidence and overall macroeconomic stability. It seems the different characteristics of each country will influence different demands for international reserves.

Besides, the results from a study by Jeanne (2007) show that many developed and developing countries began to rely on borrowing in international financial markets. The money borrowed and receipts from current account surpluses are the source of international reserves. Later, Bahmani-Oskooee and Brown (2002) study the relationship between international reserves and national income. They found the fluctuation of international reserves related to the adjustment of nominal GDP and real money which oftentimes.

After the 2000s, the compiled previous study and innovation for analysis demand for international reserves generate method more complicated to study. Sula (2011) have more validity check about the demand for international reserves survey from 108 developing nations by the considerate different conditions of international reserves in each country. The different characteristics of the country affect to change in demand for international reserves.

Due to this, previous studies are not enough for a complete explanation. The recent trend and motive of the country are not yet been evaluated. (Aizenman and Lee, 2007; Schröder, 2017) evaluated precautionary and mercantilism motive making his study investigate many new factors such as division economic openness and financial openness. Moreover, the study Bhattacharya et al. (2019) is not neglected the original factor as the opportunity cost of international reserves, volatility of exchange rate, and scale of economy to absolutely estimate demand for international reserves.

2.2 THE ROLE OF INTERNATIONAL RESERVES

The role of international reserve holdings, also known as foreign exchange reserves and domestic reserves that the country holds for different reasons. it depends on the characteristics of the country that are documented in both theoretical and empirical literature.

The official International reserves hold by monetary authorities such as the Central Bank and Ministry of Finance are part of national wealth. Dominguez et al. (2012) defined international reserves holdings can be as stocks of all international financial assets in a country's portfolio. It shows a wealth of country to trade partners, and level of development. International reserves as measuring instrument to finance process of all international transactions which manage with the central bank. The rule of thumb is the level of international reserves needs to be enough for coverage lack of four months of imports. Fischer (2001) show this perspective in the world that limited financial integration, in which trade openness reflected a country's weakness to external shocks.

Dooley et al. (2004) give an opinion that the central bank holds international reserves as a bank secures for the external competitiveness of an economy and avoid costly adjustments in the external sector of the economy. It's a byproduct of international reserves. Support with Dominguez et al. (2010) studies a byproduct of strategies for holding international reserves, as a part of economic stimulation that policy authorities be used to boost export growth.

For advanced developed countries study of Zhang et al. (2016) mention, international reserves are not only net national assets. They're given interest rate on reserve assets which countries withhold large stocks of international reserves, and a high domestic interest rate will be contracting parties to less developed countries.

This is trades and borrows foreign currencies or foreign reserves that give lower interest than domestic currency from advanced developed countries (Bonser-Neal and Tanner, 1996).

Foreign reserves are believed to play roles in adjusting the domestic exchange rate to keep stability through the change proportion held foreign currency of the country (Mishkin, 1999). The nation's international reserves include functions of a unit of account, medium of exchange, and store of value. It is successful and widespread globally (Hartmann and Issing, 2002). Also Frankel (2006) said it is treated or reduces the impact of economic recession economic and emergencies crisis on the economy which unpredictable. It is noticeable that the required foreign reserves from monetary authorities. Basically, incurring domestic-currency liabilities but there is a purchase to control the value of a local currency.

Chinn and Frankel (2008) found there is a competition of currency reserves in world ranking suggests that when the economies that possess dominant reserve currencies are recession from financial crises. The other reserve currencies will be rise and the proportion of currencies reserves can represent economic and financial strengthen. The study of Aizenman and Riera-Crichton (2008) in developing country report that international reserves are a broader buffer stock which efficient to reduces the volatility of exchange rate and support economic performance.

Another important of holding international reserves as a bumper when lacking smoothening of the tax during productivity shocks which Choi et al. (2007) study. Because foreign currency assets are correlated foreign investments that drive the domestic productivity of the country. Qian and Steiner (2016) mention that international reserves are insurance against financial which the restructuring of a country's external debt maturity and create credibility to ask international loan.

In addition, Taguchi (2011) found empirical evidence indicates the aftermath of the 2008 global financial crisis. Many countries start the fear of capital mobility, which contributes to accumulating international reserves in both developing and emerging economies. This keeps the competitiveness of the export relative to import. Also, the position in the balance of payment. In a similar way, Allegret and Allegret (2018) , investigating the relationship of international reserves aftermath of the crisis. International reserves tend to be higher than the larger the reserve holding before the crisis. Indeed, at appropriate levels of reserves holding impact output that going to collapse seems to disappear (Alberola et al., 2016).

2.3 THE EFFECTS OF EXCESS INTERNATIONAL RESERVES

Following Nguyen and Boateng (2015) found a problem from having excess reserves including excess liquidity and increasing of opportunity cost. Excess liquidity is a problem from excess international reserves according to Friedman (1989) quantity theory money specifies that the value of money is neutral when asset price increase associated with the increased volume of the money supply. So excess liquidity will lead to inflation and price bubbles. Steiner (2017) mention that according to the quantity theory of money, the accumulation of international reserves creates inflation pressure if the monetary expansion is not sterilized and excess demand of money.

At the global level, the result of Steiner (2017) found that global international reserves growth is causing world inflation. Also, provide a result from 120 countries that the growth of central bank assets is correlated with inflation which international reserves are one asset of the central bank in each country. A study by Elhiraika and Ndikumana (2007) talks about 21 African countries international reserves affect the higher price level in the long run but in the short run, it does not affect inflation because of the central bank's successful monetary policy to control inflation.

In an individual country study by (Guo and Li, 2011; Zhang, 2009) in China, The rapid expansion in the trade surplus helps build up massive foreign exchange reserves which in turn contributes to the money supply and several years

accumulation reserves. It is causing excess liquidity in the domestic market. Zhang (2009) study the consequence of inflation, has a larger impact on rising housing prices in China because when increase the money supply in the market lead to higher asset price with becoming an economic problem.

Support with Lin and Wang (2005) identifies accumulation of reserve has a positive effect on inflation in Korea and Taiwan too. In addition study by Nguyen et al. (2019) said the accumulation of foreign reserves has an impact on inflation in Vietnam both long term and short term. Also, Shrestha and Semmler (2015) found indirect effects from high reserves levels lead to carelessness in monetary policy.

The increase of opportunity cost problem raises concerns about the expenditure of holding large international reserves. Jeanne and Sandri (2020) refers to the opportunity cost of international reserves by calling "carry cost" measuring the carry cost as a spread between two different interest rates or the spread between the cost of external borrowing and the return on reserves.

This is an invisible cost because the carry cost is a theoretical term that involves a not actual interest rate that is not observed in the data. Rodrik (2006) mention to the yield of international reserves that the Central Bank earns on keeping the liquid foreign assets which computing the cost of holding reserves but must be difficult to measure in the data.

Normally, studies found that the excess of international reserves has a cost of approximately 1% of GDP (Bird and Rajan, 2003; Rodrik, 2006). The result from the study in two large economies by Nayak and Baig (2019) between India and China found opportunity cost of international reserves is an important factor to increase demand of international in India.

However, in China, the opportunity cost has no role to play in demand for international reserve. Cruz and Walters (2008) points out opportunity cost as significant in the context where emerging economies are most in need of capital for development. So, in developed countries, the opportunity cost of international reserves doesn't affect much economics.

For Hoffmann and Sigaux (2020) argue that the accumulation of excess international reserves is the result of the deal between precautionary motives and deposit interest revenue. Also, excess international reserves have evidence that mainly supports the precautionary motive of the country. It is the choice for the central bank through channels of risk-taking of financial market structure.

Whereas analysis from Dressler and Kersting (2015) suggest that moderate international reserve holdings (appropriate level) can immediately respond to monetary shocks. Excess reserve holdings can lead to fluctuation in the nominal interest rate. So, it uses more time to respond to the monetary shocks.

2.4 SPEED ADJUSTMENT AND DISEQUILIBRIUM OF INTERNATIONAL RESERVES

Bahmani-Oskooee (1985) pointed out that since many countries preferred to change the exchange rate to the system of floating management. it requires international reserves to use manage the foreign exchange rate. The float exchange rate or flexible exchange rate system has a process to economize international reserve holdings. Clark, Peter Barton (1970) mention that it makes a faster speed of adjustment from disequilibrium to equilibrium balance of payments and consequence to faster adjust the actual international reserves equal to the demand of reserves in the countries.

As the Lizondo and Mathieson (1987) study moved the exchange rate system from fixed to floated exchange rate between the 1963-72 and 1973-79 period, the results show an increase in the speed adjustment of international reserves for both developed and developing countries.

Particularly, Archibald and Richmond (1971) study theory of foreign exchange requirement mention that the disequilibrium balance of payment directly related to a disequilibrium in its domestic money market. when country is excess demand for money, it must be an increase in foreign reserves holdings of a nation's central bank. Conversely, if there is excess supply of money, then a nation's central bank will be decline in international reserves.

Frenkel (1983) found the increasing speed of adjustment which excess reserves demand when the world changes the exchange rate system. It expects that speed of adjustment is faster because of more flexible rates.

Later, the study of the speed of adjustment has developed a method to estimate with a two-step method until the recent advances in time-series studies such as cointegration and error-correction model. Huang (1995) found the study long-run demand for reserves cannot considerate short-run international reserves disequilibrium. The money disequilibrium has been combined with the estimation of the dynamic process for international reserve holdings by the error correction (ECM) model.

Moreover, the study international reserves in Austria by Badinger (2004) shows the framework of error-correction models that confirm short-run international reserve movements attached to the balance of payments for Austria. Excess demand on the national money market leads to an inflow of international reserves with a lag of one quarter. It makes the central bank change domestic credit and the interest rate level to eliminate the reserves disequilibrium.

Also, Mishra and Sharma (2011) found in India disequilibrium does play a crucial role in short-run international reserve movements. The coefficient of ECM term indicates the percentage of the last period that around 48% of the deviation from equilibrium was corrected within one quarter. This coefficient of monetary

disequilibrium indicates that RBI (Reserve Bank of India) takes measures to clear the money market by making appropriate changes in both interest rate and domestic credit.

Table 1 *Method, Data, and Causality relationship of studies on demand for international reserves.*

Author (Year)	Title	Data & Methodology	Causality relationship
Kenen and Yudin (1965)	The demand for international reserves	This study collects panel data in 14 countries which published international reserve statistics by monthly changes in 1958 to 1962 and using Autoregressive model to estimation.	Each country's demand for reserves depends on the central bank's expectations concerning the anticipated balance of payment.
Courchene and Youssef (1967)	The demand for international reserves	This study corrects panel data in 14 countries which published international reserve statistics by monthly changes in period 1958 to 1964 and using Autoregressive model to estimation.	The evidence clearly indicates that the money supply performs better than the level of imports as a determinant of the demand for reserves because the money supply coefficient has a larger than the level of imports.

Table 1 (Continued) *Method, Data, and Causality relationship of studies on demand for international reserves.*

Author (Year)	Title	Data & Methodology	Causality relationship
Clark, Peter B (1970)	Demand for international reserves: a cross-country analysis	This study corrects panel data in 38 countries which published international reserve statistics by monthly changes in the period February 1958 to September 1967 and using regression model to estimate.	Balance of payments still correlate to demand for international reserves, but this study found tariffs, quotas, or exchange control that changing the level of income play role on demand for international reserves.
Kelly (1970)	The demand for international reserves	This study corrects panel data in 38 countries in the period 1953 to 1965, divided the group of the country into more open and less open countries and using Regression model to	Maintenance of a pegged exchange rate, abstention from commercial policy, and pursuit of monetary policy independently of the balance of payments will all require large

Table 1 (Continued) *Method, Data, and Causality relationship of studies on demand for international reserves.*

Author (Year)	Title	Data & Methodology	Causality relationship
		estimate.	demand for reserve.
Flanders (1971)	The demand for international reserves	This study corrects panel data, 57 countries in the period 1953 to 1965, divided the group of the country into developed and less developed country and using Regression model to estimate.	The central bankers and monetary authorities have considerations amount held foreign reserves to demand of international reserves. Also, balance-of-payments adjustment, export variability, legal and political effect to demand of international reserves too.

Table 1 (Continued) *Method, Data, and Causality relationship of studies on demand for international reserves.*

Author (Year)	Title	Data & Methodology	Causality relationship
Levy (1983)	Demand for international reserves and exchange-rate intervention policy in an adjustable-peg economy	This study corrects time series data, firth quarter 1973 to third quarter 1979 in Turkey and using Full information maximum likelihood Regression to estimate.	The private sectors and the monetary authority's flow demand by international reserves and their effects on the balance of payments together with the exchange rate.

Table 1 *(Continued) Method, Data, and Causality relationship of studies on demand for international reserves.*

Author (Year)	Title	Data & Methodology	Causality relationship
Bahmani-Oskooee (1985)	Demand for and supply of international reserves: a simultaneous approach	This study corrects panel data in 19 developed countries over the 1972 to 1977 period and using Two-stage least squares regression to estimate.	This study found unique in the literature, the price of gold (official or market) exerts a significantly negative effect on the demand for international reserves.
Lizondo and Mathieson (1987)	The stability of the demand for international	This study corrects panel data by divided the five-country groups were characterized by the world, developed, oil-exporting, industrial,	These structural changes reflected the increase in the number of countries to international financial markets, and they have involved an

Table 1 (Continued) *Method, Data, and Causality relationship of studies on demand for international reserves.*

Author (Year)	Title	Data & Methodology	Causality relationship
	reserves	less developed country. Data from second quarter 1960 to fourth quarter 1976 and using ARIMA model to estimate.	increase in the sensitivity of demand for reserves to balance of payments variability and changes in the speeds of adjustment of actual to desired reserves.
Aizenman and Marion (2003)	The high demand for international reserves in the Far East: What	This study corrects panel data on 125 developing countries in 1980 to 1996 period and using Regression model to estimate.	Reserve demand in developing countries. Specifically, sovereign risk and costly tax collection to cover fiscal liabilities lead to a relatively large precautionary demand for international reserves. Moreover, financial crisis

Table 1 (Continued) *Method, Data, and Causality relationship of studies on demand for international reserves.*

Author (Year)	Title	Data & Methodology	Causality relationship
	is going on?		is key factor to increase their demand for reserves.
Badinger (2004)	Austria's demand for international reserves and monetary disequilibrium: The case of a	This study corrects time series data on Austria, the data from first quarter 1985 to fourth quarter 1997 and using Vector error correction model to estimate.	Austria's long-run reserve demand can be described as a stable function of imports, uncertainty, and the opportunity cost of holding reserves with strong economies of scale.

Table 1 (Continued) *Method, Data, and Causality relationship of studies on demand for international reserves.*

Author (Year)	Title	Data & Methodology	Causality relationship
	small open economy with a fixed exchange rate regime		
Mishra and Sharma (2011)	India's demand for international reserve and monetary	This study corrects time series data on India, the data from first quarter 1991 to second quarter 2009 and using ARCH model and Vector error correction model to estimate.	In India, the reserve demand function suggests that scale of foreign trade, uncertainty, and profitability important role in determining India's long-term reserve demand policies.

Table 1 (Continued) *Method, Data, and Causality relationship of studies on demand for international reserves.*

Author (Year)	Title	Data & Methodology	Causality relationship
	disequilibrium: Reserve adequacy under floating regime		
Sula (2011)	Demand for international reserves in developing	This study corrects panel data on 108 developing nations over the period of 1980 to 2007 and using Regression model to estimate.	This finding shows that the level of reserves is as important as the other determinants of the demand for reserves. Moreover, in developing countries, Asia financial crisis is a factor that

Table 1 (Continued) *Method, Data, and Causality relationship of studies on demand for international reserves.*

Author (Year)	Title	Data & Methodology	Causality relationship
	nations: A quantile regression approach		large effect on the demand for reserves.
Bhattacharya et al. (2019)	Estimating the demand for reserve assets across diverse groups of	This study corrects panel data on 133 countries in the sample, there are 22 countries of advanced, 49 countries low-income countries, and 73 emerging markets in period 1980 to 2014 and using Regression	The importance of precautionary motives is a large effect on demand international reserves through current account and capital account.

Table 1 (Continued) *Method, Data, and Causality relationship of studies on demand for international reserves.*

Author (Year)	Title	Data & Methodology	Causality relationship
	countries	model to estimate.	

2.5 CONCEPTUAL FRAMEWORK

This study investigates the economic factor that contributing to the large increase in Thailand's international reserve apply the empirical model modified from motive for holding international reserves as a general framework based on. And apply from the previous study (Aizenman and Lee, 2007; Benecká and Komarek, 2018; Lane and Burke, 2001). Therefore, the precautionary motive, mercantilism motive, and opportunity cost of international reserves are the motive that contributes to the large increase in the international reserve. Then, we use the cycle of international reserves to study the relationship of each variable with international reserves under influence of three motives in above mention.

Moreover, in the empirical model part, this study uses the dependent variables, which is international reserves ratio of real GDP (IRSV) and the explanatory variables, which are the opportunity cost of international reserves (OP), income of country (IC), trade openness (TO), financial openness (FO), exchange rate of country (ER), inflation of country (IF), external debt (ED), and financial stability (FS). Therefore, this study uses Autoregressive Distributed Lag ARDL and Error Correction Model to estimation for investigate the impact of economic factor that contributing to the large increase in Thailand's international reserve as figure 4.

In addition, the advantage of the Autoregressive Distributed Lag ARDL and Error Correction Model is we can study the impact of economic factors that contribute to the large increase in Thailand's international reserve in both the long-run and short run. Furthermore, these approaches fixed the problem of time-series data and avoid spurious regression problems which is a major problem in estimating the time-series technique.

What economic factors that impact on the increasing Thailand's international reserves?

This study aims to investigate economic factors contributing to the large increase in Thailand's international reserves.

The empirical model modified from motive for holding international reserves as a general framework based on. (Aizenman and Lee, 2007; Benecká and Komarek, 2018; Lane and Burke, 2001)

International reserves =Precautionary motive, Mercantilism motive, Opportunity

Dependent variable is international reserves ratio of real GDP **(IRSV)**

Explanatory variables: Opportunity cost of international reserves **(OP),** Income of country **(IC),** Trade openness **(TO),** Financial openness **(FO),** Exchange rate of country **(ER),** Inflation of country **(IF),** External debt **(ED),** Financial stability **(FS)**

For policy recommendations that help to monitor which economic factors affect the volatility of international reserves to manage Thailand's international reserves at adequacy level.
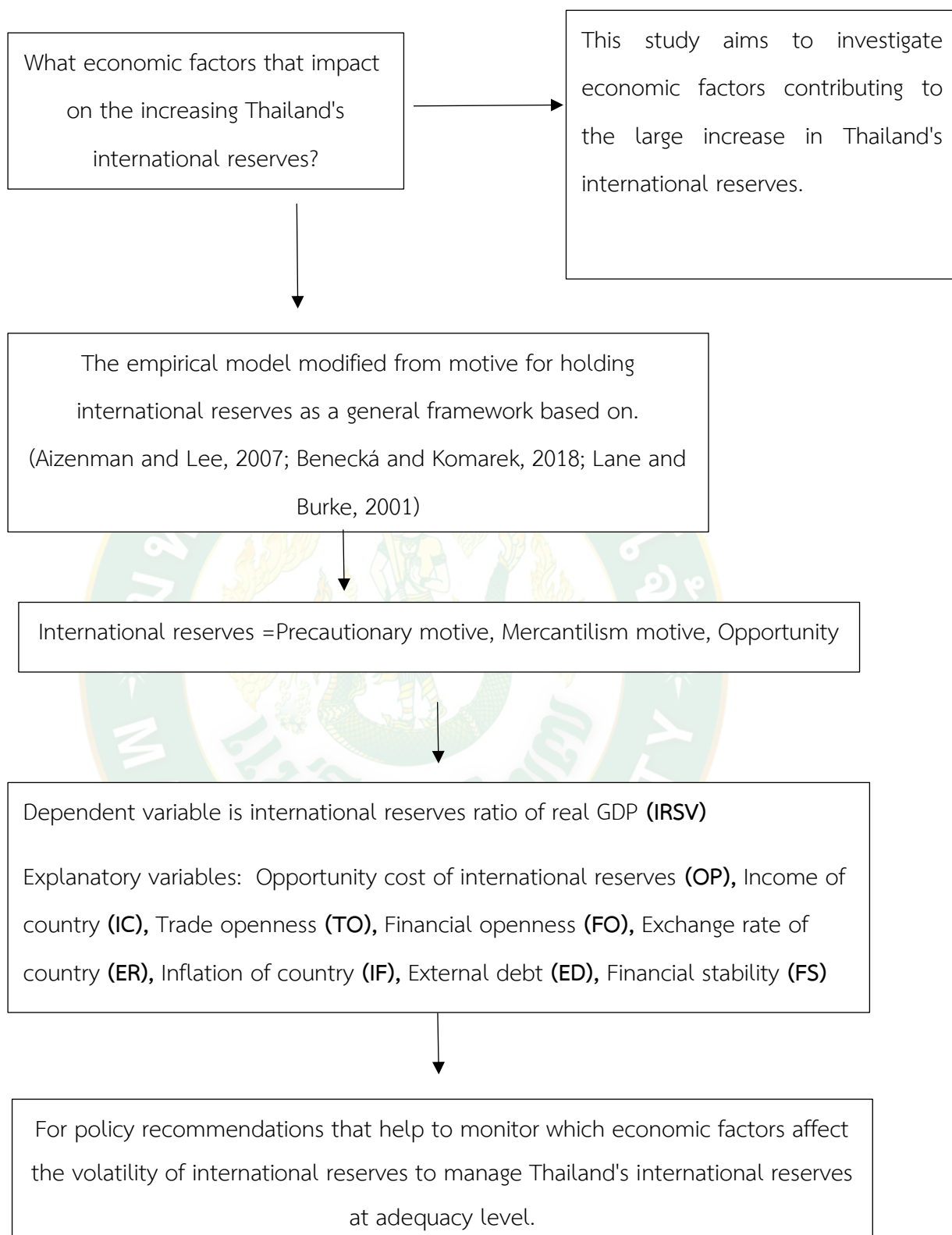
Figure 4 *Conceptual framework*

CHAPTER 3

METHODOLOGY

This study focuses on macroeconomic factors' effect on international reserves in Thailand. We collect time-series data from the first quarter in 1993s to the second quarter in 2019s by gathering 106 observations.

3.1 DATA COLLECTION

Data on eight explanatory variables including gross domestic product per capita (constant 2010) millions of US Dollars, summation of value exports and import millions of US Dollars in Thailand, summation of asset and liability US dollars millions in Thailand, liquid liabilities or broad money millions of US Dollars in Thailand, interest rate of money at market rate, period average domestic currency per U.S. Dollar in Thailand, and consumer price index for all commodity in Thailand. Their explanatory variables were collected from International Financial Statistics (IFS) And amounts outstanding of international debt securities for all issuers millions of US Dollars in Thailand were collected from Bank for International Settlements.

While data on the dependent variable is International Liquidity, Total Reserves excluding gold millions of US Dollars in ratio of real gross domestic product (constant 2010) US$ in Thailand was collected from The Bank of Thailand (BOT). Also,

we need to test the time series properties by using Augmented Dickey–Fuller Unit

root test (ADF) and found the results follow table 2.

Table 2 *Unit Root Test: Augmented Dickey–Fuller (ADF)*

Variables	Intercept & trend	
	Level I (0)	First Different I (1)
lnIRVS	0.766	0.000***
lnCPI	0.782	0.000***
lnID	0.454	0.000***
lnER	0.675	0.000***
lnFO	0.615	0.000***
lnGDP	0.200	0.000***
lnIR	0.255	0.000***
lnM2	0.646	0.000***
lnTO	0.558	0.000***

Note: ***   is   significant   at   1%,   where
lnIRVS is the logarithm form of international liquidity, total reserves excluding gold
millions of US Dollars in ratio of real gross domestic product, constant 2010 US$.
lnGDP is the logarithm form of gross domestic product per capita, constant 2010
US$. *lnTO* is the logarithm form of summation of value exports and import US$.
lnFO is summation of asset and liability US$. *lnM2* is the logarithm form of liquid
liabilities or Broad Money US$. *lnID* is the logarithm form of amounts outstanding of
international debt securities for all issuers US$. *lnIR* is the logarithm form of interest

rate of money at market rate. *lnER* period average domestic currency per US$. *lnCPI* is the logarithm form of consumer price index for all commodity.

The result from table 2 Unit Root Test: Augmented Dickey–Fuller (ADF) shows all the variables significant at first different or stationary at first different which means data have an influence from previously time to obtain predictions for the original series. when using data without transformation, it will find a spurious regression problem. So, we need to use the time series technic for transformations data by the series of changes from one period to the next or add lag of variables.

3.2 THEORETICAL MODEL

Several studies review there are many factors associated with the demand for international reserves under the country's incentives for holding international reserves including precautionary motive, mercantilism motive, and the opportunity cost of international reserves. For the precautionary motive, countries which hold international reserves to maintain the stability of the country's finances as reduce fluctuation of the domestic exchange rate, inflation, current account (Aizenman and Lee, 2007). We classify factors that affect international reserves in a group of precautionary motives as follows the period study.

Financial stability is a factor related through the central bank should hold international reserves about 5-20% of all amount money in the financial system. Because of the risk in the domestic bank sector, domestic credit markets, and

sudden foreign capital inflow or outflows (Schröder, 2017). Moreover, financial stability shows the volume of money in the financial system that represents the strengthening of the country's financial system. When the country faces a financial crisis, the country will lose capital inflow and outflow. Also, effect on the decreased volume of money in the system.

The financial process by the central bank will back up some of the international reserves in the form of local currency through a ratio money supply for protecting the domestic financial (Benecká and Komarek, 2018) and earn international reserves in the form of foreign currency through a ratio capital inflow to recover the broad money supply (M2) of the country (Lane and Burke, 2001).

External debt is a factor that relates to the international reserves with the impact of the financial crisis. After the great financial crisis in the world such as the Mexican peso crisis in 1995 and the Asian financial crisis in 1997. Many countries are faced with a sharp external debt because of the sudden stop capital inflow during a financial crisis. Countries were necessary to borrow money from United Nations Monetary that related debt problems.

So, countries find any way to protect effect from the next financial crisis from precautionary strategy. It leads to the accumulation of international reserves to support countries' financial volatility and expansion (Mendoza, 2010). Holding

international reserves are worth being able to protect financial risk because there is minimized cost to countries (Durdu et al., 2009).

Moreover, the build-up of international reserves relates to the long-term external debt which accumulating international reserves can be done in many ways and one of the popular ways is a borrowing that related to the external indebtedness of the country because it makes the potential to reduce the cost of holding international reserves (Lane and Burke, 2001). In the long-term external debt has more stability and flexibility to the financial crisis.

However, the ability of an international borrowing to a country's international reserves will be falling following increasing external debt (Hausmann et al., 2001). Hence, the ability to build-up international reserves for reinforcing stability in the country's exchange rate and financial system will decrease while high external debt (Brafu-Insaidoo, 2019).

The exchange rate is a factor related to international reserves. In developing countries and emerging countries that use the float exchange rate system. It tends to hold more international reserves because the adjusting level of international reserves can absorb the volatility of the exchange rate (Hausmann et al., 2001).

When the domestic currency is appreciated, the central bank will decide to accumulate international reserves to reduce accelerate of currency appreciation (Aizenman and Lee, 2007). To maintain a stable exchange rate, it is related to an

accumulation of reserves by purchasing foreign currency processes and keeps in form of the foreign reserves. The adjust demand and supply of foreign currency. It can resist the appreciation or depreciation of the exchange rate (Schröder, 2017). Also, the demand for international reserves is higher immediately when a country occurs a currency crisis or financial crisis (Sula, 2011).

In group of the mercantilism motive, International reserves are affected by the mercantilism motive which focuses on the size of the economy and receipt of the external transaction of the country (Schröder, 2017). We classify factors that affect international reserves in a group of mercantilism motive as follows:

The income of the country is a factor related to international reserves because it indicates economic growth. When the economy grows up the demand for money and asset will increase (Sula, 2011). The bigger economic scale will lead to more capital inflow and outflow. At the same time, it has higher fluctuation from external effects. Thus country needs increasing demand for international reserves to support economic expansion.

Moreover, the large of international reserves will refer to economic strengthening from the perspective of partner countries or foreign countries (Calvo, 1996). In developed and developing countries that have gross domestic product rapid growth. It is a possibility that the accumulation of international reserves has been accelerated sharply too (Obstfeld et al., 2010).

Trade openness and financial openness are factors that relate to international reserves through the economy growing up. The country has more external trade for promoting the country's export and encouraging a surplus of external trade. Mercantilism motive is obviously characteristic of China. The increase holding international reserves during increased exports and trade surplus will slow down the domestic currency appreciation of the country (Schröder, 2017).

Moreover, the international reserves play role in reducing risk on the current account that more fluctuates from higher country's import and export (Aizenman and Marion, 2004). Trade openness and financial openness are associated with the country's current account, It shows the size of the imports bill and export earnings. Some of the export earnings will transform in terms of international reserves to support the current account (Obstfeld et al., 2010).

Inflation has mainly caused is an increasing money supply. The inflationary will pressures to domestic currency and higher price of commodities due to a high price of domestic commodity lead to rising import and also impact to current account deficit. Some of the international reserves come from the current account surplus. So, inflation will reduce sources of international reserves (Tabata, 2011).

Other factors that should not be ignored as the opportunity cost of reserves. Every asset that has held property will incur costs. Of course, international reserves are a national asset which has the cost that countries need to pay for holding international reserve (Clark, Peter Barton, 1970; Heller, 1966).

We use the difference between the local interest rate and the U.S. interest rate to represent the opportunity cost of reserves (Benecká and Komarek, 2018). If the country needs to pay more opportunity costs for holding reserves due to higher interest rate differential instead of deposit their money in the banking system. So the demand for international reserves will fall (Sula, 2011).
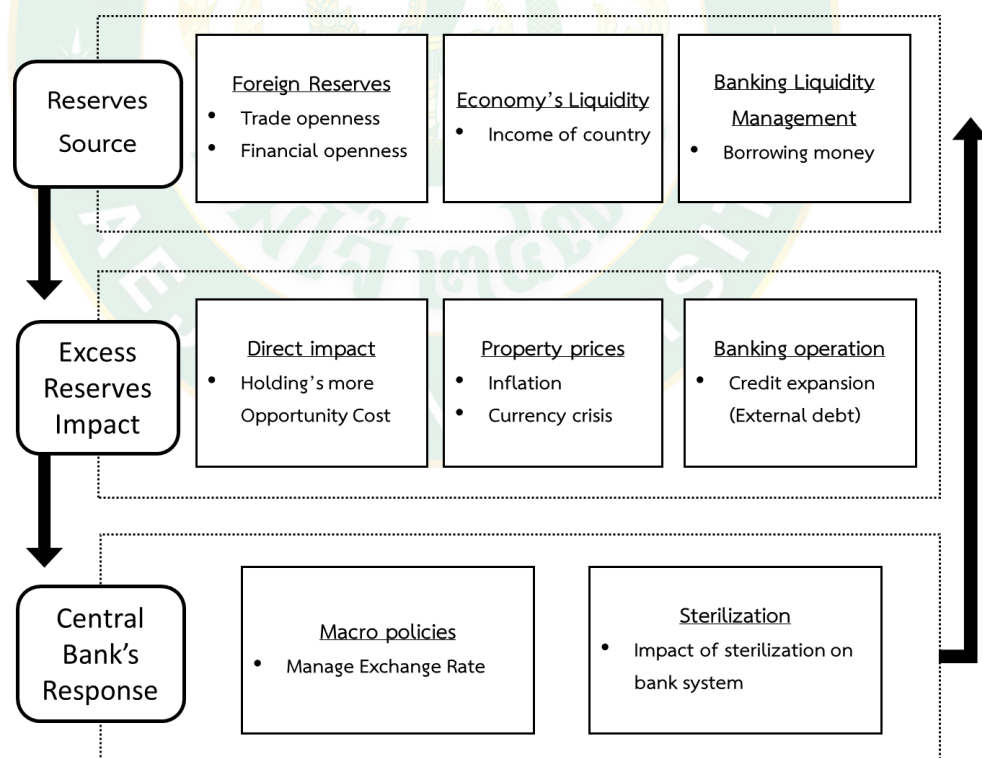

Figure 5 *The cycle of international reserves*

Source: (Brafu-Insaidoo, 2019)

In addition, we study on cycle of international reserves following the study of (Brafu-Insaidoo, 2019), then, as shown in figure 5, the sources of international reserves are the income, savings, and profitability of the country, which can divide into 3 sectors. First, the foreign reserves, which are the yield from a surplus export on current accounts, and foreign currency income from the capital inflow on capital accounts. Also, foreign reserves will be gained from trade openness and financial openness because it is an increased volume of international transactions (Cova et al., 2009).

Second, the income of a country or domestic income represents the economic liquidity which an increased income of a country, it is expansion economic scale. Thus, financial authors keep some actual money in terms of official reserves from the country's income to increase the liquidity flow (Balogh, 1960). Finally, the reserves from banking borrowing, the central bank will borrow foreign currency from the international financial institution to balance the domestic exchange rate. Moreover, the commercial banks will keep some money to reserves in the bank system to manage loan demand or lending incentives (Agénor et al., 2004).

Therefore, when a country holding excess international reserves makes an impact on the country. The direct impact is country need to pay more opportunity cost to hold excess international reserves and it reduces the efficiency of international reserves to monetary policy.

The indirect impacts are problems in the property prices of the country and the debt expansion. The debt expansion is a consequence of the less efficiency of international reserves which need to use more international reserves to drive monetary policy (Chen, 2008). As problems of the property prices, because of the excess international reserves that mean it occurs over the money supply in the financial system, it is possible to price bubble (Guo and Li, 2011).

Thus, as the figure 5, when there occurs the impact of excess international reserve, the central bank will respond to excess international reserves by using monetary policy to manage the exchange rate and sterilization inflation of the bank system. The consequence to change level country's international reserves (Frenkel, 1983).

All together we use the motived for holding international reserves as general framework based on (Aizenman and Lee, 2007; Benecká and Komarek, 2018; Lane and Burke, 2001) follow:

$IRSV = f$ (Precuationary motive, Mercantilism motived, Opportunity cost)　　　(1)

Where $IRSV$ is international reserves ratio of real GDP From *equation 1* we collect each factors that affect to demand for interantional reserves from Precuationary motive, Mercantilism motive, and opportunity cost of international reserves.

Then, we use the cycle of international reserves as figure 5 to study the relationship of each variables with international reserves in equation 2.

$$IRSV_t = \beta_0 + \beta_1 OP_t + \beta_2 IC_t + \beta_3 TO_t + \beta_4 FO_t + \beta_5 ER_t + \beta_6 IF_t + \beta_7 ED_t + \beta_8 FS_t \tag{2}$$

Where *IRSV* is international reserves ratio of real GDP, *OP* is opportunity cost of international reserves, *IC* is income of country, *TO* is trade openness, *FO* is financial openness, *ER* is exchange rate of country, *IF is* inflation of country, *ED* is external debt and *FS* is the financial stability.

We provide a hypothesis of the relationships between the international reserves and explanatory variables. We expect Opportunity cost to have a negative relationship with international reserves because the higher opportunity cost of international reserves meaning the country needs to pay more cost to hold international reserves. It will decrease demand for international reserves (Sula, 2011).

The income of the country will have a positive relationship with international reserves because the larger size of the economy needs more assets to support the economic scale. It increases the demand for international reserves of the country (Schröder, 2017).

Trade Openness and Financial openness will have a positive relationship to international reserves because the expansion of trade and financial openness increase fluctuating of the current account and the capital account of the country.

To keep the overall balance of the current account and the capital account. Countries and monetary authorities will respond to policies that more accumulate international reserves (Rodrik, 2006; Sula, 2011).

The exchange rate can be a positive or negative relationship with international reserves. Due to different strategies in each country, if need to encourage export. The central bank will reduce the appreciation of the domestic currency to gain a trade surplus which is the income of the country and some foreign reserves.

On the other hand, when the domestic currency depreciates, the central bank will accumulate international reserves to maintain the exchange rate by adjusting the demand for foreign currency to make the local currency more appreciated (Levy, 1983; Rodrik, 2006).

In the same way, External debt can be a positive or negative relationship with international reserves too. It is because external debt will increase when a country borrows for purchasing foreign reserves. On the other hand, high external debt reduces the demand for international reserves of the country due to its make unnecessary debt (Brafu-Insaidoo, 2019).

The financial stability should be a negative relationship with international reserves because in the long-term broad money high responds to increase financial stability when the central bank has enough strength of financial, it will less demand

for international reserves (Shrestha and Semmler, 2015).

Inflation rate should be a negative relationship with international reserves because more excess liquidity leads to a high inflation rate. The central bank will reduce the country's liquidity to sterilization the inflation rate and foreign exchange reserves are associate with the country's liquidity. So, drain reserves will affect the lower inflation rate (Durdu et al., 2009).

3.3 ECONOMETRIC MODEL

From equation 2 we modify to regression model in logarithmic function:

$$lnIRSV_t = \beta_0 + \beta_1 lnIR_t + \beta_2 lnGDP_t + \beta_3 lnTO_t + \beta_4 lnFO_t + \beta_5 lnER_t + \beta_6 lnCPI_t + \beta_7 lnID_t + \beta_8 lnM2_t + \varepsilon_t \tag{3}$$

As the result of the ADF unit root test, we see all variables are stationary at first different level, so our variables have spurious regression problems. Therefore, we test for cointegration to see there is a long-run relationship between our dependent variable and the explanatory variable by Bound test cointegration (Pesaran et al., 2001). After confirming whether the variables are cointegrated, we proceed to modify equation 3 to an ARDL and Error Correction Model in equation 4.

$$\Delta lnIRSV_t = \alpha0 + \sum_{i=1}^{q1} bi\,\Delta \ln IRSV_{t-i} + \sum_{i=0}^{q2} ci\,\Delta lnIR_{t-i} + \sum_{i=0}^{q3} di\,\Delta \ln GDP_{t-i}$$
$$+ \sum_{i=0}^{q4} ei\,\Delta lnTO_{t-i} + \sum_{i=0}^{q5} fi\,\Delta lnFO_{t-i} + \sum_{i=0}^{q6} gi\,\Delta lnER_{t-i} \qquad (4)$$
$$+ \sum_{i=0}^{q7} hi\,\Delta lnCPI_{t-i} + \sum_{i=0}^{q8} ji\,\Delta \ln ID_{t-i} + \sum_{i=0}^{q9} ki\,\Delta lnM2_{t-i}$$
$$+ \varepsilon_t ECM_{t-i} + u_t$$

The ARDL model has integrated an estimate between the short-run model and the long-run model. We focus on the long-run ARDL model because their model represents the theoretical analysis. So, we obtain ARDL long-run equation from an Error Correction Model as equation 5 and we select the lag length base on the Hannan-Quinn Information Criterion.

$$lnIRSV_t = y_0 + y_1 lnIRSV_{t-i} + y_2 lnIR_t + y_3 lnGDP_t + y_4 lnTO_t$$
$$+ y_5 lnFO_t + y_6 lnER_t + y_7 lnCPI_t + y_8 lnID_t + y_9 lnM2_t \qquad (5)$$
$$+ \varepsilon_t$$

Where the period is t from 1993Q1 to 2019Q2 in Thailand, (i is lag of number) y_0 is constant amount, $y_1 - y_8$ are long-run coefficients of the explanatory variables, dependent variable *IRSV* is International Liquidity, Total Reserves excluding gold millions of US Dollars in ratio real GDP in Thailand represent international reserves as the dependent variable.

The explanatory variables are *IR* is interest rate at money market rate represent opportunity cost of reserves. *GDP* is real gross domestic product per capita US dollars (millions), constant 2010 US$ in Thailand represent income of country. *TO* is sum value of exports and value of imports US dollars in Thailand represent trade openness. *FO* is sum of asset and liability in Thailand represent financial openness. *ER* is period average domestic currency per U.S. Dollar in Thailand represent exchange rate. *CPI* is Consumer Price Index in Thailand represent inflation. *ID* is amounts outstanding of international debt securities for all issuers millions of US Dollars in Thailand represent external debt. *M2* is liquid liabilities or Broad Money millions of US Dollars in Thailand represent financial stability and ε_t is error term.

Follow our expectation in theoretical model, we assume the null hypothesis is coefficient value equal zero, meaning explanatory variable does not affect to international reserves and alternative hypothesis is coefficient value not equal zero, meaning explanatory variable affect to international reserves.

The opportunity cost of holding international reserves play important role in the demand for foreign reserves. This cost is the difference between the yield on reserves and the yield that missing from alternative investment in capital (Hamada and Ueda, 1977; Rodrik, 2006). As demand for international reserves, opportunity cost like their price in demand theory. Basically, when the price increase quantity of

demand will fall. So, opportunity cost must be a negative coefficient sign to international reserves (Ben-Bassat and Gottlieb, 1992).

The demand for foreign reserves occurs from the interaction between productivity growth and the development of the domestic financial market. If looking at the country as firms, the country has limited credit for continue to generate growth of income. So country's will keep some of the income in terms of international reserves as domestic tools because it was necessary to increase their retained earnings to invest in capital (Cheng, 2015).

Moreover, larger economic scale will make more hoarding international reserves to mitigating the risk of suffering an economic crisis and also maintain a stable exchange rate, promoting economic growth and development exporting goods sector (Cruz, 2015). In the common managed-float exchange rate system, the monetary authorities will intervene to control the exchange rate when it rises or falls sharply by hold more reserves in order to smooth out the exchange rate (Seghezza et al., 2017). So, the Income of the country and the exchange rate has a positive sign of the coefficient to international reserves.

Further, all exports and imports of an economy are recorded in the current account and the international reserves get accumulated through the trade surpluses. Likewise, the country receives income from foreign to build the country's safeguard

and protect current account deficit (Sula, 2011). Similarly, foreign transactions of government through the banking system.

The country uses foreign currencies for its multinational transactions and trade credits in the capital account. The central bank receives returns from the foreign assets held in foreign banks also there is a net accretion of international reserves (Benecká and Komarek, 2018; Nayak and Baig, 2019). Trade openness and financial openness have been positive coefficients too.

On the prediction board money and inflation will negative sign coefficient on international reserves, the main reason for a central bank to hold reserves is to protect the domestic banking sector. Protection must increase from the multiplication of financial risk. When a country lacks financial liquidity can place extraordinary demands on a central bank's foreign exchange reserves (Obstfeld et al., 2010).

However, a central bank will drain international reserves when the country has excess financial liquidity. A consequence of the rapid expansion in the balance of payments helps build up massive foreign exchange reserves, which in turn contributes to the money supply and Inflationary pressure occurs from excess liquidity or more money supply (Zhang, 2009). The central bank will respond to inflation by sterilization on the financial system operation incur falling demand for international reserves (Chaudhry et al., 2011).

So, the international reserve accumulation is a key tool for managing domestic financial instability while excess financial liquidity and financial stability decrease demand for international reserves. In addition, we predict external debt is negative sign of coefficient because of financial stability, external debt from purchase international reserves adjusts the structure of external debt towards more long-term debt, which further enhances financial stability (Qian and Steiner, 2017). In long term a large amount of external debt has reduced the demand for international reserves (Brafu-Insaidoo, 2019).

And equation 6 is an estimating an error correction model associated with the short-run estimates follow:

$$
\Delta lnIRSV_t + \alpha 0 + \sum_{i=1}^{q1} bi\,\Delta \ln IRSV_{t-i} + \sum_{i=0}^{q2} ci\,\Delta lnIR_{t-i} + \sum_{i=0}^{q3} di\Delta \ln GDP_{t-i}
$$
$$
+ \sum_{i=0}^{q4} ei\,\Delta lnTO_{t-i} + \sum_{i=0}^{q5} fi\,\Delta lnFO_{t-i} + \sum_{i=0}^{q6} gi\,\Delta lnER_{t-i} \tag{6}
$$
$$
+ \sum_{i=0}^{q7} hi\,\Delta lnCPI_{t-i} + \sum_{i=0}^{q8} ji\,\Delta \ln ID_{t-i} + \sum_{i=0}^{q9} ki\,\Delta lnM2_{t-i}
$$
$$
+ \varepsilon_t ECM_{t-i} + u_t
$$

Where Δ is the first difference operator; μ represents the white noise error term; αi are short-run dynamic multipliers; $\varepsilon_t ECM$ is the error correction term, stands for the speed of adjustment from convergence to equilibrium. But we ignore for the short-run model because investigate factor that effect to demand for international

reserves is main finding of this study. So only long-run model completely to describes objective.

CHAPTER 4
RESULT AND DISCUSSION

4.1 COINTEGRATION TEST

After we test the time series properties by using Augmented Dickey–Fuller Unit root test (ADF) and all variable stationary at first different. Next step it needs to test cointegration for finding the long-run relationship of variable by we use Bound test cointegration to estimate.

Table 3 Bound test cointegration

Test Statistic	Value	Significant	I(0)	I(1)
F-statistic	9.398	10%	1.85	2.85
		5%	2.11	3.15
		1%	2.62	3.77

The result from table 3 show the calculated F-statistic value is 9.398 that higher value of the upper bound level or I(1) at all significance levels. Which mean our dependent variable is or ln IRSV (log of international reserves) has long-run relationship with all explanatory variables as lnGDP (log of GDP per capita), lnTO (log of trade openness), lnFO (log of financial openness), lnM2 (log of broad money), lnID (log of international debt), lnIR (log of interest rate), lnER (log of exchange rate), and lnCPI (log of inflation). So, we cannot ignore estimation for long-run analyzes.

4.2 THE AUTOREGRESSIVE DISTRIBUTED LAG (ARDL) ANALYSIS

After cointegration test and the variables is cointegrated, we selected Hannan-Quinn Information Criterion to base on lag range in ARDL (2, 4, 2, 3, 2, 1, 2, 1, 3) model and get long-run result as listed in Table 4.

These findings do necessarily deny a role to some variable because our study pays attention to the explicit relationship between a past situation in Thailand and surge international reserves in the case of Thailand.

The exchange rate coefficient is 0.883 significantly at 1 percent meaning a 1 percent increase in exchange will affect international reserves increased 0.883 percent associated with the prediction of this study. There are large positive effects on international reserves after Thailand change the exchange rate regime from the fixed exchange rate to the float exchange rate in the 1997s.

Thailand's international reserves continue increasing have the potential to absorb the appreciation of baht which has explicit evidence that Thailand's Real Effective Exchange Rate (REER) has increase trend since 1997s over Nominal Effective Exchange Rate (NEER) until 2007and increased again in 2015 (Chaivichayachat, 2020).

So, the Bank of Thailand (BOT) accumulate international reserves follow the purpose to maintain the exchange rate and the cause of the surge in international reserves in Thailand is currency appreciation. Similarly, the case of the Yuan appreciates the increase in China's real exchange rate since 1994 indicates that China

faces domestic currency appreciation for a long- time, and also China's international reserves sharply increase until over adequacy (Schröder, 2017; Zheng and Yi, 2007).

Further, the long-run coefficients of trade openness and financial openness are positive at the close value and both significant at 1 percent. The coefficient of trade openness is 1.090 which means increasing 1 percent of financial openness effect to an increased 1.090 percent of Thailand's international reserves and the coefficient of financial openness is 0.822 which means increasing 1 percent of financial openness effect to an increased 0.882 percent of Thailand's international reserves. which financial openness and trade openness have a positive relationship with Thailand's international reserves.

Because of wider of Thailand's trade openness led to increase the amount of export and import at the same time wider financial openness led to increase capital inflow and outflow. So, the high risk from the fluctuation of current and capital account, bank of Thailand responds to increasing official reserves for the backup of trade deficit and shock of capital inflow. This result corresponds with Benecká and Komarek (2018), and Obstfeld et al. (2010).

Gross domestic per capita that we represent income of the country significant at 10 percent with a positive coefficient equal 0.255 which mean 1 percent increase income of the country effect to increase Thailand's international reserves 0.255 percent and Mahraddika (2019) find similar results. Even income of the country will

positively effect on Thailand's international reserves following the hypothesis of this study. but its effects with small value when compared with other variables such as trade openness and financial openness. The reason is growth rate of gross domestic per capita in Thailand each year is quite constant. So, it less effects to increasing international reserves.

Conversely, we are surprised by the long-run Inflation result. The coefficients of Inflation are -3.335 and significant at less than 1 percent that the largest effect on increasing Thailand's international reserves. which means extremely negative value meaning Inflation decreasing 1 percent will affect to increase 3.335 percent of Thailand's international reserves.

Looks at the situation of inflation rate in Thailand, we found in period time that Thailand's inflation rate fell nearly zero or negatively in 1999s at 0.285, 2009 at -0.846, and 2015 at -0.9. It is at the same time Thailand's international reserves large increasing when we compare the inflation rate in Thailand with international reserves (World Bank, 2022).

This result correlates with the reason from the previous study of international reserves and inflation. The central bank needs to adjust the inflation rate while the country faced economic or financial problems. Because of using the international reserves to sterilize inflation. It will adjust the domestic money supply and reduce

the pressure of deflationary. However, the effect on the balance of payments deficit. It creates a high demand for international reserves (Kelly, 1970).

In addition, this result is similar results of Steiner (2017) that studies inflation that has a negative coefficient effect on changing international reserves. Also, its inflationary impact might be larger in the long run.

Besides, the coefficient of external debt and broad money is negative in close value and statistically significant relationship with international reserves. The coefficient of external debt is -0.283 which means a 1 percent increase in external debt will reduce 0.283 Thailand's international reserves. Due to in long-run external debt is foreign expenditure to be paid on time schedule. The central bank will pay with foreign reserves to pay off international debt. There result correct with our prediction which (Brafu-Insaidoo, 2019) finds similar results to the external debt variable

The coefficient of broad money is -0.306 which means a 1 percent increase in external debt will reduce 0.306 Thailand's international reserves while the result of broad money has a different sign from almost study (Schröder, 2017) and (Benecká and Komarek, 2018) because we use broad money represent to financial stability. However, the expansion of the broad money supply that we represent to financial stability shows more strength in the financial system. It is possible to reduce demand for Thailand's official reserves.

And the coefficient of the opportunity cost of Thailand's international reserves is -0.05 which means a 1 percent increase in the opportunity cost of Thailand's international reserves will reduce 0.05 Thailand's international reserves which is the least effect to increased Thailand's international reserves. Similar result in studies of (Clark, Peter Barton, 1970; Sula, 2011)

Because we proxy opportunity cost of reserves with a saving rate of interest rate but from several studies, it has many ways to calculate opportunity cost. So, we don't get complete actual opportunity cost, it consequences to the small value of coefficient.

Table 4 Estimated long-run coefficients using the ARDL approach

Variable	Coefficient	Std. Error	t stat	Prob.
$lnIR$	-0.050	0.023	-2.138	0.035
$lnGDP$	0.255	0.144	1.770	0.080
$lnFO$	0.822	0.101	8.083	0.000
$lnER$	0.883	0.196	4.501	0.000
$lnCPI$	-3.335	0.601	-5.546	0.000
$lnID$	-0.283	0.064	-4.424	0.000
$lnM2$	-0.306	0.172	-1.780	0.079
$lnTO$	1.090	0.089	12.153	0.000
C	-4.065	0.618	-6.572	0.000

4.3 THE ERROR CORRECTION MODEL (ECM) ANALYSIS

The short-run result in Table 5 shows that the short-run coefficient on error correction term (ECT) is -0.575 and statistically significant in 1% level of significance. Implies that there is a long-run relationship among macroeconomic variables for Thailand's international reserves. This result shows that the short-run change to the long-run equilibrium is corrected by 57.5 percent per quarter which means when occurring disequilibrium of Thailand's international reserves. Thailand's international reserves will recover in about the next two quarters.

The result of the short-run dynamic coefficients conflict with coefficients the long-run in the variable of financial openness, and income of the country. These variables are a negative effect on Thailand's international reserves in short run. Although the growth leads to higher levels of reserves, the caution from (Sula and Oguzoglu, 2021) mentions that the positive effects diminish with the size of the reserves when the over international reserve accumulation. So, it correlates with the situation in Thailand that have excess international reserves since 2006. Anyway, after the past six months, the level of international reserves will adjust to equilibrium.

Moreover, the short-run coefficient of the exchange rate is -0.673 while the lag is two, which is the second large effect on Thailand's international reserves. The short-run change of the exchange rate has a negative effect on Thailand's international reserves. Due to the frequency of exchange rate volatility in the short-

term need to several adjustments immediately. It is a decrease in Thailand's international reserves (Bhasin and Khandelwal, 2014). After a period of time, the central bank will use policy to respond to adjust international reserves again follow the long-run results.

The short-run coefficient of trade openness is -0.429 while the lag is three, the short-run change of trade openness is a negative effect to international reserves in Thailand. In the short-run volume of export and import will reduce the demand for foreign reserves follow (Eliza et al., 2008) they found the volume of export and import have a negative sign to reserves in the short-run estimation.

Whereas the short-run coefficients of interest rate, external debt, and inflation are associated with the long-run coefficients and follow our expectations (Brafu-Insaidoo, 2019). In addition, the main factor that given extremely affect to Thailand's international reserves still as Inflation, exchange rate, trade openness like long run.

The short-run coefficient of the external debt is -0.153 while lag is two, which has a negative effect on Thailand's international reserves. There is the confidence of the central bank to hold international reserves will decrease when the central bank carries more external debt. Accord the previous study increasing short-term external debt will discourage demand for international reserves. (Brafu-Insaidoo, 2019; Mishra and Sharma, 2011)

The short-run coefficient of the opportunity cost of international reserves is -0.041 while lag is four, nearly the value of long-run coefficient. It means in the short-run the opportunity cost of international reserves has more effect on international reserves than long-run. It is correct to our expectation that when the opportunity of reserves increased effect to reduce Thailand's international reserves. Due to the bank of Thailand needing to pay more cost to hold international reserves, it will decrease demand for international reserves. This result like (Badinger, 2004) that found a change in the opportunity cost while its lag of time with a negative sign coefficient.

The short-run coefficient of broad money supply (M2) that we represent financial stability is 0.277 that a positive effect on Thailand's international reserves. The short-run coefficient of broad money supply (M2) has a different sign of the coefficient to the long-run coefficient. This means in the short-run increase of broad money supply (M2) or financial stability effect to increase Thailand's international reserves. It justifies to the country wants to strengthen the financial system. The central bank will accumulate international reserves.

Table 5 Error correction representation for the selected ARDL model (2, 4, 2, 3, 2, 1, 2, 1, 3)

Variable	Coefficient	Std. Error	t stat	Prob.
$\Delta \ln IRSV_{t-1}$	0.203	0.074	2.713	0.008
$\Delta lnIR_{t-3}$	-0.041	0.016	-2.586	0.011
$\Delta lnGDP_{t-1}$	-0.129	0.063	-2.020	0.047
$\Delta lnFO_{t-2}$	-0.149	0.065	5.003	0.000
$\Delta lnER_{t-1}$	-0.673	0.136	-4.932	0.000
$\Delta lnCPI_t$	-0.934	0.481	-1.939	0.056
$\Delta lnID_{t-1}$	-0.153	0.062	-2.464	0.016
$\Delta lnM2_t$	0.277	0.104	2.642	0.010
$\Delta lnTO_{t-2}$	-0.429	0.071	-5.992	0.000
ECM_{t-1}	-0.575	0.055	-10.274	0.000
R2	0.778	DW	2.056	
Adj. R2	0.726	F:	9.398	

CHAPTER 5

CONCLUSION AND RECOMMENDATIONS

5.1 CONCLUSION

Our study analyzed eight macroeconomic factors that affect to surge of international reserves in Thailand. In an analysis method, we use autoregressive distribution lag (ARDL) with a time-series technique to avoid spurious regression problems. Estimation during first quarterly 1993s to second quarterly 2019s.

In the long run estimation result, we found the consumer price index that represents inflation is the largest effect on Thailand's international reserves. The coefficient value is an extremely negative relationship to demand international reserves in Thailand. Due to the recession economy in Thailand that consequence to deflation, Bank of Thailand increased international reserves through the financial sterilization process. There is a recovery in the economy and adjust inflation with money reserves.

Moreover, trade openness and financial openness are a highly positive effect on international reserves in Thailand because when the country's wider trading and transaction at the same time country's accumulating international reserves for protecting risk from the external economy.

In addition, the exchange rate has also highly affected Thailand's international reserves for a long time since Thailand changed to a floating exchange rate system. The exchange rate contributes to trade openness and financial openness. Especially the main role of international reserves for maintaining the exchange rate. The consequence of appreciation in baht in Thailand from trade surplus or over the capital inflow will increase international reserves to decelerate appreciate the currency.

In the short run estimation result, the speed adjustment of Thailand's international reserves when occurring shock of financial. It takes time around 6 months to recover international reserves to long-run equilibrium. After the past two quarters, Thailand's international reserves are average increasing 0.203%.

Deflation still largest affect international reserves in the short run and the second large effect on international reserves is the exchange rate. It is interesting that excess international reserves have given diminished effects to trade openness, financial openness, and income of countries that should be a positive relationship to international reserves.

Conclude that to keep looking on the change Thailand's international reserves, it needs to be monitoring the deflation and exchange rate appreciation that affect to large increasing international reserves in Thailand. Also, the consequence of

the deflation and exchange rate appreciation will associate with the trading and finances of the country.

5.2 POLICY RECOMMENDATIONS

The policy recommendation from the result of this study confirmed that the deflation and the Thai baht exchange rate are effects of a large increase of international reserves in Thailand. There is relate the activity about domestic's currency has the most impact to demand international reserves of the country and the secondary impact is an activity about international trade and transaction. So, the best way to control Thailand's international reserves to adequacy level need to focus on activity about domestic's currency of the country, and the consumer price level

For the policy implementation by monetary authorizes, deflation is the most impact on changing international reserves. Bank of Thailand (BOT) should establish funds to prevent recession by changing excess international reserves to bonds in the portfolio of the country and using the interest rate bonds to adjust the inflation rate. If countries can control the inflation rate around 2 to 3 percent, it will encourage economic growth at the same time it reduces international reserves to adequacy levels.

5.3 LIMITATION OF THIS STUDY

In recent years, Cryptocurrency and digital financial has influenced global financial transaction. Thailand has an increasing trend to invest in Cryptocurrency. Bank of Thailand going to study Central Bank Digital Currency (CBDC) and try to release Baht Digital in the Thai financial system. Our study doesn't combine factors associated with cryptocurrency and digital financial because limitation of data access. Moreover, cryptocurrency and digital financial might be the potential to change Thailand's international reserves.

5.4 RECOMMENDATIONS FOR FURTHER STUDIES

In addition, the findings of this study are not cover the direction of macroeconomic factors and international reserves. Thus, further study can apply the other estimation to analyze the direction of variables to know the structure of Thailand's international reserves and more clearly in a relationship. Furthermore, benefit to further research, our results confirm that the inflation, exchange rate, and trade openness is most affect to surge of Thailand's international reserves respectively.

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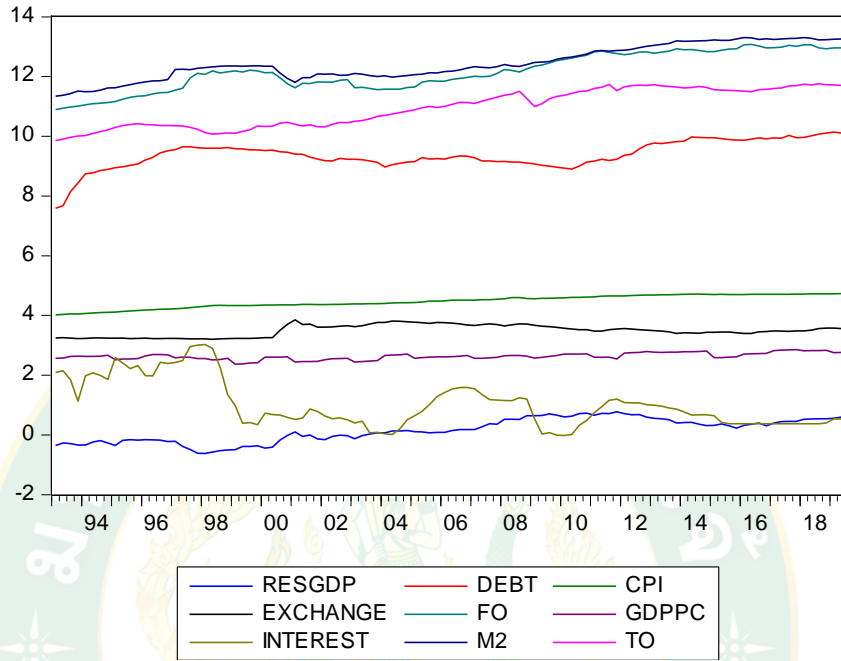
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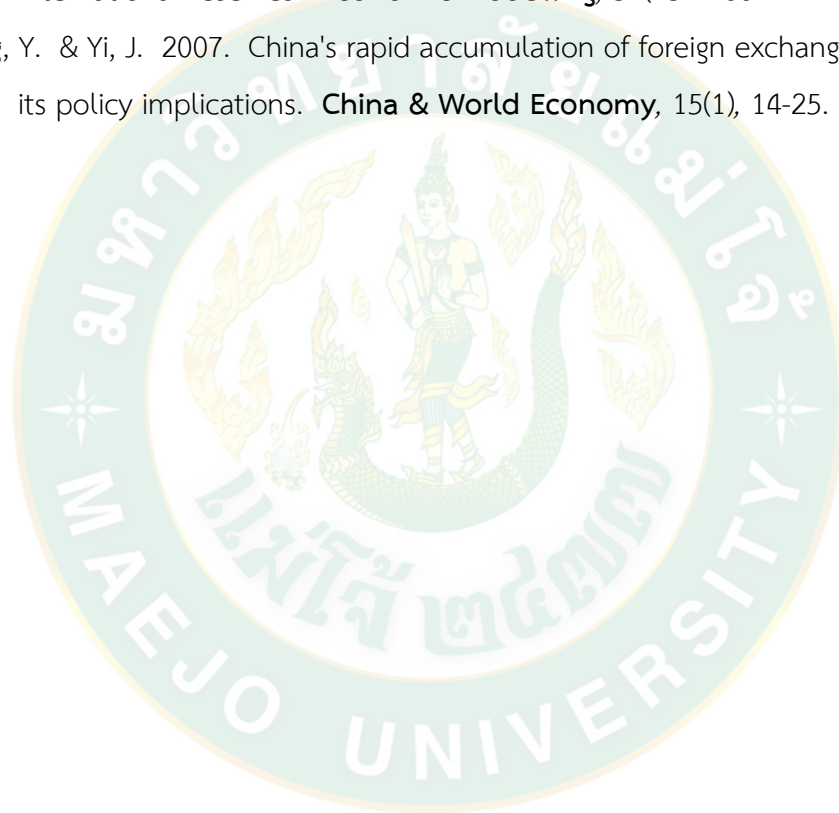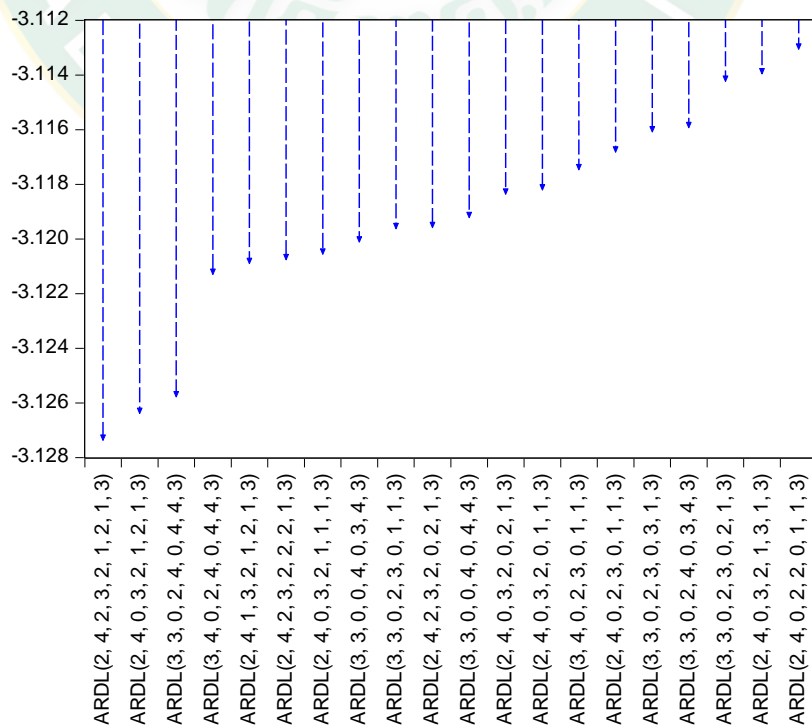
APPENDIX

Distribution of data

Legend: RESGDP, DEBT, CPI, EXCHANGE, FO, GDPPC, INTEREST, M2, TO

Lag selected with Hannan-Quinn Criteria

Hannan-Quinn Criteria (top 20 models)

Models (left to right):
ARDL(2, 4, 2, 3, 2, 1, 2, 1, 3)
ARDL(2, 4, 0, 3, 2, 1, 2, 1, 3)
ARDL(3, 3, 0, 2, 4, 0, 4, 4, 3)
ARDL(3, 4, 0, 2, 4, 0, 4, 4, 3)
ARDL(2, 4, 1, 3, 2, 1, 2, 1, 3)
ARDL(2, 4, 2, 3, 2, 2, 2, 1, 3)
ARDL(2, 4, 0, 3, 2, 1, 1, 1, 3)
ARDL(3, 3, 0, 0, 4, 0, 3, 4, 3)
ARDL(3, 3, 0, 2, 3, 0, 1, 1, 3)
ARDL(2, 4, 2, 3, 2, 0, 2, 1, 3)
ARDL(3, 3, 0, 0, 4, 0, 4, 4, 3)
ARDL(2, 4, 0, 3, 2, 0, 2, 1, 3)
ARDL(2, 4, 0, 3, 2, 0, 1, 1, 3)
ARDL(3, 4, 0, 2, 3, 0, 1, 1, 3)
ARDL(2, 4, 0, 2, 3, 0, 1, 1, 3)
ARDL(3, 3, 0, 2, 3, 0, 3, 1, 3)
ARDL(3, 3, 0, 2, 4, 0, 3, 4, 3)
ARDL(3, 3, 0, 2, 3, 0, 2, 1, 3)
ARDL(2, 4, 0, 3, 2, 1, 3, 1, 3)
ARDL(2, 4, 0, 2, 2, 0, 1, 1, 3)

CURRICULUM VITAE

NAME   Samach Sooksai

DATE OF BIRTH   27 August 1998

EDUCATION   Bachelor of Economics - International Economics,

Maejo University, Chiang Mai, Thailand