

Essays on the Exchange Rate Policy

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## **Chapter I**

### **Introduction**

Monetary policy is adopted by the monetary authority, the central bank, of a nation with the ultimate goals being to obtain price stability and to support economic growth. The central bank can control the domestic interest rate (i.e., policy rate), money supply, and the exchange rate. Another important mission of the monetary authority is to ensure the credibility of the nation's currency. However, the discussion on the choice of an exchange rate regime is still controversial in the international macroeconomic nexus as the appropriate exchange rate policy is critical for a country to achieve robust economic growth. The movement of the exchange rate has both direct and indirect impacts on macroeconomic variables. The depreciation or appreciation directly affects the prices of goods and services and indirectly affects inflation, interest rates, the labor market, and other economic activities. The exchange rate also plays a vital role in the applied trilemma theorem.

The impossible trinity theorem became a fundamental of macroeconomics of open economies in the 1980s, by which time capital controls had almost been abandoned with the conflicts of the pegged exchange rate and monetary autarky. From the late 1990s, economists included the new terminology "trilemma" into broader economic literature. Then, they developed methodologies to empirically validate this critical hypothesis in international macroeconomics (Obstfeld et al., 2005). For more than two decades, developing countries have attempted to increase the level of financial openness. The implications of trilemma policy are still under discussion in recent macroeconomics. The trilemma implies only two out of three objectives can be attainable; hence, policymakers need to choose which one to give up.

Essentially, the exchange rate plays an important role in the balance of payments (BOP) position of any country. Many studies suggest that BOP has a long-term relationship with the exchange rate and causalities with macroeconomic variables. Iyoboyi and Muftau (2014) also prove that BOP has bidirectional causalities with government expenditure, the exchange rate, real GDP, money supply, the interest rate, and openness – as share of total trade to gross domestic product.

The essays of this thesis mainly diagnose the exchange rate policies using different countries' datasets and provide policy recommendations through empirical analysis. In this dissertation, there are five chapters. Chapter 1 is the introduction. Chapter 2 is the literature review. Chapter 3 discusses the impossible trinity analysis evidence from cross countries. This chapter contributes to the literature by applying a multinomial logit model, where the exchange rate regime is the categorical dependent variable, with the combination of financial integration and monetary independence over 18 years for 171 countries. I also divide the sample into three income groups, according to the World Bank classifications. Those groups are low-income, middle-income, and high-income economies. Chapter 4 examines the impact of the exchange rate and dollarization on the balance of payments of Cambodia. Besides using a real effective exchange rate (REER) as the control variable, I also employ a broad money growth rate and the ratio of foreign currency deposits to total deposits as a dollarization indicator. After conducting statistical analysis on the applied dataset, the appropriate econometric model in this paper should be autoregressive distributed lag (ARDL) in an error correction form. Last but not least, Chapter 5 concludes and summarizes the critical monetary policy implication according to the findings of each essay. It is helpful to provide some challenges that I faced during writing these essays, such as data limitation and how to choose an appropriate methodology for future studies.

## Chapter II

### Literature Review

#### 1. Impossible Trinity

##### 1.1. The Trilemma and Mundell-Fleming's framework

In the 1960s, the studies on Trilemma were well documented in Mundell's seminal work. The model augmentation of the IS-LM New-Keynesian framework was for small open economies with the impossible trinity policy. This analysis considers one-directional binary choices among fixed or free float exchange rates, open a capital account or closed financial market, monetary autarky, or no monetary discretion.

The policy stance of free capital flows and stable exchange rate infers giving up monetary independence. Under the perfect capital flow, if the central bank injects more money, leading to a lower domestic interest rate, there will be an increase in foreign currency demand due to capital flight out aiming for higher yield foreign assets. Under the credible fixed exchange rate<sup>1</sup>, the central bank will purchase foreign bonds to match the excess supply of domestic currency or actively intervene in the currency market to maintain the exchange rate at a stable level and meet the market demand for foreign currency. The buyback of the excess supply of domestic currency triggers its original attempt of increasing the money supply.

If a small open economy wants to maintain financial openness and monetary policy independence, it needs to give up the fixed exchange rate. For instance, if the central bank decides to ease monetary policy via lowering the policy rate to boost the domestic economy, capital will fly out to the higher yield foreign assets. Under the free float exchange rate, the increase in demand for foreign currency depreciates the domestic currency. In this case, the exchange rate will float to equilibrate the market for foreign currency exchange, and the central bank can maintain a credible monetary policy.

If a country decides to restrict international capital flows in and out, the interest rate will not be set by international interest rates but by the domestic market. It is like a traditional closed economy IS-LM framework. Therefore, that country will fix the exchange rate and maintain the monetary policy discretion.

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<sup>1</sup> The credible fixed exchange rate implies the equivalent of domestic and foreign interest rates where the differences are equal to the relative changes in the foreign exchange rate. This is called the uncovered interest rate parity condition.

I continue with the discussion of empirical literature for policy suggestions in the context of the trilemma policy with the combination of economic variables. Then I explain the evolving trilemma tendency throughout the business cycle, i.e., the behavior of trilemma policy after the global financial crisis.

## **1.2. Impossible Trinity Validity**

In this section, I mainly discuss the literature that confirms the validity of the trilemma policy – i.e., it is impossible to simultaneously choose among the three policy goals, which are a stable exchange rate regime, free capital mobility, and independent monetary autonomy; but the middle ground combination of these policies is also possible – which is what I prove in this paper. I also echo that the previous findings have served as policy guidance for decades. I begin with observations of the 1980s.

During the 1980s-1990s, in line with the Trilemma theory, the OECD countries allowed greater exchange rate flexibility with large private gross financial flows and the feasibility to exercise their monetary policy (Aizenman, 2019). The outcome was a rapid increase in financial instrument creation to hedge exchange rate volatility. Also, one might observe that with a lag, capital account liberalization induced current account deficit and surplus over time higher than the minor imbalances during the Bretton Woods system period.

Obstfeld et al. (2005) show that with the absence of capital control, pegs are aligned with less monetary independence, and non-pegs coexist with considerable monetary autarky. Moreover, under the peg exchange rate, local interest rates react quickly and have a stronger long-run relationship with the policy rate than the non-peg. After then, Aizenman et al. (2010) examine the effect of the impossible trinity policy mix<sup>2</sup>, in developing economies on a combination of, at most, two policies on economic outcomes. They find that (i) monetary independence distracts output volatility, but a more stable exchange rate implies more output volatility where accumulating the international reserves can mitigate the situation (ii) higher monetary autonomy links to higher inflation levels while a high level of exchange rate stability and financial integration might lower the level of inflation (iii) the adopted policy for exchange rate stability and a medium level of financial development might increase output volatility, while greater financial openness and financial development should lower output volatility.

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<sup>2</sup> The combination of monetary autarky, exchange rate stability, and financial openness with two economic outcome policies.

Goh (2009) explains how Malaysia managed to hold the impossible trinity during and in the aftermath of the Asian financial crisis. In the crisis period, there was a surge of capital outflow from Malaysia, where the immediate policy response was to impose capital controls. By doing so, the Bank of Negara Malaysia (BNM) was able to keep the exchange rate in a narrow band and implement monetary policy to enhance economic sustainability. The BNM could lower interest rates to stimulate the economy without worrying about capital flight and currency volatility. After the recovery in 1999, the restrictions were gradually removed, yet the peg of Ringgit to USD was still in place. Again, Malaysia is now confronted with the trilemma issue whereby the country lost its sovereignty in using monetary policy for macroeconomic management. Since the monetary policy implementation was to keep the exchange rate fixed, the fiscal policy was pressured to achieve a better employment rate and better income level. As a result, the fiscal deficit was persistent from 1998. Then, on 21 July 2005, the BNM removed the peg and replaced it with a managed float regime.

Klein and Shambaugh (2015) work focused on rounding the corner of trilemma policy. Their paper confirms the impossible trinity under the intermediate binary choices of the trilemma policy variables. They argue that strong capital controls or floating exchange rates could allow an economy to maintain its monetary autarky. Nonetheless, partial capital controls do not allow a country to preserve high-level monetary control. A moderate level of exchange rate flexibility allows some room for monetary autonomy, particularly regarding emerging and developing countries.

Sun (2016) also examines the impossible trinity policy for China using “policy basket analysis<sup>3</sup>” and “policy sequence analysis<sup>4</sup>.” They impose four assumptions<sup>5</sup> that are aligned with the impossible trinity policy objectives. The first and second assumptions serve for the capital account and interest rate liberalization. If China wants to move to consumption-driven from the export-led growth model, the government should create an environment whereby SMEs can thrive by acquiring better loan rates. Meanwhile, individual savers need to spend more so the deposit rate should be elevated. The third and fourth assumptions suggest the managed floating exchange rate with a wider band.

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<sup>3</sup> Analysis of China’s economy in the context of interest rate liberalization, capital account liberalization, and peg exchange rate with wider band.

<sup>4</sup> Provision of specific sequences for realizing the recommended policy baskets.

<sup>5</sup> This policy suits China’s case under four assumptions (i) Chinese financial and banking sectors should be reformed to be more competitive and profitable (ii) Chinese’s economic growth model should be transformed from an export-led to consumption-driven (iii) China should have a sizable exporting sector and (iv) RMB as now the international currency should not reach the same extent as U.S. Dollar in the currency internationalization.

## 2. Exchange Rate Regime

An exchange rate regime reflects the management by a nation of its currency in the foreign exchange market. It also plays an essential role in a country's monetary policy. According to the IMF classifications<sup>6</sup>, there are ten categories of exchange rate classifications - no separate legal tender, currency board, conventional peg, stabilized arrangement, crawling peg, crawl-like arrangement, pegged exchange rate within horizontal bands, other managed arrangement, floating, and free-floating. However, the choice of the exchange rate may be relevant to sectoral diversification and external shock. (Chowdhury, Bhattacharya, Mallick, and Ulubaşođlu, 2014). Countries facing greater external shock might adopt a flexible regime; nonetheless, countries with a high level of corruption and lower levels of diversification may choose a fixed regime instead to shield it from international competition.

Furthermore, many studies have been conducted surrounding the discussion on the de facto and de jure exchange rate regimes. Some critical research questions of those empirical analyses focus on which factors induce a de facto peg and why countries enforce a peg but do not announce it. According to Carmignani et al. (2008), a stable socio-political environment and efficient political decision-making are key factors for choosing an exchange rate regime. However, policymakers seem somewhat concerned with regime sustainability rather than economic and socio-political fundamentals.

One might argue that to promote growth, an economy should be market-based and allow free capital movement with sound financial infrastructure. The cost associated with having a flexible exchange rate may be lower than the benefits in such a case. Indeed, a flexible regime supports the market-based economy with trade liberalization. However, a fixed regime choice might be appropriate for small economies where monetary policy independence is hard to achieve.

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<sup>6</sup> Exchange Arrangements and Exchange Restrictions 2019



## Chapter 3

### **Impossible Trinity Analysis - The Choice of Exchange Rate Regime Empirical Evidence from Multinomial Logit Model**

#### **1. Introduction**

Validating the trilemma paradigm remains a challenge. The combinations of the three policy options are possible; nonetheless, mismanagement of them leads to the severe economic downturn as an example of the Asian financial crisis. Those relevant countries neglected the impossible trinity policy while maintaining capital flows, monetary policy independence, and peg exchange rate regime. The impact was severe as their foreign reserves emptied and currency collapsed.

As no many papers have empirically verified the trilemma by examining the choice of exchange rate regime using the interaction of financial integration and monetary independence, this paper has contributed to this policy lack. Concerning the financial integration or capital mobility, both de jure and de facto measurements are employed to mitigate the limitations, which are gaps between actual and government regulatory aspects. To validate this hypothesis, I use multinomial logit models over 171 countries from 1999 to 2016 with the categorical exchange rate regime as the dependent variable. The data is also categorized into three income groups: low, middle, and high.

#### **2. Literature Review**

##### **2.1. The Trilemma Suggests Essential Policy Guidance**

Obstfeld et al. (2005) show that with the absence of capital control, pegs are aligned with less monetary independence, and non-pegs coexist with considerable monetary autarky. Moreover, under the peg exchange rate, local interest rates react quickly and have a stronger long-run relationship with the policy rate than the non-peg. After then, Aizenman et al. (2010) examine the impossible trinity policy mix<sup>7</sup> in developing economies on combining at most two policies on economic outcomes. They find that (i) monetary independence distracts output volatility, but a more stable exchange rate implies more output volatility where accumulating the international reserves can mitigate the situation (ii) higher monetary autonomy links to

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<sup>7</sup> The combination of monetary autarky, exchange rate stability, and financial openness with two economic outcome policies.

higher inflation level while the high level of exchange rate stability and financial integration might lower level of inflation (iii) the adopted policy for exchange rate stability and a medium level of financial development might increase output volatility, more financial openness and financial development should lower output volatility.

Klein and Shambaugh (2015) work on rounding the corner of trilemma policy. Their paper confirms the impossible trinity under the intermediate binary choices of the trilemma policy variables. They argue that strong capital controls or floating exchange rates could allow an economy to maintain its monetary autarky. Nonetheless, partial capital controls do not allow a country to preserve high-level monetary control. The moderate level of exchange rate flexibility allows for some room for monetary autonomy, particularly regarding the emerging and developing countries.

## **2.2. Criticism of Trilemma Policy after the Financial Crisis**

The Trilemma framework has been criticized for not reflecting the actual circumstances that some of the East Asian countries over the past decade could keep open capital markets, the monetary policy discretion, and some degree of exchange rate movement (Grenville 2011). Those countries are Singapore and Malaysia, allowing free capital flow with interest rate differential and managed float exchange rate. They try to increase the FX reserve holdings by running the interest rate level to what they need. They have to intervene heavily to resist the significant exchange rate volatility to keep it in a manageable band.

There is also a lack of model specification on suitable instruments to tackle financial stability due to capital flight crises in the context of the trilemma policy goal after the financial turmoil of the 1990s (Aizenman 2019). This is known as the transformation into a quadrilemma where policy instruments have been added. Concisely, the emerging economies' policy has converged to the trilemma middle ground consisting of the managed-floating regime, low level of financial openness, and feasible but limited monetary policy. He suggests the critical policy instruments to cope with financial stability, including international reserves management, swap transactions among central banks, and macroeconomic prudential regulations.

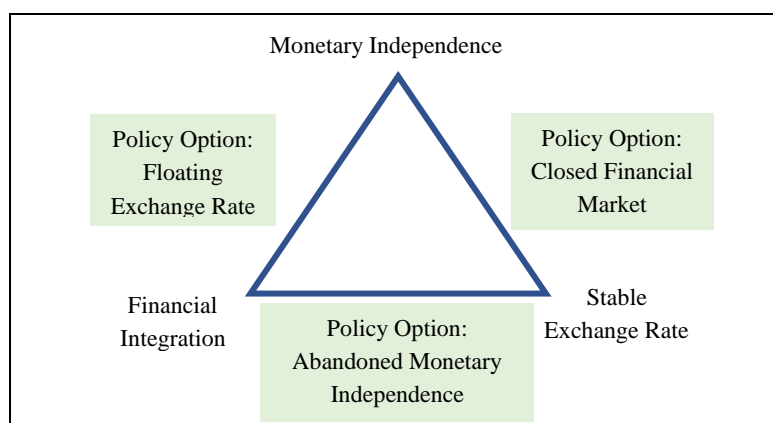
After the global financial crisis, the trilemma has been transformed into a dilemma or irreconcilable duo (Rey 2015). Indeed, monetary independence is possible if and only if under a well-managed capital account regardless of the exchange rate regime. In the international financial system, the global financial cycle determinants are the monetary policy of an

important economy that impacts global banks’ leverage, capital flows, and credit growth. To cope with that cycle and the dilemma, the author suggests some policy options (i) managing capital controls, (ii) monitoring credit growth and leverage by applying macroprudential policies (iii) imposing limits on leverage for financial intermediaries.

### 2.3. Impossible Trinity

The trilemma implies that since only two out of the three objectives can be attainable, policymakers need to choose which one to give up. The following “Trilemma Triangle” explains those policy choices. First, the “floating exchange rate” is aligned with financial integration and monetary autonomy – the choice of the U.S in the last five decades. Second, the “closed financial market” coexists with monetary autarky but stable exchange rate – the developing countries’ trilemma policy in the 1980s. Third, the “giving up monetary independence aligns with peg and financial openness – the choice of countries forming the currency union. The trilemma does not say that if you have a floating rate and an open capital account, you can be insulated from foreign monetary policy (i.e., interest rate) shocks. Besides, monetary policy may be used to influence the size and nature of the shock. Still, it is unlikely that it can completely offset all effects of the international financial shocks.

**Figure 3.1 Trilemma Triangle Diagram**



Source: Author

### 2.4. Exchange Rate Regime Classifications

Many economists classify exchange rate regimes according to what countries act – de facto – and the announced policy – de jure (Obstfeld et al. 2005; Reinhart and Rogoff 2004). However, the problem is the mismatches between the official reporting and prevailing exchange

rate arrangements. First, the actual exchange rate is more stable than the policy announcement. Second, if a government reports the pegged regime but they could not implement it as the peg exchange rate needs more frequent foreign exchange market intervention to limit actual variability. It is worth mentioning that, according to Yagci (2001), a more stable exchange rate regime is favorable by the countries in the European Union, dollarization economies, and countries with low policy credibility.

Given these reasons, “de facto” might be the better exchange rate classification to capture the related economic activities. Hence, in this paper, I apply two de facto classifications: (i) the IMF and (ii) Ilzetzki, Reinhart, and Rogoff.

#### 2.4.1. IMF Exchange Rate Arrangement (De Facto – IMF)

**Table 3.1 De Facto IMF Classification Regimes**

IMF Code	Reclassification Code	Definition
1	1	Exchange arrangement with no separate legal tender
2	1	Currency board arrangement
3	1	Conventional pegged arrangement
4	2	Stabilized arrangement
5	2	Crawling peg
6	2	Crawl-like arrangement
7	2	Pegged exchange rate within horizontal bands
8	3	Floating
9	3	Free-floating
10	N/A	Other managed arrangement

Note: For the reclassification code, 1 is for peg, 2 if intermediate, and 3 if float.  
Source: IMF Exchange Rate Arrangement (Last revision in 2009)

The IMF staff examines the de facto exchange rate classification based on the member’s actual arrangement, which is different from the government’s announcement. This classification is ranked according to the degree of flexibility and exchange rate paths for both formal and informal commitments. The IMF revised the system classification in early 2009, particularly on the de facto system.<sup>8</sup>

<sup>8</sup> The important changes include: i/ using floating and free floating with better definitions instead of managed and independent floating ii/ specifying the difference between fixed and crawling pegs, and all arrangements regarding

To fit the model specification in this paper without losing its originality, I reclassify this exchange rate arrangement into three categories: (1) if peg; (2) if intermediate, and; (3) if float. From “no separate legal tender” to “conventional pegged” regimes, I classify them as “peg.” From “stabilized arrangement” to “pegged exchange rate within horizontal bands” regimes, they are classified as “intermediate” regime. The last regime is “float,” which is categorized from “float” to “free float.” I drop the “other managed arrangement” regime as it cannot fall into any of this three-category.

#### **2.4.2. Ilzetzki, Reinhart, and Rogoff Classification (De Facto – IRR)**

This classification was first established by Ilzetzki, Reinhart, and Rogoff in 2004 and was updated in 2017. This approach is well-known as de facto as it is based on exchange rate variability by incorporating FX markets and country chronologies. In 2017, the authors extended their work by addressing (i) the anchor or reference currency classification, (ii) the inflation targeting classification, and; (iii) the Eurozone countries’ treatment.

Table 2 provides the full scheme of the exchange rate regime and the numeric classification. The lower numbers indicate less exchange rate flexibility. For simplicity, I reclassify their exchange rate regime classification into three-way: (1) if peg; (2) if intermediate, and; (3) if float. From “no separate legal tender” to “de facto peg” regimes, I classify them as “peg.” Under these regimes, the host country normally pegs its currency to one another, or another country's currency circulates as the sole legal tender (formal dollarization), from “pre-announced crawling peg “moving band < +/-1%” to “moving band (< +/-2%) by allowing both appreciation or depreciation”, these regimes are classified as intermediate.

Last but not least, from “managed float (de facto moving band +/-5%)” to “freely falling,” these regimes are classified as “float”; since by construction, the authors choose only the countries which are most transparently floating. I also include “freely falling” in the “float” category because the authors assume, under this regime, the 12-month inflation is greater than 40% for a 5-year window<sup>9</sup>. I drop the “dual market (parallel market data is missing)” regime as it has no clue whether it falls into which category. In other words, in a dual exchange rate

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the peg-like or crawl-like iii/ improving the classification to be more transparent based on rules and specific information with clearer circumscribed role for analysis. (Kokenyne et. al. 2009:7)

<sup>9</sup> The 12-month inflation for 5 years (i.e. year t and the preceding 4 years) is greater than 40%. This hyper-inflation could lead to a huge depreciation on exchange rate. Also, the authors called it as “free-falling”.

system, currencies can be exchanged in the market at both fixed and floating exchange rates. Moreover, it can be a temporary solution for some countries when they are in crisis.

**Table 3.2 De Facto Ilzetzki, Reinhart, and Rogoff's Classification**

IRR Code	Reclassification Code	Definition
1	1	No separate legal tender or currency union
2	1	Pre announced peg or currency board arrangement
3	1	Pre announced horizontal band that is narrower than or equal to +/- 2%
4	1	De facto peg
5	2	Pre announced crawling peg; de facto moving band narrower than or equal to +/-1%
6	2	Pre announced crawling band that is narrower than or equal to +/- 2% or de facto horizontal band that is narrower than or equal to +/-2%
7	2	De facto crawling peg
8	2	The de facto crawling band that is narrower than or equal to +/-2%
9	2	Pre announced crawling band that is wider than or equal to +/-2%
10	2	The de facto crawling band that is narrower than or equal to +/-5%
11	2	The moving band that is narrower than or equal to +/-2% (i.e., allows for both appreciation and depreciation over time)
12	3	De facto moving band +/-5% / Managed floating
13	3	Freely floating
14	3	Freely falling
15	N/A	The dual market in which parallel market data is missing.

Note: For the reclassification code, 1 is for peg, 2 if intermediate, and 3 if float.

Source: Ilzetzki, Reinhart, and Rogoff Classification (2017) and author's reclassification code

## 2.5. Financial Integration

Financial integration/openness is often associated with a higher economic growth rate, but the degree of openness varies across countries. It also reflects the approach towards regulating the policy on foreign investment as well as the capital flows of an individual country. It is important for a developing country to maintain some level of control in which the decision depends on their economic activities and internal policies. In this paper, I use two financial integration measurements – (1) de jure – Chinn and Ito (2018) that attaches to the government's policies and (2) de facto – Lan and Milesi-Ferretti (2017) that measures the macroeconomic effects on capital control decisions. To mitigate the limitations of each type, in this paper, I apply both of them.

### 2.5.1. De Jure - Chinn and Ito Index (KAOPEN)

Chinn and Ito calculate KAOPEN based on the IMF Annual Report on Exchange Arrangements and Exchange Restrictions (AREAER) 2017. The index consists of the information on a country's regulatory restrictions on cross-border financial transactions as of the end of 2016, and it focuses on regulatory aspects<sup>10</sup> of a country's degree of capital account openness.

The KAOPEN index, by its structure, measures the "extensity" of capital controls. One might argue that this index may also be a good proxy of capital control intensity as its correlation with Quinn<sup>11</sup> (1997, 2003) index is 83.9% (Chinn and Ito 2008). KAOPEN index is normalized from 0 to 1. The higher values indicate a higher degree of cross-border capital account openness. Two merits of this de jure index are measuring the intensity of capital control and capturing a wide range of the dataset.

### 2.5.2. De Facto-Lane and Milesi Ferretti (LMF)

Lane and Milesi Ferretti (2017) present the latest data to calculate this index. They use the standard decomposition of assets and liability shown in the balance of payment version 6.

I calculate the index using the following formula:

$$LMF\ Index = \frac{Total\ Assets + Total\ Liabilities}{Nominal\ GDP} \quad (3.1)$$

where

- Total Assets = Portfolio Equity Assets + FDI Assets + Portfolio Debt Assets + FX Reserves Minus Gold
- Total Liabilities = Portfolio Equity Liabilities + FDI Liabilities + Portfolio Debt Liabilities
- The higher the value, the more open of an economy to international/cross-border capital flow.

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<sup>10</sup> KAOPEN is constructed based on four main categories – i/ the presence of multiple exchange rate, ii/ restrictions on current account transactions, iii/ restrictions on capital account transactions, and iv/ the requirement of the surrender of export proceeds.

<sup>11</sup> According to Quinn (1997), this measure evaluates the intensity of the government policies by regulating financial transactions across time.

## 2.6. Monetary Independence (MI)

Many works of literature explain the independence of the monetary policy of one country as the freedom of the central bank to set the policy rates (Shambaugh 2004; Obstfeld et al. 2005; Aizenman et al. 2008, 2010, 2011). Hence, to test the trilemma hypothesis, the common method is to estimate the correlation level between short-term interest rates across countries then test their strength with the exchange rate movement and capital account openness.

In this paper, I consider the Chinn and Ito index as the monetary policy variable. It is constructed as the measurement of the yearly correlation of monthly interest rates between home and base country.<sup>12</sup> The index value is normalized to be from 0 to 1. The higher value of the index presents more monetary independence or a better position for policymakers to stabilize the economy through monetary policy tools. Chinn and Ito retrieve the data from the International Financial Statistics and Bloomberg.

## 3. Research Methodology and Data

### 3.1. Research Methodology

This paper discusses the validity of impossible trinity by assessing the determinant of the exchange rate regime in relation to monetary independence and financial openness. For this purpose, the multinomial logit model is used.<sup>13</sup> In the model, the exchange rate regimes are the categorical dependent variable with three alternatives. Several pieces of literature also apply a multinomial logit model to study the appropriateness of exchange rate regime choices (Aşıcı 2011<sup>14</sup>; Ondina et al. 2011<sup>15</sup>; Aliyev 2014<sup>16</sup>). I use the lagged controlled variables in this model

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<sup>12</sup> The base country is the home country's monetary policy with which it closely links. Those countries are Australia, Belgium, France, Germany, India, Malaysia, South Africa, the United Kingdom, and the United States. The IMF's AREAER and Central Intelligence Agency (CIA) Factbook determine those countries.

<sup>13</sup> This regression analysis is conducted when the dependent variable has more than two levels. For a nominal dependent variable with  $j$  categories, it is better to apply the multinomial logit model as it is able to estimate only  $j-1$  logit equations while the binary logit model needs to regress  $j$  equations.

<sup>14</sup> The author uses multinomial logit model to study on the appropriate choice of exchange rate regime into the standard early warning crisis framework.

<sup>15</sup> Multinomial logit model is used in a panel data set to determine the suitable exchange rate regimes. They also reclassify the exchange rate into three regimes which are fixed, intermediate, and flexible.

<sup>16</sup> The author mentions that multinomial logit model is the most applicable method in the context of discrete choice analysis and the dependent variable is categorical with more than two alternatives.



since the determination or decision of this period exchange rate regime is according to previous period economic activities.

I construct the model as the following:

$$ERR_{i,t} = \beta_1 + \beta_2 FI_{i,t-1} + \beta_3 FI_{i,t-1} * MI_{i,t-1} + \beta_4 FI^2_{i,t-1} + \sum_{k=1}^6 \theta_k X_{i,t-x} + \epsilon_{i,t} \quad (3.2)$$

where

- $i$ : different countries in the panel setting
- ERR: the exchange rate regimes, the categorical dependent variable where equals 1 if peg; 2 if intermediate; and 3 if float. Intermediate, 2, is the baseline regime.
- MI: monetary independence of the central bank. Chinn and Ito calculated this index.
- FI: financial integration (openness) – Chinn and Ito (KAOPEN-de jure) and Lan and Milesi-Ferretti (LMF-de facto).
- $X$ : a vector of other control variables that are expected to influence the exchange rate regime:
  - SIZE: logarithm of real GDP
  - TRADE: the ratio of the average of exports plus imports to GDP
  - TOTSH: standard deviation of the terms of trade (export as the capacity to import) over the previous five years
  - INF: inflation rate
  - MINEXP: share of mineral export to total export
  - MoI: total reserves in months of imports
  - ASEAN: the dummy variable for ASEAN countries, 1 if ASEAN and 0 if non-ASEAN.
- $\epsilon_{it}$ : the error term with standard properties
- $FI_{t-1} * MI_{t-1}$ : the cross-term between the degree of financial openness and monetary independence that explains the impossible trinity validity.
- $x$  exhibits the number of lags. I apply a 1-year lag for all the regressors except TOTSH and INF as I suspect that they might have reverse Granger causality with ERR. Table 3 presents the suggested number of lags for TOTSH and INF to solve this problem. The lag-specification varies according to the data set of each income group. For example, for full-sample estimation, we need to include 2 year-lag for TOTSH to avoid the Granger causes from ERR to TOTSH. If we compare across samples, the lags are up to four years for TOTSH and seven years for INF. This comes with economic intuition. If there is a shock to term of

trade or high and persistent inflationary pressure in the medium term, the central bank may decide to adjust the exchange rate level to absorb that disturbance.

**Table 3.3 Result of Granger Causality Test - Report on Number of Lags**

Null Hypothesis	Full sample	High-income	Middle-income	Low-income
INF does not GC IMF_ERR	1 (0.068)	7 (1.000)	1 (0.878)	1 (0.023)
IMF_ERR does not GC INF	1 (0.193)	7 (0.942)	1 (0.864)	1 (0.389)
TOTSH does not GC IMF_ERR	3 (0.943)	1 (0.664)	4 (0.778)	1 (0.897)
IMF_ERR does not GC TOTSH	3 (0.257)	1 (0.685)	4 (0.346)	1 (0.187)
INF does not GC IRR_ERR	1 (0.003)	5 (0.710)	1 (0.087)	1 (0.018)
IRR_ERR does not GC INF	1 (0.447)	5 (0.238)	1 (0.336)	1 (0.984)
TOTSH does not GC IRR_ERR	2 (0.000)	1 (0.878)	2 (0.000)	1 (0.723)
IRR_ERR does not GC TOTSH	2 (0.402)	1 (0.864)	2 (0.724)	1 (0.576)

Note:

- IMF\_ERR: IMF exchange rate classification
- IRR\_ERR: Ilzetzki, Reinhart, and Rogoff Classification
- GC: Granger cause
- The number in the bracket represents the p-value. If the p-value < 0.1 or 10%, we reject the null hypothesis.

- $\theta$  is the parameter of the six controlled variables.

### 3.2. Data

I mainly retrieve annual data for 171 countries from the IMF Annual Report on Exchange Arrangements and Exchange Restrictions (IMF-AREAER) and the World Bank Development Indicators (WDI) for the period from 1999 to 2016. The data sources are described in Table 4.

Given 18 years and 171 countries, the total number of observations should be 3,078. However, due to 1,237 missing observations in TOTSH then there are only 1,841 observations available. The observations shown in the regression outcomes are smaller than they should be.

### 3.3. Variable Behavior

In this section, I discuss the expected result for each explanatory variable by providing the relevant literature as the followings:

**Table 3.4 Statistical Summary for Full Sample**

Variable	Description	Obs	Mean	Std. Dev.	Min	Max
IMF	De facto IMF Exchange rate arrangement (2017)	2,899	2.0289	0.9261	1	3
IRR	De facto Ilzetzi, Reinhart and Rogoff Exchange rate arrangement (2017)	3,071	1.6720	0.6721	1	3
FI	Chinn-Ito FI index	2,989	0.5302	0.3728	0	1
	Lane Milesi-Ferretti FI index	2,894	5.0770	20.6747	0.07	370.88
MI	Monetary Independence Index	2,901	0.4153	0.2159	0	0.96
SIZE	Logarithm of GDP	3,016	24.1158	2.2866	18.603	29.8823
TRADE	Ratio of [export + import]/2 to GDP	2,430	0.4420	0.2759	0.0008	2.18
TOTSH	Term of trade volatility, standard deviation of the logarithm of terms of trade over the previous five years weighted by the degree	1,841	0.3416	0.4114	0.0120	4.2918
INF	Inflation	2,921	6.5689	18.7061	-18.11	513.91
MINEXP	Share of mineral export to total export	3,056	1.1133	1.2560	0.0126	14.2623
MOI	Total reserves in months of imports	2,689	4.7863	5.0568	0.0101	79.2372

- **SIZE:** An increase in GDP tends to increase the propensity in choosing float (Ondina et al. 2011). The large GDP economies might involve a lot of economic activities that are normally associated with different disturbances or even vulnerable to external shocks. To deal with this unpredictable situation, large economies might adopt a floating exchange rate regime aiming to absorb and eliminate those harmful impacts (Edwards and Yeyati 2005). Also, the large economies could be large exporters or important global financial market players who might encounter different types of risks, including financial risks or

currency mismatches. On top of that, more exchange rate flexibility is associated with the reduction of currency mismatch (Gadanecz and Mehrotra 2013).

- **TRADE:** The floating regime discourages trading activities. If a country allows the exchange rate to be highly volatile, the profit margin from imports or exports will face uncertainty. Given this reason, for some countries that their profit margin is already small, they rather tend to stabilize their exchange rate.
- **TOTSH:** It is measured by the term of trade volatility, i.e., the standard deviation of the term of trade changes over the last five years. If the incidence of real shock becomes more significant, the propensity in choosing a floating exchange rate regime increases. Indeed, the economic shock can be defined as an unanticipated shock on the supply or demand side. This phenomenon could be explained in the Asian Financial Crisis, where Thailand gave up the peg exchange rate regime to absorb shock (Broda 2004).
- **INF:** High inflation level aligns with the floating exchange rate regime, or lower inflation degree indicates greater exchange rate stability. Many studies show that high exchange rate stability is linked to lower inflation (Aizenman et al. 2011; Alogoskoufis and Smith 1991).
- **MoI:** High international reserves coexist with a high propensity to choose peg since the main purpose of holding high reserves might be for frequent FX intervention to maintain the exchange rate at a certain level. Those countries with a fixed exchange rate regime need to have higher international reserves because the exchange rate cannot absorb the shocks.

#### **4. Results:**

It is important to mention once again that there are three categorical dependent variables – 1 if peg, 2 if the intermediate (baseline), and 3 if float. I interpret the outcomes by reading the sign of point estimates. For instance, if it is positive, the propensity in choosing the peg or float to intermediate regime increases and vice versa if the coefficient is negative. Since the IMF classification results are good enough to represent the IRR classification, I only discuss them in the following subsections and leave the IRR classification results to appendix A. To keep the discussion more concentrated, I only focus on de facto – FI while leaving the outcomes under de jure – FI to the appendix for references.

For the robustness check, I also regressed all the four samples using the binary logit model, where the intermediate regime is the baseline. I got the same sign of estimates to what under the multinomial logit regressions.

#### 4.1. Full Sample

##### **First Comparison: Pegged Regime Relative to Intermediate Regime under the IMF Classification and De Facto – FI (Table 3.5)**

- The coefficient of FI is positive, which suggests that a high degree of financial integration is aligned with a peg. This result might be the case of some countries that still fear to float the exchange rate while allowing free capital movement.
- The important term that explains the trilemma condition is the interaction between financial openness and monetary independence, FI\_MI. The coefficient of FI\_MI is negative, meaning that large MI and FI coexists with the propensity in adopting intermediate where this outcome is consistent with the impossible trinity hypothesis.
- The coefficient of TOTSH is positive. The high level of the term of trade volatility coexists with the high propensity in choosing peg.
- The coefficient of INF is negative. The high inflation level is associated with an intermediate regime. High inflation countries would choose to float their exchange rate. According to the purchasing power parity theorem and the law of one price, with the appropriate exchange rate level, every consumer in any location should have the same purchasing power. With this regard, if one economy has a high inflation level, the exchange rate will adjust more frequently to stabilize the purchasing power.
- The coefficient of MINEXP is positive; a high level of mineral export is associated with a peg, or large mineral exporters would peg their exchange rate.
- The sign of the coefficient of MoI is negative, meaning that high international reserves are associated with the intermediate regime.
- The coefficient of ASEAN is negative, suggesting that the ASEAN countries adopt an intermediate regime. This outcome is in-line with the middle-income section finding that most of the ASEAN countries are classified as middle-income (i.e., lower and upper-middle-income).

##### **Second Comparison: Floating Regime Relative to the Intermediate Regime under the IMF Classification and De Facto – FI (Table 3.5)**

The FI coefficient is positive; the high degree of financial openness is associated with the floating regime. The free capital movement might encounter vulnerabilities from a sudden stop of capital inflow or the capital outflow surge. According to Edwards and Yeyati (2005), the

more flexible exchange rate can absorb those shocks. For this part, we do not get consistent results with the first comparison. This outcome suggests that countries with a high level of FI in this group might adopt a different exchange rate regime.

The coefficient of FI\_MI is negative, meaning that large FI and MI coexist with intermediate. We got the same conclusion as of the first comparison. The coefficient of SIZE is positive. The high GDP level is associated with the propensity of choosing float. The coefficient of TRADE is negative. The large share of trade to GDP coexists with intermediate. The coefficient of INF is negative; the higher inflation level is concerning the intermediate regime. The coefficient of MoI is negative; the high level of international reserve is associated with intermediate. To maintain the exchange rate level in a band, the central bank can conduct FX intervention more frequently; thus, the international reserves increase. Under full sample estimation, countries with a high degree of FI and MI prefer the intermediate regime, which is the middle ground of the peg and float. However, since the results of FI under the two comparisons are not consistent, I might be able to conclude that regardless of the FI level, different countries adopt different exchange rate regime.

I get consistent results from the previous literature, as explained in the expected variable behavior section for SIZE and TRADE. Countries with high GDP levels tend to choose a more flexible exchange rate, and the large share of trade to GDP coexists with a more stable regime. For TOTSH, INF, MINEXP, and MoI are quite different. The coefficient of TOTSH is positive and significant only under the first comparison. This means the high degree of term of trade volatility is associated with a more stable exchange rate regime. Countries holding large international reserves and persistently high inflation levels might adopt an intermediate regime. Countries with a high share of mineral exports to total exports tend to peg their exchange rate.

#### **4.2. Low-income Economies**

I report the regression results under the low-income sample in Table 3.5. The coefficient of FI is negative and significant, only under the first comparison, suggesting that the high level of financial integration coexists with an intermediate regime. As the coefficient of  $FI^2$  is positive and significant at 10%, there should be a quadratic relation between the exchange rate regime and financial integration. First, the exchange rate moves from peg to intermediate, then from intermediate to peg as FI increases. To the best of my knowledge, it is rare to find papers in this area incorporating the financial openness in quadratic form. Hence, this finding should be a

critical contribution to the literature. Regarding the MINEXP, countries with a large share of mineral exports to total exports tend to adopt an intermediate regime. However, I could not get consistent results for the MoI as under the peg versus intermediate; the result is peg; yet, under the float versus intermediate, it is float. This outcome might be proof of different policies for low-income countries with high international reserves level towards the choice of exchange rate regime. The negative coefficient of TOTSH under the second comparison means the high term of trade volatility is associated with an intermediate.

**Table 3.5 Regression Outcomes under IMF Classification and De Facto – FI**

<i>Controlled variable</i>	<b>Full Sample</b>		<b>Low-income</b>		<b>High-income</b>		<b>Middle-income</b>	
	1,089 Obs. and R <sup>2</sup> = 0.256		104 Obs. and R <sup>2</sup> = 0.566		488 Obs. and R <sup>2</sup> = 0.437		485 Obs. and R <sup>2</sup> = 0.281	
	<i>Peg</i>	<i>Float</i>	<i>Peg</i>	<i>Float</i>	<i>Peg</i>	<i>Float</i>	<i>Peg</i>	<i>Float</i>
L.FI	0.388***	0.501***	-103.13**	-6.564	0.283*	0.379**	0.590	-0.193
L.FI_MI	-0.473***	-0.698***	52.643*	-0.763	-0.241 <sup>+</sup>	-0.548***	-2.323***	-0.258
L.FI <sup>2</sup>	-0.001	-0.001	11.081*	5.250	N/A	N/A	0.019	0.041
L.SIZE	-0.097	0.351***	-6.107	-0.346	-0.649**	0.173	-0.173	0.486***
L.TRADE	0.495	-2.3066**	-24.491	-2.814	-1.328	-3.272***	0.818	-1.156
L.TOTSH	1.735***	-0.463	24.322	-5.808**	3.357*	-1.484	2.950***	0.643
L.INF	-0.071***	-0.046***	0.223	0.163***	-0.196**	0.022	-0.080**	-0.052***
L.MINEXP	0.314***	-0.046	-6.266*	-0.916***	1.468*	1.355*	0.814***	0.160
L.MoI	-0.042***	-0.071***	4.791*	0.431*	0.125	0.125*	-0.046	-0.025
ASEAN	-2.119***	-0.096	..	..	..	..	..	..

Note:

- L.: Lag operator. The decision on number of lags is based on the result of Granger causality tests. Theoretically, the TOTSH and INF might have reverse Granger causality with ERR. The specified lags in these regressions are to avoid this issue. TOTSH: lag 3 for full sample, lag 1 for low-income, lag 1 for high-income, and lag 4 for middle-income. INF: Lag 1 for full sample, lag 1 for low-income, lag 7 for high-income, and lag 1 for middle-income.

- The exchange rate regime (ERR) is the categorical dependent variable where intermediate is the baseline.

- Significantly different from zero at 80% (<sup>+</sup>), 90% (\*), 95% (\*\*), 99% (\*\*\*) confidence level.

- I dropped FI<sup>2</sup> from the high-income sample regression to solve the problem with "convergence not achieved" after running the MLOGIT model.

### 4.3. High-income Economies

Table 3.5 summarizes the choices of exchange rate regimes for the high-income economies. Under the first comparison, the coefficient of the interaction term is negative and significant at 20% level, which means the higher degree of FI and MI are associated with the intermediate regime. At least, this result can prove the theory of the impossible trinity. However, under the

second comparison, the coefficient of FI\_MI is negative and significant at 1%. This outcome proposes a higher propensity in choosing an intermediate regime rather than float where the FI and MI are at a high level. The intermediate regime is also the choice for the high GDP level, the share of trade to GDP, and inflation. The high term of trade volatility is in line with the peg, whereas the high level of international reserves is associated with the float. However, I got two results for MINEXP where the first is peg under the first comparison, and the second is float under the second comparison.

#### 4.4. Middle-income Economies

Table 3.5 captures the regression result for middle-income economies. Under the pegged regime as the dependent variable, with the high degree of FI and MI, these countries tend to choose an intermediate regime. The higher degree of TOTSH and mineral export are aligned with a peg. Under both peg and float, the high INF level is in-line with intermediate. Under a float, the large degree of SIZE is associated with a floating regime.

#### 4.5. Discussion on Impossible Trinity Results across All Samples

**Table 3.6 Summary of Impossible Trinity Results Across All Samples**

Underlined ERR	Full sample	High-income	Middle-income	Low-income
Peg vs Intermediate	Intermediate	Intermediate	Intermediate	Peg
Float vs Intermediate	Intermediate	Intermediate	Not significant	Not significant

Note: The majority of the regression results of the interaction term – FI\_MI – propose the intermediate regime as the choice.

I emphasize more on the impossible trinity results across all samples (Summary in Table 3.6). The regressions propose the intermediate regime if the level of monetary independence and financial openness are high. This middle ground exchange rate regime outcome is in-line with the economic condition evolving and consistent with Klein and Shambaugh (2015)'s finding. After the series of crises particularly the Asian Financial Crisis and Global Financial Crisis, most countries exhibit fear to float or purely peg. They also hold large FX reserves and intervene to keep the exchange rate in the manageable band. For instance, as argued by Grenvill



(2011), Singapore and Malaysia adopt managed float meanwhile, the capital moves freely with the interest rate differential.

## **5. Conclusion:**

This paper contributes to the literature of rounding the corner of policy trilemma argument, which is in line with the suggestion of Klein and Shambaugh (2015). I got consistent results for high- and middle-income groups where a higher degree of financial openness and monetary independence are in line with the higher propensity to choose an intermediate exchange rate regime. However, low-income economies do not hold the trilemma condition. The exchange rate regime that is associated with a high financial integration level varies according to different economies. Also, the low-income group's results propose the quadratic relation between the exchange rate regime and financial integration as the financial integration level increases.

Under the full sample estimation, I also got significant evidence for other controlled variables – log GDP, the share of trade to GDP, the term of trade volatility, inflation, the share of mineral exports to total exports, and total reserves in months of imports – that affect the choice of exchange rate regime. Countries with a high GDP level coexist with a more flexible exchange rate, whereas the floating exchange rate discourages trading activities. A high level of inflation and international reserves are in line with the intermediate regime. In contrast, a high level of the term of trade volatility and share of mineral exports to total exports are associated with the pegged regime.

Even though some outcomes of the controlled variables are still not consistent across all samples, most of them are well in line with economic intuition and empirical studies. These findings should serve as the critical policy guidelines for policymakers in choosing appropriate exchange rate regimes. Future studies on core monetary policy framework such that they are on the exchange rate, policy rate, and inflation targeting could be implemented by applying this research methodology where the researchers can specify categorical dependent variables and the three classifications of the dataset, which are low-, middle-, and high-income economies. However, the dataset for the low-income group is still limited. To deep down on this analysis, scholars might also incorporate variables on the structural break to capture the unexpected change in parameters and crisis dummies both the financial and business turmoil.

## Chapter 4

### **The Impact of Exchange Rate and Dollarization on the Balance of Payment in Cambodia: An Autoregressive Distributed Lag (ARDL) Approach**

#### **1. Introduction**

The exchange rate reflects the relative price of one currency to another at a specific time and links domestic prices with international prices. It is crucial in characterizing the monetary system in an economy. Indeed, the exchange rate regimes refer to the applied system of one economy in managing the exchange of a home currency with other currencies. More importantly, the exchange rate is a key determinant of any country's balance of payments (BOP) position. The judicious determination of the exchange rate level will serve as a nominal anchor for price stability. Also, the exchange rate movement impacts the demand and supply of goods, foreign direct investments, and ultimately employment.

Using the Cambodia dataset, this paper identifies the link of the real effective exchange rate (REER) and dollarization on the BOP. The controlled variables are REER, broad money growth rate, and the ratio of foreign currency deposits to total deposits as the dollarization indicator. I use the quarter dataset from 2008-Q1 to 2020-Q1 and conduct pre-statistical tests on all variables to avoid spurious regression. In line with variables' characteristics, I apply the autoregressive distributed lag (ARDL) model in the error correction form.

According to Berg and Borensztein (2001), a fully dollarized economy does not typically face BOP crises but is not exceptional to external crises. Dollarization encourages investment and involves low exchange rate risk as these two indicators limit the incidence of crisis. This paper provides an argument on dollarization from a different perspective. As Cambodia adopts a managed exchange rate regime and maintains the exchange rate level in the condition of high dollarization, the National Bank of Cambodia (NBC) might implement two primary operations. First, increasing the money supply via auctions in the foreign exchange market and liquidity providing collateralized operations (LPCOs) will bring the local currency interest rate down, encourage local currency loans, and lower the demand for foreign currency loans leading to the decline of bank lending from foreign banks. This operation will result in a decrease in BOP position as international reserves decline. Second, absorbing foreign currency is associated with

increasing international reserves, and BOP thus improves. By observing the data from NBC, the level of international reserves is rising with a high degree of dollarization.

There are three main contributions of this paper (i) the use of Cambodia's primary quarterly dataset, (ii) the implication of ARDL in the error correction form by incorporating the index of dollarization (iii) the key recommendations from the findings for regulators, particularly the central bank – the National Bank of Cambodia – to address the dollarization issue in the Cambodia economy.

## **2. Literature Review**

### **2.1. Exchange rate and the balance of payment (BOP) relationship**

Some studies examine the impact of exchange rate depreciation on the balance of payments in Nigeria:

- Odili (2014) uses the autoregressive distributed lag (ARDL) model with co-integration tests covering the period from 1971 to 2012. The author also confirms a positive long-term relationship between BOP and the exchange rate while the regression result is statistically insignificant for the short-term. The results suggest that devaluation improves the balance of payments and that the Marshall-Lerner (ML) condition subsists for the Nigerian context.
- Oladipupo (2011) proves the exchange rate depreciation can lead to an improvement of the BOP by using an ordinary least square method of estimation for 1970-2008. The persistent BOP deficits in Nigeria might be due to inappropriate allocation of domestic credit, fiscal indiscipline, and misuse of expenditure policies.
- Umoru and Odjegba (2013) analyze the relationship between exchange rate misalignment and BOP mal-adjustment in Nigeria from 1973 to 2012 applying the vector error correction model (VECM). The result of the study shows that exchange rate misalignment improves Nigeria's BOP position. The Nigerian government should implement economic policies that could enhance the appreciation of the Naira-USD exchange rate for possible favorable BOP effects.

Some further studies of other countries also embark on the relationship between exchange rates and balance of payments:

- Ahmad et al. (2014) use data from Pakistan from January 2007 to October 2013 by employing the autoregressive distributed lag model and Granger causality test. The authors assure a significant and positive relation between BOP and the exchange rate. They conclude

the stability of exchange rates might create a positive environment by encouraging trades which could improve the BOP.

## **2.2. Balance of payment crisis in a pegged exchange rate system**

As Cambodia adopts a pegged regime<sup>17</sup>, the lessons learned from BOP issues in such an exchange rate regime should be substantial. The evidence from Febrero and Bermejo (2018) shows that a BOP crisis occurs in a pegged exchange rate system when the government has no confidence in whether to hold enough international reserves to fund capital withdrawal to maintain the ongoing interest rate parity condition. An example of the Asian Financial Crisis in 1997 was when Indonesia and Thailand were most affected. This might be perceived as a BOP crisis since the foreign reserves of those countries depleted due to the aim of stabilizing the exchange rate level in the situation of a surge in capital outflows. Then, they moved to inflation targeting and adopted a float exchange rate system.

## **3. Overview**

### **3.1. Cambodia Dollarization Condition**

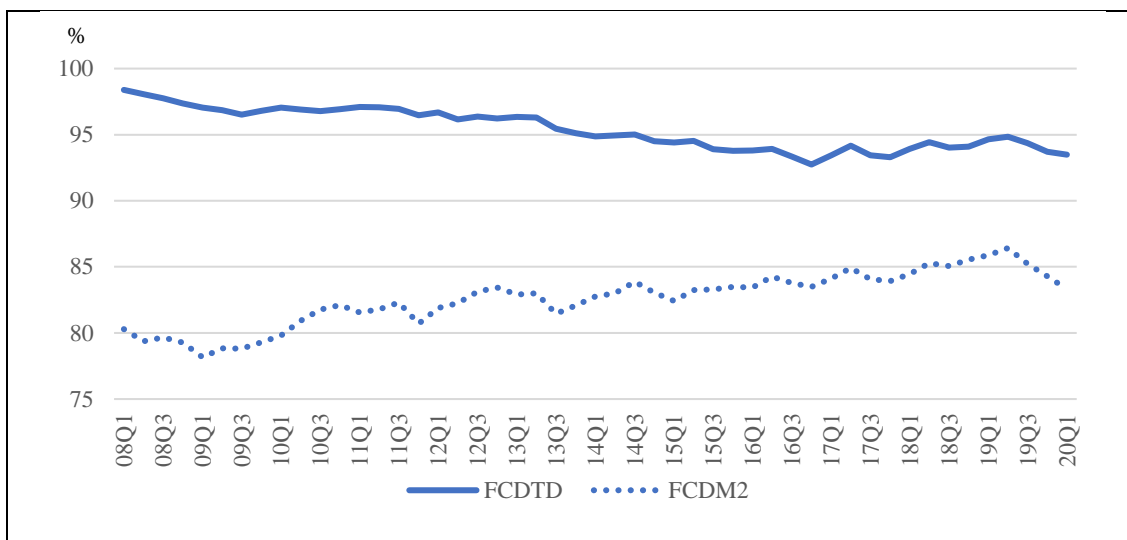
Cambodia experienced hyperinflation in the late 1980s and early 1990s when the country transitioned to a market-based economy. The unstable macroeconomic condition and political uncertainty contributed to local currency, Khmer Riel (KHR), depreciation (Samreth and Sok, 2018). The influx of the U.S Dollar (USD) due to the arrival of the United Nations Transitional Authority in Cambodia for the national election in 1992 also accelerated Cambodians use of USD widely across the country. From the first quarter of 2008 to the first quarter of 2020, the average share of foreign currency deposits to broad money (FCDM2) and the share of foreign currency deposits to total deposits (FCDTD) are 83 percent and 95 percent, respectively. These two indexes indicate the persistent high dollarization in Cambodia.

**Figure 4.1 Dollarization Indicators**  
**Q1 2008 - Q1 2020**

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<sup>17</sup> More detail is discussed in section 3.2.



Source: National Bank of Cambodia

### 3.2. Real Effective Exchange rate in Cambodia

The National Bank of Cambodia (NBC), the central bank, announces the exchange rate regime as the managed float, de jure exchange rate<sup>18</sup>. It intervenes in the foreign exchange market to achieve price stability and to maintain the exchange rate under the determined objective. The official exchange rate is announced twice per day. It is explicitly used for the transactions of NBC and its third parties and is also a benchmark for the private sector. However, the exchange rate behaves in a more stable manner than in more than a decade, particularly the Riel/USD rate. Moreover, the Riel/USD acts in a seasonal pattern where the lowest is in March and the highest is in August and September (Figure 3).

More importantly, to overview the strength of a country's price competitiveness, policymakers need to calculate the effective exchange rates (i.e., nominal and real), which are a summary measure of the changes in the exchange rates of a country vis-à-vis its trading partners. The indicator of real effective exchange rates considers changes in market exchange rates and variations in relative prices using consumer prices.

In the case of Cambodia, the real effective exchange rate is calculated the following:

$$REER = 100 * \pi \left[ E_i \left( \frac{P_i}{P} \right) \right]^{w_i} \quad (1)$$

where

- $\pi$ : the multiplication
- $E_i$ : the exchange rate (the ratio of Khmer Riels to other currencies)

<sup>18</sup> See: [www.nbc.org.kh/english/monetary\\_policy/exchange\\_rate\\_policy.php](http://www.nbc.org.kh/english/monetary_policy/exchange_rate_policy.php)

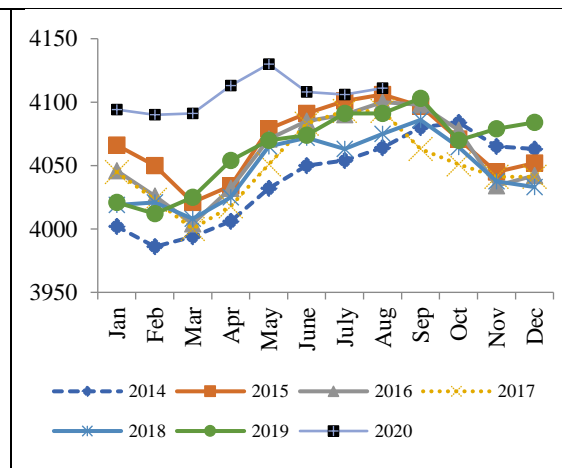
- $P_i$ : the consumer price index of foreign countries where 2010 is the base year
- $P$ : the consumer price index of Cambodia where 2010 is the base year
- $w_i$ : the weighted size of import and export of country  $i$

If the REER value increases meaning that the ratio of  $\frac{P_i}{P}$  at time  $t$  is greater than time  $t-1$ , Cambodia's competitiveness improves. In other words,  $P_i$  increases or  $P$  declines if compared to the previous period.

**Figure 4.2 Real Effective Exchange Rate Q1 2008 - Q1 2020**  
Index



**Figure 4.3 Monthly-end exchange rate movement, mid-point market rate (KHR/USD)**



Source: National Bank of Cambodia

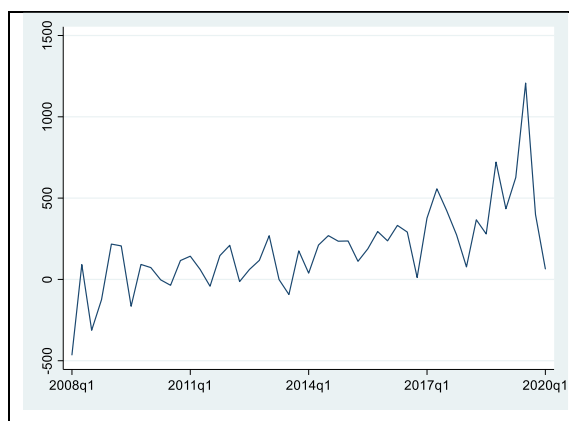
### 3.3. Balance of payment (BOP) position of Cambodia

For a specific period, the BOP records economic transactions with the rest of the world. The major components are the current account, financial account, and capital account. Imports are debits, and exports are credit. If credits are more considerable than debits, it is called the surplus current account balance. Otherwise, it is called the deficit current account balance. The financial account incorporates direct investment, portfolio investment, and other investments. The financial account balance is the net between financial assets and financial liability. The capital account consists of capital transfers and the acquisition/disposal of non-financial assets. The proportion of capital account is relatively small in calculating the overall balance. The BOP also helps to forecast a country's market potential in the short run.

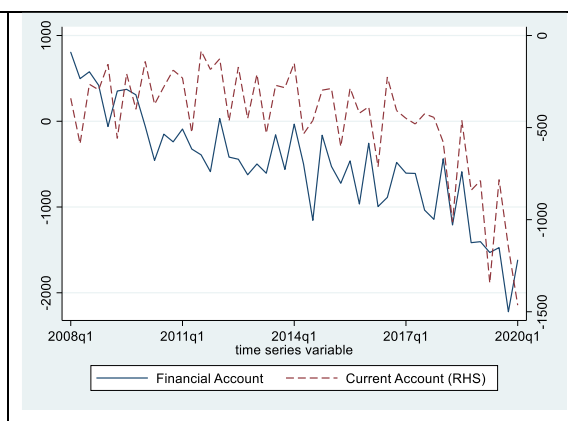
Using the analytical presentation of BOP, the overall balance (OB) is calculated as the following:

$$OB = CA + KA - FA + NEO = \Delta Reserves \quad (2)$$

**Figure 4.4 Overall Balance**  
in million USD, Q1 2008 - Q1 2020



**Figure 4.5 Current Account and Financial Account Balance**  
in million USD, Q1 2008 - Q1 2020



Source: National Bank of Cambodia

#### 4. Theoretical framework

There are three main approaches to examine the effect of exchange rate volatility on the BOP. They are the elasticity approach, the absorption approach, and the monetary approach. I describe those three approaches as follows:

- **The elasticity approach to BOP** emphasizes the trade balance and is established on the Marshall Lerner condition. If the sum of elasticities of demand for export and imports is greater than unity, the devaluation has a positive impact on BOP. If the sum is less than unity, the balance of trade should be improved by revaluation.
- **The absorption approach to BOP** assumes that devaluation would only positively affect the balance of trade if the propensity to absorb is lower than the rate at which devaluation would induce increases in the national output of goods and services. The principle of this approach is to argue that the favorable result of price elasticity might not be good enough to capture the BOP effect resulting from devaluation if that devaluation does not reduce domestic expenditure.
- **The monetary approach to BOP** restores the equilibrium of the BOP. One might need to consider the appropriate level, or the equilibrium of money demand and supply, which could

be explained by variables such as income level, interest rates, domestic and foreign price levels, and exchange rates. In addition, the depletion of international reserves, which reflects the imbalances of the prevailing money market condition, could deteriorate the BOP position. The author also argues that if the central bank increases the money supply in the fixed exchange rate system, the foreign reserves would be used up as expenditure in the form of increased purchasing of foreign assets by domestic residents. To respond to the depletion of reserves, the central bank will buy foreign currency to accumulate reserves and improve the BOP position.

## **5. Research Methodology and data**

### **5.1. Model Specification**

In this paper, I mainly use the monetary approach as it captures the current state of the BOP well. As there is no quarterly income level (i.e., GDP or GDP per capita) dataset for Cambodia yet, I do not include it in this model. However, to improve the adjusted  $R^2$ , I incorporate the broad money growth (M2G), dollarization index, and year dummies in the regression.

I use IMF data for the overall balance and obtain the primary dataset for REER, M2G, and the dollarization index from the National Bank of Cambodia on a quarterly frequency. Since I will apply time-series data, checking for stationarity is preliminary and essential to avoid spurious results. A series of studies proved that by including the  $I(1)$  series in the standard regression models, the variable relationship sometimes yields statistically significant impacts due to randomness (Grant and Lebo, 2016). To check unit-roots, I use three methods which are Augmented Dickey-Fuller (ADF), Dickey-Fuller GLS (ERS), and Phillips-Perron. Table 4.1 and Table 4.2 present the unit root test results for all variables with level and first different, respectively. All variables are  $I(1)$ <sup>19</sup>.

Figure 4.6 shows a correlation between the dependent variable (overall balance) and the controlled variables – the real effective exchange rate, broad money growth rate, ratio of foreign currency deposits to total deposits, and KHR market interest rate. So, I suspect those  $I(1)$  series might be cointegrated.

The autoregressive distributed lag model (ARDL) is the major workhorse in dynamic single-equation regressions. A particular attractiveness of the ARDL model is when it is in error-correction (EC) form. Its popularity in applied time series econometrics has increased further since it turned out for nonstationary variables that co-integration is equivalent to an error-

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<sup>19</sup>  $I(1)$  means stationary at first difference.



correction mechanism<sup>20</sup>. By differencing and forming a linear combination of the nonstationary data, all variables are transformed equivalently into an EC model with stationary series only.

**Table 4.1 Unit Root Tests  
For the variables in level**

	OB	REER	M2G	FCDTD
Augmented	t-stat.: -0.76	t-stat.: -2.74	t-stat.: -1.32	t-stat.: -1.90
Dickey-Fuller (ADF)	No exogenous	With drift and trend	No exogenous	With drift and trend
Dickey-Fuller GLS (ERS)	t-stat.: -0.24 with drift	t-stat.: -2.50 With drift and trend	t-stat.: -2.18* With drift	t-stat.: -1.78 With drift and trend
Phillips-Perron	adj. t-stat.: -3.16* No exogenous	adj. t-stat.: -2.92 With drift and trend	adj. t-stat.: -3.27* No exogenous	adj. t-stat.: -1.98 With drift and trend

Note:

- For each variable, I control different regressors in conducting the unit-root test according to its data behavior.
- The \* means to reject the null hypothesis of a unit root.
- OB: Seasonally adjusted overall balance, REER: Seasonally adjusted real effective exchange rate, M2G: Seasonally adjusted broad money growth rate, FCDTD: dollarization index - the ratio of foreign currency deposit to the total deposit.

Given this algorithm and in line with the statistical characteristics of the data, I use the method suggested by Jordan and Philips (2018) which is the Autoregressive Distributed Lag (ADL) in error correction form. The model specification is as the followings:

$$\Delta OB_t = \alpha + \beta_1 \Delta REER_t + \beta_2 \Delta M2G_t + \beta_3 \Delta FCDTD_t + \beta_4 OB_{t-1} + \beta_5 REER_{t-1} + \beta_6 M2G_{t-1} + \beta_7 FCDTD_{t-1} + Year\ Dummies + \varepsilon_t \quad (3)$$

where

- OB: seasonally adjusted overall balance in million USD.
  - REER: seasonally adjusted real effective exchange rate (index).  $\Delta REER_t = REER_t - REER_{t-1}$ .
  - M2G: seasonally adjusted broad money growth rate.  $\Delta M2G_t = M2G_t - M2G_{t-1}$ .
- This paper includes both REER and M2G on the explanatory variables to explain the BOP position. One might argue that there should be a multicollinearity problem

<sup>20</sup> See Granger's representation theorem in Engle and Granger (1987)

since they are closely correlated according to economic theory per se. However, by conducting the correlation analysis using the dataset applied in this paper, the correlation between REER and M2G is positive, only around 9%. If the central bank increases the money supply, the competitiveness improves but to a small magnitude. Therefore, the concern of multicollinearity issue should be rejected.

**Table 4.2 Unit Root Tests  
For the variables in first different**

	OB	REER	M2G	FCDTD
Augmented	t-stat.: -8.10*	t-stat.: -10.29*	t-stat.: -7.36*	t-stat.: -7.03*
Dickey-Fuller (ADF)	No exogenous	With drift and trend	No exogenous	With drift and trend
Dickey-Fuller GLS (ERS)	t-stat.: -0.32* with drift	t-stat.: -1.92 With drift and trend	t-stat.: -0.93 With drift	t-stat.: -7.05* With drift and trend
Phillips-Perron	adj. t-stat.: -16.92* No exogenous	adj. t-stat.: -10.29* With drift and trend	adj. t-stat.: -31.3* No exogenous	adj. t-stat.: -7.2* With drift and trend

- FCDTD: the dollarization index - the ratio of foreign currency deposit to the total deposit.  $\Delta FCDTD_t = FCDTD_t - FCDTD_{t-1}$ . I do not use the ratio of foreign currency deposit to M2 as M2G is already one of the controlled variables in the model. By doing so, it is to avoid possible multicollinearity problems in the independent variables as well.
- Year Dummies: I include the dummies for the year 2008, 2009, 2013, 2018, and 2019 to cover the below events:
  - 2009: Global Financial Crisis (GFC).
  - 2019: Huge capital inflow, particularly from Chinese investors as the Cambodian government encouraged more foreign investments.
- $\varepsilon$ : regression residuals

**Table 4.3 Pesaran, Shin, and Smith ARDL-bounds test for co-integration**

F-state. = 10.57	<----- I(0) ----->	----- I(1) ----->
------------------	--------------------	-------------------

10% critical value	2.205	3.421
5% critical value	2.593	3.941
1% critical value	3.498	5.149

**Table 4.4 Data Source and Description**

Variable	Source	Obs	Mean	Std. Dev.	Min	Max
OB	IMF	49	-205.9916	231.7682	-1240.605	61.2080
CA	IMF	49	-457.1657	280.4196	-1543.1100	-142.9469
FA	IMF	49	-508.4812	617.3784	-2096.5690	630.7178
NBC_REER	NBC	49	94.5282	6.2452	84.7503	107.7429
IMF_REER	IMF	47	111.2953	10.5289	93.4361	127.6560
M2G	IMF	49	5.1597	3.5599	-4.7899	12.7453
FCDTD	NBC	49	95.3932	1.5165	92.7411	98.3874

Note:

For OB, CA, FA, I use the IMF's BOP format as defined in the 6th Edition of the Balance of Payments Manual (BPM6).

**Figure 4.6 Scatter Plots**

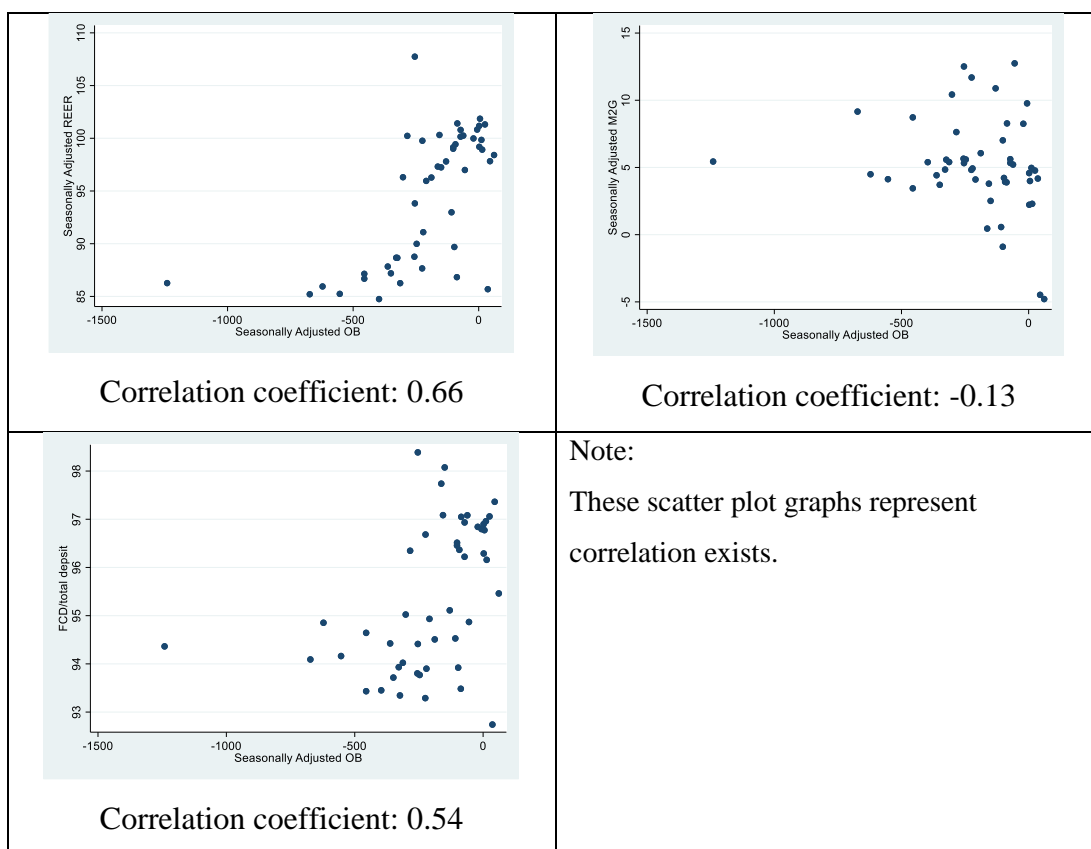


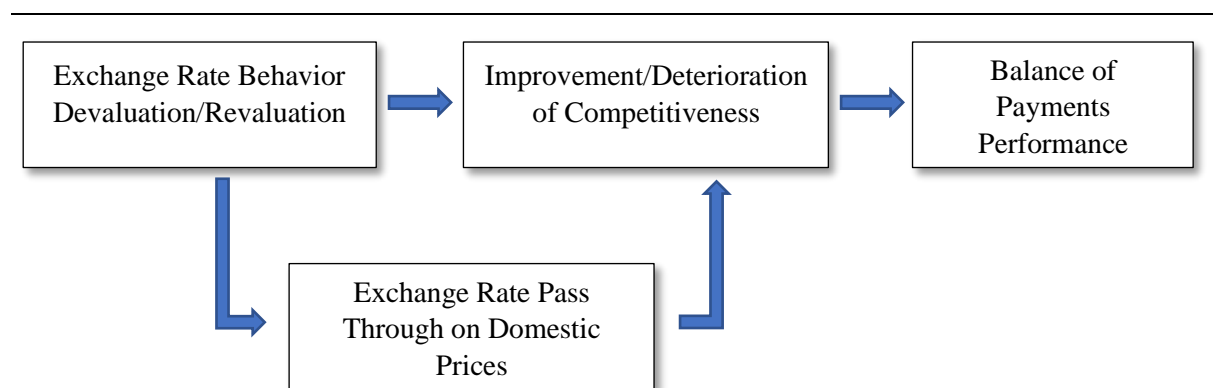
Table 4.3 presents the result of the Pesaran, Shin, and Smith ARDL-bounds test for co-integration<sup>21</sup>. The F-statistic value, 13.48, is well above the I(1) critical value. Hence, I can conclude the evidence of co-integration at the 1% level.

## 5.2. Variable Behavior

In this section, I discuss the expected result for each explanatory variable as follows:

- REER: Figure 4.7 explains the exchange rate behavior and its relation with the BOP. As mentioned above, external competitiveness for multi-lateral trade is typically measured using the Real Effective Exchange Rate (REER). Theoretically, the greater the external competitiveness, the better the BOP position via improving trade balance.

**Figure 4.7 Conceptual Framework for Relation of Exchange Rate and Balance of Payment**



Source: Author

- M2G: If the central bank increases the money supply, such as through quantitative easing or purchasing assets, including government bonds, the BOP improves. However, in the case of Cambodia, the increase of money supply is via auctions<sup>22</sup> and liquidity providing collateralized operations (LPCO) – where the financial institutions need to place a negotiable certificate of deposits (NCDs) as the collateral. These operations cause the local currency to depreciate; thus, imported products are more expensive, or domestic products are cheaper, leading to current account increases, and thus BOP improves.

<sup>21</sup> See the detail test procedure in Jordan and Philips (2018).

<sup>22</sup> NBC arranges the auctions at the predetermined amount (either in USD or KHR) by buying or selling foreign currency in the foreign exchange market.

- FCDTD: Regardless of the exchange rate regime adoption, the increase of dollarization in Cambodia mainly due to FDI inflows and the expansion of other investments (i.e., bank lending from foreign banks) usually leads to increased international reserves associated with BOP improvements.

## 6. Results and discussion

By the structure of ARDL in ECM form, the current change in the dependent variable has two components. The first is the short-run which is proportional to the recent change in the regressors. The second is the long-run (equilibrium error), a partial correction from the equilibrium values (the lag regressors).

Table 4.5 captures the regression outcomes. The main purposes of this paper are to explain the effect of REER and dollarization on the BOP position. I also construct Figure 4.9 to exhibit the impact transmission of REER, M2G, and FCDTD on the BOP in Cambodia. I explain the results as follows:

- The coefficients of both  $\Delta REER$  and  $REER_{t-1}$  are negative and significant, meaning that the increase of REER or an improvement in Cambodia's competitiveness leads to a decline of OB both in the short- and long run. REER is the underlying indicator that reflects a country's competitiveness from various economic activities.<sup>23</sup> This finding is in contrast to the expectation explained in the variable behavior section. The increase of REER (according to the NBC calculation) means the local currency depreciates leading to the decline of other investments. For instance, if local banks borrow funds from foreign banks in foreign currency (mostly in USD) and in case domestic currency depreciates, those local banks will encounter exchange rate lost; as a result, they might slow down the investments if the local currency keeps depreciating.

- The coefficient of broad money growth (M2G) is negative and significant both in the short- and long run, meaning the increase of M2 is in line with the rise in OB. NBC increases money supply via auctions in the foreign exchange market and liquidity providing collateralized operations (LPCOs). This operation should bring the depreciation of the domestic currency associated with the increase in exports and current account balance; hence, OB and BOP improve. This finding is consistent with the theory and the expected outcome.

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<sup>23</sup> The result in Table 4.9 also supports this argument as the coefficient of REER is negative and significant meaning that by using the Cambodia dataset, the increase of REER (improve competitiveness) is associated with the decline of exports leading to the decline of OB and BOP worsening.

- The coefficient of the dollarized index – the ratio of foreign currency deposits to total deposits (FCDTD) – is positive and significant only in the long run. The increase of dollarization in the case of Cambodia is associated with the increase of FDI and bank lending from abroad (classified as other investments in the BOP); therefore, the financial account declines, and BOP improves.

**Table 4.5 Regression Results ARDL with ECM model**

**Figure 4.8 Scatter Plot between REER and Exports**

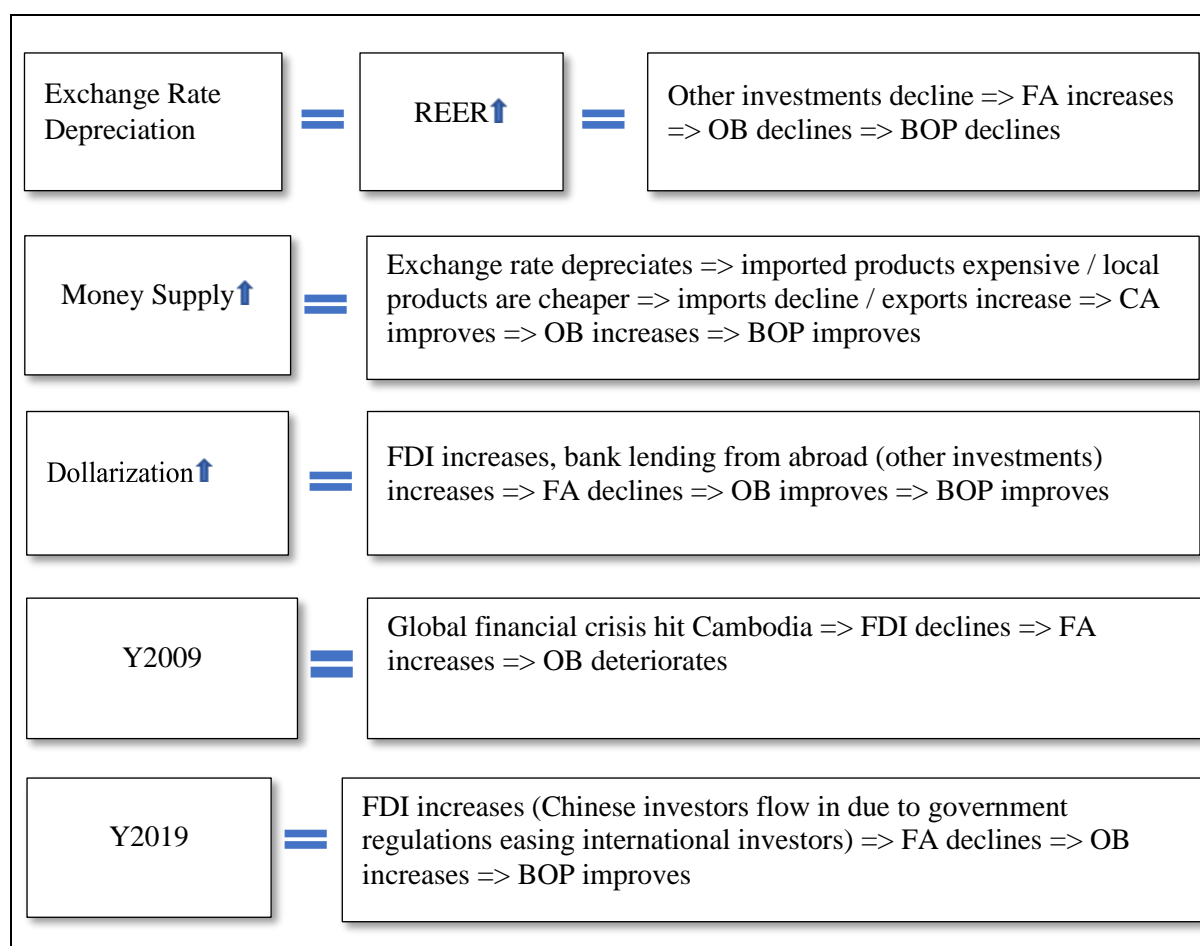
Coefficients		REER
OB <sub>t-1</sub>	-1.3280*** (0.1839)	
ΔREER <sub>t</sub>	-28.8433** (12.7092)	
ΔM2G <sub>t</sub>	24.5164*** (6.8706)	
ΔFCDTD <sub>t</sub>	6.9014 (64.2947)	
REER <sub>t-1</sub>	-46.1337*** (10.7961)	
M2G <sub>t-1</sub>	29.2771** (10.3150)	<p>Note on Table 4.5:</p> <ul style="list-style-type: none"> <li>- Dependent variable is ΔOB<sub>t</sub>.</li> <li>- Standard errors in parentheses.</li> <li>- Significantly different from zero 90% (*), 95% (**), 99% (***) confidence level.</li> </ul> <p>Note on Figure 4.8:</p> <ul style="list-style-type: none"> <li>- There is an evidence of negative correlation between Exports and REER (NBC data). I suspect that the depreciation of REER might be associated with the decline of Exports.</li> </ul>
FCDTD <sub>t-1</sub>	98.8495** (38.4035)	
Y2009	-173.0062** (85.1738)	
Y2019	391.1685*** (113.4076)	
Observation	48	
R <sup>2</sup>	0.6886	
Adjusted R <sup>2</sup>	0.6149	

- The coefficient of Y2009 is positive. In 2009, the Global Financial Crisis hit Cambodia leading to a decline in capital flows. Therefore, the financial account increases, OB declines, and BOP deteriorates.

- The coefficient of Y2019 is positive, meaning that the outbreak of the COVID-19 pandemic in 2019 improves the OB. In 2019, Cambodia’s government attracted more

international investments leading the increase in foreign direct investments and overall balances.

**Figure 4. 9 Impact Transmission Diagram  
In the Case of Cambodia – Highly Dollarized Economy**



Source: Author

### 6.1. Robustness Check

For the robustness check with the regression results in Table 4.5, I run three more regressions<sup>24</sup> by applying the REER calculated by the IMF, substituting the data obtained from the NBC, and using the current account, financial account, and overall balance as an alternative dependent variable. Table 4.6 explains these regression results. The results obtained are well in line with the regression outcomes in Table 4.5 as follows:

<sup>24</sup> I also run the regressions using CA and FA as the dependent variables and NBC's REER. I got significant coefficients of ISP and REER and the signs are consistent with the results in Table 3. However, the R<sup>2</sup> and adjusted R<sup>2</sup> are relatively low; hence, I put these regressions in the appendix only for reference.

<b>Table 4.7 Robustness Check Regressions</b>			
<b>IMF's REER</b>			
	<b>Dep. Variable:</b> $\Delta OB_t$	<b>Dep. Variable:</b> $\Delta FA_t$	<b>Dep. Variable:</b> $\Delta CA_t$
	Coefficients	Coefficients	Coefficients
Dependent Var $_{t-1}$	-1.2473*** (0.2331)	-1.2372*** (0.1688)	-0.8484*** (0.1903)
$\Delta REER_t$	15.8351 (11.4947)	-27.2589 (21.8273)	-6.7074 (11.3021)
$\Delta M2G_t$	26.3259*** (6.6768)	-19.4183 (12.2354)	-3.3050 (6.2479)
$\Delta FCDDT_t$	52.1633 (59.8328)	-33.8613 (113.0645)	-49.9930 (55.8125)
REER $_{t-1}$	40.3317*** (9.5445)	-37.1889** (14.5197)	-9.8538 (7.4493)
M2G $_{t-1}$	35.6537*** (10.9542)	-23.3186 (17.2220)	1.2598 (8.6610)
FCDDT $_{t-1}$	189.671*** (55.8043)	-74.9024 (92.9367)	1.0946 (46.7313)
Y2009	-140.9469* (82.1664)	256.1408* (152.3358)	68.5080 (76.1913)
Y2019	227.3703* (113.6543)	-698.0652*** (232.4626)	-329.868** (130.9738)
Observation	46	46	46
R <sup>2</sup>	0.6023	0.6376	0.3809
Adjusted R <sup>2</sup>	0.5029	0.5470	0.2261

Note

- Standard errors in parentheses.
- Significantly different from zero at 90% (\*), 95% (\*\*), 99% (\*\*\*) confidence level.

- Under OB as a dependent variable, the coefficients of REER are positive and significant only for the long run. By IMF's definition, if REER increases, the country's competitiveness declines where this setting is opposite to the NBC's REER formula. The regression outcome suggests that the coefficient of REER is positive, meaning that the increase in REER (i.e., the decline in a country's competitiveness) deteriorates the BOP. The coefficient of M2G is positive for both the short- and long-run. The coefficient of FCDDT is positive for only the long run. The coefficients of Y2009 and Y2019 are negative and positive, respectively.

- Under FA as a dependent variable, the coefficient of REER is negative for the long run. The increase of IMF's REER (decline in competitiveness) is associated with the decline of the FA balance. In other words, the improvement in competitiveness is in line with the increase of

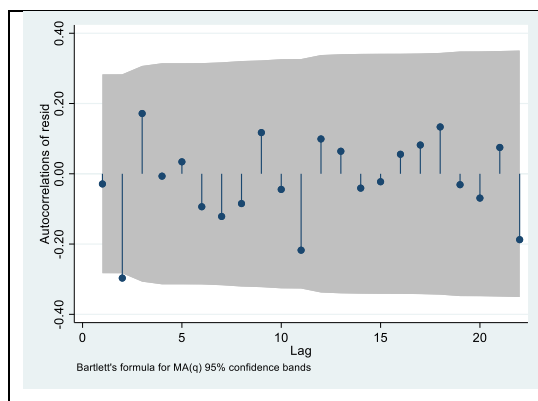


FA, leading to the deterioration of OB and BOP. Therefore, this finding is consistent with the results in Table 5. The coefficients of Y2009 and Y2019 are positive and negative, respectively (opposite to the signs of Y2009's and Y019's coefficients stated in Table 4.5). Due to GFC in 2009 (reflected by Y2009), Cambodia's FDI inflows declined leading to the increase of FA, meaning BOP declines. Also, the increase of capital flow in 2019 is aligned with the drop in FA, meaning BOP improves.

- The magnitude of the coefficient of Y2019 under FA is more prominent than under CA. Hence, the increase of FDI in 2019 leads to the improvement of the BOP.

## 6.2. Residuals Diagnostic

**Figure 4.10 Autocorrelations of Residuals**



**Table 4.8 Unit Root Test of the Residuals**

Null Hypothesis: RESIDUAL_REGRESSION_USED has a unit root		
Exogenous: Constant		
Lag Length: 1 (Automatic - based on SIC, maxlag=9)		
	t-Statistic	Prob.*
Augmented Dickey-Fuller test statistic	-6.338047	0.0000
Test critical values:	1% level	-3.581152
	5% level	-2.926622
	10% level	-2.601424

\*MacKinnon (1996) one-sided p-values.

The regression residuals (specified in equation 3) behave like white noise, as shown in Figure 10 and Table 8. Also, the Durbin-Watson d-statistic is 1.98, which is very close to 2, which means no autocorrelation is detected in the residuals. The unit root test concludes the residuals are white noise.

## 7. Conclusion

This paper explains the relationship between BOP and REER and also BOP and dollarization for Cambodia. Not limited to these main variables, I incorporate the growth of money supply and year dummies in the analysis. The regression outcomes serve as essential policy guidance, particularly for the National Bank of Cambodia.

The higher the trade competitiveness – an increase of REER according to the NBC calculation – is associated with a drop in BOP position in both the short- and long-term. The increase of money supply via open market operations and/or LPCOs is associated with BOP improvement. The increased dollarization level, which is proxied by the ratio of foreign currency deposits to total deposits, is in line with the BOP improvement. I also employ the REER using IMF data in the regression for robustness check, and the results are all consistent.

However, there are still some challenges that impose the limitation of this analysis. Cambodia does not have a long horizon of a high-frequency dataset. I hope that in the model specification; one should include income level as if the high-frequency data is ready. I do not include the policy rate in the model as Cambodia does not yet have it. Therefore, for better analysis and to cover a wider scope, the NBC should make this data available, and also by having a policy rate, the NBC could (i) influence the economy effectively and (ii) drive the interest rates in different currencies in the banking and financial system.

## Chapter 5

### Conclusion - Summary of Important Monetary Policies

#### 1. Conclusion

The results of these essays contribute significantly to the macroeconomic literature. In this section, I elaborate on the appropriate choice of exchange rate regimes for low-, middle-, and high-income economies in the impossible trinity framework which is analyzed in Chapter 3. Then, I provide the result of the exchange rate examination on the balance of payments in Cambodia, which is captured in Chapter 4 of this dissertation.

The outcomes of Chapter 3, from high- and middle-income economies, provide evidence of rounding the corner of the trilemma policy where a higher degree of financial openness and monetary independence is in line with the higher propensity to choose an intermediate exchange rate regime. For the low-income group, results propose the quadratic relation between the exchange rate regime and financial integration as the financial integration level increases. There are also significant pieces of evidence for the controlled variables: (i) countries with a high GDP level coexist with a more flexible exchange rate, whereas the floating exchange rate discourages trading activities, (ii) a high level of inflation and international reserves are in line with the intermediate regime, (iii) a high level of the terms of trade volatility and share of mineral exports to total exports are associated with the pegged regime. These findings should be the vital policy guidelines for policymakers in choosing appropriate exchange rate regimes.

Chapter 4 captures the effect of REER on the BOP in the case of Cambodia. The findings suggest higher trade competitiveness is associated with a decline in exports, leading to current account declines, then the BOP position deteriorates in both the short- and long-term. The increase of money supply due to auctions in the foreign exchange rate market and liquidity providing collateralized operation (LPCO) leads to local currency depreciation and is associated with the increase of BOP position for both the short- and long-run. This finding is consistent with the theoretical perspective per se. The higher the dollarization level – proxied by the ratio of foreign currency deposits to total deposits – is in line with BOP improvement.

#### 2. Challenges

While writing these essays, I faced many challenges, particularly the data constraint for low-income economies (Chapter 3) and Cambodia (Chapter 4). However, these analyses are still possible since I have clearly defined the appropriate methodologies corresponding to the data type for each chapter. By doing so, I need to understand the limitations of the applied models and ensure the findings are robust; therefore, I run regressions using alternative variables as detailed in the above chapters.

The main challenge of these papers is the limitation of the available dataset, and I expect future research will address this issue. In the model specification, one should include income level as if the high-frequency data is ready in Chapter 4 (the study of Cambodia). More importantly, as there is no policy rate, Cambodia's central bank should solve this problem to (i) drive the economy effectively and (ii) drive the interest rates in different currencies in the banking and financial system.

Future studies on the core monetary policy framework, such that they are on the exchange rate, policy rate, and inflation targeting, could be implemented by applying this research methodology where researchers are able to specify categorical dependent variables and the three classifications of the dataset, which are low-, middle-, and high-income economies. However, the dataset for the low-income group is still limited. To deep dive on this analysis, scholars might also incorporate variables on the structural break to capture the unexpected change in parameters and crisis dummies for both financial and business turmoil.

### **3. Policy Recommendations**

Policy recommendations are the key takeaway from these essays. There are several policy suggestions that I would like to propose:

- A fixed exchange rate can be the right choice for economies (the results of this paper suggest low-income economies) where monetary policy autonomy is hardly achieved.
- Countries with healthy financial infrastructure should adopt a floating exchange rate regime. Typically, a flexible exchange rate supports a market-based and financially liberalized economy and should also have a significant advantage in response to shocks.
  - The source of dollarization is critical in analyzing its impact on economic activities in the long run. In the case of Cambodia, if the level of dollarization

increases due to FDI and other investments (local banks borrow from foreign banks), the BOP position in the long-term will improve. However, a high degree of dollarization is generally associated with low monetary policy credibility, leading to the limitation of implementing the instruments. Therefore, the central bank should de-dollarize and promote the local currency, particularly in the banking system. This strategic plan needs involvement from inter-ministries. However, as the central bank, NBC should work closely on this plan to build public credibility.

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## Appendix 1 – Chapter 3

**Table 3.7 Results for Full Sample**

		Under IMF Classification		Under IRR Classification		Under IRR Classification	
		De Facto-FI 2,604 Obs R <sup>2</sup> = 0.0194	De Jure-FI 2,559 Obs R <sup>2</sup> = 0.0446	De Facto-FI 2,753 Obs R <sup>2</sup> = 0.0341	De Jure-FI 2,559 Obs R <sup>2</sup> = 0.0655	De Facto-FI 1,311 Obs R <sup>2</sup> = 0.2220	De Jure-FI 1,282 Obs R <sup>2</sup> = 0.2629
Dependent Variable (ERR)	Controlled variable	Coef.	Coef.	Coef.	Coef.	Coef.	Coef.
Peg	L.FI	0.3474***	-2.5493***	0.1589***	1.8783***	-0.0051	3.2540***
	L.FI_MI	-0.4762***	-3.2121***	-0.2731***	-5.3501***	-0.2750***	-5.7683***
	L.FI <sup>2</sup>	0.0005	2.6034***	0.0000	-0.1858	0.0015***	-1.2814
	L.SIZE	..	..	..	..	0.0473	-0.1423***
	L.TRADE	..	..	..	..	2.7962***	2.1026***
	L2.TOTSH	..	..	..	..	0.1313	0.0669
	L.INF	..	..	..	..	-0.1428***	-0.1217***
	L.MINEXP	..	..	..	..	0.2599***	0.2101***
	L.MoI	..	..	..	..	0.0197*	0.0425***
	ASEAN	..	..	..	..	-2.6374*	-2.2733***
Float	L.FI	0.3674***	1.2407	-0.0688 <sup>+</sup>	4.7669***	-0.1234*	6.0282***
	L.FI_MI	-0.5474***	-2.3647***	0.0652	-1.3298***	0.4341***	-0.7971
	L.FI <sup>2</sup>	0.0004	0.2758	-0.0001	-3.8120***	-0.0017	-5.3779***
	L.SIZE	..	..	..	..	0.4556***	0.4427***
	L.TRADE	..	..	..	..	-5.0505***	-4.1918***
	L2.TOTSH	..	..	..	..	-1.8264***	-1.8306***
	L.INF	..	..	..	..	0.0069	0.0042
	L.MINEXP	..	..	..	..	0.0726	0.0373
	L.MoI	..	..	..	..	0.0308*	0.0269
	ASEAN	..	..	..	..	-2.1643***	-2.6014***

Note: - Exchange rate regime (ERR) is the categorical dependent variable where intermediate is the baseline.

- Significantly different from zero at the 80% (\*), 90% (\*), 95% (\*\*), 99% (\*\*\*) confidence level.

- L.: Lag operator

**Table 3.8 Results under IRR classification**

		Low-income		Middle-income		High-income	
		De Facto-FI 128 Obs R <sup>2</sup> = 0.5209	De Jure-FI 125 Obs R <sup>2</sup> = 0.4880	De Facto-FI 682 Obs R <sup>2</sup> = 0.3629	De Jure-FI 678 Obs R <sup>2</sup> = 0.3077	De Facto-FI 577 Obs R <sup>2</sup> = 0.3049	De Jure-FI 551 Obs R <sup>2</sup> = 0.3826
Dep Var	Controlled variable	Coef.	Coef.	Coef.	Coef.	Coef.	Coef.
Peg	L.FI	13.6700	-6.7668	0.9078***	0.0985	0.2920***	2.7771***
	L.FI_MI	5.9847	15.3906	-0.8168**	-1.8170*	-0.5069***	-6.3788***
	L.FI <sup>2</sup>	-3.2313	..	-0.0596*	-0.2789	..	-0.2961***
	L.SIZE	-2.3541	-1.7265	-0.2636***	-0.3766***	-0.0869	..
	L.TRADE	19.9667 <sup>+</sup>	13.7065**	1.1575 <sup>+</sup>	1.1930*	-0.3370	0.6262*
	LX.TOTSH	-28.9602*	-24.3461**	1.4299***	1.2224***	-0.3815*	0.5616
	LY.INF	-0.0040	-0.0374	-0.0654***	-0.0697***	-0.0248	-0.0185
	L.MINEXP	0.4211	0.9529	0.5298***	0.4356***	0.4285**	0.2752*
	L.MoI	-0.0959	-0.3829	-0.0872***	-0.0650***	-0.0267	-0.0595**
Float	L.FI	-0.1297	2.6824	9.1082***	3.9369	-0.2411**	-3.2830***
	L.FI_MI	1.0654	-0.3697	0.2088	-1.1372	0.4494**	3.2671***
	L.FI <sup>2</sup>	-0.0243	..	-1.9296***	-4.3393*	..	..
	L.SIZE	-0.9425 <sup>+</sup>	-0.8289 <sup>+</sup>	1.1539***	0.8143***	0.0925	0.1583
	L.TRADE	6.0775 <sup>+</sup>	9.2383**	-13.2681***	-4.4801***	-18.4382***	-29.1469***
	LX.TOTSH	-14.0684***	-17.0985***	-3.8763***	-2.8139***	-0.4895	0.8939
	LY.INF	0.1328*	0.0934	0.0035	-0.0173	-0.1020	-0.1783**
	L.MINEXP	-0.3619	-0.2317	-2.0004***	-1.6666***	0.8572***	1.0529***
	L.MoI	-0.6137*	-0.9067**	-0.3196***	-0.1465**	-0.1857***	-0.1816**

Note: - Exchange rate regime (ERR) is the categorical dependent variable where intermediate is the baseline.

- Significantly different from zero at the 80% (\*), 90% (\*), 95% (\*\*), 99% (\*\*\*) confidence level.

- L.: Lag operator. For low-income sample, X=1 and Y=1; for middle-income sample, X=2 and Y=1; for high-income sample, X=2 and Y=5.

- I dropped FI<sup>2</sup> to solve the problem with “convergence not achieved” after running the MLOGIT model.

**Table 3.9 Other Regression Results under IMF classification**

		Full-sample	Low-income	Middle-income	High-income
		De Jure-FI 1,066 Obs R2 = 0.2372	De Jure-FI 102 Obs R2 = 0.4927	De Jure-FI 485 Obs R2 = 0.2624	De Jure-FI 466 Obs R2 = 0.3685
Dep Var (ERR)	Controlled variable	Coef.	Coef.	Coef.	Coef.
Peg	L.FI	-4.2271***	-29.0084	-4.0063*	0.9375
	L.FI_MI	-2.0466**	30.3993	-4.9970***	-0.1537
	L.FI <sup>2</sup>	4.4781***	..	4.9481**	..
	L.SIZE	-0.0120	1.3319	-0.2545**	-0.6222***
	L.TRADE	1.2561***	-20.9190	-0.8944	-0.1721
	LX.TOTSH	1.3621***	11.2137 <sup>+</sup>	2.5028***	4.5700**
	LY.INF	-0.0816***	0.1862 <sup>+</sup>	-0.0890***	-0.2887***
	L.MINEXP	0.3122***	-1.6634**	0.7445***	0.8993 <sup>+</sup>
	L.MoI	-0.0334**	1.1099*	-0.0564**	0.1162 <sup>+</sup>
	ASEAN	-2.9494***	..	..	..
Float	L.FI	1.1285	0.2921	0.4136	2.4321**
	L.FI_MI	-3.4314***	4.1968	-0.3339	-4.3413***
	L.FI <sup>2</sup>	1.4011	..	0.2117	..
	L.SIZE	0.3429***	-1.5650**	0.4631***	0.1905
	L.TRADE	-1.2197***	-2.8381	-0.9656	-1.7090***
	LX.TOTSH	-0.6176*	-10.1028***	0.4632	-0.6193
	LY.INF	-0.0393***	0.1219**	-0.0489**	-0.0402
	L.MINEXP	-0.0253	-0.7818***	0.1926	0.8506 <sup>+</sup>
	L.MoI	-0.0633***	0.2288	-0.0397	0.1190 <sup>+</sup>
	ASEAN	-0.2005	..	..	..

Note: - Exchange rate regime (ERR) is the categorical dependent variable where intermediate is the baseline.

- Significantly different from zero at the 80% (\*), 90% (\*\*), 95% (\*\*\*), 99% (\*\*\*\*) confidence level.

- L.: Lag operator. For full-sample, X=3 and Y=1; for low-income sample, X=1 and Y=1; for middle-income sample, X=4 and Y=1; for high-income sample, X=1 and Y=7.

- I dropped FI<sup>2</sup> to solve the problem with “convergence not achieved” after running the MLOGIT model.

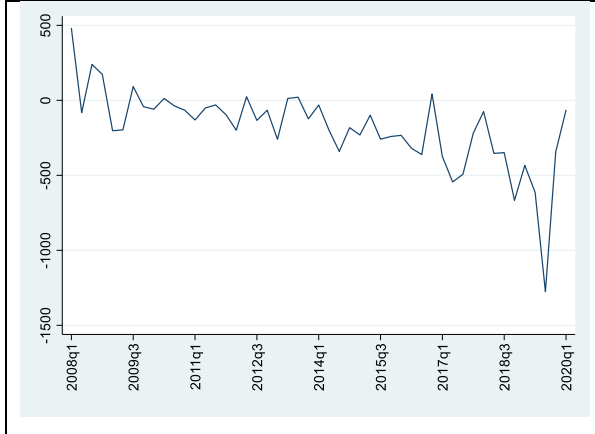
**Table 3.10 Data Sources**

Variable	Sources
IMF-ERR	IMF Exchange rate arrangement (2017)
IRR-ERR	Ilzetzki, Reinhart and Rogoff Exchange rate arrangement (2017)
De Jure - FI	De jure Chinn and Ito index (2018)
De Facto - FI	Lane and Milesi-Ferretti (2017)
MI	Chinn and Ito (2018)
SIZE	WDI: GDP (constant 2000 US\$)
TRADE	WDI: imports of goods and services (constant 2000 US\$) WDI: exports of goods and services (constant 2000 US\$)
TOTSH	WDI: Exports as a capacity to import (constant LCU)
INF	WDI: Inflation, consumer prices (annual %)
MINEXP	World Integrated Trade Solution (WITS)
MoI	WDI



**Appendix 2 – Chapter 4**

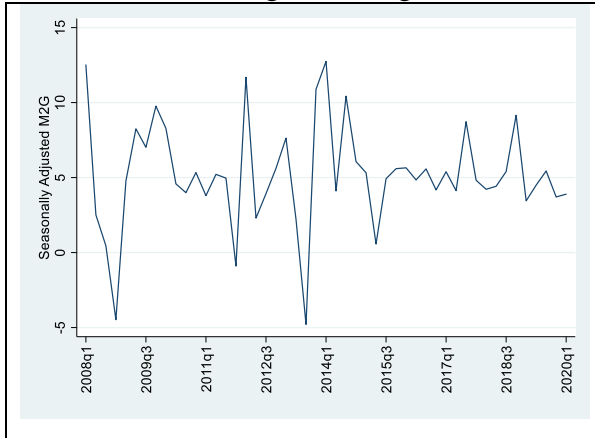
**Figure 4.11 Seasonally Adjusted Overall Balance  
2008 Q1 – 2020 Q1**



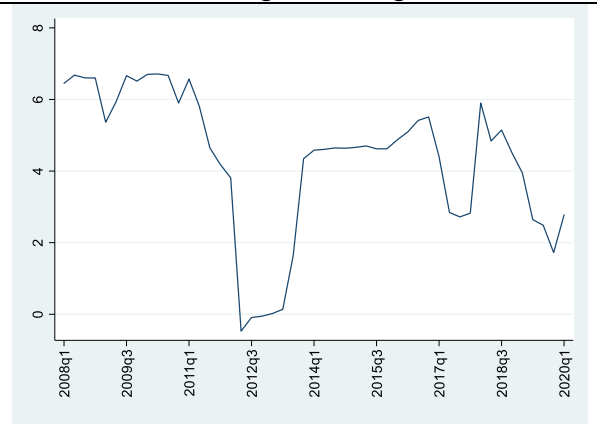
**Figure 4.12 Seasonally Adjusted REER  
2008 Q1 – 2020 Q1**



**Figure 4.13 Seasonally Adjusted M2G  
2008 Q1 – 2020 Q1**



**Figure 4.14 Market Interest Rate Spread  
2008 Q1 – 2020 Q1**



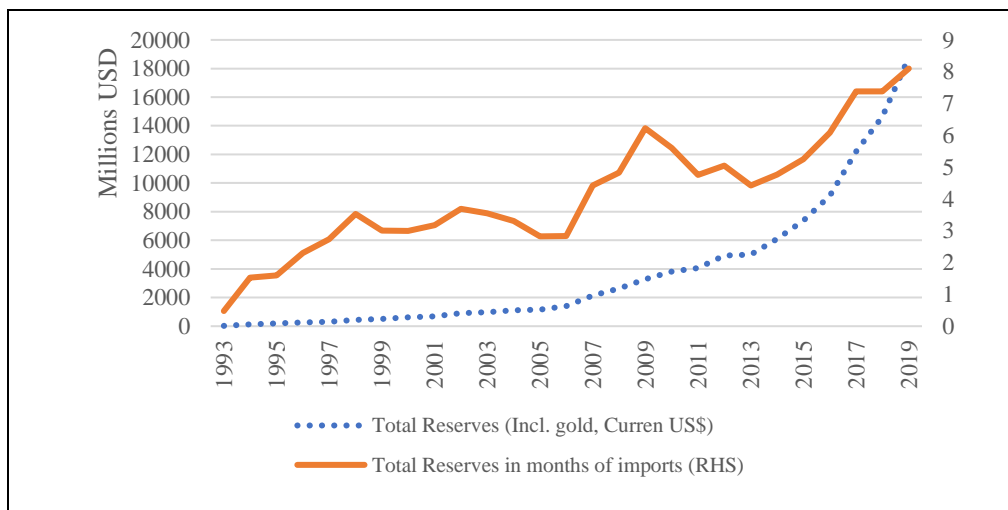
**Figure 4.15 Foreign Currency Deposit to Total Deposit  
2008 Q1 – 2020 Q1**



Note: Some variables need to be seasonally adjusted according to data behavior.

Source: National Bank of Cambodia

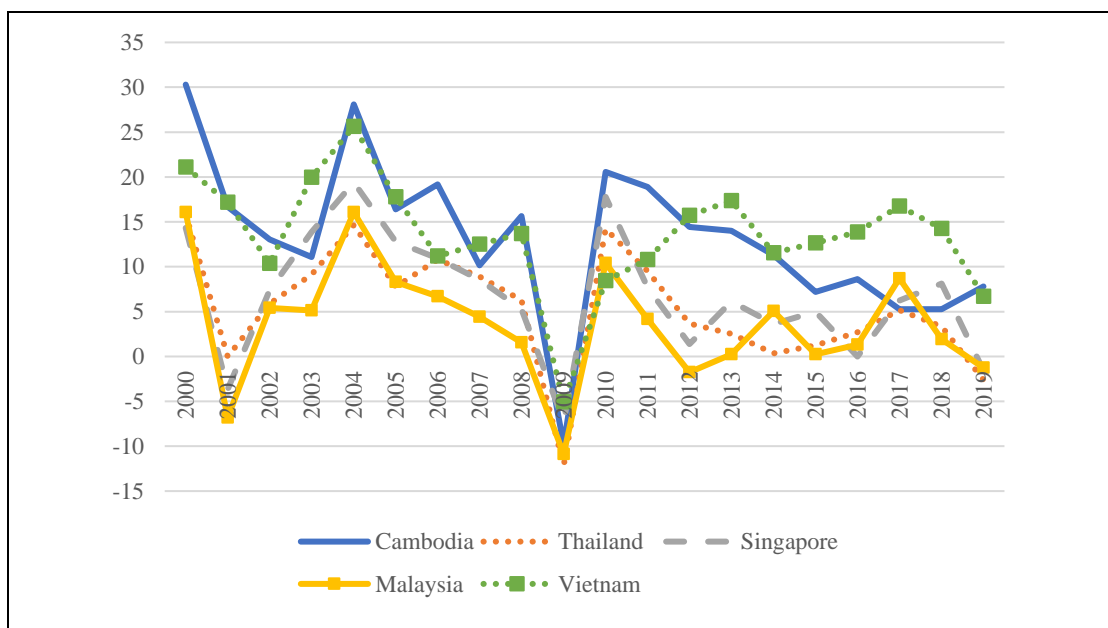
**Figure 4.16 Cambodia's International Reserves**



Source: World Bank

Note: Cambodia adopts a pegged regime and is a highly dollarized economy. To keep the exchange rate stable, the central bank needs to utilize more of the international reserves. However, in the last decades, the level of international reserves kept increasing which means the central bank has absorbed more of a foreign currency or has attempted to accumulate the international reserves.

**Figure 4.17 Exports of goods and services  
annual % growth**



Source: World Bank

**Table 4.9 Regression Results**  
**Relationship between REER and Exports**

Dependent Variable: EXPORT				
Method: Least Squares				
Date: 06/06/21 Time: 15:54				
Sample: 2008Q1 2020Q1				
Included observations: 49				
HAC standard errors & covariance (Bartlett kernel, Newey-West fixed bandwidth = 4.0000)				
Variable	Coefficient	Std. Error	t-Statistic	Prob.
C	15322.00	1722.873	8.893282	0.0000
REER	-141.6226	17.87802	-7.921602	0.0000
M2G	16.09453	21.50345	0.748463	0.4580
R-squared	0.802658	Mean dependent var	2018.825	
Adjusted R-squared	0.794078	S.D. dependent var	983.6572	

**Note:**

R<sup>2</sup> = 0.8026

Adjusted R<sup>2</sup> = 0.7940

EXPORT: Export is the dependent variable

REER: REER using NBC data

M2G: Growth rate of money supply