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On the Effects of Monetary Policy in Vietnam: Evidence from a Trilemma Analysis

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Abstract

During and after the 2008-2009 global financial crisis, the growth cycle of Vietnam's economy has shifted from an average annual growth rate of 7%-8% to an average annual growth rate of 5%-6% with a high level of macroeconomic instability and uncertainty from 2009 till 2016. Related studies have speculated that the operations of monetary policies during this period were not effective in recovering the economic growth and stabilizing the overall price level and total output level. This paper provides the first empirical examination of this speculation using the Trilemma framework. Our empirical results show that the State Bank of Vietnam has had adopted a set of policies aiming at maintaining exchange rate stability and interest rate independence while easing the restrictions on capital inflows. The combination of these three monetary policy approaches is found to violate the rule of Trilemma. Consequently, exchange rate and interest rate policies became less effective and failed to stabilize the economy in response to the global economic recession.

Keywords: Vietnamese economy; Trilemma; monetary policy; economic recession; macroeconomic conditions.
JEL Classifications: F31, F33, F36

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1. INTRODUCTION

The Trilemma suggests that the three overall macro-economic objectives: exchange rate stability, free mobility of capital flows, and monetary autonomy cannot be simultaneously attained in an open economy. One implication is that a country could only focus on the attainment of two of the three triangles of the trilemma. Rich empirical evidence suggests that there exists a trilemma constraint in many countries and regions, particularly in the aftermath of the 2008-2009 global financial crisis, which was characterized by reversals in capital flows, significant economic uncertainty, and high financial vulnerabilities (Aizenman *et al.,* 2013; Aizenman & Ito, 2014; Steiner, 2017).

While the trilemma model has been a toolkit in the domain of international macroeconomic policy, Rey (2015) argues that this trilemma has rather become a dilemma where countries must choose between monetary policy independence and financial openness, regardless of the exchange rate regime. Ligonniere (2018) using data of 161 countries from 1970 to 2013 provides strong empirical evidence to invalidate a gradual move from the trilemma to the dilemma. In fact the design of capital controls and their complementarity with other policies are still puzzling (Forbes *et al.,* 2015; Klein & Shambaugh, 2015). Several studies show a possible combination of the "middle ground" approach (Aizenman *et al.,* 2008; Herwartz & Roestel, 2017; Han & Wei, 2018; Ligonniere, 2018).

To the extent that the empirical evidence for the dilemma model is present mainly for developed economies, we examine the Trilemma model in the context of Vietnam as a small open economy. When relaxing capital inflow restrictions, those small open economies are often left to choose between two combinations: the independence of monetary policy with a floating exchange rate or a fixed exchange rate and a dependent monetary policy. Many similar economies, while trying to maintain both objectives (floating exchange rate and independence of interest rate), have experienced domestic financial crises. Well-known crises which are argued to demonstrate the violation of the Trilemma rule include the Mexican peso crisis of 1994-1995, the Asian financial crisis of 1997–1998, and the Argentinean financial collapse of 2001-2002 (Aizenman, 2010).

More specifically, we employ the approach of Aizenman *et al.* (2008) to quantify the Trilemma Index for Vietnam and, by doing so, provide answers to several research questions. First, we examine whether the Trilemma rule had been violated under the monetary policy management of the State Bank of Vietnam. Second, we assess whether the violation of the Trilemma rule might have contributed to the slowdown of macroeconomic performance since 2007. Third, what would be the impact on macroeconomic performance if the SBV had retained the same policy setting

used during the period 1998-2006 for the latter period 2007-2013? Lastly, we assess the linkages between the Trilemma rule and the two most important macroeconomic targets of Vietnam's monetary policies: economic growth and inflation.

The rest of this paper is structured as follows. Section 2 provides some background on Vietnam's economy, which constitutes an interesting case study for the empirical examination of the Trilemma model in the context of small open economies in the face of strong economic growth and increasing impacts from the global economy. Section 3 provides a concise review of the Trilemma model. Section 4 discusses the empirical methodology. Section 5 reports and discusses the results. Section 6 concludes the paper.

2. BACKGROUND ON VIETNAM ECONOMY

Since the launch of the "Doi Moi" (Renovation) programs in 1986 with a series of policies to shift the economy away from the central-planning system, markets have gradually been created for most of goods and services. The GDP growth rate was sustained at 7%-8% annually on average (giving Vietnam the second fastest growing economy in Asia, after China) since then. Vietnam's economy has also become more integrated economically and financially with the global economy and has experienced important structural changes with a shift from agriculture to industry and services.[1] Notably, the contribution of the agriculture sector dropped from 38.7% to 20.9% of GDP between 1990 and 2005, while that of the industry and the construction sector grew from 22.7% to 41.1%. Thanks to strong economic growth from 1990 to 2007, Vietnam became one of the most successful examples of poverty alleviation in the developing world and was also called the "new tiger of Asia" (Sepehri & Akram-Lodhi, 2002; Mahadevan & Hoang, 2016).

[Insert Figure 1 here]

Vietnam's economy has, however, struggled between 2007 and 2016, with significant macroeconomic instability, volatile trading activity, and a high level of non-performing loans in the banking system. In particular, the GDP growth rate slowed down to 5%-6% annually, with a high inflation rate climbing to 23% in 2008 and then remaining above 10% from 2009 to 2011 (Figure 1). The

[1] Vietnam joined the Association of Southeast Asian Nations (ASEAN) in 1995, the ASEAN Free Trade Area (AFTA), the Asia-Pacific Economic Cooperation Forum (APEC) in 1998, signed a Bilateral Trade Agreement with the United States in 2000, and became a member of World Trade Organization (WTO) in 2006. Two FTAs of the third generation, the Comprehensive and Progressive Agreement for Trans-Pacific Partnership (CPTPP) and the EU-VN FTA, were recently signed, with the CPTPP coming into effect on the 31st of December 2018.

ratio of public debt to GDP increased from 30% in 2001 to over 50% in 2010. Rising commodity prices and the dramatic surge in the price of oil have contributed to a sharp rise in the consumer price index (Nguyen *et al.,* 2012). In the reality, high inflation and high interest rates caused severe damage to the domestic economy through affecting the confidence of households and firms who reduced their consumption and investment. The banking system was frozen as a consequence of the increased amount of non-performing loans and illiquidity following the global financial crisis and the collapse of the housing markets in 2011.[2] On the other hand, the exchange rate depreciated by 25% between 2007 and 2011, coupled with a deficit in the current account that was growing each year. Foreign reserves, which reached 25 billion USD in 2007, fell to 12 billion USD in 2010. The stock market crashed from its record of 1100 index points in 2007 to 240 index points in 2009 and fluctuated in the range of 400-450 in 2010-2011.

[Insert Figures 2 and 3 here]

It is obvious that while the 2008-2009 global financial crisis had undoubtedly a range of negative effects on Vietnam's economy, other economies in Asia similar to Vietnam received much less impact, as shown in Figure 2. Some recent studies have argued that those macroeconomic instabilities were caused mainly by an inappropriate implementation of monetary policies by the State Bank of Vietnam (SBV) (Pham, 2011; To *et al.,* 2012). For example, observed data showed that the SBV responded to the increasing inflation by doubling the refinancing rate for commercial banks from 6.5% in December 2007 to 15% by June 2008 (see Figure 3). Inflation was brought down quickly from its August 2008 peak of over 28% to a low of 2% in August 2009. However, fearing a recession risk, the SBV decided to cut the refinancing rate to 7% in order to re-stimulate the economy in January 2009, which has led the inflation rate to soar afterwards and reach a peak of 23% in August 2011.

In sum, the policy responses of the SBV to address the recessionary risk and the global crisis transmission were at stake and seem to have been a source of general macroeconomic instability. Our results support this assessment as the Trilemma rule was violated in the near-crisis situation during the years from 2007 to 2009. This finding helps explain why the SBV's efforts in stabilizing exchange rates and interest rates were unlikely to have a significant impact on inflation. The policy setting during 1998-2006 is also found to be unsuitable for 2007-2013. Moreover, we find

[2] Non-performing loans were estimated at 250 trillion VND (equivalent to 12 billion USD or 10% GDP) in 2012 with a record number of bankrupt firms (Vu 2012).

that when Vietnam's economy was still relatively closed, the SBV could have used regular monetary instruments such as the interest rate and the exchange rate to effectively control inflation. In contrast, when the economy became more open, the monetary policy should have considered the influence from the increased financial openness as it can affect inflation. Lastly, a policy stabilizing the exchange rate could be more effective than policies that reduce interest rates and increase financial openness in promoting economic growth.

3. THE TRILEMMA MODEL

The term Trilemma (Impossible Trinity) became popular after the work by Mundell (1963) and Fleming (1962) on the choice of exchange rate regime.[3] The Trilemma rule implies that an economy cannot simultaneously maintain *exchange rate stability, free capital movement,* and *independent monetary policy* at the same time. Feenstra and Taylor (2011) propose a simple explanation of the Trilemma phenomenon by introducing a system of three equations in which each policy goal can be expressed as follows:

(1) Fixed exchange rate: $\frac{E^e - E}{E} = 0$,

where E refers to the exchange rate between the domestic currency and the foreign currency, and E^e is the expected exchange rate in the future. In a fixed exchange rate regime, a country tries to keep a fixed or maintain a relatively stable/small change in the value of the currency (zero or stable/small depreciation or appreciation).

(2) Free capital movement: $i = i_F + \frac{E^e - E}{E}$

International capital mobility is considered a crucial device to encourage integration, efficiency, and risk sharing. To follow this policy, the country maintains the freedom for investors to bring money in and out, implying they can buy and sell the currency whenever and in whatever quantities they want. With the adjustment from the Uncovered Interest Parity rule, the market will set and adjust the exchange rate as the result of arbitrage activities. Equation (2) describes the equilibrium position, when the difference between the domestic interest rate (i) and the international interest rate (i_F) must be equal to the change of the exchange rate level.

(3) An independent monetary policy: $i \neq i_F$

[3] In 1997, Obstfeld and Taylor (1997) brought the term "Trilemma" into widespread use within economics, an alternative to the longer phrase of "impossible trinity".

With monetary policy independence, the country can set the domestic interest rate independently of the international interest rate (and this will definitely affect the exchange rate). Monetary policy autonomy is desired in managing the domestic economy's business cycle (and other economic disturbances).

Mathematically the three equations (1), (2) and (3), cannot be satisfied simultaneously. For example, if equations (1) and (2) hold, that makes $i = i_F$ which means that equation (3) is impossible. Under the implication of the Trilemma, a country must either forego exchange rate stability to maintain a degree of monetary independence or forego monetary independence to retain exchange rate stability. The application of the Trilemma is most obvious when the policies are at the ends of a spectrum such as (i) hard peg or free float, (ii) perfect capital mobility or total immobility, or (iii) complete autonomy or no autonomy at all.

In practice, a country might not absolutely sit at one of those three "corners". In other words, the rigidity of the peg, the degree of capital mobility, and the independence of monetary policy could be partial rather than full (Feenstra & Taylor, 2011). For example, countries like Australia or the United States choose independent monetary policy and free capital flows and allow exchange rates to fluctuate freely, whereas China tries to maintain stable exchange rates and independent monetary policy, thus requiring restrictions on capital flows (Mankiw, 2010). Figure 4 provides a graphical presentation of the Trilemma rule for several countries.

[Insert Figure 4 here]

Over the recent decades, many developing countries have opted for increasing financial integration to boost economic growth. Hence, those countries had to pursue higher capital mobility as the obvious choice. Under the Trilemma rule, this leaves them to lean toward either an independence of monetary policy (with a floating exchange rate) or a fixed exchange rate (without independent monetary policy). Many countries tried to maintain both objectives and unfortunately fell into financial crises as observed in the Mexican peso crisis of 1994-1995, the Asian financial crisis of 1997-1998, and the Argentinean financial collapse of 2001-2002 (Aizenman, 2010). These financial crises prompted economists to think about ways to transform the Trilemma rule into usable applications to evaluate the performance of monetary policy.

Aizenman *et al.* (2008) propose to quantify the Trilemma index as a measurement of the stance of monetary policy setting in relation to the following three policies: the monetary independence (MI, measured as the reciprocal of the correlation of the interest rates between the home country

and the base country), the exchange rate stability (ERS, measured as a normalized formula of the annual standard deviations of the monthly exchange rate between the home country and the base country), and the capital account openness. Each of these measures are defined as below:

$$MI = 1 - \frac{\text{corr}(i_i, i_j) - (-1)}{1 - (-1)} \quad (4)$$

where i_i refers to the monthly market interest rates of the home country, i_j refers to the monthly market interest rates of the base country, and $\text{corr}(i_i, i_j)$ is their annual correlation.

$$ERS = \frac{0.01}{0.01 + stdev(\Delta(\log(exch\_rate))} \quad (5)$$

Capital account openness is proxied by the financial openness/integration ($KAOPEN$) index which is calculated as a combination of dummy variables assigned to policy restrictions including the presence of multiple exchange rates (*k1*), restrictions on current account transactions (*k2*), restrictions on capital account transactions (*k3*), and the requirement of the surrender of export proceeds (*k4*).

Note that all these three measures take values ranging between 0 and 1. Higher values for *MI, ERS*, *KAOPEN* suggest more monetary independence, a more stable exchange rate and more financial openness respectively.

Using the data for 181 countries over the period 1970-2006, Aizenman *et al.* (2008) confirm the notion that a rise in one Trilemma aspect should be traded off with a drop of the weighted sum of the other two. They report three important findings for developing countries: i) the output volatility could be reduced by a higher monetary independence or a lower exchange rate stability; ii) higher monetary independence, lower exchange rate stability or lower financial openness are all associated with a higher level of inflation; and iii) keeping a stable exchange rate with financial development at a medium level can lead to an increase in output volatility.

The empirical approach of Aizenman *et al.* (2008) has been applied to several developing and developed economies. Using quarterly data for India from 1996 to 2009, Hutchison *et al.* (2012) estimate the Trilemma indices for each of the three policy objectives: monetary policy independence, exchange rate stability, and capital account openness (financial integration). They confirm the existence of the Trilemma rule in India: an increase in capital account openness has come at the cost of reduction in monetary policy independence or of limitations on exchange rate stability. Similarly, Cortuk and Singh (2011), applying a similar approach for Turkey using quarterly data

from 1998 to 2010, show the existence of the Trilemma rule and the changing roles of three Trilemma policies in different periods of time. Particularly, monetary independence and exchange rate stability have diminishing effects on inflation, while capital openness has an increasing effect. In a similar manner, using annual data for Greece from 1970 to 2010, Hsing (2012) finds the tradeoff among exchange rate stability, monetary independence and financial integration.

Vietnam has been included in a group of several economies in the empirical Trilemma literature (Aizenman *et al.,* 2011; Aizenman & Ito, 2014; Aizenman *et al.,* 2016). In those studies, the data for Vietnam were pooled in as part of a bigger panel dataset comprising several countries[4]. Given that the characteristics of the Vietnamese financial system, macroeconomic conditions, and, more importantly, Vietnam's policy responses, are very different from those of other countries, the reported results in those studies are more relevant for the group of countries as a whole and might hide many particular policy features specific to Vietnam. The only empirical application of Trilemma analysis to Vietnam as a single country is the study by Ho and Ho (2018), but it focuses on the movements of Trilemma policies before and after the 2008-2009 global financial crisis and does not take further steps to estimate the impact of these policies on main macroeconomic indicators.

4. DATA DESCRIPTION

As stated earlier, we employ the model proposed by Aizenman *et al.* (2008) to quantify the Trilemma Index for Vietnam between 1998 and 2013. Instead of yearly data in the context of cross-country analysis as carried out in Aizenman *et al.* (2008), we use monthly data with the hope that our results will provide more useful information for policy considerations.

4.1 MEASURING MONETARY INDEPENDENCE (MI)

Following Aizenman *et al.* (2008), MI is measured based on the correlation between i_i, interest rates in the home country (Vietnam), and i_j, interest rates in the base country (the United States):

$$MI = \frac{1-\text{corr}(i_i,i_j)}{2} \quad (6)$$

[4] The group includes Cambodia, China, Hong Kong, India, Indonesia, Korea, Malaysia, Philippines, Singapore, Thailand, and Vietnam.

where i_i is the refinancing rate when commercial banks ask for loans from the SBV and i_j is the effective funds rate, similar to the policy rate from the Federal Reserve (Fed).[5]

The United States was chosen as the base country because the US dollar is the dominant foreign currency in Vietnamese markets, with almost all international transactions denominated in USD. That said, a change in the international value of US dollars, for example initiated by an adjustment of the Fed funds rate, would directly affect the foreign exchange market in Vietnam.

We estimate monthly correlations between i_t and i_j ($corr(i_i,i_j)$) from daily data.[6] As the values of $corr(i_i,i_j)$ would range in [-1,1], the value of MI would lie in [0,1]. When $corr(i_i,i_j)=-1$, this means that the two interest rates were moved/adjusted in opposite ways. For example, the Fed increased i_j by 1% and at the same time the SBV decreased i_i by 1%. In this case, MI =1 reflects that the way the SBV adjusted its policy rate was totally independent of the Fed's operation. Similarly, when $corr(i_i,i_j)$=1, the two interest rates were moved/adjusted in the same direction, for example the Fed increased i_j by 1% and at the same time the SBV increased i_i by 1%. In this case, MI = 0 implies that the way the SBV adjusted its policy rate was totally dependent on the Fed's policy.

Figure 5 depicts the MI index between January 1998 and December 2013. It shows that the SBV's interest rate policy was relatively independent from the Fed prior to 2004, since the values fluctuated around 0.5. Since then, the MI index has experienced swings of higher magnitude. The simple linear trend line of MI suggests that the interest rate policy conducted by the State Bank of Vietnam was gradually adjusted towards a less independent stance.

[Insert Figure 5 here]

4.2 Measuring Exchange Rate Stability (ES)

Following Aizenman *et al.* (2008), we measure the exchange rate stability (ES) by using the monthly standard deviations of daily logarithmic change in the exchange rate between the Vietnamese dongs and the US dollar, $\Delta(\log(exch_{rate}))$, as follows[7]:

$$ES = \frac{0.01}{0.01 + stdev(\Delta(\log(exch\_rate))} \quad (7)$$

[5] Historical Data Fed Interest Rates, Board of Governors of the Federal Reserve System. Retrieved from: http://www.federalreserve.gov/releases/h15/data.htm (Accessed on 1/9/2015)

[6] For example, $corr(i_i,i_j)$ of January 2000 is calculated from correlation of 31 daily observations in that month.

[7] Aizenman *et al.* (2008) use the annual standard deviations of the monthly log-change in the exchange rate.

where $\Delta(\log(exch_{rate})) = \log(exch\_rate)_t - \log(exch\_rate)_{t-1}$. If ES = 1, the exchange rate was kept fixed during the period. Otherwise, any significant and frequent adjustments to exchange rates would translate into bigger values of the standard deviation, which in turn lowers the value of ES. For example, if the monthly standard deviation is equal to 0.01, ES is equal to 0.5 and reflects the fact that the exchange rate deviated by 1% from its mean value over the month. We used daily USD/VND exchange rate data taken from OANDA database to calculate the ES index for Vietnam.[8]

[Insert Figure 6 here]

Figure 6 depicts the performance of the ES index between January 1998 and December 2013. It shows that the SBV's exchange rate policy was quite stable and independent (score closely to 1 point) over two distinct periods: from 1998 until mid-2000 and then from early-2002 until the end of 2004. The performance of the ES index fluctuated widely between 2005 and 2007, then became more stable again from 2008 until the end of the study sample. However, the level of independence was sharply reduced as the index fluctuated around 0.6 on average. The trend line of the ES shows that exchange rate policy was significantly adjusted towards a more flexible stance between 1998 and 2013.

4.3 MEASURING FINANCIAL OPENNESS (FO)

To measure the financial openness (FO) index, this study follows the approach of Abdul *et al.* (2010) in quantifying the financial liberalization index whereby FO is defined as the combination of four separate aspects as follows:

$$FO = \frac{\alpha_1+\alpha_2+\alpha_3+\alpha_4}{12} \quad (8)$$

where α_1, α_2, α_3, and α_4 capture respectively restrictions in the foreign exchange market, restrictions of entry for foreign financial institutions, restrictions on international capital flows, and restrictions for foreign investors in securities markets.

Information about the above restrictions was taken from the *Annual Report on Exchange Arrangements and Exchange Restrictions (AREAER* - International Monetary Fund*).* Each aspect was assigned a grade between 0-3 (0 for totally restricted and 3 for totally free/open) based on the current

[8] Historical Data on Currency Exchange Rate, OANDA - Forex Trading and Exchange Rates Services. Retrieved from: www.oanda.com (Accessed on 1/9/2015)

status of openness. Then, the aspect points were added up and divided by 12 (the maximum possible number) to obtain the final index. Accordingly, the value of FO ranges from 0 (no flow at all) to 1 (free flows). More details regarding its measurement are presented in Appendix A.

[Insert Figure 7 here]

As shown in Figure 7, international capital flows were relatively restricted in Vietnam over the period prior to 2005. In 2006, the government began to remove the barriers to these restrictions and during the same period, the securities market also experienced great expansion. However, from 2012, the progress reversed, potentially explained by the consequence of high inflation and high risk of crisis transmission since 2009.

5. EMPIRICAL RESULTS AND DISCUSSIONS

5.1 TESTING THE TRILEMMA RULE

Aizenman *et al.* (2008) propose to test the Trilemma hypothesis by estimating a regression model (without a constant term), presented in equation (9), where the dependent variable is a constant number C and the three indices are used as independent variables, such as:

$$C = a_1 MI_t + a_2 ES_t + a_3 FO_t + \varepsilon_t \quad (9)$$

Note that the regression results would be the same for any given value of C. However, C is chosen to be 2 in order to hypothetically reflect the nature of the Trilemma phenomenon. According to the rule, only a combination of two out of three policies can be maintained at the same time, so it is reasonable to assume that the combination of three measures of the three policies might be equal to 2 when scores for each aspect lie in the range [0,1].

The literature is often based on a high value of the coefficient of determination (adjusted R^2) and the statistical significance of the coefficients (a_1, a_2, a_3) to conclude that there is empirical evidence in favor of the position that the Trilemma rule is effective and that a linear specification is applicable to explain the "binding" characteristic of those three policy indicators. Otherwise, one can argue that the Trilemma rule is not effective or that the linkage among the three policy indicators is nonlinear.

We divide the whole sample period into two sub-periods: from January 1998 to December 2006 and from January 2007 to December 2013. The date 1 January 2007 is chosen as the break point because many policies related to economic liberalization came into effect on this date, as Vietnam

officially joined the WTO and a structural break test has confirmed this choice[9]. **Error! Reference source not found.** presents the estimates of equation (9) for two sub-periods and for the whole sample. All coefficients are highly statistically significant at the 99% confidence levels with high values of the adjusted R^2. These results suggest the relatively high goodness-of-fit of the empirical models under consideration.

[Insert Table 1 here]

The values of the estimated coefficients of MI, ES, and FO in **Error! Reference source not found.** show empirical evidence of the trade-off among the three policy goals. The predictions using the estimated coefficients and the actual values for the variables, such as $\hat{a}_1 MI_t$, $\hat{a}_2 ES_t$ and $\hat{a}_3 FO_t$ provide more information on the weights with which each policy goal was considered by the macro policy settings. More specifically, Figure 8 shows different predictions of each two out of three policy indicators (i.e., $MIES = \hat{a}_1 MI_t + \hat{a}_2 ES_t$, $ESFO = \hat{a}_2 ES_t + \hat{a}_3 FO_t$, and $MIFO = \hat{a}_1 MI_t + \hat{a}_3 FO_t$) for the two sub-periods 1998-2006 and 2007-2013.

[Insert Figure 8 here]

Between 1998 and 2006 (Model 1), the combination of higher exchange rate stability and more financial openness (i.e., the predicted value of $ESFO$) was the dominant bundle until the combination of monetary independence and financial openness (i.e., the predicted value of $MIFO$) increased in popularity in late 2006. For the period 2007-2013 (Model 2), the combination of monetary independence and exchange rate stability has received more weight in setting monetary policy because the predicted value for $MIES$ increased slightly in comparison with $ESFO$ and $MIFO$. As $ESFO$ and $MIFO$ always stayed over $MIES$ for the entire period from 1998 to 2013, the empirical results suggest that controlling the capital flows appears to have been the top priority of the government. On the other hand, monetary independence has received less priority, though its presence has increased slightly in the second period of 2007-2013.

5.2 Testing the Stability of Trilemma Index

Figure 9 shows the movement of the Trilemma index which was calculated using the fitted values for the period 1998-2013 (Model 3). This series reflects the fluctuation of the combined values of the three Trilemma policy indicators over time around a constant value $C = 2$. The addition of a

[9] Test result will be provided upon request.

polynomial smoother line (Kernel-weighted local polynomial smoothing) helps to detect three different periods of distinct performance of the Trilemma index.

[Insert Figure 9 here]

We first observe that, from early 1998 to late 2003, the Trilemma index was relatively stable. Second, from early 2004 to late 2007, the index made a V-shape trend line with values fluctuating in a zone between 1.5 and 2, and rarely going higher than 2. Third, from early 2008 up to late 2013, the index shows bigger fluctuations with the average values frequently higher than 2. These results indicate that the Trilemma index from 2008 onwards was less stable than in the previous period, as the value of the index fluctuated in higher and wider ranges, suggesting the violation of the Trilemma rule in the latter period.

An interesting question that arises is what would happen to the Trilemma index if the SBV had maintained the same set of policies from one period to another one? To answer this question, we used the coefficients for MI, ES, FO estimated from data for the first period 1998-2006 to calculate the Trilemma index for the entire period 1998-2013. Similarly, the coefficients estimated from the latter period 2007-2013 were used to calculate the Trilemma index for the entire sample. The results in Figure 10 show that when the estimated coefficients from 1998-2006 are applied to the whole series, the fitted values for 2007-2013 increased to the range of 3-3.5 (left figure), whereas the fitted values for 1998-2006 are stable around 1.7 when the estimated coefficients from 2007-2013 are filled in (right figure).

[Insert Figure 10 here]

The results in Figure 10 provide several important implications. First, the combination of Trilemma policies in 1998-2006 seem more stable than that in 2007-2013. More importantly, if the combination of the Trilemma policies in 1998-2006 is assumed to be optimal ($C = 2$), this bundle would violate the Trilemma rule if it was applied for 2007-2013 (when the fitted value of C reached 3-3.5). In contrast, the violation of the Trilemma rule was not observed if the combination of policies in the latter period 2007-2013 is applied for the former period 1998-2006 because the fitted value of the constant reduced stability to around 1.7.

[Insert Figure 11 here]

It is worth noting that the initial findings for the stability of the Trilemma policies appear to be well correlated with the relatively good macroeconomic performance between 1998 and 2006 and

the instability of macroeconomic conditions after 2007, reflected in higher inflation and lower industrial production trends (see Figure 11). It thus raises the question as to whether the stability in those policies might have contributed to the stability of the economy. We provide further evidence in sub-section 4.3.

5.3 Impacts of Trilemma Policies on Inflation

To analyze the interaction between the Trilemma policies and the inflation rate, we follow Aizenman *et al.* (2008) and estimate the following model:

$$Inf_t = a_0 + (a_1 Inf_{t-1}) + a_2 MI_t + a_3 ES_t + a_4 FO_t + a_5 RES_t + \varepsilon_t \quad (10)$$

where Inf_t captures two aspects of inflation: the inflation rate (cpi_g) measured as the monthly growth rate of the Consumer Price Index (CPI) and the inflation volatility (std_cpi) measured as the forward 12-month standard deviation of cpi_g. Those volatility variables are constructed based on the assumption that changes in Trilemma policies might take up to 12 months to exert their full impact on macroeconomic indicators. The inclusion of cpi_g and std_cpi on the left-hand side of equation (10) is to account for instantaneous and lagged impacts respectively. The regression with cpi_g expects to reflect possible impacts from the Trilemma policies on inflation within the same month while with std_cpi, it is expected to look at the linkages between the Trilemma policies and a fluctuation in inflation rates over the next 12 months.

RES_t is the level of current gross international reserves as a ratio to yearly GDP (summation of the previous 12 months of GDP). In line with the argument of Obstfeld *et al.* (2010), we included RES_t in the model as we expect a positive correlation between the amount of foreign reserves and the Trilemma policies. The reserve accumulation gives policymakers more flexibility in dealing with the short-run trade-offs between monetary independence and exchange rate stability, at a given level of financial openness. In short, the more reserves a country has, the higher the Trilemma index it can maintain. Inf_{t-1} is added to the models in order to account for possible dynamic effects. The inclusion of these new variables, however, reduces the range of the sample from January 2008 to December 2013 to the period from January 2008 to December 2012.

[Insert Table 2 here]

The results in Table 2 show the negative relationships between monetary independence and exchange rate stability with the inflation rate; however, those linkages disappear in the second period.[10] This means that during 1998-2006, the SBV might have increased the independence of monetary policy or kept the exchange rate more stable to reduce inflation. Nevertheless, in the next period 2007-2012, statistical evidence to support this relationship has disappeared, implying that monetary independence and exchange rate stability seem to have lost their influence on inflation. Regarding financial openness, it had no impact on inflation in 1998-2006 but has exerted significant influence since 2007. This outcome is quite reasonable given the fact that the financial openness curve is almost unchanged during 1998-2006. The statistical evidence of a strong positive relationship between inflation and financial openness is quite noticeable. Although we might need a more robust regression to confirm the linkage, the statistical result still provides some evidence to support the hypothesis that financial openness played some role in the turmoil of the inflation rate during 2007-2012.

Estimated coefficients for international reserves (RES) have no statistical impact on inflation in both sub-periods, suggesting that foreign exchange market intervention might not be an effective tool in either mitigating the Trilemma trade-off or reducing inflation. However, RES is particularly significant in explaining the volatility of inflation, implying that foreign exchange intervention could play some role in decreasing the fluctuation of price level. This outcome might also reflect the fact that the Vietnam markets and financial system are still affected by dollarization.

5.4 Impacts of Trilemma Policies on Economic Growth

Interactions between the Trilemma policies and economic growth can be predicted by the following model:

$$gdp_t = a_0 + (a_1 gdp_{t-1}) + a_2 MI_t + a_3 ES_t + a_4 FO_t + a_5 RES_t + \varepsilon_t \quad (11)$$

where economic growth[11], gdp_t, is measured in two forms: growth rate (gdp_g) as monthly real GDP growth rates and growth volatility (std_gdp) as forward 12-month standard deviation of gdp_g.

[10] The VIF tests show that none of the models in Table 2 and Table 3 in Section 5.4 suffers from multicollinearity issues. Results of the test could be provided upon request addressed to the corresponding author.
[11] As monthly data for GDP is unavailable, the data for GDP in this section is interpolated from a combination of quarterly GDP data and monthly growth of industrial production index using the technique developed by Denton (1971)

The results of the estimations, presented in Table 3, show that only exchange rate stability has a negative link with GDP growth rate while there is no significant influence from monetary independence and financial openness. However, it is quite interesting to see that higher exchange rate stability leads to lower economic growth in both periods 1998-2006 and 2007-2012 periods. This finding is further strengthened by the growth volatility regression indicating that lower growth fluctuation during 2007-2012 is associated with higher exchange rate stability. In short, these results suggest that trying to stabilize the exchange rate was unlikely to lead to higher economic growth during 1998-2012.

The impact of monetary independence is statistically insignificant in all economic growth regressions, while financial openness only influences growth volatility during 2007-2012. The insignificant impact of monetary independence is unexpected but is explainable given the fact that the interest rate is not the ultimate objective of monetary policy in Vietnam (To *et al.,* 2012).

[Insert Table 3 here]

Similar to the inflation regressions, international reserves have no significant impact on economic growth but strongly affect growth volatility in both sub-periods. To some extent, the positive relationship between international reserves and growth volatility indicates that foreign exchange intervention might help to maintain economic growth stability.

6. CONCLUDING REMARKS

The Mundell-Fleming trilemma suggests that a country has three policy options in setting monetary policy, by combining either two of fixed exchange rates, free capital flows, and monetary policy independence. In this paper, we performed a quantitative analysis of the Trilemma indices for Vietnam to provide insights about the policy framework that has been employed by the State Bank of Vietnam in order to cope with the harmful effects of the global financial crisis, macroeconomic instability, and rising market uncertainty. Our study covers the period from 1998 to 2013 and obtained several important findings.

Our results show that prior to 2005, the exchange rate was maintained in a relatively fixed manner, while financial openness was nearly constant. From 2006 onwards, financial openness has increased gradually, and the exchange rate has become more volatile. This would indicate that the SBV might have found it easier to keep the exchange rate at the desired level because the capital account was still in a restricted mode. The capital account opening put great pressure on the way

the SBV controls the exchange rate. Additionally, it might raise the question about the appropriateness of the exchange rate regime the SBV has used since 2006, and whether or not the regime is suitable to the changing conditions of the domestic economy, as well as the international financial system following the global financial crisis of 2008-2009.

Second, the implementation of the Trilemma policies was less volatile in 1998-2006 than in 2007-2014. There was indeed a shock in the progression of the Trilemma index between 2006 and 2007, which lead us to believe that the Trilemma rule was violated suddenly. This result leads us to speculate that while easing the restrictions on capital inflows, the SBV still tried to maintain exchange rate stability and interest rate independence concurrently. This policy setting would see insufficiently sterilized capital inflows, thus causing high inflation and negative impacts on the domestic financial system.

Third, between 1998 and 2006, the interest rate and the exchange rate policies showed some significant linkages with the inflation rate. However, those linkages disappeared over the period 2007-2012 as only financial openness exerted a significant impact on inflation rate. This finding suggests that when the economy was still relatively closed, the SBV could use regular monetary instruments such as the interest rate and exchange rate to effectively control inflation. By contrast, when the economy became more open, external forces from the increased financial openness appear to have had more of an impact on inflation.

Lastly, exchange rate stability proved to be the most effective policy to manage the trends and volatility of economic growth. The effects from the interest rate and financial openness policies were unclear and insignificant. This finding suggests that the SBV should have to pay more attention to its exchange rate policy.

REFERENCES

Abdul, A., Enrica, D., Thierry, T., 2010. A New Database of Financial Reforms. IMF Staff Papers 57, 281-302

Aizenman, J., 2010. The Impossible Trinity (aka The Policy Trilemma). In: Working Paper Series. Department of Economics, UC Santa Cruz

Aizenman, J., Chinn, M.D., Ito, H., 2008. Assessing the Emerging Global Financial Architecture: Measuring the Trilemma's Configurations over Time. National Bureau of Economic Research Working Paper Series No. 14533

Aizenman, J., Chinn, M.D., Ito, H., 2011. Surfing the waves of globalization: Asia and financial globalization in the context of the trilemma. Journal of the Japanese and International Economies 25, 290-320

Aizenman, J., Chinn, M.D., Ito, H., 2013. The "Impossible Trinity" Hypothesis in an Era of Global Imbalances: Measurement and Testing. Review of International Economics 21, 447-458

Aizenman, J., Chinn, M.D., Ito, H., 2016. Monetary policy spillovers and the trilemma in the new normal: Periphery country sensitivity to core country conditions. Journal of International Money and Finance 68, 298-330

Aizenman, J., Ito, H., 2014. Living with the Trilemma Constraint: Relative Trilemma Policy Divergence, Crises, and Output Losses for Developing Countries. Journal of International Money and Finance 49, 28-51

Cortuk, O., Singh, N., 2011. Turkey's trilemma trade-offs: Is there a role for reserves? In: MPRA Paper. University Library of Munich, Germany

Denton, F.T., 1971. Adjustment of Monthly or Quarterly Series to Annual Totals: An Approach Based on Quadratic Minimization. Journal of the American Statistical Association 66, 99-102

Feenstra, R.C., Taylor, A.M., 2011. International Economics. Worth Publishers, New York.

Fleming, M., 1962. Domestic Financial Policies Under Fixed and Under Floating Exchange Rates. In: Staff Papers, pp. 369-380. International Monetary Fund

Forbes, K., Fratzscher, M., Straub, R., 2015. Capital Flow Management Measures: What Are They Good For? National Bureau of Economic Research Working Paper Series No. 20860

Han, X., Wei, S.-J., 2018. International transmissions of monetary shocks: Between a trilemma and a dilemma. Journal of International Economics 110, 205-219

Herwartz, H., Roestel, J., 2017. Mundell's trilemma: Policy trade-offs within the middle ground. Journal of International Money and Finance 75, 1-13

Ho, T.T., Ho, T.H., 2018. Operating the impossible trinity before and after the global financial crisis 2007-2008: Evidence in Vietnam. International Journal of Trade and Global Markets 11, 40-49

Hsing, Y., 2012. Impacts of the Trilemma Policies on Inflation, Growth and Volatility in Greece. International Journal of Economics and Financial Issues 2, 373-378

Hutchison, M., Sengupta, R., Singh, N., 2012. India's Trilemma: Financial Liberalisation, Exchange Rates and Monetary Policy. The World Economy 35, 3-18

Klein, M.W., Shambaugh, J.C., 2015. Rounding the Corners of the Policy Trilemma: Sources of Monetary Policy Autonomy. American Economic Journal: Macroeconomics 7, 33-66

Ligonniere, S., 2018. Trilemma, dilemma and global players. Journal of International Money and Finance 85, 20-39

Mahadevan, R., Hoang, V.-N., 2016. The nexus between poverty and deprivation in Vietnam. Journal of Policy Modeling 38, 290-303

Mankiw, G., 2010. The Trilemma of International Finance. In: The New York Times, New York

Mundell, R., 1963. Capital Mobility and Stabilization Policy under Fixed and Flexible Exchange Rates. The Canadian Journal of Economics and Political Science / Revue canadienne d'Economique et de Science politique 29, 475-485

Nguyen, H.M., Cavoli, T., Wilson, J., 2012. The determinants of inflation in Vietnam, 2001 - 09. ASEAN Economic Bulletin. Vol. 29.2012, 1-14

Obstfeld, M., Shambaugh, J.C., Taylor, A.M., 2010. Financial Stability, the Trilemma, and International Reserves. American Economic Journal: Macroeconomics 2, 57-94

Obstfeld, M., Taylor, A.M., 1997. The Great Depression as a Watershed: International Capital Mobility over the Long Run. National Bureau of Economic Research Working Paper Series No. 5960

Pham, T.A., 2011. Inflation and Monetary Policy Rules. In: VEPR Working Paper Series. Vietnam Centre for Economic and Policy Research, Hanoi, Vietnam

Rey, H., 2015. Dilemma not Trilemma: The Global Financial Cycle and Monetary Policy Independence. National Bureau of Economic Research Working Paper Series No. 21162

Sepehri, A., Akram-Lodhi, A.H., 2002. A crouching tiger? A hidden dragon? Transition, savings and growth in Vietnam, 1975-2006. International Institute of Social Studies of Erasmus University (ISS), Hague, The Netherlands.

Steiner, A., 2017. Central banks and macroeconomic policy choices: Relaxing the trilemma. Journal of Banking & Finance 77, 283-299

To, T.A.D., Bui, Q.T., Pham, S.A., Duong, T.T.B., Tran, T.K.C., 2012. Inflation Targeting and Implications for Monetary Policy Framework in Vietnam. Committee NAE (Ed.). Knowledge Publishing House, Hanoi, Vietnam

Vu, K., 2012. Vietnam Tells Central Bank to Clean Up Bad Debt. In: The Wall Street Journal, US

TABLES

Table 1: Empirical Evidence of Trilemma Violation

Time period	1998-2006 (Model 1)	2007-2013 (Model 2)	1998-2013 (Model 3)
MI (coefficient)	0.275*	0.632***	1.804***
MI (standard error)	(0.149)	(0.123)	(0.174)
ES (coefficient)	0.452***	0.917***	0.679***
ES (standard error)	(0.054)	(0.111)	(0.087)
FO (coefficient)	4.302***	1.800***	1.170***
FO (standard error)	(0.160)	(0.130)	(0.094)
BIC	-197.146	-166.537	-74.932
Sample size	108	84	192
R^2	0.9979	0.9982	0.9907

Notes: *, **, *** indicate statistical significance at 5%, 1% and 0.1% levels, respectively.

Table 2: Estimation Results for Inflation Model

	Inflation rate 1998-2006	Inflation rate 2007-2012	Inflation volatility 1998-2006	Inflation volatility 2007-2012
Inf_{t-1}	0.159	**0.630*** **		
	(0.096)	(0.095)		
MI	**-0.029***	0.008	**0.010*** **	-0.007
	(0.013)	(0.018)	(0.002)	(0.005)
ES	**-0.016***	0.005	-0.001	0.002
	(0.007)	(0.014)	(0.001)	(0.004)
FO	-0.04	**0.028*** **	-0.005	-0.004
	(0.037)	(0.029)	(0.005)	(0.008)
RES	0.001	0.016	**-0.009***	**0.020*** **
	(0.024)	(0.015)	(0.003)	(0.004)
_Cons	0.014	-0.025	0.006*	0.008
	(0.016)	(0.026)	(0.002)	(0.007)
R2	0.143	0.43	0.403	0.45
p-value	0.007	0.000	0.000	0.000
df_r	101	66	103	67
BIC	-724.603	-474.21	-1161.77	-670.562
Sample size	107	72	108	72

Notes: * p<0.05, ** p<0.01, *** p<0.001 (standard errors are shown in parentheses below the individual coefficient estimates).

Table 3: Estimation Results for Growth Model

	Growth rate 1998-2006	Growth rate 2007-2012	Growth volatility 1998-2006	Growth volatility 2007-2012
gdp_{t-1}	**0.219***	0.234		
	(0.094)	(0.121)		
MI	-0.175	-0.028	-0.015	-0.044
	(0.222)	(0.353)	(0.015)	(0.029)
ES	**-0.011***	**-0.023****	0.000	**-0.105*****
	(0.117)	(0.279)	(0.008)	(0.023)
FO	-0.104	-0.305	-0.03	**0.372*****
	(0.672)	(0.581)	(0.046)	(0.048)
RES	-0.168	-0.087	**0.061***	**0.217*****
	(0.445)	(0.299)	(0.030)	(0.025)
_Cons	0.177	0.254	0.147***	-0.05
	(0.294)	(0.505)	(0.020)	(0.042)
r2	0.058	0.056	0.101	0.658
p-value	0.297	0.56	0.026	0.000
df_r	101	66	103	67
BIC	-103.769	-45.432	-689.365	-406.579
Sample size	107	72	108	72

Notes: * p<0.05, ** p<0.01, *** p<0.001 (standard errors are shown in parentheses below the individual coefficient estimates).

FIGURES

Figure 1: GDP growth, current account balance and inflation rate in 1993-2012[12]

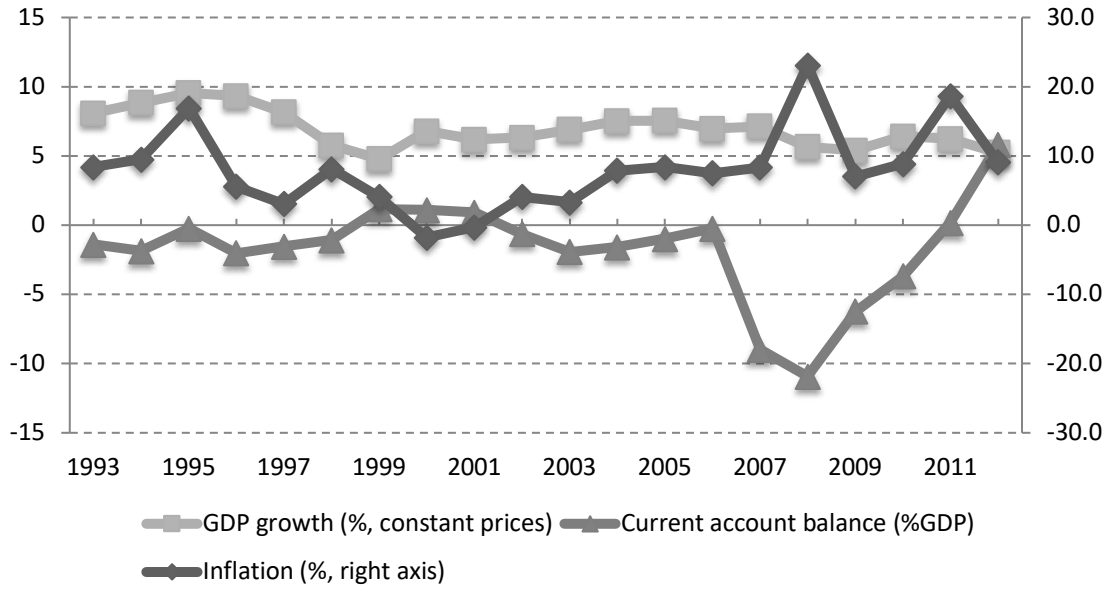
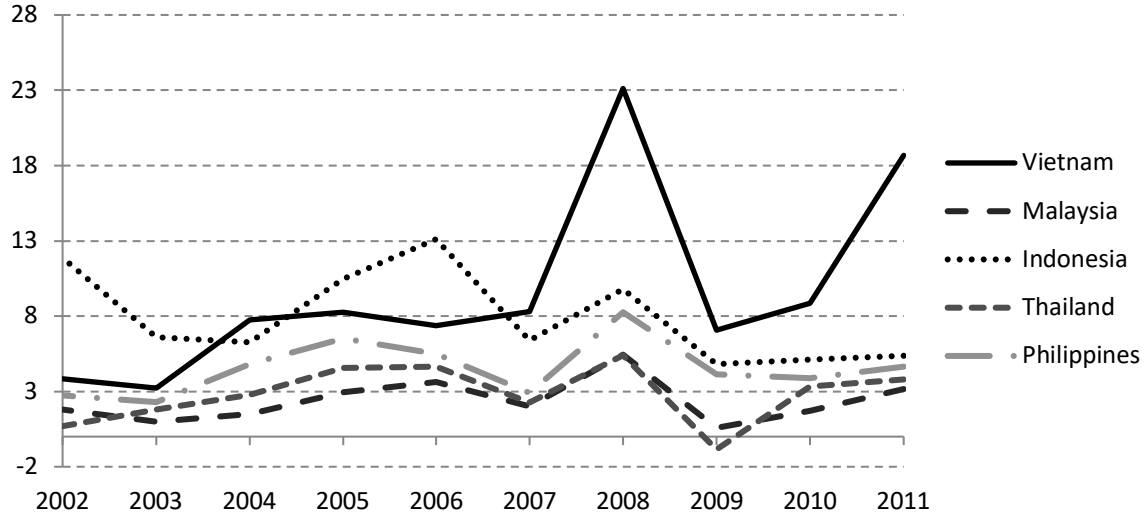


Figure 2: Inflation rates in ASEAN economies[13]



[12] Data are sourced from World Development Indicators Database and Global Development Finance.
[13] Data are sourced from World Development Indicators Database and Global Development Finance.

Figure 3: Reactions from State Bank of Vietnam

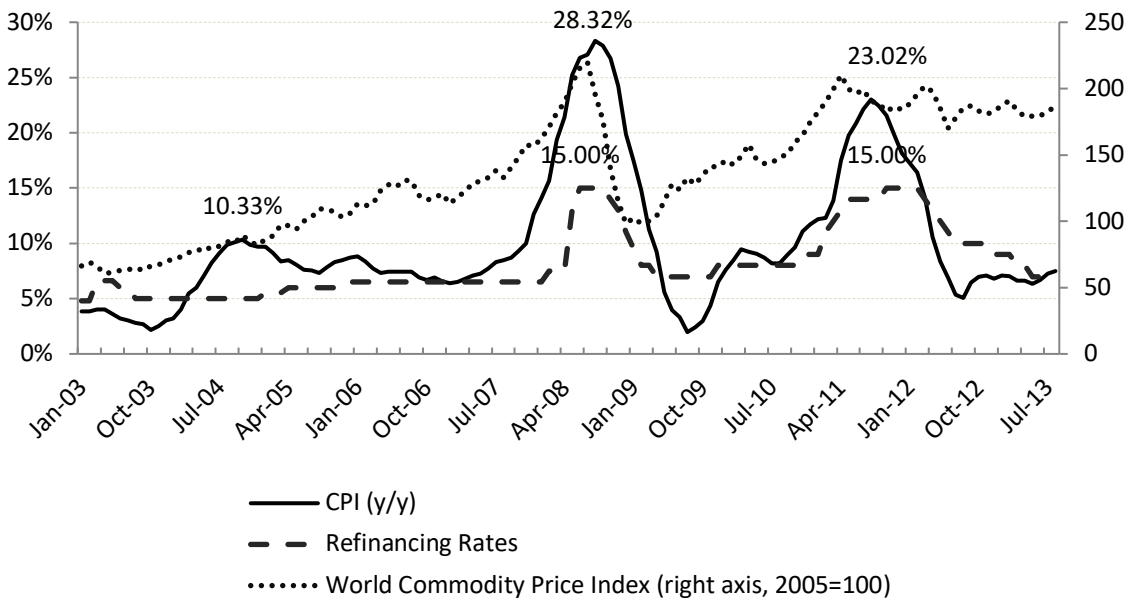
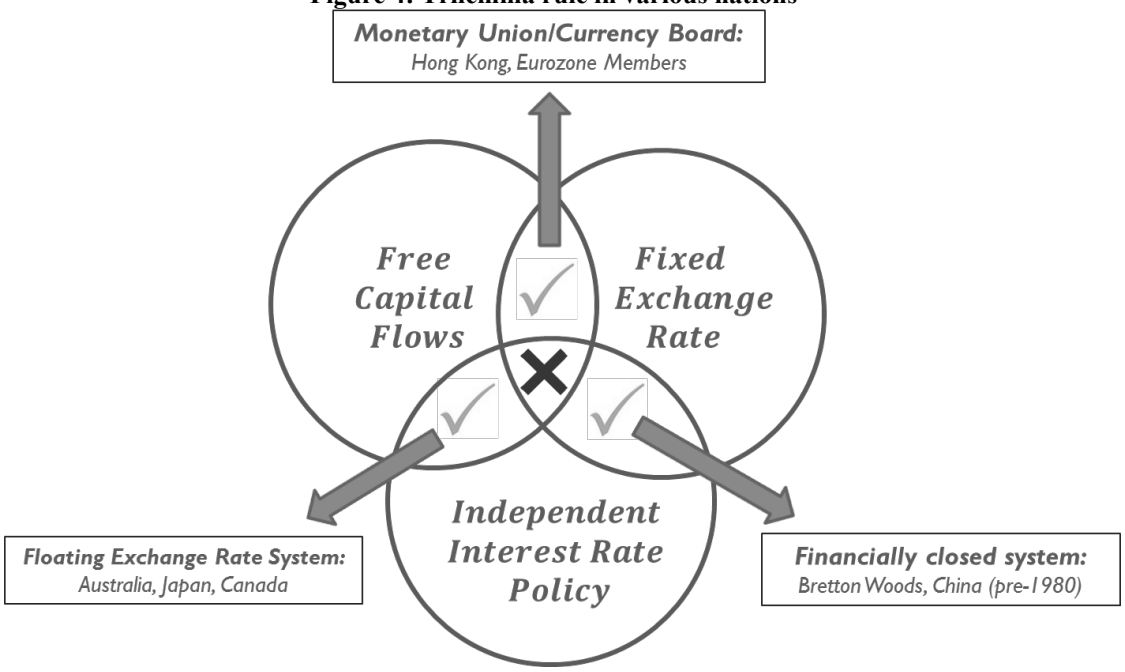


Figure 4: Trilemma rule in various nations[14]



[14] Adapted from Aizenman and Ito (2014)

Figure 5: Monetary Independence Index[15]

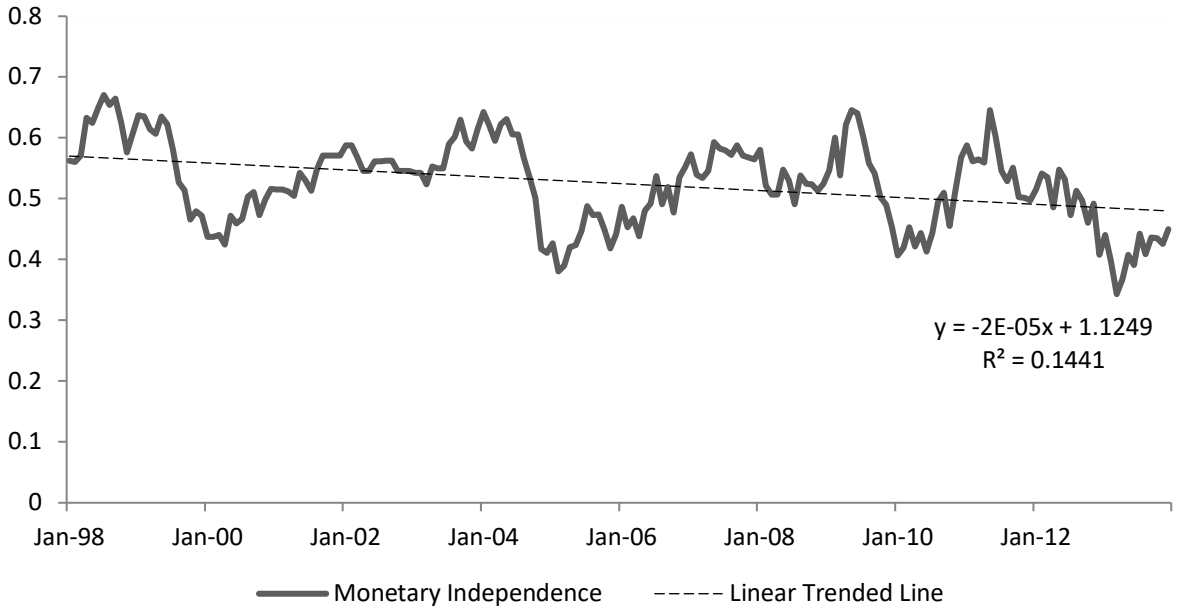
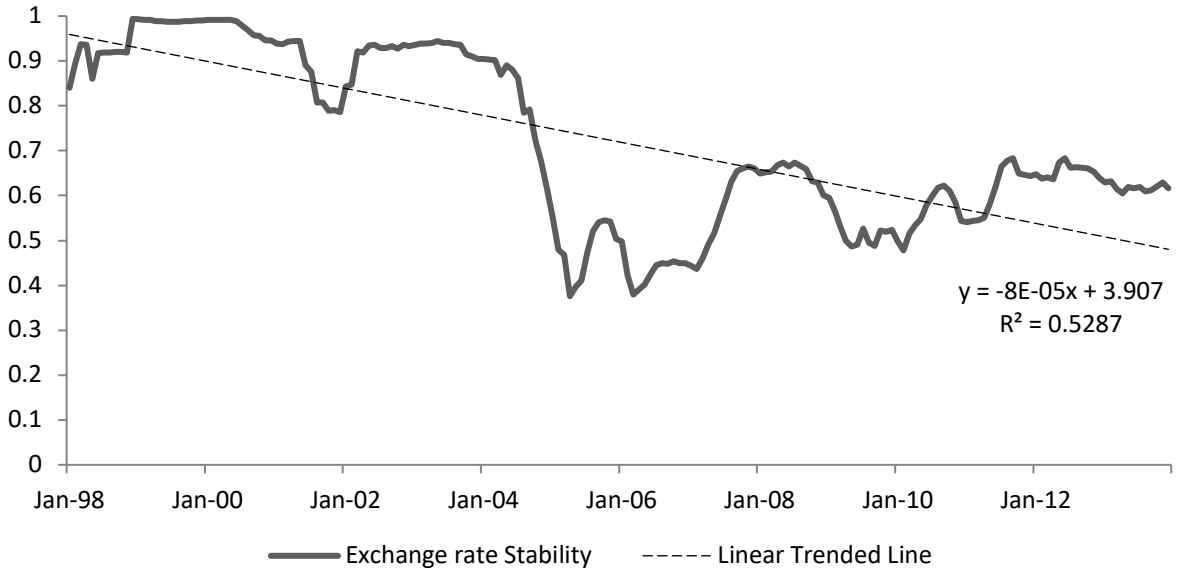


Figure 6: Exchange Rate Stability Index[16]



[15] The index is smoothed out by taking the seven-month moving averages encompassing the preceding three-months concurrently, and the following three months of each observation.

[16] The index is smoothed out by taking the seven-month moving averages encompassing the preceding three-months concurrently, and the following three months of each observation.

Figure 7: Financial Openness Index

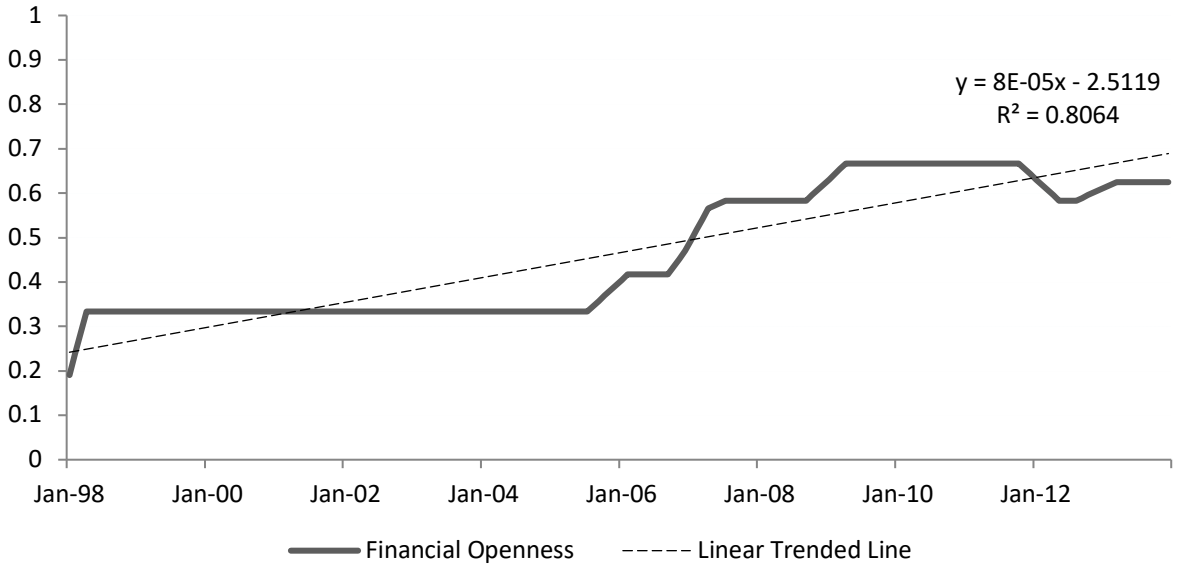


Figure 8: Combinations of Trilemma Policy indicators

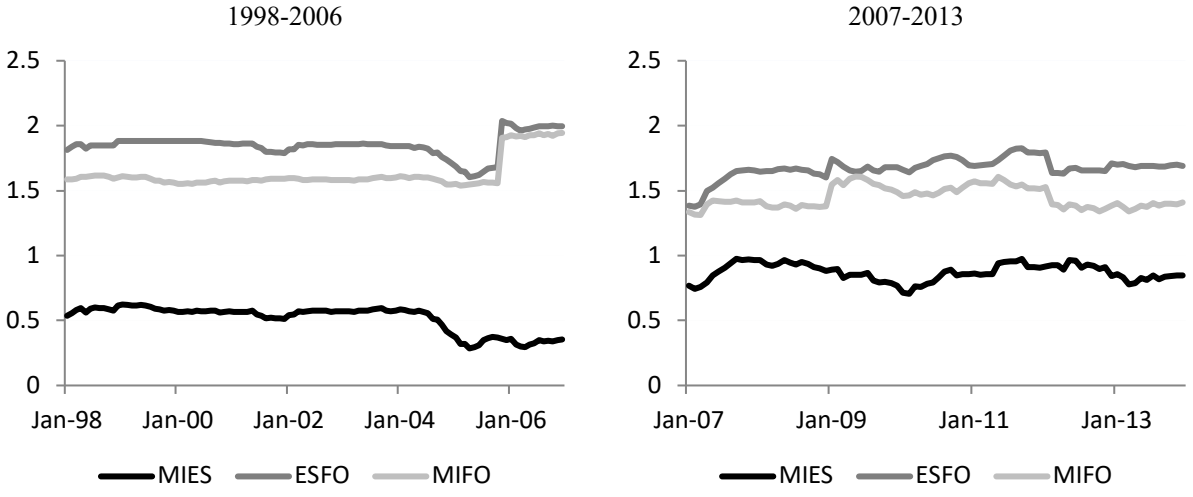


Figure 9: The stability of Trilemma index

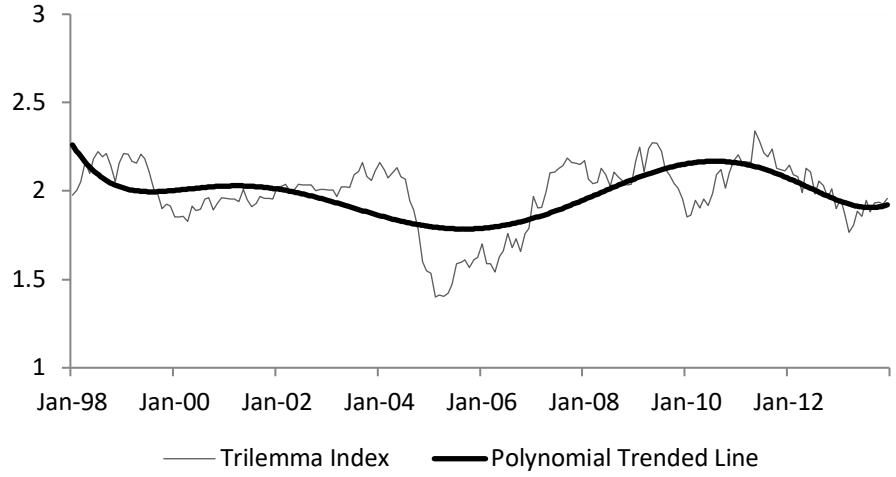


Figure 10: The stability of Trilemma index in two sub-periods 1998-2006 (left) and 2006-2013 (right)

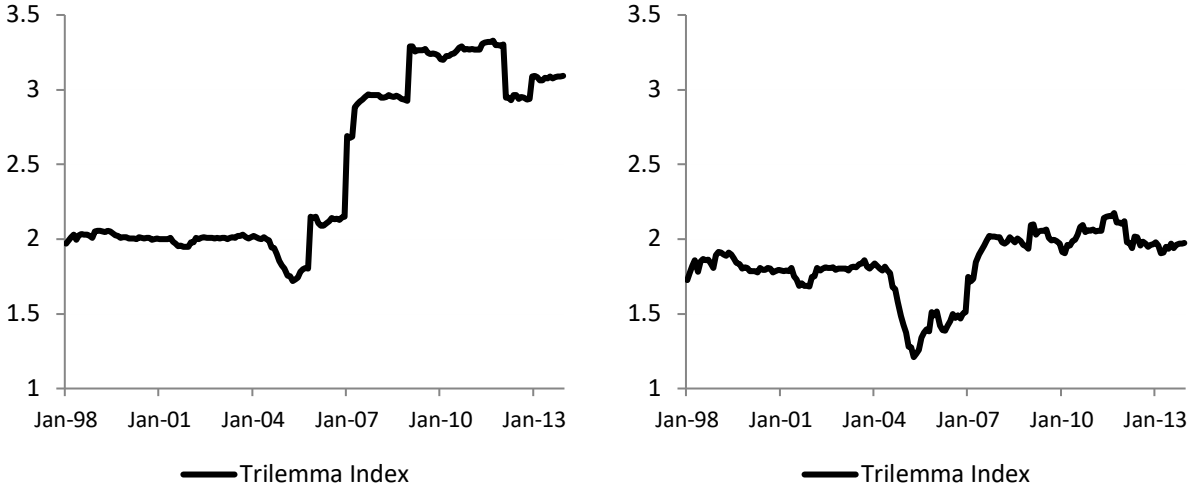
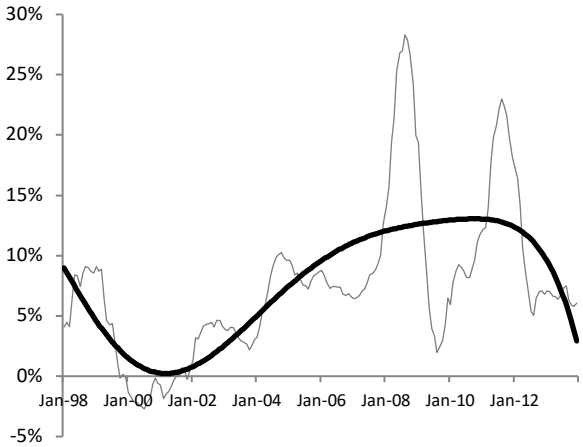
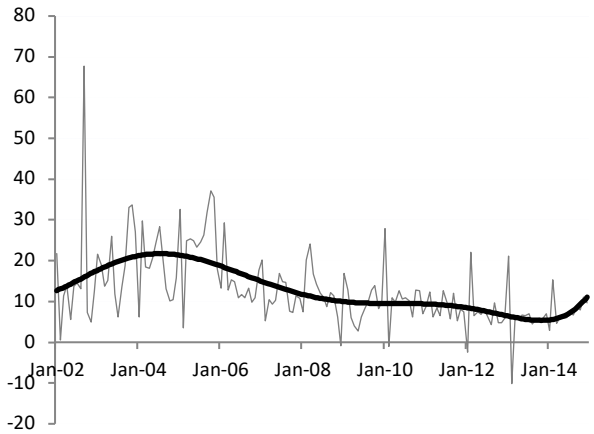


Figure 11: The Performance of Inflation and Industrial Production Index[17]

Inflation



Industrial Production Index



[17] The bold lines is Polynomial trended lines for Inflation and Industrial Production Index respectively.

APPENDIX A: CODING RULES FOR THE FREE CAPITAL MOVEMENT INDEX

1. Restrictions in foreign exchange market

Coded as 0 whenever a special exchange rate regime for either capital or current account transactions exists.
Coded as 1 when the surrender of export proceeds is lower than 100%.
Coded as 2 if there is no requirement on surrender of export proceeds.
Coded as 3 if no restrictions in foreign exchange activities; foreigners are allowed to bring in/out an equivalent or more than USD 10.000 value in cash.

2. Restrictions of entry for foreign financial institutions

Coded as 0 when no entry of foreign banks is allowed.
Coded as 1 when there are branching restrictions or joint venture is allowed, but the range of activities that banks can take consists of only banking activities; and nonresidents must hold less than 50 percent equity share.
Coded as 2 when the majority of share of equity ownership of domestic banks by nonresidents is allowed; or equal treatment is ensured for both foreign banks and domestic banks; or an unlimited number of branches is allowed for foreign banks.
Coded as 3 when there are no branching restrictions; all banks are allowed to become universal banks.

3. Restrictions on international capital flows

Coded as 0 when significant restrictions exist on both capital inflows and outflows.
Coded as 1 when slight restrictions exist on either capital inflows or outflows.
Coded as 2 when no restrictions applied to either capital inflows or outflows.
Coded as 3 when banks are allowed to borrow from abroad freely without restrictions and there are no tight restrictions on other capital inflows.

4. Restrictions for foreign investors on securities markets

Coded as 0 if there is no securities market.
Coded as 1 when a securities market is starting to form with the introduction of auctioning of T-bills or the establishment of a security commission; foreign equity ownership is allowed but only if less than 50 percent.
Coded as 2 when further measures have been taken to develop securities markets (tax exemptions, introduction of medium and long-term government bonds in order to build the benchmark of a yield curve, policies to develop corporate bond and equity markets, or the introduction of a primary dealer system to develop government security markets); majority equity share of foreign ownership is allowed.
Coded as 3 when further policy measures have been taken to develop derivative markets or to broaden the institutional investor base by deregulating portfolio investments and pension funds or completing the full deregulation of stock exchanges.