Chapter

1

Trilemma Configurations in Asia in an Era of Financial Globalization

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Abstract

This chapter examines how trilemma choices affect macroeconomic performance with focus on the Asian economies, and finds that these choices matter for output volatility and medium-term inflation, but do not matter for economic growth. Greater monetary independence is associated with lower output volatility while greater exchange rate stability implies greater output volatility, which can be mitigated if a country holds international reserves (IR) above a

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threshold of about 20% of the GDP. Greater monetary autonomy is associated with higher inflation, while greater exchange rate stability could result in lower inflation. Greater exchange rate stability could stabilize real exchange rate movements, yet it could also make investment more volatile, though this volatility-enhancing effect can be offset by higher levels of IR. Greater financial openness helps reduce real exchange rate volatility. Asian emerging market economies chose policy configurations and sizable IR to dampen the volatilities in both investment and real exchange rate.

***Keywords*:** Impossible trinity; international reserves; financial liberalization; exchange rate; capital flows; output volatility.

1. Introduction

In the fall of 2008, many countries were hit by the most severe and persistent crisis since the Great Depression. By the summer of 2009, however, there were various signs of recovery among countries. Even the US, the epicenter of the crisis, started to show some signs of recovery by the fall of 2009. Although smaller economies seem to remain in a frail situation, bigger emerging economies in Asia started reporting economic data that suggested robust recovery. In the second quarter of 2009, emerging Asian economies' gross domestic product (GDP) grew at an average annualized rate of over 10% while the US fell by 1%. As the Asian Development Bank Chief Economist Jong-Wha Lee commented in July 2009, people started expecting that "Emerging East Asia could see a V-shaped recovery" by 2010.[1]

The V-shaped recovery in Asia, if it happens, is not unprecedented. Many economies in the region demonstrated similar behavior following the Asian crisis of 1997/1998. Despite a severe output contraction in 1998, Asian crisis economies made a remarkable comeback with robust growth in exports and output as early as 1999. Asia's quick

[1] Asian Development Bank News Release on July 23, 2009, www.adb.org/Media/Articles/2009/12944-east-asian-economics-growths/.

bounce this time is not only impressive but also surprising given that, unlike in the aftermath of the Asian crisis, the US economy is not providing the "demand of last resort" (Aizenman and Jinjarak, 2009) that can fill the foregone demand in the world economy.

If the Asian economies show robust and sustainable recovery while the advanced economies do not, that could suggest one hypothesis that economies in the Asian region, most of which are quite open to international trade in goods and financial assets, are better prepared to cope with economic crises in a highly globalized environment. Figure 1-1 shows that output volatility — measured by the standard deviations of per capita output growth rates — for Asian emerging market economies has been maintained at low levels comparable to those of the industrialized countries. This suggests that these economies may have adopted international economic policies that allow them to experience better macroeconomic performance. In this chapter, we investigate whether Asian economies are better-suited

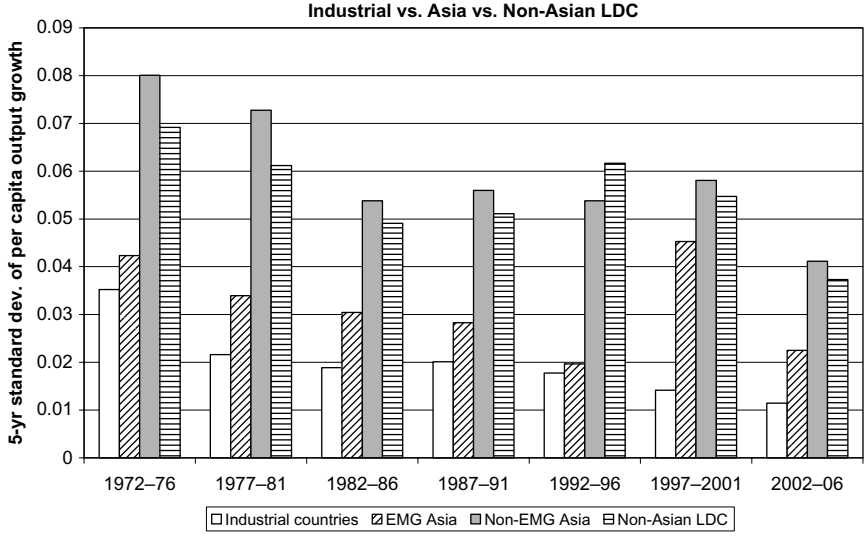

Figure 1-1: Output volatility (1972–2006)

Notes: Output volatility is measured by five-year standard deviations of the growth rate of per capita output. The data for per capita output are extracted from the PWT database.

to cope with globalization by examining their economic performance in the context of international economic policies.

In its effort to examine policy configurations, this chapter focuses on a very powerful hypothesis in international finance called the "impossible trinity", or the "trilemma". The hypothesis states that a country may simultaneously choose any two, but not all of the following three goals: monetary independence, exchange rate stability, and financial integration.

Asian emerging market economies have collectively outperformed other developing economies in terms of output growth stability. This may suggest that their international macroeconomic policy management, determined within the constraint of the trilemma, has contributed to making these economies better prepared for higher vulnerability possibly exacerbated by recent globalization. Using the "trilemma indexes" that measure the extent of achievement in each of the three policy goals (developed by Aizenman *et al.*, 2008), this chapter will examine how policy configurations based on the trilemma affect dimensions of macroeconomic performances such as output growth, output volatility, inflation volatility, and the medium-term rate of inflation for developing countries.

Furthermore, this study focuses on output volatility and attempts to identify the channels by which the trilemma policy choices affect output volatility. As candidate channels, the volatilities of investment and the real exchange rate will be examined. This exercise should yield inferences about how policy configurations can differ depending on the extent of openness of the economy.

Section 2 briefly reviews the theory of the trilemma and also assesses the evolution of the three macroeconomic policies based on the trilemma by using the "trilemma indexes". Section 3 conducts a more formal analysis of how the policy choices affect macroeconomic policy goals, namely, output growth, output volatility, inflation rates, and the volatility of inflation. We will examine the implications of the estimation results for Asian economies. In Section 4, we extend our empirical investigation to investigate the channels by which international macroeconomic policy configurations affect output volatility. Section 5 presents concluding remarks.

2. The "Impossible Trinity" or "Trilemma": Theory and Evidence

2.1 *Brief review of the theory*

The current global crisis has put the international financial architecture and individual countries' international macroeconomic policies into question as symbolized by the series of recent G20 meetings. Policymakers dealing with the crisis cannot avoid confronting the "impossible trinity", or the "trilemma" — a hypothesis that states that a country simultaneously may choose any two, but not all of the three goals of monetary independence, exchange rate stability, and financial integration.[2]

Monetary independence allows the monetary authorities of an economy to have autonomy over its macroeconomic management and therefore to stabilize economic growth. However, in a world with price and wage rigidities, policymakers can manipulate output movement (at least in the short-run), increasing output and inflation volatility.[3]

Exchange rate stability could induce price stability by providing an anchor, lessening the risk premium by mitigating uncertainty, and consequently fostering investment and international trade. Also, at the time of an economic crisis, maintaining a pegged exchange rate could increase the credibility of policymakers and thereby contribute to stabilizing output movement (Aizenman *et al.*, 2009). However, greater levels of exchange rate fixity could also deprive policymakers of a policy choice of using the exchange rate as a tool to absorb external shocks. This could prevent policymakers from implementing appropriate policies consistent with macroeconomic reality, resulting in misallocation of resources.

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[2] See Obstfeld, Shambaugh, and Taylor (2005) for further discussion and references dealing with the trilemma.

[3] Furthermore, it is also possible that monetary authorities abuse their autonomy to monetize fiscal debt, and therefore end up destabilizing the economy through high and volatile inflation.

Financial liberalization is probably the most contentious and hotly debated policy among the three.[4] Theory predicts that more open financial markets could lead to economic growth through more efficient resource allocation, mitigating information asymmetry, enhancing and/or supplementing domestic savings, and helping the transfer of technological or managerial know-how (i.e., growth in total factor productivity). Greater access to international capital markets should provide greater risk sharing and portfolio diversification. However, financial openness could expose economies to sudden stops or reversals of capital flows, and thereby to boom-bust cycles (Kaminsky and Schmukler, 2002).

Therefore, each one of the three trilemma policy choices can be a double-edged sword, which should explain the wide variety of empirical findings regarding each of the three policy choices.[5] Furthermore, the effect of each policy choice can differ depending on what the other policy choice it is paired with. For example, exchange rate stability can be more stabilizing when it is paired with greater monetary autonomy, but it is more destabilizing if paired with financial openness. Hence, the three types of policy combinations should be subject to comprehensive and systematic empirical scrutiny.

2.2 *The "trilemma indexes"*

Despite its pervasive recognition, there has been almost no empirical work that tests the concept of the trilemma systematically because of the lack of appropriate metrics that measure the extent of achievement

[4] For a summary on the cost and benefits of financial liberalization, refer to Henry (2006).

[5] Monetary independence is often discussed in the context of the impact of central bank independence or inflation targeting such as Alesina and Summers (1993) and Cechetti and Ehrmann (1999) among many others. On the impact of the exchange rate regime, refer to Ghosh *et al.* (1997), Levy-Yeyati and Sturzenegger (2003), and Eichengreen and Leblang (2003). The empirical literature on the effect of financial liberalization is surveyed by Edison *et al.* (2002), Henry (2006), and Prasad *et al.* (2003).

in the three policy goals.[6] Aizenman *et al.* (2008) overcame this deficiency by developing a set of the "trilemma indexes" that measure the degree of three policy choices countries make with respect to the trilemma. The "trilemma indexes" are created for more than 170 countries for 1970 through 2007. The monetary independence index (MI) is based on the correlation of a country's interest rates with the base country's interest rate.[7] The index for exchange rate stability (ERS) is an invert of the exchange rate volatility, i.e., standard deviations of the monthly rate of depreciation, for the exchange rate between the home and base countries. The degree of financial integration is measured with the Chinn-Ito (2006) capital controls index (KAOPEN). More details on the construction of the indexes can be found in Aizenman *et al.* (2008).

Figure 1-2 summarizes the trends of the trilemma indexes for emerging Asian economies in the "Diamond chart". The four vertices of the chart measure monetary independence, exchange rate stability, IR/GDP, and financial integration with the origin normalized so as to represent zero monetary independence, pure float, zero international reserves, and financial autarky.

In the figure, we can observe that emerging Asian economies have had a well-balanced development of the three indexes since as early as the 1980s. The three indexes have been clustered around the middle range and seem to have converged in recent years. This characterization does not appear to be applicable to other groups of industrialized countries nor to developing countries.[8] Most importantly, the group of Asian

[6] Of course, the notable exceptions include the papers by Obstfeld, Shambaugh, and Taylor (2005, 2008, and 2009) and Shambaugh (2004).

[7] The base country is defined as the country that a home country's monetary policy is most closely linked with as in Shambaugh (2004). The base countries are Australia, Belgium, France, Germany, India, Malaysia, South Africa, the UK, and the US. For the countries and years for which Shambaugh's data are available, the base countries from his work are used, and for the others, the base countries are assigned based on IMF's *Annual Report on Exchange Arrangements and Exchange Restrictions (AREAER)* and *CIA Factbook*. See Aizenman, *et al.* (2008) for more details.

[8] See Aizenman *et al.* (2008) for more observations of the indexes and the diamond charts of other country groups.

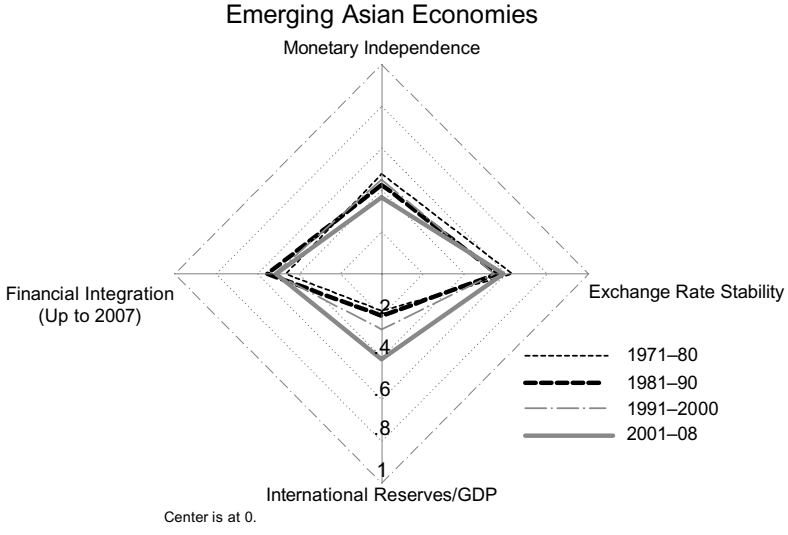

Figure 1-2: The "diamond charts": Variation of the trilemma and IR configurations for emerging Asia

emerging market economies stands out from the others with their sizeable and rapidly increasing amount of IR holding, which may make one suspect potential implications of such IR holdings on trilemma policy choices and macroeconomic performances.

3. Regression Analyses

We examine econometrically how the various choices regarding the three policies affect final policy goals, namely, high economic growth, output growth stability, low inflation, and inflation stability. The estimation model is based on Aizenman *et al.* (2008) and given by:

$$y_{it} = \alpha_0 + \alpha_1 TLM_{it} + \alpha_2 IR_{it} + \alpha_3 (TLM_{it} \times IR_{it}) + X_{it}B + Z_t\Gamma + D_t\Phi + \varepsilon_{it} \quad (1)$$

y_{it} is the measure of macro policy performance for country i in year t, i.e., per capita output growth, output volatility, inflation volatility,

and the medium-term level of inflation.[9] TLM_{it} is a vector of any two of the three trilemma indexes, namely, *MI*, *ERS*, and *KAOPEN*.[10] IR_{it} is the level of international reserves (excluding gold) as a ratio to GDP, and ($TLM_{it} \times IR_{it}$) is an interaction term between the trilemma indexes and the level of IR that may allow us to observe whether IR is a complement or substitute for other policy stances.

X_{it} is a vector of macroeconomic control variables that includes variables common to the literature. More specifically, for the estimation on economic growth, X_{it} includes income per capita from the initial year of each five-year panel, average investment ratio to GDP, years of schooling (based on Barro and Lee, 2001), population growth, trade openness (= $(EX + IM)/GDP$), and private credit creation (% of GDP) as a measure of financial development. The regressions on output volatility, inflation volatility, and the level of inflation include relative income (to the US per capita real income — based on Penn World Table (PWT)), its quadratic term, trade openness, the terms-of-trade (TOT) shock defined as the five-year standard deviation of trade openness times TOT growth, fiscal procyclicality, five-year average of M2 growth, private credit creation (as percent of GDP), the inflation rate and inflation volatility with some variation of included variables depending on the dependent variable.[11] Z_t is a vector of global shocks that includes the change in US real interest rate, the world output gap, and relative oil price shocks (measured as the log of the ratio of oil price index to the world's

[9] Output growth is measured as the five-year average of the growth rate of per capita real output (using Penn World Table 6.2); output volatility is measured as the five-year standard deviations of the per capita output growth rate; inflation volatility as the five-year standard deviations of the monthly rate of inflation; and the medium-term level of inflation as the five-year average of the monthly rate of inflation.

[10] Aizenman *et al.* (2008) have shown that these three measures of the trilemma are linearly related. Therefore, it is most appropriate to include two of the indexes simultaneously, rather than individually or all three jointly. This also means that for each dependent variable, three types of regressions, i.e., those with three different combinations of two trilemma variables, are estimated.

[11] Fiscal procyclicality is measured as the correlations between Hodrick-Prescott (HP)-detrended government spending series and HP-detrended real GDP series.

consumer price index). D_i is a set of characteristic dummies that includes a dummy for oil exporting countries and regional dummies. Explanatory variables that persistently appear to be statistically insignificant are dropped from the estimation. ε_{it} is an *i.i.d.* error term.

The estimation model also includes a vector, $ExtFin_{it}$, of external finances that includes net foreign direct investment (FDI) inflows, net portfolio inflows, net "other" inflows (which mostly include bank lending), short-term debt, and total debt service. One motivation for this vector is that the *KAOPEN* index may not capture the actual ebb and flow of cross border capital and its impact. Edwards (1999) also observes that the private sector often circumvents capital account restrictions, nullifying the expected effect of regulatory capital controls.[12] Furthermore, we could argue that while the *de jure* measures may reflect policymakers' intentions, *de facto* ones may represent actuality in cross-border capital flows.

For net capital flows, we use the *International Financial Statistics* (*IFS*) data and define them as external liabilities (= capital inflows with a positive sign) minus assets (= capital inflows with a negative sign) for each type of flows.[13] Short-term debt is included as the ratio of total external debt and total debt service as is that of gross national income (GNI). Both variables are retrieved from World Development Indicators (WDI). To isolate the effect of external financing from currency crises, we include a dummy for currency crises.[14]

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[12] More recently, China's *de facto* openness, despite its *de jure* closeness, is often the subject of researchers (Aizenman and Glick, 2009; Prasad and Wei, 2007).

[13] Negative values mean that a country experiences a net outflow capital of the type of concern.

[14] The currency crisis dummy variable is derived from the conventional exchange rate market pressure (EMP) index pioneered by Eichengreen *et al.* (1996). The EMP index is defined as a weighted average of monthly changes in the nominal exchange rate, the percentage loss in international reserves, and the nominal interest rate. We make an adjustment for countries that experienced hyperinflation following Kaminsky and Reinhart (1999). For countries without the necessary data to compute the EMP index, the currency crisis classifications in Glick and Hutchison (2001) and Kaminsky and Reinhart are used.

The data set is organized into five-year panels of 1972–1976, 1977–1981, 1982–1986, 1987–1991, 1992–1996, 1997–2001, and 2002–2006. All time-varying variables are included as five-year averages. The regression is conducted for the group of developing countries (LDC) and a subgroup of emerging market economies (EMG).[15]

3.1 *Estimation results of the basic models*

3.1.1 *Output growth*

For the estimation, we use a parsimonious model akin to that of Kose *et al.* (2009), and three estimation methods: pooled OLS, Fixed Effects (FE) model (with robust standard errors clustered by country) to factor out country-specific effects, and system GMM to control for potential endogeneity.[16] The regression results are reported in Table 1-1 for developing countries and Table 1-2 for emerging market economies.

In both Tables 1-1 and 1-2, across different models, the results for the macroeconomic control variables are mostly consistent with the literature. The negative coefficient on the (log of) initial per capita income level illustrates the convergence effect (though only in the FE models for the LDC group). The investment ratio, and population growth to a lesser degree, are positive and negative contributors, respectively, to per capita output growth. Financial development is found to be a positive contributor in the OLS and

[15] The emerging market economies are defined as the countries classified as either emerging or frontier during 1980–1997 by the International Financial Corporation. For those in Asia, emerging market economies are "Emerging East Asia-14" defined by Asian Development Bank plus India.

[16] For the fixed-effects estimation, time-fixed effects are also included. The system GMM estimation is conducted using the two-step method and Windmeijer (2005) standard errors with finite-sample correction. We treat initial levels of per capita income, investment ratio, total years of school, and population growth rate as endogenous and instrument using second lag. Time-fixed effects are also included in the estimation and treated as exogenous instruments.

Table 1-1: The impact of the trilemma configurations on economic growth: Less developed countries (LDC)

	(1) Pooled	(2) FE	(3) sys-GMM	(4) Pooled	(5) FE	(6) sys-GMM	(7) Pooled	(8) FE	(9) sys-GMM
Ln initial income per capita	0.001	–0.034	0.016	0.001	–0.037	0.017	0.001	–0.034	0.011
	[0.003]	[0.009]***	[0.012]	[0.003]	[0.009]***	[0.013]	[0.003]	[0.009]***	[0.015]
Investment as % of GDP, WDI	0.11	0.073	0.155	0.109	0.068	0.139	0.109	0.067	0.154
	[0.019]***	[0.027]***	[0.040]***	[0.019]***	[0.030]**	[0.039]***	[0.019]***	[0.028]**	[0.047]***
Total years of schooling (Barro-Lee)	0.001	0	–0.004	0.001	0.001	–0.004	0.001	–0.001	–0.005
	[0.001]	[0.005]	[0.004]	[0.001]	[0.005]	[0.004]	[0.001]	[0.005]	[0.003]
Population growth	–0.405	–0.004	0.11	–0.4	0.035	0.014	–0.389	0.038	–0.085
	[0.279]	[0.339]	[0.470]	[0.280]	[0.348]	[0.634]	[0.278]	[0.323]	[0.530]
Private credit creation	0.03	–0.004	0.042	0.03	0.004	0.045	0.03	–0.007	0.048
	[0.007]***	[0.017]	[0.023]*	[0.007]***	[0.018]	[0.023]*	[0.007]***	[0.016]	[0.022]**
Trade openness	–0.008	0.016	–0.021	–0.008	0.017	–0.029	–0.009	0.022	–0.015
	[0.005]	[0.011]	[0.015]	[0.005]	[0.012]	[0.015]*	[0.005]*	[0.011]*	[0.019]
Monetary independence (MI)	0.013	0.003	0.016	0.013	0.005	0.018			
	[0.013]	[0.012]	[0.024]	[0.013]	[0.013]	[0.025]			
Exch. rate stability	0.002	0.028	–0.018				0.001	0.026	–0.013
	[0.005]	[0.007]***	[0.024]				[0.005]	[0.007]***	[0.022]
KA openness				0.004	0.018	–0.002	0.003	0.016	–0.013
				[0.006]	[0.007]**	[0.013]	[0.005]	[0.007]**	[0.017]

(*Continued*)

Table 1-1: (*Continued*)

	(1) Pooled	(2) FE	(3) sys-GMM	(4) Pooled	(5) FE	(6) sys-GMM	(7) Pooled	(8) FE	(9) sys-GMM
Net FDI inflows/GDP	0.069	–0.002	0.127	0.061	–0.044	0.168	0.059	–0.038	0.214
	[0.100]	[0.108]	[0.241]	[0.101]	[0.107]	[0.188]	[0.104]	[0.108]	[0.231]
Net portfolio inflows/ GDP	0.094	0.132	0.456	0.094	0.155	0.423	0.111	0.15	0.456
	[0.103]	[0.109]	[0.478]	[0.105]	[0.123]	[0.406]	[0.101]	[0.122]	[0.374]
Net 'other' inflows/ GDP	0.079	0.023	0.127	0.073	0.016	0.154	0.07	0.002	0.131
	[0.053]	[0.072]	[0.092]	[0.053]	[0.076]	[0.079]*	[0.053]	[0.071]	[0.083][12%]
Short-term debt (as % of total external debt)	–0.041	–0.003	–0.061	–0.042	–0.007	–0.047	–0.042	–0.005	–0.054
	[0.019]**	[0.018]	[0.063]	[0.019]**	[0.019]	[0.041]	[0.019]**	[0.018]	[0.049]
Total debt service (as % of GNI)	–0.176	–0.052	–0.193	–0.18	–0.078	–0.207	–0.177	–0.049	–0.111
	[0.049]***	[0.091]	[0.119][11%]	[0.049]***	[0.092]	[0.131][12%]	[0.050]***	[0.087]	[0.120]
Observations	325	325	325	325	325	325	325	325	325
Adjusted R-squared	0.27	0.42		0.27	0.41		0.27	0.43	
Hansen test of overident. (p-value)			0.973			0.968			0.979
Arellano-Bond test for AR(2) (p-value)			0.436			0.152			0.166

Notes: The estimation models do include the benchmark macroeconomic variables and other characteristic dummies though their estimation results are omitted to conserve space. Robust standard errors in brackets * significant at 10%; ** significant at 5%; *** significant at 1%. For the fixed effects estimation, country and time fixed effects are included and robust standard errors are clustered by country. The system GMM estimation is conducted using two step method and Windmeijer standard errors with finite-sample correction and treating all explanatory variables as endogenous and instrumented using second lag. The Hansen test is conducted against the null hypothesis of no overidentifying restrictions, and the Arellano-Bond test is conducted to test the null hypothesis of no serial correlation for AR(2) errors.

Table 1-2: The impact of the trilemma configurations on economic growth: Emerging market economies (EMG)

	(1) Pooled	(2) FE	(3) sys-GMM	(4) Pooled	(5) FE	(6) sys-GMM	(7) Pooled	(8) FE	(9) sys-GMM
Ln initial income per capita	–0.007	–0.036	–0.153	–0.008	–0.035	0.009	–0.007	–0.033	0.005
	[0.004]*	[0.014]**	[0.048]***	[0.004]**	[0.015]**	[0.107]	[0.004]*	[0.014]**	[0.141]
Investment as % of GDP,	0.13	0.072	–0.26	0.135	0.089	–0.094	0.125	0.073	0.059
WDI	[0.027]***	[0.052]	[0.288]	[0.026]***	[0.051]*	[0.428]	[0.028]***	[0.051]	[0.684]
Total years of schooling	0	–0.004	0.041	0	–0.001	–0.003	0	–0.004	0.012
(Barro-Lee)	[0.001]	[0.006]	[0.022]*	[0.002]	[0.006]	[0.045]	[0.001]	[0.006]	[0.030]
Population growth	–1.389	–0.883	–1.11	–1.408	–1.029	3.252	–1.41	–0.995	2.018
	[0.443]***	[1.137]	[2.932]	[0.461]***	[1.140]	[6.425]	[0.454]***	[1.096]	[4.076]
Private credit creation	0.018	0.005	0.146	0.02	0.006	0.059	0.019	–0.003	–0.01
	[0.009]*	[0.024]	[0.124]	[0.010]**	[0.027]	[0.154]	[0.009]**	[0.024]	[0.117]
Trade openness	0.01	0.02	–0.061	0.009	0.027	–0.076	0.01	0.03	–0.114
	[0.008]	[0.010]*	[0.135]	[0.007]	[0.017]	[0.127]	[0.007]	[0.016]*	[0.140]
Monetary independence	0.005	0.005	–0.023	0.006	0.006	–0.101			
(MI)	[0.015]	[0.017]	[0.101]	[0.016]	[0.019]	[0.131]			
Exch. rate stability	0.009	0.021	0.056				0.008	0.019	0.046
	[0.008]	[0.007]***	[0.041]				[0.007]	[0.007]**	[0.040]
KA openness				0.006	0.018	0.048	0.005	0.016	0.024
				[0.008]	[0.015]	[0.019]**	[0.007]	[0.014]	[0.047]

(*Continued*)

Table 1-2: (*Continued*)

	(1) Pooled	(2) FE	(3) sys-GMM	(4) Pooled	(5) FE	(6) sys-GMM	(7) Pooled	(8) FE	(9) sys-GMM
Net FDI inflows/GDP	0.143	0.069	0.651	0.134	0.01	–0.142	0.125	0.015	0.475
	[0.132]	[0.114]	[1.153]	[0.129]	[0.136]	[1.205]	[0.131]	[0.138]	[1.150]
Net portfolio inflows/ GDP	0.241	0.163	0.861	0.249	0.226	0.482	0.24	0.181	0.688
	[0.126]*	[0.114]	[0.600]	[0.130]*	[0.135]	[0.896]	[0.128]*	[0.127]	[1.765]
Net 'other' inflows/ GDP	0.11	0.112	0.463	0.104	0.101	0.36	0.109	0.092	0.084
	[0.084]	[0.116]	[0.124]***	[0.085]	[0.125]	[0.393]	[0.083]	[0.120]	[0.360]
Short-term debt (as % of total external debt)	–0.027	0	0.03	–0.03	–0.01	–0.139	–0.028	–0.003	–0.075
	[0.023]	[0.023]	[0.085]	[0.023]	[0.024]	[0.124]	[0.023]	[0.022]	[0.193]
Total debt service (as % of GNI)	–0.284	–0.139	0.466	–0.284	–0.134	–0.163	–0.286	–0.117	0.25
	[0.068]***	[0.123]	[0.877]	[0.069]***	[0.126]	[1.124]	[0.068]***	[0.121]	[0.990]
Observations	150	150	150	150	150	150	150	150	150
Adjusted R-squared	0.42	0.49		0.42	0.48		0.43	0.50	
Hansen test of overident. (p-value)			1.00			1.00			1.00
Arellano-Bond test for AR(2) (p-value)			0.904			0.695			0.492

Notes: The estimation models do include the benchmark macroeconomic variables and other characteristic dummies though their estimation results are omitted to conserve space. Robust standard errors in brackets * significant at 10%; ** significant at 5%; *** significant at 1%. For the fixed effects estimation, country and time fixed effects are included and robust standard errors are clustered by country. The system GMM estimation is conducted using two step method and Windmeijer standard errors with finite-sample correction and treating all explanatory variables as endogenous and instrumented using second lag. The Hansen test is conducted against the null hypothesis of no overidentifying restrictions, and the Arellano-Bond test is conducted to test the null hypothesis of no serial correlation for AR(2) errors.

GMM estimations. Trade openness has an ambiguous effect; it is a negative factor in the OLS model for the LDC sample and a positive one in the FE models.

The trilemma variables enter the estimation relatively weakly, but this is consistent with the ambivalent theoretical predictions of the trilemma policy choices as discussed above. The effect of the trilemma variables is most apparent in the FE models for both LDC and EMG sample. Greater exchange rate stability is expected to lead to higher economic growth, a consistent result with Dubas *et al.* (2005) and De Grauwe and Schnabl (2004). These findings may indicate that exchange rate stability promotes price stability and predictability for investment, thereby lowering the country risk premium and eventually the interest rate.[17]

Financial openness is also found to be a growth enhancer in one of the system-GMM models for EMG. However, the variables for net capital inflows do not appear to perform well, except for net "other" or bank lending inflows in some of the models. This possibly suggests that cross-border bank lending may have supplemented domestic saving and contributed to economic growth. This result has an important implication for Asia because bank lending is the most pervasive form of cross-border capital flow in the region. Total debt services as a percentage of GNI is found to hamper output growth, especially for the LDC sample. Short-term debt is also negatively associated with economic growth, but only in the OLS models.

3.1.2 *Output volatility*

The relatively weak results for the trilemma configurations in the growth regression could arise because policy arrangements relevant to the trilemma primarily affect the volatilities in output or inflation, and indirectly affect output growth. Hnatkovska and Loayza (2005) find that macroeconomic volatility and long-run economic

[17] We are aware, however, that the FE model fails to incorporate cross-sectional variation and that the number of observations for the time dimension is small.

growth are negatively related, and that the negative link is considerably larger for the last two decades. As such, we now investigate the effect of the trilemma configurations on other variables relevant to macroeconomic performances by replacing the dependent variable of Equation (1) with the variables for output volatility, inflation volatility, and the level of inflation. The estimation models for output volatility, inflation volatility, and the level of inflation are based upon Aizenman *et al.* (2008). The estimation results on output volatility and inflation are shown in Tables 1-3 and 1-4, respectively.

Overall, macroeconomic variables retain the characteristics consistent with the literature. In the regression for output volatility, the higher the level of income is (relative to the US), the more reduced output volatility is, though the effect is nonlinear. The bigger the change in US real interest rate, the higher the output volatility of developing countries may become — indicating that the US real interest rate may proxy for the debt payment burden on these countries. The higher TOT shock there is, the higher output volatility countries experience, consistent with Rodrik (1998) and Easterly *et al.* (2001).[18] Countries with procyclical fiscal policy tend to experience more output volatility while countries with more developed financial markets tend to experience lower output volatility though they are not statistically significant.[19] The results hold qualitatively for the subsample of emerging market economies though the statistical significance tends to appear weaker.

Monetary independence is found to have a significantly negative effect on output volatility, naturally reflecting the impact of stabilization

[18] The effect of trade openness is found to be persistently insignificant and is therefore dropped from the estimations. This finding reflects the debate in the literature, in which both positive (i.e., volatility enhancing) and negative (i.e., volatility reducing) effects of trade openness has been evidenced. See Easterly *et al.* (2001) and Rodrik (1998) for the volatility-enhancing effect of trade openness and refer to Calvo *et al.* (2004) and Cavallo (2007) for the volatility reducing effect.

[19] For theoretical predictions on the effect of financial development, refer to Aghion *et al.* (1999) and Caballero and Krishnamurthy (2001). For empirical findings, see Blankenau *et al.* (2001) and Kose *et al.* (2003).

Table 1-3: The impact of the trilemma configurations on output volatility

	Less developed countries (LDC)			Emerging market countries		
	(1)	(2)	(3)	(4)	(5)	(6)
Relative income	–0.03	–0.13	–0.143	–0.033	–0.018	–0.033
	[0.035]	[0.036]***	[0.036]***	[0.073]	[0.072]	[0.075]
Relative income, sq.	0.007	0.278	0.311	0.041	0.009	0.043
	[0.066]	[0.067]***	[0.067]***	[0.160]	[0.161]	[0.165]
Change in US real interest rate	0.122	0.11	0.119	0.143	0.119	0.142
	[0.049]**	[0.050]**	[0.050]**	[0.060]**	[0.060]**	[0.060]**
Volatility of TOT*OPN	0.026	0.03	0.027	–0.001	0.015	–0.002
	[0.009]***	[0.009]***	[0.009]***	[0.016]	[0.016]	[0.016]
Inflation volatility	0.023	0.02	0.023	0.066	0.036	0.065
	[0.006]***	[0.006]***	[0.006]***	[0.008]***	[0.008]***	[0.008]***
Fiscal procyclicality	0.002	0.004	0.004	0.004	0.003	0.004
	[0.002]	[0.002]*	[0.002]*	[0.003]	[0.003]	[0.003]
Currency crisis	0.005	0.005	0.005	0.004	0.007	0.004
	[0.003]*	[0.003]*	[0.003]*	[0.003]	[0.003]**	[0.004]
Private credit creation	–0.003	–0.008	–0.005	0	–0.005	0.001
	[0.006]	[0.006]	[0.007]	[0.007]	[0.007]	[0.007]

(*Continued*)

Table 1-3: (*Continued*)

	Less developed countries (LDC)			Emerging market countries		
	(1)	(2)	(3)	(4)	(5)	(6)
Total reserve (as % of GDP)	0.072	–0.055	0.065	0.087	–0.043	0.096
	[0.052]	[0.052]	[0.034]*	[0.055]	[0.056]	[0.035]***
Monetary independence (MI)	–0.019	–0.035		–0.018	–0.038	
	[0.014]	[0.014]**		[0.017]	[0.018]**	
MI × reserves	0.005	0.112		0.008	0.096	
	[0.085]	[0.089]		[0.088]	[0.094]	
Exchange rate stability (ERS)	0.008		0.012	0.023		0.028
	[0.007]		[0.006]*	[0.009]**		[0.009]***
ERS × reserves	–0.086		–0.095	–0.125		–0.15
	[0.044]*		[0.044]**	[0.052]**		[0.051]***
KA openness		–0.02	–0.014		–0.01	–0.002
		[0.008]**	[0.008]*		[0.009]	[0.009]
KAOPEN × reserves		0.086	0.048		0.062	0.016
		[0.045]*	[0.042]		[0.047]	[0.042]
Net FDI inflows/GDP	0.047	0.092	0.109	–0.121	–0.105	–0.155
	[0.068]	[0.071]	[0.070]	[0.107]	[0.112]	[0.113]

(*Continued*)

Table 1-3: (*Continued*)

	Less developed countries (LDC)			Emerging market countries		
	(1)	(2)	(3)	(4)	(5)	(6)
Net portfolio inflows/GDP	0.241	0.289	0.286	–0.113	–0.048	–0.081
	[0.122]**	[0.129]**	[0.127]**	[0.140]	[0.145]	[0.147]
Net 'other' inflows/GDP	0.069	0.063	0.071	0.025	0.017	0.022
	[0.029]**	[0.029]**	[0.029]**	[0.037]	[0.037]	[0.037]
Short-term debt	–0.009	–0.008	–0.007	–0.013	–0.008	–0.011
(as % of total external debt)	[0.016]	[0.016]	[0.016]	[0.019]	[0.019]	[0.019]
Total debt service	0.063	0.081	0.078	0.008	0.037	0.011
(as % of GNI)	[0.035]*	[0.035]**	[0.035]**	[0.044]	[0.044]	[0.044]
Observations	311	311	311	154	154	154
Adjusted R-squared	0.37	0.39	0.4	0.45	0.29	0.46

Notes: Robust regressions are implemented. * significant at 10%; ** significant at 5%; *** significant at 1%. The dummy for Sub-Saharan countries is included in the regressions for output and inflation volatility, as are the dummies for Latin America and Caribbean and East Europe and Central Asia in the regression for the level of inflation. "Trade openness" that is insignificant is omitted from presentation to conserve space.

Table 1-4: The impact of the trilemma configurations on the level of inflation

	LDC (1)	LDC (2)	LDC (3)	EMG (4)	EMG (5)	EMG (6)
Relative income	–0.163	–0.157	–0.182	0.067	–0.051	–0.003
	[0.087]*	[0.087]*	[0.084]**	[0.233]	[0.205]	[0.225]
Relative income, sq.	0.25	0.25	0.278	–0.371	–0.109	–0.216
	[0.149]*	[0.150]*	[0.144]*	[0.477]	[0.427]	[0.464]
Volatility of TOT*OPN	0.021	0.019	0.018	0.046	0.013	0.045
	[0.021]	[0.021]	[0.020]	[0.047]	[0.042]	[0.046]
Inflation volatility	0.299	0.284	0.297	0.325	0.383	0.325
	[0.015]***	[0.015]***	[0.015]***	[0.026]***	[0.023]***	[0.024]***
Relative oil price shocks	0.014	0.007	0.012	–0.003	–0.007	–0.005
	[0.006]**	[0.006]	[0.006]**	[0.010]	[0.009]	[0.010]
World output gap	0.323	0.159	0.276	0.877	0.604	0.711
	[0.304]	[0.308]	[0.294]	[0.490]*	[0.434]	[0.472]
Trade openness	0.007	0.01	0.015	0.016	0.033	0.02
	[0.012]	[0.012]	[0.011]	[0.022]	[0.020]*	[0.021]
M2 growth	0.425	0.481	0.417	0.453	0.425	0.433
	[0.023]***	[0.023]***	[0.022]***	[0.035]***	[0.032]***	[0.034]***
Currency crisis	0.031	0.032	0.029	0.024	0.017	0.02
	[0.006]***	[0.007]***	[0.006]***	[0.010]**	[0.009]*	[0.010]**

(*Continued*)

Table 1-4: (*Continued*)

	LDC (1)	LDC (2)	LDC (3)	EMG (4)	EMG (5)	EMG (6)
Private credit creation	–0.018	–0.014	–0.019	–0.037	–0.027	–0.043
	[0.017]	[0.017]	[0.016]	[0.026]	[0.022]	[0.025]*
Total Reserve (as % of GDP)	–0.053	–0.182	–0.198	–0.18	–0.242	–0.176
	[0.122]	[0.123]	[0.076]***	[0.162]	[0.153]	[0.098]*
Monetary independence (MI)	–0.002	–0.017		–0.037	–0.051	
	[0.033]	[0.034]		[0.051]	[0.048]	
MI × reserves	–0.04	0.055		0.063	0.14	
	[0.199]	[0.208]		[0.257]	[0.249]	
Exchange rate stability (ERS)	–0.04		–0.04	–0.06		–0.053
	[0.016]**		[0.015]***	[0.028]**		[0.026]**
ERS × reserves	0.074		0.071	0.25		0.225
	[0.104]		[0.098]	[0.151]**		[0.140][11%]
KA openness		–0.055	–0.055		–0.065	–0.045
		[0.019]***	[0.018]***		[0.024]***	[0.024]*
KAOPEN × reserves		0.261	0.254		0.252	0.11
		[0.107]**	[0.097]***		[0.126]**	[0.121]

(*Continued*)

Table 1-4: (*Continued*)

	LDC (1)	LDC (2)	LDC (3)	EMG (4)	EMG (5)	EMG (6)
Net FDI inflows/GDP	–0.477	–0.442	–0.441	–0.847	–0.598	–0.678
	[0.177]***	[0.184]**	[0.173]**	[0.345]**	[0.324]*	[0.347]*
Net portfolio inflows/GDP	0.064	0.297	0.228	–0.34	–0.06	–0.159
	[0.286]	[0.302]	[0.287]	[0.411]	[0.383]	[0.412]
Net 'other' inflows/GDP	0.037	0.09	0.045	0.016	0.059	0.018
	[0.069]	[0.070]	[0.068]	[0.121]	[0.107]	[0.116]
Short-term debt	–0.007	–0.003	0.012	0.047	0.041	0.069
(as % of total external debt)	[0.037]	[0.038]	[0.036]	[0.058]	[0.052]	[0.057]
Total debt service	0.176	0.184	0.154	0.197	0.07	0.206
(as % of GNI)	[0.088]**	[0.088]**	[0.086]*	[0.164]	[0.147]	[0.159]
Observations	311	310	310	151	151	151
Adjusted R-squared	0.86	0.86	0.86	0.88	0.91	0.89

Notes: Robust regressions are implemented. * significant at 10%; ** significant at 5%; *** significant at 1%. The dummy for Sub-Saharan countries is included in the regressions for output and inflation volatility, as are the dummies for Latin America and Caribbean and East Europe and Central Asia in the regression for the level of inflation. "Fiscal procyclicality" is mostly insignificant and thus is omitted from presentation to conserve space.

measures.[20,21] Mishkin and Schmidt-Hebbel (2007) find that countries that adopt inflation targeting — one form of increasing monetary independence — experience reduced output volatility, and that the effect is bigger among emerging market economies.[22] This volatility-reducing effect of monetary independence may explain the tendency for developing countries, especially non-emerging market ones, to not reduce the extent of monetary independence over the years.

Countries with more stable exchange rate tend to experience higher output volatility for both LDC and EMG groups, as was found in Edwards and Levy-Yeyati (2003) and Haruka (2007). However, the interaction term is found to have a statistically negative effect, suggesting that countries holding high levels of IR are able to reduce output volatility. The threshold level of international reserves holding is 13–19% of GDP.[23] Singapore, a country with a middle level of exchange rate stability (0.50 in 2002–2006) and a very high level of international reserves holding (100% as a ratio of GDP), is able to reduce the output volatility by 4.1–6.1 percentage points.

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[20] Once the interaction term between monetary independence and IR holding is removed from the estimation model, the coefficient of monetary independence becomes significantly negative at the 5% significance level in model (1) of the LDC sample and in models (1) and (2) of the EMG sample.

[21] This finding can be surprising to some if the concept of monetary independence is taken synonymously to central bank independence because many authors, most typically Alesina and Summers (1993), have found that more independent central banks would have no or at most, little impact on output variability. However, in this literature, the extent of central bank independence is usually measured by the legal definition of the central bankers and/or the turnover ratios of bank governors, which can bring about different inferences compared to our measure of monetary independence.

[22] The link is not always predicted to be negative theoretically. When monetary authorities react to negative supply shocks, that can amplify the shocks and exacerbate output volatility. Cecchetti and Ehrmann (1999) find a positive association between adoption of inflation targeting and output volatility.

[23] In Model (3) of Table 1-3, $\hat{\alpha}_1 TLM_{it} + \hat{\alpha}_3(TLM_{it} \times IR_{it})$ for ERS is found to be $0.012ERS_{it} - 0.095(ERS_{it} \times IR_{it})$ or $(0.012 - 0.095IR_{it})ERS_{it}$. In order for ERS to have a negative impact, $0.012 - 0.095IR_{it} < 0$, and therefore, it must be that $IR_{it} > 0.012/0.095 = 0.12.6$.

China, whose exchange rate stability index is as high as 0.97 and whose ratio of reserves holding to GDP is 40% in 2002–2006, is able to reduce volatility by 2.2–2.6 percentage points.

Countries with more open capital account tend to experience lower output volatility according to Model (2) in Table 1-3. However, those with higher IR holding than 23% of GDP can experience higher volatility by pursuing more financial openness, which is somewhat counterintuitive.[24]

Among the external finance variables, the more "other" capital inflows (i.e., banking lending) or net portfolio inflows a country receives, the more likely it is to experience higher output volatility, reflecting the fact that countries that experience macroeconomic turmoil often experience an increase in inflows of banking lending or "hot money" such as portfolio investment. Total debt service is found to be a positive contributor to output volatility while short-term debt does not seem to have an effect. These results contrast with the conventional wisdom regarding short-term external debt.[25]

3.1.3 *Inflation volatility*

The regression models for inflation volatility do not provide as significant results as those for output volatility including the performance of the trilemma indexes. We do not report the results in

[24] The result of model (2) in Table 1-3 is consistent with those of models (1) and (3). That is, as long as the three policy goals are linearly related, as Aizenman *et al.* (2008) empirically proved, the efforts of increasing both *MI* and *KAOPEN* are essentially the same as lowering the level of exchange rate stability. Models (1) and (3) predict that lower ERS leads to lower output volatility. But these models also predict that if the country holds IR more than thresholds, it would have to face higher output volatility, which is found in model (2).

[25] One might suspect that this result can be driven by multicollinearity between the short-term debt variable and the variables for the various net inflows. However, even when the three net inflow variables are removed from the models, the total debt service still continues to be a positive factor while the short-term debt variable continues to be an insignificant one.

the table. While the findings on the macro variables are generally consistent with the literature, the performance of the trilemma indexes appears to be the weakest for this group of estimations. However, exchange rate stability is now a volatility-increasing factor, which is contrary to what has been found in the literature (such as Ghosh *et al.*, 1997). Economies with more stability in their exchange rates should experience lower inflation and thereby lower inflation volatility. One possible explanation is that economies with fixed exchange rates tend to lack fiscal discipline and eventually experience devaluation as argued by Tornell and Velasco (2000).[26] When we include the interaction term between the crisis dummy and the *ERS* variable to isolate the effect of exchange rate stability for the crisis economies, the estimated coefficient on *ERS* still remains with the same magnitude and statistical significance.[27]

3.1.4 *Medium-run level of inflation*

The models for the medium-run level of inflation fit as well as those for output volatility. Higher inflation volatility, higher M2 growth, and oil price shocks are associated with higher inflation. Also, when the world economy is experiencing a boom, developing countries tend to experience higher inflation, which presumably reflects strong demand for exports from developing countries.

Greater exchange rate stability leads to lower inflation for both developing and emerging market economies, a result consistent with the literature (such as Ghosh *et al.*, 1997). This finding and the positive association between exchange rate stability and output volatility are in line with the trade-off confronting policymakers; exchange rate stability helps to achieve lower inflation by showing a higher level of

[26] Tornell and Velasco argue that while economies with flexible exchange rates face the cost of having lax fiscal policy immediately, economies with fixed exchange rates tend to lack fiscal discipline because "under fixed rates bad behavior today leads to punishment tomorrow".

[27] Among the variables for external finances, while FDI inflows are found to be inflation stabilizers, total debt service can destabilize inflation, both of which are consistent with the literature.

credibility and commitment, but eliminates an important adjustment mechanism through fluctuating exchange rates.

For emerging market economies, the interaction term between *ERS* and international reserves holding is found to have a positive impact on the rate of inflation. Models (5) and (6) in Table 1-4 show that if the ratio of reserves holding to GDP is greater than about 24%, pursuing exchange rate stability can help to *increase* the level of inflation. This means that countries with excess levels of reserves holding will eventually face the limit in the efforts to fully sterilize foreign exchange intervention to maintain exchange rate stability.

The estimations for both subsamples show that the more financially open a developing country is, the lower inflation it will experience. In the LDC sample, we can find the same kind of threshold as in the case of *ERS* in models (2) and (3); financial openness can lead to lower inflation, but only up to the case when IR hold is below 21–22% as a ratio to GDP. Considering that only in a financially open economy do monetary authorities face the need for foreign exchange interventions, the threshold of IR holding for financial openness can be interpreted in the same way as that for exchange rate stability. This implies limits to sterilized interventions, and that it is more binding for financially open economies. Aizenman and Glick (2009) and Glick and Hutchison (2008) show that China started facing more inflationary pressure in 2007 when allegedly intervening the foreign exchange market intensively to sustain exchange rate stability. Hence, sterilized interventions would eventually lead to a rise in expected inflation if they are conducted as an effort to maintain monetary independence and exchange rate stability while having somewhat open financial markets. The rise in the inflationary pressure provides evidence that policymakers cannot evade the constraint of the trilemma.

FDI inflows are found to be an inflation reducer. One possible explanation is that countries tend to stabilize inflation movement to attract FDI. Lastly, and unsurprisingly, higher levels of total debt services are found to help increase inflation for the LDC sample.

3.2 *Implications for Asia*

In the growth regressions, we found that investment ratios, exchange rate stability, financial openness, bank lending inflows, and low levels of total debt services are the positive contributors to economic growth among developing countries. How do these variables behave for the Asian economies? In Figure 1-2, we have seen that Asia on average maintained a medium level of exchange rate stability, but its level is not as high as other non-Asian developing countries. Asian economies, especially emerging markets ones, have achieved medium levels of financial openness since the 1980s, but have not experienced rapid financial liberalization as Latin American emerging market economies. Historically, especially before the crisis, both emerging and non-emerging Asian economies were more dependent on bank lending than FDI. Both short-term debt as a ratio to total external debt and total debt service as a ratio to GNI have stayed at relatively high levels for this group of economies. Given these observations, the source of high economic growth among Asian emerging market economies can be narrowed down to high investment ratios and high levels of bank lending inflows. As many researchers have discussed, one of the keys to economic success, especially with respect to the link between Asia and globalization, is the high level of openness to bank lending, which may have had a synergistic relationship with domestic investment.

The estimation results on the determinants of output volatility also provide interesting insights on Asian economic development. The finding that countries can reverse the volatility-increasing effect of greater exchange rate stability by holding higher levels of international reserves than some threshold (about 13–18% of GDP) may explain the reason why many Asian developing countries hold higher levels of IR. Unraveling the motive for IR holding also has an important implication for the current global crisis. Some economists argue that the efforts made by Asian economies to hold international reserves in an attempt to stabilize their exchange rates could have expanded liquidity rapidly in global capital markets. We will shed further light on how IR holding and the trilemma policy choices interact with each other in a later section.

4. Further Investigation into Output Volatility and Trilemma Choices

4.1 *Channels to output volatility*

The current state of the world economy warrants focus on the estimation results for output volatility. One natural question that arises is through what channels these factors contribute to output volatility. To answer this question, we estimate similar models for output volatility, but replace the dependent variable with real exchange rate stability, through which net exports and the volatility of investment can be affected.

4.1.1 *Results on investment volatility and real exchange rate volatility*

The results shown in columns (1) through (3) of Tables 1-5 and 1-6 correspond to investment volatility and columns (4) through (6) of Tables 1-5 and 1-6 correspond to real exchange rate stability specifications. For the estimation of the real exchange rate stability, some of the explanatory variables have been changed. In particular, change in the US real interest rate, fiscal procyclicality and financial development (measured by private credit creation as a ratio to GDP) are dropped from the estimation and replaced with inflation volatility and differentials in inflation volatility between the home and base economies.

By comparing the results of these specifications with different dependent variables, we can make some interesting observations. First, we observe the negative effect of monetary independence on the investment volatility estimation, as we did on output volatility. However, if the level of IR holding is above 15–20% of GDP, higher monetary independence could lead to higher volatility in investment. This may be because higher levels of IR could lead to higher levels of liquidity, and thus to more volatile movement in the cost of capital. Second, while a higher degree of exchange rate stability could (unsurprisingly) induce greater real exchange rate stability, it could also lead to more volatile investment. As was the case with output volatility, if the level of IR holding exceeds a given threshold, greater exchange

Table 1-5: Determinants of output volatility: Less developed countries (LDC)

	Investment volatility			Real exchange rate volatility		
	(1)	(2)	(3)	(4)	(5)	(6)
Relative income	–0.1	–0.15	–0.125	–0.016	0.027	–0.015
	[0.143]	[0.142]	[0.139]	[0.020]	[0.031]	[0.020]
Relative income, sq.	0.121	0.239	0.211	0.017	–0.041	0.019
	[0.264]	[0.265]	[0.258]	[0.037]	[0.057]	[0.038]
Change in US real interest rate	0.39	0.306	0.259			
	[0.199]*	[0.198]	[0.194]			
Volatility of TOT*OPN	0.095	0.121	0.103	0.008	0.011	0.008
	[0.036]***	[0.036]***	[0.035]***	[0.005]	[0.008]	[0.005]
Inflation volatility	0.134	0.133	0.131	0.038	0.031	0.038
(Infl. vol. differentials in (4)–(6))	[0.025]***	[0.025]***	[0.025]***	[0.003]***	[0.005]***	[0.004]***
Fiscal procyclicality	–0.001	0.003	0.004			
	[0.009]	[0.009]	[0.009]			
Trade openness				–0.005	–0.011	–0.005
				[0.003]*	[0.004]***	[0.003]*
Currency crisis	0.01	0.002	0.007	0.009	0.013	0.009
	[0.011]	[0.011]	[0.011]	[0.002]***	[0.002]***	[0.002]***

(*Continued*)

Table 1-5: (*Continued*)

	Investment volatility			Real exchange rate volatility		
	(1)	(2)	(3)	(4)	(5)	(6)
Private credit creation	–0.011	–0.012	–0.001			
	[0.026]	[0.026]	[0.025]			
Total reserve (as % of GDP)	–0.229	–0.393	0.158	0.022	0.038	–0.013
	[0.210]	[0.205]*	[0.132]	[0.030]	[0.045]	[0.019]
Monetary independence (MI)	–0.181	–0.159		0.004	0.024	
	[0.056]***	[0.057]***		[0.008]	[0.012]**	
MI × reserves	1.193	0.785		–0.049	–0.086	
	[0.342]***	[0.351]**		[0.048]	[0.076]	
Exchange rate stability (ERS)	0.077		0.07	–0.037		–0.038
	[0.026]***		[0.025]***	[0.004]***		[0.004]***
ERS × reserves	–0.413		–0.254	–0.007		0.001
	[0.179]**		[0.170]	[0.025]		[0.024]
KA openness		–0.042	–0.012		–0.008	–0.004
		[0.032]	[0.030]		[0.007]	[0.004]
KAOPEN × reserves		0.223	0.051		0.029	0.019
		[0.178]	[0.165]		[0.038]	[0.024]

(*Continued*)

Table 1-5: (*Continued*)

	Investment volatility			Real exchange rate volatility		
	(1)	(2)	(3)	(4)	(5)	(6)
Net FDI inflows/GDP	0.327	0.347	0.25	–0.041	–0.088	–0.033
	[0.274]	[0.280]	[0.272]	[0.041]	[0.064]	[0.042]
Net portfolio inflows/GDP	1.48	1.414	1.364	0.052	0.046	0.054
	[0.493]***	[0.508]***	[0.494]***	[0.069]	[0.108]	[0.071]
Net 'other' inflows/GDP	0.376	0.38	0.418	–0.028	–0.014	–0.028
	[0.116]***	[0.116]***	[0.112]***	[0.016]*	[0.025]	[0.016]*
Short-term debt	–0.042	–0.042	–0.042	0.006	0.004	0.007
(as % of total external debt)	[0.063]	[0.063]	[0.062]	[0.008]	[0.013]	[0.008]
Total debt service	0.264	0.232	0.213	0.02	0.081	0.02
(as % of GNI)	[0.140]*	[0.138]*	[0.136]	[0.020]	[0.031]***	[0.021]
Observations	309	309	309	310	310	310
Adjusted R-squared	0.31	0.26	0.25	0.63	0.29	0.63

Notes: Robust regressions are implemented. * significant at 10%; ** significant at 5%; *** significant at 1%. The dummy for Sub-Saharan countries is included in the regressions for output and inflation volatility, as are the dummies for Latin America and Caribbean and East Europe and Central Asia in the regression for the level of inflation.

Table 1-6: Determinants of output volatility: Emerging market economies (EMG)

	Investment volatility			Real exchange rate volatility		
	(1)	(2)	(3)	(4)	(5)	(6)
Relative income	0.237	0.119	0.193	–0.045	0.072	–0.073
	[0.254]	[0.272]	[0.255]	[0.054]	[0.074]	[0.050]
Relative income, sq.	–0.625	–0.36	–0.452	0.099	–0.108	0.176
	[0.557]	[0.604]	[0.561]	[0.118]	[0.166]	[0.112]
Change in US real interest rate	–0.1	–0.07	–0.134			
	[0.218]	[0.232]	[0.212]			
Volatility of TOT*OPN	–0.098	–0.022	–0.09	0.021	0.002	0.019
	[0.056]*	[0.059]	[0.055]	[0.011]*	[0.016]	[0.010]*
Inflation volatility	0.143	0.151	0.142	0.05	0.038	0.051
(Infl. vol. differentials in (4)–(6))	[0.028]***	[0.029]***	[0.027]***	[0.006]***	[0.008]***	[0.005]***
Fiscal procyclicality	0.017	0.014	0.02			
	[0.010]	[0.011]	[0.010]*			
Trade openness				–0.004	–0.004	–0.006
				[0.005]	[0.006]	[0.004]
Currency crisis	0.038	0.033	0.034	0.011	0.013	0.009
	[0.012]***	[0.013]**	[0.012]***	[0.003]***	[0.003]***	[0.002]***

(*Continued*)

Table 1-6: (*Continued*)

	Investment volatility			Real exchange rate volatility		
	(1)	(2)	(3)	(4)	(5)	(6)
Private credit creation	0.025	0.004	0.033			
	[0.024]	[0.025]	[0.024]			
Total reserves (as % of GDP)	–0.374	–1.045	0.368	0.035	0.052	0.001
	[0.192]*	[0.211]***	[0.118]***	[0.040]	[0.058]	[0.023]
Monetary independence (MI)	–0.286	–0.365		0.027	0.042	
	[0.060]***	[0.066]***		[0.013]**	[0.018]**	
MI × reserves	1.867	2.095		–0.068	–0.123	
	[0.306]***	[0.353]***		[0.064]	[0.096]	
Exchange rate stability (ERS)	0.127		0.121	–0.039		–0.037
	[0.032]***		[0.030]***	[0.007]***		[0.006]***
ERS × reserves	–0.818		–0.583	–0.012		–0.006
	[0.183]***		[0.173]***	[0.037]		[0.033]
KA openness		–0.065	0.026		–0.001	–0.009
		[0.034]*	[0.029]		[0.009]	[0.006]
KAOPEN × reserves		0.414	–0.138		–0.013	0.011
		[0.175]**	[0.144]		[0.047]	[0.028]

(*Continued*)

Table 1-6: (*Continued*)

	Investment volatility			Real exchange rate volatility		
	(1)	(2)	(3)	(4)	(5)	(6)
Net FDI inflows/GDP	–0.216	0.237	–0.433	–0.054	–0.114	0.024
	[0.373]	[0.422]	[0.384]	[0.081]	[0.117]	[0.077]
Net portfolio inflows/GDP	0.76	1.34	0.736	–0.043	–0.149	–0.018
	[0.488]	[0.543]**	[0.497]	[0.102]	[0.147]	[0.097]
Net 'other' inflows/GDP	0.586	0.637	0.6	–0.078	–0.08	–0.056
	[0.131]***	[0.139]***	[0.127]***	[0.027]***	[0.038]**	[0.025]**
Short-term debt	–0.102	–0.07	–0.113	0.014	–0.002	0.009
(as % of total external debt)	[0.067]	[0.072]	[0.066]*	[0.013]	[0.017]	[0.011]
Total debt service	0.172	0.277	0.182	0.027	0.034	0.032
(as % of GNI)	[0.155]	[0.165]*	[0.151]	[0.038]	[0.052]	[0.035]
Observations	149	149	149	151	151	151
Adjusted R-squared	0.62	0.49	0.49	0.68	0.39	0.69

Notes: Robust regressions are implemented. * significant at 10%; ** significant at 5%; *** significant at 1%. The dummy for Sub-Saharan countries is included in the regressions for output and inflation volatility, as are the dummies for Latin America and Caribbean and East Europe and Central Asia in the regression for the level of inflation.

rate stability reduces investment volatility.[28] Third, financial openness has a negative impact on both real exchange rate stability and investment volatility. Hence, we can conclude that financial liberalization could help reduce output volatility by making both real exchange rate and investment more stable (but only for EMGs). Last, the investment volatility regressions show that net portfolio and bank lending inflows can be volatility-increasing, although bank lending inflows can reduce real exchange rate volatility.

4.2 *A closer look at the transmission channels and policy implications for Asia*

In the previous exercise, we found different dynamics between the models for investment volatility and real exchange rate volatility. This difference suggests that the effect of international macroeconomic policy configurations differ depending upon how much weight policymakers place on these two policy goals. For example, if policymakers put greater weight on real exchange rate stability, it is better to pursue more exchange rate stability and greater financial openness (which implies lower levels of monetary independence). This policy strategy could have a volatility-enhancing impact on investment and output, depending on the level of IR holding. More concretely, the results from model (1) in Table 1-6 show that greater (weaker) monetary independence increases (decreases) real exchange rate volatility. The estimation results also indicate that the IR threshold (as a ratio to GDP) necessary for greater (weaker) monetary independence to have a positive (negative) effect on investment volatility is 15% of GDP whereas that for greater (weaker) exchange rate stability to have a negative (positive) effect is 16%. Hence, if an emerging market country holds a level of IR higher than 16% and tries to pursue a higher level of exchange rate stability and a *lower* level of monetary independence (or a combination of greater exchange rate stability and

[28] The threshold levels of IR holding are 19% of GDP in model (1) and 28% of GDP in model (3) in Table 1-5. In Table 1-6, they are 16% in model (1) and 21% in model (3).

greater financial openness), that country could achieve lower levels of not only real exchange rate stability, but also investment. This result may explain why many emerging market economies, especially those in Asia, are more open to international trade, tend to prefer exchange rate stability and hold a massive amount of IR while also pursuing financial liberalization.

This finding has significant relevance to Asian economies. The average ratio of trade openness (the sum of exports and imports as a ratio to GDP) to investment (as a ratio to GDP) from 1990 to 2006 for the Asian emerging market economies (EMG) is higher than the average of developing countries and the highest compared to other regional subgroups of developing countries. Asian EMGs are more open, and the results shown in columns (4) through (6) of Tables 1-5 and 1-6 are more relevant to this group of economies than any other groups. Furthermore, in the same period, the level of IR holding for the Asian EMG is well above the threshold of 15–16%, suggesting that Asian emerging market economies may have pursued international macroeconomic policies that help reduce the level of volatility in both investment and real exchange rates, or at least the latter if not both.[29]

Figure 1-3 illustrates the estimated effects of the three trilemma variables on the volatilities of investment volatility and real exchange rate calculated using the estimation results shown in Table 1-5.[30] The

[29] In fact, throughout the sample period, Asian EMGs have achieved lower levels of volatilities in both investment and real exchange rate than any other group of developing economies (naturally, except for the late 1990s when the real exchange rate was highly volatile due to the Asian crisis), and their levels are comparable to that of industrialized economies.

[30] That is, the bars in the panels of figures refer to $\acute{\alpha}_1 TLM_{it} + \acute{\alpha}_3 (TLM_{it} \times IR_{it})$ for each of the trilemma indexes and its interaction with IR holding. The estimated effects are calculated using the estimated coefficients and actual values for the trilemma indexes and the IR ratio. However, because only two out of the three trilemma variables are included in the estimations, the estimation results from two types of regressions: one with *MI* and *ERS* included in TLM_{it} and the other with *ERS* and *KAOPEN* are used to calculate the estimated effects for all the three indexes. The estimated effect of ERS is, however, based on the average of the estimated coefficients for the two regressions.

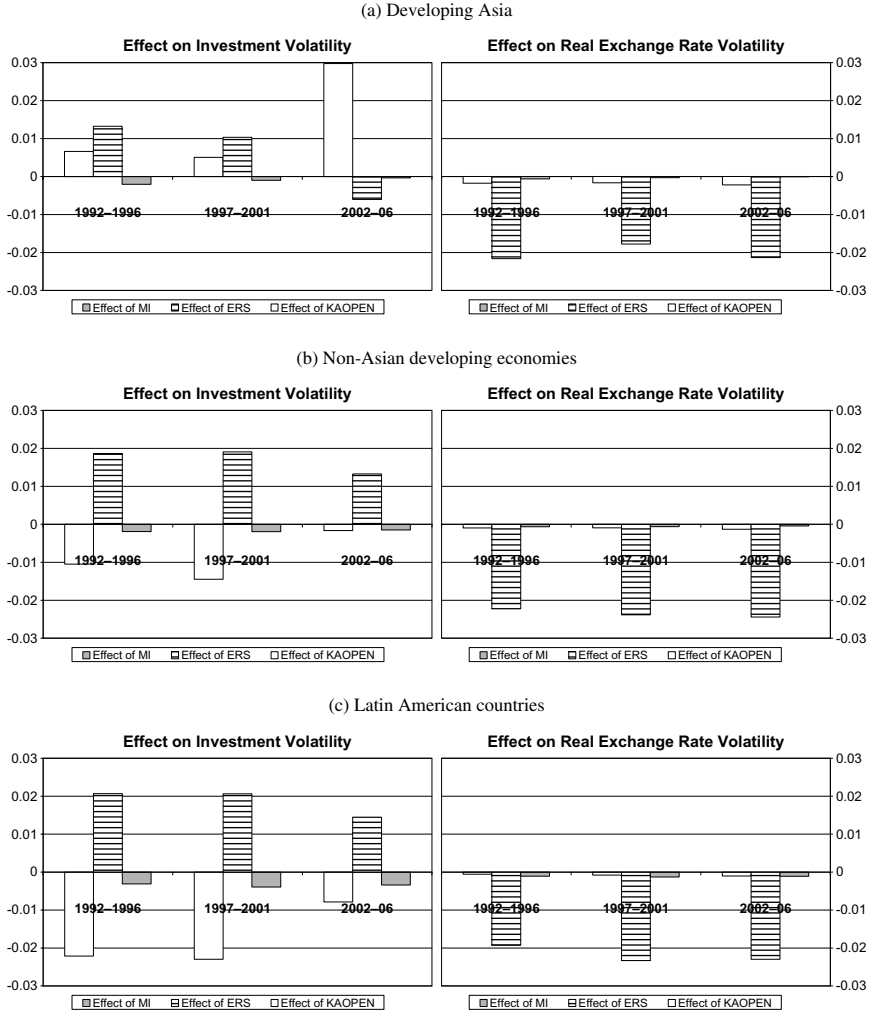

Figure 1-3: The impacts of the trilemma configurations on investment volatility and real exchange rate volatility

panels of Figure 1-3 allow us to make several interesting observations for the Asian economies. First, across different groups of developing economies, exchange rate stability and its interaction with IR holding have contributed significantly to lowering the real exchange rate

volatility over the years. Second, between the group of Asian developing economies and that of non-Asian economies, the role of monetary independence is different.[31] For the Asian economies, it has been a volatility-enhancing factor for investment with its impact rising rapidly over the last period (2002–2006). The rapid increase in the volatility-increasing impact for this group of economies can be explained by the rapid increase in the level of IR holding in this period. For non-Asian economies, on the other hand, monetary independence has been a volatility reducer, especially for Latin American economies though its impact dwindled in the last period. Third, exchange rate stability and its interaction with IR holding contribute to lower investment volatility among the Asian economies but only during the 2002–2006 period, while it has been a volatility-increasing factor throughout the period for the other groups.

Fourth, although we have found that a country with an above threshold level of IR holding can lessen the volatilities in both investment and real exchange rate with weaker monetary independence and greater exchange rate stability, the Asian economies on average do not appear to be following that sort of policy combinations. In the last five-year period, their monetary independence levels are not low enough to contribute to reducing investment volatility with the high level of IR holding. Despite this, they have succeeded in making exchange rate stability contribute to lowering investment volatility and real exchange rate stability. Fifth, financial openness does not play a role in affecting the volatilities of investment and real exchange rate, which reflects the ambiguous impact of financial liberalization as we discussed previously. This also suggests that the motivation for financial liberalization may not be relevant to policymakers' intention of alleviating macroeconomic volatilities through more open financial markets. Last, for all groups, the three policies on net have contributed negatively to real exchange rate volatility, but positively to investment volatility over years, though the net impact of the trilemma policies seems to be nil for the group of Latin American

[31] Most of the "Asian developing economies" are emerging market economies due to data availability.

economies. Having the trilemma policy combinations as volatility-increasing factors for investment may not be an objective for Asian emerging market economies which are quite open to international trade.

The top row of Figure 1-4 displays the actual levels of volatilities in output, investment, and real exchange rate (blue bars) along with the estimated impacts of the trilemma configurations (orange bars) for the period of 2002–2006, using the estimated coefficients from and the actual data for model (1) in Table 1-3 (for output volatility) and models (1) and (4) in Table 1-5 (for investment volatility and real exchange rate volatility, respectively). The bottom row presents the diamond charts for each of the country groups and the figures in parentheses beside the country groups report the average ratios of trade openness to the investment rates for the period of 2002–2006.

For the group of Asian emerging market economies, the trilemma policy combination contributes to lowering the volatilities of output and the real exchange rate, but to raising the volatility of investment. However, given that these economies are quite open (the ratio of relative trade openness to the investment rate (x) is 4.83), the volatility-reducing impact of the trilemma policy combination on the real exchange rate volatility should outweigh the volatility-increasing impact on the investment volatility, thus contributing to a lower output volatility. Latin American EMGs are on average less open economies ($x = 2.37$). As an aggregate, we can see that the impact of trilemma policy combinations of these economies is nil though the level of investment volatility is high.[32] This may imply that Asian economies design their trilemma policies in a way that does not exacerbate the volatility of investment or output.

Based on what we have found so far, economies should be able to alleviate volatility in both investment and real exchange rate by implementing certain trilemma combinations. It may be important, especially for relatively closed economies, to pursue investment stability. Hence, for relatively closed economies which hold above

[32] Note that the scale for the volatility level is different for this group of economies than the other groups.

(a) Country groups (x = the average ratio of trade openness to the investment rate as of 2002–2006)

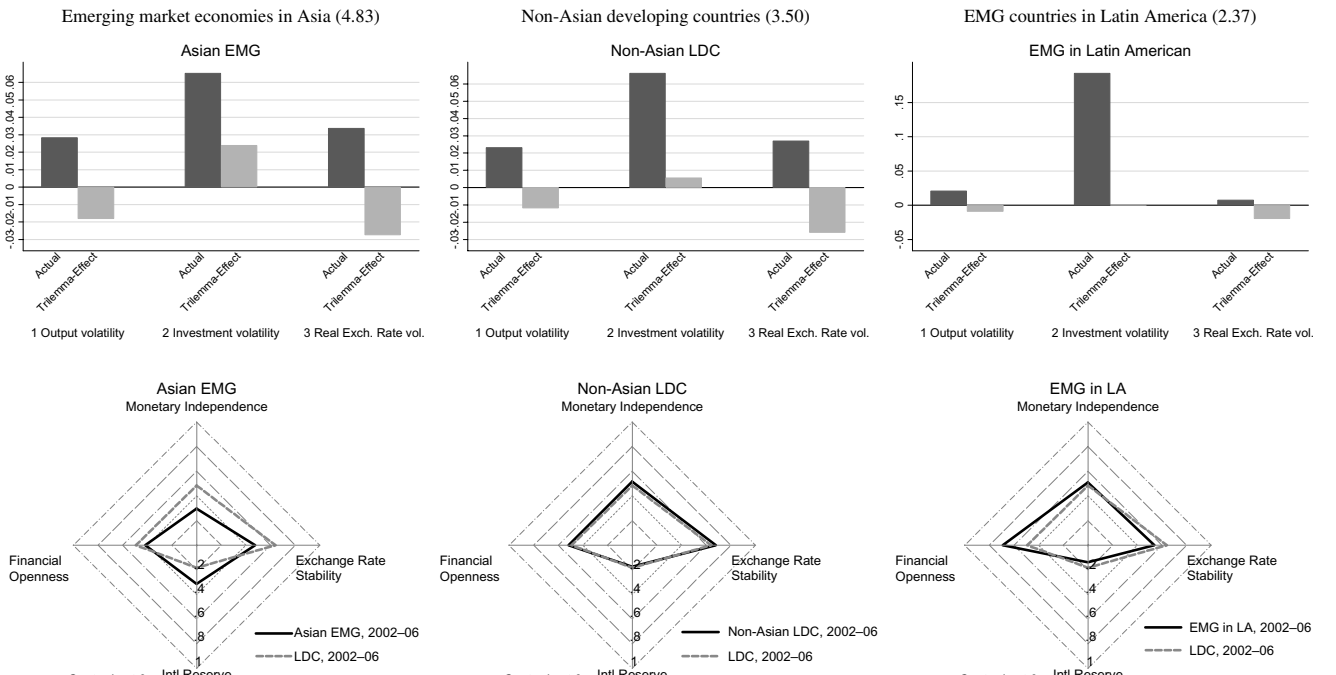

Figure 1-4: Contributions of trilemma policies to the volatility of output, investment, and real exchange rates

(b) Asian countries (x = the average ratio of trade openness to the investment rate as of 2002–2006)

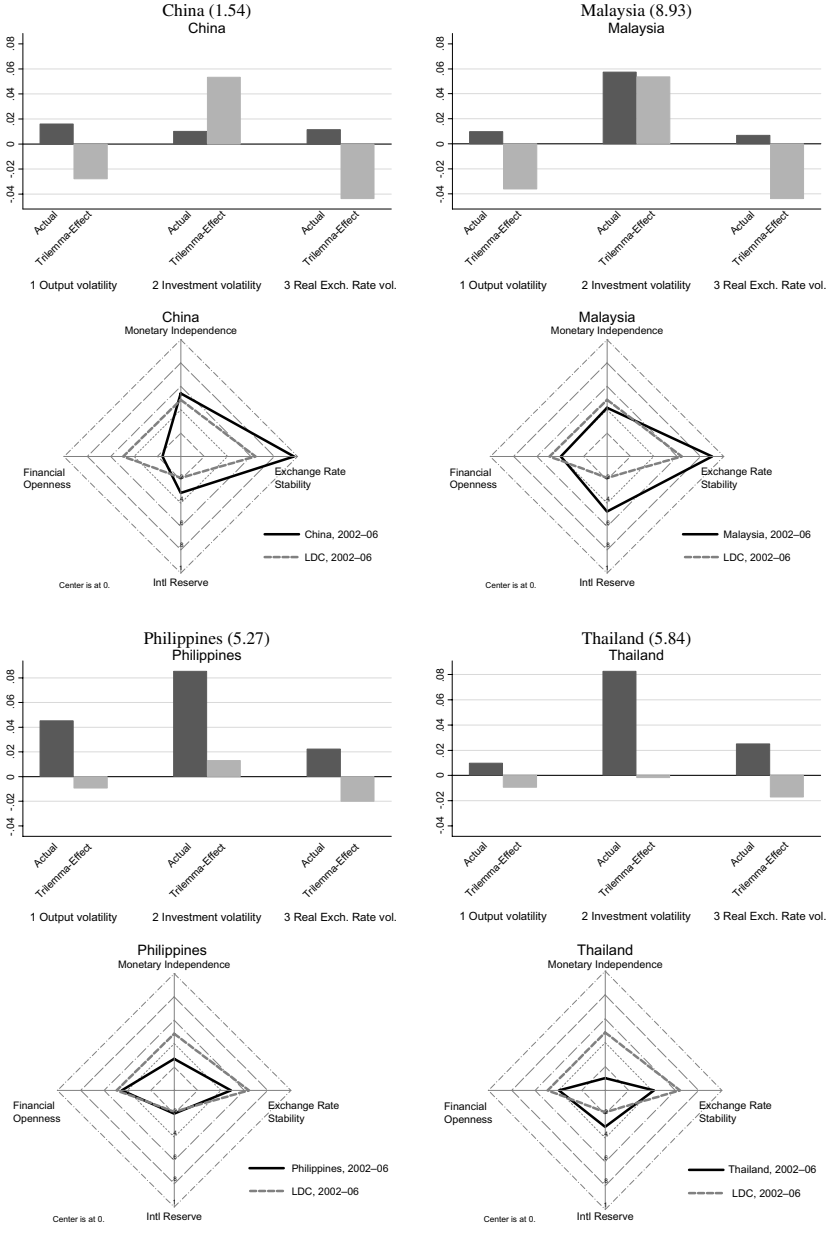

Figure 1-4: (*Continued*)

(c) Other countries (x = the average ratio of trade openness to the investment rate as of 2002–2006)

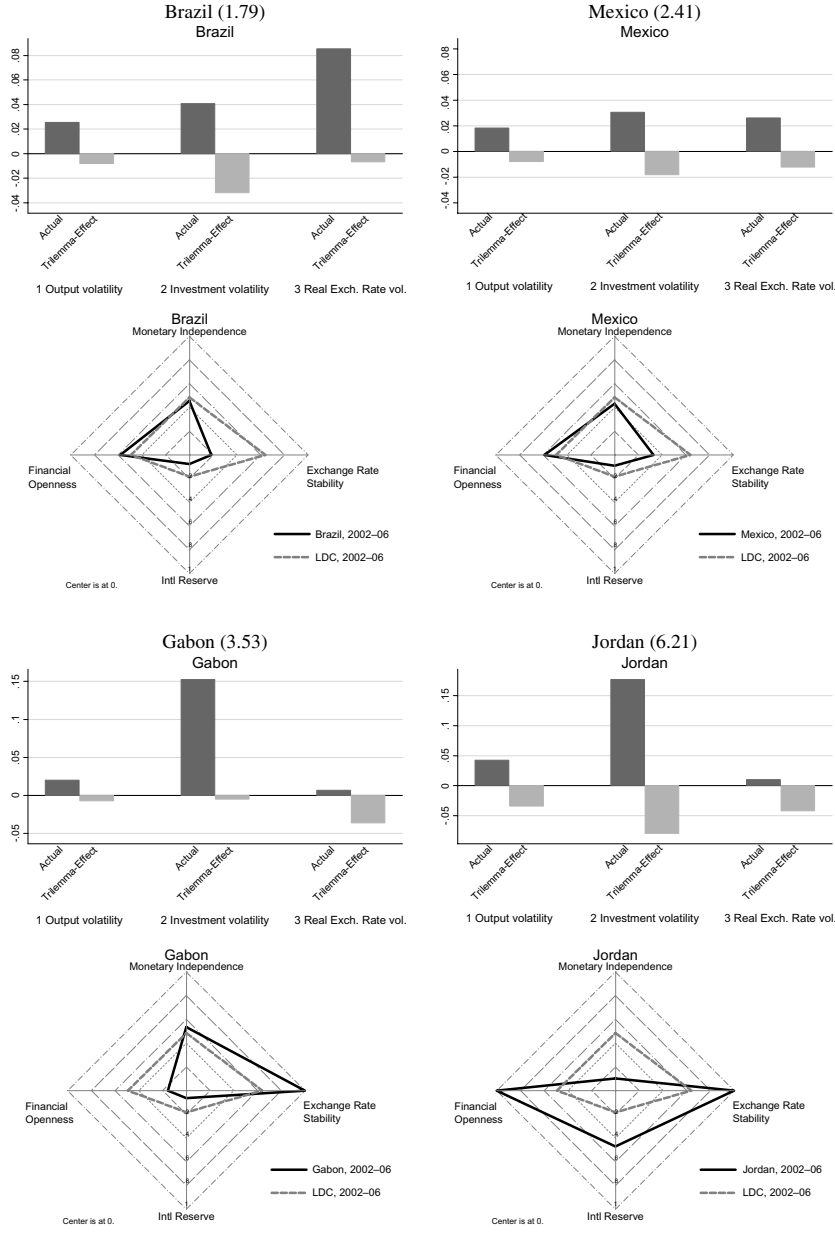

Figure 1-4: (*Continued*)

threshold levels of IR, policymakers may choose to pursue weaker monetary independence and greater exchange rate stability in order to achieve higher stabilities in both investment and real exchange rates. However, in those economies which hold low levels of IR, policymakers may choose to pursue greater monetary independence and lower exchange rate stability although they could not minimize the volatility of real exchange rate with greater monetary independence and lower ERS.[33] Table 1-7 presents the summary of these points.

Those economies that are highly open may focus on pursuing real exchange rate stability. For these open economies, the volatility of

Table 1-7: Policy combinations and implications on volatilities of investment (var(I)) and real exchange rate (var(q))

Closed Economy		
Policy Goals	(a) Lower var(I) and Lower var(q)	(b) Lower var(I) and Not too high var(q)
	High IR Lower MI Higher ERS (Middle ERS if IR is very high) (Higher KAOPEN or middle if IR is very high)	Low IR Higher MI Lower ERS (Higher KAOPEN)
Open Economy		
Policy Goals	(c) Lower var(I) and Lower var(q)	(d) Not too high var(I) and Lower var (q)
	High IR Lower MI Higher ERS (Higher KAOPEN)	High IR Middle MI Higher ERS (Middle KAOPEN)

[33] As we have discussed, the level of financial openness is irrelevant in terms of its impact on these volatilities. But because monetary independence and exchange rate stability is a trade-off issue, whether it holds a high or low level of IR, it can pursue greater financial openness.

investment becomes less important and the importance of holding high levels of IR increases. It is important to pursue greater exchange rate stability to achieve more stable real exchange rate movement, but to alleviate the volatility-increasing impact of greater exchange rate stability, a country needs to hold higher levels of IR. As monetary independence is a volatility-increasing factor for real exchange rate, and can be a volatility-reducer for a country with high IR, monetary independence must be at low levels. But given that we found the effect of monetary independence is minimal for the real exchange rate stability, monetary independence can be at middle levels. The more open the economy, the more it can afford to have slightly higher levels of monetary independence because it can neglect the volatility-increasing impact of greater monetary independence on investment (Table 1-7). This may explain the reason why emerging market economies, many of which are very open economies, have a balanced combination of the three trilemma policies.

Panels (b) and (c) of Figure 1-4 again present the contributions of the trilemma policies to the volatility of output, investment, and real exchange rates and the diamond charts for individual economies. Although the predictions summarized in Table 1-7 do not necessarily fit with the actual experiences of all individual economies, we can find some cases that are consistent with the above discussions. Brazil and Mexico may be considered good examples of scenario (b) shown in Table 1-7 — closed economies in terms of low trade-investment ratios, with low *IR*, high *MI*, lower *ERS*, and higher *KAOPEN*. Egypt can be representative of scenario (a) (not reported). Malaysia, the Philippines, and Thailand are somewhat consistent with scenarios (c) and (d) though the high *IR* holdings allow the latter two economies to have lower levels of *ERS*. For these economies, it is clear that the trilemma policies contribute to lowering output volatility by stabilizing real exchange rate movement. Jordan is a good example of scenario (c) while Gabon is of scenario (d). One interesting outlier is China; its level of monetary independence is so high that it contributes positively to higher investment volatility despite having a combination of very high *IR* and *ERS*. Despite the high volatility-increasing impact of the trilemma configuration on investment, the

volatility-reducing effect on the real exchange rate seems to be outweighing the former and contributing to lower output volatility although it is not such an open economy. Overall, the trilemma policy configuration seems to be effective in reducing the volatility of real exchange rate for the Asian economies. For this group of economies, it is the trade channel through which the trilemma policies seem to be affecting the volatility of output.

5. Concluding Remarks

More than one year after the onset of the most severe global crisis since the Great Depression, in the summer of 2009, some signs of recovery appeared, though none of them yet suggested sustainable recovery. Asia has impressed the world with its most robust recovery. This chapter focuses on how the region has dealt with the waves of financial globalization and achieved relatively stable macroeconomic development through the perspective of the "impossible trinity" or "trilemma". A series of empirical analyses yielded interesting findings.

First, the growth regressions provided very weak evidence that per capita economic growth can be affected by policy choices among the three trilemma policies as well as the various types of external financing.

Second, we found that higher levels of monetary independence are associated with lower output volatility. Countries with higher levels of exchange rate fixity tend to experience higher output volatility though this effect can be mitigated by holding a higher level of international reserves than the threshold of about 20% of GDP.

We also found that countries with greater monetary autonomy tend to experience higher inflation while countries with greater exchange rate stability or more open capital accounts tend to experience lower inflation. However, we found some evidence that if countries pursue greater exchange rate stability or financial openness while holding a sizeable amount of IR, they can experience a rise in the level of inflation, suggesting that countries with excess levels of reserves holding may eventually face a limit to foreign exchange sterilization.

Furthermore, greater monetary independence is found to help reduce investment volatility, though it would become a volatility-enhancer for investment if the level of IR holding gets above 15–20% of GDP. A higher degree of exchange rate stability makes investment volatile. The volatility-enhancing effect of exchange rate stability on investment can be cancelled by holding higher levels of IR. These results indicate that policymakers in a more open economy would prefer pursuing greater exchange rate stability and weaker monetary independence (or greater financial openness) while holding a massive amount of IR because this policy combination would help them stabilize both investment and real exchange rate.

Overall, Asian economies, especially the ones with emerging markets, are found to be equipped with macroeconomic policy configurations that help the economies to dampen the volatilities in both investment and real exchange rate. These economies' sizeable amount of IR holding appears to enhance the stabilizing effect of the trilemma policy choices, which explains the recent phenomenal buildup of IR in the region.

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