

The “Impossible Trinity,” the International Monetary Framework, and the Pacific Rim

Joshua Aizenman*
University of California, San Diego and the NBER

Hiro Ito**
Portland State University

November 2011

Abstract:

We examine the development of open macroeconomic policy choices among developing economies from the perspective of the powerful “trilemma” hypothesis. Using the “trilemma indexes” (Aizenman, Chinn, and Ito, 2010) that measure the extent of achievement in monetary independence, exchange rate stability, and financial openness, we observe that the three dimensions of the trilemma configurations are converging towards a “middle ground” among emerging market economies with managed exchange rate flexibility, underpinned by sizable holdings of international reserves, and intermediate levels of monetary independence and financial integration. We also find emerging market economies with more converged policy choices tend to experience smaller output volatility in the last two decades. Emerging markets with low levels of international reserves holding could experience higher levels of output volatility when they choose a policy combination with a greater degree of policy divergence while it does not apply to economies with high levels of international reserves holding. These results indicate that holding a high volume of international reserves may give room to emerging market economies to choose a policy combination from a wider spectrum of policy combinations.

JEL Classification Nos.: F31, F36, F41, O24

Keywords: Impossible trinity; international reserves; financial liberalization; exchange rate regime.

* Aizenman: Economics Department, University of California, Santa Cruz, Engineering 2, 401, Santa Cruz, CA 95064. Phone: (831) 459-2743. Email: jaizen@ucsc.edu.

** Ito: Department of Economics, Portland State University, 1721 SW Broadway, Portland, OR 97201. Tel/Fax: +1-503-725-3930/3945. Email: ito@pdx.edu

1. Introduction

Ever since the breakout of the global financial crisis of 2008-09, policy makers have gathered and discussed the future of the international monetary system. Policy makers from many countries have questioned the current international monetary system that has been essentially a uni-currency system heavily dependent on the U.S. dollar, the currency of the epicenter of the crisis, as the international reserve currency. China, with its mighty economy that has been growing at an impressive rate in the last two decades, has been one of the biggest challengers to the current international financial framework. However, while it challenges the dollar-dominant system and criticizes the U.S. profligacy for being responsible for the crisis, China itself is the largest holder of dollar reserves. It holds more than \$3 trillion of foreign reserves, more than 30% of the world's foreign reserves, with more than two-thirds denominated in the U.S. dollar.

The global financial crisis of 2008-09 has been followed by the Euro debt crisis, damaging the credibility of the Euro as the second largest international reserve currency and, consequently, leaving the U.S. dollar as the sole safe haven currency. Despite the feeble recovery of the U.S. economy, and given no other alternative international currency that can replace the role of the dollar or the Euro, international investors choose the U.S. dollar as the sole safe haven currency only after the process of elimination. That means, the U.S. still maintains the “exorbitant privilege” even though it is its profligacy partially financed by capital inflow that started the chain of crises. In such an international monetary system, frustration has amounted among high-growth developing countries, such as the BRIC countries – Brazil, Russia, India, and China – that are increasing their presence in the world economy. While the global financial crisis of 2008-09 barely left a dent on these economies' economic growth, the U.S. attempts to provide ample liquidity through extremely loose monetary policy have caused influx of capital to these high-growth economies, sowing seeds for asset inflation, especially in emerging market economies with de facto exchange rate fixity to the dollar.

With the low yield and expected depreciation trend of dollar-denominated assets, the opportunity cost of holding dollar assets has been increasing rapidly among the countries that hold massive international reserves (Jeanne, 2011) while they cannot find alternative international reserve currencies that can provide the same level of safe haven and liquidity to the extent of the U.S. dollar. Some developing economies, most notably China, hold so large an

amount of dollar assets that any attempt of selling off dollar assets could exacerbate the depreciation trend, increasing capital losses.

In sum, the international monetary system is facing the Triffin dilemma again. As countries created the Special Drawing Rights (SDRs) as a solution to the dilemma in the 1960s, powerful developing countries are now seeking for a drastic reform in the SDR as well as the international monetary system. However, a rise in the relative economic power has not been matched by a proportional rise in the status of these economies' currencies. One main reason for that it is only for the last two decades when middle-income developing countries have been actively opening their financial markets. Slow and cautious process for financial liberalization is due to its double-edged sword nature; while it can supplement domestic financial intermediation, financial opening can make countries exposed to economic and financial turmoil.

However, moving toward further financial globalization seems to be an irreversible trend for developing countries. At least, that is how policy makers in those economies perceive financial liberalization even including those in financially closed economies such as China. Now the question is, how to proceed with financial liberalization, especially in a way that would not put the country in a turbulence. Such a task can be complex in such a globalized environment.

Despite the complexity of policy management, policy makers face a simple, old theoretical constraint, called the “impossible trinity,” or “trilemma.” This is a hypothesis that was first made popular by Mundell (1963). The hypothesis 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 to the full extent. This hypothesis has been widely taught and recognized since it is quite intuitive and helpful to understand the constraints policy makers must face in an open economy setting.

Despite its pervasive recognition, the hypothesis has not faced much empirical scrutiny until recently. The main reason for that is because it is quite difficult to create systematic metrics that measure the extent of achievement in the three policy goals of the trilemma. If one does not know to what extent each of the policy choices has been achieved, it is difficult to estimate what kind of other policy choices are still available and to what extent.

Aizenman, Chinn, and Ito (2010) developed a set of the “trilemma indexes” that measure the degree to achievement in each of the three policy choices for a wide coverage of countries

and years. Using the indexes, they empirically proved that the hypothesis is valid by showing that the three measures of the trilemma are linearly related to each other.

In this paper we will characterize the policy choices developing economies have adopted over years from the perspective of the powerful hypothesis of the trilemma. For this attempt, we will use the “trilemma indexes” of Aizenman, et al. (2010), empirically proving that the hypothesis is “binding” – the three policies are linearly related with each other so that policy makers must face a trade-off in choosing a combination of two out of the three open macro policies. Lastly, we will focus on a characteristic of emerging market economies that have been evident in recent decades. That is the tendency for the “middle-ground convergence” – emerging market economies tend to choose a policy combination composed of intermediate levels of all three policies. We provide some evidence that a country equipped with intermediate levels of the three trilemma policies tend to experience a lower level of output volatility. That may explain the recent tendency of middle-ground convergence among emerging market economies.

2. The Trilemma Theory and Evidence

2.1. The Trilemma Hypothesis

The trilemma is illustrated in Figure 1. Each of the three sides of the triangle—representing monetary independence, exchange rate stability, and financial integration—depicts a potentially desirable goal, yet it is not possible to be simultaneously on all three sides of the triangle. For example, the top vertex, labeled “floating exchange rate,” is associated with the full extent of monetary policy autonomy and financial openness, but not exchange rate stability.

History has shown that different international financial systems have attempted to achieve combinations of two out of the three policy goals, such as the Gold Standard system – guaranteeing capital mobility and exchange rate stability – and the Bretton Woods system – providing monetary autonomy and exchange rate stability. The fact that economies have altered the combinations as a reaction to crises or major economic events may be taken to imply that each of the three policy options is a mixed bag of both merits and demerits for managing macroeconomic conditions.

Greater monetary independence could allow policy makers to stabilize the economy through monetary policy without being subject to other economies’ macroeconomic management, thus potentially leading to stable and sustainable economic growth. However, in a world with

price and wage rigidities, policy makers could also manipulate output movement (at least in the short-run), thus leading to increasing output and inflation volatility. Furthermore, monetary authorities could also abuse their autonomy to monetize fiscal debt, and therefore end up destabilizing the economy through high and volatile inflation.

Exchange rate stability could bring out price stability by providing an anchor, and lower risk premium by mitigating uncertainty, thereby fostering investment and international trade. Also, at the time of an economic crisis, maintaining a pegged exchange rate could increase the credibility of policy makers and thereby contribute to stabilizing output movement (Aizenman and Glick, 2009). However, greater levels of exchange rate stability could also rid policy makers of a policy choice of using exchange rate as a tool to absorb external shocks.¹ Hence, the rigidity caused by exchange rate stability could not only enhance output volatility, but also cause misallocation of resources and unbalanced, unsustainable growth.

Financial liberalization is perhaps the most contentious and hotly debated policy among the three policy choices of the trilemma. On the one hand, more open financial markets could lead to economic growth by paving the way for more efficient resource allocation, mitigating information asymmetry, enhancing and/or supplementing domestic savings, and helping transfer of technological or managerial know-how (i.e., growth in total factor productivity).² Also, economies with greater access to international capital markets should be better able to stabilize themselves through risk sharing and portfolio diversification. On the other hand, it is also true that financial liberalization has often been blamed for economic instability, especially over the last two decades, including the current crisis. Based on this view, financial openness could expose economies to volatile cross-border capital flows resulting in sudden stops or reversal of capital flows, thereby making economies vulnerable to boom-bust cycles (Kaminsky and Schmukler, 2002).

Thus, theory tells us that each one of the three trilemma policy choices can be a double-edged sword, which should explain the wide and mixed variety of empirical findings on each of

¹ Prasad (2008) argues that exchange rate rigidities would prevent policy makers from implementing appropriate policies consistent with macroeconomic reality, implying that they would be prone to cause asset boom and bust by overheating the economy.

² Henry (2006) argues that only when it fundamentally changes productivity growth through financial market development, could equity market liberalization policies have a long-term effect on investment and output growth. Otherwise, the effect of financial liberalization should be short-lived, which may explain the weak evidence on the link between financial liberalization and growth.

the three policy choices.³ Furthermore, to make the matter more complicated, while there are three ways of pairing two out of the three policies (i.e., three vertices in the triangle in Figure 1), 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 destabilizing when it is paired with financial openness while it can be stabilizing if paired with greater monetary autonomy. Hence, it may be worthwhile to empirically analyze the three types of policy combinations in a comprehensive and systematic manner.

2.2 Development of Policy Combinations in the Trilemma Context

Despite its pervasive recognition, there has been almost no empirical work that we are aware of, that tests the concept of the trilemma systematically. Many of the studies in this literature often focus on one or two variables of the trilemma, but fail to provide a comprehensive analysis of all of the three policy aspects of the trilemma.⁴ This is partly because of the lack of appropriate metrics that measure the extent of achievement in the three policy goals.

Aizenman et al. (2008) overcame this deficiency by developing a set of the “trilemma indexes” that measure the degree to which each of the three policy choices is implemented by economies for more than 170 economies for 1970 through 2007.⁵ The monetary independence index (MI) is based on the correlation of a country’s interest rates with the base country’s interest rate. The index for exchange rate stability (ERS) is an invert of exchange rate volatility, i.e., standard deviations of the monthly rate of depreciation, using the exchange rate between the home and base economies. The degree of financial integration is measured with the Chinn-Ito (2006, 2008) capital controls index (KAOPEN). More details on the construction of the indexes can be found in Appendix as well as in Aizenman et al. (2009).

Figure 2 shows the trajectories of the trilemma indexes for different income-country groups. For the industrialized economies, financial openness accelerated after the beginning of

³ As for monetary independence, refer to Obstfeld, et al. (2005) and Frankel et al. (2004). 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), Kose et al. (2006), Prasad et al. (2003), and Prasad and Rajan (2008).

⁴ Notable exceptions include works by Obstfeld, Shambaugh, and Taylor (2005, 2009, and 2010) and Shambaugh (2004).

⁵ The data are updated to 2010 for monetary independence and exchange rate stability and to 2009 for financial openness. The indexes are available at http://web.pdx.edu/~ito/trilemma_indexes.htm.

the 1990s while the extent of monetary independence started a declining trend. After the end of the 1990s, exchange rate stability rose significantly. All these trends seem to reflect the introduction of the euro in 1999.⁶

Developing economies on the other hand do not present such a distinct divergence of the indexes, and their experiences differ depending on whether they are emerging or non-emerging market economies.⁷ For emerging market economies, exchange rate stability declined rapidly from the 1970s through the mid-1980s. After some retrenchment around early 1980s (in the wake of the debt crisis), financial openness started rising from 1990 onwards. For the other developing economies, exchange rate stability declined less rapidly, and financial openness trended upward more slowly. In both cases though, monetary independence remained more or less trendless.

Interestingly, for the emerging market economies, the indexes suggest a convergence toward the middle ground, even as talk of the disappearing middle has been doing the rounds. This pattern of results suggests that developing economies may have been trying to cling to moderate levels of both monetary independence and financial openness while maintaining higher levels of exchange rate stability. In other words, they have been leaning somewhat against the trilemma over a period that interestingly coincides with the time when some of these economies began accumulating sizable international reserves (IR), potentially to buffer the trade-off arising from the trilemma.

None of these observations is applicable to non-emerging developing market economies (Figure 2[c]). For this group of economies, exchange rate stability has been the most aggressively pursued policy throughout the period. In contrast to the experience of the emerging market economies, financial liberalization has not been proceeding rapidly for the non-emerging market developing economies.

⁶ If the euro economies are removed from the sample (not reported), financial openness evolves similarly to the IDC group that includes the euro economies, but exchange rate stability hovers around the line for monetary independence, though at bit higher levels, after the early 1990s. The difference between exchange rate stability and monetary independence has been slightly diverging after the end of the 1990s.

⁷ The emerging market economies are defined as the economies 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.

Furthermore Asia, especially those economies with emerging markets, stand out from other geographical groups of economies.⁸ Panel (a) in Figure 3 shows that for Asian emerging market economies, this sort of convergence is not a recent phenomenon. Since as early as the early 1980s, the three indexes have been clustered around the middle range. However, for most of the time, except for the Asian crisis years of 1997-98, exchange rate stability seems to have been the most pervasive policy choice. In the post-crisis years in the 2000s, the indexes diverged, but seem to be converging again in the recent years. This characterization does not appear to be applicable to non-emerging market economies (non-EMG) in Asia (b) or Latin America (c). For non-EMG economies in Asia or non-Asian developing economies, convergence in the trilemma configurations seems to be the case in the last decade.

3 Linear Relationships of the Trilemma Indexes

While the preceding analyses are quite useful for tracing out the evolution of international macroeconomic policy orientation, we have not demonstrated whether these three macroeconomic policy goals are “binding” in the sense of the impossible trinity. That is, it is important for us to provide evidence that countries have faced the trade-offs based on the trilemma. A challenge facing a full test of the trilemma tradeoff is that the trilemma framework does not impose any obvious functional form on the nature of the tradeoffs between the three trilemma variables. To illustrate this concern, we must note that the instrument scarcity association with the trilemma implies that increasing one trilemma variable, say higher financial integration, should induce lower exchange rate stability, or lower monetary independence, or a combination of these two policy adjustments.⁹ Hence, we test the validity of the simplest possible trilemma specification – a linear tradeoff. Specifically, we test whether the weighted sum of the three trilemma policy variables equals a constant. This reduces to examining the goodness of fit of this linear regression:

$$1 = a_j MI_{i,t} + b_j ERS_{i,t} + c_j KAOPEN_{i,t} + \varepsilon_t \text{ where } j \text{ can be either IDC, ERM, or LDC.} \quad (1)$$

⁸ The sample of “Asian Emerging Market Economies” include Cambodia, China, Hong Kong, India, Indonesia, Rep. of Korea, Malaysia, Philippines, Singapore, Thailand, and Vietnam.

⁹ More generally, increasing of one Trilemma variable should induce a drop of the second Trilemma variable, or a drop in the third Trilemma variable, or a combination of the two.

Because we have shown that different subsample groups of countries have experienced different development paths, we allow the coefficients on all the variables to vary across different groups of countries – industrialized countries, the countries that have been in the European Exchange Rate Mechanism (ERM), and developing countries – by allowing for interactions between the explanatory variables and the dummies for these subsamples.¹⁰ The regression is run for the full sample period as well as the subsample periods that are divided by major economic event and crises, i.e., the collapse of the Bretton Woods system in 1973, the Mexican debt crisis of 1982, and the Asian crisis of 1997-98. The results are reported in Table 1.

The rationale behind this exercise is that policy makers of an economy must choose a weighted average of the three policies in order to achieve a best combination of the two. Hence, if we can find the goodness of fit for the above regression model is high, it would suggest a linear specification is rich enough to explain the trade off among the three policy dimensions. In other words, the lower the goodness of fit, the weaker the support for the existence of the trade-off, suggesting either that the theory of the trilemma is wrong, or that the relationship is non-linear.

Secondly, the estimated coefficients in the above regression model should give us some approximate estimates of the weights countries put on the three policy goals. However, the estimated coefficients alone will not provide sufficient information about “how much of” the policy choice countries have actually implemented. Hence, looking into the predictions using the estimated coefficients and the actual values for the variables (such as $\hat{a}MI$, $\hat{b}ERS$, and $\hat{c}KAOPEN$) will be more informative.

Thirdly, by comparing the predicted values based on the above regression, i.e., $\hat{a}MI + \hat{b}ERS + \hat{c}KAOPEN$, over a time horizon, we can get some inferences about how “binding” the trilemma is. If the trilemma is found to be linear constraint, the predicted values should hover around the value of 1, and the prediction errors should indicate how much of the three policy choices have been “not fully used” or to what extent the trilemma is “not binding.”

Table 2 presents the regression results. The results from the regression with the full sample data are reported in the first column, and the others for different subsample periods are in

¹⁰ The dummy for ERM countries is assigned for the countries and years that corresponds to participation in the ERM (i.e., Belgium, Denmark, Germany, France, Ireland, and Italy from 1979 on, Spain from 1989, U.K. only for 1990-91, Portugal from 1992, Austria from 1995, Finland from 1996, and Greece from 1999).

the following columns. First of all, the adjusted R-squared for the full sample model as well as for the subsample periods is found to be above 94%, which indicates that the three policy goals are linearly related to each other, that is, countries face the trade-off among the three policy options. Across different time periods, the estimated coefficients vary, suggesting that the nature of the tradeoffs varies, either because of changes in the governments' objective functions, or the changing nature of the economies.

Figure 4 illustrates the goodness of fit from a different angle. In both panels, the solid lines show the means of the predicted values (i.e., $\hat{a}MI + \hat{b}ERS + \hat{c}KAOPEN$) based on the full sample model in the first column of Table 1 for the groups of industrial countries (top) and developing countries (bottom).¹¹ To incorporate the time variation of the predictions, the subsample mean of the prediction values as well as their 95% confidence intervals (that are shown as the shaded areas) are calculated using five-year rolling windows.¹² The panels also display the rolling means of the predictions using the coefficients and actual values of only two of the three trilemma terms – $\hat{a}MI + \hat{b}ERS$ (brown line with diamond nodes), $\hat{a}MI + \hat{c}KAOPEN$ (green line with circles), $\hat{b}ERS + \hat{c}KAOPEN$ (orange line with “x”).

From these panels of figures, we can see first that the predicted values based on the model hover around the value of one closely for both subsamples. For the group of industrial countries (IDC), the prediction average is statistically below the value of one in the late 1970s, the early 1980s, and the late 1980s. However, since the beginning of the 1990s, one cannot reject the null hypothesis that the mean of the prediction values is one, indicating that the trilemma is “binding” for industrialized countries since then. For developing countries, the model is under-predicting from the end of the 1970s through the beginning of the 1990s. However, unlike the IDC group, the mean of the predictions has become statistically smaller than one since 2000. At

¹¹ For this exercise, predictions also incorporate the interactions with the dummy variables shown in Table 2.

¹² Both the mean and the standard errors of the predicted values are calculated using the rolling five-year windows.

The formula for the mean and the standard errors can be shown as $\bar{x}_{it-4} = \frac{\sum_t \sum_{i=1}^n \hat{x}_{it}}{n \times 5}$ and

$SE(\hat{x}) = \sqrt{\frac{\sum_t \sum_{i=1}^n (\hat{x}_{it} - \bar{x}_{it-4})^2}{n \times 5 - 1}} / \sqrt{n \times 5}$, respectively, where n refers to the number of countries in a subsample (i.e., IDC and

LDC), \hat{x}_{it} to the prediction values, and \bar{x}_{it-4} to the mean of \hat{x}_{it} in the rolling five-year window.

Because of the use of rolling five-year windows, the lines in the figures only start in 1974.

the very least, the mean of the predictions never gets above the value of one in statistical sense, implying that, despite some years when the trilemma is not binding, the three macroeconomic policies are linearly related with each other.¹³

The top panels also show that, among industrialized countries, the policy combination of increasing exchange rate stability and more financial openness became increasingly prevalent after the beginning of the 1990s whereas that of monetary independence and exchange rate stability has been consistently declining over the years. Among developing countries, the policy combination of exchange rate stability and financial openness has been the least prevalent over the sample period, most probably reflecting the bitter experiences of currency crises. The policy combinations of monetary independence and financial openness or that of monetary independence and exchange rate stability has been quite dominant, but that is mainly because of the dominant preference for monetary independence through the time period.

We also repeat the exercise using the regression models for each of the subsample period (excluding the break years corresponding to the end of the Bretton Woods system and the two crises). The results (not reported) are qualitatively the same as in Figure 4.

4. Further Look into the “Middle-Ground” Convergence

Now that we have empirical evidence for the theoretical validity of the indexes, let us take a closer look at the distribution of the indexes. We pay particular attention to the tendency of the “middle-ground convergence” – a tendency that the indexes cluster around the intermediate levels for all three policy choices – especially among emerging market economies.

4.1 The Index of Policy Convergence

To see how much convergence is taking place, we calculate a new variable that measures the extent of divergence in all three trilemma indexes. The measure of triad policy divergence d_{it} is calculated as follows:

$$d_{it} = \sqrt{(mi_{rit} - 1)^2 + (ers_{rit} - 1)^2 + (ka_{rit} - 1)^2}$$

¹³ One may question the uniqueness of this regression exercise by pointing at the left-hand side variable being an identity scalar. As a robustness check, we ran a regression of $MI_{i,t}$ on $ERS_{i,t}$ and $KAOPEN_{i,t}$, recovered the estimated coefficients for a_j , b_j , and c_j in equation (1), and recreated panels of figures comparable to those in Figure 4. These alternative figures appeared to be very much comparable to Figure 4 and therefore confirmed our conclusions about the linearity of the trilemma indexes as well as the development of the subsample mean of prediction values based on equation (1).

where $X_{rit} = \frac{X_{it}}{\bar{X}_t}$ for $X = MI, ERS,$ and $KAOPEN$, and \bar{X}_t is cross-country average of X in year t .

Here, we can consider d_{it} as the measure of dispersion in all three policies in a particular year. The higher the d_{it} is, the more dispersion among the three indexes in a particular year we can expect for country i , meaning that country i tends to have a combination of distinctively different triad policies. In terms of the triangle shown in Figure 1, a country with a higher d_{it} is considered to be closer to one of the corners or the sides of the triangle whereas a lower d_{it} represents a policy combination closer to the middle of the triangle (see Aizenman and Ito (2011)).

Figure 5 illustrates the average of d_{it} for different subgroups of countries based on income levels. Essentially, this figure allows us to observe Figure 2 from a different perspective.

We can make several interesting observations based on this figure. For the last two decades, advanced economies tend to have combinations of distinctive policies. Not surprisingly, the Euro country group has the highest degree of policy divergence among the country groups, followed by the group of non-Euro advanced economies. As we have observed in Figure 2, the group of emerging market economies has had the lowest degree of policy convergence in the last two decades. Since the beginning of the 1980s, developing economies, whether or not with emerging markets, have had relatively stable movement in the degree of policy convergence except for the mid-1990s when both subgroups of developing economies experienced a drop in the degree of policy divergence. In the crisis years of 1982, 1997-98, and 2008-09 – the Mexican debt crisis, the Asian financial crisis, and the global financial crisis, interestingly, the policy convergence measure tends to fall in the years prior to the crisis years.

To see what is driving the trajectories in Figure 5, we look at the group mean of the ratios of each of the three indexes to its cross-country mean. We focus on developing economies and report the average ratios for emerging market economies and non-emerging market developing economies in Figures 6 and 7, respectively.

These figures show clear differences between emerging market economies and non-emerging market developing economies. First, from the beginning of the sample period through the end of the 1990s, it is exchange rate stability that non-emerging market developing economies have prioritized. In the same period, emerging market economies, on the other hand, have pursued monetary independence. Second, despite the prevalent anecdotal view that emerging market economies have pursued greater exchange rate stability, exchange rate stability

has not been given the first priority over the sample period. Third, most distinctively from the non-emerging market group, emerging market economies have increased the extent of financial openness very rapidly in the last two decades. Fourth, while the role of retaining monetary independence has been increasing for non-emerging market developing economies in the first half of the 2000s, the opposite is true for emerging market economies. However, facing the global financial crisis of 2008-09, emerging market economies rapidly regained monetary independence.

We are also curious to see if there are any regional characteristics in the formation of triad open macro policies. Externality can play a role in concerting policy decision makings among neighboring countries in a region. Plus, there can be a regional economic integration such as the case of East Asian supply chain network. Figure 8 illustrates the averages of the policy dispersion measure (d_{it}) for different regional country groups.

One interesting observation we can make is that both Asian emerging market economies and countries in the middle-east and northern Africa experienced high levels of policy divergence from the beginning of the 1980s through the early 1990s. This is mainly because the countries in both regional groups achieved higher levels of financial opening compared to the average of developing economies.¹⁴ More interestingly, since the last few years of the 1990s, which coincides with the Asian Crisis period, the degrees of policy divergence have been persistently small among all regional groups. This policy convergence among developing economies may reflect the great moderation, but the convergence seems to be still in place in the last few years of the sample despite the global financial crisis. Lastly, despite its high levels of policy divergence in the 1980s, emerging market economies in Asia have been experiencing lowest levels of policy divergence. Aizenman, Chinn, and Ito (2011) examined econometrically how the triad open macro policy combinations can affect macroeconomic performances such as output growth and volatility, inflation, and inflation volatility. They concluded that the policy combinations implemented by emerging market economies in Asia have allowed these economies to experience low levels of output volatility. The figures here suggest that the

¹⁴ Plus, Latin American countries, many of which went through debt crises, retrenched financial openness around the same period, dragging down the average.

“middle-ground convergence” of the triad open macro policies may also have contributed to the stability of these economies’ output performances.¹⁵

4.2 Effect of Policy Convergence

Given that Asian emerging market economies, as well as developing economies in general, were barely affected by the global financial crisis of 2008-09, the high degree of policy convergence we observe for developing economies, especially emerging market economies, may have also contributed to more stable output performances of developing economies. We focus on this issue in this subsection.

An economy with its triad open macro policies clustered around the intermediate levels, as is the case with many emerging market economies, may be able to retain stability in its output performance. By avoiding a policy combination of distinctive choices among the three open macro policies, the economy may be able to dampen the negative aspects of each of the three policy choices we discussed in a previous section. If that is true, we can expect smaller the d_{it} 's to be correlated with smaller output volatilities.

Figure 9 displays a scatter diagram for the correlation between five-year standard deviations of per capita output growth (in local currency) and the five-year average of the policy divergence measure d for non-overlapping five-year panels from 1970 through 2009. The red triangles are for the group of non-emerging market developing economies whereas the blue circles are for emerging market economies. Both subsamples have slightly positive correlation coefficients as our prior suggested, but the coefficients are insignificant.

For the last two decades, some of the developing economies have been actively opening up their financial markets. One other prior we can make is that countries may try to have a smaller degree of policy divergence to be prepared for potential negative consequences of financial liberalization. If that is true, more financially open economies may experience smaller output volatility when they adopt a policy combination with smaller policy divergence. Let us see if the data are consistent with this prior.

Figure 10 again illustrates the correlation between output volatility and the measure of policy divergence, but now the sample is divided into two groups: financial open economies and

¹⁵ The methodology outlined in the section has been applied for several studies, including Hutchison, Sengupta, and Singh (2011), Cortuk and Singh (2011), and Popper, Mandilaras, and Bird (2011).

financial closed economies. A country is categorized as a financial open economy if its measure of financial openness is greater than the average of the measure among developing economies in a particular year. Financially open economies are shown in blue circles and financially closed economies are in red triangles. As we suspected, financially open economies have a positive, but insignificant, correlation between output volatility and policy dispersion whereas financially closed economies have a slightly negative, insignificant correlation. The p-value of the positive correlation is now 28%, much lower than that for the negative correlation.

What if we focus on the time period when developing economies, especially those with emerging markets, have been actively liberalizing financial markets? Figure 11 is a recreation of Figure 9, but we now restrict the sample to the 1990-2009 period. We see a clear difference between emerging market economies and non-emerging market economies. Emerging market economies with lower levels of policy dispersion measure tend to experience lower levels of output volatility – the correlation coefficient is significant with a conventional significance level. Non-emerging market economies, on the other hand, tend to experience *higher* levels of output volatility if they pursue lower levels of policy dispersion though the correlation coefficient is only marginally statistically. It appears that emerging market economies have dealt with financial globalization better than non-emerging market developing economies by having more converged policy combinations.

Figure 12 is a recreation of Figure 10, but focusing on emerging market economies in the 1990-2009 period. Emerging market countries without open financial markets have a significantly positive and high correlation between policy convergence and output volatility while those with open financial markets have an insignificantly positive correlation (with a smaller magnitude). This result can be counter-intuitive for those who believe that an economy can experience a turbulence if it pursues greater financial openness and a more distinctively divergent policy combination.

4.3 The Trilemma to The Quadrilemma?

Open macroeconomic management is never an easy task especially for developing countries. Those economies that have decided to pursue greater financial openness have to be prepared for financial turbulences associated with sudden stops of inflows of capital, capital flights, and deleveraging crises. One byproduct of pursuit for greater financial openness while

retaining financial and economic stability is rapid accumulation of international reserves among developing economies. As many researchers have pointed out, developing countries, especially emerging market economies, have increased the amount of international reserves holding significantly in recent years. While the international reserves/GDP ratio of industrial countries was overall stable, hovering below 10%, the reserves/GDP ratio of developing countries increased dramatically, close to tripling in 25 years. By 2007, about two thirds of the global international reserves were held by developing countries. Most of this increase has been in Asia. The most dramatic changes occurred in the China, increasing its reserve/GDP from below 5% in 1980, to about 50% in 2009. As has been widely discussed, a rapid increase in international reserves holding, especially in Asia, started in the post-Asian crisis period, suggesting that insurance motives are one of the motivations for developing economies to hold massive international reserves (Aizenman and Marion 2003).¹⁶

Prior to the financial integration, the demand for reserves provided self-insurance against volatile trade flows. However, financial integration of developing countries also added the need to self-insure against volatile financial flows. By the nature of financial markets, the exposure to rapidly increasing demands for foreign currency triggered by financial volatility, exceeds by a wide margin the one triggered by trade volatility. The East Asian crisis was a watershed event, as it impacted high saving countries with overall balanced fiscal accounts. These countries were viewed as being less exposed to sudden stop events as compared with other developing countries prior to the crisis. With a lag, the affected countries reacted by massive increases in their stock of reserves.

Recent studies validate the importance of “financial factors” as key determinants, in addition to the traditional trade factors, in accounting for increased international reserves/GDP ratios. Indeed, recent research has revealed that the role of financial factors has increased in tandem with growing financial integration. More financially open, financially deep countries, with greater exchange rate stability tend to hold more reserves. Within the emerging market sample, the fixed exchange rate effect is weaker, but financial depth (measured by M2/GDP) is highly significant and growing in importance over time (Cheung and Ito 2009, Obstfeld et al.

¹⁶ These economies also cannot expect stable access to the international financial market to the same extent of advanced economies (Obstfeld, et al. 2009). Further, distaste among developing countries for rescue programs offered by the International Monetary Fund (IMF) since the Asian crisis period could have also motivated these economies to be prepared on their own for a rainy day.

2010). Trade openness is the other robust determinant of reserve demand, though its importance seems to have diminished over time (Cheung and Ito 2009). The growing importance of financial factors helps in accounting for a greater share of the international reserves/GDP ratios (Aizenman and Lee 2007). These results are in line with a broader self-insurance view, where reserves provide a buffer, both against deleveraging initiated by foreign parties, as well as against the sudden wish of domestic residents to acquire new external assets. That is, developing countries often face “sudden capital flight” (Calvo 1998, 2006; Aizenman and Lee 2007) in the form of “double drains” or “external and internal drains” (Obstfeld, et al. 2009).¹⁷

All these issues suggest that developing countries may need to manage their open macro policies on the basis of the “quadrilemma” rather than the trilemma.

The “diamond charts” in Figure 13 are useful to trace the changing patterns of the “quadrilemma” configurations. Each country’s configuration at a given instant is summarized by a “generalized diamond,” whose four vertices measure monetary independence, exchange rate stability, IR/GDP ratio, and financial integration. The origin has been normalized so as to represent zero monetary independence, pure float, zero international reserves, and financial autarky. The panels of figures summarize the trends for industrialized economies, emerging Asian economies, non-emerging market developing Asian economies, non-Asian developing economies, and Latin American emerging market economies.

In Figure 13, we can observe again the divergence of the trilemma configurations for the industrial economies over the years—a move toward deeper financial integration, greater exchange rate stability, and weaker monetary independence—while reducing the level of IR holding over years. Asia, especially those economies with emerging markets, appears distinct from other groups of economies; the middle-ground convergence observed for the emerging market group is quite evident for this particular group of economies. This is not a recent phenomenon for the Asian emerging market economies, however. Since as early as the 1980s, the three indexes have been clustered around the middle range, though exchange rate stability has been the most pervasive policy choice and the degree of monetary independence has been gradually declining. This characterization is not applicable to the other groups of developing economies such as Latin American emerging market economies. Most importantly, the group of

¹⁷ The high positive co-movement of international reserves and M2 is consistent with the view that the greatest capital flight risks are posed by the most liquid assets, i.e., by the liquid liabilities of the banking system as measured by M2.

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

Aizenman, et al. (2010) empirically show that pursuing greater exchange stability can be increasing output volatility for developing economies, but that that can be mitigated by holding a greater amount of international reserves than the threshold of about 20% of GDP. Aizenman, et al. (2011) find that emerging market economies seem to have adopted a policy combination of the three trilemma policies and international reserves that allow these economies to lessen output volatility through reduced real exchange volatility. Thus, it is not surprising for developing economies to have become active in accumulating international reserves in recent years.

Lastly, let us examine the impact of holding international reserves in the context of policy convergence. Figure 14 again displays a scatter diagram for the correlation between output volatility and the measure of policy divergence for emerging market economies in the 1990-2009 period. The sample is divided into two subgroups: one composed of emerging market economies that hold international reserves more than the annual median level among developing countries and the other of those economies with reserves lower than the median. Those emerging market economies with lower levels of international reserves have a significantly positive correlation while those with higher levels of reserves have an insignificantly negative association. One interpretation of this result is that holding high levels of international reserves may give countries a wider choice for the degree of policy divergence. For countries with low international reserves, it is better to have a more convergence, but high reserve holders do not face the same kind of trade-off.

What if we restrict the sample to those emerging market economies that have more open financial markets? Figure 15 is the same as Figure 14, except that the sample is now restricted to only emerging market economies with more open financial markets (“open” as defined in Figure 10). The figures illustrates that emerging market economies with more open financial markets may face higher levels of output volatility if they pursue higher degrees of policy divergence but do not hold high levels of international reserves, though the positive association is not statistically significant. For emerging market economies with more open financial markets and high levels of international reserves, the level of policy divergence does not seem to have an effect on output volatility levels.

Having seen these results, we can conclude not only that the tendency for emerging market economies to have more converged policy combinations help them to experience lower levels of output volatility, but also that holding a higher level of international reserves may help them to get prepared for a future choice of policies that are more distinctively different from each other.

5. Concluding Remarks

We have examined the development of open macroeconomic policy choices among developing economies from the perspective of the powerful hypothesis of the “trilemma” – a country may not simultaneously pursue the full extent of achievement in all of the three policy goals of monetary independence, exchange rate stability, and financial openness. Using the metrics introduced by Aizenman, Chinn, and Ito (2010), or the “trilemma indexes,” that measure the extent of achievement in each of the three policy choices, we have observed several interesting characteristics of the international monetary system.

There are striking differences in the choices that industrialized and developing countries have made over the 1970-2009 period. More importantly, recent trends suggest that among developing countries, the three dimensions of the trilemma configurations are converging towards a “middle ground” with managed exchange rate flexibility, underpinned by sizable holdings of international reserves, and intermediate levels of monetary independence and financial integration. Industrialized countries, on the other hand, have been experiencing divergence of the three dimensions of the trilemma and moved toward the combination of high exchange rate stability and financial openness and low monetary independence (most clearly exemplified by the advent of the euro).

To ensure the validity of the results based on the trilemma indexes, we also tested whether the three macroeconomic policy goals are “binding” in the context of the impossible trinity, by estimating the nature of the trade-offs faced by countries. Because there is no specific functional form of the trade-offs or the linkage of these three policy goals, we estimated the simplest linear specification for the three trilemma indexes and examined whether the weighted sum of the three trilemma policy variables equals a constant. Our results confirmed that countries do face a binding trilemma. That is, a change in one of the trilemma variables induces a change

with the opposite sign in the weighted average of the other two variables. In that sense, we have provided substantial content to the hypothesis of the “impossible trinity.”

We also focused on the characteristics of the “middle-ground convergence” among emerging market economies. When we examined the correlation between the measure of policy divergence and the level of output volatility, we found that emerging market economies with more converged policy choices tend to experience smaller output volatility in the last two decades. In a world with rapidly proceeding financial globalization, financial liberalization can be a risky policy for developing economies, raising the importance of holding a large amount of international reserves as it has happened in the last decade. On that issue, we found some evidence that emerging markets with low levels of international reserves holding could experience higher levels of output volatility when they choose a policy combination with a greater degree of policy divergence while it does not apply to economies with high levels of international reserves holding. This may indicate that holding a high volume of international reserves may give room to emerging market economies to choose a policy combination from a wider spectrum of policy combinations.

Appendix: Construction of the Trilemma Measures

Monetary Independence (MI)

The extent of monetary independence is measured as the reciprocal of the annual correlation between the monthly interest rates of the home country and the base country. Money market rates are used for the calculation.¹⁸

The index for the extent of monetary independence is defined as:

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

where i refers to home countries and j to the base country. By construction, the maximum value is 1, and the minimum value is 0. Higher values of the index mean more monetary policy independence.^{19,20}

Here, 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 United Kingdom, and the United States. 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 the International Monetary Fund's *Annual Report on Exchange Arrangements and Exchange Restrictions (AREAER)* and *Central Intelligence Agency Factbook*.

Exchange Rate Stability (ERS)

To measure exchange rate stability, annual standard deviations of the monthly exchange rate between the home country and the base country are calculated and included in the following formula to normalize the index between 0 and 1:

$$ERS = \frac{0.01}{0.01 + stdev(\Delta(\log(exch_rate)))}$$

Merely applying this formula can easily create a downward bias in the index, that is, it would exaggerate the "flexibility" of the exchange rate especially when the rate usually follows a narrow band, but is de- or

¹⁸ The data are extracted from the IMF's *International Financial Statistics* (60B..ZF...). For the countries whose money market rates are unavailable or extremely limited, the money market data are supplemented by those from the Bloomberg terminal and also by the discount rates (60...ZF...) and the deposit rates (60L..ZF...) series from *IFS*.

¹⁹ The index is smoothed out by applying the 3-year moving averages encompassing the preceding, concurrent, and following years ($t-1$, t , $t+1$) of observations.

²⁰ We note one important caveat about this index. Among some countries and in some years, especially early ones, the interest rate used for the calculation of the MI index is often constant throughout a year, making the annual correlation of the interest rates between the home and base countries ($corr(i_i, i_j)$ in the formula) undefined. Since we treat the undefined $corr$ the same as zero, it makes the MI index value 0.5. One may think that the policy interest rate being constant (regardless of the base country's interest rate) is a sign of monetary independence. However, it can reflect the possibilities not only that (i) the home country's monetary policy is independent from the base country's; but also (ii) the home country uses other tools to implement monetary policy than manipulating the interest rates, such as changing the required reserve ratios and providing some window guidance (while leaving the policy interest rate unchanged); and/or that (iii) the home country implements a strong control on financial intermediary, including credit rationing, that makes the policy interest rate appear constant. To make the matter more complicated, some countries have used (ii) and (iii) to exercise monetary independence while others have used them while strictly following the base country's monetary policy. The bottom line is that it is impossible to incorporate these issues in the calculation of MI without over- or under-estimating the degree of monetary independence. Therefore, assigning an MI value of 0.5 for such a case should be a reasonable compromise. However, it does not preclude the necessity of robustness checks on the index, which we plan to undertake.

revalued infrequently.²¹ To avoid such downward bias, we also apply a threshold to the exchange rate movement as has been done in the literature. That is, if the rate of monthly change in the exchange rate stayed within +/-0.33 percent bands, we consider the exchange rate is “fixed” and assign the value of one for the ERS index. Furthermore, single year pegs are dropped because they are quite possibly not intentional ones.²² Higher values of this index indicate more stable movement of the exchange rate against the currency of the base country.

Financial Openness/Integration (KAOPEN)

Without question, it is extremely difficult to measure the extent of capital account controls.²³ Although many measures exist to describe the extent and intensity of capital account controls, it is generally agreed that such measures fail to capture fully the complexity of real-world capital controls. Nonetheless, for the measure of financial openness, we use the index of capital account openness, or *KAOPEN*, by Chinn and Ito (2006, 2008). *KAOPEN* is based on information regarding restrictions in the International Monetary Fund’s *Annual Report on Exchange Arrangements and Exchange Restrictions (AREAER)*. Specifically, *KAOPEN* is the first standardized principal component of the variables that indicate the presence of multiple exchange rates, restrictions on current account transactions, on capital account transactions, and the requirement of the surrender of export proceeds.²⁴ Since *KAOPEN* is based on reported restrictions, it is necessarily a *de jure* index of capital account openness (in contrast to *de facto* measures such as those in Lane and Milesi-Ferretti [2006]). The choice of a *de jure* measure of capital account openness is driven by the motivation to look into policy intentions of the countries; *de facto* measures are more susceptible to other macroeconomic effects than solely policy decisions with respect to capital controls.²⁵

The Chinn-Ito index is normalized between zero and one. Higher values of this index indicate that a country is more open to cross-border capital transactions. The index is originally available for 181 countries for 1970 through 2006.²⁶ The data set we examine does not include the United States.

²¹ In such a case, the average of the monthly change in the exchange rate would be so small that even small changes could make the standard deviation big and thereby the ERS value small.

²² The choice of the +/-0.33 percent bands is based on the +/-2% band based on the annual rate, that is often used in the literature. Also, to prevent breaks in the peg status due to one-time realignments, any exchange rate that had a percentage change of 0 in 11 out of 12 months is considered fixed. When there are two re/devaluations in 3 months, then they are considered to be one re/devaluation event, and if the remaining 10 months experience no exchange rate movement, then that year is considered to be the year of fixed exchange rate. This way of defining the threshold for the exchange rate is in line with the one adopted by Shambaugh (2004).

²³ See Chinn and Ito (2008), Edison and Warnock (2001), Edwards (2001), Edison et al. (2002), and Kose et al. (2006) for discussions and comparisons of various measures on capital restrictions.

²⁴ This index is described in greater detail in Chinn and Ito (2008).

²⁵ *De jure* measures of financial openness also face their own limitations. As Edwards (1999) discusses, it is often the case that the private sector circumvents capital account restrictions, nullifying the expected effect of regulatory capital controls. Also, IMF-based variables are too aggregated to capture the subtleties of actual capital controls, that is, the direction of capital flows (i.e., inflows or outflows) as well as the type of financial transactions targeted.

²⁶ The original dataset covers 181 countries, but data availability is uneven among the three indexes. *MI* is available for 172 countries; *ERS* for 182; and *KAOPEN* for 178. Both *MI* and *ERS* start in 1960 whereas *KAOPEN* in 1970. For *MI* and *ERS* are updated to 2008 while *KAOPEN* is updated only to 2007 because the information in *AREAER* is available up to 2007.

References:

- Aizenman, J., M. D. Chinn and H. Ito. 2011. Surfing the Waves of Globalization: Asia and Financial Globalization in the Context of the Trilemma, *Journal of the Japanese and International Economies*, vol. 25(3), p. 290 – 320.
- Aizenman, J., and H. Ito. 2011. Trilemma Policy Convergence Patterns and Output Volatility, manuscript, UCSC.
- Aizenman, J., M. D. Chinn and H. Ito. 2010. The Emerging Global Financial Architecture: Tracing and Evaluating the New Patterns of the Trilemma's Configurations, *Journal of International Money and Finance*, Vol. 29, No. 4, p. 615-641.
- Aizenman, J., Glick, R., 2009. Sterilization, Monetary Policy, and Global Financial Integration, *Review of International Economics* 17 (4), 816-840.
- Aizenman, J. and Lee, J. 2007. International reserves: precautionary versus mercantilist views, theory and evidence, *Open Economies Review*, 2007, 18 (2), pp. 191-214.
- Aizenman, J. and Marion, N. 2004. International reserves holdings with sovereign risk and costly tax collection. *Economic Journal* 114, pp. 569–91.
- Calvo, G. 1998. Capital Flows and Capital-market Crises: The Simple Economics of Sudden Stops. *Journal of Applied Economics* 1: 35–54.
- Calvo, G. 2006. Monetary Policy Challenges in Emerging Markets: Sudden Stop, Liability Dollarization, and Lender of Last Resort. Working Paper 12788, National Bureau of Economic Research.
- Cheung, Y. W, and H. Ito. 2009. Cross-sectional analysis on the determinants of international reserves accumulation. *International Economic Journal* (23) 4: 447–481.
- Chinn, M. D. and H. Ito. 2008. A New Measure of Financial Openness. *Journal of Comparative Policy Analysis*, Volume 10, Issue 3 (September), p. 309 - 322.
- Chinn, M. D. and H. Ito, 2006. What Matters for Financial Development? Capital Controls, Institutions, and Interactions, *Journal of Development Economics*, Volume 81, Issue 1, Pages 163-192 (October).
- Cortuk, O. and N. Singh. 2011. Turkey's trilemma trade-offs: is there a role for reserves? Manuscript.
- Edison, Hali J., M. W. Klein, L. Ricci, and T. Sløk. 2002. Capital Account Liberalization and Economic Performance: A Review of the Literature. IMF Working Paper. Washington, D.C.: International Monetary Fund (May).
- Eichengreen, B. and D. Leblang. 2003. Exchange Rates and Cohesion: Historical Perspectives and Political-Economy Considerations. *Journal of Common Market Studies*, 41(5): 797–822.
- Frankel, J.A., S.L. Schmukler, and L. Servén. 2004. “Global Transmission of Interest Rates: Monetary Independence and Currency Regime,” *Journal of International Money and Finance*, 2004, v23(5,Sep), 701-733.
- Ghosh, A., A. Gulde and J. Ostry. 1997. Does the Nominal Exchange Rate Regime Matter? NBER Working Paper No 5874.
- Hutchison, M., Sengupta, R., and Singh, N., 2011. India's Trilemma: Financial Liberalization, Exchange Rates and Monetary Policy, forthcoming, *The World Economy*.

- Henry, P. B. 2006. Capital Account Liberalization: Theory, Evidence, and Speculation. NBER Working Paper No. 12698.
- Jeanne, O. 2011. The Triffin Dilemma and the Saver's Curse, prepared for the 4th Santa Cruz Institute for International Economics (SCIIE) – Journal of International Money and Finance Conference, September 23-24, 2011.
- Kaminsky, G. and S. L. Schmukler. 2002. Short-Run Pain, Long-Run Gain: The Effects of Financial Liberalization. World Bank Working Paper No. 2912; IMF Working Paper No. 0334. Washington, D.C.: International Monetary Fund (October).
- Kose, M. A., E. Prasad, K. Rogoff, and S. J. Wei, 2006, Financial Globalization: A Reappraisal. IMF Working Paper, WP/06/189. Washington, D.C.: International Monetary Fund.
- Levy-Yeyati, E. and F. Sturzenegger. 2003. To float or to fix: Evidence on the impact of exchange rate regimes on growth. *The American Economic Review* 93(4): 1173–1193.
- Mundell, R. A. 1963. "Capital mobility and stabilization policy under fixed and flexible exchange rates". *Canadian Journal of Economic and Political Science* 29 (4): 475–485.
- Obstfeld, M., Shambaugh, J. C. and Taylor, A. M. 2010. Financial Stability, the Trilemma, and International Reserves. *American Economic Journal: Macroeconomics* (2): 57–94.
- Obstfeld, M., J.C. Shambaugh, and A.M. Taylor. 2009. "Financial Instability, Reserves, and Central Bank Swap Lines in the Panic of 2008." NBER Working Papers 14826. Cambridge, MA : National Bureau of Economic Research (March).
- Obstfeld, M., J. C. Shambaugh, and A. M. Taylor, 2005. "The Trilemma in History: Tradeoffs among Exchange Rates, Monetary Policies, and Capital Mobility." *Review of Economics and Statistics* 87 (August): 423-38.
- Popper H., A. Mandilaras, and G. Bird, 2011, Trilemma Stability and International Macroeconomic Archetypes, manuscript, Santa Clara University.
- Prasad, E. S., 2008. Monetary Policy Independence, the Currency Regime, and the Capital Account in China. In Goldstein, M. and N. R. Lardy (Eds.), *Debating China's Exchange Rate Policy*, Washington, D.C.: Peterson Institute for International Economics.
- Prasad, E. S. and R. Rajan. 2008. A Pragmatic Approach to Capital Account Liberalization. NBER Working Paper #14051. (June).
- Prasad, E.S., K. Rogoff, S. J. Wei, and M. A. Kose. 2003. "Effects of Financial Globalization on Developing Countries: Some Empirical Evidence." Occasional Paper 220. Washington, D.C.: International Monetary Fund.

Table 1: Regression for the Linear Relationship between the Trilemma Indexes:

$$1 = a_j MI_{i,t} + b_j ERS_{i,t} + c_j KAOPEN_{i,t} + \varepsilon_t$$

	(1) FULL	(2) 1970-72	(3) 1974-81	(4) 1983-96	(5) 1999-2006
Monetary Independence	1.084 [0.039]***	0.946 [0.127]***	1.339 [0.069]***	0.99 [0.057]***	0.336 [0.109]***
Exch. Rate Stability	0.611 [0.032]***	0.665 [0.076]***	0.597 [0.090]***	0.647 [0.051]***	0.223 [0.181]
KA Openness	0.437 [0.021]***	0.369 [0.050]***	0.29 [0.063]***	0.448 [0.031]***	0.869 [0.072]***
ERM x MI	-0.166 [0.072]**	–	0.375 [0.299]	-0.287 [0.111]***	0.159 [0.119]
ERM x ERS	-0.026 [0.055]	–	0.254 [0.165]	0.073 [0.073]	-0.115 [0.183]
ERM x KAOPEN	-0.005 [0.052]	–	-0.273 [0.128]**	-0.009 [0.054]	0.039 [0.075]
LDC x MI	0.148 [0.045]***	0.389 [0.164]**	-0.175 [0.097]*	0.299 [0.065]***	0.78 [0.119]***
LDC x ERS	-0.193 [0.035]***	-0.371 [0.094]***	-0.118 [0.097]	-0.21 [0.055]***	0.211 [0.184]
LDC x KAOPEN	-0.158 [0.030]***	-0.136 [0.079]*	-0.043 [0.081]	-0.176 [0.051]***	-0.536 [0.080]***
Observations	1850	150	400	700	400
Adjusted R-squared	0.95	0.98	0.94	0.96	0.95

NOTES: Robust standard errors in brackets * significant at 10%; ** significant at 5%; *** significant at 1%. ERM is a dummy for the countries and years that correspond to participation in ERM (i.e., Belgium, Denmark, Germany, France, Ireland, and Italy from 1979, Spain from 1989, U.K. only for 1990-91, Portugal from 1992, Austria from 1995, Finland from 1996, and Greece from 1999).

Figure 1: The Trilemma

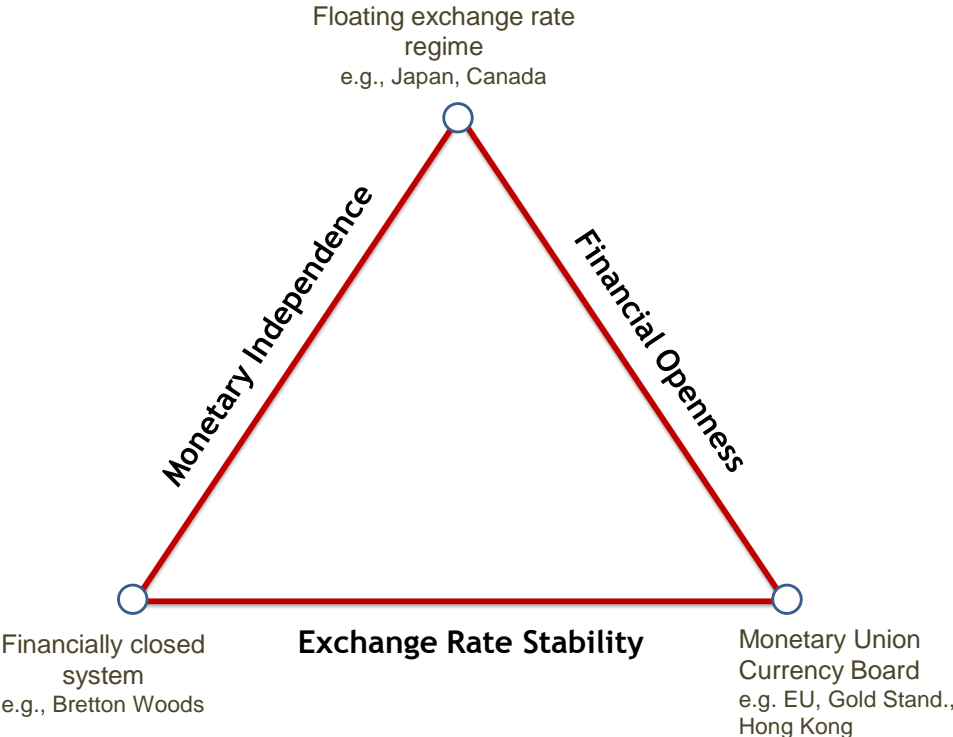
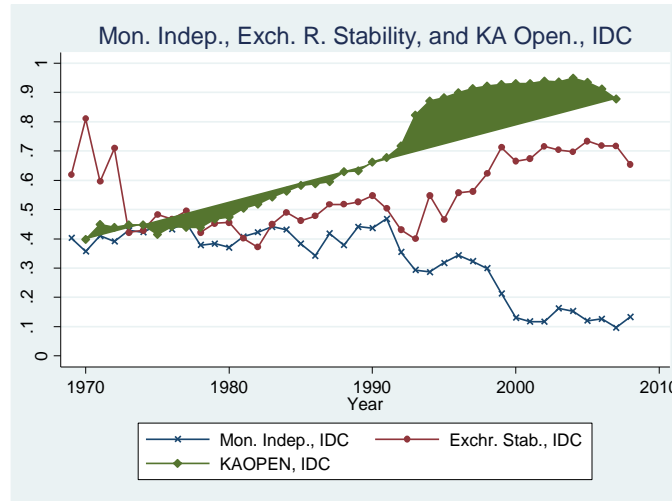
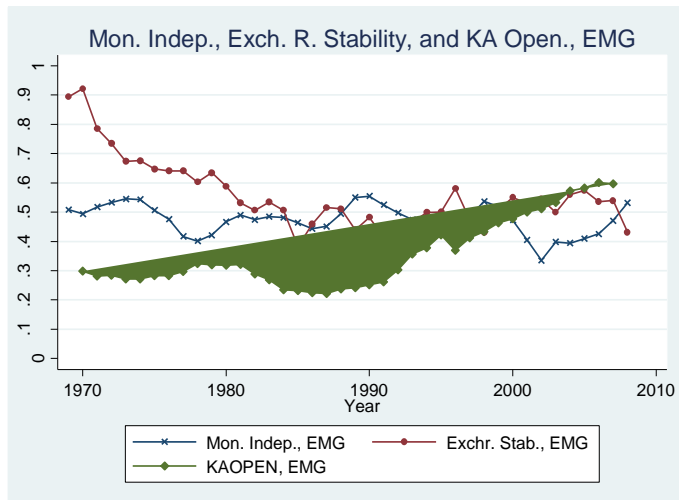


Figure 2: Development of the Trilemma Configurations Over Time

(a) Industrialized Countries



(b) Emerging market economies



(c) Non-Emerging Market Developing Countries

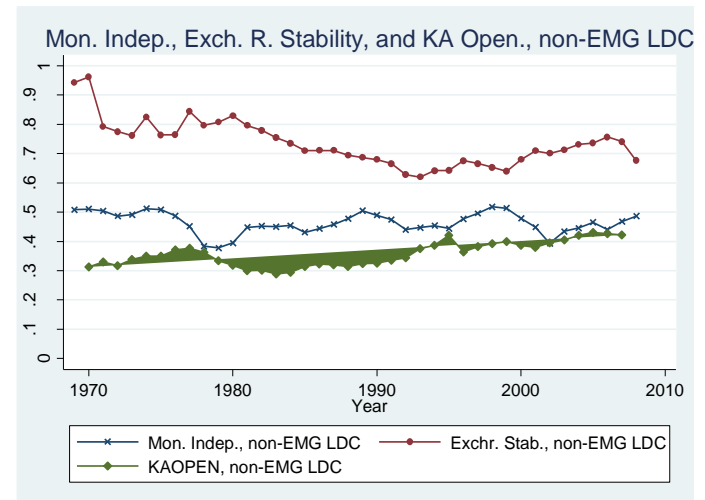
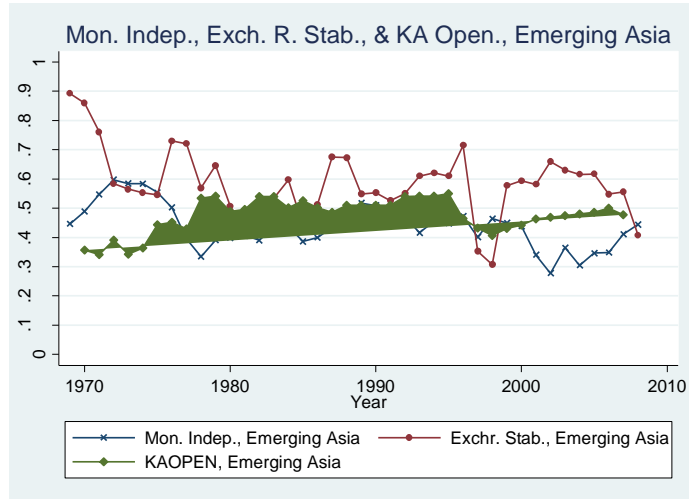
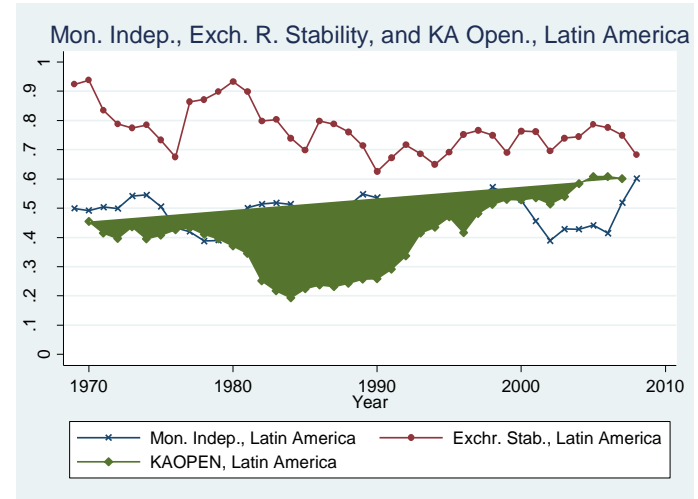


Figure 3: Regional Comparison of the Development of the Trilemma Configurations

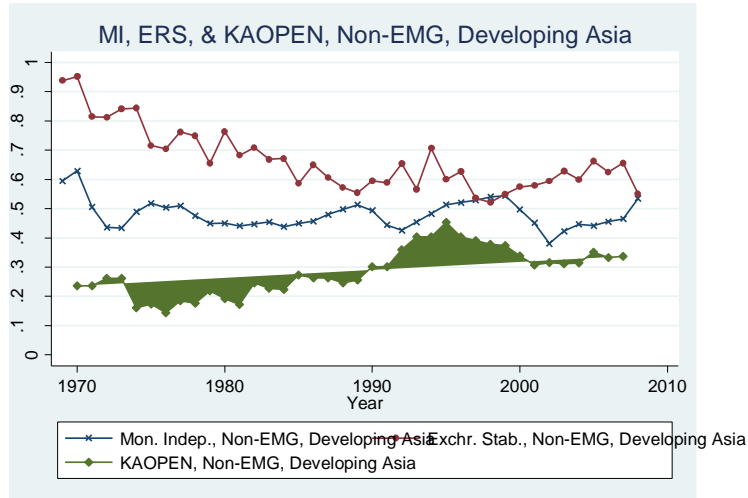
(a) Emerging Market Economies (EMG) in Asia



(c) Latin American Countries



(b) Non-EMG, Developing Asia



(d) Less Developed Countries (LDC) excluding Asia

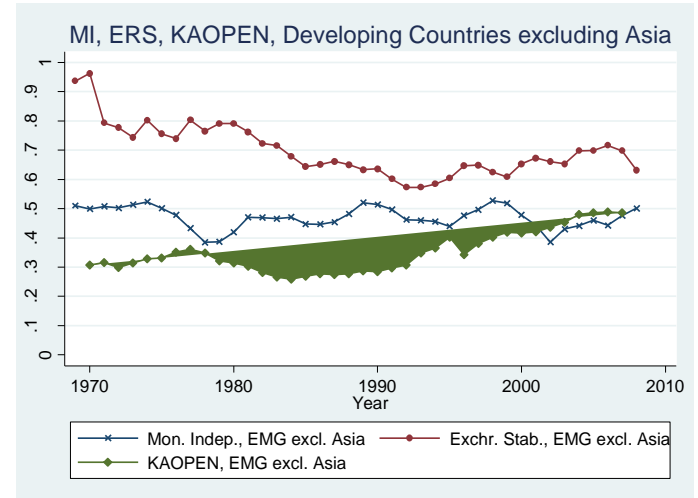
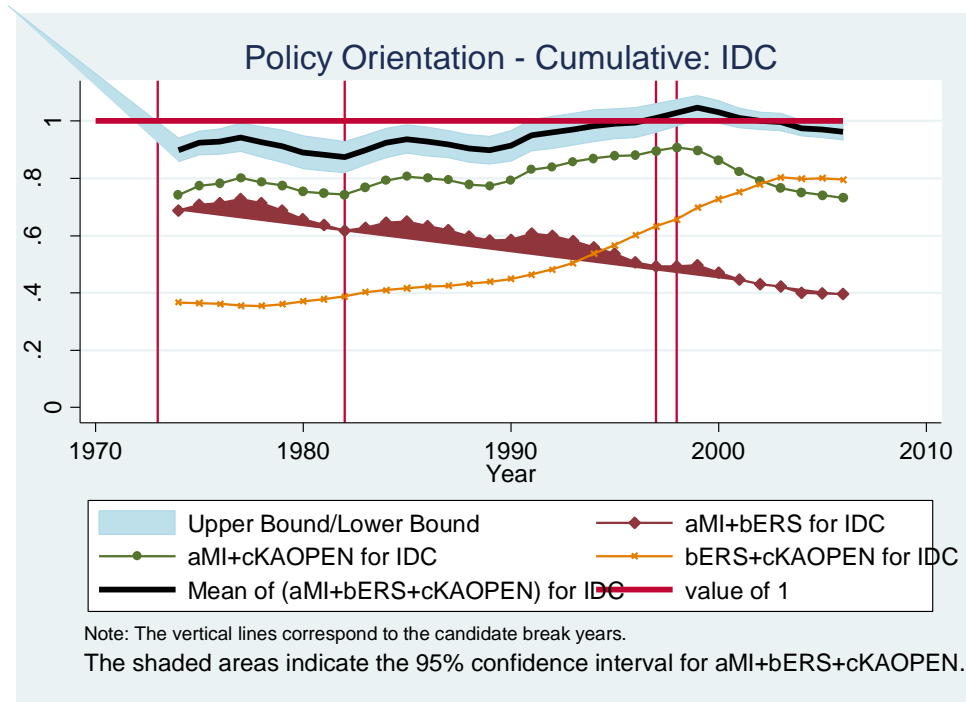


Figure 4: Policy Orientation of IDCs and LDCs

Cumulative Effects:

$(\hat{a}MI + \hat{b}ERS)$, $(\hat{a}MI + \hat{c}KAOPEN)$, $(\hat{b}ERS + \hat{c}KAOPEN)$, and $(\hat{a}MI + \hat{b}ERS + \hat{c}KAOPEN)$

Industrial Countries



Developing Countries

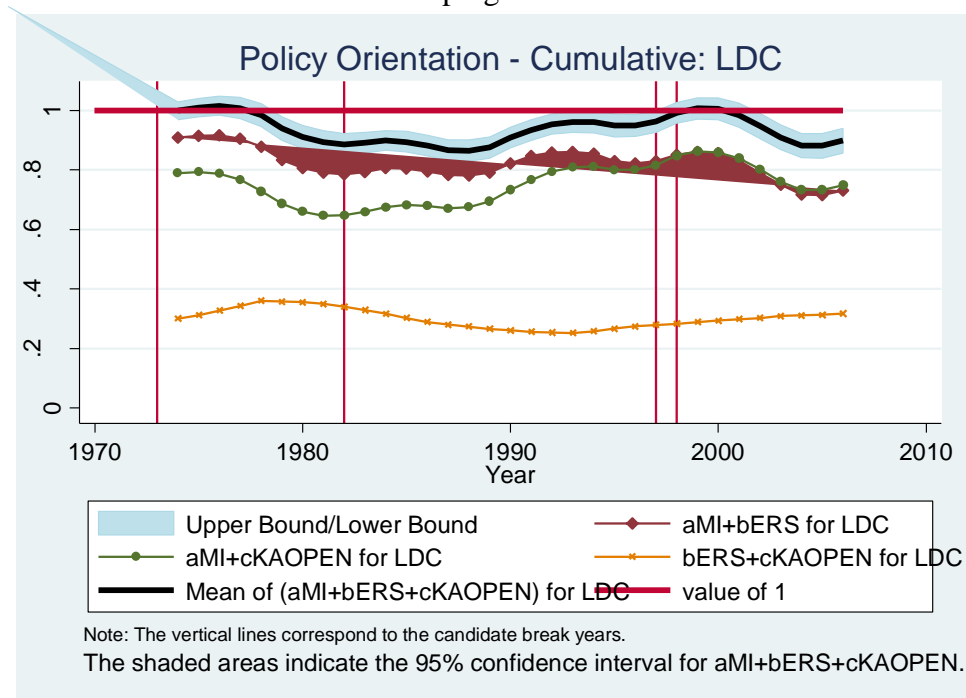


Figure 5: Degree of Policy Dispersions among Different Income Groups of Countries

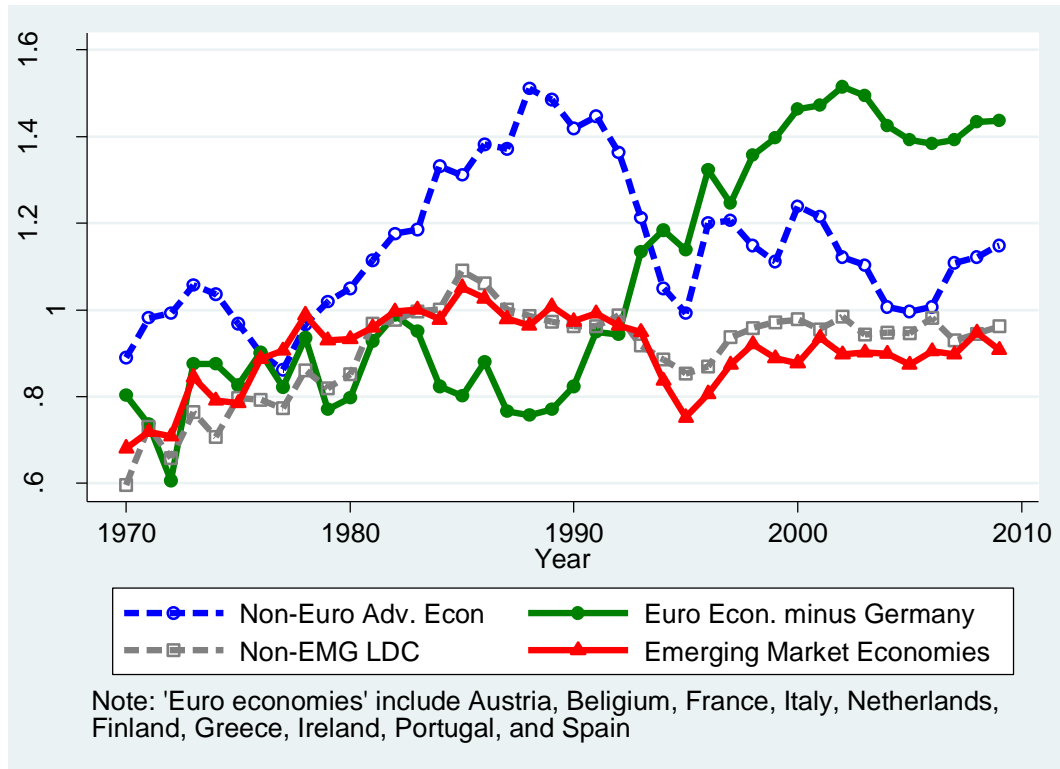


Figure 6: Deviations from the Means – Emerging Market Economies

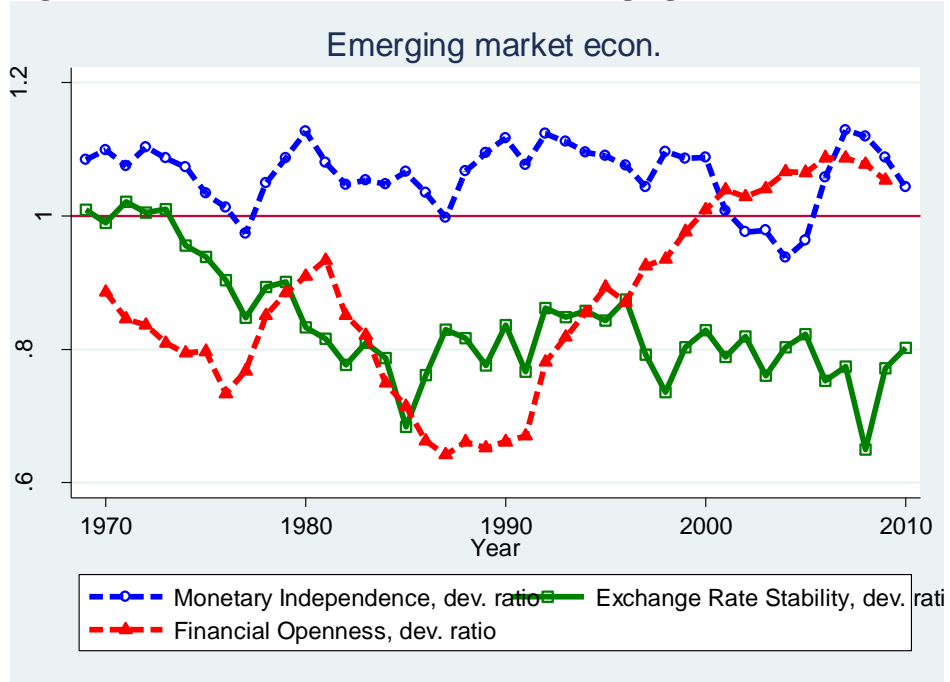


Figure 7: Deviations from the Means – Non-Emerging Market Developing Economies

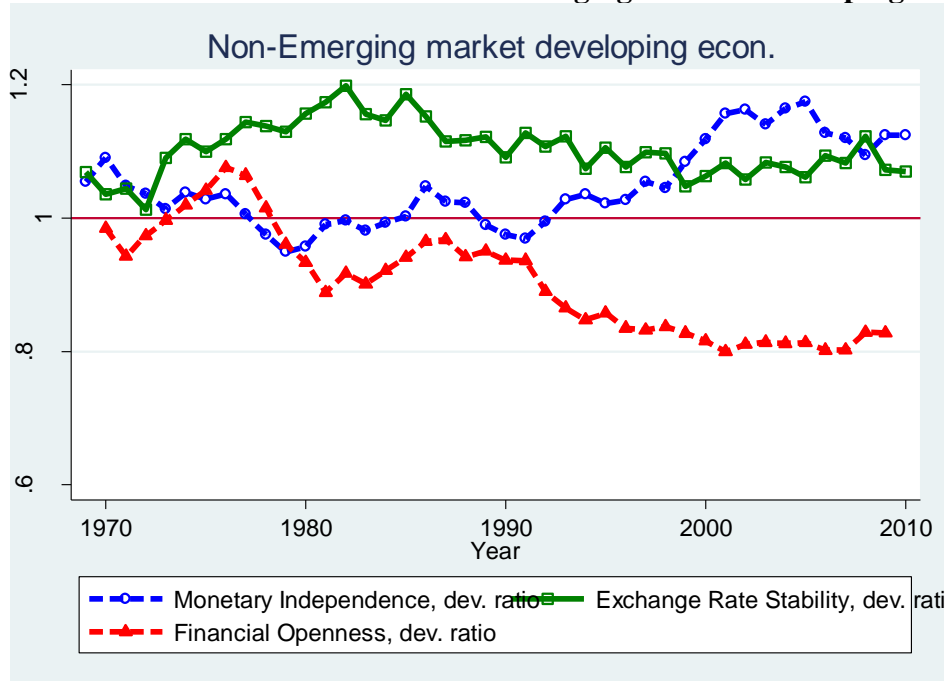


Figure 8: Degree of Policy Dispersions among Different Regional Country Groups

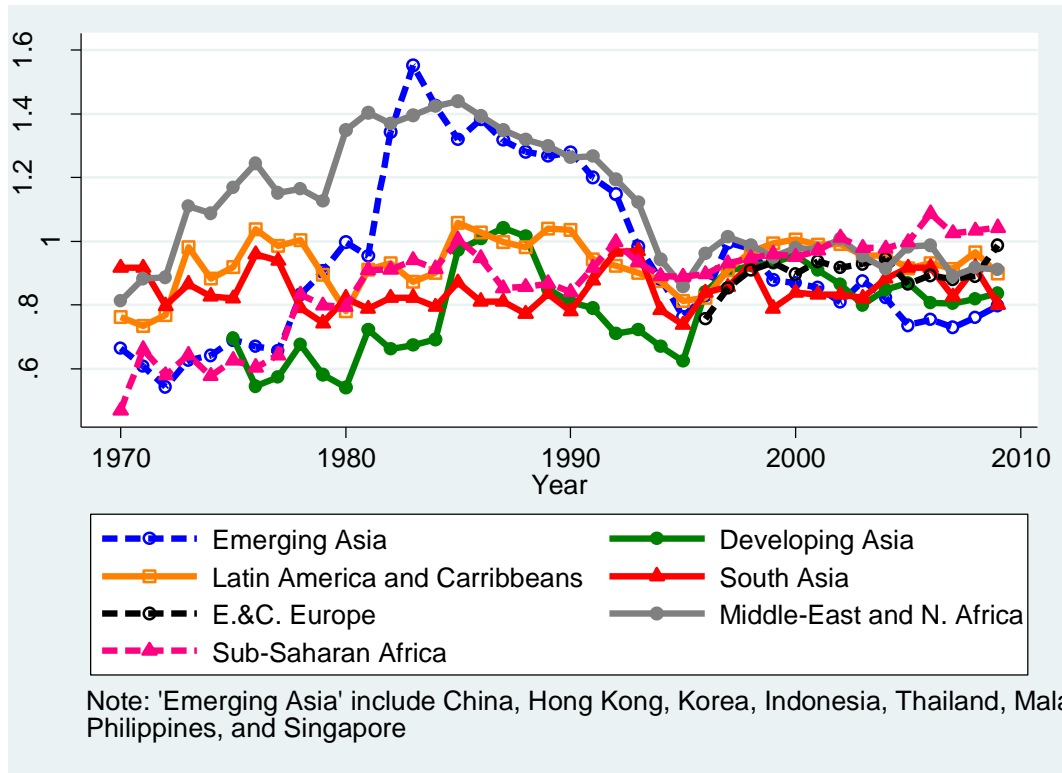


Figure 9: Correlations between Policy Dispersion and Output Volatility: EMG vs. Non-EMG

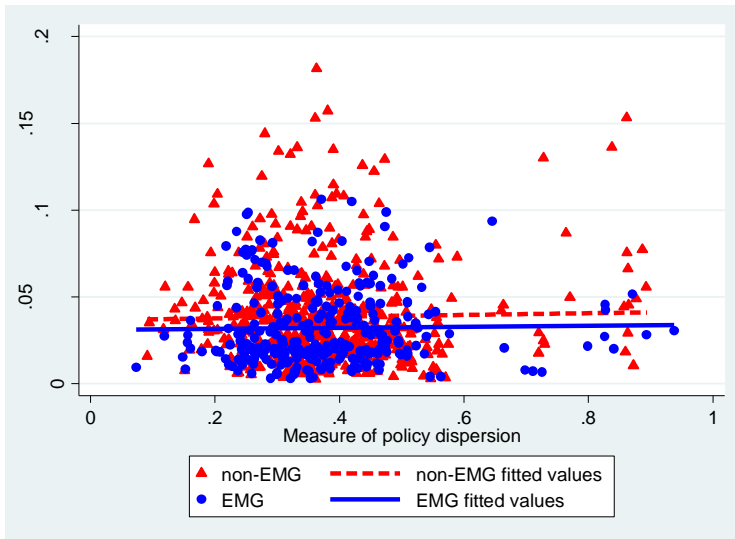


Figure 11: Correlations between Policy Dispersion and Output Volatility: EMG vs. Non-EMG since 1990

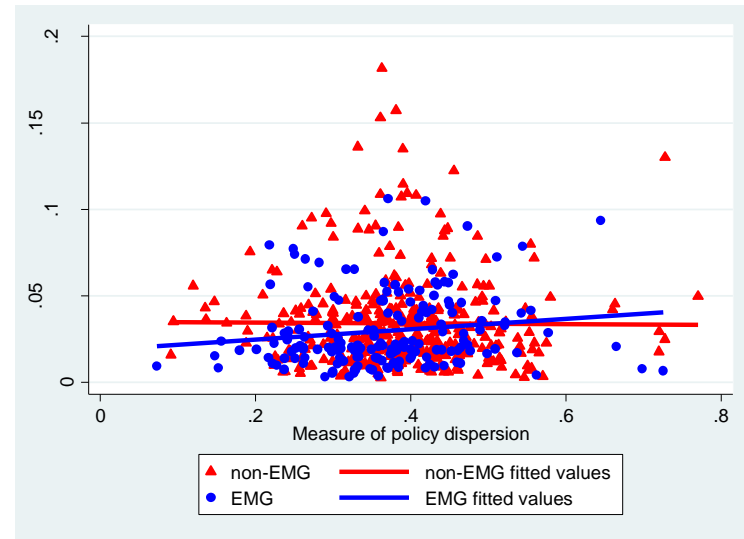


Figure 10: Correlations between Policy Dispersion and Output Volatility: Financially Open vs. Not Open

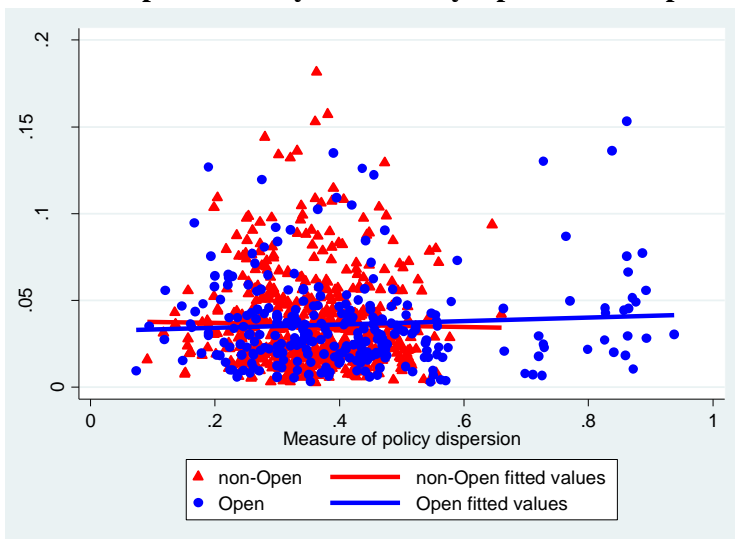


Figure 12: Financially Open vs. Not Open Since 1990

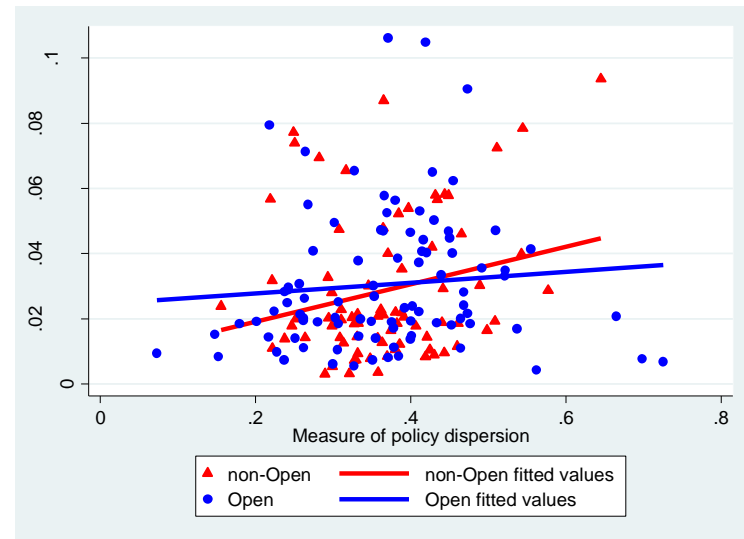


Figure 13: The “Diamond Charts”: Variation of the “Quadrilemma” Across Different Country Groups

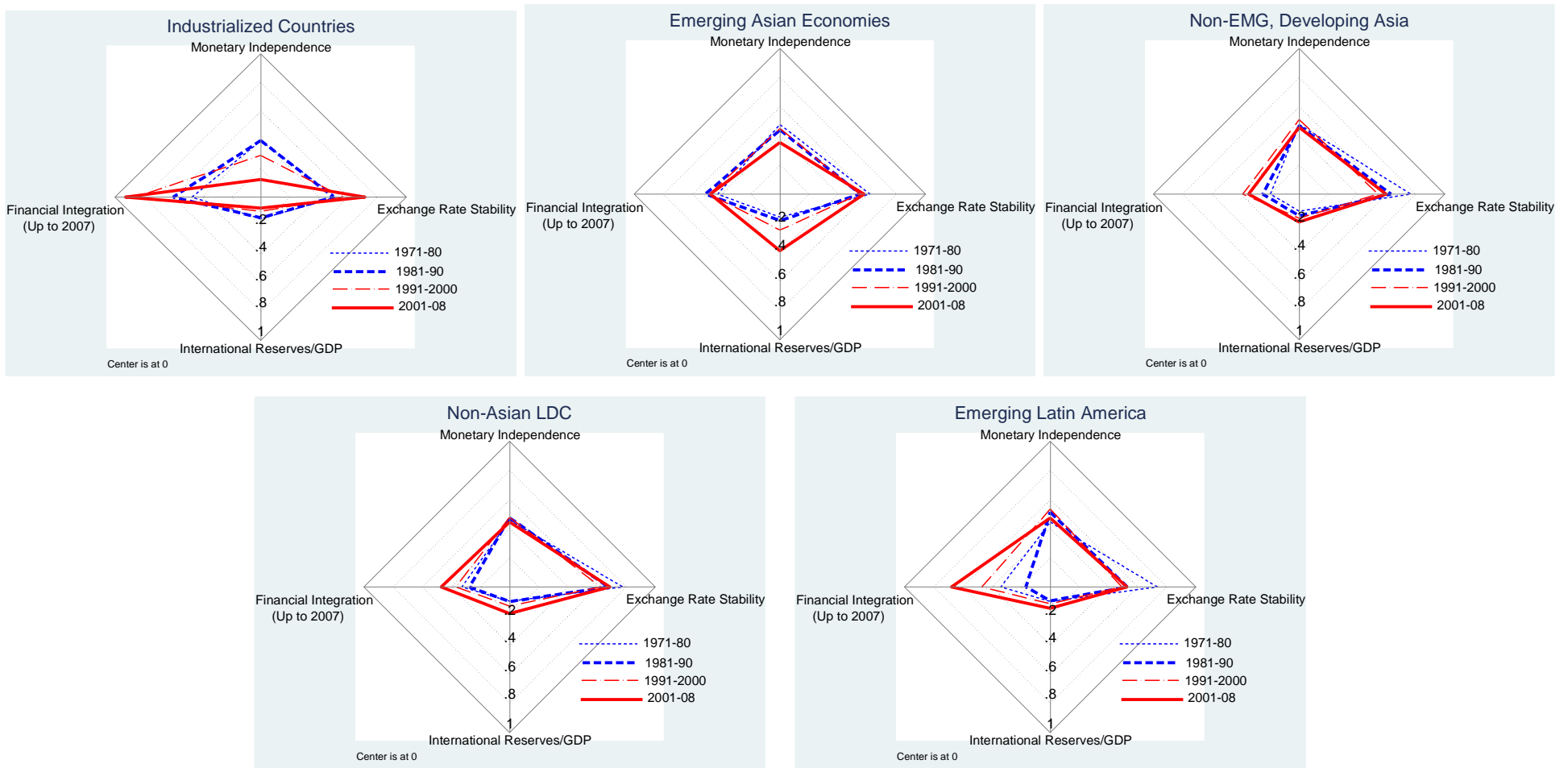


Figure 14: EMGs w/ High IR Holding and Those w/out since 1990

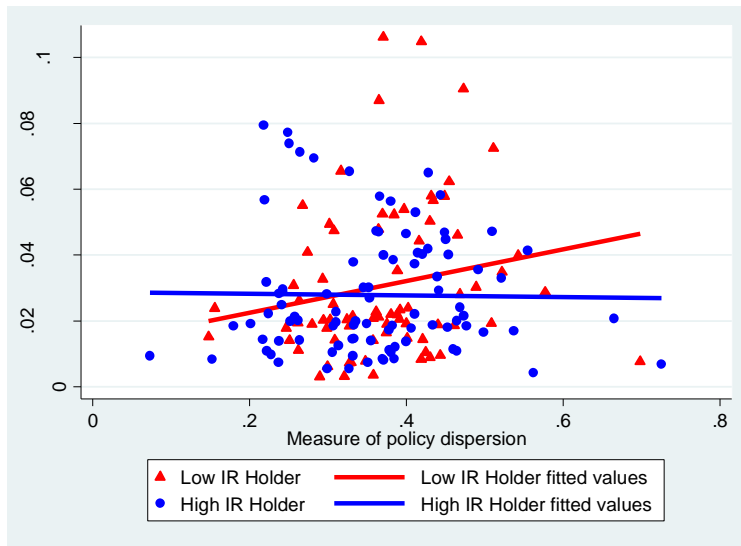


Figure 15: EMGs w/ Open Financial Markets and High IR Holding vs. EMGs w/ Open Financial Market, but w/ Low IR Holdings

