Discussion Papers in Economics

TRILEMMA STABILITY AND INTERNATIONAL MACROECONOMIC ARCHETYPES IN DEVELOPING ECONOMIES

By

Helen Popper
(Santa Clara University)
Alex Mandilaras
(University of Surrey)
&
Graham Bird
(University of Surrey)

Department of Economics
University of Surrey
Guildford
Surrey GU2 7XH, UK
Telephone +44 (0)1483 689380
Facsimile +44 (0)1483 689548
Web www.econ.surrey.ac.uk
ISSN: 1749-5075

Trilemma Stability and International Macroeconomic Archetypes in Developing Economies*

Helen Popper†, Alex Mandilaras‡, and Graham Bird§

March 30, 2011

Abstract

In this paper, we examine the stability of international macroeconomic policies of developing countries in the post-Bretton Woods period. We use the simple geometry of the classic, open-economy trilemma to construct a new, univariate measure of international macroeconomic policy stability, and to characterize international macroeconomic arrangements in terms of their semblance to definitive policy archetypes; and, we use the trilemma constraint to provide a new gauge of monetary sovereignty. Using these measures, we find that the greatest international macroeconomic stability among developing economies exists where there are capital controls and limited exchange rate flexibility. The least stable policies occur in the economies with flexible exchange rates and open financial markets. We also find that official holdings of foreign exchange reserves seem to be weakly linked to greater policy stability, and their link is further weakened where financial markets are open.

JEL: F3, F4, O1, O2

Keywords: Trilemma, Foreign Exchange Rate Regimes, International Reserves, Financial Openness, Fear of Floating, Monetary Sovereignty

*We gratefully acknowledge financial support from the British Academy.

†Corresponding Author. Department of Economics, Santa Clara University, Santa Clara, CA, 95053, USA. Email: hpopper@scu.edu.

‡Department of Economics, University of Surrey, Guildford, Surrey, GU2 7XH, UK. Email: a.mandilaras@surrey.ac.uk.

§Department of Economics, University of Surrey, Guildford, Surrey, GU2 7XH, UK. Email: g.bird@surrey.ac.uk.

1 Introduction

In this paper, we examine the stability of international macroeconomic policies in developing economies. To do so, we construct a new, formal measure of stability. Applying the new measure to 93 poor and lower-middle income economies in the modern (post-Bretton Woods) era, we find that the most stable international macroeconomic policies exist in economies with relatively fixed exchange rates and in those with relatively high barriers to international financial openness. Correspondingly, among poor and lower-middle income economies, policies of flexible exchange rates and open financial markets exhibit the least stability. We also examine the link between international macroeconomic policy stability and foreign exchange reserves. We find that the two are correlated, and we document that foreign exchange reserves are (weakly) linked to policy stability when they are combined with exchange rate stability and low levels of financial openness.

Our new measure of international macroeconomic policy stability starts with the classic, open-economy trilemma that potentially constrains the exchange rate policies, international capital market access, and monetary policies of all countries. According to the trilemma, a country cannot simultaneously achieve exchange rate stability, capital market openness, and monetary sovereignty. The trilemma thus suggests that we can think of an individual country's international macroeconomic policies in terms of a location in a constrained three-dimensional space, one that is defined by exchange rate stability, financial openness, and monetary sovereignty. In this framework, the *change* in a country's international macroeconomic policy is naturally measured as a movement from one point to another in the three-dimensional policy space. Here, we gauge a country's policy *stability* using the extent of the changes. Specifically, overall stability or instability is measured by the distances between the sequential locations in the policy space. A stable international macroeconomic policy is defined as one with small movements within the policy space; while large movements within the policy space represent unstable policies.

We also provide a new measure of monetary sovereignty. The new measure is derived from the trilemma's constraint: the trilemma constrains monetary sovereignty to come at the expense of reductions in exchange rate stability and financial openness.[1] Given measures of exchange rate stability and financial openness, the trilemma's constraint yields

[1] In related, exploratory work, we examine a similarly construct implicit measure of financial openness.

an implicit measure of monetary sovereignty. This new measure provides a distinct alternative to the now-standard measures that rely on the correlation between a country's interest rate with the interest rate of a base country. Using the new monetary sovereignty measure, we confirm the findings described above, but we also find that the international macroeconomic policies of poor and lower-middle income economies appear to be more stable than would be suggested by a standard measure, which generally also implies less sovereignty than is indicated by our new measure.

In the remainder of this paper, we first introduce our new measure of stability. Next, we use this measure to gauge the stability of the trilemma among poor and lower-middle income economies, and in doing so we rely on our new measure of monetary sovereignty. Then, we examine how stability is related to the underlying policies and to reserves. Finally, we conclude with a discussion of the approach of the paper and the implications that it has for our assessments of the exchange rate arrangements and other international macroeconomic policies of developing countries.

2 A Stability Measure

To gauge stability, we begin with the international trilemma's standard triad of policies. We denote the i^{th} country's extant regime in period t as $R_{i,t}$, where:

$$R_{i,t} = (S_{i,t}, F_{i,t}, M_{i,t}),$$

and $S_{i,t}$ represents exchange rate stability, $F_{i,t}$ represents financial openness, and $M_{i,t}$ represents monetary sovereignty. The measures of $S_{i,t}$, $F_{i,t}$, and $M_{i,t}$, are normalized so that each falls between zero and one (inclusive); and values of one represent perfectly sovereign monetary policy, perfectly open financial markets, and perfectly fixed exchange rates. So, a pure fix with open financial markets is: $R_{i,t} = (1, 1, 0)$; a pure fix with monetary sovereignty is $R_{i,t} = (1, 0, 1)$, and a pure float with open capital markets and monetary sovereignty is $R_{i,t} = (0, 1, 1)$.

In this framework, a *change* in the country's regime from one period to the next is simply the vector connecting the two consecutive points in the policy space:

$$r_{i,t} = R_{i,t} - R_{i,t-1}$$

$$= (s_{i,t}, f_{i,t}, m_{i,t}) = (S_{i,t} - S_{i,t-1}, F_{i,t} - F_{i,t-1}, M_{i,t} - M_{i,t-1}).$$

Using this vector of policy changes, $r_{i,t}$, we can definitively measure the overall change in policy using the vector's norm, $||r_{i,t}||$.[2] Using the norm, we define a single, univariate measure made to fall between zero and one:

$$n_{i,t} = \frac{||r_{i,t}||}{\sqrt{2}}.$$

This simple scalar, $n_{i,t}$, captures the full extent of the change in a country's triad of international macroeconomic policies.[3]

Figure 1 illustrates this approach to measuring policy stability. The figure displays the data underlying a single observation of the measure, $n_{i,t}$; namely, that of Indonesia during the time of the Asian Crisis (i = Indonesia, and t = 1997). As is well-known, Indonesia experienced a substantial drop in its exchange rate stability and a small drop in its financial openness during the crisis, while it increased its monetary sovereignty considerably. These changes are indicated by the vector shown between the observations for 1996 and for 1997.[4] The normalized length of the vector measures the overall change in the policy triad. In this case, $n_{i,t} = 0.578$. This is a large change: it is about five times the values typical of Indonesia earlier in the decade, and it exceeds (by a substantial margin) 95 percent of the values in the sample.

In general, the norm of the vector summarizes the overall changes in the international macroeconomic policies of the trilemma. Below, we use the norm (adjusted to fall between zero and one) to examine the stability of various policies and to assess the extent to which stability may be linked to official holdings of foreign exchange reserves.

[2] We use the Euclidean norm (henceforth, in this paper, the norm).

[3] By providing a univariate gauge of multivariate changes in policies, our new measure follows Girton and Roper's (1977) 'exchange market pressure' measure. Although lacking the norm's clear, geometric interpretation, their classic measure provides an early, univariate amalgam of foreign exchange policies.

[4] As discussed in more detail below, we use data from Aizenman, Chinn, and Ito (2010). The cartesian coordinates $(S_{i,t}, F_{i,t}, M_{i,t})$ are (0.66, 0.94, 0.4) for 1996 and (0.11, 0.88, 1.0) for 1997.

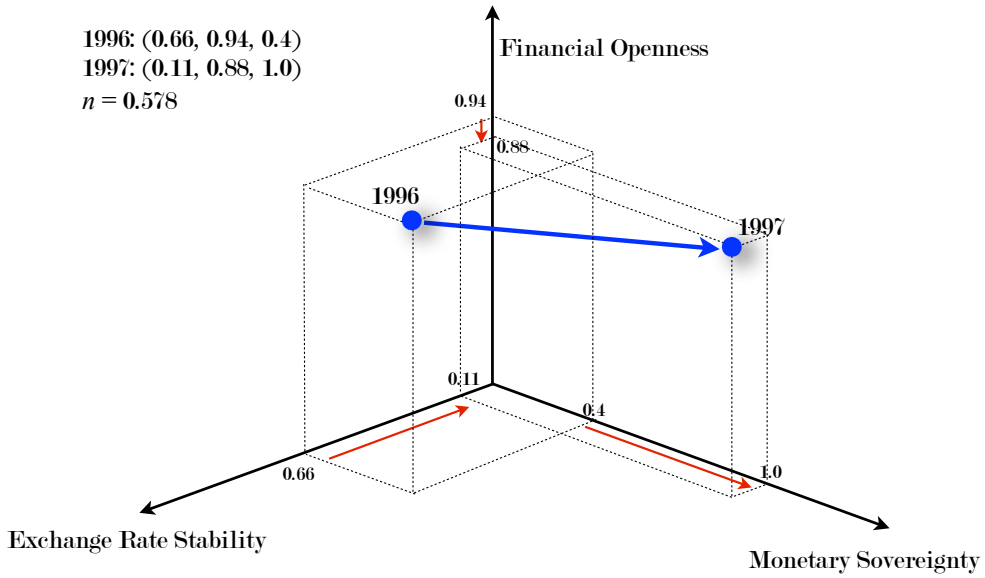

Figure 1: Indonesia 1996–97

3 Data and Overall Stability

In this section, we calculate the new stability measure for the full sample. We begin with the *de facto* exchange rate stability and monetary sovereignty measures provided by Aizenman, Chinn, and Ito (2010), updated with the latest version of the *de jure* financial account openness measure of Chinn and Ito (2008). Then, we recalculate our measure of stability using an alternative gauge of monetary sovereignty. Using data from 1970 to 2008, we focus on the experience of developing economies by including only the countries in the Aizenman, Chinn, and Ito dataset that were designated by the World Bank in 2008 as being poor or lower middle income countries – that is, those whose annual per capita GDP was $3855 or less. These countries are listed in Appendix A.

Aizenman *et. al.* construct the annual measure of exchange rate stability, $S_{i,t}$, using the exchange rate's monthly standard deviation against a base country.[5] Like many other researchers, they follow Shambaugh (2004) in constructing monetary sovereignty measures, $M_{i,t}$, using the correlation between each country's money market interest rate and that of its base country. Finally, Chinn and Ito's *de jure* measure of financial market openness, $F_{i,t}$, is essentially a weighted average of the International Monetary Fund's indicators of

[5]Like others, Aizenman, Chinn, and Ito apply a threshold to the standard deviation method in order to capture the stability of those currencies that remain in narrow bands; and, they also allow for individual devaluations or revaluations. The base countries include Australia, Belgium, France, Germany, India, Malaysia, South Africa, the United Kingdom, and the United States.

exchange restrictions.[6]

Table 1 provides a summary of the adjusted norms, $n_{i,t}$, calculated using these data on developing economies. The statistics are broken down by region, and they are compared with the summary statistics for the rest of the world. As shown in the second and third columns, the adjusted norms range from zero to 0.73 in our sample of developing economies. Notably, there is little apparent difference between the policy stability among developing economies and that in the rest of the world. As shown in the table's last two rows, both the mean and the maximum for developing economies are very close to the corresponding values for the rest of the world. However, among developing economies, the values do differ significantly across regions. The averages are largest in east Asia and the Pacific, and in eastern Europe and central Asia. The average is smallest for the sub Saharan African countries. The adjusted norms – both overall and by region – are graphed in Figure 2, where the dashed lines correspond to the measure discussed so far and to Table 1. The graphs' solid lines correspond to a second, closely related measure of stability – one that substitutes an implicit measure of monetary sovereignty for the Shambaugh measure used by Aizenman, Chinn, and Ito.

4 Other, Related Measures and Tests

4.1 An Implicit Measure of Monetary Sovereignty

As discussed above, the Shambaugh approach to gauging monetary sovereignty uses the correlation between a country's domestic, short-term interest rate and that of a putative base country, often the United States. High correlations are taken as indicative of monetary dependence. (That is, they are taken as a lack of monetary sovereignty.) Unfortunately, these otherwise valuable measures entail a drawback: in addition to reflecting monetary dependence, they also reflect the correlations between the underlying circumstances to

[6]Specifically, Chinn and Ito measure financial openness with the first principal component of the IMF's binary indicators of restrictions on current and capital account transactions, of multiple exchange rates, and of the required surrender of export proceeds. This is also the measure subsequently used by Aizenman *et. al.*. Miniane (2004) provides a *de jure* index that uses finer IMF data on capital account restrictions, but Miniane's data are available for only thirty countries. Many other, related, *de jure* indices have been developed, but few blend the easy interpretation and the wide coverage that Chinn and Ito provide. The natural alternative is to use *de facto* measure of openness, and we plan to explore those measures in future work.

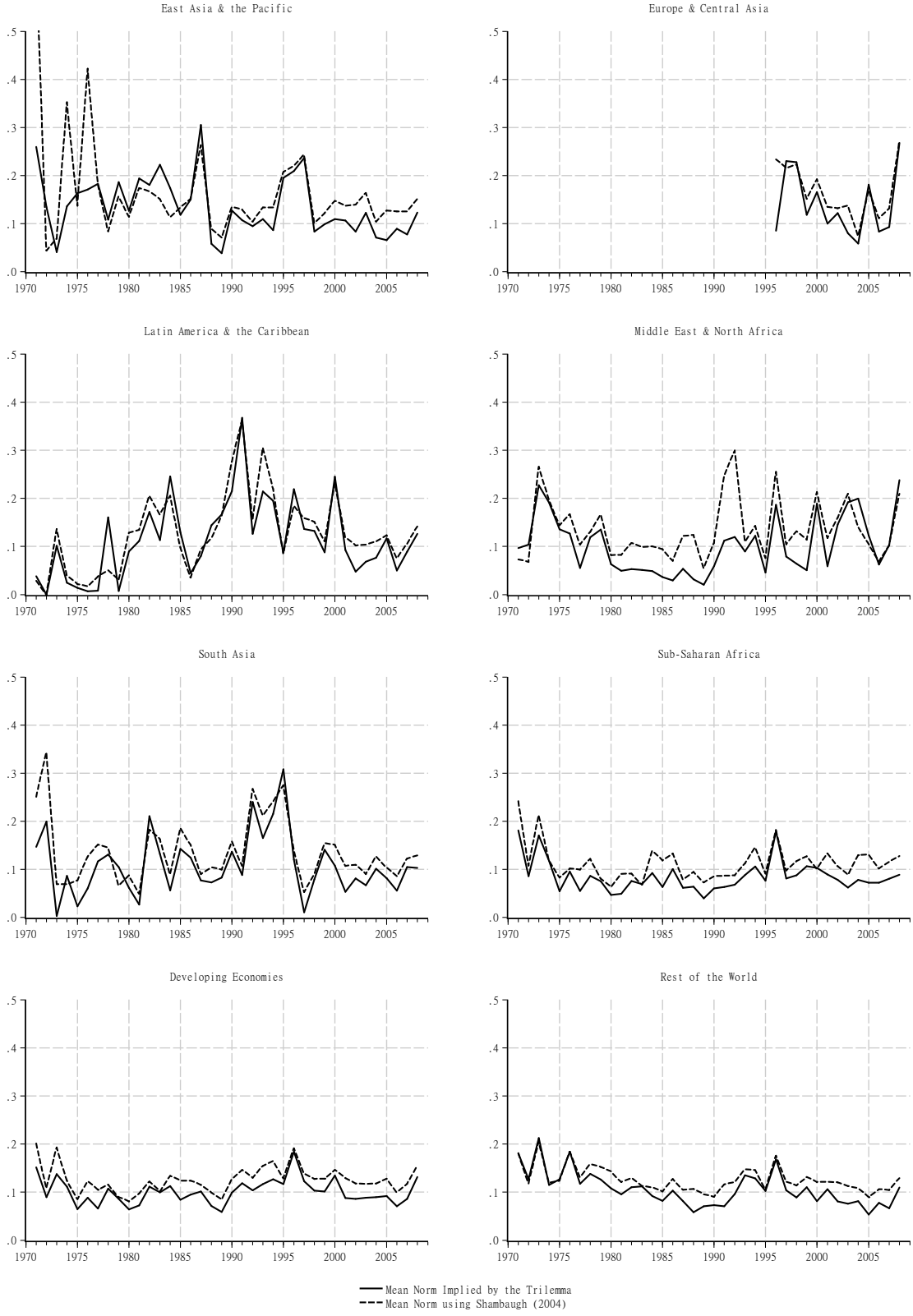

Figure 2: Norms by Region

Table 1: Norm using Shambaugh (2004)

	Mean	Max.	Min.	St. Dev.	Obs.	H_0
East Asia & Pacific	0.15	0.69	0.00	0.13	341	−3.37(***)
Europe & Central Asia	0.16	0.63	0.01	0.10	94	−2.71(***)
Latin America & Caribbean	0.14	0.73	0.00	0.15	274	−1.84(*)
Middle East & North Africa	0.14	0.68	0.00	0.13	186	−1.08
South Asia	0.14	0.60	0.00	0.12	228	−1.22
Sub-Saharan Africa	0.11	0.72	0.00	0.11	1131	6.07(***)
Developing	0.13	0.73	0.00	0.12	2254	−1.01
R.o.W.	0.12	0.75	0.00	0.11	2453	–

Notes: See Appendix A for a list of countries by region. The last column reports the value of the t-statistic for a test of equality of each region's mean against the mean of all other developing countries in the sample. The last two rows report descriptive statistics and a t-test for the developing sample against the rest of the world (R.o.W.). R.o.W. includes upper middle and higher income countries. (*) denotes significance at the 10% level; (**) at the 5% level; (***) at the 1% level.

which independent monetary policies may respond.[7] Other researchers, such as Frankel, Schmukler, and Serven (2004, in work contemporaneous with Shambaugh's), and Reade and Volz (2008), provide related measures of monetary sovereignty that allow for more general dynamic links between the interest rates of the countries. However, even these more general measures ultimately rely on interest rate comovements, so they are subject to the same drawback.[8]

Here, we introduce an alternative measure of monetary sovereignty that does not suffer from this drawback, and we use the new measure to recalculate our gauge of stability, $n_{i,t}$. Our new measure of monetary sovereignty starts by taking the trilemma seriously: we assume that the trilemma holds. With that assumption, the existing measures of exchange rate stability, $S_{i,t}$, and of financial openness, $F_{i,t}$, provide us with an implicit measure of monetary sovereignty, $M_{i,t}$. Specifically, the implicit measure of monetary sovereignty is:

$$M_{i,t} = 2 - S_{i,t} - F_{i,t}.$$

[7] Canada provides a telling example of the measure's problem: despite Canada's own demonstrable monetary sovereignty, its interest rates are highly correlated with those of the United States. Taken at face value, this approach would say that the Bank of Canada echoes the policies of the Federal Reserve Board.

[8] Two other, more recent studies take important steps toward mitigating the problem. Duburcq and Girardin (2010) allow domestic monetary conditions to matter in a study of eight Latin American countries over eleven years. Bluedorn and Bowdler (2010) separate the anticipated and unanticipated components of the base country's interest rate changes using the U.S. as the base country.

Table 2: Norm using the Trilemma-Implied Monetary Sovereignty Measure

	Mean	Max.	Min.	St. Dev.	Obs.	H_0
East Asia & Pacific	0.13	0.70	0.00	0.16	414	−4.17(***)
Europe & Central Asia	0.14	0.70	0.00	0.12	101	−2.92(***)
Latin America & Caribbean	0.12	0.77	0.00	0.18	357	−2.02(**)
Middle East & North Africa	0.10	0.88	0.00	0.16	292	−0.05
South Asia	0.11	0.61	0.00	0.14	259	−0.99
Sub-Saharan Africa	0.08	0.76	0.00	0.13	1326	6.09(***)
Developing	0.10	0.88	0.00	0.15	2749	0.44
R.o.W.	0.10	0.94	0.00	0.14	2633	–

Notes: Same as in Table 1.

Figure 3 provides graphs that depict both this implicit measure of monetary sovereignty (the solid lines), along with the Shambaugh measure (the dashed lines).[9] Overall, the new, implicit measure suggests a greater degree of monetary sovereignty than does the Shambaugh measure.

Since this implicit measure of monetary sovereignty takes the trilemma as given, we cannot use it to test the trilemma's validity, which is what Aizenman, Chinn, and Ito test.[10] However, we can use the implicit measure to explore what is of interest to us here: policy stability, which we can still gauge using the adjusted norm, $n_{i,t}$.

Table 2 provides a summary of policy stability using the adjusted norms calculated with the new, implied measure of monetary policy. The regional comparisons are essentially the same: the economies in east Asia and the Pacific, and in eastern Europe and central Asia have the largest means, while the countries of sub Saharan Africa have the smallest means. The regional differences are again statistically significant. Using the new measure, the average policy changes are smaller; though the maxima are larger. The slight (and statistically insignificant) difference between the stability in the developing economies and the stability in the rest of the world diminishes even further.

4.2 Stability over Time

The graphs in Figure 2 were suggestive of some possible changes over time in the stability of policy. Table 3 examines whether some of the seeming changes in stability are statisti-

[9] In cases where the implicit measure would yield a value in excess of one, we have equated the measure with one.

[10] As do Obstfeld, Shambaugh, and Taylor (2005), among others.

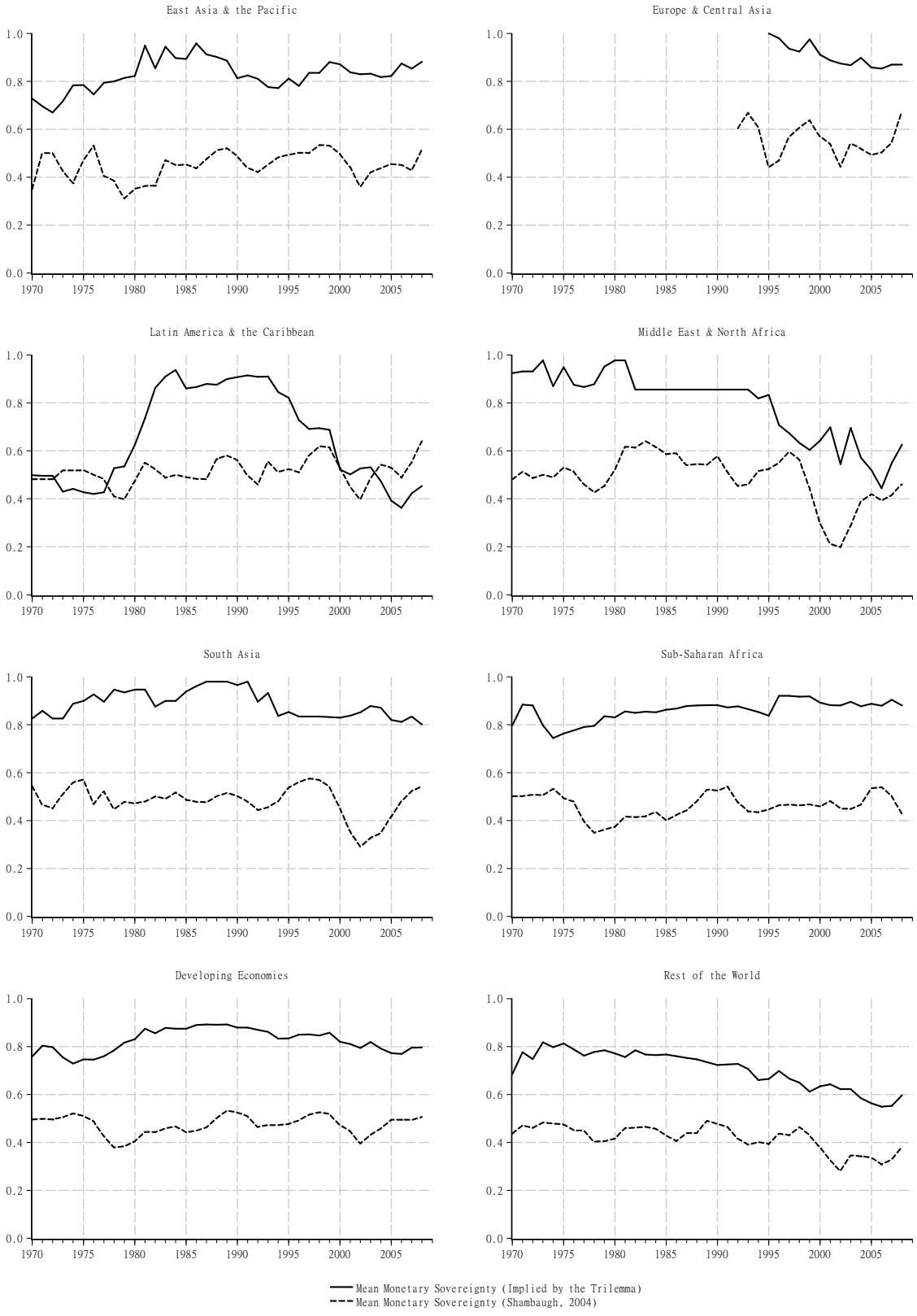

Figure 3: Implicit and Shambaugh (2004) Measures of Monetary Sovereignty

Table 3: Implicit Norm Means Before and After Recent Crises, 1994 (Mexico), 1997 (Southeast Asia), 2002 (Argentina)

	1970–1994	1995–2008	1970–1997	1998–2008	1970–2002	2003–2008	H_0
	0.138	0.119					1.25
E. Asia & Pac.			0.152	0.093			3.78(***)
					0.139	0.091	2.53(**)
	n.a.	n.a.					n.a.
Eur. & C. Asia			0.212	0.137			1.53
					0.157	0.127	1.13
	0.118	0.112					0.29
L. Am. & Car.			0.122	0.103			0.93
					0.121	0.088	1.36
	0.087	0.125					−2.05(**)
M. East & N. Afr.			0.089	0.13			−2.08(**)
					0.091	0.153	−2.58(**)
	0.116	0.1					0.87
S. Asia			0.119	0.088			1.68(*)
					0.115	0.085	1.31
	0.08	0.089					−1.26
Sub-Sah. Afr.			0.084	0.083			0.1
					0.086	0.075	1.09
	0.098	0.106					−1.54
Developing			0.103	0.097			1.02
					0.103	0.092	1.49
	0.11	0.093					3.47(***)
R.o.W.			0.112	0.085			5.05(***)
					0.109	0.077	4.69(***)

Notes: The last column reports the value of the t-statistic for a test of the hypothesis that the two means (before and after the relevant breakpoint) are equal. (*) denotes significance at the 10% level; (**) at the 5% level; (***) at the 1% level.

cally significant. Specifically, the table provides tests of whether the mean adjusted norm remained the same after the key crises that occur in the sample: the Mexican Crisis (1994), the Southeast Asian Crisis (1997), and the Argentinean Crisis (2002). Here, and unless otherwise indicated below, we now calculate the norms using the new, trilemma-implied measure of monetary stability.

As the table shows, in most cases, we cannot reject the hypothesis that there was no change in the mean. There are three notable exceptions. First, the policies in east Asian and Pacific economies seem to be more stable now than in the past: the mean norm in the east Asian and Pacific economies declined significantly after the Asian crisis. The decline is also detectable (though less markedly) if the Argentinean Crisis is given as the break point. Second, trilemma stability has declined in sub Saharan African countries: no matter

which of the three breaks point is used, their mean norm has risen significantly. Finally, while there is no overall change in the measured stability of the trilemma policies in the developing economies when taken as a whole (with east Asia and the Pacific's stability increase offsetting Africa's stability decline), the trilemma policies in the rest of the world do seem to have become more stable, regardless of which of the three break points is used.

4.3 Large Norms

When it comes to policy stability, it is arguably the very large changes in policy that are of most interest. So, we separately examine the incidence of large observations. Table 4 provides data on the largest decile of adjusted norms. The table lists the number of these large observations in each year, by region, for the full sample, and for the rest of the world. For each cell in the table, the numerator in the table gives the number of the large observations, while the denominator gives the total number of observations.

Among developing economies, the large changes echo the means. It is again the eastern European and central Asian economies, along with the east Asian and Pacific economies that exhibit the least stable policies. Likewise, by these measures, it is again the sub Saharan African countries that exhibit the greatest policy stability. When comparing developing economies with the rest of the world, however, a difference that could not be seen in the means does arise here: somewhat more (and a greater percentage of) large policy changes arise in the developing economies. In the regressions later, we first examine all the policy changes, then we focus on the probability of a large change in policy.

4.4 Archetypes

Next, we explore how the norms differ across the types of international macroeconomic arrangements. We assign observations to four different types of arrangements based on their semblance to one of four "archetypes:" a Hong-Kong-type, with exchange rate stability and open capital markets; a China-type, with exchange rate stability and monetary sovereignty; a U.S.-type with open financial markets and monetary sovereignty; and a Middle-type, with a modest degree of all three characteristics.

We use the simple geometry of the trilemma to describe the types of arrangements more formally. Letting j= "Hong Kong", "China", "U.S.", "Middle", we define $type_j$

Table 4: Number of Implicit Norm Values in the Last Decile by Region

Year	E. Asia & Pac.	Eur. & C. Asia	L. Am. & Car.	M. East & N. Afr.	S. Asia	Sub-Sah. Afr.	Developing	R.o.W.
1971	2/6	na	0/9	1/7	2/5	12/27	17/54	10/49
1972	1/6	na	0/9	1/7	2/5	3/28	7/55	8/49
1973	0/6	na	1/9	2/7	0/5	12/29	15/56	19/51
1974	2/7	na	0/9	1/7	1/5	3/30	7/58	4/52
1975	1/5	na	0/9	1/7	0/5	2/30	4/56	6/51
1976	2/5	na	0/9	1/7	0/5	1/30	4/56	9/52
1977	1/5	na	0/8	0/7	0/6	1/30	2/56	6/56
1978	0/5	na	1/8	0/7	2/6	3/30	6/56	9/59
1979	1/5	na	0/8	1/7	1/6	1/30	4/56	7/59
1980	1/6	na	1/8	1/7	0/6	2/31	5/58	4/60
1981	2/7	na	2/8	0/7	0/6	1/31	5/59	4/60
1982	2/8	na	1/8	0/7	2/6	2/34	7/63	4/62
1983	3/9	na	1/8	0/8	1/7	1/35	6/67	7/64
1984	2/9	na	2/8	0/8	0/7	3/35	7/67	4/66
1985	1/10	na	1/9	0/8	1/7	1/36	4/70	5/66
1986	1/11	na	1/10	0/8	1/8	3/36	6/73	7/67
1987	5/11	na	1/10	0/8	0/8	0/36	6/73	4/69
1988	0/11	na	1/10	0/8	0/8	1/36	2/73	2/69
1989	0/11	na	2/10	0/8	0/8	0/38	2/75	4/70
1990	2/12	na	2/10	0/8	2/8	1/38	7/76	2/70
1991	0/13	na	5/10	1/8	0/8	1/37	7/76	1/70
1992	1/13	na	2/10	1/8	4/8	1/37	9/76	4/70
1993	0/13	na	3/10	0/8	2/8	0/37	5/76	10/71
1994	1/13	na	2/10	1/8	3/8	4/38	11/77	9/71
1995	3/13	na	1/10	0/7	3/7	3/38	10/75	4/73
1996	5/15	0/1	3/10	3/8	0/7	3/38	14/79	8/73
1997	6/16	1/7	2/10	1/8	0/7	1/38	11/86	8/84
1998	1/16	4/9	2/10	0/8	0/7	3/38	10/88	7/84
1999	0/16	2/9	0/10	0/8	1/7	6/39	9/89	10/84
2000	2/16	2/10	2/10	2/8	1/7	4/39	13/90	3/84
2001	2/15	0/9	0/10	0/8	0/7	3/38	5/87	11/84
2002	1/15	0/8	0/10	1/8	0/7	4/38	6/86	3/84
2003	2/15	0/8	1/10	3/9	0/8	2/38	8/88	4/84
2004	1/15	0/8	1/10	3/9	0/8	2/38	7/88	6/84
2005	0/15	1/8	1/10	2/9	0/7	3/38	7/87	2/84
2006	1/14	0/8	0/10	0/8	0/7	2/38	3/85	4/83
2007	0/13	0/8	0/10	1/7	1/7	2/35	4/80	3/82
2008	1/13	4/8	1/10	3/7	1/7	3/34	13/79	6/83
Total	56/414	14/101	43/357	31/292	31/259	100/1326	275/2749	228/2633
(%)	13.5%	13.9%	12.0%	10.6%	12.0%	7.5%	10.0%	8.7%

Notes: An extraordinary norm value is a value in the last decile in the developing sample –over 0.2896. For each region, the numerators are the sum of extraordinary norms (in each year). Denominators represent the number of countries in the sample in each year.

such that R_j takes on the values: $(1,1,0)$, $(1,0,1)$, $(0,1,1)$, and $(\frac{\sqrt{2}}{3},\frac{\sqrt{2}}{3},\frac{\sqrt{2}}{3})$. Each of these four values of R_j represents a point on the frontier of the feasible set defined by the trilemma. The first three points represent the three corners corresponding to the "Hong Kong," "China," and "U.S." archetypes described above, and the last point represents the "Middle" of the feasible frontier. Then, we define country i's type in period t by its proximity to one of the four points. Specifically, we let:

$$j = \underset{j}{argmin}||(R_{i,t} - R_j)||$$

$$type_{i,t} \overset{def}{=} type_j.$$

That is, the observation's type is defined by the one that minimizes the distance between the observation and the archetype.

Using this definition of assigned types, Figure 4 shows the number of economies in each year of each type.[11] By far the most common arrangement among developing economies is the "China" type. In most years, more than forty economies have relatively stable exchange rates and relative monetary sovereignty. Few developing economies exhibit much financial openness. With the exception of a very brief period right after the Asian Crisis, fewer than two dozen economies fall into either the "Hong Kong" or "U.S." categories. The second most common arrangement type is the "Middle." The number of "Middle" observations briefly peaked at nearly fifty economies in the mid-nineties but more typically there are closer to half of that number. Only relative to the brief peak can one say that there has been any "hollowing out of the middle." There has been no obvious migration to any of the trilemma corners.

Table 5 summarizes how our measure of policy stability, the adjusted norm, differs across the four types of arrangements. As shown in the Table 5, policy stability differs markedly by type. For every type, one can strongly reject the hypothesis that the norm is the same as for the remaining developing economies as a whole. Notably, the least stable international macroeconomic policies occur when international macroeconomic arrangements are most like the U.S. archetype: when exchange rates are flexible and financial markets are open. The mean of the adjusted norm for this category is more than two

[11] Appendix B lists the number of observations of each type by country.

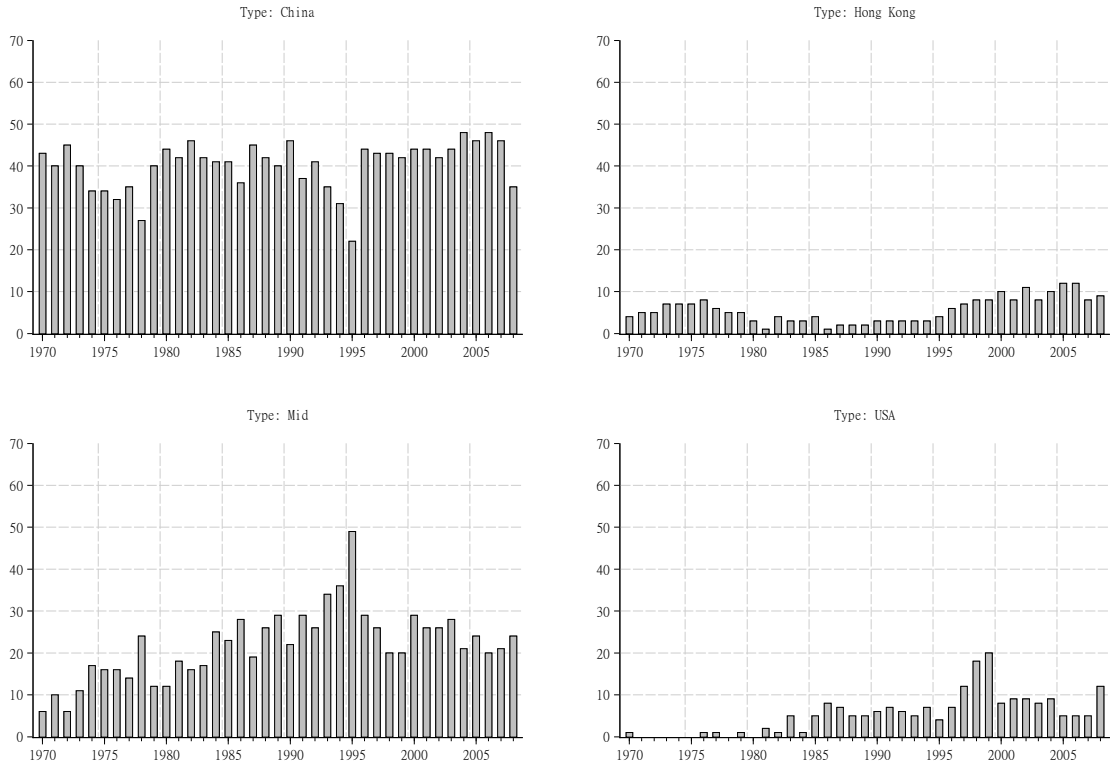

Figure 4: Archetypes: Number of Countries

to three times larger than the mean for the "China" and "Hong Kong" categories, which exhibit the most stability.

Figure 5 gives a richer picture of how stability changes over time for each of the types. The four graphs display the adjusted norm for the four types over the sample. Keeping in mind that the tallest spikes in the "Hong Kong" and "U.S." types represent at most only a handful of observations, we can see that even now the observations of economies with the least financial openness exhibit the most stable international macroeconomic policy.

Table 5: Norm using the Trilemma-Implied Monetary Sovereignty Measure

	Mean	Max.	Min.	St. Dev.	Obs.	H_0
China	0.09	0.75	0.00	0.14	1507	5.52(***)
Hong Kong	0.06	0.71	0.00	0.13	210	3.88(***)
U.S.	0.19	0.88	0.00	0.20	203	−9.11(***)
Mid	0.11	0.74	0.00	0.14	829	−3.09(***)

Notes: The t-test reported in the last column is for the mean of the archetype against the mean of the other observations in the developing sample. (*) denotes significance at the 10% level; (**) at the 5% level; (***) at the 1% level.

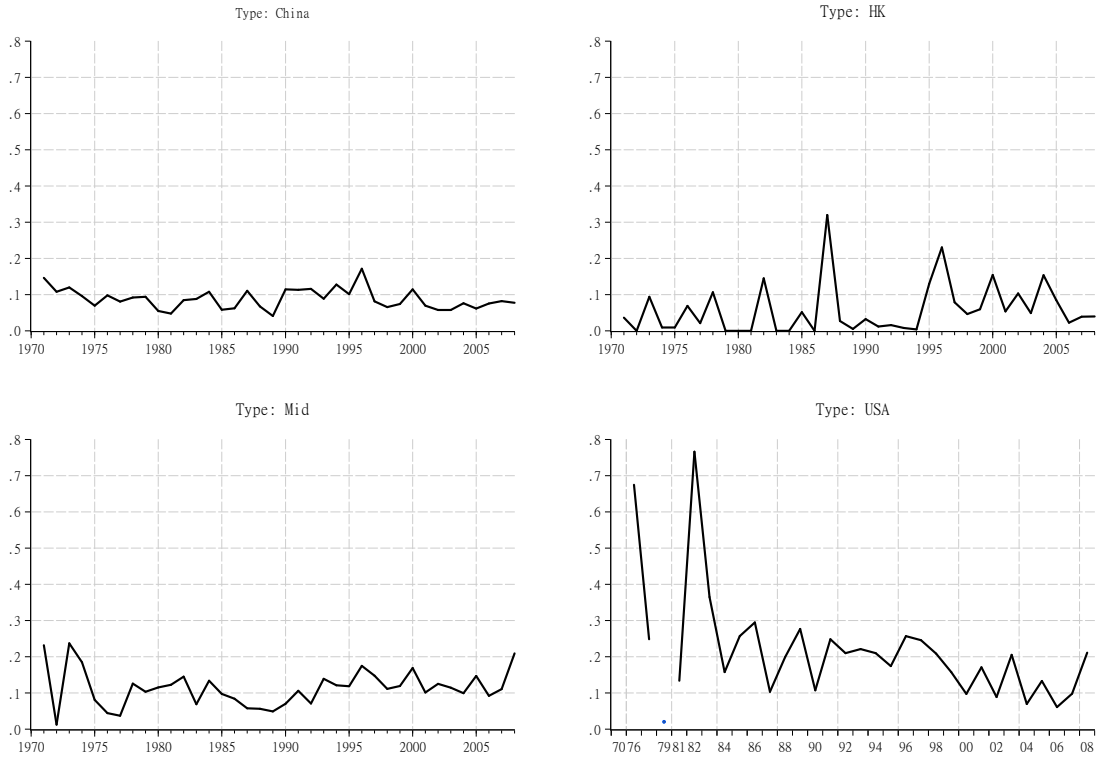

Figure 5: Archetypes: Norm

5 Regressions

In this section, we use regressions to further explore the stability of the various international macroeconomic policy arrangements. First, we use a linear panel regression to provide an overall perspective. Then, we use a probit model to examine how the likelihood of large changes in policy varies with different underlying arrangements. In these regressions, we also examine the link between policy stability and official holdings of foreign exchange reserves.

Figure 6 motivates the inclusion of reserves in our assessment of policy stability. The figure provides scatter plots of the adjusted norm (on the vertical axis) and the ratio of foreign exchange reserves to GDP (on the horizontal axis). For the developing economies as a whole, and for several of the regions (most notably Asia), the link between the two is negative. That is, in our sample, larger reserve holdings are correlated with greater policy stability.

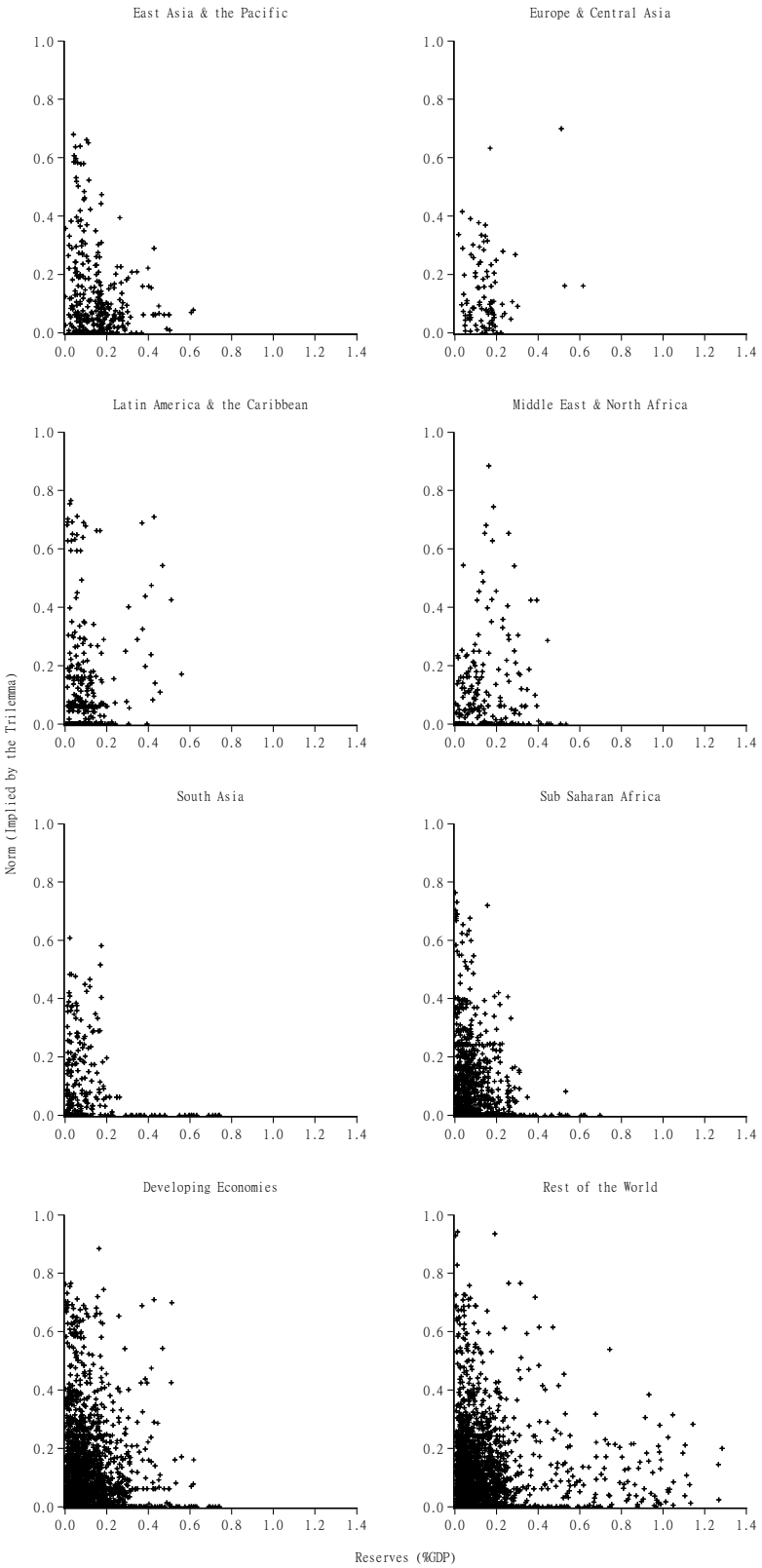

Figure 6: Scatter Plots of Norm and Reserves (% GDP)

5.1 Linear Panel Regressions

Table 6 summarizes the linear panel regressions. We examine the link between the adjusted norm and: the previous period's official foreign exchange reserves as a fraction of GDP (which we denote $\rho_{i,t}$) and measures of the previous period's international macroeconomic arrangements.

The table includes two main specifications. The first specification regresses the adjusted norm on reserves, on the measures of exchange rate stability and financial openness, and on the interactions between reserves and the two measures. The second specification also regresses the adjusted norm on reserves, but instead of including the measures of exchange rate stability and openness, it includes dummies for the economy's international macroeconomic arrangement *type*.

Specifically, the two linear panel specifications are:

$$n_{i,t} = \beta_0+\beta_1\rho_{i,t-1}+\beta_2 S_{i,t-1}+\beta_3 F_{i,t-1}+\beta_4(S_{i,t-1}-\overline{S})(\rho_{i,t-1}-\overline{\rho})+\beta_5(F_{i,t-1}-\overline{F})(\rho_{i,t-1}-\overline{\rho})+\epsilon_{i,t} \quad \text{(I)}$$

$$n_{i,t} = \gamma_0 + \gamma_1\rho_{i,t-1} + \gamma_2 D_{\text{“}China\text{”},i,t-1} + \gamma_3 D_{\text{“}HongKong\text{”},i,t-1} + \gamma_4 D_{\text{“}U.S.\text{”},i,t-1} + \varepsilon_{i,t} \quad \text{(II)}$$

where overbars indicate sample means, and D_j indicates a dummy variable for $type_{i,t} = R_j$.[12] Each of the two specifications is estimated with no effects, with country effects, with time effects, and with both country and time effects; and, for all of regressions, both simple OLS and cluster-robust standard errors are reported.[13]

The estimation results for both specifications provide additional documentation of the link between exchange rate stability and overall stability within the trilemma, but the two specifications show little support for the idea that reserves matter much for policy stability.

In the first specification, the coefficients on lagged reserves are statistically insignificant

[12] Note that the second specification excludes $R_{\text{“}Middle\text{”}}$.

[13] That is, the constants, β_0 and γ_0 are defined sequentially as a simple constant, as a sum of country effects, as a sum of time effects, and as a sum of both country and time effects; and $\epsilon_{i,t}$ and $\varepsilon_{i,t}$ are allowed to be block diagonal in the cluster-robust versions.

Table 6: OLS Estimates –Norm Implied by the Trilemma

	No Effects		**Country Effects**		**Time Effects**		**Country & Time Effects**	
	Spec. I	Spec. II	Spec. I	Spec. II	Spec. I	Spec. II	Spec. I	Spec. II
Reserves (%GDP)	−0.43	−0.062	0.002	−0.023	−0.039	−0.063	0.018	0.003
	(0.029)	(0.028)**	(0.042)	(0.041)	(0.031)	(0.03)**	(0.062)	(0.046)
	(0.05)	*(0.05)*	*(0.062)*	*(0.058)*	*(0.051)*	*(0.055)*	*(0.062)*	*(0.059)*
Exchange Rate Stability	−0.1		−0.087		−0.101		−0.083	
	(0.009)***		(0.012)***		(0.009)***		(0.019)***	
	*(0.012)****		*(0.019)****		*(0.013)****		*(0.019)****	
Financial Openness	0.002		−0.021		0.002		−0.02	
	(0.011)		(0.016)		(0.011)		(0.035)	
	(0.002)		*(0.034)*		*(0.02)*		*(0.034)*	
Res. (%GDP) × E. R. S.	−0.188		−0.225		−0.174		−0.219	
	(0.088)**		(0.111)**		(0.088)**		(0.174)	
	(0.14)		*(0.177)*		*(0.139)*		*(0.177)*	
Res. (%GDP) × Fin. Op.	−0.216		0.066		0.231		0.083	
	(0.094)**		(0.123)		(0.093)**		(0.208)	
	(0.164)		*(0.202)*		*(0.166)*		*(0.202)*	
China Archetype		−0.027		−0.03		−0.024		−0.025
		(0.006)***		(0.007)***		(0.007)***		(0.007)***
		*(0.008)****		*(0.01)****		*(0.008)****		*(0.01)***
Hong Kong Archetype		−0.038		−0.06		−0.035		−0.052
		(0.012)***		(0.015)***		(0.012)***		(0.015)***
		*(0.017)**		*(0.023)**		*(0.018)**		*(0.025)**
U.S. Archetype		0.076		0.069		0.077		0.072
		(0.012)***		(0.007)***		(0.012)***		(0.012)***
		*(0.017)****		*(0.015)****		*(0.017)****		*(0.014)****
Constant	0.173	0.119	0.167	0.119	0.173	0135	0.154	0.126
	(0.007)***	(0.006)***	(0.01)***	(0.007)***	(0.022)***	(0.021)***	(0.025)***	(0.021)***
	*(0.009)****	*(0.01)****	*(0.014)****	*(0.007)****	*(0.022)****	*(0.025)****	*(0.014)****	*(0.024)****
F (OLS)	30.07***	26.43***	11.58***	21.61***	5.99***	4.94***	9.29***	4.66***
F (Clustered)	20.76***	14.27***	6.25***	17.01***	14.93***	11.19	6.25	10.9***
R^2 (OLS & Clustered)	0.058	0.041	0.053	0.039	0.094	0.077	0.087	0.074

Notes: Dependent variable is the norm implied by the trilemma. OLS standard errors are in parentheses and cluster-robust errors are reported in italics underneath.

in all of the eight of specifications variants. There might at first glance – seem to be some indication that reserves are linked to stability in countries with fixed exchange rates since the coefficients on their interaction with exchange rate stability are uniformly negative. However, the magnitude of the coefficients is underwhelming and their limited significance disappears with clustered errors. There does appear, though, to be a role for exchange rate stability. In all eight versions of the first specification, the coefficient on lagged exchange rate stability itself is negative and statistically significant, indicating that exchange rate stability is robustly indicative of a lower adjusted norm in the subsequent period, that is, it is indicative of overall stability within the trilemma policy space.

In the second specification, the reserve coefficients are again underwhelming, but all of the archetype indicators are significant at the five percent level or better, and most are significant at the one percent level. The coefficients on the dummy for the China archetype and the Hong-Kong archetype are both negative, indicating greater subsequent stability (relative to the left-out "Middle" archetype); and the coefficient on the U.S. archetype is positive, indicating greater instability in the subsequent period.

The linear panel estimates confirm our earlier assessment that policy stability varies with the underlying international macroeconomic arrangements, and, despite the correlations shown in Figure 6, they provide only the slightest evidence that reserves may be systematically linked to trilemma stability. We explore both these issues in terms of large policy changes in the section below.

5.2 Probit Regressions

In this section, we back away from the linear framework in order to focus on big policy changes. Specifically, we turn our attention to whether an economy's foreign exchange reserves or its location in the trilemma policy space is linked to a greater probability of a policy change that is large. Probit regressions are naturally suited to such questions, and we use them here.

To implement the probit regressions, we define a large policy change as an adjusted norm in the top decile, which in our sample means a value that exceeds 0.29. Defining a dependent variable that takes on a value of one when $n_{i,t} > 0.29$, and takes on a value of zero otherwise, we now can estimate a probit model using the same explanatory variables

Table 7: Probit Estimates –Norm Implied by the Trilemma

	Panel A		**Panel B**		**Panel C**	
	Spec. I	Spec. II	Spec. I	Spec. II	Spec. I	Spec. II
Reserves (%GDP)	−0.925	−0.82	−0.925	−0.82	−0.864	−0.932
	(0.407)**	(0.373)**	(0.548)*	(0.552)	(0.479)*	(0.456)**
Exchange Rate Stability	−0.207		−0.207		−0.211	
	(0.105)**		(0.134)		(0.119)**	
Financial Openness	−0.024		−0.024		−0.152	
	(0.132)		(0.213)		(0.161)	
Res. (%GDP) × E. R. S.	−1.611		−1.611		−1.85	
	(1.144)		(1.53)		(1.276)	
Res. (%GDP) × Fin. Op.	3.02		3.02		2.615	
	(1.186)**		(1.676)*		(1.368)*	
China Archetype		−0.099		−0.099		−0.127
		(0.079)		(0.08)		(0.089)
Hong Kong Archetype		−0.023		−0.023		−0.147
		(0.147)		(0.156)		(0.168)
U.S. Archetype		0.508		0.508		0.546
		(0.119)***		(0.113)***		(0.13)***
Constant	−1.062	−1.199	−1.062	−1.199	−1.107	−1.226
	(0.09)***	(0.072)***	(0.111)***	(0.078)***	(0.11)***	(0.093)***
LR					21.27***	25.3***

Notes: Dependent variable is a discrete variable taking the value 1 if the norm is in the last decile and 0 otherwise. Standard errors are in parentheses. Panel A reports simple probit estimates; Panel B reports estimates with cluster-robust errors; and Panel C reports estimates from a probit with random effects. The interaction variables are expressed in deviation from the sample mean.

as in the two linear panel specifications above. Table 7 summarizes the estimation of the probit regressions. The two specifications are each estimated with conventional standard errors (Panel A), then with clustered errors (Panel B), then with random effects (Panel C).

Some evidence that foreign exchange reserves are linked to subsequent stability emerges here. In five out of the six variants of the probit regression, the coefficient on reserves is at least mildly statistically significant. Its sign is uniformly negative, indicating that greater reserves relative to GDP are indicative of greater policy stability.[14] The first specification, which allows for interaction terms, adds something to the interpretation of the relationship between reserves and stability. Notably, the interaction of reserves with financial openness has a positive, mildly significant coefficient. While not strongly significant, this positive interaction coefficient nevertheless tells us that the link between reserves and stability is

[14]Unlike the linear models, the probit's coefficients are not immediately interpretable straight off the page. However, an example gives an indication of the modest economic significance of the coefficient on reserves: India increased its reserves from just under ten percent in 2001 to over 21 percent by 2008. The coefficients in Panels A and B imply that such a change would be tied to a decline in the likelihood of a large policy change of about 22 percent.

strongest when capital controls are in place.

The probit regressions also provide a degree of confirmation of the links identified above between the underlying trilemma policies and subsequent policy stability. In the first specification, the coefficients on exchange rate stability are uniformly negative, as they were in the linear panel regressions, though they are no longer uniformly significant. As in the second specification above, here the dummy for the "U.S." archetype is positive and strongly significant in all three versions. This again suggests that, among developing economies, the least stable trilemma policies occur for those with relatively flexible exchange rates and open financial markets.

6 Conclusions

Underlying this paper is a willingness to take the classic, open-economy trilemma seriously and to draw out some of its implications for empirical work on international macroeconomic policies. It is the simple geometry of the trilemma that provides us with a univariate gauge of the stability of a country's multidimensional, international macroeconomic policies. Given existing measures of exchange rate stability and international financial openness, it is the trilemma's constraint that provides us with an implicit gauge of monetary sovereignty. It is the trilemma's policy space that allows us to characterize international arrangements in terms of their semblance to definitive policy archetypes.

Taking the trilemma seriously and using its implications, we explore the international macroeconomic policies of a large group of developing economies. The results of this work confirm that most of the developing economies still remain closest to the archetype of fixed exchange rates and closed financial markets. Among the developing economies in our sample, there has been – for example – no sustained "hollowing out of the middle." Focusing our attention on trilemma policy stability, we see that it is precisely the many financially closed economies with limited exchange rate flexibility that tend to have the most stable international macroeconomic policies. Finally, it is primarily in these financially closed economies that official holdings of foreign exchange reserves seem to be linked, however weakly, to greater policy stability.

References

Aizenman, Joshua, Menzie D Chinn, and Hiro Ito. 2010. "The Emerging Global Financial Architecture: Tracing and Evaluating New Patterns of the Trilemma Configuration." *Journal of International Money and Finance*, 29(4): 615–641.

Bluedorn, John C., and Christopher Bowdler. 2010. "The Empirics of International Monetary Transmission: Identification and the Impossible Trinity." *Journal of Money, Credit and Banking*, 42(4): 679–713.

Chinn, Menzie, and Hiro Ito. 2006. "What Matters for Financial Development? Capital Controls, Institutions, and Interactions." *Journal of Development Economics*, 81(1): 163–192.

Duburcq, Caroline, and Eric Girardin. 2010. "Domestic and External Factors in Interest Rate Determination: The Minor Role of the Exchange Rate Regime." *Economics Bulletin*, 30(1): 624–635.

Edwards, Sebastian. 2007. "Capital Controls, Sudden Stops, and Current Account Reversals." In *Capital Controls and Capital Flows in Emerging Economies: Policies, Practices and Consequences*. 73–120. National Bureau of Economic Research.

Frankel, Jeffrey, Sergio L. Schmukler, and Luis Serven. 2004. "Global Transmission of Interest Rates: Monetary Independence and Currency Regime." *Journal of International Money and Finance*, 23(5): 701–733.

Girton, Lance, and Don Roper. 1977. "A Monetary Model of Exchange Market Pressure Applied to the Postwar Canadian Experience." *The American Economic Review*, 67(4): 537–548.

Miniane, Jacques. 2004. "A New Set of Measures on Capital Account Restrictions." *IMF Staff Papers*, 51(2): 276–308.

Mundell, R. A. 1963. "Capital Mobility and Stabilization Policy under Fixed and Flexible Exchange Rates." *The Canadian Journal of Economics and Political Science*, 29(4): 475–485.

Obstfeld, M, JC Shambaugh, and AM Taylor. 2005. "The Trilemma in History: Tradeoffs among Exchange Rates, Monetary Policies, and Capital Mobility." *Review of Economics and Statistics*, 87(3): 423–438.

Reade, J. James, and Ulrich Volz. 2010. "Chinese Monetary Policy and the Dollar Peg." Free University Berlin, School of Business & Economics Discussion Paper 35.

Shambaugh, Jay C. 2004. "The Effect of Fixed Exchange Rates on Monetary Policy." *Quarterly Journal of Economics*, 119(1): 300–351.

A Appendix: Countries

The countries used in this paper are those for which Aizenman, Chinn and Ito (2010) report data and have an annual per capita income of $3,855 or less (we are using the 2008 World Bank classification).

- **East Asia and Pacific regional aggregate.** Cambodia; China; Indonesia; Kiribati; Lao PDR; Micronesia, Fed. Sts.; Mongolia; Myanmar; Papua New Guinea; Philippines; Samoa; Solomon Islands; Thailand; Tonga; Vanuatu; Vietnam.

- **Europe and Central Asia regional aggregate:** Albania; Armenia; Azerbaijan; Georgia; Kyrgyz Republic; Moldova; Tajikistan; Turkmenistan; Ukraine; Uzbekistan.

- **Latin America and Caribbean regional aggregate.** Belize; Bolivia; Ecuador; El Salvador; Guatemala; Guyana; Haiti; Honduras; Nicaragua; Paraguay.

- **Middle East and North Africa regional aggregate:** Djibouti; Egypt, Arab Rep.; Iran, Islamic Rep.; Iraq; Jordan; Morocco; Syrian Arab Republic; Tunisia; Yemen, Rep.

- **South Asia regional aggregate.** Afghanistan; Bangladesh; Bhutan; India; Maldives; Nepal; Pakistan; Sri Lanka.

- **Sub-Saharan Africa regional aggregate.** Angola; Benin(*); Burkina Faso(*); Burundi; Cameroon(*); Cape Verde; Central African Republic(*); Chad(*); Comoros; Congo, Dem. Rep.; Congo, Rep.(*); Côte d'Ivoire(*); Eritrea; Ethiopia; Gambia, The; Ghana; Guinea; Guinea-Bissau(*); Kenya; Lesotho; Liberia; Madagascar; Malawi; Mali(*); Mauritania; Mozambique; Niger(*); Nigeria; Rwanda; São Tomé and Príncipe; Sénégal(*); Sierra Leone; Somalia; Sudan; Swaziland; Tanzania; Togo(*); Uganda; Zambia; Zimbabwe.

Note: (*) indicates a member state of the Communauté française d'Afrique.

B Appendix: Classification of Observations by Archetype

Country	Type: Hong Kong	Type: China	Type: Mid	Type: USA	Obs.
Afghanistan	21	0	7	1	29
Albania	2	0	11	1	14
Angola	8	0	6	2	16
Armenia	0	0	9	4	13
Azerbaijan	10	0	3	0	13
Bangladesh	30	0	3	0	33
Belize	13	1	10	0	24
Benin*	13	0	17	0	30
Bhutan	24	0	0	0	24
Bolivia	1	14	20	4	39
Burkina Faso*	13	0	8	0	21
Burundi	24	0	15	0	39
Cambodia	8	0	8	0	16
Cameroon*	23	0	16	0	39
Cape Verde	26	0	1	0	27
Central African Republic*	29	0	10	0	39
Chad*	31	0	8	0	39
China	21	0	3	1	25
Comoros	28	0	0	0	28
Congo, Dem. Rep.	9	0	9	13	31
Congo, Rep.	34	0	5	0	39
Côte d'Ivoire*	23	0	16	0	39
Djibouti	0	27	0	0	27

Continued on next page

Country	Type: Hong Kong	Type: China	Type: Mid	Type: USA	Obs.
Ecuador	3	5	24	7	39
Egypt, Arab Rep.	26	6	4	3	39
El Salvador	23	13	3	0	39
Eritrea	9	0	1	1	11
Ethiopia	39	0	0	0	39
Gambia, The	11	0	12	15	38
Georgia	0	0	7	6	13
Ghana	34	0	5	0	39
Guatemala	10	8	18	3	39
Guinea	28	0	7	2	37
Guinea-Bissau*	12	0	14	2	28
Guyana	22	8	6	3	39
Haiti	1	6	13	12	32
Honduras	11	11	17	0	39
India	35	0	4	0	39
Indonesia	0	18	10	11	39
Iran, Islamic Rep.	24	2	12	1	39
Iraq	30	0	4	0	34
Jordan	14	12	13	0	39
Kenya	22	0	11	6	39
Kiribati	0	16	0	0	16
Kyrgyz Republic	0	0	7	5	12
Lao PDR	23	0	8	3	34
Lesotho	27	0	10	0	37
Liberia	1	16	12	10	39

Continued on next page

Country	Type: Hong Kong	Type: China	Type: Mid	Type: USA	Obs.
Madagascar	16	0	19	4	39
Malawi	19	0	19	1	39
Maldives	0	17	5	5	27
Mali*	17	0	22	0	39
Mauritania	33	0	6	0	39
Micronesia, Fed. Sts.	0	13	0	0	13
Moldova	8	0	4	1	13
Mongolia	1	0	9	4	14
Morocco	35	0	4	0	39
Mozambique	17	0	4	0	21
Myanmar	30	0	9	0	39
Nepal	35	0	4	0	39
Nicaragua	14	21	2	2	39
Niger*	26	0	13	0	39
Nigeria	28	0	9	2	39
Pakistan	32	0	7	0	39
Papua New Guinea	2	0	27	1	30
Paraguay	20	0	11	8	39
Philippines	16	0	19	4	39
Rwanda	27	0	10	2	39
Samoa	21	0	13	0	34
São Tomé and Príncipe	10	0	14	4	28
Sénégal*	16	0	23	0	39
Sierra Leone	25	0	5	9	39
Solomon Islands	11	0	15	1	27

Continued on next page

Country	Type: Hong Kong	Type: China	Type: Mid	Type: USA	Obs.
Somalia	20	0	1	0	21
Sri Lanka	17	0	18	4	39
Sudan	28	0	7	3	38
Swaziland	16	0	20	0	36
Syrian Arab Republic	36	0	0	0	36
Tajikistan	7	0	5	0	12
Tanzania	22	0	16	1	39
Thailand	1	0	36	2	39
Togo*	34	0	5	0	39
Tonga	3	0	16	1	20
Tunisia	30	0	9	0	39
Turkmenistan	6	0	0	0	6
Uganda	17	1	12	9	39
Ukraine	9	0	3	1	13
Uzbekistan	2	0	0	0	2
Vanuatu	0	0	12	4	16
Vietnam	31	0	1	0	32
Yemen, Rep.	0	5	6	0	11
Zambia	17	0	7	13	37
Zimbabwe	19	0	1	3	23
All	1570	220	855	205	2850