Does the policy trilemma still hold? Fresh evidence and its implications

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Abstract: Economic success of any nation intrinsically hinges on the tradeoff between external policy choices and their internal consequences. An enduring challenge that countries confront is the 'trilemma' of choices between three desirable, yet jointly unattainable objectives of maintaining a fixed exchange rate regime, unfettered cross-border capital flows and monetary policy independence. This study examines the extent of monetary autonomy for over 130 nations spanning the period 1999–2011. Using both pooled cross-sectional as well as time series analyses I find more loss of monetary sovereignty for fixed regimes than non-fixed ones, supporting the trilemma's predictions. However, I do note this difference is only marginal and several floaters exhibit 'fear of floating' behaviour allowing sufficient transmission of foreign interest rates. Finally, I examine the macroeconomic consequences of the three tenets of the trilemma. I find higher monetary independence, greater capital openness as well as greater regime flexibility to promote economic stability.

Keywords: capital controls; exchange rate regimes; fear of floating; interest rate pass-through; monetary policy independence; policy trilemma.

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1 Introduction

Economic success of any nation intrinsically hinges on the tradeoff between external policy choices and their internal macroeconomic consequences. One of the more enduring challenges that open economies confront is the constraint that increasing economic interdependence places on monetary policymaking. The Mundell-Fleming paradigm posits that policymakers in open economies face a trilemma of choices. Typically they are confronted with three desirable, yet jointly unattainable objectives of maintaining free international capital flows, fixed exchange rates and monetary policy independence oriented towards purely domestic goals. Any two pair of policy choices requires abdicating the third. Under a credibly pegged exchange rate regime and unfettered capital flows, domestic interest rates cannot be set independently based on internal considerations, but rather follow that of a foreign nation. While under a flexible regime a country retains monetary policy independence as domestic interest rates are less sensitive to changes in international rates.[1]

However, a differing view to this argument is the 'fear of floating' phenomenon (Calvo and Reinhart, 2002). Countries with floating regimes may not allow their exchange rates to fluctuate beyond a certain magnitude and allow changes in foreign interest rates to be transmitted to domestic interest rates. Thus the extent of monetary policy independence will not be significantly different between fixed and flexible regimes.

Empirical evidence on the trilemma's predictions is rather contrasting. A conspicuous absence is the lack of studies for the new millennium. This time period is especially critical as several nations have changed their exchange rate regimes in the aftermath of the currency crises of the late 1990s. More importantly, the end of the last century saw the introduction of the euro. In fact, a pertinent illustration of the trilemma is the recent euro area crisis. The euro zone nations have a fixed regime between themselves. There is also free flow of capital among them with, for instance, banks from Germany and France holding sizeable portion of Greek sovereign bonds. However, in keeping with what the trilemma' would posit each nation has sacrificed monetary policy sovereignty. This inability to pursue domestic goals with its monetary policy is posing hardships for some in the recovery process from the recent crisis.

In the backdrop of this changed global financial architecture post-1999, a renewed examination of the policy trilemma is necessitated that is presently lacking. Moreover, most existing studies have focused on exploring whether the trilemma holds or not rather than on its implications. Understanding this is crucial, since they have a profound influence on key economic policy outcomes. Greater monetary independence might result in less output volatility and hence imbue more macroeconomic stability. On the other hand, lack of such policy flexibility may lead to some disconnection between the desired policy needs of the country and that actually implemented.[2]

The present study makes four key contributions. I first provide a tripartite regime classification; as well create a capital controls index for 133 nations from 1999 to 2011. Secondly, I examine the extent of monetary policy autonomy for nations with fixed and non-fixed exchange rate regimes using pooled annual data. Thirdly, I perform a similar country-specific analysis for selected nations with starkly different exchange rate regimes using monthly data. Pointedly, my analysis includes the seldom researched smaller nations. Finally, I investigate the implications of the three tenets of the trilemma on macroeconomic stability.

This remainder of the paper proceeds as follows. Section 2 surveys and synthesises the seminal studies on policy trilemma. Section 3 discusses the empirical methodology and the data. Section 4 presents the results. Section 5 examines the implications of the trilemma on some policy variables. Finally, Section 5 concludes.

2 Survey of recent studies on the trilemma

In one of the earlier studies, Borensztein et al. (2001) test the insulating properties of floating exchange rates from foreign shocks by analysing the impact of changes in both US monetary policy and international risk premium on interest rates in countries with starkly opposite exchange rate regimes (Hong Kong vis-a-vis Singapore, Mexico and Argentina). These two types of foreign shocks are measured by changes in the Federal funds futures rate and the emerging market bond index (EMBI), respectively. Using both single equation regressions and impulse response functions with data spanning from 1989 to 2000 the results provide mixed evidence. While the response of Hong Kong to both types of shocks is much more than in Singapore, consistent with the monetary policy autonomy under floating regimes, the response of Mexico do not differ much from Argentina to changes in EMBI.

Obstfeld et al. (2004) examine the trilemma in the interwar period, an era characterised by the use of a multilateral gold standard regime and varying degrees of capital account openness. They use annual averages of short-term monthly nominal interest rates (discount rates) in first-differenced form for 16 countries for the period 1919-38 and split the sample into panels of pegged vs. non-pegged regimes. The results reveal pegged regimes to have an interest rate pass-through (IRPT, henceforth) of 72% while for non-pegged ones it is statistically insignificant, in keeping with the trilemma's predictions. Following on the heels of this study, the same authors in 2005 examine the issue for three episodes in history: the Gold Standard period characterised by mostly fixed exchange rates and unfettered capital flows; the Bretton Woods period, featured by fixed but adjustable exchange rates and strict capital mobility, and the post Bretton Woods era, marked by varied choice of regimes and more liberal capital openness. The trilemma would predict monetary policy autonomy to be least during the classic Gold Standard era. The authors again use annual averages of short-term monthly interest rates (either money-market or T-bill rates) from 1870 to 1914 for 16 nations across the Gold Standard era, for 21 nations from 1959 to 1970; and 103 countries from 1973 to 2000 for the two other eras. Specifically for the Gold Standard there is an IRPT of 52 and 16%, for pegs and non-pegs, respectively, while those for the modern era were 46 and 27%, respectively. These are again supportive of the predictions of the trilemma. For the Bretton Woods era there is no significant pass-through. This is attributed to the explicit use of capital controls that allowed nations to retain monetary policy sovereignty.[3]

Shambaugh (2004) examines monetary policy autonomy for 155 countries across 1973–2000. The author finds countries with fixed exchange rates to follow the interest rates of the base country more closely than countries with flexible exchange rates (IRPT of 50% for fixed regimes vs. 30% for non-fixed ones). These three studies employ the methodology developed by Pesaran et al. (2001).

Kim and Lee (2008) examine the independence of monetary policy for eight East Asian nations (Hong Kong, Indonesia, Japan, Korea, Malaysia, the Philippines, Singapore and Thailand) using monthly data from January 1987–April 2002. Employing an instrumental variable methodology to account for potential endogeneity and also accounting for structural breaks, the authors make country-specific estimates. They find the sensitivity of local interest rates to US rates decline for Korea and Thailand post-crises with the switch towards floating regimes. Also, Japan a nation with a floating regime exhibits greater monetary independence than Hong Kong, a nation with a fixed regime. Their results suggest more floating regimes provide greater degree of monetary sovereignty as the trilemma would posit.

Bluedorn and Bowdler (2010) focus on delineating unanticipated and exogenous changes in US Federal funds rate from aggregate changes (which also include anticipated and endogenous elements). The transmission of both these two types of changes in US interest rates into changes in domestic interest rates for 36 countries with either pegged or non-pegged regimes are next examined. They find IRPT for unanticipated changes to be 78% for pegs while it is 52% for non-pegs. Using both static and dynamic analyses their results indicate the difference in interest rate pass-through is three times larger for pegged regimes than with non-pegged ones, again lending support to the trilemma's logic.

In rebuttal, several studies find results contrary to the trilemma predictions. For instance, Frankel et al. (2004) examine the transmission of foreign interest rates into domestic rates for 46 countries (18 industrial, 28 developing) from 1970 to 1999. Unlike other studies the authors use data in levels form. Using monthly money market rates and pooling the sample according to regime types, the authors find IRPT of 74, 55 and 54%, for fixed, intermediate and flexible regimes, respectively, a result supporting the trilemma. However, after splitting the sample by country-income groups, decade and regime, the authors find full transmission of global interest rates in the 1990s across regime types. Such convergence in interest-rate pass-through across exchange rate regime types suggests no monetary autonomy even under flexible regimes, and is more reflective of the 'fear of floating' phenomenon.

Forssbaeck and Oxelheim (2006) focus on 11 European countries (Austria, Belgium, Denmark, Greece, Ireland, Netherlands, Portugal, Sweden and Switzerland) from 1979 to 2000 and use monthly data to estimate elasticity of domestic interest rates to changes in foreign rates (either Germany or the USA). After classifying nations into groups of different regimes and varied degrees of capital controls, the authors find exchange rate regimes to not influence monetary policy autonomy regardless of whether capital controls are in place or not. While this result undermines the trilemma, the authors attribute it to adjustability in fixed regimes and imperfect capital mobility. This finding further reflects the so-called 'German-dominance hypothesis' (GDH) to capture the fact that nations in Europe largely follow Germany in setting their interest rates, and hence are susceptible to loss of monetary policy freedom.

Cheung et al. (2008) explore the links between exchange rate regimes and monetary policy independence for China, a nation characterised with a fixed type arrangement. Using monthly data on China's interbank interest rates and the US Federal funds rate from February 1996–April 2006, and employing the VAR and PSS methods, the authors do not find any evidence of US interest rates affecting that of China's. This finding while not supportive of the trilemma can be reconciled by the explicit use of capital controls and sterilisation measures, which enables China to preserve monetary policy

independence. However, as a benchmark of comparison the authors do find Hong Kong's interest rates to be affected by US rates.[4]

Clearly, a synthesis of these seminal studies provides differing results on the issue of monetary policy independence, much like the theoretical arguments. This provides an added incentive to revisit the issue after the turn of the millennium.

3 Methodology and data

I measure monetary policy sovereignty (or lack of it) by the observed co-movement of the short-term nominal interest rate of a nation with that of a base-country.[5] Nominal interest rates are the typical instrument of central banks. Real interest rates may not be equal across two nations even under a credibly fixed exchange rate regime and free capital mobility, thus providing no strong theoretical predictions that interest rate pass-through would be different under fixed and non-fixed regimes (see Obstfeld et al., 2005).

The theoretical foundation for estimation of monetary policy independence is the uncovered interest rate parity condition.

$$r_i = r_j + E[e_{t+1} - e_t] + \rho \tag{1}$$

where r_i denotes interest of home country i, r_j is the interest rate of base country j, $E[e_{t+1} - e_t]$ represents expected changes in exchange rates, and ρ the risk premium.

Monetary policy independence is the ability of a nation to set its nominal interest rate. However, in the long-run such ability might be a reflection of that nation's ability to choose a different long-run inflation rate compared to the base country. I disentangle this factor by using the inflation rate differential between the home and base country. Moreover, risk premium might reflect overall economic activity instability, which may be highly correlated with the inflation rate. Currency premium may reflect fear of depreciation, which in turn would also reflect in inflation differentials. Thus, both these risk premia can be proxied by inflation differential between the home and the base nation (see Frankel et al., 2004).[6]

3.1 Estimation model

I use annual data on short-term nominal interest from 1999 to 2011 and pool nations into two panels of fixed and non-fixed regime episodes. Annual data are most appropriate under panel framework as it minimises international asymmetries caused by different short-term dynamic adjustment patterns to foreign interest rate changes. Further, the response to a change in the foreign interest rate may not be immediate and may vary across countries, so the results on the pooled sample using monthly data are quite uninformative.

However, using data in levels form raises questions of stationarity and hence spurious regressions. The typical unit root tests are ill-known for their inability to distinguish between a unit root process from a persistent but stationary one. In general, nominal interest rates have a lower limit of zero and do not in practicality have an upper limit of infinity. So they are more likely not pure unit roots, but rather appear to be like unit roots in finite samples. I use interest rates in first differenced form that removes problems of both serial correlation and report robust standard errors to correct for possible

heteroskedasticity that could be present in the panel.[7] I refrain from using country-fixed effects as such an effect would assume a constant rate of change in the interest rate for an individual country, which is highly implausible (see Obstfeld et al., 2004, 2005; Shambaugh, 2004) for a similar treatment).

$$\Delta R_{it} = \beta_1 + \beta_2 \Delta R_{jt} + \beta_3, {}_i Z_{it} + e_{it} \quad (2)^8$$

where i = home country, j = base nation. Z_{it} is a vector of control variables that includes inflation differential with base country, capital openness, trade intensity, financial depth and international reserves-to-imports ratio.

If β_2 is greater for fixed regimes than non-fixed regime nations that is evidence of the constraints posited by the trilemma. On the other hand, if β_2 is either lower or not significantly different for the two groups, it is supportive of the fear of floating hypothesis.

3.2 Data description

The interest rate that is most favourable in such empirical analysis is one that is most likely to be set in a market related manner. The official or policy rates are deemed less suitable for this purpose because these rates change only infrequently (see inter alia Obstfeld et al., 2004; Cheung et al., 2008). I use either the money-market or 3-month Treasury-bill rate. I use the series for which data are available for a longer time period with T-bill rates the default one if both rates are available for the entire sample period.[9]

The base country is defined as the country with which a home country's monetary policy is most closely linked or the one used as the anchor currency in the case of fixed regimes, as in Shambaugh (2004). For nations outside his analysis, I assign the base countries based on IMF's *Annual Report on Exchange rate Arrangements and Exchange Restrictions* (AREAER). Table A1 in Appendix provides the details of the data sample.

Exchange rate regime classification for each country-period is based on the information provided in *AREAER*.[10] The IMF's regime categorisation covers eight categories till 2007. I treat no separate legal tender, currency board and conventional fixed pegs under the fixed exchange rate regime category; pegged regimes within horizontal bands, crawling pegs and crawling bands under intermediate regimes; and finally both managed floating with no predetermined band and independently floating under floating regimes. From 2008 onwards the IMF introduced three new categories: stabilised arrangements, pegged-exchange rates with horizontal bands, and other managed arrangements that I club under the intermediate category. Managed floating and independently floating were further renamed by the IMF as floating and free floating, respectively, that I aggregate under floating regimes. Table 1 shows the distribution of exchange rate regime classification for the years 1999, 2005 and 2011, respectively. At the beginning and middle of the sample period the polar regimes of fixed and floating dominate with fewer cases of intermediate regimes. But for the last year in the sample the distribution is very symmetric across the three categories. Clearly, there is a convergence towards intermediate regimes, something that was considered to be vulnerable to currency crises in the early 1990s.[11]

Table 1 Distribution of exchange rate regimes

	1999	*2005*	*2011*
Floating regimes	59	65	49
Intermediate regimes	15	8	42
Fixed regimes	57	60	42
Number of nations	131	133	133

Monetary policy independence is typically contingent on the extent of capital controls. Greater capital account openness should correspond to more pass-through of foreign interest rates and thus lower monetary independence, for a given exchange rate regime. Capital controls are measured using the information in the text of the *AREAER* that is the premier source for de jure measures. I assign a value of 1 if any restrictions are in place in any year in any country, zero otherwise, for each of the 13 categories under capital transactions as well as five other categories to capture exchange-based controls that indirectly affect capital flows (presence of dual exchange rates, bilateral payments arrangements, controls on payments for invisible transactions and current transfers, repatriation and surrender requirements).[12] These 18 categories are then averaged for each year to construct the capital controls index, very similar to Miniane (2004) who covers 14 categories. A higher value of the index implies more capital restrictions.[13] Thus, one minus the capital controls index will measure capital account openness. Table 2 shows the average capital openness across regime types over the time period. Overall trend is that nations with both floating and intermediate regimes have greater capital openness than pegs.

Table 2 Capital account openness across regime types

	1999	*2005*	*2011*
Floating	0.447	0.466	0.495
Intermediate	0.510	0.659	0.418
Fixed	0.361	0.399	0.361

The co-movement of interest rates may be driven by common shocks and not just the exchange rate regime per se. Countries that trade more with their base nation may follow the base interest rate more tightly. I measure trade intensity by sum of country *i*'s exports and imports with base nation *j*, relative to that with the world. All trade data are sourced from IMF's *Direction of Trade Statistics Database* (DOTS). Further, nations with less developed financial markets lack in short-term financial instruments to purse open market operations and are more likely to follow the base country's interest rates. I control for the level of financial development or depth by the ratio of quasi-money to money in an economy. The former is the difference between M2 and M1 in circulation. Finally, the last few years have seen rapid accumulation of foreign exchange reserves by nations. Aizenman et al. (2010) argue that holding massive amounts of foreign exchange reserves allows a relaxation of the trilemma. I control for this by using the share of international reserves-to-imports where total reserves minus gold data are sourced from *IFS*. Table A2 in Appendix provides a summary statistics of the variables.

4 Results

4.1 Pooled first-differenced results

Results for equation (2) are presented in Table 3(a). For the pooled data covering the entire sample, I find a positive and significant IRPT of 19%. For the fixed-regime country period episodes the coefficient of β_2 is higher at 37%. The coefficients for both intermediate and floating regimes are not significantly different from zero. When I combine the latter two regime categories into the broader non-fixed one, the coefficient of base interest rate change is still statistically insignificant.[14] The results using the different control variables were unchanged.

Next, I examine the impact of the other potential issues on monetary autonomy more explicitly by using several interaction terms (Table 3(b)).

$$\Delta R_{it} = \beta_1 + \beta_2 \Delta R_{jt} + \beta_3 (Fix_{it} * \Delta R_{jt}) + \beta_{4,i} Z_{it} + e_{it} \quad (3)$$

where Fix_{it} is a dummy variable with a value of one for fixed regime episodes in any given year. This allows examining differences in the response of home interest rates to changes in the base across exchange rate regime-type. A significant β_2 coefficient implies evidence of fear of floating or common shocks. On the other hand, an insignificant coefficient of β_2 but a significant and higher coefficient of β_3 would reflect the monetary constraints due to fixing.

Regs 1 and 2 provide support of the trilemma. The higher value of β_3 implies countries with fixed regimes respond more to changes in base interest rates relative to non-fixed regime nations. I next introduce the term *tradeintensity*$*\Delta R_{jt}$ in Reg 3. This does little to the overall relationship and β_3 is again significant with a value of 0.26 while β_2 is insignificant. I do not find any significant role of capital openness in the interest rate transmission process. This openness index is derived from the institutional measure of capital controls. The rapid process of financial innovation is more likely to have reduced the effectiveness of such controls in influencing monetary independence. As an alternate measure of capital openness I used the sum of the absolute values of inward and outward flows of capital (both foreign direct and portfolio investments) as a share of GDP from IMF's *International Financial Statistics* database (lines 78bdd, 78bed, 78bfd, 78bgd, 78bhd, and 78bid). This measure was also insignificant.[15]

Then, I use an interaction term between financial development and changes in base interest rate. Its coefficient is negative albeit insignificant. In this specification (Reg 4) both β_2 and β_3 are positive and significant with a higher coefficient of the latter providing support towards the trilemma's predictions. Finally, I introduce an interaction term between reserves-to-imports ratio, Fix_{it} and ΔR_{jt}. If holding huge amounts of foreign exchange reserves allows countries to avoid the trilemma then the coefficient of this term should be negative and significant while that for β_2 should be positive and significant suggesting no systematic difference in monetary autonomy across regime types. The coefficient of reserves$*Fix_{it}*\Delta R_{jt}$ is negative but insignificant while ΔR_{jt} is significant and holds its positive sign (Reg 5).

In general, the results presented in Table 3 are supportive of the trilemma. It is also apparent that loss of monetary independence is not complete for fixed regimes.

Table 3(a) Pooled first-differenced results

	Pooled results	*Intermediate results*	*Floating results*	*Non-fixed results*	*Fixed results*
c	*–0.004***	*–0.007***	*–0.008***	*–0.008***	0.000
	(–3.53)	(–3.15)	(–4.15)	(–4.83)	(0.02)
ΔR_{jt}	*0.189***	–0.071	0.097	0.060	*0.374***
	(2.81)	(–0.41)	(1.03)	(0.73)	(3.21)
R^2	0.005	0.001	0.001	0.001	0.022
N	1618	215	706	1002	608

Terms in brackets denote *t*-stat based on robust standard errors. *, **,*** indicates significance at the 10%, 5%, 1% level.

Table 3(b) Pooled first-differenced results with interaction terms

	Reg 1	*Reg 2*	*Reg 3*	*Reg 4*	*Reg 5*
c	*–0.004***	–0.002	–0.002	*–0.004***	*–0.005***
	(–3.896)	(–1.028)	(–1.027)	(–3.65)	(–4.843)
ΔR_{jt}	*0.117**	0.102	0.143	*0.139**	*0.143***
	(1.636)	(1.265)	(1.235)	(1.669)	(2.096)
$Fix_{it}*\Delta R_{jt}$	*0.211**	*0.237**	*0.262**	*0.219**	
	(1.689)	(1.698)	(1.649)	(1.66)	
$KAOpen*\Delta R_{jt}$		–0.255	–0.229		
		(–1.07)	(–0.926)		
$Tradeintensity*\Delta R_{jt}$			–0.209		
			(–0.545)		
$FinDev*\Delta Rjt$				–0.015	
				(–0.646)	
$Reserves*Fix_{it}*\Delta R_{jt}$					–0.004
					(–0.202)
R^2	0.006	0.007	0.007	0.006	0.003
N	1614	1485	1457	1554	1550
F-stat	4.85*	3.34**	2.319*	3.078**	2.335*
D-W	2.066	1.928	1.938	1.985	2.268

Terms in brackets denote *t*-stat based on robust standard errors. *, **,*** indicates significance at the 10%, 5%, 1% level. *KAOpen* is Capital Account Openness.

4.2 Country-specific analysis

I next perform regressions on individual countries that are either pure floats or hard pegs across the entire sample period and not characterised by switches in regimes.[16]

In light of the earlier discussed problems with unit root tests on interest rates, I use the methodology developed by Pesaran et al. (2001) that is employed widely in this strand of literature. This methodology allows for not only testing the existence of a levels relationship between interest rates, but simultaneously examines the dynamics of the adjustments of individual countries. I adopt the following specification in employing the PSS test,

$$\Delta R_{i,t} = \theta(c + R_{i,t-1} - \gamma R_{j,t-1}) + \beta_1 \Delta R_{j,t} + \sum_{j=1}^{p-1} \beta_{2,j} \Delta R_{i,t-j} + \sum_{j=0}^{p-1} \beta_{3,j} \Delta R_{j,t-j} + \beta_{4,i} Z_{i,t} + u_{i,t} \quad (4)$$

Z_{it} is a vector of same control variables used in equation (2) excepting capital control for which there is not data of monthly frequency. In essence, this methodology is similar to an error correction model. But the advantage of the former is that it does not require the time series to be either $I(1)$ or $I(0)$, while the latter requires the variables to be $I(0)$. One can examine the presence of a levels relationship between interest rates without necessarily assuming their order of integration, based on the t-statistic of θ and the critical values provided by PSS (2001). Thus if the test statistic either surpasses both critical values or falls short of both critical values, one can reject the null of no levels relationship between interest rates or not, without having to take a stand on the order of integration. The speed of adjustment towards a cointegrating relationship is captured by a statistically significant coefficient θ along with a negative sign. The larger the absolute value of θ is, the faster the adjustment with $\theta = -0.5$ implying a half-life of one month. The coefficient of ΔR_{jt} (β_1) would capture the extent of monetary autonomy. A higher value of this IRPT elasticity, β_1, implies lower monetary sovereignty. The levels relationship is based on the cointegrating coefficient γ. For nations with fixed regimes, I expect γ to approach unity along with higher values for both θ (and hence lower half-lives) and β_1, compared to their counterparts for floaters. Table 4 summarises the results.

Comparing the t-statistic of θ with the 95% critical values for $I(0)$ and $I(1)$ series provided by PSS (2001), I fail to reject the null hypothesis of no levels relationship for all 14 floaters. The θ coefficient itself is negative and significant for all 14 floaters with an average value of –0.07, suggesting the speed of adjustment towards the long-run relationship to be rather slow. The corresponding half-lives range from 19 months for South Africa to five months in the case of the UK. IRPT elasticity, β_1, is only significant in 6 out of the 14 cases, with the UK exhibiting complete monetary dependence on euro zone money market rates, while Sweden, Switzerland, Canada and New Zealand also showing sufficient loss of monetary autonomy. On the other hand, known floaters like Japan, Australia, EMU-nations etc. exhibit complete monetary sovereignty. These results add to the recent research that has been mixed regarding whether any economy outside the few largest actually has monetary freedom.

Turning to the hard pegs, I find the θ coefficient to be negative and significant in 14 out of the 15 cases, with a higher average value of –0.193, and hence lower half-lives. If one assumes the data are $I(0)$, Hong Kong and Latvia reject the null of no levels relationship at 95% confidence. Interestingly, for Hong Kong the value of γ is 1.101, suggesting complete monetary dependence, while that for Latvia is 0.52. The results for Latvia lend some support to its recent decision of joining the euro zone. Furthermore, for hard pegs, the speed of adjustment towards the long-run relationship (θ), as well as the response to a shock in foreign interest rates (β_1) happens more quickly, indicative of more monetary dependence with the base nation's interest rates. Pointedly, the β_1 coefficient is positive and significant for 11 out of the 15 nations, with Lithuania also showing full IRPT and complete dependence on the base nation's interest rates. Dollar-peggers in the Middle East like Bahrain and Oman show significant monetary dependence on US interest rates. The same applies for the African nations of Lesotho and Swaziland whose currencies are fixed with the South African rand, and for the mountain state of Nepal fixed with the Indian rupee.

Table 4(a) PSS results for floating regimes[a]

	θ	θ-tstat	Sig at I(0)	Sig at I(1)	θ*γ	γ	β	β-tstat	Half-life
Australia	–0.04*	–1.950	Fail to reject null	Fail to reject null	0.015	0.382	0.191	1.540	17.058
Brazil	–0.076*	–1.735	Fail to reject null	Fail to reject null	0.016	0.214	0.241	0.855	8.768
Canada	–0.065**	–2.087	Fail to reject null	Fail to reject null	0.055	0.835	0.62***	4.629	10.256
Chile	–0.188**	–2.746	Fail to reject null	Fail to reject null	0.158	0.839	–0.868*	–1.683	3.327
Czech Republic	–0.067***	–4.933	Fail to reject null	Fail to reject null	0.055	0.820	0.139	1.430	10.065
Euro area	–0.028*	–1.735	Fail to reject null	Fail to reject null	0.026	0.926	0.199	1.635	24.434
Japan	–0.047*	–1.740	Fail to reject null	Fail to reject null	0.007	0.141	0.053	1.326	14.500
Korea	–0.041***	–2.781	Fail to reject null	Fail to reject null	0.018	0.441	0.104	1.460	16.410
Mexico	–0.086***	–3.455	Fail to reject null	Fail to reject null	0.095	1.114	0.261	1.046	7.741
New Zealand	–0.043**	–2.304	Fail to reject null	Fail to reject null	0.076	1.784	0.658***	4.066	15.853
South Africa	–0.036**	–2.405	Fail to reject null	Fail to reject null	0.025	0.696	0.066	0.562	18.986
Sweden	–0.045**	–2.216	Fail to reject null	Fail to reject null	0.038	0.840	0.423***	3.643	15.102
Switzerland	–0.072*	–1.700	Fail to reject null	Fail to reject null	0.035	0.490	0.6***	2.533	9.226
United Kingdom	–0.12**	–2.304	Fail to reject null	Fail to reject null	0.101	0.841	1.494***	4.421	5.438

[a]Data are from 1999M1-2011M12. *, **,*** indicates significance at the 10%, 5%, 1% level.

Table 4(b) PSS results for fixed regimes[b]

	θ	θ-tstat	S	γ	β	β-tstat	Half-life
Bahrain	–0.152***	–2.946	Fail	0.918	0.411**	2.392	4.191
Barbados	–0.042*	–1.660	Fail	0.194	0.321***	3.101	15.964
Benin	–0.054	–1.333	Fail	0.354	0.117	1.296	12.536
Bulgaria	–0.308***	–3.504	Fail	0.986	0.174	0.399	1.882
Estonia	–0.040	–1.470	Fail	2.347	0.192	0.853	17.106
Hong Kong	–0.328***	–5.203	F	1.017	0.986***	5.206	1.742
Jordan	–0.217***	–2.647	Fail	0.513	0.343*	1.644	2.832
Latvia	–0.596***	–5.286	F	0.517	–0.492	–0.596	0.765
Lesotho	–0.161***	–4.322	Fail	0.951	0.431***	4.524	3.956
Lithuania	–0.25**	–2.313	Fail	0.883	1.103*	1.764	2.405
Morocco	–0.111***	–3.166	Fail	0.133	0.395**	2.201	5.887
Nepal	–0.136***	–2.992	Fail	–0.162	0.301**	2.040	4.741
Oman	–0.245**	–2.101	Fail	0.564	0.635***	3.432	2.462
Qatar	–0.105***	–2.986	Fail	0.533	0.446	1.405	6.236
Swaziland	–0.15***	–3.006	Fail	0.743	0.492***	3.194	4.259

[b]Data for Estonia are till 2010M10. For Oman and Q… significance at the 10%, 5%, 1% level.

The average IRPT elasticity for nations with significant β_1 under floating regimes is 49%, compared to that of 53% for hard pegs. The results suggest that monetary independence is higher for floaters than for hard pegs, supporting the trilemma's predictions, and consistent with the earlier findings using pooled cross-sectional data.

However, these results need to be interpreted with guarded caution. Although, the IRPT elasticity for hard pegs is higher than for pure floats, such difference is only marginal. There is sufficient closeness in the extent of monetary independence across the two regimes. This is best illustrated for three non-euro zone European nations – Sweden, Switzerland and UK, who are not insulated from changes in euro zone short-term interest rates. Their results are reminiscent of the erstwhile German-dominance-hypothesis syndrome found in the earlier literature. Likewise, Canada and New Zealand allow sufficient transmission of changes in interest rates of their immediate neighbours, the USA and Australia, respectively. The findings for these advanced nations with flexible regimes add to the recent credence that increasing financial integration in combination with converging inflation rates and the pursuit of similar nominal stability targets in most industrialised countries, may constrain monetary policy as much as an explicit currency peg.

4.2.1 Error correction model estimation

For further robustness tests on the aforementioned results, I used an error correction model. The ECM term is the lagged residual of the least squares regression in levels from. If there is indeed a causal relationship between the home and base interest rates, ECM would reveal the dynamics of such a relationship.

$$\Delta R_{i,t} = c_0 + c_1 (ECM)_{t-1} + \sum_{j=1}^{p-1} c_{2,j} \Delta R_{i,t-j} + \sum_{j=0}^{p-1} c_{3,j} \Delta R_{j,t-j} + c_{4,i} Z_{i,t} + \varepsilon_t \quad (5)$$

The presence of a cointegrating relationship would be captured by a statistically significant coefficient c_1 along with a negative sign. Moreover, if a nation has lower monetary policy autonomy, the absolute value of c_1 should be rather large. Again, the coefficient of $\Delta R_{j,t}$ (c_3) would capture the extent of monetary autonomy.

Results shown in Table 5 mirror similar findings. The error correction coefficient, c_1, is negative and significant for 13 out of 14 floaters with an average value of –0.072, suggesting the speed of adjustment towards the long-run relationship is again rather slow. As a consequence the corresponding half-lives are also higher with an average value of 11.7 months. For hard pegs c_1 is negative and significant in 14 out of the 15 cases, with an average value of –0.20, and a corresponding average half-life of 5.44 months. Notably, the IRPT-elasticity is now significant at 44% for Qatar, another oil exporting US dollar-pegger.

The IRPT elasticity is significant for 7 out of the 14 floaters with an average value of 48%. For hard pegs, IRPT is significant for 12 out of 15 nations with an average value of 51%.

Table 5(a) ECM Results for floating regimes

	θ	*θ-tstat*	*β*	*β-tstat*	*Half-life*
Australia	*–0.04**	–1.976	0.187	1.511	16.941
Brazil	*–0.117***	–2.089	0.636	1.648	5.587
Canada	*–0.066***	–2.118	*0.615****	4.622	10.188
Chile	*–0.188****	–2.774	*–0.873**	–1.710	3.324
Czech Republic	*–0.066****	–4.966	0.143	1.472	10.160
Euro area	*–0.029**	–1.943	0.164	1.407	23.744
Japan	–0.049	–1.631	0.050	1.326	13.888
Korea	*–0.042****	–2.784	0.102	1.432	16.345
Mexico	*–0.084****	–3.239	0.267	1.027	7.932
New Zealand	*–0.043***	–2.283	*0.652****	4.098	15.861
South Africa	*–0.049****	–2.806	0.031	0.248	13.884
Sweden	*–0.045***	–2.224	*0.422****	3.680	15.137
Switzerland	*–0.074**	–1.685	*0.597****	2.478	9.064
UK	*–0.092***	–2.014	*1.573****	3.969	7.204

*, **,*** indicates significance at the 10%, 5%, 1% level.

Table 5(b) ECM results for fixed regimes

	θ	*θ-tstat*	*β*	*β-tstat*	*Half-life*
Bahrain	*–0.153****	–3.102	*0.415***	2.404	4.184
Barbados	*–0.053**	–1.982	*0.264****	2.790	12.818
Benin	*–0.111**	–1.869	0.102	1.238	5.902
Bulgaria	*–0.31****	–3.531	0.174	0.386	1.867
Estonia	–0.030	–1.117	*0.393**	1.736	22.396
Hong Kong	*–0.309****	–4.766	*0.969****	5.076	1.875
Jordan	*–0.246****	–2.841	0.332*	1.706	2.452
Latvia	*–0.595****	–5.389	–0.449	–0.555	0.767
Lesotho	*–0.162****	–4.444	*0.421****	4.310	3.934
Lithuania	*–0.25***	–2.320	*1.102**	1.780	2.406
Morocco	*–0.111****	–3.241	*0.357***	2.020	5.873
Nepal	*–0.099***	–2.395	*0.281***	2.382	6.657
Oman	*–0.246***	–2.107	*0.635****	3.431	2.455
Qatar	*–0.105***	–2.325	*0.444**	2.091	6.235
Swaziland	*–0.151****	–3.109	*0.482****	2.995	4.230

*, **,*** indicates significance at the 10%, 5%, 1% level.

5 Implications of the three trilemma cornerstones on economic performance

Finally, I examine the macroeconomic consequences of the three facets of the trilemma. These are issues that are of paramount interest for policymakers in any nation.

To answer these, I first obtain the time varying IRPT elasticity ($\hat{\beta}_2$) using the recursive least squares method on the first specification of Table 2(a). A higher value of $\hat{\beta}_2$ implies higher monetary dependence. I regress $\hat{\beta}_2$ and the other trilemma variables along with relevant controls as regressors on output and inflation volatilities, and the inflation rate, respectively. A positive coefficient of $\hat{\beta}_2$ implies more monetary dependence increases macroeconomic instability, i.e., there is an inverse relationship between monetary autonomy and output or inflation volatility. Restrictions on cross-border capital flows are measured by the *AREAER* capital controls index used earlier with a positive coefficient of the index implying greater financial or capital liberalisation reduces economic instability. Exchange rate regimes are captured by a fixed-dummy that has a value of one for any country in a given year with a fixed regime, and zero otherwise. A positive coefficient implies the movement from a non-fixed regime towards a fixed regime to increase economic instability. The final estimation equation is:

$$y_t = \delta' x_t \tag{6}$$

where $x_t = [\hat{\beta}_2$, capital controls index, fixed-regime dummy, real shocks, nominal shocks, external debt-to-GDP ratios, money supply growth, government expenditure growth, international reserves-to-imports ratios, financial development]; $y_t = [GDP$ *volatility, inflation rate, inflation volatility*]. Volatilities are measured using 5-years moving standard deviation.

To proxy the risk of currency crises I use the ratio of Total reserves minus gold to imports of a nation. Financial development or financial depth is measured by the ratio of quasi-money to money in an economy, where the null hypothesis is that higher financial development lowers macroeconomic instability. Real and nominal shocks are measured by the volatilities of government spending over GDP and M2 growth, respectively. Again, both measure proxy volatility by 5-years moving standard deviation. Data on these variables are taken from the World Bank's *World Development Indicators*. Table 6 shows the results.

I find a positive and significant effect of IRPT on both output and inflation volatilities. This suggests greater monetary independence lowers macroeconomic instability. If the primary objective of central banks is to promote price stability, the finding for inflation volatility is clearly indicative that greater independence in conduit of monetary policy clearly strengthens such a cause. Turning to the other tenets of the trilemma, the fixed regime dummy is insignificant for output volatility but is positively significant for inflation volatility. The latter result supports the role of flexible-type regimes as shock absorbers and to promote macroeconomic stability. Likewise, higher capital account openness lowers both output and inflation volatilities. This finding should provide comfort to those who fear financial liberalisation increase macroeconomic instability. Higher external debt-to-GDP ratio increases macroeconomic instability while greater financial development significantly lowers output volatility but is insignificant in affecting inflation volatility. Both real and nominal shocks significantly increase output volatility. Nominal shocks also increase inflation volatility. Higher reserves-to-imports ratio lowers both output and inflation volatilities supporting its precautionary role in promoting macroeconomic stability.[17]

Table 6 Effect of trilemma variables on macroeconomic outcomes

	Output volatility			*Inflation volatility*			*Inflation*		
	Spec. 1	*Spec. 2*	*Spec. 3*	*Spec. 1*	*Spec. 2*	*Spec. 3*	*Spec. 1*	*Spec. 2*	*Spec. 3*
Interest-rate pass-through	*0.142***	*0.111***	*0.111***	*0.658***	*0.616***	*0.637***	*0.962***	0.495	0.501
	(7.58)	(6.073)	(6.037)	(3.564)	(3.404)	(3.462)	(2.684)	(1.349)	(1.345)
Volatility of G-to-GDP ratio	*0.003***	*0.002***	*0.002**	–0.018	–0.014	–0.017			
	(2.269)	(1.93)	(1.974)	(–1.36)	(–1.101)	(–1.319)			
Real GDP-PPP growth							0.007	–0.001	0.008
							(1.098)	(–0.748)	(1.075)
Volatility of M2 growth	*0.000**	0.000	0.000	*0.008****	*0.007****	*0.008****			
	(1.858)	(1.566)	(1.534)	(6.405)	(5.417)	(6.455)			
ΔM							*0.014****	*0.013****	*0.013****
							(6.027)	(5.894)	(5.89)
ΔG							–0.001	–0.001	–0.001
							(–0.622)	(–0.748)	(–0.862)
Trade openness							–0.019	–0.036	–0.006
							(–0.156)	(–0.275)	–(0.043)
Fixed regime dummy	0.003		–0.001	*0.155****		*0.149****	*–0.047**		*–0.112**
	(1.267)		(–0.563)	(5.994)		(5.681)	(–1.827)		(–1.906)

Table 6 Effect of trilemma variables on macroeconomic outcomes (continued)

	Output volatility			*Inflation volatility*			*Inflation*		
	Spec. 1	*Spec. 2*	*Spec. 3*	*Spec. 1*	*Spec. 2*	*Spec. 3*	*Spec. 1*	*Spec. 2*	*Spec. 3*
Capital controls index		*0.026****	*0.026****		*0.113***	*0.048**		*0.362****	*0.44****
		(5.701)	(5.758)		(2.157)	(1.92)		(3.419)	(3. 941)
Reserves-to-imports ratio	*–0.002***	–0.001	0.000	*–0.013****	–0.005	*–0.011**			
	(–2.098)	(–0.656)	(–0.574)	(–2.544)	(–0.865)	(–1.732)			
External debt-to-GDP ratio	*0.013****	*0.012****	*0.012****	*0.203****	*0.21****	*0.200****			
	(3.36)	(3.049)	(3.067)	(4.521)	(4.739)	(4.606)			
Financial development	*–0.001***	*–0.001****	*–0.001****	0.004	–0.002	0.003			
	(–2.236)	(–3.355)	(–3.357)	(0.413)	(–0.205)	(0.364)			
$\pi_{(t-1)}$							*0.567****	*0.538****	*0.533****
							(17.367)	(15.384)	(15.231)
R^2	0.38	0.2	0.1	0.141	0.114	0.141	0.364	0.376	0.372
N	1020	1019	1019	998	997	997	1039	984	984

Terms in brackets denote t-stat. *, **,*** indicates significance at the 10%, 5%, 1% level.

Finally, moving to the effect on inflation rates, the trilemma variables are supplemented with trade openness, money supply and government expenditure growth rates and past inflation to control for their possible influences on inflation. I find higher monetary independence to lower inflation in the first specification, while IRPT elasticity is positive albeit insignificant in the latter two cases. The fixed-regime dummy is negative underscoring the explicit commitment mechanism that a fixed regime provides to curb inflation. Capital controls is positively significant, suggesting greater financial liberalisation disciplines monetary policymaking by central banks and hence lowers inflation. Money supply growth significantly raises inflation rates supporting the age old adage that inflation is a monetary phenomenon. However, trade openness, both real GDP and government expenditure growths are found to be insignificant. Lastly, the lagged inflation term is positively significant capturing inflation inertia.[18]

6 Conclusions

The global economy has recently suffered from economic hardships with strong contagious effects felt from one nation to another. In this economic backdrop, this study examines the predictions of the open-economy policy trilemma from 1999 to 2011 for 133 nations.

Using pooled cross-sectional data of annual frequency I find monetary policy independence to be higher for nations with non-fixed regimes compared to ones with fixed regimes. Similar findings are mirrored when I use monthly data and employ several time-series techniques for individual nations with either fixed or floating regimes. However, the extent of greater monetary independence for floaters is only marginal. This underscores the fact that monetary policy (in) dependence is not of extreme magnitudes. Pegs are rarely completely constrained because of exchange rate bands and, impediments to capital flows. At the same time, I do note some pure floaters choosing to follow the base interest rate to substantial degrees. As such there is sufficient closeness in the extent of monetary independence across regime-types. Overall, my findings support earlier studies that have espoused that countries that claim to float in fact display a fear of floating behaviour. Furthermore, I do not find any significant role of capital openness in influencing monetary autonomy.

Finally, I investigate the economic consequences of the three cornerstones of the trilemma, and find higher monetary independence, greater capital account openness as well as a more flexible-type regime to promote overall macroeconomic stability. The message of the paper is not to advocate a particular type of exchange rate regime or extent of capital openness over another. It is also acknowledged that the optimal trilemma mix would be country-specific. The findings suggest, the trilemma configurations of higher monetary independence along with both greater financial liberalisation and a more flexible regime would minimise gyrations in both output and price levels.

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Notes

[1]The rationale behind the trilemma is as follows: let us suppose that the interest rates in the US rise. This will cause investors in say, Mexico to move funds out of there as they seek higher returns on their investments in the USA. This capital outflow from Mexico puts pressure on its exchange rate to change as investors demand more dollars. Now if Mexico had a fixed exchange rate regime its central bank would provide these dollars to keep it unchanged. This would deplete Mexico's foreign exchange reserves (stock of dollars, here) and lead to a decline in its level of money, which in turn raises Mexico's interest rates. Money stock and interest rates are inversely related, and foreign exchange reserves are a component of the former. Thus a rise in US interest rates causes a corresponding rise in interest rates of Mexico and hence a loss of the latter's monetary policy sovereignty. If on the other hand, Mexico had a floating exchange rate regime, then its currency (the peso) would change and absorb the rise in US interest rates and keep its interest rate unchanged. So, in this scenario Mexico retains its monetary policy autonomy.

[2]Of course, loss of monetary policy independence is not necessarily a bad outcome. If a country, has not conducted monetary policy in a responsible manner, by 'importing' policy (and hence credibility) of another nation, it can reap certain beneficial outcomes like lowering its inflation rate.

[3]Moreover, pooling the sample across eras the authors find more interest rate pass-through for pegs (43%) vs. non-pegs (26%). Further, nations with pegs and no capital controls have least monetary autonomy while on the other spectrum while those with floating and capital controls retain most autonomy.

[4]Other recent studies that have examined the extent interest rate pass-through include those of Bista *et al.* (2012) for the EU, Ghosh and Ghosh (2012) on India, Jayaraman and Dahalan (2008) on Samoa and Moreira *et al.* (2014) on Brazil.

[5]Other older approaches used in the literature to measure monetary independence includes the response of exchange rates to shocks in monetary aggregates (Rose, 1996); central bank reaction functions (Clarida *et al.*, 2000) or using target-zone models (Svensson, 1994).

[6]Of course there could be other forms of risk like political or institutional that might affect interest rates. For a recent study on the role of financial and political risk premium on stock market performance, see Asteriou (2008).

[7]First-differencing removes any constant risk-premium or expected depreciation from the data, and thus minimises the role of inflation differential.

[8]I use $R = \log(1 + r)$ as interest rates where 10% is expressed as 0.10. This shrinks the role of outliers.

[9]If a given country, say *i*, uses money market rates then I use the same for the base. But if another nation, say *j*, is pegged to the same base but uses Treasury bills rates then I use that for the base nation. For a few nations I use deposit rates when either money market or T-bill rates were not available.

[10]Since 1998, the IMF's classification methodology has shifted to compiling more factual regimes of countries as determined by the Fund based on various sources, including information from their staff, press reports, other relevant papers, as well as the behaviour of bilateral nominal exchange rates and international reserves. The change reflects the Fund's efforts to keep its regime nomenclature in line with the actual exchange rate policies of nations.

[11]The increase in intermediate regimes reflects the change in IMF's regime classification that was primarily motivated by a surge in the number of countries more actively managing their exchange rates in recent years by using increasingly complex intervention practices. This helps to limit movements in their currency, especially from sharp depreciations, which can pose inflationary problems, raise the costs of imports or increase their burden of foreign currency-denominated debt.

[12]The 13 categories include controls on capital market securities, money market instruments, collective investment securities, derivatives and other securities, commercial credits, financial credits; guarantees, sureties, and financial backup facilities; controls on direct investment, liquidation of direct investment, real estate transactions, personal capital transactions, commercial banks and other credit institutions, and finally controls on institutional investors.

[13]A caveat is of the order here. While the *AREAER*'s capital controls measure provides the broadest country coverage and covers the entire time period of the analysis here, it does not provide the intensity of capital controls or their actual enforcement.

[14]For comparative purposes with the 1990s, Shambaugh (2004) finds the coefficients for his full sample, pegs and non-pegs to be 44%, 56%, and statistically insignificant, respectively.

[15]In a somewhat different but related context, Miniane and Rogers (2007) and Edwards (2010) also do not find any significant role of capital controls in the transmission of US monetary shocks to other nations.

[16]The countries I use in the sample of floaters are: Australia, Brazil, Canada, Chile, Czech Republic, euro area, Japan, Korea, Mexico, New Zealand, South Africa, Sweden, Switzerland, and the UK. The hard pegs consist of Bahrain, Barbados, Benin, Bulgaria, Estonia, Hong Kong, Jordan, Latvia, Lesotho, Lithuania, Morocco, Nepal, Oman, Qatar, and Swaziland.

[17]For a comprehensive analysis on the role of exchange rate regimes per se on output volatility spanning the entire post-Bretton Woods period for 169 countries see, Petreski (2010).

[18]The results are robust to the use of rolling estimates in capturing IRPT. Furthermore, I replaced the fixed regime dummy with a more market-based measure. I used the absolute values of the changes in exchange rate per unit of US dollar divided by sum of the changes in itself and foreign exchange reserves. This exchange rate flexibility was found to be negative and significant in affecting both output and inflation volatilities, and was positive and significant in affecting inflation, consistent with the regime dummy results.

Appendix

Table A1 List of countries covered

Home country	*Base country*	*Interest rate used*
Afghanistan	USA	Money market
Algeria	Euro area	Money market
Antigua and Barbuda	USA	Money market
Argentina	USA	Money market
Armenia	Russia	Money market
Australia	USA	Money market
Azerbaijan	USA	Treasury bill
Bahamas, The	USA	Money market
Kingdom of Bahrain	USA	Money market
Bangladesh	USA	Deposit
Barbados	USA	Treasury bill
Belarus	Euro area	Deposit
Belize	USA	Money market
Benin	Euro area	Money market
Bhutan	India	Deposit
Bolivia	USA	Money market
Bosnia and Herzegovina	Euro area	Deposit
Brazil	USA	Money market
Brunei Darussalam	Japan	Deposit
Bulgaria	Euro area	Money market
Burkina Faso	Euro area	Money market
Cambodia	USA	Deposit
Canada	USA	Money market
Chile	USA	Money market
Hong Kong	USA	Money market
Mainland	USA	Deposit
Colombia	USA	Money market
Costa Rica	USA	Deposit
Cote d'Ivoire	Euro area	Money market
Croatia	Euro area	Money market
Czech Republic	Euro area	Money market
Denmark	Euro area	Money market
Dominica	USA	Money market
Dominican Republic	USA	Money market

Appendix (continued)

Table A1 List of countries covered

Home country	*Base country*	*Interest rate used*
Ecuador	USA	Deposit
Egypt	USA	Treasury bill
El Salvador	USA	Money market
Estonia	Euro area	Money market
Ethiopia	USA	Treasury bill
Euro Area	USA	Money market
Fiji	USA	Money market
Finland	Euro area	Money market
Georgia	USA	Money market
Ghana	USA	Treasury bill
Grenada	USA	Money market
Guatemala	USA	Money market
Guyana	USA	Treasury bill
Haiti	USA	Deposit
Honduras	USA	Deposit
Hungary	Euro area	Treasury bill
Iceland	Euro area	Money market
India	USA	Money market
Indonesia	USA	Money market
Iran Islamic Republic of	USA	Deposit
Iraq	USA	Treasury bill
Israel	USA	Treasury bill
Jamaica	USA	Money market
Japan	USA	Money market
Jordan	USA	Money market
Kazakhstan	USA	Treasury bill
Kenya	USA	Treasury bill
Korea, Republic of	USA	Money market
Kuwait	USA	Money market
Kyrgyz Republic	Russia	Money market
Lao PDR	USA	Treasury bill
Latvia	Euro area	Money market
Lebanon	USA	Treasury bill
Lesotho	South Africa	Treasury bill

Appendix (continued)

Table A1 List of countries covered

Home country	*Base country*	*Interest rate used*
Libya	USA	Deposit
Lithuania	Euro area	Money market
Madagascar	Euro area	Money market
Malawi	USA	Treasury bill
Malaysia	USA	Money market
Maldives	USA	Treasury bill
Mali	Euro area	Money market
Malta	Euro area	Treasury bill
Mauritius	UK	Money market
Mexico	USA	Money market
Mongolia	USA	Deposit
Morocco	Euro area	Money market
Mozambique	USA	Money market
Myanmar	USA	Deposit
Namibia	South Africa	Money market
Nepal	India	Treasury bill
New Zealand	Australia	Money market
Nicaragua	USA	Deposit
Niger	Euro area	Money market
Nigeria	USA	Treasury bill
Norway	Euro area	Money market
Oman	USA	Money market
Pakistan	USA	Money market
Papua New Guinea	USA	Treasury bill
Paraguay	USA	Money market
Peru	USA	Money market
Philippines	USA	Money market
Poland	Euro area	Money market
Qatar	USA	Money market
Romania	Euro area	Money market
Russia	Euro area	Money market
Saudi Arabia	USA	Money market
Senegal	Euro area	Money market
Serbia	Euro area	Money market

Appendix (continued)

Table A1 List of countries covered

Home country	*Base country*	*Interest rate used*
Seychelles	USA	Treasury bill
Sierra Leone	UK	Treasury bill
Singapore	Malaysia	Money market
Slovak Republic	Euro area	Money market
Slovenia	Euro area	Money market
Solomon Islands	USA	Treasury bill
South Africa	USA	Money market
Sri Lanka	India	Money market
St. Kitts and Nevis	USA	Money market
St. Lucia	USA	Money market
St. Vincent & the Grenadines	USA	Money market
Swaziland	South Africa	Money market
Sweden	Euro area	Money market
Switzerland	Euro area	Money market
Syria	USA	Deposit
Tajikistan	USA	Money market
Tanzania	USA	Treasury bill
Thailand	USA	Money market
Timor-Leste	USA	Deposit
Togo	Euro area	Money market
Trinidad and Tobago	USA	Treasury bill
Tunisia	Euro area	Money market
Turkey	USA	Money market
Ukraine	USA	Money market
UK	Euro area	Money market
Uruguay	USA	Money market
Vanuatu	USA	Money market
Venezuela, Republic	USA	Money market
Viet Nam	USA	Treasury bill
Yemen	USA	Treasury bill
Zambia	USA	Treasury bill
Zimbabwe	USA	Treasury bill

Appendix (continued)

Table A2 Summary statistics

	Mean	*Maximum*	*Minimum*	*Std. dev.*	*N*
ΔR_{it}	–0.005	0.421	–0.432	0.044	1618
ΔR_{jt}	–0.004	0.063	–0.179	0.016	1754
Capital openness (1-capital controls)	0.440	1	0	0.284	1603
Capital flows-to-GDP	0.219	10.585	0.0002	0.693	1536
Financial development	2.176	24.563	0.022	2.647	1649
Trade intensity	0.252	4.470	0.000	0.240	1716
Trade openness	0.418	2.95	0.000	0.344	1690
International reserves-to-imports	0.685	34.316	0.016	1.577	1635
Inflation differential	20.116	24408.180	–85.094	596.091	1681
Inflation	22.916	24411.030	–10.067	596.086	1681
Inflation volatility	0.656	3.532	0.004	0.456	1654
Output volatility	0.075	0.468	0.005	0.044	1753
External debt-to-GDP	0.518	2.186	0.021	0.348	1156
Exchange rate flexibility	0.283	0.997	0	0.269	1663
ΔG	4.641	293.590	–57.815	11.948	1283
ΔM	16.887	219.268	–58.172	17.849	1661
Government spending-to-GDP volatility	1.329	19.867	0.040	1.636	1675
M2 growth volatility	11.263	204.126	0.271	14.227	1704