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RESEARCH ARTICLE

Exchange Rate Policy in Small Rich Economies

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Abstract We look at the exchange rate policy choices and outcomes for small rich economies. Small rich economies face significant policy challenges due to proportionately greater economic volatility than larger economies. These economies usually choose some form of fixed exchange rate regime, particularly in the very small economies where the per capita cost of independent monetary policy is relatively high. When such countries do choose a free or managed floating regime, they appear to derive no benefit from those regimes; their exchange rate volatility seems to rise without any significant change in fundamental economic volatility. Thus, for these countries, floating exchange rates seem to create problems for policy makers without solving any.

Keywords Small economies · Exchange rate regimes

JEL codes F33 · E52

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1 Introduction

In the last few years both positive and negative aspects of small economies have come into prominence. Prior to the recent financial crisis, small economies were widely lauded as more successful, flexible and entrepreneurial than larger ones. However, the crisis brought many of these small countries, such as Iceland and the Baltic countries (especially Latvia), into the headlines as suffering more extreme economic hardship. In fact, the experience of small economies both before and during the crisis highlights that their economic advantages (in terms of openness and social cohesion) may be offset by the disadvantage of high exposure to external shocks and the accompanying macroeconomic volatility. It is natural that small countries should be more volatile, since their openness tends to encourage a high degree of specialization. Their lack of regional diversification contributes to volatility, as does the fact that smaller countries may be less able to bear the fixed costs associated with organizing and regulating efficient capital markets that typically provide intertemporal insurance.

In this paper we ask the question "What kind of monetary policy in general and exchange rate policy in particular suits small economies?" In particular, we are interested in whether freely floating exchange rates provide insulation from external shocks for small countries. The answer is not obvious; while a floating exchange rate can in principle be a buffer against foreign shocks, it may also act as an intrinsic source of shocks itself. We attempt to answer this question by looking at the historical experience of the small rich economies, and examining their economic performance under different currency regimes.

We find that small countries mostly choose tightly managed exchange rate regimes (mainly in the form of currency unions and currency boards). We investigate the reasons for this, but are unable to shed much light on the differences between countries that choose to fix their exchange rates and those that adopt more flexible regimes. However, the motivation for small countries choosing to fix is borne out by our empirical analysis, since we find little relationship between fundamental macroeconomic volatility and exchange rate volatility. That is, countries with tightly pegged exchange rates seem to benefit from more stable exchange rates without any significant difference in underlying macroeconomic volatility. So for these economies, a floating exchange rate appears to generate exchange rate volatility without any obvious benefit to the economy. In this sense, tightly fixed exchange rate regimes appear to be something of a free lunch; they deliver lower exchange rate volatility without any obvious negative consequence.

In this paper we are particularly interested in the Icelandic experience. Iceland is a very small and rich economy with strong institutions and a long history of having its own currency that has been managed with a different degree of flexibility, most lately almost freely floating in the run up to the recent financial crisis where it experienced a very serious banking and currency crisis. The Icelandic case therefore provides an interesting case study for our analysis.

2 Preliminaries

2.1 Data Sample

We choose our sample based on two criteria; population and income per head. We include only countries with a population between 30,000 and 3,000,000, as well as real GDP per capita above $11,500 (both measured using 2007 data, the latter based on PPP exchange rates). The size criterion is a little larger than is usually applied to studies of small countries, but is by no means extreme. Most comparable studies focus on countries with populations up to 1.5 or 2 million people, though Kuznets' famous study included countries with populations up to 10 million (Kuznets 1960). Our choice of sample ensures that country size is at most an order of magnitude away from Iceland's population of about 309,000. According to the CIA's "World Factbook" data-set, at the time of this writing (December 2010), the largest of the countries/territories in our sample is Oman, with a population of almost 3 million people, just under ten times Iceland's population, while the smallest country is San Marino (31,500) just over a tenth of Iceland's.

We also restrict ourselves to countries that are relevant for Iceland vis-à-vis income; in practice, our income criterion closely coincides with the World Bank's definition of high income. Unsurprisingly, the CIA data set indicates that our countries also bracket Iceland in terms of real income; annual GDP per capita for members of our sample range from Lichtenstein's $122,000, through Iceland's $40,000, down to Grenada's $11,000. Finally, total annual real GDP varies within our sample from a high of Qatar ($101 billion) which is somewhat less than an order of magnitude larger than Iceland's $12 billion; the low end is St. Kitts and Nevis ($750 million), just over an order of magnitude smaller. We end up with a set of thirty-seven countries and territories; the names are tabulated in Table 1. It is also worth noting that there are a range of specializations in the sample (oil exporters, financial centers, and countries focused on tourism).

We gather an annual data set for this set of countries. A higher frequency data set would be preferable in some respects, but would limit the cross-country dimension considerably, since many of our smaller countries do not collect quarterly observations on the national accounts and other variables of interest to us. We

Table 1 List of countries and territories in sample

Andorra	Antigua	Aruba	Bahamas
Bahrain	Barbados	Bermuda	Brunei
Caymans	Cyprus	Equatorial Guinea	Estonia
Faroe Islands	French Polynesia	Greenland	Grenada
Guam	Guernsey	Iceland	Isle of Man
Jersey	Latvia	Liechtenstein	Luxembourg
Macau	Malta	Mauritius	Netherlands Antilles
New Caledonia	Oman	Qatar	San Marino
Seychelles	Slovenia	St. Kitts & Nevis	St. Lucia
Trinidad & Tobago			

begin our sample in 1970, shortly before the start of the "modern era" of exchange rate regimes that follows the collapse of the Bretton Woods system. We collect data, where available, through 2008 (leaving us with thirty-nine annual observations for each country in most cases).

The data used in this study come from International Financial Institutions namely the UN, IMF and World Bank. In most cases (e.g., end-of-period exchange rates, real and nominal GDP, interest rates, consumer prices, and money) this means the UN National Accounts data base, International Financial Statistics, and World Development Indicators. Other sources are described below. There are, inevitably, a number of gaps in the series, though these are generally for highly dependent economies (data for Jersey, Guernsey and Isle of Man for example are rarely available).

2.2 Comparison of Small and Large Economies

Small economies have been widely studied in the literature on economic development, though little work has been done on the specific area of the monetary policy and exchange rate challenges they face. Generally, the literature on small economies highlights two major problems associated with their size. First, indivisibilities and fixed costs in the provision of public services may lead to increasing returns to scale which small countries cannot exploit. In the case of monetary policy, it seems reasonable to believe that the formulation and implementation of monetary and exchange rate policy requires a minimum scale which makes the per capita cost of this service more onerous in smaller economies. Second, economies of scale in the private sector may cause small economies to become specialized, which increases their dependence on international trade in general and a small range of export industries in particular. This combination of openness and specialization is likely to result in a greater exposure to substantial terms of trade shocks, resulting in fundamental economic volatility. Indeed, Furceri and Karras (2007) have clearly shown that size has a large negative effect on economic volatility. Set against these disadvantages, small countries may benefit from less tangible advantages such as greater social cohesion (though, as Easterly and Kraay (1999) point out their ethno linguistic diversity is similar to larger countries). They may also be able to use international financial markets to diversify their output risk, resulting in lower consumption volatility. Appendix 1 discusses these issues more thoroughly.

In order to assess the scale of these effects for our sample of small rich countries, Table 2 compares the average characteristics of our small countries with all other economies that meet our GDP per capita criteria (i.e. countries with in income per capita above $11,500 and a population above 3 million in 2007).[1] We compare country characteristics over the period 1970–2008 (e.g. average growth, standard deviation of growth, etc.) using data from the World Bank Development Indicator Database (except government effectiveness which comes from the World Bank's Governance dataset and export concentration which is UNCTAD data). It shows that

[1] We end up with a control group of 39 large rich economies ranging in population size from Uruguay (3.46 million) to USA (301 million) and ranging in income from Costa Rica ($11,833) to United Arab Emirates ($51,342).

Table 2 Comparing small and large rich economies

		Large	Small
Openness	Merchandise Exports+Imports (% of GDP)	70.2	110.5**
Export Concentration	Herfindahl Index of Export Industries (index value)	0.18	0.40**
Economic Volatility	Standard Deviation of Terms of Trade	5.8	9.2*
	Standard Deviation of GDP growth	3.7	5.7**
	Standard Deviation of consumption growth	3.1	5.7**
Government Scale	Government Consumption (% of GDP)	17.7	19.0
	Government Effectiveness (index value)	1.07	0.77
Risk Sharing	Absolute Current Balance (% of GDP)	4.7	14.0**
	Growth Correlation with World Growth	0.46	0.30**
	Growth Covariance with World Growth	1.76	1.74
Economic Performance	Average Growth	3.5	4.5*
	Average Inflation	18.7	6.5
Income	GDP per capita (2008 $ PPP)	31,000	35,000

Average across countries of time series average using annual World Bank WDI data for the period 1970–2008 (where available) except government effectiveness which is the country average of World Bank estimate for 2008 (based on survey data, see Kaufmann et al. 2009) and export concentration which is based on UNCTAD data (three-digit SITC, Revision 2 level) average of 1995–2007. Asterisks indicate that the difference between small and large country samples is significant at the 5% level (one asterisk) or 1% level (two asterisks) based on Mann–Whitney-Wilcoxon test. All figures are percentages unless otherwise noted

our sample of small economies seem to display most of the characteristics predicted above. They are significantly more open than large economies, are more highly specialized in terms of export industries and display greater terms of trade and output volatility.[2] We also find some evidence of small country effects in the provision of public services through a larger average share of government consumption and a lower perceived level of government effectiveness for small countries. However neither of these indicators is significantly different between the two groups.

We find mixed evidence on risk diversification. Firstly, we find that that growth in small countries has lower correlation with world growth than that of large, but the covariance is very similar. This indicates that the higher macroeconomic volatility of small economies is related to idiosyncratic shocks rather than a greater exposure to the global business cycle and thus, in principle, should be relatively easy to diversify away. Secondly, the fact that the average absolute current account (i.e. the average scale of current account surpluses and deficits) is very much higher for small countries—even larger than might be expected given their openness—is indicative of extensive use of international borrowing and lending—presumably to help smooth shocks. However, when we look at the volatility of consumption, we find that it is higher for small countries and is roughly the same as their output volatility (whereas for large countries consumption volatility is lower than output volatility). This is

[2] It would have been interesting to include data on employment volatility, but data problems prevented this.

prima face evidence against small countries using global financial markets to smooth out output shocks and suggests that their extensive use of international financial markets is for some other purpose.

Finally, we find that despite the disadvantages outlined above, small economies generally enjoy more rapid growth and lower inflation than their larger cousins—though the inflation difference is due to a few outliers in the large country group and so is not statistically significant and cannot be much read into. The higher average growth seems consistent with the idea that small countries benefit from intangible advantages—such as greater social cohesion—that offset their disadvantages.

3 Exchange Rate Regime Choice

Having outlined our sample of countries and their key characteristics, we now move on to look at their choice of exchange rate regime and the impact of that choice. Our first step is to outline how exchange rate regimes are classified. Our preference here is to use *de facto* measures of regimes rather than *de jure* classifications.

3.1 Exchange Rate Regime Data

We take this from two different sources. First, we use the classification scheme developed by Levy-Yeyati and Sturzenegger (2003)—abbreviated to LYS below. They combine data on exchange rates and international reserves using cluster analysis; that way they can account for foreign exchange market intervention as well as exchange rate movements. They end up with a classification that splits countries into three exchange rate regimes: fixed; intermediate; and floating. Unfortunately their data sample ends in 2004 and so we have extended it by hand.[3] To check the sensitivity of our results, we also use the method developed by Reinhart and Rogoff (2004)—abbreviated to RR below. These authors rely on the movements of market-determined exchange rates. Black market exchange rates often diverge from official ones when there are parallel or dual markets because of capital controls. At this stage, we use the "coarse" classification provided, which divides the data set into five bins: fixed exchange rates (including those in currency unions or boards); narrow crawling pegs; wide pegs/managed float; floating; and "freely falling" countries with high inflation. In practice, the floating and falling categories appear rarely in our data set so we merge these into the wide pegs/managed float classification leaving us with three bins as in LYS. The RR data set has been updated through 2008.[4] Both methods classify *nominal* exchange rate regimes.

[3] To do this, we first identified changes in regime by checking for changes in the behavior of exchange rate and reserves data over the extended sample that are large enough to move a country from one cluster to another and then double-checked these changes with changes in *de jure* regime and the RR classification. If these latter sources both contradicted the initial data assessment, the latter sources were preferred.

[4] We note in passing that other classifications exist as well, e.g., the official IMF classifications and the binary classification scheme of Shambaugh (2004). We choose not to use the former since it is based on declared official *de jure* policy rather than actual behavior. The latter is problematic since it is based on the official exchange rate.

For both classification systems, we find that our thirty-seven countries choose overwhelmingly to maintain fixed exchange rate regimes. As the data in Table 3 show, over three-quarters of our sample are classified as fixed exchange rate regime observations by both LYS and RR; only 13% of the sample is not classified as fixed by either system (i.e. as being classified as intermediate/floating in LYS and crawling/wide peg in RR). Our sample of small, rich, open economies therefore demonstrates a clear preference for tight exchange rate regimes. This is unsurprising; Rose (2011) documents conventional wisdom in showing that countries with fewer than around 2.5 million people have disproportionately chosen to have fixed rather than floating exchange rate regimes. The economic logic is clear; there are fixed costs associated with running a monetary authority, and larger countries find it easier to absorb these costs. Smaller countries also trade more than larger ones and may also reap larger trade benefits from lower exchange rate volatility, especially in the face of imperfect financial markets which raise the cost of hedging foreign exchange risk. More extensive trade could also leave small countries' inflation rates more exposed to exchange rate shocks, leaving them with more volatile inflation rates (cf. Pétursson 2010b).

Figure 1 shows the time series of exchange rate regimes choices for both classifications (both for our extended dataset labeled 'interpolated' and the underlying raw data). As well as highlighting once again the preponderance of fixed regimes in our sample, it also seems to demonstrate the well-known phenomenon of 'the disappearing middle' whereby for LYS, for example, intermediate currency regimes are the only alternative to fixed ones at the beginning of the sample, but at the end of the sample no intermediate regimes exist and the floating regimes become the only alternative to fixed ones.

Iceland's historic choice of exchange rate regimes stands out as an outlier, at least compared with this sample of countries. Iceland is *never* classified as fixed by RR. LYS classify Iceland as fixed for 13 years between 1987 and 2000, during this period of time, RR assert it as being in a narrow crawl.[5] On both classifications Iceland has fewer years of fixed exchange rates than any other country in our sample.[6] Iceland's closest comparator is Mauritius that has floated for around 10 years since 1970 according LYS.

3.2 What Determines Regime Choices?

Although there is a large and generally inconclusive literature on the determinants of currency regime choices it is interesting to look at our sample, given the characteristics of small countries discussed above. In particular, there are two unusual features of small countries that may have an impact on their regime choices. Firstly, indivisibilities in the provision of an independent currency (ranging from currency issuance to monetary policy formulation and implementation) may make the cost of currency independence more onerous for small countries. Secondly, small countries are often not fully political independent or have only been granted

[5] During this period of time, the official IMF *de jure* classification has Iceland as fixed, while Shambaugh's classification has it as "non-pegged."

[6] Gudmundsson et al. (2000) give a detailed historical account of Iceland's exchange rate arrangements. They also analyze the Optimal Currency Area (OCA) criteria for Iceland and, while acknowledging the limitation of the OCA criteria, they conclude that the analysis mainly points towards a flexible exchange rate arrangement for Iceland.

Table 3 Exchange rate regimes: Levy-Yeyati & Sturzenegger vs. Reinhart & Rogoff

	RR Fix	RR Crawling	RR Wide Peg	RR Total
LYS Fix	986	7	93	1,086
LYS Intermediate	16	38	76	130
LYS Floating	1	21	24	46
LYS Total	1,003	66	193	1,262

independence quite recently. As Imam (2010) has shown, this limited or recent political independence may influence exchange rate regime choice.

To assess the determinants of regime choice, we estimate an ordered-response probit model where the dependent variable is currency regime classified as fixed, intermediate and floating (or fixed, narrow crawl and managed float/float in the case of the RR). Each regime classification is assigned values of one to three, respectively, and then the choice of classification is estimated as a function of standard optimal currency area variables and specific small country variables. We include fixed effects for each year, but not for each country (as some of our independent variables have no time series variation).

The independent variables we choose are:

- *Openness*. The Optimal Currency Area (OCA) literature predicts that the benefits of a common currency are increasing in trade openness. Openness is measured as exports plus imports as a share of GDP.

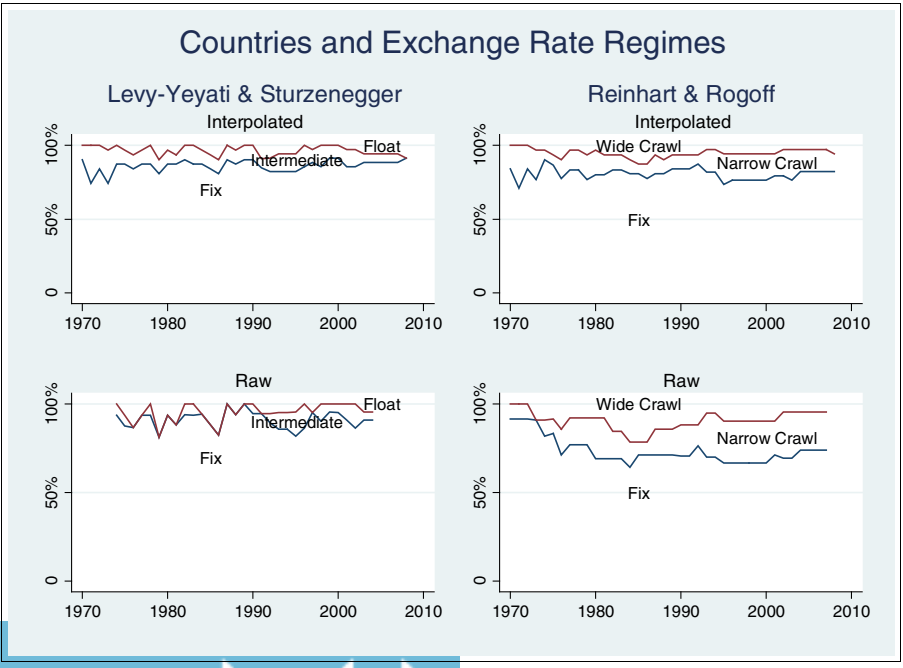

Fig. 1 Distribution of exchange rate regimes

- *A Dominant Trading Partner*. Using similar arguments, OCA also predicts that a single dominant trading partner increases the benefit of a common currency with that partner. Since our countries have/can choose a wide range of currency partners we use the trade share of the largest trading partner based on IMF direction of trade data (average import trade shares of the period 1980–2008).
- *Business Cycle Correlation*. Standard OCA theory suggests that an independent currency can help a country adjust to asymmetric shocks (though more recent evidence including that presented below questions this view). Given this, countries exposed to more asymmetric shocks may tend to choose an independent currency. We measure this asymmetry as the full sample correlation of each country's output gap with the trade-weighted output gap of its trading partners (with trend output estimated using an HP filter, $\lambda=100$).
- *Population*. As discussed above, indivisibilities in the provision of public services, such as an independent currency, can make then too costly for smaller countries. Thus, the smaller countries in our sample may be more likely to choose a common currency. We take the log of population to capture this per capita effect.
- *Political independence*. Countries with limited political independence may also find themselves required to adopt a common currency. We use a dummy variable which equals one if a country is not classified as politically independent in the CIA Factbook.
- *Years since independence*. Alternatively, since almost all the independent countries in our sample have only been granted independence in the last 50 years or so, they may choose an independent currency as a way of reinforcing their independence from former colonial masters. If this is the case we might expect countries that have been independent for many years to revert to a fixed regime. Years since independence are derived from CIA Factbook.

Table 4 shows the results of estimating the determinants of regime choice for our two regime classifications. Generally speaking, the results for the standard OCA variables are poor; openness is insignificant and of mixed sign for both classifications, trading partner is of the right sign but is significant only for the LYS classification and business cycle correlation is also of the right sign but significant only for the RR classification.[7] When we move to the three small country variables (population and the two measure of political independence), the results are more clear cut, all three are highly significant with the right sign so that very small countries tend to choose a common currency as do countries with limited political independence or with a long history of political independence. These results suggest that the costs of running an independent currency are significant for small countries and that political considerations are important in currency regime choice. Overall, however, our ability to explain regime choice is poor with Psuedo R^2 around the 10% mark in both these regressions. Note that if we drop Iceland from the estimation, R^2 improves by about 2% for both specifications, Iceland has many attributes that would suggest it should be a fixed regime according to these models.

[7] It is worth noting that we tried a number of alternative specifications of these OCA variables including exports as a share of GDP for openness, a Herfindahl index of trading partner concentration for dominant trading partner and GDP growth correlation with world GDP growth for correlation. The results were similar with all these variants.

Table 4 Determinants of currency regime choice

Independent variables	LYS regime classification	RR regime classification
Openness (exports+imports as share of GDP)	−0.12 (0.15)	0.01 (0.03)
Trade share of largest trading partner	−0.62* (0.31)	−0.05 (0.25)
Business Cycle Correlation with trading partners	−0.12 (0.20)	−0.56** (0.16)
Log of Population	0.38** (0.06)	0.35** (0.04)
Political Independence Dummy (1=not independent)	−1.23** (0.16)	−0.74** (0.10)
Years since independence	−0.44** (0.07)	−0.55** (0.06)

Each column is a separate ordered probit estimation with exchange rate regime as dependent variable (1= fix; 2=intermediate/narrow crawl; 3=float/others). Period fixed effects are included but not reported. Standard errors are in parentheses; coefficients significantly different from zero at the 5% (1%) level are marked with one (two) asterisk(s). Coefficient and standard errors for years since independence are multiplied by 100

4 Currency Regimes and Exchange Rate Volatility

To some extent the overwhelming tendency for small countries to choose fixed exchange rate regimes is indicative of the advantages of such regimes for these countries. In this section we test that proposition more directly. Firstly, by undertaking a simple comparison of economic performance under different regimes and secondly, by a more formal test of the relationship between economic fundamentals and exchange rate volatility under different regimes.

4.1 Economic Performance in Different Regimes

Table 5 shows the average economic performance of our sample of countries under each regime. Starting with the simple growth and inflation comparisons, it is clear that both average growth and growth volatility is very similar across regimes whilst the inflation performance varies significantly with floating regimes experiencing far greater average inflation and inflation volatility.[8] Both nominal and real effective exchange rates are also significantly more volatile in both intermediate and floating regimes (note that since most currency pegs are against a single currency, effective currency volatility can be considerable even for fixed regimes). We also look at the relationship between real exchange rate changes and the output gap. If exchange rates act as shock absorbers, we might expect a significant negative relationship between the real exchange rate and the output gap (i.e. a negative output gap should be associated with depreciating real exchange rate). As a simple test of this relationship we undertake a fixed effect regression of the real effective exchange rate against the output gap (panel unit root tests indicate that both series are stationary), where trend output is estimated using an HP filter as above. The results of this

[8] We obtained more or less identical results for consumption as for output. The results are available from the authors at request.

Table 5 Macroeconomic performance by currency regime

	LYS classification			RR classification		
	Fixed	Intermediate	Float	Fixed	Intermediate	Other
Average growth	4.1%	4.7%	3.6%	4.2%	4.3%	4.1%
Growth volatility	5.3%	5.9%	3.9%	5.4%	5.3%	4.4%
Average inflation	6.0%	8.3%**	15.3%**	5.7%	6.5%**	10.2%**
Inflation volatility	6.7%	11.5%**	14.2%**	5.7%	5.5%**	14.3%**
EER volatility	5.5%	15.0%**	23.0%**	6.1%	8.5%**	16.5%**
REER volatility	6.9%	9.3%**	18%**	6.7%	8.0%**	12.8%**
REER/output gap coefficient	−2.6%††	0.0%	−0.4%	−0.5%††	0.0%	−8.0%††
GDP per capita	36700	28300**	27300**	36000	34500	28000**

The table compares average annual growth and inflation and standard deviation of growth, inflation, change in nominal effective exchange rate (EER) and change in real effective exchange rate (REER) under different currency regimes. *,** indicates that the difference between figure with asterisk and figure for fixed regime is statistically significant at the 1% and 5% level, respectively, based on Satterthwaite Welch *t*-test for means and F-test for variances. REER/Output gap coefficient shows estimated coefficient of fixed effect regression of REER on the output gap, †† indicates that coefficient is significant at the 1% level

regression are a little surprising as it indicates that the output gap exchange rate relationship is strongest for fixed regimes (for LYS), whilst it is insignificant for intermediate regimes. Even though the results are mixed for other regimes, it seems clear that non-fixed exchange rate regimes do not generally find that their real exchange rates help offset the business cycle.

4.2 Exchange Rate Volatility and Fundamentals

As a floater, there is little doubt that Iceland has experienced higher exchange rate volatility than other countries in the sample which have maintained fixed exchange rates. The question of interest is whether Iceland has channeled volatility into the exchange rate from some other part of the economy.[9] If economies have a certain unavoidable amount of volatility stemming from shocks striking their economies, the foreign exchange market may be a good place to send it, since risk there can be more easily hedged than on (say) labor or product markets. As Friedman (1953) argued:

> " … instability of exchange rates is a symptom of instability in the underlying economic structure … a flexible exchange rate need not be an unstable exchange rate. If it is, it is primarily because there is underlying instability in the economic conditions … "

Friedman's argument is that exchange rate instability is a *manifestation* of economic volatility. Exchange rate regimes differ in the mechanisms through which this underlying volatility is channeled. For instance, "money supply" or "liquidity"

[9] Using a signal-extraction approach to identify the non-fundamental part of exchange rate fluctuations, Pétursson (2010a) finds that an unusually large share of exchange rate fluctuations in Iceland are not related to economic fundamentals.

shocks affect the nominal exchange rate when rates float, but the money supply if rates are fixed. Underlying systemic volatility cannot be *reduced* by the regime, only *channeled* to one locus or another. According to this theory, the economy can be thought of as a balloon; squeezing volatility out of one part merely transfers the volatility elsewhere.

So in principle, if exchange rate volatility varies by (endogenously-chosen) exchange rate regimes, so should macroeconomic volatility. But does this theory actually work in practice? We now proceed to see if macroeconomic volatility varies systematically by exchange rate regime. Unfortunately for the theory, as we now show there is remarkably little evidence of a systematic relationship between the exchange rate regime and measurable macroeconomic phenomena (at least for low- and moderate-inflation countries at high- and medium-frequencies). In doing so, we actually confirm conventional wisdom; a number of researchers have shown formally that the variability of observable macroeconomic variables such as money, output, and consumption do not differ systematically across exchange rate regimes.

The vehicle we use to frame our discussion is a completely standard model of the foreign exchange market which links the exchange rate to macroeconomic fundamentals. This monetary model allows us to explore the trade-off between exchange rate and macroeconomic volatility in a transparent fashion.

We keep the model simple. It consists merely of asset market equilibrium and a purchasing power parity (PPP) condition:

$$m_t - p_t = \beta y_t - \alpha i_t + \varepsilon_t \tag{1}$$

$$p_t = e_t + p^*_t + v_t \tag{2}$$

where: m_t is the domestic stock of money at time t; p_t is the price level; y_t is real output; i_t is the interest rate (level), e_t is the domestic price of foreign exchange; α and β are parameters, an asterisk represents a foreign variable; all variables (except interest rates) are expressed as natural logarithms, ε_t is a shock to the money market; and v_t is a stationary deviation from PPP. It is important to note that the model is structural, so that the parameters and shocks are not policy-dependent.[10]

We assume there is an identical foreign analogue to (1). Subtracting it from (1) and substituting into (2), we arrive at:

$$e_t = (m - m^*)_t - \beta(y - y^*)_t + \alpha(i - i^*)_t - (\varepsilon - \varepsilon^*)_t - v_t \tag{3}$$

which expresses the exchange rate as a function of macroeconomic "fundamentals", namely differentials (differences between domestic and foreign values) of money, output, interest rates and shocks.

Equation 3 implies a volatility trade-off. If the exchange rate is fixed, then (ε_t or v_t) shocks translate into volatile money, output or interest rates. If the exchange rate floats cleanly, then the same shocks create exchange rate movements.[11] Expressed

[10] Most modern "new open economy" macroeconomic models lead to equations very much like Eqs. 1–2.
[11] This straightforward intuition is the heart of Mundell's "Incompatible Trinity" of fixed exchange rates, domestic monetary sovereignty and perfect capital mobility.

alternatively, volatility in the exchange rate—the left-hand side of (3)—should mirror fundamental macroeconomic volatility of the right-hand side.

Unfortunately, our simple macroeconomic model does not capture even the grossest features of the data. We focus on one key feature; the volatility of the different sides of Eq. 3. If the model works well, these should be similar. In reality though, exchange rate volatility (the left side) varies systematically and dramatically across exchange rate regimes, while observable macroeconomic volatility—its counterpart on the right—does not.

Measuring the left-hand side of Eq. 3 is trivial, since exchange rates are among the most accurately measured economic data available. The right-hand side is trickier. There are two potentially serious complications. The first issue is the unknown parameters. We could directly estimate α and β, but choose simply to use plausible values from the literature (unity for both the income elasticity and the interest semi-elasticity of money demand). Flood and Rose (1995) show that this result holds for a very wide range of reasonable parameter values.

The second issue is the unobservable nature of the money market and price disturbances terms. Flood and Rose (1995) estimate these directly, and substitute in the estimates. Setting the disturbances to their unconditional values (of zero) leads to very similar results, however. The reason is simple; since the disturbances are structural, there is little reason why they should differ with the exchange rate regime. For the same reason, measurement error of money and output is an unimportant problem.

4.3 Empirics of Volatility

We now compare the volatility of the left- and right-hand sides of Eq. 3 for a number of different countries. We ask "Do countries with volatile exchange rates also have high macroeconomic volatility?" This test exploits *cross-country* evidence from a given period of time, and is thus immune to *time-specific* effects, such as oil prices.

Our evidence is contained in Fig. 2, which plots standard deviations of exchange rates (e_t) on the ordinate (y-axis) against macroeconomic fundamentals $[(m - m^*)_t - (y - y^*)_t + (i - i^*)_t]$ on the abscissa (x-axis). We do this for the (twenty-two) countries of our sample with complete data. There are four panels in Fig. 2. Where the top row uses *effective* exchange rates, the row below it is the analogue computed using *bilateral* (dollar) rates and accordingly compares domestic and US fundamentals. The graphs on the left use M1 as the measure of the money stock, while the graphs on the right use M2 instead.

Figure 2 shows clearly that there are enormous differences in exchange rate volatility across countries. But these differences are essentially unrelated to those in macroeconomic fundamentals. Both stable and unstable exchange rates are consistent with similar macroeconomic volatility. The regression line for the cross-country relationship between exchange rate and fundamental volatility is included in the graphs, along with a ±2SE confidence interval. While the slopes are all positive, none is significantly different from zero at conventional statistical levels. It is also interesting to note that Iceland is an outlier in all four cases; it has the highest degree of nominal exchange rate volatility in all four graphs. Using M1 as the money

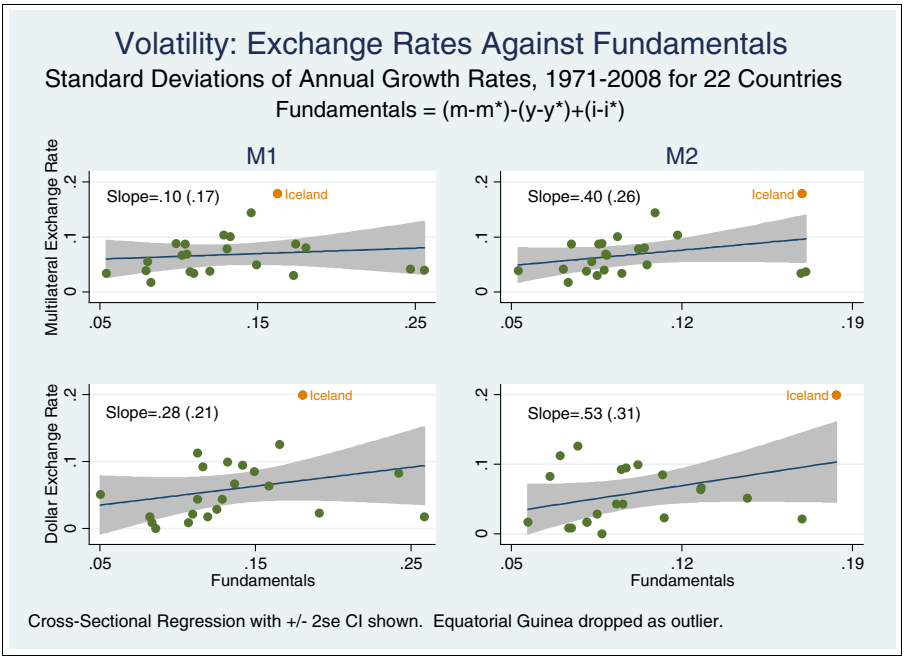

Fig. 2 Cross-country volatility of exchange rates and fundamentals

measure, Iceland has mid-sample fundamental volatility, though Iceland's fundamental volatility is at the top end of the sample when we use M2 to measure money.[12]

Correlation is of course not causation. But the point is that here there's almost no correlation: countries that float tend to have systematically higher exchange rate volatility but barely distinguishable fundamental volatility to those that choose fixed exchange rate regimes.

As a more formal test of the relationship between exchange rate and fundamental volatility across regimes, Table 6 compares the standard deviation of fundamentals across different exchange rate regimes with the volatility of exchange rate based measures. Monetary fundamentals are calculated for both M1 and M2 and all measures are calculated on a trade-weighted and dollar basis. It shows that exchange rate volatility varies significantly across regimes and although fundamental volatility also rises from fixed to floating regimes (significantly so for the RR classification) the rise in fundamental volatility is considerably smaller than the increase in exchange rate volatility across regimes.

4.4 Interpretation

Our finding is grossly inconsistent with the spirit of Mundell's Incompatible Trinity or trilemma, since small open economies seem to be able to experience lower

[12] Honjo and Hunt (2006) find that Iceland faces unusually unfavorable tradeoff between output and inflation fluctuations compared to many other inflation-targeting small open economies.

Table 6 Volatility of exchange rates and fundamentals

		LYS classification			RR classification		
		Exchange rate volatility	Fundamental volatility (M1 based)	Fundamental volatility (M2 based)	Exchange rate volatility	Fundamental volatility (M1 based)	Fundamental volatility (M2 based)
fixed	Trade-weighted basis	0.06	0.16	0.12	0.06	0.16	0.12
intermediate		0.12**	0.17	0.14	0.09	0.15	0.11
floating		0.18**	0.17	0.14	0.15**	0.20**	0.17**
fixed	Dollar basis	0.05	0.16	0.12	0.06	0.16	0.11
Intermediate		0.14**	0.17	0.13	0.08**	0.14	0.11
floating		0.16**	0.19	0.14	0.16**	0.22**	0.18**

Estimates of the standard deviation of fundamentals and exchange rates by regime where both exchange rates and fundamentals are estimated on a trade-weighted and bilateral dollar basis. *,** indicates difference between figure with asterisk and figure for fixed regime is statistically significant at the 1% and 5% level respectively based on F-Test of variance

exchange rate volatility without any visible cost in terms of macroeconomic volatility (which might be expected if monetary autonomy is compromised).

That said, our finding is quite consistent with the literature. Mussa (1986) established convincingly that nominal and real exchange rate variability changes substantially and systematically with the exchange rate regime. Mussa used bilateral dollar exchange rates for a variety of industrial countries from 1957 to 1984 to show that the variance of real exchange rates is an order of magnitude greater in the floating period after the Bretton Woods period than it was during the Bretton Woods regime of pegged rates.[13] In his published comment on Mussa, Fisher Black (1986) argued that "empirical workers in the field of exchange rates will not regard this as new information" and cites work which precedes Mussa's.[14] Mussa's evidence is especially convincing to us for two reasons. First, it is undisputed, at least to our knowledge. Second, the objective of Mussa's paper is unrelated to ours; he was interested in rejecting models which do not incorporate price sluggishness, since the latter embody the property of nominal exchange regime neutrality.

Baxter and Stockman (1989) extended Mussa's work on exchange rates to other macroeconomic variables. Using data for a variety of both OECD and developing countries, Baxter and Stockman examine the variability of output, trade variables, and both private and government consumption, using different de-trending techniques. They find they are:

> "unable to find evidence that the cyclic behavior of real macroeconomic aggregates depends systematically on the exchange-rate regime. The only exception is the well-known case of the real exchange rate."

Flood and Rose (1995) performed similar cross-country volatility analysis with nominal *effective* exchange rates, money, output, interest rates, inflation and stock

[13] Mussa's "first important regularity" is: "The short term variability of real exchange rates is substantially larger when the nominal exchange rate between these countries is floating rather than fixed."

[14] Certainly, Stockman (1983) and Aliber (1976) provide consistent earlier evidence. See also other references given by Black.

markets and found comparable results. Obstfeld and Rogoff (2001) refer to this stylized fact as being part of their sixth "Exchange Rate Disconnect" puzzle. Recent empirical papers, such as Artis and Ehrmann (2006) and Farrant and Peersman (2006), also reach similar conclusions. Using a structural VAR analysis, they find that a significant share of nominal and real exchange rate fluctuations is explained by shocks originating in the foreign exchange market itself, which they attribute to movements in a currency risk premium. So we think that our findings are consistent with long-established stylized facts.

Theoretical models to rationalize the stylized fact (of exchange rate volatility that varies by regime in the face of similar fundamental macroeconomic volatility) are provided by Flood and Rose (1999) and Jeanne and Rose (2002). Flood and Rose (1999) emphasize the existence of non-linearity and multiple equilibria, while Jeanne and Rose (2002) introduce noise traders into the foreign exchange market that can generate high exchange rate volatility that is unrelated to economic fundamentals.[15] The Flood and Rose model is described briefly in Appendix 2.

5 What Type of Fixed Regime?

So far our analysis has focused on the broad regime choices, largely between fixed, intermediate and floating. We have found that fixed regimes appear to have the key advantage of removing a source of extraneous volatility (exchange rate volatility) and that this result seems consistent with the *de facto* choice of regime by the small countries we analyze since the overwhelming majority have opted for some form of fixed regime.

In this section we look in more detail at the type of fixed regime that countries choose. To do this we utilize the fine grid exchange rate classification produced by Reinhart and Rogoff. This classification has 14 categories ranging from freely falling to no separate legal tender, and whilst the classifications of non-fixed regimes are far too numerous for our purposes (recall that only 14% of our sample contains non-fixed regimes on the LYS classification), the subset of fixed regimes is informative. Thus, in this section we break up our coarse grid category of fixed regimes into three sub categories based on the fine grid, namely: 1) No separate legal tender; 2) Pre-announced peg or currency board; 3) narrow band or *de facto* peg (which combines the two categories from RR; pre-announced horizontal band that is narrower than or equal to±2% and *de facto* peg). As well as analyzing these sub-categories of the RR classification, we also use the fine grid classification to split the LYS classification of fixed regimes into the same three sub-categories. In a few cases this means identifying the appropriate sub-category for regimes that are classified as fixed by LYS but not RR. We do this by reference to the *de jure* regime classification (i.e. the publically announced regime) since these are relatively accurate in the case of fixed regime classifications 1 and 2 (and so category 3 can be inferred). Table 7 shows the distribution of sub-categories of fixed regimes.

[15] Devereux and Engel (2002) add local currency pricing and heterogeneous international distribution of commodities to a model of noise traders and show that such a model can generate high exchange rate volatility, that is much larger than the volatility in underlying fundamentals and that this high exchange rate volatility has no implications for other macroeconomic variables.

Table 7 Fixed exchange rate regimes: Levy-Yeyati & Sturzenegger vs. Reinhart & Rogoff

	Currency Union	Pre-announced peg or currency board	Pre-announced Narrow Band or *de facto* peg
RR	209	655	71
LYS	248	740	86

5.1 What Determines the Choice of Fixed Regime?

Table 8 repeats the regime choice regression described above but focuses purely on the choice of fixed regime type. The most remarkable aspect of this table is the similarity of the results with those of Table 4 that looked at the determinants of overall regime choice. As in Table 4 most of the OCA variables work poorly, with the exception of business cycle correlation which predicts a greater likelihood of stricter fixed regimes, the more correlated the domestic business cycle is with its global counterpart (though it is possible that more fixed regimes such as currency unions encourage greater business cycle correlation). Small economy and political independence variables all work well, with smaller countries more likely to choose the stricter fixed regimes, and countries that are either not independent or have been independent a long time more likely to choose the stricter regimes. In fact, the R^2 of these regressions are around the 25% mark - far better than the broader regime choice equations.

5.2 Economic Outcomes for Fixed Regimes

Table 9 examines economic performance by fixed regime and finds that currency unions have significantly lower volatility of growth, inflation and the real effective exchange rate than the other fixed regimes but significantly lower growth. The lower growth can probably be explained through "the iron law of convergence" (where poorer countries tend to catch-up with richer ones) since currency unions tend to have significantly higher GDP per capita than the other regimes. Interestingly, despite lower

Table 8 Determinants of fixed currency regime choice

Independent variables	LYS regime classification	RR regime classification
Openness (exports+imports as share of GDP)	−0.12 (0.15)	0.08** (0.02)
Trade share of largest trading partner	−0.14 (0.38)	0.13 (0.41)
Business Cycle Correlation with trading partners	−0.56** (0.16)	−1.00** (0.19)
Log of Population	0.69** (0.06)	0.66** (0.07)
Political Independence Dummy (1=not independent)	−1.16** (0.12)	−1.23** (0.13)
Years since independence	−0.36** (0.08)	−0.39** (0.08)

Each column is a separate ordered probit estimation with exchange rate regime as dependent variable (1= currency union; 2=currency board/pre-announced peg; 3=pre-announced narrow band/ *de facto* peg). Period fixed effects are included but not reported. Standard errors are in parentheses; coefficients significantly different from zero at the 5% (1%) level are marked with one (two) asterisk(s). Coefficient and standard errors for years since independence are multiplied by 100

Table 9 Macroeconomic performance by fixed currency regime

	LYS classification			RR classification		
	Currency union	Currency Board/Peg	defacto peg/ narrow band	Currency union	Currency Board/Peg	defacto peg/ narrow band
Average growth	3.2%	4.4%**	4.2%*	3.2%	4.4%**	4.5%**
Growth volatility	3.2%	5.8%**	3.7%	3.2%	5.8%**	3.1%
Average inflation	6.2%	5.5%	6.8%	6.0%	5.6%	5.0%
Inflation volatility	5.2%	6.4%**	6.8%**	5.1%	5.9%**	4.7%
REER volatility	4.8%	7.2%**	6.5%**	3.8%	7.3%**	5.9%**
REER/output gap coefficient	−1.3%††	−0.1%†	−0.4%†	−1.3%††	−0.1%†	−0.4%†
Probability of Exit (per year)	0.0%	3.0%**	10.5%**	0.0%	3.2%**	12.7%**
GDP per capita	55200	30000**	45600*	64500	28600**	46400**

Table compares average annual growth and inflation and standard deviation of growth, inflation, change, change in real effective exchange rate (REER), probability of exit (i.e. number of regimes exits divided by number of years regime is observed) and GDP per capita under different currency regimes. *,** indicates that the difference between figure with asterisk and figure for currency union is statistically significant at the 1% and 5% level respectively based on Satterthwaite Welch *t*-test for means and F-test for variances. REER/Output gap coefficient shows estimated coefficient of fixed effect regression of REER on the output gap, †† indicates that coefficient is significant at the 1% level

real exchange rate volatility, currency unions tend to have a strong tendency for the real exchange rate to depreciate when the output gap is negative. Finally, and perhaps most importantly, no small country currency union has been abandoned over our sample whilst other fixed regimes have a significant tendency to be ended (mainly through currency crisis or progression to a stricter fixed regime). In particular, *de facto* pegs/narrow bands have a probability of exit of more than 10% per annum over our sample, indicating that these regimes are surprisingly transient.

6 Conclusion

Although rich small economies are generally highly successful, their acute exposure to external shocks makes monetary and exchange rate policy problematic, and these problems are compounded by the relatively high per capita cost of creating institutions to combat them. In this paper we not only find that the most common response of small countries is to adopt a strictly fixed exchange rate regime such as joining a currency union or adopting a currency board, but we also demonstrate that this choice makes sense given the fact a freely floating exchange rate tends to result in greater exchange rate volatility without any corresponding impact on underlying macroeconomic volatility. In fact, given our results it is something of a puzzle why small rich countries ever choose to operate with a free float except perhaps for non-economic reasons such as reinforcing political independence. Additionally, our results on types of fixed regimes suggest that currency unions and, to a lesser extent, currency board type arrangements have significant advantages over less strict fixed regime. In particular, we find that currency unions are longed-lived whilst less strict fixed regimes, such as narrow bands or *de facto* pegs, are surprisingly transient.

Thus, in the case of Iceland, our results suggest that a strict peg, such as a membership in a currency union or a currency board arrangement, will lead to a more stable exchange rate without adding to macroeconomic fluctuations. We therefore find limited empirical evidence supporting the commonly cited argument that the current flexible exchange rate arrangement facilitates economic adjustment to shocks and thus reduces real economic volatility.

However, it is important to bear in mind that a fixed currency regime is by no means a panacea for small countries; they still face significantly more macroeconomic volatility than their larger cousins, irrespective of exchange rate regime. This suggests that these countries should consider other means of managing these shocks such as forms of international risk sharing (though, as Iceland's recent experience suggests, openness to international financial markets need not in itself lead to improved risk sharing) and aggressively counter-cyclical fiscal policy. Perhaps these countries need even to consider more innovative solutions to the problem of volatility such as sovereign debt with state-contingent payouts and counter-cyclical resource exploitation.

Appendix 1: Why Might Country Size Matter?

Numerous theorists have discussed the effects of national size, especially in recent economics and not-so-recent political philosophy. Much recent economics focuses

on "scale effects", so that larger countries should be more successful countries. At the other extreme, a number of celebrated political philosophers argue that smaller countries make better states. There is also a strand of reasoning that articulates a tradeoff between the benefits and costs of size. We now review these briefly; the objective is simply to point out that size matters in a number of different literatures.

Bigger is Better Size has an effect on output in a number of different recent literatures of interest in economics. Increasing returns remain an intrinsic part of the "new wave" trade theory that began in the 1980s, and lead to offshoots in economic geography and urban economics. Agglomeration effects are also an important element of endogenous macroeconomic growth. Finally, they are part of the political economy literature that focuses on the provision of public goods. There is also a long tradition in political philosophy arguing that size is positively disadvantageous.

Helpman and Krugman (1985) analyze the impact of increasing returns on trade, and discuss economies of scale both internal and external to the firm. The former can be due to plant-runs or dynamic scale economies; while the latter can be due to an effect of scale on the variety of intermediate inputs, effects on market structure, or information spillovers. When there are increasing returns to scale and transportation costs, countries also exert a "home market effect" (Krugman 1980). Agglomeration effects are also used in modeling urban dynamics as part of the new economic geography (e.g., Fujita et al. 1999). Indeed, the importance of numerous "border" effects is consistent with the fact that a number of economic relations are more efficient within a single country than in separate countries (Drazen 2000).

The literature on scale effects in macroeconomics stretches back a long way to Adam Smith's idea that the specialization of labor is limited by the extent of the market. Robinson (1960) lists a number of reasons why there might be scale effects across countries, including: enhanced intra-national integration (of capital, goods, and especially labor and services markets); higher productivity due to enhanced specialization or longer production runs; a scale effect on competition; and greater ability to respond flexibly to technological progress.

Much recent work in growth theory has formalized such scale effects. Many models rely on learning by doing and/or knowledge spillovers, and result in the conclusion that larger countries should grow faster: e.g., Barro and Sala-i-Martin (1995). Indeed, scale effects are generic to endogenous growth models (Aghion and Howitt 1998, p 28). Jones (1999, p 143) discusses three classes of endogenous growth models and shows that they all have a scale effect: "the size of the economy affects either the long-run growth rate or the long-run level of per capita income" since larger countries can support more research which delivers a higher level or growth rate of productivity. Ventura (2005, p 92) refers to "the standard idea that economic growth in the world economy is determined by a tension between diminishing returns and market size effects to capital accumulation."

The most authoritative work of relevance in public economics is the recent book by Alesina and Spolaore (2003), hereafter AS. They list (pp 3–4) five benefits of large population size: 1) lower per-capita costs of public goods (monetary and financial institutions, judicial system, communication infrastructure, police and crime preven-

tion, public health, etc.) and more efficient tax systems; 2) cheaper per-capita defense and military costs; 3) greater productivity due to specialization (though access to international markets may reduce this effect); 4) greater ability to provide regional insurance; and 5) greater ability to redistribute income within the country.

Tradeoffs Exist In all this work, larger countries are predicted to be richer or more efficient. There is little analysis of the costs of size. AS discuss two costs of larger country size. A minor consideration is the potential for administrative and/or congestion costs. The only real issue of importance is that larger countries have more diverse preferences, cultures, and languages. The AS hypothesis (p 6) is that "on balance, heterogeneity of preferences tends to bring about political and economic *costs* that are traded off against the benefits of size." This reasoning is not new. In chapter XVII of the *Leviathan*, Hobbes argued that small populations were insufficient to deter invasion and provide security, while excessively large countries would be incapable of the common defense because of lack of a common purpose and internal distractions. Olson (1982) argues that small homogenous societies are less burdened by the logic of collective action and have more capacity to create prosperity; see also Robinson (1960) and Wei 1991, unpublished. Drazen (2000) provides an excellent critique, and emphasizes (among other things) that public goods can be supplied by clubs instead of countries.

Small is Beautiful In arguing that size has its costs, AS join a long tradition of political philosophers, many of whom believe that small is beautiful. Plato quantified the optimal size of a city-state at 5,040 households.[16] Similarly in *Politics*, Aristotle argued that a country should be small enough for the citizens to know (and hear!) each other; the entire territory should be small enough to be surveyed from a hill. More recently, Rousseau stated:

> "Large populations, vast territories! There you have the first and foremost reason for the misfortunes of mankind, above all the countless calamities that weaken and destroy polite peoples. Almost all small states, republics and monarchies alike, prosper, simply because they are small, because all their citizens know each other and keep an eye on each other, and because their rulers can see for themselves the harm that is being done and the good that is theirs to do and can look on as their orders are being executed. Not so the large nations: they stagger under the weight of their own numbers, and their peoples lead a miserable existence – either, like yourselves, in conditions of anarchy, or under petty tyrants that the requirements of hierarchy oblige their kings to set over them."[17]

This line of reasoning stretches all the way to at least Myrdal (1968).

Montesquieu believed that republican countries were necessarily small in both territory and population. His logic was that large countries were necessarily diverse

[16] It is interesting to note that Plato's logic was that 5,040 is divisible by all numbers 1 through 10. Indeed, 5,040 is a colossally abundant number; its factorization is 2^2*3^2*5*7; http://mathworld.wolfram.com/ColossallyAbundantNumber.html.

[17] Jean Jacques Rousseau in *The Government of Poland* quoted at http://www.brothersjudd.com/blog/archives/010141.html.

and thus required strong governments, resulting in monarchies or even despots (for very large countries). Small countries without excessive wealth were the most democratic. He famously wrote:

> "In a large republic, the common good is sacrificed to a thousand considerations; it is subordinated to various exceptions; it depends on accidents. In a small republic, the public good is more strongly felt, better known, and closer to each citizen; abuses are less extensive, and consequently less protected."[18]

Interestingly, Montesquieu's logic was inverted by David Hume (1752), who argued in "Idea of a Perfect Commonwealth" that

> "in a large government, which is modeled with masterly skill, there is compass and room enough to refine the democracy, from the lower people, who may be admitted into the first elections or first concoction of the commonwealth, to the higher magistrate, who direct all the movements. At the same time, the parts are so distant and remote, that it is very difficult, either by intrigue, prejudice, or passion, to hurry them into any measure against the public interest."

Madison used this logic to argue that large countries were less likely to be affected by factions in *The Federalist Papers 10*.[19]

Previous Empirics

To our knowledge, there has been only almost no work on a national scale effect on the level of economic well-being (Drazen 2000 argues that the reverse is also true), aside from Rose (2006). A number of different studies in Robinson (1960) tested for economies of scale and found them to be mostly unimportant. They also considered the impact of country size on national patterns of specialization, diversification, and competition, usually with a similar lack of success. Furceri and Karras (2007) have convincingly shown that size has a large negative effect on business cycle volatility.

By way of contrast, there has been much work done which searches for a scale effect in economic growth. Barro and Sala-i-Martin (1995) are typical of the literature and provide limited evidence of a scale effect on growth. Alesina et al. (2000, 2005) focus on whether the effect (if any) of size on growth is mediated through openness; they find moderately supportive results using a panel of data and IV techniques.But most of the focus in AS is on the causes and determination of country size rather than its effects.

Appendix 2: A Sketch of a Theoretical Model of Non-fundamental FX Volatility

In this appendix, we outline a simple theoretical model that removes the strong linkage between fundamental macroeconomic volatility and exchange rate volatility.

[18] *De l'Esprit des Lois* Vol I, Book 8, p 131.

[19] There is also a modern strain of political thought which argues that larger countries are inferior; E. F. Schumacher and especially Leopold Kohr (especially in *The Breakdown of Nations*) are among the more well-known writers.

This is motivated by the absence of any strong linkage as shown in Fig. 2 and Table 6.

Flood and Rose (1999) developed a non-linear model of the exchange rate which links it to expectations about both the future level and volatility of the exchange rate. This non-linearity induces multiple equilibria and results in regime- and equilibrium-dependent coefficients; it is important in two ways. First, when exchange rate variability disappears, certain shocks (to portfolios) effectively disappear. Second, the non-linearity in the models produces the possibility of multiple equilibria. When the exchange rate is flexible, the model can produce several perfectly viable equilibria. These equilibria may correspond to exchange rate regimes with differing volatility; but movements across these equilibria could also produce exchange rate volatility without corresponding changes in fundamentals.

A credibly fixed exchange rate has neither volatility nor an expected rate of change. Accordingly, the foreign exchange risk premium disappears in the model, and the domestic interest rate is equal to the foreign rate. So, one of the equilibria corresponds to a credible stable fixed rate regime.

The situation is dramatically different when the exchange rate either floats explicitly, or is fixed unreliably so that speculative attacks are possible. In this case, expected volatility is non-zero, so that in the presence of risk-averse agents, forces other than those from money and goods markets drive the foreign exchange market. These shocks enter the risk premium non-linearly; its importance for the exchange rate is proportional to perceived exchange-rate variance. The "portfolio-balance" shock has no role in determining the balance of payments under reliably fixed rates, but it plays a major exchange rate role in a float. Thus, the shift from fixed to flexible rates is an essential shift in market structure. If the variance of portfolio balance shocks is large compared to the other disturbances, then the exchange rate becomes very much a *non*-monetary phenomenon.

This sort of non-monetary approach to the exchange rate is helpful when the money market disturbances are small compared to portfolio balance disturbances. Of course, there is no reason why portfolio balance shocks need *always* be large compared to other shocks. For instance during periods of high inflation, the money market reasserts itself. If inflationary changes in money, bonds, and domestic interest rates are large relative to portfolio shocks, macroeconomic variables will have a lot of explanatory power. But during ordinary periods of tranquility, nominal variables are relatively stable and so do not explain exchange rate changes. The same is true at low frequencies.

This model allows one to understand why exchange rate volatility can change across regimes without noticeable differences in macroeconomic phenomena. It can handle either pegged or flexible interest rates; the monetary authorities can conduct essentially any interest rate policy independent of the exchange rate. Since there are no constraints on international capital flows, this model violates Mundell's "Incompatible Trinity" of fixed exchange rates, monetary sovereignty, and capital mobility. As the endogenous risk premia can adjust to accommodate monetary policy, the central bank has almost complete freedom to manipulate interest rates. When the interest rate is pegged and exchange rates float, the portfolio-balance shocks that might otherwise be absorbed by the interest rate are instead shunted off into the exchange rate. This can magnify the effects of the "taste disturbances" on

exchange rates as compared with completely market-responsive interest rates. But the portfolio balance structure is regime-dependent. When interest and exchange rates are fixed simultaneously, the variance created by portfolio balance shocks does not move from the interest rate locus to the exchange rate or the balance of payments. It simply disappears.

Further Information on Data Sources

- *GDP, Inflation, M1, M2, Population, Exports and Imports:* UN Data cross-referenced with World Development Indicators and International Financial Statistics. (though note that small vs. large country comparison based on world development indicators only)
- *Exchange Rates:* International Financial Statistics
- *Trade weights (for EER, REER* etc.*)*: Average import shares (1980–2008) from IMF direction of trade data (sometimes supplemented with local sources)
- *Exchange rate volatility:* Standard deviation of monthly exchange rate changes
- *GDP and Inflation growth and volatility:* Annual growth and standard deviation
- *GDP per capita:* 2008 data from CIA world Factbook

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