Original Sin, Passthrough, and Fear of Floating

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Abstract

In this paper we consider a set countries with a *de jure* floating exchange rate and show that there are substantial differences in their exchange rate policies. In particular, we explore how the ability to borrow in own currency and the degree of passthrough from exchange rate to prices affect the degree of exchange rate management. We find strong evidence for a negative link between exchange rate flexibility and ability to borrow in own currency, and a much weaker link between passthrough and exchange rate flexibility.

Keywords: Exchange rate, Emerging Markets, Dollarization.
JEL Codes: F31, F33, F41.

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1. Introduction

The currency and financial crises of the last decade gave new strength to the debate on monetary policy and exchange rate options for small open economies in general and for emerging market countries in particular. On the one hand, some economists highlight the risks of floating and non-credible fixed exchange rate regimes and point out that, as emerging markets have a very limited ability to conduct an independent monetary policy, they should move to super-fixed exchange rate systems such as a currency board or dollarization (Calvo, 2000a, Dornbusch, 2000, and Hausmann, 1999). On the other hand, some economists point out that dollarization and currency boards cannot solve the fundamental problems of emerging markets and may end up being more of "a straitjacket than an anchor of salvation" (Chang and Velasco, 2000, Mishkin, 1998, and Sachs and Larrain, 1999). Yet, other economists suggest that there are no one-size-fits-all monetary policy regimes and that "no single exchange rate regime is right for all countries or at all times" (Frankel, 1999, Mussa et al., 2000). While there is disagreement on what is the best exchange rate regime for emerging countries, there is now some agreement on the fact that the standard textbook model
--suggesting that the main benefit of a flexible exchange system consists of the ability to conduct an independent monetary policy-- may not be applicable to emerging market countries. In particular, some authors emphasize that emerging market countries with an open current account may have a limited ability to conduct an independent monetary policy, both because they have a high degree of passthrough from exchange rate to prices (therefore, nominal devaluations will not affect the real exchange rate) and a limited ability to borrow long-term (either domestically or abroad) in their own currency (what Hausmann, 1999, calls the "Original Sin" of emerging markets). This new awareness of the peculiarity of emerging-market countries has generated a new class of model that explicitly includes the role of liability dollarization and high passthrough. Some of these models (Céspedes, Chang, and Velasco, 2000a, 2000b) show that the standard analysis carries on even when one considers liability dollarization and find that, even for emerging market countries, a flexible exchange rate system is superior to a super-fixed exchange rate system. Other papers, however, find that there are conditions under which the option of conducting an independent monetary policy has very limited value and therefore a strong fix could be superior to a floating exchange rate (Mendoza, 2000, Ghironi and Rebucci, 2000). Lahiri and Végh (2001b) show that countries that, in countries that face small monetary shocks, policymakers may find it optimal to let the exchange rate adjust to partly offset the shocks. However, in countries that face large shocks, policymakers may find it optimal to completely stabilize the exchange rate. Lahiri and Végh conclude that this non-monotonic relationship between exchange rate and the size of the shock may explain the fact that developed countries (that are likely to face smaller shocks)

tend to let their exchange rate float freely and developing countries (that are likely to face larger shocks) tend to heavily manage their exchange rate. Together with this new theoretical literature, a series of empirical papers has documented that countries with a formally floating exchange rate show remarkable differences regarding the way in which they intervene in the exchange rate market (Hausmann et al., 1999 and Calvo and Reinhart, 2000a and 2000b). In particular, these papers document that, while most OECD countries hold limited international reserves and tend not to intervene in the foreign exchange market, most emerging market countries tend to hold large amounts of international reserves and use these reserves to intervene in the foreign exchange rate market. Furthermore, Levy-Yeyati and Sturzenegger (1999) show that there are important differences between the *de facto* and *de jure* exchange rate policies for countries with both fixed and flexible exchange rates.

The purpose of this chapter is to focus on countries with a formally flexible exchange rate and try to provide an explanation for their different *de facto* exchange rate policies. In particular, the chapter focuses on the degree of passthrough from exchange rate to prices and on the ability to borrow in own currency. After building an extremely stylized model that relates the degree of exchange rate flexibility to passthrough and ability to borrow in own currency, we test the model and find a strong and extremely robust positive correlation between ability to borrow in own currency and degree of exchange rate flexibility. We also find a negative but not statistically significant correlation between passthrough and exchange rate flexibility and conjecture that the weak correlation between passthrough and exchange rate flexibility could be due to the presence of noise in our passthrough index.

The chapter is organized as follows: Section 2 presents evidence of large differences in exchange rate management among countries that have a *de jure* floating exchange rate regime; Section 3 sets the stage for the empirical analysis by discussing a very stylized model that highlights the relationship among passthrough, ability to borrow in own currency, and exchange rate flexibility; Section 4 builds an aggregate index of (in)ability to borrow in own currency and uses this index to test the model of Section 3; Section 5 concludes.

2. Do Emerging Markets Really Float?

The aim of this section is to document differences regarding the way in which countries with a formally flexible exchange rate manage their exchange rate policy. To this purpose, we follow Hausmann et al. (1999) and classify as having a *de jure* flexible exchange rate all the countries that, according to the November 1999 IMF classification of exchange rate regimes (International Monetary Fund, 1999), adopted one of the following 3 exchange rate arrangements: (i) independently floating (49 countries); (ii) managed floating with no preannounced path for exchange rate (25 countries); and (iii) countries with a crawling exchange rate or a horizontal band with a width of at least 18 percent (5 countries).

Even though the above classification should yield a sample of 79 countries, we do not have data for many of the countries included in the first two categories. As a result, our sample includes only 30 countries: the G3 (the United States, Germany, and Japan),[1] nine other industrial countries (Australia, Canada, Greece, Israel, New Zealand, Norway, Sweden, Switzerland, and the United Kingdom), and 18 developing and emerging market countries (Brazil, Chile, Colombia, the Czech Republic, the Dominican Republic, Guatemala, India, Indonesia, Jamaica, Mexico, Paraguay, Peru, Philippines, Poland, Singapore, South Africa, South Korea, and Thailand).[2]

As in Hausmann *et al.* (1999), we focus on three aspects of exchange rate management policy: (i) the stock of international reserves; (ii) the relative volatility of exchange rate and international reserves; and (iii) the relative volatility of exchange rate and interest rate.

For the first indicator, we focus on the ratio between the average stock of international reserves and broad money supply (M2) over the April 1998-April 1999 period. We think that this is a good indicator of exchange rate management policy because, while a country with a freely floating exchange rate does not need a lot of reserves to defend its exchange rate, the opposite is true for countries that intervene (or plan to intervene) in the exchange rate market. Therefore, countries with an active exchange rate management policy should be characterized by high reserves to M2 ratios and countries with freely floating exchange rates should have much lower reserves to M2 ratios.[3]

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[1] Even though Germany is formally classified as a part of a monetary union, we assume that, during the period considered in this paper, the Bundesbank was actually dictating the European monetary policy and therefore the Deutsch Mark was floating against the US dollar.

[2] Hausmann et al. (1999) study a sample of 38 countries and find similar results.

[3] One caveat is that, countries may also accumulate reserves to be able to cope with the shut-down of the international capital markets that characterizes periods of financial turmoil.

Fig. 1: International Reserves over M2

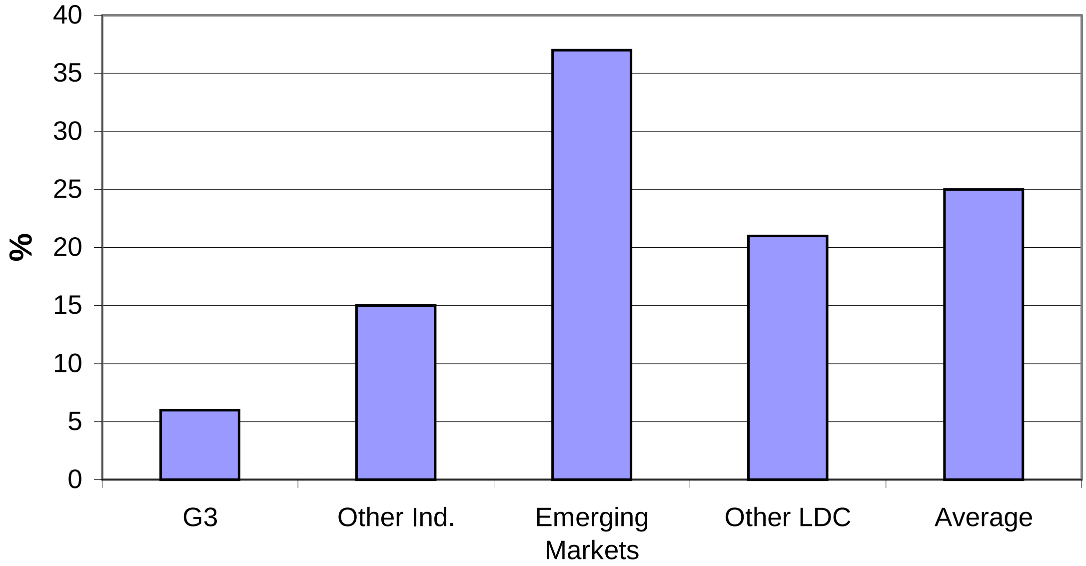


Table A1 in the Appendix documents that there are large cross-country differences in the stock of international reserves. While most industrial countries hold levels of reserves that are well below 10 percent of M2 (the average for the group is 12 percent), emerging market countries have an average reserve to M2 ratio of 33 percent. Interestingly, this value is higher than the reserve to M2 ratio of Argentina (28 percent), a country with a very strong commitment to a fixed exchange rate. If we divide the group of developing countries into two sub-groups: emerging market countries (we follow Bordo and Eichengreen, 2000, and classify countries as emerging markets on the basis of whether they are net recipients of substantial capital inflows) and other developing countries (LDC), we find that the level of reserves in emerging market countries is higher than in the LDC group (37 versus 21 percent, Figure 1) suggesting that emerging countries that do not rely (or rely less) on the international capital market need lower levels of international reserves.[4] Figure 1 provides strong support for Calvo's statement that emerging market countries, instead of floating freely, tend to float with a lifejacket (i.e., with a large amount of international reserves).

After having established that emerging market countries tend to hold a large amount of international reserves, we move on to explore whether these countries use their international reserves to defend their exchange rate. In order to do so, we look at the relative volatility of exchange rate over reserves (Hausmann et al., 1999, discuss why comparing relative volatilities is better than comparing the absolute volatility of reserves or exchange

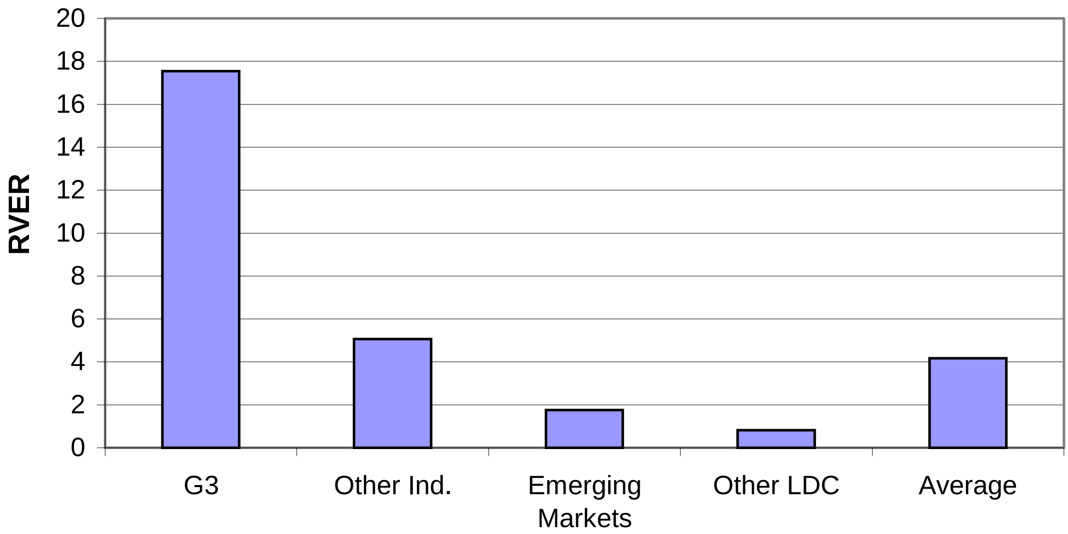
[4] We classify as emerging markets the following countries: Brazil, Chile, Colombia, Czech Republic, Indonesia, Mexico, Peru, Philippines, Poland, Singapore, South Africa, South Korea and Thailand.

rate). We measure the volatility of the exchange rate by using the standard deviation of the rate of depreciation. This is a better indicator of exchange rate volatility than the standard deviation of the exchange rate because the latter would not be able to capture the fact that one possible objective of monetary policy is the achievement of a stable crawling peg. To prevent changes in the exchange rate from affecting the dollar value of the denominator of the reserves to M2, we average M2 over the period under consideration. Formally, we measure the degree to which countries intervene with reserves with the following ratio:

$$\text{RVER} = \frac{\sigma(DEP)}{\sigma\left(RES \big/ \overline{M2}\right)} \qquad (1)$$

Clearly, under a perfectly flexible exchange rate system, the volatility of international reserves would be low (approaching zero) and therefore the relative volatility of exchange rate and international reserves (RVER) would be high. In the opposite case of a fixed exchange rate or a constant crawl, the numerator of Equation (1) would be zero (or close to zero), yielding a low RVER. Hence, RVER gives us a good indication of a country's willingness to use international reserves to defend its exchange rate. In particular, the higher the RVER the lower the degree of exchange rate interventions. In order to compute the RVER index, we need to decide which exchange rate should be used for each country. We follow Hausmann et al., (1999) and use the Deutsch Mark for European countries, the Australian dollar for New Zealand (the results are also robust to the use of the US dollar), and the US dollar for all the other countries in the sample.

Fig. 2: Relative Volatility of Exchange Rate and International Reserves



The second column of Table A1 shows the values of the RVER index for all the countries in our sample.[5] As in the case of the stock of reserves, we find strinking differences in our sample (Figure 2). The G3 and industrial countries have very high average values of the RVER index (17.5 and 5 respectively), whereas emerging markets and other developing countries tend to have extremely low values of the RVER index (1.7 and 0.8 respectively). While this leads us to conclude that emerging market and developing countries seem to be characterized by higher degrees of intervention in the foreign exchange market, it should be pointed out that there are large within-group differences. In fact, Table A1 shows that there are some developed countries with low values of the RVER index (Norway, Israel, and Sweden) and developing countries with high values of the RVER index (Thailand and, to some extent, Brazil, South Africa, the Philippines, and Indonesia).

We now move on to a different kind of intervention. Besides buying and selling international reserves, the monetary authority can affect the behavior of the exchange rate by tightening or relaxing monetary policy. In practice, when a country wants to defend its exchange rate, it will often both sell international reserves and adopt a tight monetary policy (Lahiri and Végh, 2001a). To capture this kind of intervention, we build a measure of the

[5] For most countries, the values of the index are computed for the January 1997- April 1999 period. However, for countries that started floating after January 1997, we start the period of measurement three months (5 months in the case on Indonesia) after the shift in the regime.

relative volatility of depreciation and interest rate (RVEI).[6] Formally, we measure interest rate interventions with the following index:

$$\text{RVEI} = \frac{\sigma(DEP)}{\sigma(i)} \qquad (2)$$

Countries with limited interest rate interventions will have a relatively low volatility of the domestic interest rate and a higher volatility of their exchange rate; the opposite is true for countries that actively try to manage their exchange rate.[7] Therefore, as in the case of the RVER index, the RVEI index will tend to assume large values for those countries that allow their exchange rate to freely float and low values for countries that heavily manage their exchange rate.

Table A1 presents individual country values for the RVEI index. As in the case of the first two indices, there are large cross-country differences in the relative volatility of depreciation and interest rate. The G3 countries are characterized by very high values of the RVEI index (Japan has the highest value) and developing countries are characterized by extremely low values of the index (Figure 3). Even if we exclude the G3 countries, the average value of the industrialized countries group is more than twice the average value of the emerging market and other LDC groups (38 versus 16 and 11 respectively).

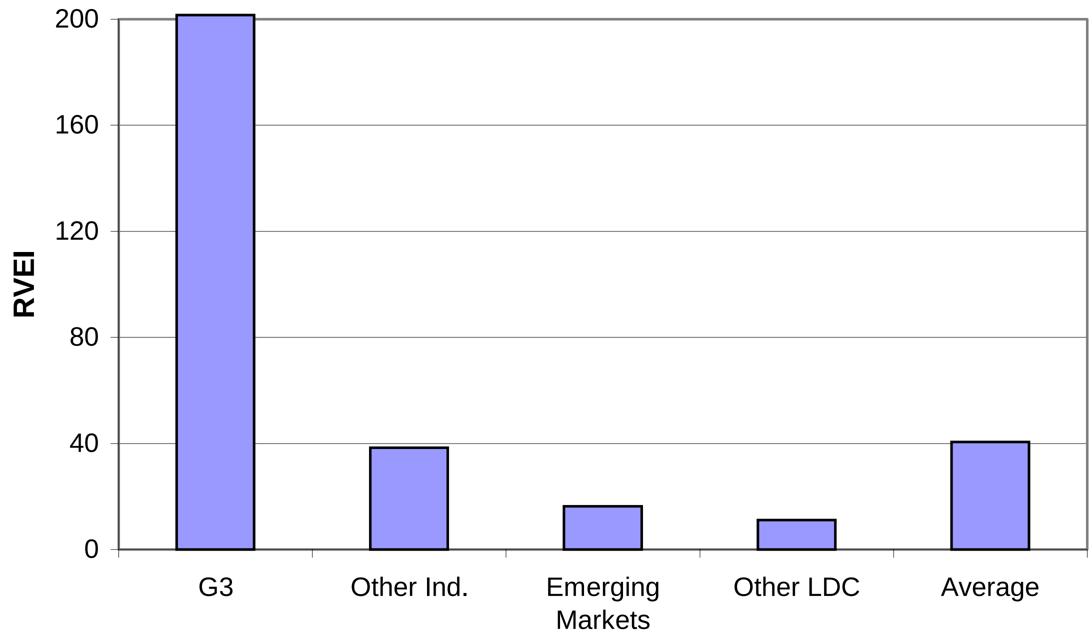
One possible critique of the RVEI index is that, while large movements in interest rate may originate from an attempt to manage the exchange rate, they are also consistent with a floating exchange regime *cum* inflation targeting framework (Levy-Yeyati and Sturzenegger, 1999) and this is especially true in countries with a large passthrough from exchange rate to prices. However, as pointed out in Hausmann et al. (1999), this observational equivalence is not an issue here. In fact, we are not interested in knowing if the actions of the monetary authority are dictated by a concern about the exchange rate per se; what matters to us is whether the authorities act "as if" that concern existed. Furthermore, it is easy to find many real world examples in which, during period of crisis, the monetary authority completely subordinated its interest rate policy to the defense of a given exchange

[6] As in Hausmann et al. (1999), we compute the RVEI index by using money market interest rates from IFS and, when these are not available, using data on money market interest rates from Bloomberg and lending or deposit rates from IFS (see Hausmann et al, 1999, for a detailed definition of the variables).

[7] As in the case of the RVER index we focus on the January 1997-April 1999 period. For those countries that adopted a floating exchange rate after January 1997, we started three months after the regime shift. As we use nominal interest rate, countries with a downward trend in inflation could end up showing excessive volatility of the interest rate. To attenuate this problem, we transform annual interest rate into monthly rates. The rationale for this transformation is the following: If a country has during the period under study a downward trend in inflation, this will translate into a downward trend in interest rates, as well as in monthly devaluation. By using the same unit of time for the devaluation and the interest rates, we ensure that the effect of these trends due to changes in inflation on both volatilities will be fairly symmetric, and will cancel out when the relative volatilities are calculated.

rate parity. An interest rate defense of the exchange rate, aimed at preventing a vicious cycle of devaluation and inflation, often coincides with the policy advice of the International Monetary Fund (Ghosh and Phillips, 1998).

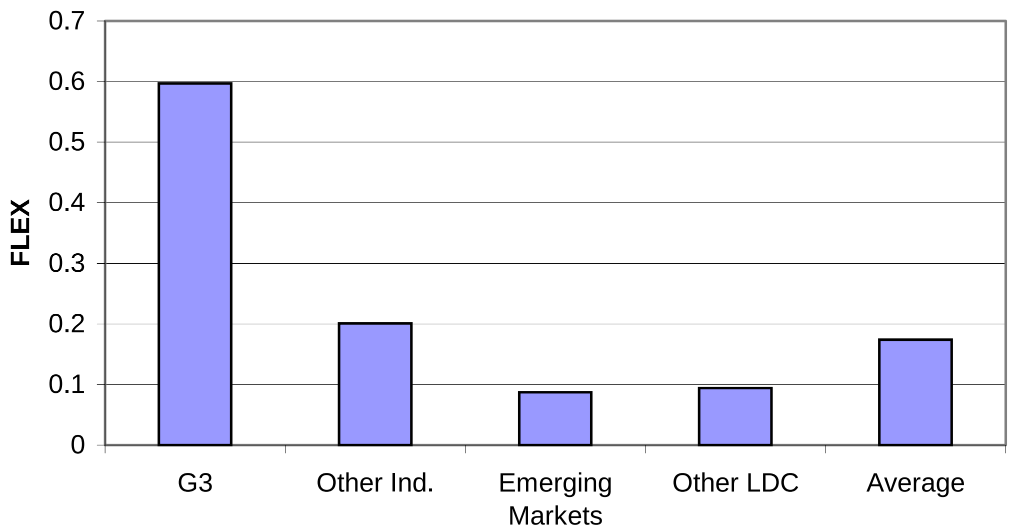
Fig. 3: Relative Volatility of Exchange Rate and Interest Rate



While in Hausmann et al. (1999) we consider the above three indices of exchange rate flexibility separately, this paper uses factor analysis to build an overall index of exchange rate flexibility (FLEX). The aggregate index of exchange rate flexibility is reported in the last column of Table A1 (we normalize the index so that all its values are included between zero and one). As one would expect, FLEX is highly correlated with the reserves to M2 ratio and the RVER and RVEI indices. However, as factor analysis gives more weight to RVER and RVEI, the correlation between FLEX and each of our two measures of relative depreciation (0.96 for RVER and 0.87 for RVEI) is higher than the correlation (0.57) between FLEX and the reserves to M2 ratio. FLEX has an average value of 0.17 and ranges between 0 (Singapore) and 1 (Japan). As in the case of the individual indicators, there are large differences across group of countries, with the industrial countries (especially the G3) characterized by a high degree of exchange rate flexibility and the group of developing countries characterized by low degrees of flexibility (Figure 4).

We conclude that there is ample evidence that countries with a formally floating exchange rate do follow very different policies regarding the way in which they manage their exchange rate policy and that, while industrial countries (especially the G3 countries) seem to follow a policy of "benign neglect" characterized by limited interventions in the exchange rate market, most emerging market and developing countries heavily intervene in the exchange rate market. Hence, a good answer to the question in the title of this section is: "Not too much." The remaining part of this paper will try to provide an explanation for this behavior.

Fig. 4: Aggregate Index of Exchange Rate Flexibility



3. A Simple Model

Even though this is mainly an empirical paper, we set the stage for the empirical work with a simple and stylized model of the behavior of a country's central bank. The building blocks of the model are the following three equations:

$$Y = Y\left(i, \kappa(\dot{e}-\pi), (\dot{e}-\pi)\right) \quad (3)$$

$$\pi = \gamma\dot{e} \quad (4)$$

$$i - i^* = E(\dot{e}_{+1}) + \varepsilon \quad (5)$$

Equation (3) states that income (*Y*) is a function of the nominal interest rate (i) and the real exchange rate $(\dot{e}-\pi)$.[8] We also assume that $Y_1 < 0$, $Y_2 < 0$, and $Y_3 > 0$. Equation (3) is derived under the assumptions that firms are credit constrained and that their ability to borrow (and produce) depends, through a credit multiplier, on profits (Aghion et al., 2000). Furthermore, we assume (but Aghion et al. derive it formally) that both profits and the credit multiplier are inversely related to the interest rate, hence $Y_1 < 0$. The assumption that $Y_3 > 0$ comes from a standard competitiveness effect (i.e., a real depreciation increase

[8] All the results carry on to using the real interest rate $(i-\pi)$ instead of the nominal interest rate.

competitiveness and hence the profits of firms). $Y_2 < 0$ comes from assuming that a fraction $\kappa \in [0,1]$ of firms' total liabilities is denominated in foreign currency. Therefore, a depreciation of the real exchange rate will increase the real burden of debt repayment and decrease profits, production, and income. Hence, while Equation (3) postulates a negative relationship between income and the nominal interest rate, the relationship between income and the real exchange rate is uncertain and will depend on the sign of $\kappa Y_2 + Y_3$. Clearly, if the fraction of liabilities denominated in foreign currency is low, devaluations will always be expansionary.

There two possible interpretations for κ. The first is that firms find it convenient to have some of their liabilities in foreign currency and therefore the parameter κ is endogenous and derived within the firms' maximization process (Aghion et al., 2000). The second interpretation is that firms are unable (at least at a reasonable rate) to contract all their debt in domestic currency and therefore κ is exogenous to the firm. This second interpretation is closer to Hausmann's (1999) "Original Sin" idea and is formally modeled by Chamon (2001).

Equation (4) describes the short-run links between inflation and devaluations. The key determinant of this relationship is the coefficient of passthrough γ. When $\gamma=1$, real devaluations are impossible and PPP will hold both in the short and long run. However, when $\gamma<1$, PPP will not hold in the short-run and nominal devaluations are translated into short-run real devaluations.

Equation (5) is the standard uncovered interest parity condition and states that the difference between domestic (i) and foreign (i^*) interest rate is equal to expected devaluation ($E(\dot{e}_{+1})$) plus country risk (ε).

Before moving to the Central Bank's (CB) objective function, let us assume that there is a sudden jump in country risk (possibly due to international contagion) or in the foreign interest rate and discuss what are the CB's policy options.[9] On the one hand, it is clear that the CB can just let the domestic interest rate increase and compensate the increase in country risk (i.e., set $\Delta i = \Delta \varepsilon$). On the other hand, the CB could try to balance the sudden jump in country risk by generating expectations for a currency appreciation. As the exchange rate is a jump variable, the only way to generate expectations for a future appreciation is to let the exchange rate jump above its equilibrium value. As long as $\gamma<1$, this will generate a real depreciation and hence expectations for a nominal appreciation. Hence, the only way to set $E(\dot{e}_{+1}) < 0$, is to let the exchange rate to jump to a value above its long run equilibrium and

[9] We will focus on a jump in country risk, the discussion for an increase in foreign interest rate would be identical. A real shock that pushes income below potential and, in order to stabilize income,

therefore to suddenly depreciate ($\dot{e} > 0$). It should be clear that this is an option only if $\gamma<1$, in the case of perfect passthrough it is not possible to engineer real depreciations and therefore the only response to a sudden increase in country risk is an increase in the domestic interest rate. We assume that it takes one period for the real exchange rate to go back to its equilibrium level, therefore expected nominal appreciation needs to be equal to the real depreciation: $E(\dot{e}_{+1}) = -(\dot{e} - \pi)$.[10] We also assume (without loss of generality) that $i^*=0$, and rewrite Equation (5) as:

$$i = -(\dot{e} - \pi) + \varepsilon \quad (6)$$

After having discussed the Central Bank's policy options, we are now ready to describe the Central Bank's objective function. We assume that the CB sets the interest rate (and through Equation (5) the exchange rate) in order to minimize a standard Barro-Gordon quadratic loss function of the kind:

$$L = \frac{\lambda}{2}\pi^2 + \frac{1}{2}\left(Y - \overline{Y}\right)^2 \quad (7)$$

For sake of simplicity, and without loss of generality, we assume that target inflation is zero and that target income ($\overline{Y}$) is equal to the natural rate and therefore there is no inflation bias. We also assume that we start at a point in which $\varepsilon = 0$ and $\overline{Y} = Y$ (therefore, Equation (6) is minimized by setting $i = i^*$ and $\dot{e} = E(\dot{e}_{+1}) = 0$) and analyze the CB's optimal response to a sudden jump in country risk to $\varepsilon = \varepsilon > 0$.

To study the CB's optimal response, we substitute Equations (3), (4), and (6) into Equation (7) and express the CB's problem as:[11]

$$\min_{e} L = \frac{\lambda}{2}(\dot{e}\gamma)^2 + \frac{1}{2}\left[\left(\varepsilon - (\dot{e} - \pi), \kappa(\dot{e} - \pi), (\dot{e} - \pi)\right) - \overline{Y}\right]^2 \quad (8)$$

Equation (8) yields the following first order condition:

$$\frac{\partial L}{\partial \dot{e}} = \lambda \dot{e}\gamma^2 + \left(Y - \overline{Y}\right)Y_{\dot{e}} = 0, \quad (9)$$

with:

$$Y_{\dot{e}} = (1-\gamma)\left(-Y_1 + \kappa Y_2 + Y_3\right) \quad (10)$$

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requires either cut in the real interest rate or a real devaluation would also lead to an analogous discussion.

[10] If we assume the real exchange rate takes more than one period to go back to its equilibrium level, we need to write expected nominal appreciation as: $E(\dot{e}_{+1}) = -\theta(\dot{e} - \pi)$, with $\theta<1$. All the results carry on to this case.

[11] Note that, as devaluation and nominal interest rate are linked by Equation (6), the two instruments are equivalent and we can express Equation (8) as a function of either variable. We choose $\dot{e}$ because it simplifies the algebra.

We are now ready to analyze how passthrough and liability dollarization affects the optimal response of the exchange rate and therefore the degree of exchange rate flexibility. Let us first look at the role of passthrough. If γ=1, real devaluations are not possible and the nominal exchange rate will have no effect on output. Hence, if the CB had no concern for inflation (λ=0), any exchange rate policy would be consistent with the CB's optimal policy, but none could isolate the domestic interest rate from external shocks (Calvo, 2000b, makes the same point). However, if λ>0, devaluations will have a cost in terms of inflation and therefore the optimal policy will be $i = \varepsilon$ and $\dot{e} = 0$. Next, let us consider the case in which 0<γ<1 and $Y_{\dot{e}} > 0$.[12] In this case, the first term of Equation (9) measures the marginal costs (in terms of inflation) of a devaluation and the second term of Equation (9) represents the marginal benefits (in terms of output stabilization) of a devaluation. Equations (9) and (10) clearly show that the higher γ, the higher the marginal costs and the lower the marginal benefits of a devaluation. Finally, if γ=0, there are no inflation costs of a devaluation and therefore the CB will let the currency depreciate up to the point where the output is fully stabilized (i.e., $, Y = \overline{Y}$). The above discussion clearly shows that, other things equal, the higher γ, the smaller the exchange rate (and the higher the interest rate) response to a given ε shock.

Let us now move to the relationship between κ and $\dot{e}$. Contrary to γ, κ does not enter into the first term of Equation (9) and therefore does not affect the marginal costs of devaluation. However, κ does enter into the second term of Equation (9) and therefore it does affect the marginal benefits of a devaluation. In particular, Equation (10) shows that, the higher κ, the lower the marginal benefits of a devaluation. Hence, as in the case of γ, the higher κ, the smaller the exchange rate (and the higher the interest rate) response to a given ε shock.

It is also important to analyze the joint effect of κ and γ. In particular, Equation (10) shows that the higher γ, the smaller the impact of κ on the marginal benefits of a devaluation and hence the smaller the impact of κ on the CB's monetary policy decision. The intuition for this result is the following: κ affects the marginal cost of a devaluation by increasing the real value of foreign currency liabilities; however, the higher the degree of passthrough, the lower the impact of a nominal devaluation on the real value of foreign currency liabilities. At the

[12] $Y_{\dot{e}} > 0$ implies that devaluations are expansionary, the discussion carries on (substituting devaluation with appreciation) to the case of contractionary devaluations ($Y_{\dot{e}} < 0$).

limit, when γ=1, a nominal devaluation will have no impact on the real exchange rate and therefore on the real value of foreign currency liabilities.

We conclude that the very stylized model of this section has three testable implications for the relationship among a country's willingness (or ability) to let the exchange rate float freely, the degree of passthrough from exchange rate to prices, and the ability to borrow in own currency: (i) other things equal, the higher the passthrough the lower the degree of exchange rate flexibility; (ii) other things equal, the lower the ability to borrow in own currency, the lower the degree of exchange rate flexibility; and (iii) other things equal, the higher the passthrough, the lower the impact of ability to borrow in own currency on the exchange rate policy. The next section tests these three implications of the model.

4. Taking the Model to the Data

The model of Section 3 illustrated that the degree of exchange rate flexibility is a function of passthrough (γ) and inability to borrow in own currency (κ). We can therefore test the implication of the model by estimating a linearized version of the following equation: FLEX= $f(\gamma, \kappa, z)$. In particular, we focus on the following specification:

$$FLEX_i = \alpha_0 + \alpha_1 PT_i + \alpha_2 SIN_i + \alpha_3 (PT_i * SIN_i) + \alpha_4 Z_i + u_i \tag{11}$$

Where *FLEX* is a measure of exchange rate flexibility, *PT* is a measure of passthrough from exchange rate to prices, *SIN* is a measure of the inability to borrow in own currency, *Z* is a vector of controls, and *u* a random error. Following the discussion of the previous section, we expect α_1 and α_2 to be negative and α_3 to be positive. While we can use the indices discussed in Section 2 to measure the degree of exchange rate flexibility, we still need to develop measures of passthrough and inability to borrow in own currency. This is the object of the next section.

4.1 Measures of passthrough and ability to borrow in own currency

In order to estimate Equation (11) we need to have a measure of passthrough from exchange rate to prices and an indicator of the ability (or inability) to borrow in own currency. The most difficult task consists of finding a good index of passthrough. In this paper, we will make use of the coefficients of passthrough estimated in Hausmann et al. (1999). The full set of coefficients is reported in column 1 of Table A2.[13] However, we need to point out that estimating passthrough for a large cross-section of countries is an extremely difficult exercise and the data set of our 1999 paper is far from being problem free. In that paper, we do our best by estimating error correction models for a sample of 27 countries and we show that, while for some countries we do find reasonable results, for other countries we obtain very puzzling results. For instance, we find that Singapore (one of the most open economies in the world) has an extremely low passthrough (approximately 2 percent) and that the correlation between our index of passthrough and openness is negative. Therefore, our measure of passthrough has a large measurement error that is likely to cause an attenuation bias in the estimation of the relationship between passthrough and flexibility.

To measure the inability to borrow in own currency, we rely on the three indices developed in Hausmann et al. (1999). In that paper, we make the point that the inability of countries to borrow abroad in their own currency is a fundamental determinant of the existence of currency mismatches in the country's balance sheets, since it is this inability that makes it more difficult for agents to hedge their currency risks. The three indices were built using two different databases from the Bank of International Settlements (BIS). The first records international transactions involving the banking sector, and the second reports international debt securities transactions (including bonds and money market instruments).

The first indicator derived in Hausmann et al. (ABILITY1, column 2 of Table A2) measures the ratio between the stock of international debt securities issued by a country in its own currency and the total stock of securities issued by the country in all currencies. This ratio is 0 in almost half of the countries, and it is very small (lower than 3 percent) in more than two-thirds of the cases. There is also a high correlation between this indicator and the level of development (Figure 5). In fact, South Africa is the only developing country with a significant amount of debt securities denominated in its own currency. A drawback of ABILITY1 is that it only captures one third of the total claims registered by the BIS.

To address the limited coverage of ABILITY1, Hausmann et al. compute a second indicator (ABILITY2, column 3 of Table A2) using, together with the data on debt securities included in ABILITY1, BIS data on total claims of the banking sector. As BIS provides the currency breakdown of the claims of the banking sector only for six out of the thirty currency in the sample, for the remaining 24 countries all bank debt in "other currencies" was assumed to be denominated in a country's own currency. Hence, ABILITY2 overestimates a country's ability to borrow abroad in own currency. The main advantage of ABILITY2 is that this

[13] Hausmann et al. (1999) estimated Passthrough for 27 countries, we fill in the three missing observations in the following way: for New Zealand we use the estimations of Calvo and Reinhart (2000b) and for Brazil and Chile we obtain an estimate of passthrough by regressing the changes in prices over lagged changes in exchange rate.

indicator covers more than 60 percent of the total foreign debt of the countries in the sample. As in the case of the first index, industrial countries (especially G3) tend to have much larger values of ABILITY2 (Figure 6).

Fig. 5: ABILITY1 INDEX

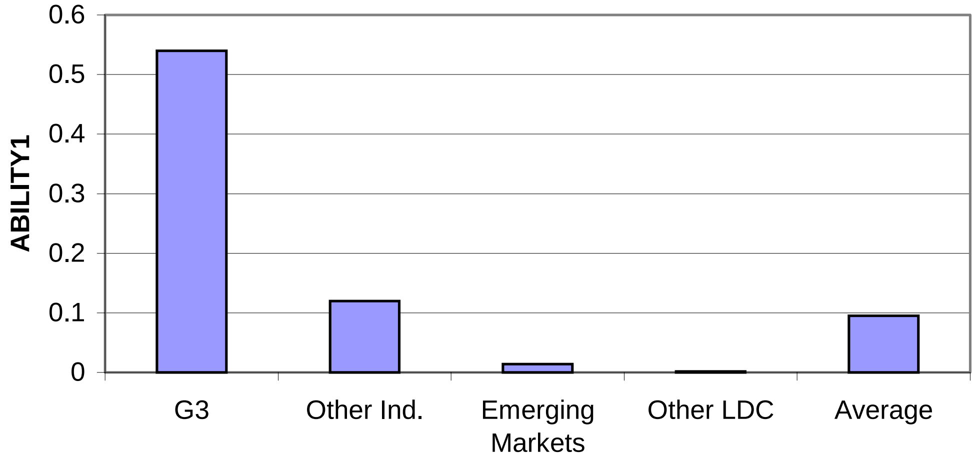
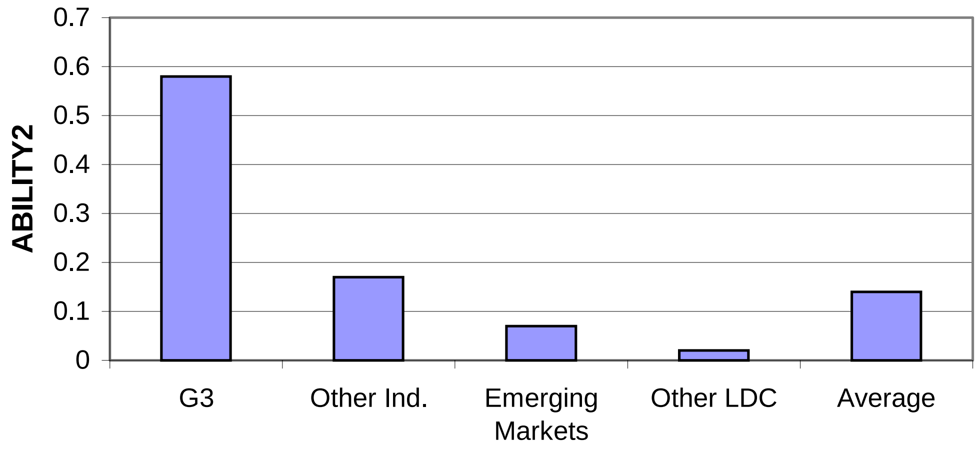


Fig. 6: ABILITY2 INDEX



The third indicator (ABILITY3) of Hausmann et al. was built using the debt securities database. ABILITY 3 is the ratio between the stock of foreign securities issued in a given currency (regardless of the nationality of the issuer) and the amount of foreign securities issued by the corresponding country. As expected, several developed countries have values greater than one, indicating that other countries issue securities in those currencies (the average value for the G3 countries is 1.57, Figure 7). Not surprisingly, the value corresponding to the United States is the largest (the data are reported in column 4 of Table A2). In fact, by comparing ABILITY1 with ABILITY3, we find that about two-thirds of the total stock of dollar debt instruments has been issued by countries other than the United

States. More surprising is the fact that South Africa has a value greater than unity, suggesting that its currency is widely used by nationals of other countries. Hausmann et al. make the point that, although ABILITY3 may seem less precise than the other two indices, it is a good measure of the potential for foreign currency mismatches and for a country's ability to hedge its foreign currency risk.

Fig. 7: ABILITY3 INDEX

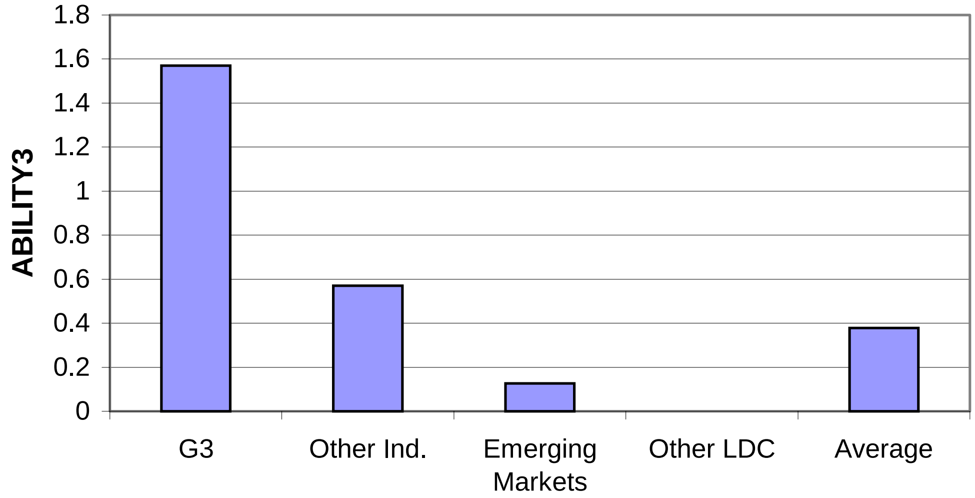
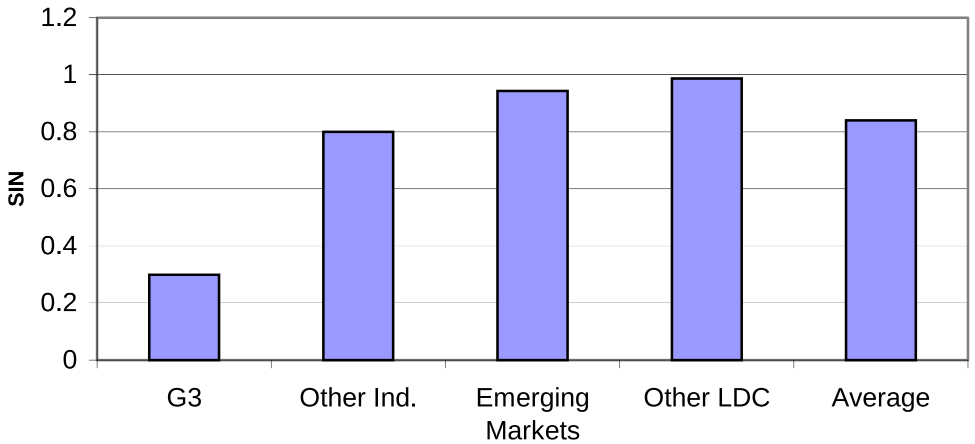


Fig. 8: Index of Original Sin



Rather than working with each index separately, we here use the same strategy as in Section 2 and use factor analysis to build an aggregate index of the inability to borrow in own currency.[14] Following Hausmann's (1999) definition of "original sin," we label this index SIN. The values of SIN are reported in the fifth column of Table A2. Interestingly, large values of the original sin index do not seem to be characteristics of developing countries only and even our group of industrial countries has a high average value of the SIN index (Figure 8).

4.2 Estimations

Equipped with our measures of passthrough and original sin, we are now ready to estimate the relationship between these two variables and the degree of exchange rate flexibility (all the regression results are reported in Table 1). We start with a very basic specification in which we regress FLEX on passthrough (PT) and original sin (SIN) only and then we check whether the results of this basic regression are robust to the inclusion of a series of controls that are likely to be correlated with both our explanatory and dependent variables.

The results of columns 1 and 2 of Table 1 are consistent with the prediction of the model of Section 3. In fact, they show that, while both PT and SIN are negatively correlated with FLEX, their interaction (PT*SIN) is positively correlated with FLEX. However, while the coefficient attached to SIN is highly significant, the coefficients attached to PT and PT*SIN are not statistically significant. Next, we control for the strong correlation between the level of development (measured with per capita income) and both the degree of exchange rate flexibility and the index of original sin (0.55 and –0.64, respectively) by augmenting the regression with the log of per capita GDP (GDPPC). Column 3 shows that controlling for the level of development does not change the results discussed above. In particular, we still find a negative and highly significant relationship between SIN and FLEX, a negative (non-significant) relationship between PT and flex and a positive (non-significant) relationship between PT*SIN and FLEX. Furthermore, column 3 shows that, once we control for SIN and PT, the correlation between exchange rate flexibility and level of development completely disappears.

Three other variables that are likely to be correlated with PT, SIN, and FLEX are the degree of openness (OPEN), total GDP (GDPT), and the number of months since the country started floating (MONTHS).[15] The degree of openness is likely to be important, because countries that trade a lot with the rest of the world are likely to be more concerned with the behavior of their exchange rate. Furthermore, even though this is not the case in our sample the degree of openness should also be correlated with the degree of passthrough (Goldfajn and Werlang, 2000). The rationale for including total GDP comes from the observation that,

[14] Clearly, as we are interested in an index of the inability to borrow in own currency we need to multiply ABILITY1, ABILITY2, and ABILITY3 by minus one. As in the case of the FLEX index, we apply a linear transformation to SIN, so that the index lays into the 0-1 range.
[15] We actually use the log of total GDP and the log of MONTHS.

if the willingness to hold assets in a given currency is positively correlated with the amount of transactions executed in that currency, then currencies of large countries will have deeper markets and residents of these countries will find it easier to borrow in their own currency. There is in fact a strong negative correlation between the SIN index and the level of total GDP (-0.88). Furthermore, there is a strong positive correlation (0.67) between the degree of exchange rate flexibility and total GDP. Finally, the rationale for including the number of months since the country started floating is based on the idea that countries need time to "learn how to float" and therefore their "fear of floating" could be negatively correlated with the duration of their floating experience. Our estimations show that, once we control for SIN and PT, none of these variables is significantly correlated with FLEX and that including them in the regression, either one at a time (column 4, 6 and 6 of Table 1) or all together (column 9) does not affect the result of a strong negative and significant correlation between SIN and FLEX.

One last problem with the estimations of Table 1 is that both FLEX and SIN take extreme values for the G3 countries (see Figures 4 and 8). Therefore, SIN could just be capturing some G3-specific factor that does not have anything to do with the ability to borrow in own currency. In fact, if we drop the SIN variable and substitute it with a G3 dummy (taking value 1 for the US, Japan and Germany, zero otherwise), we find that G3 countries have an average degree of flexibility which is 42 percentage points higher than the average degree of flexibility of the other 27 countries in the sample (column 7). This is a very high number, corresponding to more than 2 standard deviations of the FLEX index. However, if we include both the G3 dummy and the SIN index in a horserace regression, we find that, while SIN remains statistically significant at the 5 percent confidence level, the coefficient attached to the G3 dummy drops substantially and becomes insignificant (column 8 of Table 1). This last results indicates that the ability to borrow in own currency is an important determinant of exchange rate flexibility, independently from the extreme behavior of the G3 countries. Admittedly, if we include the G3 dummy in the model with all controls, both the SIN and G3 variables become insignificant (column 10). However, the high R^2 and low *t* statistics of this regression signal that there is a clear multicollinearity problem. This can be seen by regressing SIN over the other explanatory variables and noting that they explain 87 percent of the variance of the index of original sin and therefore their inclusion in the regression leads to very unstable estimates of the SIN coefficient.[16] In any case, to make sure

[16] Formally, assume that we are interested in estimating the model: $FLEX_i = \alpha_0 + \alpha_1 SIN_i + \alpha_2 X_i + u_i$ and define *RS* as the R^2 in the regression of *SIN* over *X*. Then, it is easy to show that $Var(\alpha_1) = \frac{\sigma^2}{(1-RS)\sum\left(SIN_i - \overline{SIN}\right)}$. Therefore, $\lim_{RS \to 1} Var(\alpha_1) = \infty$.

that our results of a strong negative correlation between SIN and FLEX are not driven by the inclusion of the G3 countries, we drop US, Japan, and Germany from our sample and then re-estimate the model with the full set of controls. The results of this experiment (column 11 of Table 1) clearly show that our findings are not driven by the G3 countries. In fact, even after dropping US, Japan, and Germany, we still find a negative and significant correlation between SIN and FLEX.[17]

We conclude that there is a strong and robust correlation between the ability to borrow in own currency and the degree of exchange rate flexibility. In particular, our results suggest that a one standard deviation decrease in our SIN index would be associated with a 14-percentage point increase in our FLEX index. This is equivalent to bringing the Philippines or South Africa to the same level of exchange rate flexibility as Australia or Germany. In the case of the PT index, our results always have the expected sign (both in the case of PT and of its interaction with SIN) and suggest that PT has an *economically* significant impact on exchange rate flexibility (they imply that a one standard deviation decrease in PT is associated with a 20 percentage point increase in the FLEX index). However, the PT coefficient is never *statistically* significant.[18] While we like to think that this finding is due to the attenuation bias caused by large measurement errors in our index of passthrough, we need to conclude that we have no proof that passthrough significantly affects the degree of exchange rate flexibility.

We conclude by mentioning that, while we work with aggregate indices of flexibility and original sin, in Hausmann et al. (1999) we work with disaggregated indicators of both exchange rate flexibility (the three indicators discussed in this paper plus one from Levy-Yeyati and Sturzenegger, 2000) and ability to borrow in own currency (the three ABILITY indicators discussed in this paper plus a dummy variable aimed at capturing non-linearities in the relationship between ability to borrow in own currency and exchange rate flexibility) and show that the negative relationship between original sin and exchange rate flexibility is extremely robust across specifications and definitions of the variables.

5. Conclusions

In this paper, we document that there are large differences in the exchange rate management policies of countries with a formally flexible exchange rate. In particular, we show that countries hold different levels of international reserves and are characterized by different

[17] We report that SIN is statistically significant at the 5 percent confidence level. However, with a p value 0.018, the coefficient of SIN is close to being significant at the 1 percent confidence level.

[18] Attempts to treat the PT index as a discrete variable by dividing our sample into two groups (countries with low and high passthrough) or three groups (low, medium, and high passthrough) did not yield any interesting result.

degrees of intervention in the exchange rate market. After building an aggregate index of exchange rate flexibility, we show that emerging markets are characterized by an extremely low degree of flexibility.

After documenting striking cross-country differences in the degree of exchange rate management, we discuss a model that relates the degree of exchange rate flexibility to the passthrough from exchange rate to prices and to the ability to borrow in own currency. The model finds that the higher the degree of passthrough and the lower the ability to borrow in own currency, the lower the degree of exchange rate flexibility. The model also suggests that the higher the passthrough, the weaker the connection between ability to borrow in own currency and exchange rate flexibility.

We test the model by using the passthrough coefficient estimated by Hausmann et al. (1999) and an aggregate index of (in)ability to borrow in own currency and find a strong and extremely robust negative correlation between inability to borrow in own currency and exchange rate flexibility. We also find the expected negative correlation between passthrough and exchange rate flexibility and positive correlation between flexibility and the interaction of passthrough and inability to borrow in own currency. However, the coefficients attached to these variables are never statistically significant. We conjecture that these weak results are due to the attenuation bias caused by measurement errors in the passthrough variable; however, we have no proof for this conjecture.

Table 1: The Determinants of Exchange Rate Flexibility

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)
PT	-0.017	-0.99	-1.01	-1.17	-1.13	-1.01	-0.09	-0.04	-1.24	-0.79	-0.6
	(-0.136)	(-0.136)	(-0.58)	(-0.68)	(-0.65)	(-0.57)	(-0.66)	(-0.28)	(-0.69)	(-0.44)	(-0.58)
SIN	-0.65***	-0.65***	-0.7***	-0.63***	-0.61***	-0.71***		-0.41**	-0.57**	-0.31	-0.54**
	(-5.69)	(-4.73)	(-4.39)	(-3.66)	(-3.12)	(-4.28)		(-2.01)	(-2.72)	(-1.17)	(-2.58)
PT*SIN		1.016	1.04	1.16	1.14	1.02			1.23	0.74	0.59
		(0.58)	(0.58)	(0.65)	(0.63)	(0.56)			(0.66)	(-0.4)	(052)
GDPPC			2.E-03	1.E-02	-3.E-03	2.E-03	2.E-02	4.E-03	8.E-03	2.E-02	-0.01
			(0.07)	(0.46)	(--0.11)	(0.08)	(0.94)	(0.16)	(0.26)	(0.53)	(-0.08)
OPEN				-5.E-04					-5.E-04	-6.E-04	-3.E-04
				(-1.11)					(-0.90)	(-1.15)	(-0.96)
GDPT					0.02				0.014	0.006	0.006
					(0.84)				(0.57)	(0.24)	(0.44)
MONTHS						0.001			0.005	0.008	0.005
						(0.001)			(0.24)	(0.36)	(0.40)
G3							0.42***	0.21		0.22	
							(4.65)	(1.58)		(1.47)	
Constant	0.73***	0.78***	0.76**	0.65**	0.63*	0.76**	-0.04	0.47	0.53	0.26	0.59*
	(7.91)	(6.04)	(2.52)	(2.05)	(1.83)	(2.27)	(-0.20)	(1.42)	(1.36)	(0.61)	(1.95)
Adj. R^2	0.57	0.56	0.54	0.54	0.53	0.52	0.53	0.58	0.51	0.53	0.38
N. Obs.	30	30	30	30	30	30	30	30	30	30	27

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Appendix

Table A1: Measures of Exchange Rate Flexibility

	RES/M2		RVER		RVEI		FLEX	
	Level	**Rank**	**Level**	**Rank**	**Level**	**Rank**	**Level**	**Rank**
Australia	0.06	25	6.91	5	90.21	3	0.30	26
Brazil	0.25	14	2.92	8	12.13	24	0.12	17
Canada	0.06	26	3.37	7	23.46	12	0.17	23
Chile	0.49	3	0.42	25	7.96	27	0.04	3
Colombia	0.41	5	0.93	19	8.48	26	0.06	5
Czech Republic	0.31	8	1.26	16	13.97	20	0.09	12
Dominican Rep.	0.09	23	1.58	14	11.57	25	0.12	18
Germany	0.11	21	2.84	9	157.91	2	0.29	25
Greece	0.36	6	0.39	28	25.02	9	0.08	9
Guatemala	0.3	9	0.42	26	24.94	10	0.09	11
India	0.13	20	1.21	17	3.7	29	0.10	15
Indonesia	0.34	7	2.15	13	23.38	13	0.11	16
Israel	0.26	12	0.76	21	21.38	15	0.09	13
Jamaica	0.25	15	0.27	30	2.75	30	0.07	6
Japan	0.05	28	30.45	1	377.26	1	1.00	30
Korea	0.24	16	1.35	15	14.14	19	0.10	14
Mexico	0.3	10	0.84	20	6.99	28	0.07	8
New Zealand	0.06	27	12.68	4	23.78	11	0.33	27
Norway	0.29	11	0.36	29	12.34	23	0.07	7
Paraguay	0.26	13	0.62	23	12.38	22	0.08	10
Peru	0.64	2	0.51	24	13.13	21	0.03	2
Philippines	0.24	17	2.32	11	38.5	8	0.14	19
Poland	0.45	4	0.42	27	14.58	18	0.05	4
Singapore	0.88	1	0.69	22	20	16	0.00	1
South Africa	0.06	24	2.47	10	22.8	14	0.15	20
Sweden	0.14	19	0.98	18	62.59	5	0.16	21
Switzerland	0.09	22	2.27	12	40.43	7	0.16	22
Thailand	0.23	18	6.62	6	15.16	17	0.19	24
UK	0.02	29	17.95	3	46.54	6	0.45	28
USA	0.01	30	19.38	2	69.63	4	0.50	29
Average	0.25		4.18		40.57		0.17	
St. Dev	0.19		6.99		70.99		0.20	
Min	0.01		0.27		2.75		0.00	
Max	0.88		30.45		377.26		1.00	

RES/M2, RVER, and RVEI are from Hausmann et al. (1999). FLEX is obtained by applying factor analysis to -RES/M2, RVER, and RVEI.

Table A2: Explanatory Variables

	PT	ABILITY1	ABILITY2	ABILITY3	SIN	MONTHS
Australia	0.21	0.21	0.25	0.44	0.73	189
Brazil[a]	0.81	0.00	0.05	0.00	0.97	5
Canada	0.07	0.15	0.17	0.27	0.81	359
Chile[a]	0.18	0.00	0.03	0.00	0.98	6
Colombia	0.38	0.00	0.00	0.00	1.00	1
Czech Republic	0.02	0.00	0.24	0.00	0.86	26
Dominican Rep.	0.25	0.00	0.02	0.00	0.99	32
Germany	0.07	0.28	0.46	0.87	0.54	323
Greece	0.15	0.03	0.15	0.25	0.88	298
Guatemala	0.28	0.00	0.00	0.00	1.00	118
India	0.07	0.00	0.04	0.00	0.98	250
Indonesia	0.49	0.01	0.05	0.00	0.97	23
Israel	0.16	0.00	0.02	0.00	0.99	25
Jamaica	0.31	0.00	0.01	0.00	0.99	122
Japan	0.04	0.51	0.49	1.52	0.36	250
Korea	0.18	0.00	0.01	0.00	0.99	237
Mexico	0.58	0.00	0.01	0.00	0.99	56
New Zealand [b]	0.07	0.04	0.14	1.05	0.81	175
Norway	0.09	0.01	0.13	0.05	0.92	80
Paraguay	0.59	0.00	0.00	0.00	1.00	127
Peru	0.22	0.00	0.05	0.00	0.97	109
Philippines	0.30	0.01	0.04	0.02	0.98	180
Poland	0.62	0.02	0.15	0.32	0.88	17
Singapore	0.02	0.01	0.03	0.00	0.98	318
South Africa	0.11	0.11	0.23	1.17	0.72	250
Sweden	0.14	0.02	0.21	0.08	0.87	81
Switzerland	0.02	0.16	0.27	2.06	0.60	237
Thailand	0.03	0.02	0.02	0.00	0.98	24
UK	0.03	0.47	0.19	0.94	0.60	330
USA	0.04	0.78	0.80	2.33	0.00	359
Average	0.22	0.09	0.14	0.38	0.84	153.6
St. Dev	0.21	0.19	0.18	0.65	0.23	121.6
Min	0.02	0.00	0.00	0.00	0.00	1
Max	0.81	0.78	0.80	2.33	1.00	359

[a] PT coefficients estimated by regressing changes in prices over changes in lagged exchange rate; [b] PT coefficient form Calvo and Reinhart (1999). All the other PT coefficients are from the ECM estimations of Hausmann et al. (1999). The ABILITY indices and the MONTH variables are from Hausmann et al. (1999). The SIN variable is obtained by applying factor analysis to the ABILITY variables.