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Productivity Growth and the Exchange Rate Regime: The Role of Financial Development

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Abstract

This paper offers empirical evidence that a country's choice of exchange rate regime can have a significant impact on its medium-term rate of productivity growth. Moreover, the impact depends critically on the country's level of financial development, its degree of market regulation, and its distance from the global technology frontier. We illustrate how each of these channels may operate in a simple stylized growth model in which real exchange rate uncertainty exacerbates the negative investment effects of domestic credit market constraints. The empirical analysis is based on an 83 country data set spanning the years 1960-2000. Our approach delivers results that are in striking contrast to the vast existing empirical exchange rate literature, which largely finds the effects of exchange rate volatility on real activity to be relatively small and insignificant.

1 Introduction

Throughout the developing world, the choice of exchange rate regime stands as perhaps the most contentious aspect of macroeconomic policy; witness the intense international debate over China's exchange rate system. On the one hand, the conventional wisdom in international economic policy circles is that flexible exchange rates are the best option for most countries, outside those contemplating joining a larger economic and currency union. Most developing countries, particularly commodity price exporters, face massive terms of trade shocks, and arguably need a flexible exchange rate as a shock absorber. Moreover, it appears that one of the biggest mistakes made by many Asian countries prior to the region's late 1990s financial crisis, was to try to liberalize financial markets without simultaneously making the exchange rate more flexible.

Flexibility may be the new conventional wisdom in international economic policy circles, but relatively fixed exchange rate regimes remain quite popular – and surprisingly durable – throughout the developing world, most famously in Asia, but also in many poorer developing countries.[1] Policymakers have in many cases, strongly resisted outside pressure to make rates more flexible. Who is right? The canonical theoretical literature on choice of exchange rate regime (see the discussion in Obstfeld and Rogoff, 1996, or Garber and Svensson, 1995) would seem to broadly support the case of more flexibility, given the pervasive volatility facing many of these economies. That is especially the case today, when inflation has broadly subsided throughout the developing world, and the case for needing a hard currency peg as an anti-inflation anchor is far weaker than it seemed twenty years ago.

Yet, whereas the conventional theoretical literature points towards allowing more exchange rate flexibility in many developing countries, the empirical evidence is far from decisive. Indeed, since the classic paper of Baxter and Stockman (1989), researchers have had a difficult time demonstrating that a countries choice of exchange rate regime has any systematic effect on macroeconomic performance, for variables ranging for consumption and output volatility to the level or real interest rates. There is some evidence of an effect of exchange rate volatility on trade levels (Frankel and Wei, 1993 and

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[1]Calvo and Reinhart (2002) have famously labeled many countries reluctance to allow their exchange rates to float as "fear of floating." See Rogoff et. al. (2004) for evidence on the surprising durability of fixed or pegged exchange rate regimes in poorer developing countries that have little de facto international capital market integration.

Rose, 2000). The effect, however, does not appear to be large and it is even less clear that the resulting trade expansion has any great impact on welfare (see Krugman, 1987)).[2]

In this paper, we argue that the main effect of exchange volatility may be on medium-term productivity growth, especially in countries with poorly developed financial markets. Moreover, this effect is likely to be magnified the farther behind a country is technologically relative to the frontier. Our theoretical analysis builds on the closed economy model of Aghion-Angeletos-Banerjee-Manova (2005).[3] We develop a simple stylized model that shows how exchange rate volatility can cause a higher percentage of firms in the economy to run into credit constraints. These constraints, in turn, imply a lower economy-wide average level of investment, and lower growth. The idea that exchange rate volatility can be a major source of macroeconomic volatility in many countries is supported by table 1; the table illustrates just how volatile exchange rates can be compared to most other sources of macroeconomic disturbances.

The empirical part of the paper develops a cross-country analysis where we look at data across 83 countries over the years 1960-2000. When a

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[2]Husain, Mody and Rogoff (2005) do find that developing countries with more flexible exchange rates have historically tended to have lower inflation rates, though they do not find any significant difference in growth rates. They argue informally that fixed rates may be more important for countries with more fragile political and financial institutions, but they do not provide any direct evidence for this view. For emerging markets, they find no significant different in growth or inflation across exchange rate regimes.

[3]Aghion-Angeletos-Banerjee-Manova argue that volatility can affect productivity growth in the presence of credit constrained firms. The basic explanation put forward by AABM, can be summarized as follows. Suppose that producers can decide whether to invest in short-run capital or in a long-term productivity enhancing venture. Typically, the long-term productivity-enhancing investment creates a need for liquidity in order to face medium term idiosyncratic liquidity shocks. With perfect credit markets the necessary liquidity is always supplied, but this is no longer the case when credit markets are imperfect. The liquidity shock is only financed when the firm has enough profits, because only profitable firms can borrow enough to cover their liquidity costs. A negative aggregate shock, by making all firms less profitable, makes it less likely that the liquidity need of any of them will be met. As a result, a fraction of the potentially productivity-enhancing long-term investments will go to waste, with obvious consequences for growth. A main implication is that firms in countries with better financial markets will deal better with volatility, and therefore will tend to go more for long-term investments, which in turn should generate higher aggregate growth. We note that Baldwin (1992), in his analysis of European Monetary Union, noted that a single currency might have growth effects on Europe by reducing the exchange rate premium on capital within Europe.

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country's de facto degree of exchange rate flexibility (measured in a variety of ways, including the one suggested by Reinhart and Rogoff, 2003) is interacted with its level of financial development (as measured by private credit to GDP), the results prove both robust and highly significant. Whereas a high degree of exchange rate volatility actually leads to faster productivity growth in advancing countries, it leads a lower growth in countries with relatively thin financial markets. Moreover, these effects are not only statistically significant, they appear quantitatively significant as well. For example, consider the case of Chile, whose level of financial depth ranges from 10% in 1975 to 70% in 2000. Our point estimates for our baselines regression suggest that this dramatic increase in financial development has reduced the effect of exchange rate volatility on Chile's growth by a factor of five. Our core results appears to hold intact against a variety of standard robustness tests, including attempts to quarantine the results against outliers and regional effects and allowing for alternative control variables. We also consider alternative measures of exchanger rate volatility, as well as considering distance to the technological frontier and degree of market regulation as both alternative, and supplementary, interaction variables.

Overall, our results point towards an important exception to the standard exchange rate "disconnect" puzzle (Obstfeld and Rogoff, 2001), as well as suggesting new directions for research on the choice of exchange rate regime. We present our simple stylized model in the first section after the introduction, and our empirical results come after that. The data are detailed in an appendix, which also includes further robustness tests.

2   The model

In this section, we try to develop the simplest model possible to analyze the effect of exchange rate flexibility on productivity growth. We consider a small open economy with overlapping generations of entrepreneurs and workers. We assume that nominal wages are rigid and that the central bank either fixes the nominal exchange rate or follows an interest rate rule. Productivity grows as a result of innovation, where innovation occurs to each entrepreneur with sufficient funds at the end of the first period of her life. The model focuses on the interaction of nominal exchange rate fluctuations and productivity growth. We first describe the production environment and derive the expression for equilibrium profits in function of the exchange rate. We then

analyze how firms innovate under credit constraints. Next, we introduce the central bank and the nominal exchange rate behavior. Finally, we state our main predictions on the interplay between growth, credit constraints, and the choice of exchange rate regime, which we put to test in the next section.

In our analysis, we compare the impact of different regimes on productivity growth, but do not examine the factors that lead a country to choose one or the other regime. In practice, economic ideology, history, political considerations and many other "exogenous" factors almost surely play a role in the choice of exchange rate regime. Such an analysis, while fascinating, goes behind the scope of this paper.

2.1 The environment: agents, firms, and equilibrium profits

Consider a small open economy producing a single good identical to the world good. At each period, a new continuum of two-period lived individuals is born. One half of the individuals is selected to become entrepreneurs, while the other half become workers. Individuals are risk-neutral and consume their accumulated income at the end of their life.

During the first period of their life, entrepreneurs can produce using a technology with current average productivity, namely:

$$y_t = A_t \left(l_t \right)^{\alpha},$$

where A_t denotes the country's current productivity level at date t, $\alpha < 1$, and l_t denotes the firm's labor input at date t. At the end of the first period, entrepreneurs can invest in innovation and thereby realize extra rents in their second period. We shall describe the innovation technology below. But first we derive the equilibrium labor demand and equilibrium first period profit of an entrepreneur born at date t.

Since firms in the small domestic economy are price-takers, they take the foreign price of the good, P_t^*, as given. Assuming purchasing power parity (PPP), converted back in units of the domestic currency, the value of one unit of sold output will then be equal to:

$$P_t = S_t P_t^*, \tag{1}$$

where P_t is the domestic price level and S_t is the nominal exchange rate

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(number of units of the domestic currency per unit of the foreign currency).[4] We will assume that P_t^* is constant and normalize it to 1.[5] Thus, $P_t = S_t$.

In a fixed exchange rate regime, S_t is constant, whereas under a flexible exchange rate regime S_t is random and fluctuates around its mean value $E(S_t) \equiv \overline{S}$. The reason why fluctuations in the nominal exchange rate S_t will lead to fluctuations in firms' real wealth, and consequently on innovation and growth, is that nominal wages are rigid and preset before the realization of S_t. This in turn exposes firms to an exchange rate risk as the value of sales will vary according to S_t whereas the wage bill will not.[6]

For simplicity, we take the wage rate at date t to be determined such that the real wage at the beginning of that period is equal to some reservation value, kA_t; where $k < 1$ refers to the workers' productivity-adjusted reservation utility, say from working on a home activity. We thus have:

$$\frac{W_t}{E(P_t)} = kA_t,$$

where W_t is the nominal wage rate preset at the beginning of period t and $E(P_t)$ is the expected price level. Using the fact that $E(P_t) = E(S_t) = \overline{S}$, we immediately get

$$W_t = k\overline{S}A_t.$$

The entrepreneur then chooses the amount of labor l_t to maximize profits:

$$\max_{l_t}\{A_t P_t (l_t)^\alpha - A_t k\overline{S}l_t\} = \Pi_t$$

which yields

$$l_t = \left(\frac{\alpha S_t}{k\overline{S}}\right)^{\frac{1}{1-\alpha}}$$

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[4]It is analogous to assume that exporting domestic firms do "local currency pricing". In a model with monopolistic competition and preset prices, exporting firms would also have the option to set the price in their own currency (producer currency pricing). Note that in this case, exporting firms will still be sensitive to nominal exchange rate fluctuations as foreign demand fluctuates and a strong exchange rate appreciation tends to squeeze profits. However, Bacchetta and van Wincoop (2005a) show that firms prefer to price the export good in the importer's currency when their country represents a small market share from the point of view of the importer.

[5]Implicitly we are assuming that the foreign country strictly targets the price level.

[6]In this benchmark model, the interesting measure of the real exchange rate is based on labor costs. The real rate based on price levels becomes of interest once we introduce non-traded goods or distribution services.

and

$$\Pi_t = \psi A_t \left(S_t \right)^{\frac{\alpha}{1-\alpha}}, \tag{2}$$

where $\psi \equiv (1-\alpha)(\alpha/k\overline{S})^{\frac{\alpha}{1-\alpha}}$. We thus see that equilibrium profits are increasing in the nominal exchange rate S_t.

2.2 Innovation and credit constraints

We assume that in any firm i the entrepreneur can upgrade her technology up to the current (foreign) technology frontier A_t^* in the second period of her life, if she is able to pay an innovation cost C_t^i that occurs at the end of her first period. Because innovation allows her to catch up with current frontier productivity, it is natural to assume that the cost of innovation itself depends upon foreign productivity A_t^*.[7] We assume the following linear form (multiplied by S_t as it is expressed in units of the domestic currency):

$$C_t^i = c^i S_t A_t^*,$$

where c^i is independently and identically distributed across firms in the domestic economy, and for simplicity we take its log to be uniformly distributed over some interval $[f - \gamma, f]$. The parameter $f < 0$ determines the average level of the innovation cost. While all firms face the same probability distribution over c^i ex ante, ex post the realization of c^i differs across firms. We assume that the net productivity gain from innovating is sufficiently high that it is always profitable for any entrepreneur to try and innovate.

In order to pay for her innovation cost, the entrepreneur can borrow on the local credit market. However, credit constraints will prevent her from borrowing more than a finite multiple $\mu\Pi_t$ of her current profits. We take μ as the measure of financial development and assume it constant.[8]

Thus, the funds available for innovative investment at the end of the first period are at most equal to $(1 + \mu)\Pi_t$ and therefore the entrepreneur will

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[7] A similar assumption is made by Acemoglu-Aghion-Zilibotti (2005) and Aghion-Howitt-Mayer (2005).

[8] If μ was endogenous, it would decrease with more volatile profits, thus reinforcing the negative impact of exchange rate volatility. However, we do not consider this effect explicitly.

innovate whenever:[9]

$$(1 + \mu)\Pi_t \geq C_t^i$$

Using (2), this can be reexpressed as:

$$S_t^{\frac{2\alpha-1}{1-\alpha}} \geq \frac{c_t^i}{(1+\mu)\psi a_t}$$

where $a_t \equiv A_t/A_t^*$ represents the country's productivity relative to the world technology frontier, and therefore measures the country's proximity to that frontier. By taking logs:

$$s_t \geq \widetilde{\alpha} \ln \frac{c^i}{(1+\mu)\psi a_t} \tag{3}$$

where $s_t = \ln S_t$ and $\widetilde{\alpha} \equiv \frac{1-\alpha}{2\alpha-1}$ ($\widetilde{\alpha} > 0$, since empirically $\alpha > 0.5$).[10]

In particular, an entrepreneur is more likely to innovate when the exchange rate is depreciated, with a large level of financial development, and with a greater proximity to the technology frontier. We now turn to the determination of the exchange rate.

2.3   Shocks and exchange rate behavior

Firms are affected by real and financial shocks. First, there are productivity shocks. More specifically, we assume that domestic productivity relative to the foreign frontier is random and can be expressed as:

$$a_t = \widetilde{a}_t e^{u_t}, \tag{4}$$

where $\widetilde{a}_t$ is the deterministic part of a_t and u_t is a productivity shock with $E(u_t) = 0$ and variance σ_u^2.

Second, there are shocks to the foreign exchange market. Arbitrage between domestic and foreign bonds by foreign investors give the following interest parity condition (expressed in logs):

$$s_t = s_{t+1}^e + \ln(1 + i^*) - \ln(1 + i_t) + \eta_t \tag{5}$$

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[9]The exent of borrowing and the interest rate charged obvsiously affect entrepreneurs' consumption, but has no impact on growth in this model. It would be interesting to extend the model to analyze the impact of debt and its currency composition, e.g., as in Aghion, Bacchetta, and Banerjee (2004).

[10]The reason why we need $\alpha > 0.5$ is that the innovation cost is also sensitive to the exchange rate, so that both this cost and firms profits decline in case of currency appreciation.

where i_t and i^* represent domestic and foreign nominal interest rates (on one-period bonds). The foreign interest rate is taken as given and assumed constant throughout the analysis.[11] The variable η_t represents a time-varying risk premium determined by investors in the foreign exchange market. Risk-premium shocks are introduced to model the "disconnect" between nominal exchange rate variations and other fundamental variables.[12] The variance of the risk premium is σ_η^2 and we assume that $E(\eta_t) = 0$.

For notational simplicity, we assume that when the exchange rate regime is fixed, it is set at $s_t = 0$. When the exchange rate regime is flexible, the central bank follows an interest rate (or *Taylor*) rule and the exchange rate is determined by the market. In order to stabilize profits, the central bank reacts to exchange rate shocks (equivalent to price level shocks) and to productivity shocks.[13] The rule takes the form:

$$\ln(1 + i_t) = \phi_0 + \phi_1 \cdot s_t + \phi_2 \cdot u_t \tag{6}$$

where we will assume that $\phi_0 = \ln(1 + i^*)$. For the moment we take ϕ_1 and ϕ_2 as given, but we examine below the case where they are determined optimally by the central bank.

By substituting this rule back into (5), integrating forward and ruling out speculative bubbles, we find that the equilibrium exchange rate can be expressed as:

$$s_t = \frac{1}{1 + \phi_1} \eta_t - \frac{\phi_2}{1 + \phi_1} u_t. \tag{7}$$

Now, substituting back for s_t into (3), we reexpress the innovation condition as:

$$\frac{1}{1 + \phi_1} \eta_t + \left(\widetilde{\alpha} - \frac{\phi_2}{1 + \phi_1} \right) u_t \geq \widetilde{\alpha} \ln \frac{c^i}{(1 + \mu)\psi \widetilde{a}_t} \tag{8}$$

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[11] A constant foreign interest rate can be justified if we assume a technology with constant real return r^*. Since there is no inflation in the foreign country we have $i^* = r^*$.

[12] Risk-premium shocks come from the behavior of investors who trade for reasons other than the rationally expected return. For example, Jeanne and Rose (2002) and Devereux and Engel (2003) assume that some traders have biased expectations; Duarte and Stockman (2005) assume shocks to perceived covariances; and Bacchetta and van Wincoop (2005b) assume hedging trade. The latter show that when investors have heterogenous information, small shocks to hedging trade have a large impact on the exchange rate.

[13] See Woodford (2003) for a discussion of interest rate rules and Kollman (2002) and Obstfeld (2004) for an application in an open-economy context. Kollman also introduces risk premium shocks to generate more realistic exchange rate volatility.

2.4 Productivity growth and the main theoretical prediction

Productivity growth depends on the proportion of firms that satisfy the innovation condition (8). If we let this proportion be ρ_t, the level of productivity at time t is given by:[14]

$$A_t = \rho_t A_t^* + (1 - \rho_t) A_{t-1} \tag{9}$$

Dividing through by A_t^*, and if we assume that foreign productivity A_t^* grows at the exogenous rate g^*, the domestic productivity growth rate is given by:

$$g_t = \rho_t \left[\frac{1 + g^*}{a_{t-1}} - 1 \right]. \tag{10}$$

How do we determine ρ_t? Consider first the case where the domestic economy has chosen a flexible exchange rate regime. Since the innovation costs c^i are identically and independently distributed across firms, by the law of large numbers the proportion of innovating firms ρ_t is simply equal to the probability that any individual firm innovate, namely:

$$\rho_t = \Pr\left(\frac{1}{1 + \phi_1} \eta_{t-1} + \left(\widetilde{\alpha} - \frac{\phi_2}{1 + \phi_1} \right) u_{t-1} \geq \widetilde{\alpha} \ln \frac{c^i}{(1 + \mu) \psi \widetilde{a}_{t-1}} \right). \tag{11}$$

Thus, if we let

$$\widetilde{\rho}_t = 1 + \frac{1}{\gamma} \left[\frac{\eta_{t-1}}{\widetilde{\alpha}(1 + \phi_1)} + \left(\widetilde{\alpha} - \frac{\phi_2}{1 + \phi_1} \right) \frac{u_{t-1}}{\widetilde{\alpha}} + \ln((1 + \mu)\psi a_{t-1}) - f \right],$$

we have

$$\rho_t = \begin{array}{ll} 1 & \text{if } \widetilde{\rho}_t \geq 1 \\ \widetilde{\rho}_t & \text{if } 0 < \widetilde{\rho}_t < 1 \\ 0 & \text{if } \widetilde{\rho}_t \leq 0 \end{array} . \tag{12}$$

We will assume that volatility can never help growth through some kind of a "gambling for resurrection" effect (see AABM). More precisely, we assume that with no volatility (i.e., $\eta_{t-1} = u_{t-1} = 0$) $\widetilde{\rho}_t \geq 1$, that is:
Assumption A1:

$$\ln((1 + \mu)\psi a_{t-1}) - f \geq 0.$$

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[14] The technology level is determined by the extent of innovations of firms in their second period, while new firms take the level of technology as given.

(remember that $f < 0$).

Since empirical evidence shows that exchange rate shocks are much larger than other shocks, we now focus on the case where $\sigma_u^2 = 0$. Figure 1 illustrates how the probability ρ_t depends on the exchange rate (or risk premium) shock in (12). First, consider the solid line. The innovation probability ρ_t declines for negative values of η_t, that is, with the occurrence of a domestic currency appreciation. It is easy to see that a larger variance σ_η^2 reduces ρ_t, and therefore growth. However, the broken line shows that growth declines less with σ_η^2 the higher financial development μ or technological development a_t and lower the average innovation cost as parametrized by f.

$$FIGURE\ 1\ HERE$$

While these comparative statics results hold in general, it will be convenient to develop our analysis in the special case where the exchange rate shock η_t takes only two values with equal probability, namely

$$\eta_t \in \{-\varepsilon^\eta, \varepsilon^\eta\}.$$

In this case, the variance of the exchange rate shock is simply equal to $\sigma_\eta^2 = (\varepsilon^\eta)^2$. Moreover, if we assume that ε^η is such that for all t, $0 < \widetilde{\rho}_{t+1} < 1$ when $\eta_t = -\varepsilon^\eta$, then the average growth rate g_{t+1} in period $(t+1)$, is simply expressed as:

$$g_{t+1} = E(\rho_{t+1}) \left[\frac{1+g^*}{a_t} - 1 \right],$$

where

$$E(\rho_{t+1}) = \min\{1, 1 + \frac{1}{2\gamma}[-\frac{\varepsilon^\eta}{\widetilde{\alpha}(1+\phi_1)} + \ln((1+\mu)\psi a_t) - f]\} \tag{13}$$

whenever this expression is positive.

Notice that for sufficiently large levels of financial and technological development (that is, when μ and a_t are large enough), we have

$$E(\rho_{t+1}) = 1.$$

However, when μ and a_t are not too large, (13) holds and expected growth decreases with exchange rate volatility measured by ε^η.

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If we now consider the case where the domestic economy has chosen a fixed exchange rate regime, Assumption A1 implies that the expected growth rate in period $(t + 1)$ is independent of volatility and always equal to:

$$g_{t+1} \equiv \left[\frac{1 + g^*}{a_t} - 1 \right].$$

We thus have:

Proposition 1 *Suppose that $\rho_t = 1$ when $\sigma_\eta^2 = 0$. Then, moving from a fixed to a flexible exchange rate will reduce average growth all the more: i) with a lower level of financial development as measured by μ; ii) in a country where productivity lies further below the world frontier productivity.*

Remark 1: *Convergence:* Combining the above analysis with that in Aghion-Howitt-Mayer (2005), we conjecture that the lower the degree of financial development in a country, the more likely it is that higher exchange volatility will prevent the country from converging to the world technological frontier in growth rates and/or in per capita GDP levels.

Remark 2: *Market Regulation:* Suppose that innovation costs reflect market flexibility, with more flexible product and/or labor markets implying a lower innovation costs as they allow firms to re-orient production across markets more easily. Then, the innovation cost parameter f will reflect the degree of product or labor market rigidity or regulation. Obviously, the innovation probability ρ_t decreases with f. In particular, the higher f, the more an increase in exchange rate volatility will reduce growth (starting from no volatility) and the more detrimental to growth it will be to move from a fixed to a flexible exchange rate regime.

Remark 3: *Endogenous interest rate rule:* Assume that the government chooses the optimal ϕ_1, but faces a cost to adjust interest rates (so that ϕ_1 is finite). The government will then be more "aggressive" with larger volatility. In other words, the optimal ϕ_1 increases with σ_η^2, as shown in the Appendix. It is easy to see from (12) and Figure 1 that an increase in ϕ_1 tends to dampen the effect of increased volatility on expected growth, but that the conclusions in Proposition 1 remains valid.

2.5   On the stabilizing role of flexible exchange rates

Proposition 1 was established for the case without productivity shocks. However, it is often argued that a flexible exchange rate regime may be desirable

because it allows a country to stabilize the effect of real shocks.[15] The interesting question, then, is whether a fixed exchange rate still dominates a flexible exchange rate once we introduce productivity shocks on top of exchange rate shocks. The answer turns out to be positive insofar as σ_u^2 is not too large compared to σ_η^2.

To see this, consider the simple case of two-point distributions for both shocks, with $u_t \in \{-\varepsilon^u, \varepsilon^u\}$ and $\eta_t \in \{-\varepsilon^\eta, \varepsilon^\eta\}$. Moreover, let us assume that[16]:

$$\begin{aligned} \widetilde{\rho}_{t+1}(\varepsilon^\eta, \varepsilon^u) &\geq& 1; \widetilde{\rho}_{t+1}(-\varepsilon^\eta, \varepsilon^u) < 1; \\ \widetilde{\rho}_{t+1}(\varepsilon^\eta, -\varepsilon^u) &<& 1; \widetilde{\rho}_{t+1}(-\varepsilon^\eta, -\varepsilon^u) < 1. \end{aligned}$$

Now, under the assumption that $\rho_t = 1$ in the absence of volatility, we can compare expected growth rates respectively under flexible and fixed exchange rate regimes using an equation analogous to (13). We find that a flexible exchange rate regime yields a higher growth rate whenever:

$$\frac{\varepsilon^u}{\varepsilon^\eta} > (\widetilde{\alpha} - 1)(1 + \phi_1) + \phi_2. \tag{14}$$

This inequality has interesting implications. First, in most countries the parameter $\widetilde{\alpha}$ $(\equiv \frac{1-\alpha}{2\alpha-1})$ is close to 1 and ϕ_2 is less than one, so that we essentially need $\sigma_u^2 > \sigma_\eta^2$ for exchange rate flexibility to be growth-enhancing. Second, to the extent that financial (and also technological) development affect the optimal Taylor rule (ϕ_1, ϕ_2), they interact with the relative variance $\varepsilon^u/\varepsilon^\eta$ in determining which exchange rate regime dominates. More specifically, the Appendix examines the case where ϕ_1 and ϕ_2 are determined optimally by the central bank. In particular, it is shown that ϕ_1 and ϕ_2 decrease with μ and a_t. Thus, (14) is more likely to hold when μ and a_t are large. In other words, a flexible exchange rate is more likely to foster growth in countries at higher level of financial development and technology.

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[15]Broda (2004) and Edwards and Levy-Yeyati (2003) show empirically that flexible exchange rates dampen the impact of terms-of-trade shocks on output or growth. We will show that this finding also holds in our data sample.

[16]It is straightforward to extend the analysis to the case where $\widetilde{\rho}_t(-\varepsilon^\eta, \varepsilon^u) \geq 1$ and/or $\widetilde{\rho}_t(\varepsilon^\eta, -\varepsilon^u) \geq 1$.

3 Empirical Results

The theoretical analysis showed that exchange rate volatility can reduce productivity growth for countries with a low level of financial development, far from the technology frontier, and with a higher degree of market regulation. In this section we test these predictions in a dynamic panel of 89 countries over the 1960-2000 period. We consider three measures related to exchange rate flexibility: i) the exchange rate regime based on the natural classification of Reinhart and Rogoff (2004), henceforth RR; ii) the standard deviation of the real effective exchange rate; iii) the degree of "overvaluation". The latter measure is suggested by our theoretical analysis: with rigid wages, only real appreciations reduce profits.[17] We first present the methodology and the variables used and then examine each prediction in turn. We find that they are confirmed by the data.

3.1 Data and Methodology

As is now standard in the literature, we construct a panel data set by transforming our time series data into five-year averages. This filters out business cycle fluctuations, so we can focus on long run growth effects. Our dependent variable is productivity growth, rather than total growth. We use the GMM dynamic panel data estimator developed in Arellano and Bond (1991), Arellano and Bover (1995) and Blundell and Bond (1997) and we compute robust two-step standard errors by following the methodology proposed by Windmeijer (2004).[18] This approach addresses the issues of joint endogeneity of all explanatory variables in a dynamic formulation and of potential biases induced by country specific effects. The panel of country and time-period observations is unbalanced. Appendix C presents the lists of country included

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[17]This prediction comes from the simple specification of our model. There may be other channels at work. For example, in the context of financial crises, it is an undervaluation that may lead to a squeeze in profits and a decline in output (e.g., see Aghion, Bacchetta, and Banerjee, 2004). Whether an overvaluation has a negative impact is an empirical question that we examine in this section.

[18]It has been recognized that the two steps standard errors are downward biased in a small sample and the Windmeijer (2004) method corrects for that. Notice that, as the two-step estimator is asymptotically efficient, this approach is superior to just relying on first step estimates and standard errors as is common in the empirical growth literature that uses small samples. See Bond (2002) for a simple description of the methodology we follow.

in the sample.

Our benchmark specification follows Levine, Loayza and Beck (2000) who provide evidence of a growth enhancing effect of financial development; they were the first to use the system GMM estimation we are using. We consider productivity growth instead of total growth, but our regressions are estimated with the same set of control variables.[19] Starting from this benchmark, we examine the direct effect on growth of our exchange rate flexibility measures. Then, we look at the interaction between these measures and the level of financial development, the distance to the technology frontier, and various measures of regulation. More specifically, we estimate the following equation:

$$y_{i,t} - y_{i,t-1} = (\alpha - 1) y_{i,t-1} + \gamma_1 ER_{i,t} + \gamma_2 ER_{i,t} * I_{i,t} + \delta I_{i,t} + \beta' Z_{i,t} + \mu_t + \eta_i + \varepsilon_{i,t}$$
$$(15)$$

where $y_{i,t}$ is the logarithm of output per worker; $ER_{i,t}$ is either the degree of flexibility of the exchange rate regime, real exchange rate volatility, or a measure of overvaluation; $I_{i,t}$ is the dimension of interaction (financial development, distance to frontier or market regulation); Z_{it} is a set of other control variables, μ_t is the time-specific effect, η_i is the country-specific effect, and $\varepsilon_{i,t}$ is the error term.

We use three measures for the variable $ER_{i,t}$. First, we compute an index of flexibility of the exchange rate regime in each five-year period based on the RR exchange rate classification. Ignoring the free falling category, the RR annual natural broad classification orders regimes from the most rigid to the most flexible: $ERR_t \in \{1,2,3,4\} = \{fix, peg, managed\ float, float\}$. Hence, we construct the index of exchange rate flexibility in each five year interval as:[20]

$$Flex_{t,t+5} = \frac{1}{5} \sum_{i=1}^{5} ERR_{t+i}$$

The second measure we consider for $ER_{i,t}$ is the five-year standard deviation of annual log differences in the effective real exchange rate. We construct

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[19]See their table 5, page 55. The other differences with Levine et al. (2000) are that we use a larger data set, we use the Windmejer standard errors, and we include a banking crisis dummy. Loayza and Ranciere (2005) show that their results stay unchanged when the original panel is extended to 83 countries over 1960-2000 and when a banking crisis dummy is introduced. Levine et al. (2000) show similar results when the same equation is estimated in cross-section with legal origin as external instrument.

[20]The information on the flexibility of exchange rate is reported for each country-5 years interval during which the RR classification indicates a non free falling regime for at least 3 out of 5 years.

the effective rate as a trade-weighted index of multilateral real rates as explained in Appendix A. The third measure is the five-year average deviation from a predicted level of the real effective exchange rate.[21]

For the interaction variable $I_{i,t}$ we first consider financial development measured as in Levine, Loayza and Beck (2000) by the aggregate private credit provided by banks and other financial institutions as a share of GDP. Second, we use the distance to the world technology frontier measured by initial labor productivity in each five-year period. Third, we consider a set of indicators of market regulations constructed by Loayza, Oviedo and Serven (2004). In the latter case, we only have cross-country averages.

The dependent variable is growth in real GDP per worker. Our set of control variables includes average years of secondary schooling as a proxy for human capital, inflation and the size of the government (government expenditure as proportion of GDP) to control for macroeconomic stability, and an adjusted measure of trade openness.[22] A dummy indicating the frequency of a banking or a currency crisis within each five years interval is introduced in the robustness checks. This indicator controls for rare but severe episodes of aggregate instability likely to be associated with large changes in the variables of interest.[23]. Definition and sources for all variables are given in Appendix B.

The introduction of an interaction term $I_{i,t}$ allows to identify non linear effects of the degree of flexibility of the exchange rate on productivity growth. Furthermore when γ_1 and γ_2 have opposite signs, a threshold effect arises:

$$\frac{\delta(y_{i,t} - y_{i,t-1})}{\delta ER_{i,t}} = \gamma_1 + \gamma_2 I_{i,t} > 0 \Leftrightarrow I_{i,t} > \widetilde{I} := -\frac{\gamma_1}{\gamma_2}$$

In tables 3 to 5, we report threshold levels of financial development and technological development above which a more flexible exchange rate becomes

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[21]More precisely, we compute the average log difference between the actual exchange rate and the exchange rate predicted by country and time specificic characteristics (income per capita, population densisty, regional and time dummies) as in Dollar (199*). We also consider average log differences from a HP detrended multilateral exchange rate series as in Goldfajn and Valdes (1999), and find similar results.

[22]precisely: the residuals of a pooled regression of (imports + exports)/GDP over structural determinants of trades such as landlock situation, an oil producers dummy, and population.

[23]For instance, Loayza and Hnakovska (2003) present evidence hat crisis volatility can explain for an important part the negative relashionship between volatility and growth oberved in middle-income economies.

growth enhancing. The standard errors of the respective threshold levels are computed using a delta method, that is by taking a first order Taylor approximation around the mean. Notice that in small sample, the delta method is known to result in excessively large standard errors[24].

3.2 Estimation Results: Exchange Rate Flexibility and Financial Development

Tables 2, 3 and 4 present the estimations of the impact of the exchange rate regime, exchange rate volatility and real overvaluation on productivity growth. Each table displays the results of four regressions. The first regression estimates the effects of the exchange rate measure along with financial development and a set of control variables, without interaction term. The second regression adds a variable interacting the exchange rate measure and the measure of financial development in order to test our main prediction: the presence of a *non-linear effect* of exchange rate volatility in the level of financial development. The third and fourth regressions replicate the same regressions with the addition of a dummy variable indicating the frequency of a currency or banking crisis in the five-year interval.

In Table 2, regression [2.1] illustrates the absence of a linear effect of the exchange rate regime on productivity growth. This result is consistent with many previous studies. In contrast, regression [2.2] shows that the interaction term of exchange rate flexibility and financial development is positive and significant. The more financially developed an economy, the higher is the point estimate of the impact of exchange rate flexibility on productivity growth. Furthermore, the combined interacted and non-interacted coefficient of flexibility becomes significant at the 5% level (as indicated by the Wald Test in Table 2). Combining these two terms enables us to identify a threshold of financial development below (above) which a more rigid (flexible) regime fosters productivity growth. The point estimate of the threshold is close to the sample mean of the financial development measure. In regressions [2.3] and [2.4], we introduce the crisis dummy described above. While the frequency of crisis has indeed a negative impact on productivity growth, the non-linear effect of exchange rate regime on growth remains robust and its point estimate stays almost unchanged.

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[24]An more accurate procedure would be to derive standard errors on thresholds using a bootstrap method.

The main result of Table 2 is that letting the degree of exchange rate flexibility vary with the level of financial development allows us to identify significant growth effects of the exchange rate regime.[25] The implication is that less financially developed economies may derive growth benefits from maintaining a rigid exchange rate regime. This result provides a novel rational interpretation for the "fear of floating" behavior based on long run productivity growth.

Table 3 presents similar results with exchange rate volatility measured by the five-year volatility of the change in multilateral real exchange rates. Regression [3.1] indicates that exchange rate volatility has a significant negative impact on productivity growth. This effect is economically important: an increase of 50 percent in exchange rate volatility - which corresponds to the mean difference in volatility between a fixed and a flexible exchange rate (see Table 1) - leads to a 0.33 percent reduction in annual productivity growth. This effect is only marginally reduced when we control for the impact of a crisis as in regression [3.3]. Regression [3.2] shows that the interaction between exchange rate volatility and financial development is positive and significant: the more financially developed an economy is, the less adversely is it affected by exchange rate volatility. Here again, the economic impact is important. For instance, consider Chile, whose level of financial depth ranges from 10% in 1975 to 70% in 2000. This drastic change decreases the negative impact of exchange rate volatility on growth by a factor of five. Moreover, our estimate indicates that exchange rate volatility exhibits no significant impact on productivity growth for the set of the most financially developed economies.[26]

Table 4 presents regressions that focus on the effect of real exchange overvaluation. Here, we test the implication of our model that exchange rate fluctuations resulting in overvaluations will dampen productivity growth by reducing firms' profits and by increasing their exposure to liquidity risk. We present the results using the deviation between the actual effective real exchange rate and its predicted value.[27] In the baseline regression [4.1], real overvaluation has a significant and economically important negative effect on growth: a 20% overvaluation translates into a reduction of 0.2% in annual

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[25]**We also considered alternative classifications ...**

[26]These are countries with a private credit to GDP ratio in the range of [90%,120%]. This includes the euro aera, the U.K., Switzerland, Finland, Sweden, the US, and Australia.

[27]We obtain similar results when we consider HP deviation from trend when - as in Golfajn and Valdes - the HP filter parameter is set high enough (lamba=10^8)

productivity growth (computed from regression [3.1] as 0.99*ln(120/100)). Regression [4.2] studies the effect of interacting real overvaluation and financial development and shows that the more financially developed an economy is, the less vulnerable it becomes to real overvaluations. Using the previous example, a change in financial depth comparable to the one experienced by Chile over 1975-2000 results in a reduction by two of the negative effect of real overvaluation on productivity growth.

The set of regressions presented in Tables 2, 3 and 4, offers robust evidence that the level of financial development plays an important role in mitigating the negative effects of exchange rate volatility on productivity growth. They rationalize the observation that countries with a low or intermediate level of financial development manage their exchange rate and monetary policies in order to reduce real exchange rate fluctuations. These results stay unchanged when the effects of crises are accounted for. It is also reassuring that control variables in the regression have the expected effects: education and trade openness have a positive and significant impact on growth while the effect of inflation and government burden is negative although not always statistically significant..

The estimation procedure is valid only under the assumption of weak exogeneity of the explanatory variables. That is, they are assumed to be uncorrelated with future realizations of the error term. The consistency of the GMM estimators depends on whether lagged values of the explanatory variables are valid instruments in the growth regression. We address this issue by considering two specification tests suggested by Arellano and Bond (1991) and Arellano and Bover (1995). The first is a Sargan test of over-identifying restrictions, which tests the overall validity of the instruments. Failure to reject the null hypothesis gives support to the model. The second test examines whether the differenced error term is second-order serially correlated. In all regressions, we can safely reject second order serial correlation and the non-validity of our instruments.

3.3 Estimation Results: Exchange Rate Flexibility and Distance to the Productivity Frontier

In this section, we test the prediction that the effect of exchange rate flexibility on growth depends on the level of technological development measured by labor productivity. The empirical strategy is similar to the one previously

followed to assess the role of financial development. The impact of exchange rate volatility and of labor productivity are first analyzed in a linear set-up before being interacted in order to uncover any non-linear effects. Formally, the distance to the technology frontier can be expressed as:

$$d_{i,t} = \ln(y_{i,t}/l_{i,t}) - \ln(y_{us,t}/l_{u,t})$$

where $y_{i,t}$ and $l_{i,t}$ are respectively the initial level of output and the labor force at the inception of each five year period. As our regressions include a common time effect, we can simply ignore the term $\ln(y_{us,t}/l_{u,t})$ and measure the distance to the frontier with the absolute level of labor productivity, $\ln(y_{i,t}/l_{i,t})$.

As we are using the same baseline specification, the regressions without interacted terms are identical to the ones presented in columns 1 and 3 of Tables 2, 3, and 4. Notice that in the pure linear specification, the coefficient on initial output per worker, i.e. the convergence term, is negative but not significant except in the regression using real exchange rate volatility. Table 5 presents the results of regressions performed using the flexibility of exchange rate regime, real exchange rate volatility and real overvaluation.

Regression [5.1] shows that the interaction between labor productivity and the exchange rate regime has a positive and significant impact on growth. The interpretation is that the higher the level of productivity, the better (or the less detrimental) is the impact of a more flexible exchange rate regime on productivity growth. We can identify a threshold level of output per worker above (below) which a more flexible (rigid) regime fosters productivity growth. The point estimate of this threshold is US\$ 5000 (constant 1995 US\$), which is close to the actual productivity levels of present day Thailand and Peru and to the levels of Korea and Chile in the seventies.

Regressions [5.2] and [5.3] reveal a similar non-linear effect when exchange rate volatility and real overvaluation are considered. A higher initial level of productivity dampens the negative impact of exchange rate volatility or overvaluation on productivity growth. A threshold analysis suggests that, in economies close enough to the technological frontier [i.e. with $y_{i,t}/l_{i,t} > \$30000$, the level of Spain in 1985], exchange rate volatility or real overvaluation does not impact the productivity growth process.

3.4 Estimation Results: Exchange Rate Flexibility and

Term of Trade Growth

In the theory, we showed that a flexible exchange rate regime can stabilize the effects of real shocks, but still have a negative impact on growth. In order to test this hypothesis in our sample and to contrast it with our prior findings, we analyze here the effect of change in the terms of trade on productivity growth. Broda (2004) and Edwards and Levy-Yeyati (2003) have confirmed empirically that flexible exchange rate regimes tend to absorb the effects of term of trade shocks. In the baseline regression [6.1], a 10% deterioration in terms of trade leads to a reduction of 0.8% in productivity growth. In regression [6.2], we find that the impact on productivity growth of a term of trade shock depends crucially on the nature of the exchange rate regime. It is maximal under a fix exchange rate regime and close to zero under a floating regime. In regression [6.3], we show that this stabilization effect of a more flexible regime fully coexists with the growth enhancing effect of a more fixed regime in less financially developed economies.

3.5 Estimation Results: Exchange Rate Flexibility and Market Regulations

In section 2.4, we propose an alternative interpretation of our model in terms of market regulations. The bottom line is that a highly regulated economy may find itself ill-suited to face large real exchange rate shocks. For example, a high degree of product regulation, e.g. the need for licenses to produce and trade some goods, can prevent firms to respond to large exchange rate shocks by investing in the production of new goods or by shifting production between home and foreign markets. Regulation of entry can have similar effects. Another example is the regulation on closure: the absence of bankruptcy protection can force firms into lengthy and costly liquidation procedures and prevent a more productive use of their assets.

We use the regulation indices constructed by Loayza, Oviedo and Serven (2004) from various sources including the "Doing Business Survey" (The WorldBank Group). Here we consider 4 indices: labor regulation, product regulation, regulation of entry and bankruptcy regulation (or regulation of closure). We also include an overall index of regulation. Regulation indices are normalized between zero and one with a higher value standing for higher levels of regulation.

An important caveat is that, in contrast to the other variables, the regulation indices are constructed from various surveys performed in the nineties and do not exhibit time variation. Therefore, we can identify and test the effect of the interaction between regulation indices and the flexibility of the exchange rate but not their individual effect on productivity growth. More precisely, the regulation index, along with any fixed effect, drops out when equations are taken in differences.[28] The number of observations is also smaller

Our model predicts a negative interaction between the indices of regulation for entry, closure and product and the degree of flexibility of the exchange rate regime. That is, highly regulated economies may suffer more severely from exchange rate volatility and could therefore benefit from a more rigid exchange rate regime. The prediction on labor regulation is more ambiguous because labor market regulation, usually associated with more rigid nominal wages, can also be an amplifying source of exchange rate shocks. The results presented in Table 7, provide encouraging support to our model's predictions: the interaction between the degree of flexibility of the exchange rate regime is in all cases negative. It is significant, at the 5% level, in the case of production and closure but not in the case of entry or labor.[29]

4   Conclusion

The vast empirical literature following Baxter-Stockman (1989) and Flood-Rose (1994) generally finds no detectable difference in macroeconomic performance across fixed versus floating exchange rate regimes. In this paper, we argue that instead of just looking at macroeconomic volatility, it is also important to look for the effects of the exchange rate regime on growth. We develop a theoretical model in which higher levels of exchange rate volatility can stunt growth, especially in countries with thin capital markets. We offer what seems to be fairly robust evidence suggesting the importance of the financial development for how the choice of exchange rate regime affects

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[28]A separate coefficient for each regulation index could in principle be estimated only from the level equation. We nevertheless choose not to include it in order to keep only variables that enters both in the level and difference equations of the system estimated by GMM.

[29]**a natural robustness check would be to add to these regressions the interaction between financial development and flexibility of the exchange rate regime analysed in Table 3.**

growth.[30] Indeed, at this point, the main qualification to our results would seem to be the standard question of endogeneity. Whereas it is indeed difficult to find satisfactory instruments, we note that we obtain similar results for various measures of exchange rate volatility, as well as when we look at measures of distance from frontier and degree of market regulation in place of the level of financial development. Also, by excluding high inflation "freely falling" exchange rate regimes in our baseline regressions, we are hopefully eliminating the most egregious cases where weak institutions would simultaneously explain low productivity growth and the choice of exchange rate regime (generally flexible because high inflation makes a sustained fix impossible.)

Are our result necessarily at odds with the prescriptions of the standard exchange rate models? Not necessarily. The classical literature holds that the greater the volatility of real shocks relative to financial shocks a country faces, the more flexibility is should allow in its exchange rate. Our analysis shows that this prescription has to be modified to allow for the fact that financial market shocks are amplified in developing countries with thin and poorly developed credit markets. In particular, countries should adopt more flexible exchange rates the greater the effective volatility of real shocks relative to the effective volatility of financial market shocks. Clearly, more fully articulated structural models are needed to properly measure the tradeoffs, and this would appear to be an important challenge for future research.

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[30]Rogoff et. al (2004) and Husain, Mody and Rogoff (2005) do find differences in exchange rate regime performance across developing countries, emerging markets and advanced economies. However, perhaps because they do not incorporate any structural variables in their regressions such a private credit to GDP, or distance to frontier, they only found significant and robust effects of exchange rate regime choice on growth in advanced economies.

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A   Endogenous Interest Rate Rule

A.1   Risk-premium shocks

First assume $\sigma_u^2 = 0$. Consider the interest rate rule that maximizes growth in period t minus a convex cost of interest rate deviation from its steady-state value.[31] Suppose that deviating from the long-run steady-state interest rate i^* entails a convex cost

$$C(\ln(1 + i_t) - \ln(1 + i^*)) = C(\frac{\phi_1}{1 + \phi_1} \eta_t).$$

The central bank will choose ϕ_1 to solve:

$$\max_{\phi_1}\{E_{\eta_t}(g(\eta_t)) - E_{\eta_t}(C(\frac{\phi_1}{1 + \phi_1} \eta_t))\}.$$

In the special case where the cost C is quadratic with

$$C(x) = \chi x^2,$$

the first order condition for this maximization program is expressed as:

$$\frac{2\chi\sigma_\eta^2}{(1 + \phi_1)^3} = \frac{d}{d\phi_1} E_{\eta_t}(g(\eta_t)) = \frac{\varepsilon^\eta}{2\gamma\widetilde{\alpha}(1 + \phi_1)^2}\left[\frac{1 + g^*}{a_t} - 1\right],$$

or equivalently

$$1 + \phi_1 = 4\gamma\chi\widetilde{\alpha}\varepsilon^\eta / \left[\frac{1 + g^*}{a_t} - 1\right],$$

which in turn determines a finite value of ϕ_1, which is increasing in ε^η. We then have:

$$\frac{dE_{\eta_t}(g(\eta_t))}{d\varepsilon^\eta} = -\frac{1}{2\gamma\widetilde{\alpha}(1 + \phi_1)}\left[\frac{1 + g^*}{a_t} - 1\right] = -\frac{1}{8\gamma^2(\widetilde{\alpha})^2\chi\varepsilon^\eta}\left[\frac{1 + g^*}{a_t} - 1\right]^2$$

for sufficiently low μ, otherwise this derivative is equal to zero. In particular, we see that endogeneizing ϕ_1 tends to dampen the effect of increased volatility on expected growth, as it allows the government or central bank to adjust the interest rate and therefore the exchange rate so as to partly offset the negative effect of the exchange rate shock on average growth. Yet, adjustment costs prevent the government from fully eliminating the shock, and therefore the conclusions of Proposition 1 regarding the interactions between exchange rate volatility and financial or technological development remain valid.

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[31]This cost is meant to capture complementary reasons for interest rate smoothing, e.g along the arguments put forward by Sack and Wieland (2000) or Woodford (2003).

A.2 Productivity and risk-premium shocks

Here we introduce a productivity shock on top of the exchange rate shock, and assume two-point distributions for both shocks. Under the assumption that $\widetilde{\rho}_{t+1}(\varepsilon^\eta, \varepsilon^u) \geq 1$, $\widetilde{\rho}_{t+1}(-\varepsilon^\eta, \varepsilon^u) < 1$, $\widetilde{\rho}_{t+1}(\varepsilon^\eta, -\varepsilon^u) < 1$, $\widetilde{\rho}_{t+1}(-\varepsilon^\eta, -\varepsilon^u) < 1$, the analogue of equation (13) is:

$$E_{\eta_t, u_t}(g(\eta_t, u_t)) = E(\rho_{t+1}) \left[\frac{1 + g^*}{a_t} - 1 \right]$$

where

$$E(\rho_{t+1}) = \left\{ 1 - \frac{1}{4\gamma} \left[\frac{\varepsilon^\eta}{\widetilde{\alpha}(1 + \phi_1)} + \left(\frac{1}{\widetilde{\alpha}} - \frac{\phi_2}{\widetilde{\alpha}(1 + \phi_1)} \right) \varepsilon^u + 3\ln((1 + \mu)\psi a_t) - f \right] \right\}$$

The quadratic cost of deviating from i^* is (assuming $\sigma_{\eta u} = 0$):

$$E_{\eta_t, u_t} C(\eta_t, u_t) = \frac{\chi}{(1 + \phi_1)^2} \left(\phi_1^2 \sigma_\eta^2 + \phi_2^2 \sigma_u^2 \right)$$

The central bank will choose ϕ_1 and ϕ_2 to solve:

$$\max_{\phi_1, \phi_2} E_{\eta_t, u_t} \{ (g(\eta_t, u_t)) - C(\eta_t, u_t) \}.$$

The first order conditions give:

$$1 + \phi_1 = \frac{8\gamma\chi\widetilde{\alpha}\sigma_\eta^2}{\varepsilon^\eta - \phi_2 \varepsilon^u} \Big/ \left[\frac{1 + g^*}{a_t} - 1 \right]$$

$$\phi_2 = \frac{1 + \phi_1}{8\gamma\chi\widetilde{\alpha}\varepsilon^u} \left[\frac{1 + g^*}{a_t} - 1 \right]$$

In particular, we see that ϕ_1 is independent of ε^u, while ϕ_2 only depends upon ε^η and ε^u.

Now consider what happens when μ or a_t increases. For sufficiently large μ or a_t, we have $\widetilde{\rho}_{t+1}(-\varepsilon^\eta, \varepsilon^u) = 1$ and/or $\widetilde{\rho}_t(\varepsilon^\eta, -\varepsilon^u) = 1$, which in turn leads to lower optimal values for ϕ_1 and ϕ_2.

28

B Construction of the Real Exchange Rate Measures

B.1 Effective Real Exchange Rate

The empirical counterpart to the real exchange rate concept proposed in the model is a trade-weighted effective exchange rate measure deflated using labor costs. We use the same time invariant trade weights as in Goldfajn and Valdes (1999): trade shares with major trade partners in 1985 from United Nation Trade Statistics [32]. As reliable data on labor costs are available only for a small subset of countries, we use the relative price level of consumption from international comparison of prices in Penn World Tables 6.1 in order to obtain real exchange rate values. The formula for the effective real exchange rate is:

$$RER_i^{SH} = \prod_{j=1}^{J}(P_i/S_{ij}P_j)^{w_{i,j}}$$

where $i \in [1, 99]$ and $j \in [1, 14]$ index the country and its trade partners, P_i and P_j are the prices of the same basket of consumption goods in domestic currency in country i and country j, S_{ij}, the nominal exchange rate, i.e. the number of units of currency i for a unit of currency j, and w_{ij} the weight of country j in the trade exchange of country i.

An alternative measure of the effective real exchange rate is constructed using monthly CPI data from International Finance Statistics and monthly nominal exchange rate. As CPI is an index series normalized at 100 in 2000 for every countries, we obtained an *index* of real exchange rate:

$$RER_i^{cpi} = \prod_{j=1}^{J}(I_i^{cpi}/S_{ij}I_j^{cpi})^{w_{i,j}}$$

where I_i^{cpi} is the CPI index.

B.2 Real Exchange Rate Volatility.

The volatility of the real exchange rate used in the regression analysis is computed in each five year interval as the annual standard deviation of the

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[32]see Appendix B for the list of major trade partners.

growth rate of the effective real exchange rate:[33]

$$\sigma_{i,t,t+5} = stdev[\ln(RER_{it}^{SH}) - \ln(RER_{it-1}^{SH})]$$

B.3 Real Overvaluation

In order to construct a measure of real exchange rate overvaluation, we follow Dollar (1987). The equilibrium concept for the real exchange rate is Purchasing Power Parity adjusted from differences in the relative price of non tradeables to tradeables attributed to differences in factor endowments (i.e. the "Balassa-Samuelson" effect). Following Dollar (1987), we perform the following pooled OLS regression where income per capita and geographical dummies are used as proxies for factor endowments:

$$\ln(RER_{i,t}^{SH}) = \alpha + \beta_t d_t + \gamma \ln(Y_{it}) + \delta lac + \eta afri + \varepsilon_{i,t} \qquad (16)$$

where d_t is a time dummy, Y_{it} GDP per capita, lac and $afri$ continental dummies for Latin-American and African countries. Therefore, the real overvaluation measure is defined as:

$$ROVI_{i,t} = 100 \times [((RER_{i,t}^{SH}) - \widehat{RER_{i,t}^{SH}})]$$

where $\widehat{RER_{i,t}^{SH}}$ is obtained by taking the antilog of the predicted series in regression (16).[34]

An alternative measure of Real Overvaluation is derived following Goldfajn-Valdes (1999) as the log deviation of the CPI based measure of real exchange rate, RER_i^{CPI} from a stochastic trend constructed using a Hodrick-Prescott filter with a smoothing parameter: $\lambda = 10^8$

---

[33]Using growth rates to control for trending behavior in real exchange rate is standard in the literature (e.g. Hussain, Mody and Rogoff (2005))

[34]The estimation of equation (16) yields

	coef
	coef
$\widehat{\gamma}$	0.234***
$\widehat{\delta}$	-0.139*** *** denotes 1% significance
$\widehat{\eta}$	-0.081***
R^2	0.27

Appendix B: List of Countries

	Full 99 Countries Sample	Sample of 83 Countries Used in the Regression Analysis	Major Trade Partner
Algeria	x	x	
Argentina	x	x	x
Australia	x	x	x
Austria	x	x	
Bahrain	x		
Bangladesh	x	x	
Belgium	x	x	
Bolivia	x	x	
Botswana	x	x	
Brazil	x	x	x
Burkina Faso	x	x	
Burundi	x		
Cameroon	x		
Canada	x	x	
Central African Republic	x		
Chile	x	x	
China	x	x	
Colombia	x	x	
Congo, Dem. Rep.	x	x	
Congo, Rep.	x	x	
Costa Rica	x	x	
Cote d'Ivoire	x	x	
Denmark	x	x	
Dominican Republic	x	x	
Ecuador	x	x	
Egypt, Arab Rep.	x	x	
El Salvador	x	x	
Ethiopia	x		
Finland	x	x	
France	x	x	x
Gabon	x		
Gambia, The	x	x	
Germany	x	x	x
Ghana	x	x	
Greece	x	x	
Guatemala	x	x	
Haiti	x	x	
Honduras	x	x	
Hong Kong, China	x		
Hungary	x		
Iceland	x	x	
India	x	x	
Indonesia	x	x	
Iran, Islamic Rep.	x	x	
Ireland	x	x	
Israel	x	x	
Italy	x	x	x
Jamaica	x	x	

Japan	x	x	x
Jordan	x	x	
Kenya	x	x	
Korea, Rep.	x	x	
Kuwait	x		
Liberia	x		
Madagascar	x	x	
Malawi	x	x	
Malaysia	x	x	
Mexico	x	x	
Morocco	x	x	
Nepal	x		
Netherlands	x	x	x
New Zealand	x	x	
Nicaragua	x	x	
Niger	x	x	
Nigeria	x	x	
Norway	x	x	
Pakistan	x	x	
Panama	x	x	
Papua New Guinea	x	x	
Paraguay	x	x	
Peru	x	x	
Philippines	x	x	
Poland	x		
Portugal	x	x	
Romania	x		
Rwanda	x		
Saudi Arabia	x		x
Senegal	x	x	
Sierra Leone	x	x	
Singapore	x	x	x
South Africa	x	x	x
Spain	x	x	x
Sri Lanka	x	x	
Sudan	x		
Sweden	x	x	
Switzerland	x	x	
Syrian Arab Republic	x	x	
Thailand	x	x	
Togo	x	x	
Trinidad and Tobago	x	x	
Tunisia	x	x	
Turkey	x	x	
Uganda	x	x	
United Kingdom	x	x	x
United States	x	x	x
Uruguay	x	x	
Venezuela, RB	x	x	
Zambia	x	x	
Zimbabwe	x	x	

Appendix C: Definitions and Sources of Variables Used in Regression Analysis

| Variable	Definition and Construction	Source
GDP per capita	Ratio of total GDP to total population. GDP is in 1985 PPP-adjusted US$.	Authors' construction using Summers and Heston (1991) and The World Bank (2002).
GDP per capita growth	Log difference of real GDP per capita.	Authors' construction using Summers and Heston (1991) and The World Bank (2002).
Initial GDP per capita	Initial value of ratio of total GDP to total population. GDP is in 1985 PPP-adjusted US$.	Authors' construction using Summers and Heston (1991) and The World Bank (2002).
Output per worker	Real GDP per worker.	Summers and Heston (1991).
Output per worker growth	Log difference of real output per worker.	Authors' construction using Summers and Heston (1991).
Initial Output per worker	Initial value of Real GDP Chain per worker.	Authors' construction using Summers and Heston (1991).
Degree of exchange rate flexibility	See Section 3.1	Reinhart and Rogoff (2001).
Education	Ratio of total secondary enrollment, regardless of age, to the population of the age group that officially corresponds to that level of education.	World Development Network (2002) and The World Bank (2002).
Private Credit	Ratio of domestic credit claims on private sector to GDP	Author's calculations using data from IFS, the publications of the Central Bank and PWD. The method of calculations is based on Beck, Demiguc-Kunt andLevine (1999).
Trade Openness	Residual of a regression of the log of the ratio of exports and imports (in 1995 US$) to GDP (in 1995 US$), on the logs of area and population, and dummies for oil exporting and for landlocked countries.	Author's calculations with data from World Development Network (2002) and The World Bank (2002).
Government Size	Ratio of government consumption to GDP.	The World Bank (2002).
CPI	Consumer price index (2000 = 100) at the end of the year.	Author's calculations using data from IFS.
Inflation rate	Annual % change in CPI.	Author's calculations using data from IFS.
Lack of Price Stability	log(100+inflation rate).	Author's calculations using data from IFS.
Real Effective Exchange Rate	See Appendix A	Author's calculations using data from IFS and UN Trade Statistics
Real Effective Exchange Rate Volatility	See Appendix A	Author's calculations with data from IFS and UN Trade Statistics
Real Exchange Rate Overvaluation	See Appendix A	Author's calculations with data from IFS and UN Trade Statistics
Crisis dummy	Number of years in which a country underwent a systemic banking or a currency crisis, as a fraction of the number of years in the corresponding period.	Author's calculations using data from Caprio and Klingebiel (1999), Kaminsky and Reinhart (1998), and Gosh, Gulde and Wolf (2000).
REGULATION INDEXES	Each index measures the intensity of the regulatory system on a scale from 0 to 1 (1 representing the heaviest regulation). In order to be able to combine all components, Loayza, Oviedo and Serven (2004) apply the following standarization formula to each one of them: $$X = \frac{X_i - X_{min}}{X}$$	Loayza, Oviedo and Serven (2004).

$$X = \frac{X_i - X_{min}}{X_{max} - X_{min}}$$

higher values of X indicate heavier regulation

Overall Regulation	Average score of entry, financial market, labor, trade, fiscal burden, contract enforcement and bankrupcy regulation measures.	Loayza, Oviedo and Serven (2004).
Product Market Regulation	Average score of entry, financial market, trade, contract enforcement and bankrupcy regulation measures.	Loayza, Oviedo and Serven (2004).
Labor Regulation	Combines the percentage of workers that belong to a union, the minimun mandatory conditions and the degree of hiring and firing flexibility granted.	Loayza, Oviedo and Serven (2004).
Regulation of Entry	Combines the number of legal steps required to register a new business with an indicator of the overall legal burden of registration and willingness of the government to facilitate the process and intervene minimally.	Loayza, Oviedo and Serven (2004).
Bankrupcy Regulation	Regulation measures the efficiency of bankrupcy process by combining the time and cost of insolvency, the enforcement of priority of claims, the extent to which the efficient outcome is achieved , and the degree of court involvement in the process.	Loayza, Oviedo and Serven (2004).
Period-specific Shifts	Time dummy variables.	Authors' construction.

Figure 1
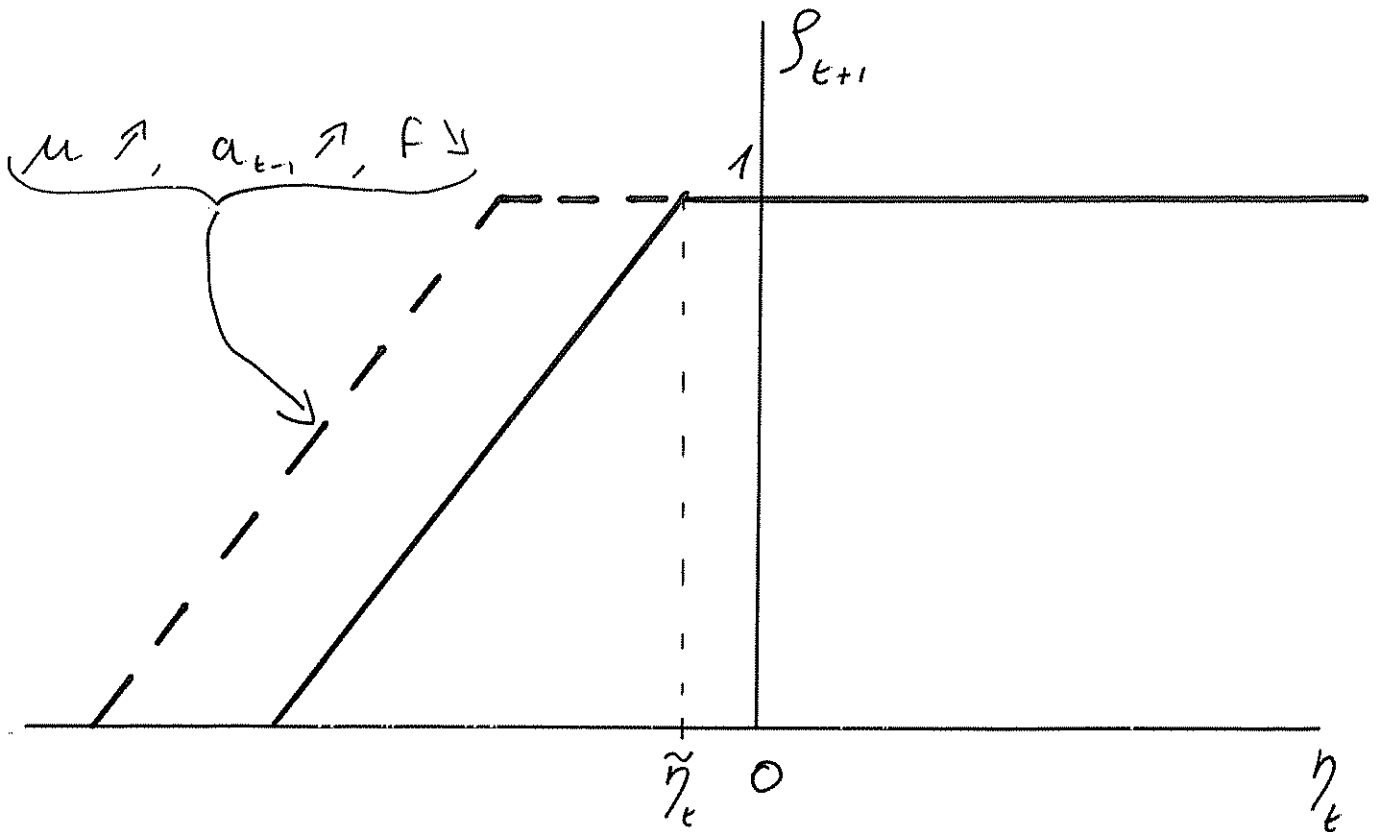
Probability of innovation in fonction of the risk premium shock η_t

$$\tilde{\eta}_t = -\tilde{\alpha}(1+\phi_1)[\ln((1+\mu)\psi a_t)-f]$$

Table 1: Descriptive Statistics

Panel A : Average Annual Volatility (%) of Real Effective Exchange Rate and Selected Aggregate Variables*

Variable	Full sample	Sample without free falling years
Volatility of Real Effective Exchange Rate	18.01	15.45
Volatility of Real Per Capita Output Growth	4.55	3.78
Volatility of CPI inflation	16.35	7.24
Volatility of Term of Trade Growth	10.65	9.71
Volatility of Fiscal Expenditures over GDP	9.93	8.06
Volatility of Trade Weighted Comodity Price Change	7.59	7.53

* cross-sectional average of the standard deviation computed for each variable in each country over 1960-2000

Panel B : Average Monthly Volatility of Real Effective Exchange Rate by Exchange Rate Regime*

regime	full sample	excluding outliers**
Fix	1.61	1.53
Peg	1.60	1.60
Managed Float	2.84	2.56
Float	2.59	2.59
Free Falling	7.35	5.38

*average by exchange rate regime of monthly volatility

monthly Volatility = standard deviation of change in RER computed over a year

**excluding the 1% upper tail of each distribution of monthly volatility

Table 2
 Growth effects of the flexibility of exchange rate regime: the role of financial development
Dependent Variable: Growth Rate of Output per Worker
Estimation: 2-step system GMM estimation with Windmeijer (2003) Small Sample Robust Correction and Time Effects
(Standard errors are presented below the corresponding coefficient)

Period:	1961-2000			
Unit of observation:	Non-overlapping 5-year averages			
Estimation Technique:	System GMM			
	[2.1]	[2.2]	[2.3]	[2.4]
Degree of the Exchange Flexibility	-0.191	-1.135 *	-0.1442	-1.2266 **
(Reinhart and Rogoff Clasisification)	0.349	0.579	0.2880	0.5629
Financial Development	0.684 **	0.185	0.655 **	0.258
(private domestic credit/GDP, in logs)	0.347	0.160	0.326	0.941
Initial Output per Worker	-0.150	-0.117	-0.152	-0.126
(log(Initial Output per Worker))	0.418	0.447	0.447	0.461
Flexibility * Financial Development		0.303 **		0.336 **
		0.146		0.159
Control Variables:				
Education	1.493 **	1.518 **	1.481 **	1.509 **
(secondary enrollment, in logs)	0.630	0.676	0.574	0.605
Trade Openness	1.632 *	1.626 *	1.719 **	1.407 *
(structure-adjusted trade volume/GDP, in logs)	0.914	0.858	0.869	0.799
Government Burden	-1.842 *	-1.950 *	-1.917 *	-1.989 *
(government consumption/GDP, in logs)	1.088	1.136	1.114	1.150
Lack of Price Stability	-2.731	-2.767	-1.660	-2.470
(inflation rate, in log [100+inf. rate])	1.757	1.761	2.088	1.850
Crisis			-1.826 *	-1.741 *
(0-1 dummy for banking or currency crisis)			1.054	1.075
Intercept	15.711 **	17.418 **	10.940	15.731 *
	7.5131	8.509	9.4513	9.2799
No. Countries / No. Observations	79/497	79/497	79/497	79/497
SPECIFICATION TESTS (P-Values)				
(a) Sargan Test:	0.252	0.227	0.291	0.367
(b) Serial Correlation :				
First-Order	0.000	0.000	0.000	0.000
Second-Order	0.348	0.361	0.441	0.388
WALD TESTS (P-values)				
Ho :Exchange Rate Flexibility Total Effect		0.009		0.000
Ho :Financial Development Total Effect =0		0.035		0.044

** means significant at 5% and * means significant at 10%
Source: Authors' estimations

THRESHOLD ANALYSIS

Growth enhancing effect of exchange rate flexibility:

Private Credit /GDP greater than:		0.42		0.38
s.e.		0.19		0.17

Table 3

Growth effects of real effective exchange rate volatility: the role of financial development

Dependent Variable: Growth Rate of Output per Worker

Estimation: 2-step system GMM estimation with Windmeijer (2003) Small Sample Robust Correction and Time Effects

(Standard errors are presented below the corresponding coefficient)

	[3.1]	[3.2]	[3.3]	[3.4]
Period:		1961-2000		
Unit of observation:		Non-overlapping 5-year averages		
Estimation Technique:		System GMM		
Real Exchange Rate Volatility	-0.637 **	-3.124 **	-0.554 **	-3.319 **
	0.273	1.204	0.262	1.208
Financial Development	1.111 **	-0.650	0.987 **	-0.729
(private domestic credit/GDP, in logs)	0.455	0.808	0.402	0.821
Initial Output per Worker	-1.112 **	-0.530	-1.025 **	-0.828 **
(log(Initial Output per Worker))	0.391	0.474	0.360	0.404
Exchange Rate Volatility * Financial Development		0.677 **		0.706 **
		0.262		0.277
Control Variables:				
Education	1.807 **	1.778 **	1.976 **	2.378 **
(secondary enrollment, in logs)	0.532	0.694	0.465	0.585
Trade Openness				
(structure-adjusted trade volume/GDP, in logs)	1.053 *	1.115 **	1.420 **	1.579 *
	.5722	.7693	.5693	0.9748
Government Burden	-0.416	-0.928	-1.068	-0.871
(government consumption/GDP, in logs)	1.153	1.070	1.104	1.372
Lack of Price Stability	-2.569 *	-1.961	-1.872 *	-1.172
(inflation rate, in log [100+inf. rate])	1.487	1.237	1.117	1.379
Crisis			-2.250 **	-2.857 **
(banking or currency crisis)			0.878	1.374
Intercept	18.325 **	13.346 **	15.689 **	14.556 **
	7.043	5.072	5.848	6.971
No. Countries / No. Observations	83/548	83/548	83/548	83/548
SPECIFICATION TESTS (P-Values)				
(a) Sargan Test:	0.461	0.241	0.663	0.187
(b) Serial Correlation :				
First-Order	0.000	0.000	0.000	0.000
Second-Order	0.462	0.383	0.572	0.516
WALD TESTS (P-values)				
Ho :Exchange Rate Flexibility Total Effect=0		0.000		0.000
Ho :Financial Development Total Effect =0		0.032		0.012

** means significant at 5% and * means significant at 10%

Source: Authors' estimations

THRESHOLD ANALYSIS

Growth enhancing effect of exchange rate flexibility if:

	[3.1]	[3.2]	[3.3]	[3.4]
Private Credit /GDP greater than:		1.01		1.10
s.e		0.34		0.39

Table 4
Growth effects of effective exchange rate real overvaluation: the role of financial development
Dependent Variable: Growth Rate of Output per Worker
Estimation: 2-step system GMM estimation with Windmeijer (2003) Small Sample Robust Correction and Time Effects
(Standard errors are presented below the corresponding coefficient)

Period:		1961-2000		
Unit of observation:		Non-overlapping 5-year averages		
Estimation Technique:		System GMM		
	[4.1]	[4.2]	[4.3]	[4.4]
Degree of the Real Exchange Rate Overvaluation	-0.9949 **	-1.1618 *	-1.1760 **	-1.1787 **
(log deviation from equilibrium exchange rate)	0.5038	0.7108	0.5339	0.6590
Financial Development	0.6361 *	-0.1007	0.5948 *	-0.0404
(private domestic credit/GDP, in logs)	0.3446	2.5091	0.3296	2.1631
Initial Output per Worker	-0.0384	-0.3604	-0.0574	-0.3545
(log(Initial Output per Worker))	0.3815	0.5308	0.3690	0.5181
Real overvaluation * Financial Development		0.2053 **		0.1629 **
		0.0769		0.0818
Control Variables:				
Education	1.1854 *	1.5315 **	1.2454 **	1.6449 **
(secondary enrollment, in logs)	0.6131	0.7724	0.5952	0.8002
Trade Openness	1.3277 **	1.6194 **	1.4615 *	1.6297 **
(structure-adjusted trade volume/GDP, in logs)	0.6264	0.6876	0.8116	0.7773
Government Burden	-1.4566 *	-2.1841	-1.3286	-1.9306
(government consumption/GDP, in logs)	0.8274	1.3576	0.8749	1.4829
Lack of Price Stability	-4.5052 **	-3.8190 **	-3.8574 **	-3.7077 **
(inflation rate, in log [100+inf. rate])	1.0087	1.1602	0.9345	0.8811
Crisis			-1.2813	-2.0817
(banking or currency crisis)			1.3257	1.2843
Intercept	27.6120 **	27.5510 **	25.1475 **	26.8815 **
	5.7204	8.7510	5.5564	7.6262
No. Countries / No. Observations	83/548	83/548	83/548	83/548
SPECIFICATION TESTS (P-Values)				
(a) Sargan Test:	0.413	0.224	0.279	0.220
(b) Serial Correlation :				
First-Order	0.000	0.000	0.000	0.000
Second-Order	0.268	0.278	0.359	0.271
WALD TESTS (P-values)				
Ho :Exchange Rate Flexibility Total Effect=0		0.000		0.000
Ho :Financial Development Total Effect =0		0.037		0.028

** means significant at 5% and * means significant at 10%
Source: Authors' estimations

THRESHOLD ANALYSIS

Growth enhancing effect overvaluation:

Private Credit /GDP greater than:		1.63		1.28
s.e.		0.65		0.48

Table 5

Growth effects of the flexibility of exchange rate regime, real exchange rate volatility and real overvaluation: the role of distance to the technological frontier

Dependent Variable: Growth Rate of Output per Worker
Estimation: 2-step system GMM estimation with Windmeijer (2003) Small Sample Robust Correction and Time Effects
(Standard errors are presented below the corresponding coefficient)

Period:	1961-2000		
Unit of observation:	Non-overlapping 5-year averages		
Estimation Technique:	System GMM		
	[5.1]	[5.2]	[5.3]
Degree of the Exchange Flexibility	-4.845 **		
(Reinhart and Rogoff Clasisification)	2.287		
Real Exchange Rate Volatility		-3.361 *	
		1.797	
Degree of the Real Exchange Rate Overvaluation			-3.886 **
(log deviation from equilibrium exchange rate)			1.308
Financial Development	0.640 **	1.180 **	0.593 *
(private domestic credit/GDP, in logs)	0.315	0.504	0.305
Initial Output per Worker	-1.474 **	-1.830 **	-3.074
(log(Initial Output per Worker))	0.641	0.595	2.126
Flexibility*Initial Ouput Per Worker	0.568 **		
	0.265		
Exchange Rate Volatility*Initial Ouput Per Worker		0.358 **	
		0.173	
Real overvaluation*Initial Ouput Per Worker			0.401 **
			0.180
Control Variables:			
Education	1.505 **	2.470 **	1.518 **
(secondary enrollment, in logs)	0.703	0.567	0.678
Trade Openness	1.003	1.137	1.212 *
(structure-adjusted trade volume/GDP, in logs)	0.718	1.1022	0.706
Government Burden	-0.952	-0.795	-1.327
(government consumption/GDP, in logs)	1.419	1.261	0.988
Lack of Price Stability	-4.006 **	-2.034	-3.801 **
(inflation rate, in log [100+inf. rate])	0.981	1.347	0.945
Crisis	-1.889 *	-2.623 **	-1.908 *
(0-1 dummy for banking or currency crisis)	1.064	1.184	1.050
Intercept	30.217 **	20.266 **	46.119 **
	6.837	7.668	16.205
No. Countries / No. Observations	79/497	83/548	83/548
SPECIFICATION TESTS (P-Values)			
(a) Sargan Test:	0.595	0.180	0.423
(b) Serial Correlation :			
First-Order	0.000	0.000	0.000
Second-Order	0.364	0.417	0.312
WALD TESTS (P-values)			
Ho :Exchange Rate Measure Total Effect=0	0.000	0.017	0.000
Ho :Initial Output Total Effect =0	0.014	0.000	0.000

** means significant at 5% and * means significant at 10%
Source: Authors' estimations

THRESHOLD ANALYSIS			
Growth enhancing effect of each exchange rate measure:			
Ouput Per Worker greater than (1995 US$)	5099	12063.391	16047
s.e.	2321	5329	6477

Table 6

Growth effects of the flexibility of exchange rate regime and term of trade growth

Dependent Variable: Growth Rate of Output per Worker

Estimation: 2-step system GMM estimation with Windmeijer (2003) Small Sample Robust Correction and Time Effects

(Standard errors are presented below the corresponding coefficient)

Period:		1961-2000	
Unit of observation:		Non-overlapping 5-year averages	
Estimation Technique:		System GMM	
	[6.1]	[6.2]	[6.3]
Term of Trade Growth	0.083 *	0.327 *	0.385 **
(Growth Rate of Term of Trade Index)	0.049	0.169	0.173
Degree of the Exchange Flexibility			-0.126
(Reinhart and Rogoff classification)			0.350
Financial Development	0.572 *	0.783 *	0.285
(private domestic credit/GDP, in logs)	0.322	0.395	0.192
Initial Output per Worker	-0.887 *	-0.644 *	-0.702
(log(Initial Output per Worker))	0.531	0.381	0.465
Flexibility*Term of Trade Growth		-0.107 **	-0.136 **
		0.044	0.062
Flexibility*Financial Development			0.357 **
			0.159
Control Variables:			
Education	2.045 **	2.301 **	2.301 **
(secondary enrollment, in logs)	0.542	0.467	0.571
Trade Openness	0.980	1.493	1.385 *
(structure-adjusted trade volume/GDP, in logs)	0.746	1.074	0.706
Government Burden	-1.033	-0.762	-0.707
(government consumption/GDP, in logs)	0.738	1.191	0.982
Lack of Price Stability	-3.349 **	-4.354 **	-3.560 **
(inflation rate, in log [100+inf. rate])	1.189	1.784	1.432
Crisis	-2.043 *	-2.104 *	*
(0-1 dummy for banking or currency crisis)	1.054	1.065	1.050
Intercept	20.222 **	32.117 **	35.334 **
	4.044	10.706	9.815
No. Countries / No. Observations	83/548	83/548	79/494
SPECIFICATION TESTS (P-Values)			
(a) Sargan Test:	0.130	0.420	0.680
(b) Serial Correlation :			
First-Order	0.000	0.000	0.000
Second-Order	0.400	0.450	0.450

** means significant at 5% and * means significant at 10%

Source: Authors' estimations

Table 7: Exchange Rate Regime, Regulation and Productivity Growth

Estimation: 2-step system GMM estimation with Windmeijer (2003) Small Sample Robust Correction

(Standard errors are presented below the corresponding coefficient)

	[7.1]	[7.2]	[7.3]	[7.4]	[7.5]
Period:		1961-2000			
Unit of observation:		Non-overlapping 5-year averages			
Estimation Technique:		System GMM			
Financial Development	1.113 *	1.046 **	1.141 **	0.942	0.863 *
(private domestic credit/GDP, in logs)	0.594	0.441	0.562	0.571	0.511
Initial Output per Worker	-0.640	-0.461	-0.749 *	-0.556	-1.090 *
(log(Initial Output per Worker))	0.515	0.374	0.448	0.651	0.622
Degree of Exchange Rate Flexibility (fld)	0.966	0.426	0.230	0.134	0.838
[Reinhart and Rogoff Clasisification)	0.930	0.576	0.815	0.823	0.512
fld*Overall Regulation	-2.479 **				
	1.225				
fld*Labor Regulation		-1.528			
		0.912			
fld*Product Regulation			-1.577 **		
			0.668		
fld*Regulation of Entry				-1.024	
				0.867	
fld*Bankruptcy Regulation (Closure)					-2.233 **
					1.075
Control Variables:					
Education	1.033 *	1.294 **	1.299 **	1.292 *	1.916 *
(secondary enrollment, in logs)	0.524	0.528	0.514	0.672	0.988
Trade Openness	0.824	1.217	1.081	1.088	0.363
(structure-adjusted trade volume/GDP, in logs)	0.990	0.957	0.935	1.052	0.904
Government Burden	-0.855	-1.071	-0.916	-1.842	0.083
(government consumption/GDP, in logs)	0.973	0.980	0.890	1.314	0.951
Lack of Price Stability	-2.846 *	-3.354 **	-2.255	-2.598	-4.257 **
(inflation rate, in log [100+inf. rate])	1.637	1.380	1.520	1.742	1.598
Intercept	16.349 **	3.168	16.658 **	14.618 *	19.578 **
	7.788	6.133	7.415	8.753	8.065
No. Countries / No. Observations	72/546	70/530	72/546	72/546	61/460
SPECIFICATION TESTS (P-Values)					
(a) Sargan Test:	0.44	0.45	0.52	0.47	0.67
(b) Serial Correlation :					
First-Order	0	0	0	0	0
Second-Order	0.335	0.389	0.233	0.292	0.331

** means significant at 5% and * means significant at 10%

Source: Authors' estimations