Exchange Rate Volatility and Productivity Growth: The Role of Financial Development[1]

Philippe Aghion
Harvard University
NBER

Philippe Bacchetta
Study Center Gerzensee
FAME & CEPR

Romain Ranciere
IMF Research Department

Kenneth Rogoff
Harvard University
NBER

May 8, 2006

[1] We would like to thank Jaume Ventura, Alan Stockman, Eric van Wincoop, Daron Acemoglu, Ben Sorensen, Henri Pages and several participants at ESSIM 2005, the NBER Summer Institute 2005, and at seminars at Harvard, Pompeu Fabra, PSE, Lausanne, and Zurich for useful comments. Luis Angeles and Guillermo Vuletin provided able research assistance. We acknowledge financial support from the Fondation Banque de France. The views expressed in this paper are those of the authors and do not necessarily represent those of the IMF or IMF policy.

Abstract

This paper offers empirical evidence that real exchange rate volatility can have a significant impact on the long-term rate of productivity growth, but the effect depends critically on a country's level of financial development. For countries with relatively low levels of financial development, exchange rate volatility generally reduces growth, whereas for financially advanced countries, there is no significant effect. Our empirical analysis is based on an 83 country data set spanning the years 1960-2000; our results appear robust to time window, alternative measures of financial development and exchange rate volatility, and outliers. We also offer a simple monetary growth model in which real exchange rate uncertainty exacerbates the negative investment effects of domestic credit market constraints. 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, on the one hand, the intense international criticism of China's inflexible exchange rate system. On the other hand, South African policymakers are chastised for not doing enough to stabilize their country's highly volatile currency. Yet, despite the perceived centrality of the exchange rate regime to long-run growth and economic stability, the existing theoretical and empirical literature offers little guidance. The theoretical literature is mainly tailored to richer countries with highly developed institutions and markets (e.g., Garber and Svensson 1995 and Obstfeld and Rogoff, 1996), and there is almost no discussion of long-run growth. The empirical literature is largely negative, suggesting to some that the degree of exchange rate flexibility simply does not matter for growth, or for anything except the real exchange rate.[1]

In this paper, we develop and test a simple framework suggesting that a country's level of financial development ought to be central in choosing how flexible an exchange rate system to adopt, particularly if the objective is long-run productivity growth. Interestingly, we find striking and apparently robust evidence that the more financially developed a country is, the better it will do with a more flexible exchange rate. The volatility of real shocks relative to financial shocks – which features so prominently in the literature on developed country exchange rate regimes – also matters for developing countries. But because financial shocks tend to be greatly amplified in financially underdeveloped economies, one has to adjust calibrations accordingly.

Figure 1 shows the relationship between productivity growth and exchange rate flexibil-

[1] The classic paper is Baxter and Stockman (1989). In their survey, Gosh, Gulde, and Wolf (2003) state that "perhaps the best one can say is that the growth performance of pegged regimes is no worse than that of floating regimes". More recent studies include Levy-Yeyati and Sturzenegger (2003), Razin and Rubinstein (2004), Husain, Mody and Rogoff (2005), De Grauwe and Schnabl (2005), and Dubas et al. (2005). We note that Baldwin (1992), in his analysis of European Monetary Union, argued that a single currency might have growth effects on Europe by reducing the exchange rate premium on capital within Europe. Husain et al. (2005) 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. There is some evidence of an effect of exchange rate volatility on trade levels (Frankel and Wei, 1993 and 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, or Bacchetta and van Wincoop, 2000). Dubas et al. (written independently) conclude relatedly to our starting Figure 1 below, that low income countries grow faster under fixed rates. Levy-Yeyati and Sturzenneger (2003)(LYS), however, find the opposite. (We will show in our robustness section that LYS's different findings stem from treatment of dual exchange rate and high inflation regimes.)

ity for countries at different levels of financial development. The upper graphs consider the volatility of the effective real exchange rate and the lower graphs deal with the exchange rate regime classification proposed by Reinhart and Rogoff (2004). In each case, we compare the residuals of a productivity growth regression on a set of variables with the residuals of an exchange rate flexibility regression on the same variables.[2] By doing so, we obtain adjusted measures of volatility and flexibility that are purged from any collinearity with the standard growth determinants. Countries are ranked in function of their financial development measured by private credit to GDP over five-year averages. The left-hand side of both Panels shows the lower quartile and the right-hand side shows the upper quartile of the distribution. There is clearly a negative relationship between productivity growth and exchange rate flexibility for less financially developed countries, while we see no relationship for the most developed economies.

We take the results in Figure 1 as preliminary evidence that the growth effects of real exchange rate volatility and the flexibility of the exchange rate regime vary with the level of financial development. The main purpose of this paper is to rationalize and then explore the robustness of this finding. In Section 2 we develop a model of an open monetary economy with wage stickiness, where exchange rate fluctuations affect the growth performance of credit-constrained firms. Exchange rate fluctuations in turn are caused by both real and financial aggregate shocks. The basic mechanism underlying the positive growth interaction between financial development and exchange rate volatility can be explained as follows. Suppose that the borrowing capacity of firms is proportional to their current earnings, with a higher multiplier reflecting a higher degree of financial development in the economy. Suppose in addition that the nominal wage is preset and cannot be adjusted to variations in the nominal exchange rate. Then, following an exchange rate appreciation, firms' current earnings are reduced, and so is their ability to borrow in order to survive idiosyncratic liquidity shocks and thereby innovate in the longer term. Depreciations have the opposite effect. However, the existence of a credit-constraint implies that the positive effects of a depreciation on innovation will in general not fully compensate the negative effect of an appreciation. This, in turn, may help explain why in Figure 1 growth in countries with lower financial development benefits

[2] We perform a pooled regression using five-year average data for 83 countries over 1970-2000. The controls include initial productivity, secondary schooling, financial depth, government expenditure, trade openness, term-of-trade growth and an indicator of banking and currency crises. The variables are defined in Section 2 and in the Appendix. For each quartile, we regress growth residuals on the adjusted measures of real exchange rate volatility and the flexibility of the exchange rate regime.

more from a fixed exchange rate regime, and more generally from a stabilized exchange rate.[3] We also show in Section 2 that the superior growth performance of a more stable exchange rate holds as long as the volatility of financial market shocks is large compared to the volatility of real shocks (and that, in principle, the optimal monetary regime allows the exchange rate to move to offset real shocks without introducing excess noise in the exchange rate.) Regardless, the source of shocks (real versus financial) only matters at lower levels of financial development.

In the second part of the paper, we test our theoretical predictions by conducting a systematic panel data analysis with a data set for 83 countries over the years 1960-2000. When a country's de facto degree of exchange rate flexibility is interacted with its level of financial development the results prove both robust and highly significant. We consider various measures of exchange rate flexibility, including the volatility of the real effective exchange rate and the exchange rate regime. We use the classification of Reinhart and Rogoff (2004) in the main analysis, but find that our results are generally robust to other de facto classifications.[4] We consistently find that a high degree of exchange rate flexibility leads to 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, our estimates indicate that a country which lies in the middle of the lower quartile (e.g., Zambia in 1980), with credit to GDP of 15%, would have gained 0.94 percent of annual growth had it switched from a flexible to a totally rigid exchange rate. Even a country in the middle of the second quartile (like Egypt in 1980), with credit to GDP of about 27%, would have gained 0.43 percent growth per year by adopting a uniform pegged exchange rate. 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 exchange rate volatility, as well as considering distance to the technological frontier as both alternative, and supplementary, interaction variables. Finally, we adopt a variety of approaches to addressing the problem of exchange regime endogeneity, both using techniques within our GMM methodology and by examining the broader historical

[3] A related explanation, which can be easily formalized in the context of our model, is that the lower financial development, the more the anticipation of exchange rate fluctuations should discourage R&D investments. This would lower growth if these investments were to be decided before firms know the realization of the aggregate shock (since firms anticipate that with higher probability, their R&D investment will not pay out in the long run as it will not survive the liquidity shock).

[4] The classification of Reinhart and Rogoff is more appropriate in our context, since they focus mainly on exchange rate volatility, in particular including dual and multiple exchange rates. Other classifications, such as Levy-Yeyati and Sturzenegger (2003), capture better the constraints on monetary policy by including changes in reserves in defining their classification. However, our focus is on exchange rate volatility.

evidence on the choice of exchange rate regime.

The remaining part of the paper is organized as follows. Section 2 presents an illustrative model to think about exchange rate policy and growth, and it derives our main theoretical predictions. Section 3 develops our empirical analysis and results. The data are detailed in an appendix, which also includes the results of further robustness tests.

2 A Simple Model

In this section, we develop a stylized model that illustrates how excess volatility in the exchange rate can, in principle, produce excess volatility in profits and thereby lower the economy wide average level of investment. An example of the idea we have in mind can be drawn, for example, from the exchange rate pass-through literature (à la Dornbusch, 1987). Suppose a Korean exporter to the United States faces relatively fixed wage costs in local currency. However, when the dollar/won exchange rate fluctuates, the exporter is not able to completely pass through the cost change to US importers (perhaps because of competitive pressures in the US market). Then, exchange rate volatility leads to fluctuations in profits. These, in turn, can lower investment in an environment where the costs of external finance exceed those of internal finance (as documented by the large empirical literature on the effects of cash flow on investment, see, for example Gertler and Gilchrist, 1994).

Our model combines two main elements. First, productivity grows as a result of innovation by those entrepreneurs with sufficient funds to meet short-run liquidity shocks. This feature is similar to Aghion, Angeletos, Banerjee, and Manova (2005)(AABM). Second, macroeconomic volatility is driven by *nominal* exchange rate movements in presence of *wage stickiness*. This monetary feature borrows from the recent New Open Economy Macroeconomics literature. Critically, we make the realistic assumption that unless exchange rates are pegged, risk premium shocks lead to exchange rate volatility in excess of any movement required to offset real shocks (an assumption that is strongly supported by the vast literature on the empirical determinants of exchange rates.)

Although extremely simple, our model illustrates both why our base case is a reasonable one, as well as why other cases might arise under alternative assumptions on production technologies and the distribution of exchange rate shocks[5]. The model also makes clear that a literally fixed exchange rate is never the optimal policy for any developing country that also faces, say, shocks to the world price of its main export goods. The fact that we later

[5] See the footnotes at the end of Section 2.3.

find that exchange rate flexibility tends to lower growth for countries with relatively weak levels of financial development suggests that, in practice, the monetary authorities may have difficulty filtering out exchange rate risk premium and other noise shocks, and only allowing the exchange rate to respond to real shocks.

2.1 A small open economy with sticky wages

We consider a small open economy populated by overlapping generations of two-period lived entrepreneurs and workers. The economy produces a single good identical to the world good. One half of the individuals are 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. Growth will be determined by the proportion of entrepreneurs who innovate.

Since firms in the small domestic economy are price-takers, they take the foreign price of the good at any date t, 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 at date t is 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 (number of units of the domestic currency per unit of the foreign currency). We will assume that P_t^* is constant and normalize it to 1. Thus, $P_t = S_t$. We will begin with the case where exchange rates are driven entirely by risk premium (or noise) shocks, so that under floating S is exogenous. Later, we will introduce productivity shocks and illustrate how only excess exchange rate volatility is an issue.

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, with consequences for innovation and growth, is that nominal wages are rigid for one period and preset before the realization of S_t. This in turn exposes firms' short-run profits to an exchange rate risk as the value of sales will vary according to S_t whereas the wage bill will not.[6,7]

[6] The crucial feature in the model is that the input price is rigid. On the other hand, the degree of price flexibility is not crucial. It would not be difficult to generate other examples of how excess exchange rate volatility raises the volatility of profits and thereby lowers investment under a broad variety of assumptions and models.

[7] 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.

For simplicity, we take the wage rate at date t to equate the real wage at the beginning of that period to some reservation value, kA_t. The parameter $k < 1$ refers to the workers' productivity-adjusted reservation utility, say from working on a home activity, and A_t is current aggregate productivity which we first assume to be non-random. 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

$$W_t = k\overline{S}A_t. \tag{2}$$

2.2 The behavior of firms

Individuals who become entrepreneurs take two types of decisions.[8] First, at the beginning of their first period, they need to decide how much labor to hire at the given nominal wage; this decision occurs after the aggregate shocks are realized. Second, at the end of their first period entrepreneurs face a liquidity shock and must decide whether or not to cover it (if they can) in order to survive and thereby innovate in the second period. The proportion ρ_t of entrepreneurs who innovate determines the growth rate of this economy. We first describe production and profits and then consider these two decisions in turn.

2.2.1 Production and profits

The production of an entrepreneur born at date t in her first period, is given by

$$y_t = A_t\sqrt{l_t}, \tag{3}$$

where l_t denotes the firm's labor input at date t.[9]

Given current nominal wages, nominal profits at the end of her first period are given by

$$\Pi_t = P_t y_t - W_t l_t = A_t S_t \sqrt{l_t} - kA_t\overline{S}l_t \tag{4}$$

In her second period, the entrepreneur innovates and thereby realizes the value of innovation v_{t+1}, with probability ρ_t which depends upon whether the entrepreneur can cover her

That real exchange rates are more volatile under a flexible exchange rate regime is documented in Appendix D.

[8] One can easily extend the model so as to allow firms to increase the probability of innovation by investing more in R&D ex ante.

[9] Our choice of production technology is made for analytical simplicity and our results extend to more general settings.

liquidity cost at the end of her first period. As we shall see, in an economy with credit constraints, the latter depends upon the short-term profit realization and therefore upon both employment and the aggregate shocks in the first period.

Employment in the first period is then chosen by the entrepreneur in order to maximize her net present value:

$$\max_{l_t}\{A_t P_t \sqrt{l_t} - kA_t\overline{S}l_t + \beta\rho_t E_t v_{t+1}\}, \tag{5}$$

where β denotes the entrepreneur's discount rate.

2.2.2 Innovation, liquidity shocks and credit constraints

Innovation upgrades the entrepreneur's technology up by some factor $\gamma > 1$, so that a successful innovator has productivity $A_{t+1} = \gamma A_t$. It is natural to assume that the value of innovation v_{t+1} is proportional to the productivity level achieved by a successful innovator, that is

$$v_{t+1} = vP_{t+1}A_{t+1},$$

with $v > 0$.

Next, we assume that innovation occurs in any firm i only if the entrepreneur in that firm survives the liquidity shock C_t^i that occurs at the end of her first period. Absent credit constraints, the probability of overcoming the liquidity shock would be equal to one, if the value of innovation is larger than the cost, and to zero otherwise. In either case, this probability would be independent of current profits. However, once we introduce credit constraints, the probability of the entrepreneur being able to innovate will depend upon her current cash-flow and therefore upon the choice of l_t.

We assume that the liquidity cost of innovation is proportional to productivity A_t, according to the following linear form (multiplied by P_t as it is expressed in nominal terms):

$$C_t^i = c^i P_t A_t,$$

where c^i is independently and identically distributed across firms in the domestic economy, with uniform distribution over the interval between 0 and c. 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 (e.g., as measured by $v\gamma$) is sufficiently high that it is always profitable for an entrepreneur to try and overcome her liquidity shock.

In order to pay for her liquidity cost, the entrepreneur can borrow on the local credit market. However, credit constraints will prevent her from borrowing more than a multiple $\mu - 1$ of current cash flow Π_t. We take μ as being the measure of financial development and we assume that is it constant.[10] The borrowing constraint is no longer binding if μ becomes large.

Thus, the funds available for innovative investment at the end of the first period are at most equal to

$$\mu\Pi_t,$$

and therefore the entrepreneur will innovate whenever:

$$\mu\Pi_t \geq C_t^i. \tag{6}$$

Thus, the probability of innovation ρ_t is equal to[11]

$$\rho_t = \min(\frac{\mu\Pi_t}{cS_tA_t}, 1). \tag{7}$$

2.2.3 Equilibrium profits

Now, we can substitute for ρ_t in the entrepreneur's maximization problem. The entrepreneur will choose l_t to maximize (5) which yields

$$l_t = \left(\frac{S_t}{2k\overline{S}}\right)^2$$

and therefore

$$\Pi_t = \psi A_t S_t^2, \tag{8}$$

where $\psi \equiv 1/(4k\overline{S})$. We thus see that equilibrium profits are increasing in the nominal exchange rate S_t.

Next, from (7), we can express the probability of innovation as:

$$\rho_t = \min(\frac{\mu\psi}{c}S_t, 1). \tag{9}$$

2.3 Productivity growth and the main theoretical prediction

Expected productivity at date $t+1$ is equal to:

$$E(A_{t+1}) = E(\rho_t)\gamma A_t + (1 - E(\rho_t))A_t.$$

The expected rate of productivity growth between date t and date $(t+1)$, is correspondingly given by

$$g_t = \frac{E(A_{t+1}) - A_t}{A_t} = (\gamma - 1)E(\rho_t). \tag{10}$$

[10] If μ was endogenous, it would decrease with more volatile profits, thus reinforcing the negative impact of exchange rate volatility.

[11] We always have $\rho_t > 0$ since $\Pi_t > 0$ in equilibrium and $S_t > 0$.

We consider distributions of S_t such that for some values of S_t we have $\rho_t = 1$.[12] We can then establish:

Proposition 1 *Moving from a fixed to a flexible exchange rate reduces average growth. Moreover when μ is not too small, the growth gap decreases with financial development.*

Proof: From (10), the average growth rate g_t is proportional to the expected proportion of innovating firms. Thus, to compare a fixed exchange rate (i.e., no exchange rate volatility) with a flexible rate, we just need to look at the difference between the corresponding expected innovation probabilities:[13]

$$\Delta_t = \overline{\rho} - E(\rho_t),$$

where

$$\overline{\rho} = \min(\frac{\mu}{4kc}, 1)$$

and

$$E(\rho_t) = E\left(\min(\frac{\mu S}{4kc\overline{S}}, 1)\right)$$

To demonstrate the first part of the proposition, consider first the case where $\overline{\rho} < 1$. Then $E(\rho_t) = E\left(\min(\overline{\rho}S/\overline{S}, 1)\right)$. If we had $\rho_t < 1$ for all S_t, then ρ_t would be linear in S_t and therefore we would have $E(\rho_t) = E(\overline{\rho}S/\overline{S}) = \overline{\rho}$. But, since we assume that there are some values of S_t for which $\rho_t = 1$, then ρ_t is a concave function of S_t and therefore by Jensen's inequality we have that $E(\rho_t) < \overline{\rho}$. When $\overline{\rho} = 1$, it is also obvious that $E(\rho_t) \leq \overline{\rho}$ since $\rho_t \leq 1$.

The second part of the proposition follows from the fact that $\overline{\rho} = 1$ when $\mu \geq 4kc$, so that for such levels of μ, the growth gap decreases with μ since $E(\rho_t)$ increases with μ (while $\overline{\rho}$ is constant). QED.

The superior performance of fixed exchange rates is driven by the asymmetry implied by the liquidity constraint and the resulting concavity of the ρ function.[14] These in turn imply

[12] A standard assumption would be that $\ln S_t \sim N(0, \sigma_s^2)$.

[13] The model can be turned into a convergence model, for example by assuming that innovating firms catch up with a world technology frontier growing at some rate $\overline{g}$, at a cost which is proportional to the world frontier productivity. Based upon the convergence analysis in Aghion, Howitt, and Mayer (2005), we conjecture that the lower the degree of financial development in a country, the more likely it is that higher exchange rate volatility will prevent the country from converging to the world technological frontier in growth rates and/or in per capita GDP levels.

[14] Such concavity would not hold, for example if the distribution of liquidity costs c had mass points on (the upper part of) its support. In that case, an increase in the volatility of exchange rates might foster growth by making it possible for firms to pay a high liquidity cost at least under exceptionally high realizations of S_t. Note however that in a world where such a "gambling for resurrection" effect were to dominate, one would

that large depreciations do not compensate the impact of large appreciations: once $\rho_t = 1$ is reached any further depreciation cannot have any impact on growth.[15]

2.4 On the stabilizing role of flexible exchange rates

In the previous section, the only aggregate shocks were exchange rate risk premium (noise) shocks to the exchange rate. In this section, we allow for real shocks. Assume that domestic productivity is random and can be expressed as:

$$A_t = \overline{A}_t e^{u_t}, \tag{11}$$

where: (i) $\overline{A}_t$ is the country's level of knowledge at date t, which in turn results from innovations in period $t-1$, according to:

$$\overline{A}_t = (\rho_{t-1}(\gamma - 1) + 1)A_{t-1};$$

(ii) u_t is a productivity shock with mean $E(u_t) = 0$ and variance σ_u^2.

We assume that the nominal wage is set before the productivity shock is known. Thus, analogously to equation (2) we have $W_t = k\overline{SA}_t$. It is easy to show that equation (8) is replaced by:

$$\Pi_t = \overline{\psi}_t A_t^2 S_t^2, \tag{12}$$

where $\overline{\psi}_t \equiv 1/(4k\overline{SA}_t)$. Thus, the probability of innovation is given by:

$$\rho_t = \min(\frac{\mu\overline{\psi}_t}{c} A_t S_t, 1). \tag{13}$$

This probability is determined by the volatility of the product $A_t S_t$. Following the same logic as in our previous analysis, the optimal policy now is for the monetary authorities to stabilize AS as opposed to simply S. This is a completely standard result (e.g., Obstfeld and Rogoff, 1996). Any policy conclusions from our empirical results below must be tempered by this observation: an ideal central bank policy would stabilize AS. In a world where the central bank has perfect information on the shocks and can exactly control the exchange rate, the growth-maximizing regime does not literally involve a fixed exchange rate. However, as

observe a positive correlation between exchange rate (or, more generally, macroeconomic) volatility and growth. However, this is not what we observe if we look at cross-country panel data (see AABM and the empirical analysis in the next section).

[15] Notice that a crucial aspect in our analysis is that nominal profits are more sensitive to the nominal exchange rate than the liquidity cost. Given the production function (3), this property holds in the model. With a different production function, we may need to introduce some nominal rigidity in the liquidity cost in order to get the same result.

long as exchange rate risk premium shocks remain when the productivity shock is introduced, and as long as the central bank is not entirely successful in offsetting them, there remains the possibility that fixed rate regime is still preferable to an imperfect managed float. This is particularly likely to be the case when the effective size of the real shocks are small relative to the risk premium shocks and when the country has a low level of financial development. The fact that we later find the consistent result that relatively fixed exchange rate regimes produce higher growth rates in financially less developed countries perhaps suggests that, in practice, countries have difficulties offsetting A shocks without introducing other significant volatility in S.

3 Empirical Analysis

Previous studies have shown that financial development fosters growth and convergence, conditions macroeconomic volatility, or may play a crucial role in financial crises. An interesting question is whether the level of financial development also conditions the impact of monetary arrangements, such as the exchange rate regime. Our basic hypothesis is that the exchange rate regime, or more generally exchange rate volatility, has a negative impact on (long-run) growth when countries are less developed financially.

To test these predictions, we consider standard growth regressions to which we add a measure of exchange rate flexibility, as well as an interaction term with exchange rate flexibility and financial development or some other measures of development. In this section, 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 real "overvaluation", as a deviation of the real exchange rate from its long-term value. We also examine the interaction between terms-of-trade shocks, the exchange rate regime, and growth. We first present the methodology and the variables used and then the results based on a dynamic panel of 83 countries over the 1960-2000 period.

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).[16] 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 B presents the list of countries included 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.[17] 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. More specifically, we estimate the following equation:

$$y_{i,t} - y_{i,t-1} = (\alpha - 1)\, y_{i,t-1} + \gamma_1 ER_{i,t} + \gamma_2 ER_{i,t} * I_{i,t} + \delta I_{i,t} + \beta' Z_{i,t} + \mu_t + \eta_i + \varepsilon_{i,t} \qquad (14)$$

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, i.e., financial development; 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.

Our hypothesis is that $\gamma_1 < 0$ and $\gamma_2 > 0$ so that the impact of exchange rate flexibility $\gamma_1 + \gamma_2 * I_{i,t}$ is more negative at low levels of financial development. Moreover, 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 1 to 3, we report threshold levels of financial development above which a more flexible exchange rate becomes growth enhancing. The standard errors of the respective

[16] It has been recognized that the two-step 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.

[17] 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 financial 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 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.

threshold levels are computed using a delta method, that is by taking a first order Taylor approximation around the mean. Notice that in small samples, the delta method is known to result in excessively large standard errors.

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:[18]

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

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 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.[19]

For the interaction variable $I_{i,t}$ we 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. 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.[20] A dummy indicating the frequency of a banking or a currency crisis within each five-year 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.[21] Definition and sources for all variables are given in Appendix C.

3.2 Exchange rate flexibility and financial development

[18] 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.

[19] 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 (1992). We also considered average log differences from a HP detrended multilateral exchange rate series as in Goldfajn and Valdes (1999), and found similar results.

[20] More precisely we use the residuals of a pooled regression of (imports + exports)/GDP against structural determinants of trades such as landlock situation, an oil producers dummy, and population.

[21] For instance, Loayza and Hnakovska (2003) present evidence that crisis volatility can explain an important part of the negative relashionship between volatility and growth observed in middle-income economies.

Tables 1, 2 and 3 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 on growth depending on 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 1, regression [1.1] 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 [1.2] shows that the interaction term of exchange rate flexibility and financial development is positive and significant. The more financially developed an economy is, 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 1). 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 [1.3] and [1.4], we introduce the crisis dummy described above. While the frequency of crisis indeed has 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.

The main result of Table 1 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. The implication is that less financially developed economies may derive growth benefits from maintaining a rigid exchange rate regime. As illustrated by the examples given in the Introduction, these benefits can be economically large. This result provides a novel rational interpretation for the "fear of floating" behavior based on long run productivity growth.

Table 2 presents similar results with exchange rate volatility measured by the five-year volatility of the change in multilateral real exchange rates. Regression [2.1] 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 Appendix D) - 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 [2.3]. Regression [2.2] 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 it is 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 financially most developed economies.[22]

Table 3 presents regressions that focus on the effect of real exchange rate overvaluation. We present the results using the deviation between the actual effective real exchange rate and its predicted value.[23] In the baseline regression [3.1], real overvaluation has a significant and economically important negative effect on growth: a 20% overvaluation translates into a reduction of 0.2% in annual productivity growth (computed from regression [3.1] as 0.99*ln(120/100)). Regression [3.2] 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 overvaluation. 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.

3.3 Terms-of-trade growth and exchange rate flexibility

It is often argued that a flexible exchange rate regime is desirable since it can stabilize the effects of real shocks. In subsection 2.4, we showed that a flexible exchange rate can indeed lead to higher growth when the variance of real shocks is large. Moreover, there is recent empirical evidence showing that flexible exchange rate regimes tend to absorb the effects of terms-of-trade shocks (see Broda, 2004, and Edwards and Levy-Yeyati, 2005). We examine this issue by including terms-of-trade growth and terms-of-trade volatility in our previous regressions and present the results in Table 4.

In regression [4.1], a 10% deterioration in the terms of trade leads to a reduction of 0.9%

[22] 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.

[23] We obtain similar results when we consider HP deviation from trend when - as in Golfajn and Valdes (1999) - the HP filter parameter is set high enough (lamba=10^8).

in productivity growth.[24] In regression [4.2], we find that the impact on productivity growth of a terms-of-trade shock crucially depends on the nature of the exchange rate regime. It is larger under a fixed exchange rate regime and close to zero under a floating regime. This result confirms the stabilizing role of flexible exchange rates. However, in regression [4.3], we show that this stabilization effect fully coexists with the growth enhancing effect of a more fixed regime at low level of financial development. Thus, the empirical evidence shows that even though exchange rate flexibility dampens the impact of terms-of-trade shocks, it has a negative overall impact on growth for financially less developed countries since on average, terms-of-trade growth is close to zero.

In regression [4.4], we show that terms-of-trade volatility has a negative effect on productivity growth: a one standard deviation increase in terms-of-trade volatility reduces growth by 0.4 percentage point. In regression [4.5], we find that a more flexible exchange rate regime dampens the negative impact of terms-of-trade volatility. In fact, the total effect of terms-of-trade volatility on productivity growth becomes close to zero under a fully flexible regime. In regression [4.6], we find that the interaction of exchange flexibility with financial development and with terms-of-trade volatility are both positive and significant suggesting that both variables condition the impact of exchange rate flexibility on productivity growth. However, even under the assumption of large terms-of-trade volatility - set at the 75th percentile of the variable sample distribution- a more fixed exchange regime is growth enhancing for countries in the lowest quartile of financial development.[25]

3.4 Endogeneity issues

At this point, the main qualification to our results would seem to be the standard question of endogeneity. To examine whether this is a serious issue in our context, we can i) make various test within our GMM methodology and ii) examine the broader existing empirical evidence on the determinants of exchange rate regimes or exchange rate volatility. Both perspectives indicate that endogeneity is not a major factor behind our results. First, our dynamic panel procedure using the GMM system estimator controls for the potential endogeneity of all the explanatory variables and accounts explicitly for the biases induced by including the initial

[24] Our findings confirms the results of Mendoza (1997) who show that both negative terms-of-trade change and terms-of-trade uncertainty lower economic growth.

[25] The 75th percentile of the sample distribution of terms-of-trade volatility in log is 2.38 and the 25th percentile of the sample distribution of financial development in log is 2.65. The total growth effect of exchange rate flexibility, moving up one step in the RR classification, for a country with such levels of terms-of-trade volatility and financial development is therefore $-2.748 + 0.476 * 2.38 + 0.525 * 2.6 = -0.25$.

level of productivity in the growth regressors. It is true that 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. We can test this assumption using a Sargan test of overidentification which evaluates the entire set of moment conditions in order to assess the overall validity of the instruments. The results of the Sargan test in Tables 1 to 4 show that the validity of the instruments cannot be rejected.[26] As a robustness check, we re-estimate regression 1.2 in Table 1 by substituting in the instrument matrix the third lag level of the explanatory variables for the second lag level.[27,28] Regression 5.2 in Table 5 presents the results of the estimation. Lagging the set of internal instruments yields very similar estimates and insures that our results are not biased by the presence of some omitted variables that could be correlated with exchange rate flexibility and might have an independent effect on the next period's innovation in productivity growth.

Furthermore, our empirical approach has several features that makes it less vulnerable to a potential endogeneity bias. First, we focus on identifying *contrasting growth effects* of exchange rate flexibility and volatility at different levels of financial development. Endogeneity will be less of an issue with an interaction term than with single variables.[29] Second, we note that we obtain similar results for various measures of exchange rate volatility, as well as when we look at other measures of financial development (see below). Finally, 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

[26] A second test examines whether the differenced error term is second-order serially correlated, a necessary condition for the consistency of the estimation. In all regressions, we can safely reject second order serial correlation.

[27] For predetermined variables, such as initial income or initial secondary schooling, the first lag level is replaced by the second lag level. In order to make the estimations comparable with alternative sets of instruments, regression 1.2 (Table 1) is re-estimated over 1970-2000 and over 1975-2000. See Section 3.5.1 and Table A1 for a complete analysis of the robustness of the results for alternative time windows.

[28] The results reported in the main tables are obtained using an instrument matrix that includes only the closest appropriate lags of the explanatory variables. The choice to restrict the instrument matrix is dictated by two considerations: (i) the Sargan test loses power when the set of instruments becomes large; (ii) if we used more instruments, we would run into a classical overfitting problem.

[29] Assume for instance that the choice of exchange rate regime coincides with the choice of other policies associated with higher future growth opportunities unaccounted for by the set of explanatory variables. This could directly bias the estimation of the effect of exchange flexibility in a linear regression. In contrast, this could bias the estimation of the interaction coefficient in our set up only to the extent that the correlation between such policies and exchange rate flexibility or volatility varies significantly with the level of financial development.

low productivity growth and the choice of exchange rate regime (generally flexible because high inflation makes a sustained fix impossible).

The second avenue to evaluate the potential endogeneity problem is to rely on the existing literature that tries to explain exchange rate volatility or exchange rate regimes. The literature on exchange rate volatility is small, but it finds some robust determinants for the degree of volatility. For instance, Hau (2002) finds a negative correlation between real exchange rate volatility and trade openness.[30] However, this does not affect our estimation as our specification includes both real exchange rate volatility and trade openness as regressors and treat them as jointly endogenous. Hausmann et al. (2006) investigate the determinants of real exchange rate volatility and find that GDP growth has a positive and statistically significant effect. This finding suggests that if a reverse causality link stems for growth to volatility, this link should be positive thus reinforcing our results.

The literature on the endogeneity of exchange rate regimes is more extensive, but it has been largely inconclusive. For instance, Juhn and Mauro (2002) apply the extreme bound method of Levine and Renelt (1992) on the effect of a large set of variables on the exchange rate regime and do not find any robust determinant.[31] However, in a recent paper, Levy-Yeyati, Sturzenegger, and Reggio (2004), using a logit analysis, find that some political variables can explain the likelihood of adopting a given exchange rate regime. We find that one of their political variables, VetoPoints, is a good instrument for exchange rate regimes.[32] We re-estimate our baseline specification with the variable VetoPoints as an external instrument. The estimates are presented in regression 5.3 in Table 5 and show results similar to the ones obtained using internal instruments. We also introduce a time-varying index of creditor protection constructed by Djankov, McLiesh, and Schleifer (2006) as an external instrument

[30] Bravo and di Giovanni (2005) have complemented this finding by showing that real exchange volatility is correlated with an index of remotness defined as weighed geographical distance from main trade centers. This correlation suggests that remotness can be a valid external instrument for real exchange volatility. However, remotness exhibits almost no time variation and thus is a weak instrument in our dynamic panel context. When we use remoteness as an external instrument in a pure cross-sectional estimation, our results broadly hold but with less significance.

[31] The findings of Juhn and Mauro (2002) have been obtained using Levy-Yeyati and Sturzenegger (2003) de facto classification and the IMF de jure classification. We applied the same methodology to the RR classification and found the same result. We would like to thank Paulo Mauro for sharing his methodology.

[32] We would like to thank Eduardo Levy-Yeyati for providing us with the data. VetoPoints is an index measuring the extent of institutionalized constraints on the decision-making powers of chief executives. Notice that the non-political variables used in Levy-Yeyati et al. (2004) are already included in our set of control variables.

for the level of financial development and, again, find very similar results (see regressions 5.5 and 5.6.)

Beyond econometric tests, one can use the broad historical evidence to form a judgement on the endogeneity of exchange rate choices to future growth prospects. This is the approach followed by Eichengreen (1992) in his classical treatise. He shows that countries' choice to exit the inter-war gold standard had a huge impact on their subsequent growth trajectories. At the same time, the undisputed dogma in that period was that staying within the gold standard system was a necessary condition for economic recovery. A detailed discussion of the history of post-War exchange rate regimes falls outside the scope of this paper. However, our reading of the evidence compiled by Margaret De Vries (1985) and James Boughton (2001), in their massive sequential histories of the International Monetary Fund, is certainly consistent with politics, history and ideology playing a dominant role in most countries' choice of exchange rate or monetary policy regime.[33] Indeed, although it is hard to deny that growth was always an objective of monetary policy, these histories make clear that there is a very large exogenous (for our purposes) component to exchange regime choice as well.[34]

3.5 Robustness tests

The set of regressions presented in Tables 1 to 4 offers solid evidence that the level of financial development plays an important role in mitigating the negative effects of exchange rate volatility on productivity growth. It is also reassuring that control variables in the regressions have the expected effects: education and trade openness have a positive and often significant impact on growth while the effect of inflation and government burden is negative although not always statistically significant. Moreover, the results stay unchanged when the effects of crises are accounted for.

In this subsection, we discuss further evidence on the robustness of our main empirical

[33] The dominant view of the IMF on exchange rate arrangement changed several time the last thirty years of the past century. In the early seventies, the IMF proposed to substitute to the failing Bretton Woods system a system of fixed but adjustable exchange rate. Later in the decade, the conventional wisdom in the Fund became that the floating-rate regimes were working reasonably well. In the eighties, the Fund became gradually more favorable to fixed exchange rates regimes and their associated stabilizing and trade-promoting virtues. This position was later reversed in the nineties and the IMF started promoting exit strategies for countries seeking exchange rate flexibility (Eichengreen et al., 1998).

[34] Mussa (1986), especially, presents compelling evidence that the different behavior of real exchange rates under fixed versus floating regimes cannot possibly be attributed to exchange rate regime endogeneity (in part because the change typically occurs exactly on the day a country switches regimes even when the decision is announced long in advance.)

findings. We examine whether the results are robust to different time periods, alternative exchange rate classifications, different measures of financial development and the omission of subgroups of countries. The main results corresponding to this discussion are presented in tables A1 to A8.

3.5.1 Different time windows

Using time effects in all our regressions, we control for any common factor that could affect all countries in any five-year interval. Moreover, our non-linear specification implicitly allows for time and cross-country variation in the effect of the flexibility of the exchange rate regime on productivity growth. However, we would like to check if our results hold when different time windows are used for the estimation. A sensitive issue is whether we should use any information from the period prior to the collapse of the Bretton-Woods system (1973). Our baseline time span is 1960-2000, but the early observations are used as internal instruments so that the first observation in levels that is actually considered in the estimation belongs to the 1970-1975 interval, while the first observation in difference is taken between the 1970-1975 and the 1965-1970 intervals. In Table A1, we are more restrictive and consider the information available only for the period 1970-2000 and in the period 1975-2000. In both cases, our main result holds. Moreover, the interaction coefficient is higher, indicating a stronger dependence of the effect of the flexibility of the exchange regime on the level of financial development. We also consider three successive periods of 20 years: 1960-1980; 1970-1990; 1980-2000. Our result holds significantly in the last two periods but not in the first, suggesting that our finding is actually stronger when we restrict our regression analysis to the post Bretton-Woods era. Performing the same robustness test on the effect of the interaction between financial development and real exchange rate volatility leads to the same conclusions. As shown in Table A2, the interaction effect is stronger when the information available is restricted to 1970-2000.

3.5.2 Alternative exchange rate regime classifications

We have already examined the impact of three substantially different measures of exchange rate flexibility and obtained very similar results. However, it is useful to examine the results with other exchange rate classifications. Table A3 presents the robustness test to four alternative exchange rate classifications. In three out of four cases, our main result holds. First, our result is confirmed when the degree of exchange rate flexibility is measured on a more detailed scale using RR fine classification (i.e., using 13 categories instead of the 4 used in the other tables). We notice that the implicit threshold above which a flexible exchange rate regime is growth enhancing is almost identical for the fine and coarse RR classifications.[35] Second, the alternative de facto "consensus" classification of Gosh et al. (2003) yields similar results.

In contrast, when the classification of Levy-Yeyati and Sturzenegger (2003) (LYS) is used, the interaction with the level of financial development becomes negative but insignificant. In order to understand the differences between the results obtained with the RR and LYS classifications, we modify the latter in the following way: first, we eliminate the observations classified as free-falling by RR; second, we reclassify the observations with a dual exchange rate according to the RR classification. We then obtain a classification that combines the LYS clustering approach with the main innovations of RR. Interestingly, when this modified classification is used in the baseline regression, our main finding is confirmed.[36] In that case, the point estimate of the interaction term is slightly higher than the point estimate of the interaction term in the regression using the RR classification on the same sample period (0.68 vs. 0.43).

3.5.3 Alternative measures of real exchange rate volatility

We consider two alternative measures of exchange rate volatility: first, a measure of real effective exchange rate volatility computed with CPI indices and nominal exchange rates; second, a measure of nominal effective exchange rate volatility computed only with nominal exchange rates (see Appendix A for details). Table A4 reproduces the first two regressions presented in Table 2 over the full sample period and over a subsample period restricted to the post Bretton-Woods era.

When CPI-based real exchange volatility is introduced in the linear growth regression, it exerts a negative and significant impact of productivity growth. The non-linear specification gives results very similar to our baseline estimation: the point estimate of the interaction term between exchange rate volatility and financial development is almost identical. The non-linear specification using nominal effective exchange rate volatility delivers results similar to our baseline specification when the estimation is restricted to the post Bretton-Woods era. In that case, the magnitude of the interaction effect is close to the one obtained with real volatility (0.69 vs. 0.74). However, this result is not robust to the inclusion of the pre Bretton-Woods era: in that case, the interaction coefficient becomes small and insignificant. This result may

[35] 55% vs 59% when the fine classification over 1970-2000 is considered (Table A1, col. 1)

[36] This seems to indicate that the LYS method tends to classify as fixed countries that are, de facto, more flexible through a dual exchange rate system, as well as countries that experience episodes of high inflation.

not be surprising since nominal volatility was much lower under Bretton Woods.

3.5.4 Alternative measures of financial development

Table A5 shows the robustness of our main result to the use of alternative measures of financial development. Our initial and preferred measure is private credit to GDP from banks and other financial institutions. Our main result still holds when we consider the other side of the financial sector balance sheet (liquid liabilities over GDP) or when we restrict ourselves to a measure of the degree of financial intermediation provided by deposit money banks (deposit money banks assets over GDP).

3.5.5 Alternative measure of economic development

Instead of financial development we consider the distance to the technology frontier (represented by the US) 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 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 using 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 1, 2, and 3. 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 A6 presents the results of regressions performed using the flexibility of exchange rate regime, real exchange rate volatility and real overvaluation.

The three regressions shown in Table A6 show that the interaction between labor productivity and exchange rate flexibility has a positive and significant impact on growth. The interpretation is that the higher the level of productivity is, the better (or the less detrimental) is the impact of a more flexible exchange rate on productivity growth. We can identify a threshold level of output per worker above (below) which a more flexible (rigid) regime fosters productivity growth. For example, in the first column the point estimate of this threshold is US$ 5000 (constant 1995 US$), which is close to the current productivity levels of present-day Thailand and Peru and to the levels of Korea and Chile in the seventies.

3.5.6 Omission of continents

Table A7 and Table A8 show that our main result remains stable and significant when subgroups of countries are omitted in a systematic way. Our sample is partitioned into seven "continents" according to the World Bank classification. Then, the two baseline regressions (Regression [2], Table 1 and Regression [2], Table 2) are repeated with the omission of one continent at a time. The interaction term between exchange rate flexibility or volatility and financial development remains positive and significant at the 10 percent confidence level in thirteen out of fourteen regressions.[37] Moreover, its point estimate is also stable and varies within a one standard error band around the corresponding benchmark point estimate.

3.5.7 Crises and regime switching

A typical scenario of a currency crisis is a period of a fixed exchange rate with growth followed, after a large devaluation, by a more flexible exchange rate and a depressed economy (e.g., the Asian, Mexican and Southern Cone crises). To determine whether this might be the driving force behind our results in Table 1 we conducted various tests. First, we introduced a crisis dummy in Table 1 and showed that this does not significantly affect our results. A second and more stringent test consists of assigning the growth costs associated with a currency collapse to the pre-collapse regime. We implement this test according the following procedure: First, we first identify exchange rate regime changes that coincide with currency crises.[38] Second, we re-classify the observations on the exchange rate regime up to two years after the crisis by applying the exchange rate regime prior to the currency crisis.[39] Third, we re-compute our five-year average measure of exchange rate flexibility using the re-coded exchange rate. Finally, we re-estimate regression [1] in Table A1 using the new exchange rate flexibility variables. The results are presented in regression [2] in Table A9, yielding estimates that are very similar to our baseline specification. Two reasons explain the stability of our results: first, the number of re-classified observations only represents a small share of our dataset; second

[37] This result is especially remarkable considering that Windmejier (2004) correction for small sample is used in the estimation.

[38] The dates of currency crises over 1970-2000 come from Glick and Hutchinson (2001), who construct an indicator of currency crises based on “large” changes in an index of currency pressure, defined as a weighted average of real exchange rate changes and reserve losses. Large changes in exchange rate pressure are defined as changes in the pressure index exceeding the mean by more than twice the country-specific standard deviation.

[39] This procedure leads to the re-classification of 90 annual observations. For example, Korea experienced a currency crisis in 1997, while the exchange rate regime was pegged, and then moved to a free-falling regime (1998) and a pure floating regime (1999.) In that case, we will re-classify Korea as having had a pegged exchange rate until 1999.

and more importantly, with the exception of the notorious "twin" banking and currency crises of the 90s that were associated with large output contractions, currency crises, in contrast to banking crises, are not generally associated with large output losses.

3.5.8 Robustness against alternative non linear hypotheses

We use an interaction term to test the hypothesis of a non linear growth effect of exchange rate flexibility or exchange rate volatility in the level of financial development. It is therefore important to distinguish our hypothesis from alternative non-linear hypotheses. As a first robustness test, we add to our specification a quadratic term in exchange rate flexibility and a quadratic term in financial development.[40] Our main result changes very little in this specification (see regressions [1] and [2] in Table A10). A second robustness test is performed using the following procedure:[41] (i) first, we regress exchange rate flexibility on the other regressors and obtain a flexibility residual; (ii) second, we regress financial development on the other regressors and obtain a financial development residual; (iii) we perform our baseline estimation replacing the interaction term with the interaction of the computed residuals. By using this method, we exclude the possibility that our result might be influenced by other interaction effects between financial development or exchange rate flexibility and the remaining explanatory variables.[42] The result of the estimation is presented in regression [3] in Table A10. The interaction effect between exchange rate flexibility and financial development remains strongly significant.[43]

4 Conclusion

The vast empirical literature following Baxter-Stockman (1989) and Flood-Rose (1994) generally finds no detectable difference in macroeconomic performance between fixed and floating exchange rate regimes. In this paper, we argue that instead of looking at exchange rate volatility in isolation, it is important to look at the interaction between exchange rate volatility and both the level of financial development and the nature of macroeconomic shocks. We develop

[40] The idea of the test is that if financial development is correlated with exchange rate flexibility, the interaction term can capture a quadratic effect in financial development or in exchange rate flexibility.

[41] We are grateful to Ben Sorensen for having suggested this robustness test.

[42] We also exclude, once more, the hypothesis of a quadratic effect in financial development or in exchange rate flexibility.

[43] Notice that in regression [3] in Table A10, the interaction term represents the interaction of residuals. Hence, the point estimate of the interaction cannot be directly compared to the one obtained in previous regressions.

a theoretical model in which higher levels of excess exchange rate volatility can stunt growth, especially in countries with thin capital markets and where financial shocks are the main source of macroeconomic volatility. Our predictions are then shown to be largely validated by cross-country panel data, which thus provide fairly robust evidence suggesting the importance of the financial development for how the choice of exchange rate regime affects growth.[44]

Are our result 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 it 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. Clearly, more fully articulated structural models are needed to properly measure the trade-offs, and this would appear to be an important challenge for future research.

[44] 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 as 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.

References

[1] Acemoglu, D., S. Johnson, J. Robinson and Y. Thaicharoen (2003), "Institutional Causes, Macroeconomic Symptoms: Volatility, Crises, and Growth", *Journal of Monetary Economics* 50, 49-123.

[2] Aghion, Ph., G.M. Angeletos, A. Banerjee, and K. Manova (2005), ”Volatility and Growth: Financial Development and the Cyclical Behavior of the Composition of Investment,” mimeo.

[3] Aghion, Ph., Ph. Bacchetta, and A. Banerjee (2004), "A Corporate Balance-Sheet Approach to Currency Crises," *Journal of Economic Theory* 119, 6-30.

[4] Aghion, Ph., P. Howitt, and D. Mayer-Foulkes (2005), "The Effect of Financial Development on Convergence: Theory and Evidence," *Quarterly Journal of Economics* 120(1), 173-222.

[5] Arellano M. and S. Bond (1991), “Some Tests of Specification for Panel Data: Monte Carlo Evidence and an Application to Employment Equations,” *Review of Economic Studies*, 58, 277-297.

[6] Arellano M. and O. Bover (1995), “Another Look at the Instrumental-Variable Estimation of Error-Components Models,” *Journal of Econometrics* 68, 29-51.

[7] Bacchetta, Philippe and van Wincoop, Eric (2000), “Does Exchange Rate Stability Increase Trade and Welfare?,” *American Economic Review* 90, 1093-1109.

[8] Baldwin, Richard (1989) "Growth Effects of 1992," *Economic Policy*, 9, 247-282.

[9] Baum Christopher, Mark E. Schaffer and Steven Stillman, 2003, "Instrumental variables and GMM: Estimation and testing," *Stata Journal*, 3(1):1-31.

[10] Baxter, Marianne and Alan Stockman (1989), "Business Cycles and the Exchange-Rate Regime," *Journal of Monetary Economics* 23(3), 377-400.

[11] Blundell R., and S. Bond (1998), “Initial conditions and Moment Conditions in Dynamic Panel Data Models,” *Journal of Econometrics*, 87, 115-143.

[12] Bond, S. (2002), "Dynamic Panel Data Models: A Guide to Micro Data Methods and Practice," cemmap working paper no. 09/02.

[13] Boughton, James (2001), *Silent Revolution,The International Monetary Fund, 1979-1989*, International Monetary Fund

[14] Bravo-Ortega Claudio and Julian di Giovanni (2005), "Remoteness and Real Exchange Rate Volatility," IMF Working Paper No. 05/01

[15] Broda, Christian (2004), "Terms of Trade and Exchange Rate Regimes in Developing Countries," *Journal of International Economics* 63, 31-58.

[16] Calvo, G.A. and C. M. Reinhart (2002), "Fear of Floating," *Quarterly Journal of Economics* 117, 379-408.

[17] Clark, P., N. Tamirisa, and Shang-Jin Wei (2004), "A New Look at Exchange Rate Volatility and Trade Flows," IMF Occasional Paper No. 235.

[18] De Grauwe, P. and G. Schnabl (2005), "Exchange Rate Stability, Inflation and Growth in (South) Eastern and Central Europe," mimeo.

[19] Devereux, M.B. and P.R. Lane (2003), "Understanding Bilateral Exchange Rate Volatility," *Journal of International Economics* 60, 109-132.

[20] Djankov Simeon, Caralee McLiesh and Andrei Shleifer (2006), "Private Credit in 129 Countries," *Journal of Financial Economics,* forthcoming.

[21] Dollar D. (1992), "Outward Oriented Economies Really Do Grow More Rapidly: Evidence from 95 LDCs, 1976-1985," *Economic Development and Cultural Change, 9*40-3, 523-544.

[22] Dornbusch, Rudiger (1987), "Exchange Rate and Prices," *American Economic Review* 77(1), 93-106.

[23] Dubas, J.M., B.-J. Lee, and N.C. Mark (2005), "Effective Exchange Rate Classifications and Growth," NBER Working Papers 11272.

[24] Easterly, W. (2005), "National Policies and Economic Growth: A Reappraisal", in Ph. Aghion and S. Durlauf (eds), *The Handbook of Economic Growth*, (Amsterdam, Elsevier Press).

[25] Eichengreen Barry (1992), *Golden Fetters: The Gold Standard and the Great Depression,1919-1939*, Oxford University Press.

[26] Eichengreen, Barry J., Johnston, R. B, Masson, Paul R, Jadresic, Esteban and Bredenkamp, Hugh Hamann, A. Javier and Inci Ötker (1998), "Exit Strategies: Policy Options for Countries Seeking Exchange Rate Flexibility," IMF Occasional Paper No. 168

[27] Edwards, Sebastian, and Eduardo Levy Yeyati (2005), "Flexible Exchange Rates as Shock Absorbers," *European Economic Review* 49(8), 2079-2105.

[28] Frankel, J. and A. Rose (2002), "An Estimate of the Effect of Common Currencies on Trade and Income," *Quarterly Journal of Economics* May, 437-468.

[29] Garber, Peter M., and Lars E.O. Svensson (1995), "The Operation and Collapse of Fixed Exchange Rate Regimes" in Gene M. Grossman and Kenneth Rogoff (eds.), *The Handbook of International Economics*, vol. 3, (Amsterdam, Elsevier Press).

[30] Gertler, M. and Gilchrist, S. (1994), "Monetary Policy, Business Cycles and the Behaviour of Small Manufacturing" *Quarterly Journal of Economics* CIX, May, 309-40.

[31] Ghosh, A., A.M. Gulde, and H.C. Wolf (2003), *Exchange Rate Regimes: Choices and Consequences*, MIT Press.

[32] Glick R. and M. Hutchinson, 2001, "Banking Crises and Currency Crises: How Common are the Twins," in *Financial Crises in Emerging Markets*, ed. by Glick, Moreno, and Spiegel: New York: Cambridge University Press.

[33] Goldfajn, I. and R.Valdes (1999), "The Aftermath of Appreciations," *Quarterly Journal of Economics* 114, 229-62.

[34] Hau, Harald (2002), "Real Exchange Rate Volatility and Economic Openness: Theory and Evidence," *Journal of Money, Credit and Banking* 34(3), 611-630.

[35] Global Development Network (2002), "Global Development Network Growth Database." Washington: World Bank.

[36] Hausmann, R., U. Panizza, and R. Rigobon (2006), "The Long-Run Volatility Puzzle of the Real Exchange Rate," *Journal of International Money and Finance* 25, 93-124.

[37] Huang, H. and P. Malhotra (2004), "Exchange Rate Regimes and Economic Growth: Evidence from Developing Asian and Advanced European Economies," mimeo, IMF.

[38] Husain, A. M., A. Mody, and K.S. Rogoff (2005), "Exchange Rate Regime Durability and Performance in Developing versus Advanced Economies," *Journal of Monetary Economics* 52, 35-64.

[39] International Monetary Fund (2002), International Financial Statistics. Washington, D.C.

[40] Juhn, Grace and Mauro, Paolo (2002), "Long-Run Determinants of Exchange Rate Regimes: A Simple Sensitivity Analysis," IMF Working Papers 02/104.

[41] Krugman, Paul (1987), *The Age of Diminished Expectations*, MIT Press.

[42] Levine, R., Loayza N. and T. Beck (2000), "Financial Intermediation and Growth: Causality and Causes," *Journal of Monetary Economics*, 46(1), 31-77.

[43] Levine, Ross and Renelt, David (1992), "A Sensitivity Analysis of Cross-Country Growth Regressions," *American Economic Review*, 82(4), 942-63.

[44] Loayza, N. and R. Ranciere (2005), "Financial Development, Financial Fragility and Growth", *Journal of Money, Credit and Banking,* forthcoming

[45] Levy-Yeyati, E. and F. Sturzenegger (2003), "To Float or to Fix: Evidence on the Impact of Exchange Rate Regimes on Growth," *American Economic Review* 93, 1173-1193.

[46] Levy-Yeyati, E., F. Sturzenegger and I. Reggio (2004), "On the Endogeneity of Exchange Rate Regimes," mimeo.

[47] Mussa, Michael (1986), "Nominal Exchange Rate Regimes and the Behavior of Real Exchange Rates: Evidence and Implications," *Carnegie-Rochester Series on Public Policy*, 25:117-214.

[48] Mendoza Enrique (1997), "Terms-of-trade uncertainty and economic growth," *Journal of Development Economics*, 54(2), 323-356.

[49] Obstfeld, M. (2004), "Pricing-to-Market, the Interest-Rate Rule, and the Exchange Rate," mimeo.

[50] Obstfeld, Maurice and Kenneth Rogoff (1996), *Foundations of International Macroeconomics*, MIT Press.

[51] Obstfeld, Maurice and Kenneth Rogoff (2000), "The Six Major Puzzles in International Macroeconomics: Is There a Common Cause?" *NBER Macroeconomics Annual* 15.

[52] Razin, A. and Y. Rubinstein (2004), "Growth Effects of the Exchange-Rate Regime and the Capital-Account Openness in A Crisis-Prone World Market: A Nuanced View," NBER WP No. 10555.

[53] Reinhart, C.M. and K.S. Rogoff (2004), "The Modern History of Exchange Rate Arrangements: A Reinterpretation," *Quarterly Journal of Economics* 119(1):1-48, February.

[54] Rogoff, Kenneth, Aasim M. Husain, Ashoka Mody, Robin J. Brooks, and Nienke Oomes (2004), "Evolution and Performance of Exchange Rates Regimes", International Monetary Fund Occasional Paper No. 229.

[55] Rose, A. (2000), "One Money, One Market: Estimating the Effect of Common Currencies on Trade," *Economic Policy* 30, 7-46.

[56] Shambaugh, J.C. (2004), "The Effect of Fixed Exchange Rates on Monetary Policy," *Quarterly Journal of Economics* 119, 301-352.

[57] Summers, R. and A. Heston (1991). "The Penn World Table (Mark 5): An Expanded Set of International Comparisons, 1950-1988." Quarterly Journal of Economics 106(2): 327-68.

[58] Windmeijer, F., (2004), "A finite sample correction for the variance of linear two-step GMM estimator," *Journal of Econometrics,* 126-1, 25-51.

[59] World Bank (2002), World Development Indicators. Washington, D.C.

A Construction of the Real Exchange Rate Measures

A.1 Effective Real Exchange Rate

We construct a trade-weighted effective exchange rate measure using 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. The list of major trade partners is given in Appendix B. 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:

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

where $i \in [1, 83]$ 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 US dollars in country i and country 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 in country i and S_{ij} is the nominal exchange rate between country i and country j. A corresponding index of nominal effective exchange rate is computed as $EER_i^{cpi} = \prod_{j=1}^{J} (1/S_{ij})^{w_{i,j}}$

A.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 *growth rate* of the effective real exchange rate:[45]

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

An alternative measure of real exchange rate volatility and a measure of nominal exchange rate volatility are derived with the same formula using respectively the second measure of real

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

effective exchange rate (RER_i^{cpi}) and the corresponding measure of nominal effective exchange rate (EER_i^{cpi}).

A.3 Real Overvaluation

In order to construct a measure of real exchange rate overvaluation, we follow Dollar (1992). 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 (1992), we perform the following pooled OLS regression where income per capita and geographical dummies are used as proxies for factor endowments:

$$\ln(RER_{i,t}^{SH}) = \alpha + \beta_t d_t + \gamma \ln(Y_{it}) + \delta lac + \eta afri + \varepsilon_{i,t} \tag{15}$$

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 (15).[46]

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 $\lambda = 10^8$.

[46] The estimation of equation (15) yields

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

Figure 1: Real Exchange Rate Volatility, Exchange Rate Flexibility and Productivity Growth

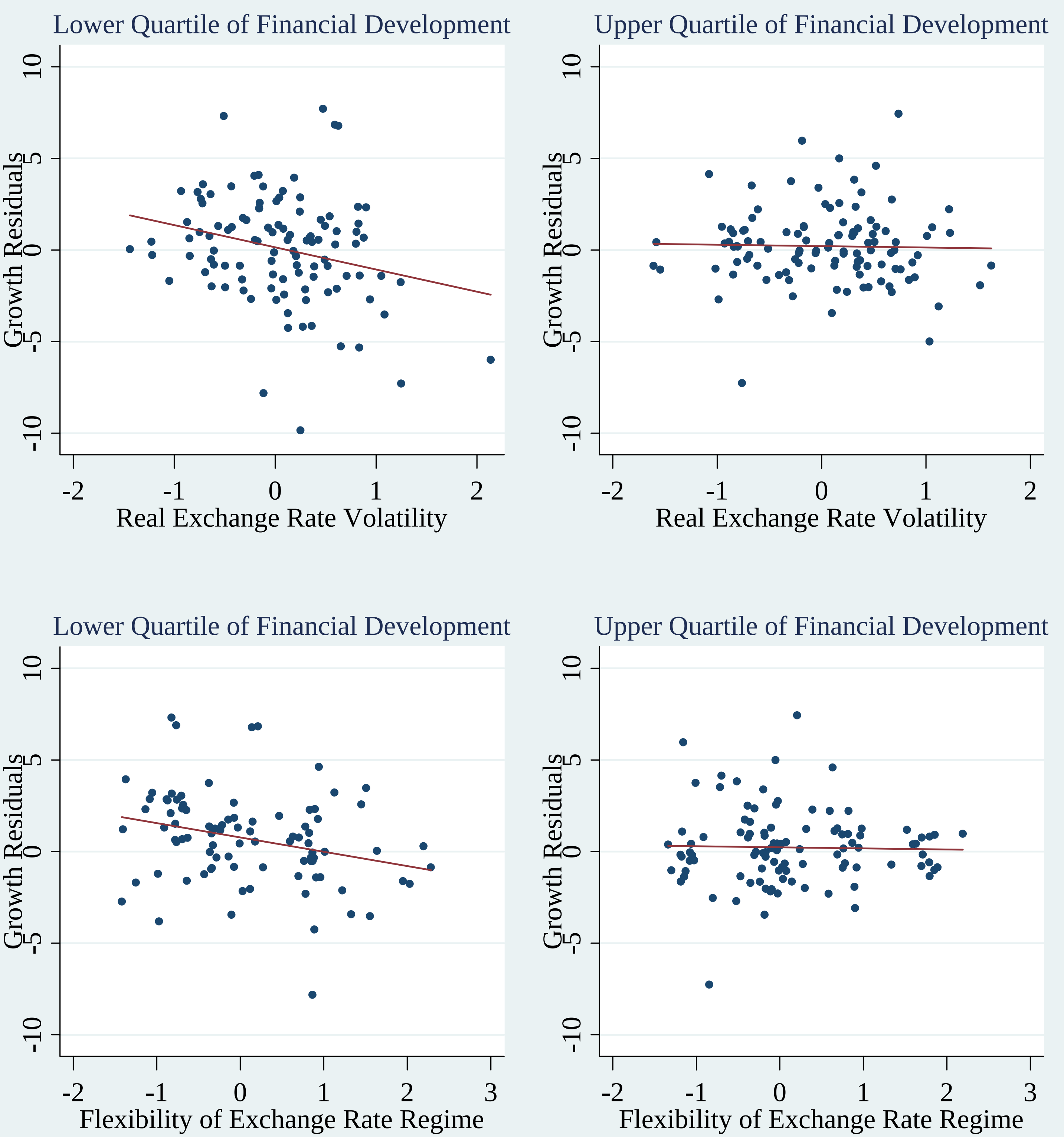

Table 1
Growth Effects of the Flexibility of Exchange Rate Regime
Dependent Variable: Growth Rate of Output per Worker
Estimation: 2-step system GMM estimation with Windmeijer (2003) Small Sample Robust Correction and Time Effects
(Standard errors are presented below the corresponding coefficient)

Period:	1960-2000			
Unit of observation:	Non-overlapping 5-year averages			
	[1.1]	[1.2]	[1.3]	[1.4]
Degree of the Exchange Flexibility	-0.191	-1.135 *	-0.144	-1.227 **
(Reinhart and Rogoff clasisification)	*0.349*	*0.579*	*0.288*	*0.563*
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 *
(banking or currency crisis dummy)			*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	79/562	79/562	79/562	79/562
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		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:		0.424		0.385
s.e.		*0.190*		*0.170*

Table 2
Growth Effects of Real Effective Exchange Rate Volatility
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:	1960-2000			
Unit of observation:	Non-overlapping 5-year averages			
	[2.1]	[2.2]	[2.3]	[2.4]
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 *
	0.572	*0.769*	*0.569*	*0.975*
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 dummy)			*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	83/615	83/615	83/615	83/615
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:				
Private Credit /GDP greater than:		1.01		1.10
s.e		*0.34*		*0.39*

Table 3
Growth Effects of Effective Exchange Rate Real Overvaluation
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:	1960-2000			
Unit of observation:	Non-overlapping 5-year averages			
	[3.1]	[3.2]	[3.3]	[3.4]
Degree of the Real Exchange Rate Overvaluation	-0.995 **	-1.162 *	-1.176 **	-1.179 **
(log deviation from equilibrium exchange rate)	*0.504*	*0.711*	*0.534*	*0.659*
Financial Development	0.636 *	-0.101	0.595 *	-0.040
(private domestic credit/GDP, in logs)	*0.345*	*2.509*	*0.330*	*2.163*
Initial Output per Worker	-0.038	-0.360	-0.057	-0.355
(log(initial output per worker))	*0.382*	*0.531*	*0.369*	*0.518*
Real overvaluation * Financial Development		0.205 **		0.163 **
		0.077		*0.082*
Control Variables:				
Education	1.185 *	1.532 **	1.245 **	1.645 **
(secondary enrollment, in logs)	*0.613*	*0.772*	*0.595*	*0.800*
Trade Openness	1.328 **	1.619 **	1.462 *	1.630 **
(structure-adjusted trade volume/GDP, in logs)	*0.626*	*0.688*	*0.812*	*0.777*
Government Burden	-1.457 *	-2.184	-1.329	-1.931
(government consumption/GDP, in logs)	*0.827*	*1.358*	*0.875*	*1.483*
Lack of Price Stability	-4.505 **	-3.819 **	-3.857 **	-3.708 **
(inflation rate, in log [100+inf. rate])	*1.009*	*1.160*	*0.935*	*0.881*
Crisis			-1.281	-2.082
(banking or currency crisis dummy)			*1.326*	*1.284*
Intercept	27.612 **	27.551 **	25.148 **	26.882 **
	5.720	*8.751*	*5.556*	*7.626*
No. Countries / No. Observations	83/615	83/615	83/615	83/615
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 4
Growth Effects of the Flexibility of Exchange Rate Regime,Terms-of-Trade Growth and Volatility
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:	1960-2000					
Unit of observation:	Non-overlapping 5-year averages					
	[4.1]	[4.2]	[4.3]	[4.4]	[4.5]	[4.6]
Terms-of-Trade Growth	0.092 *	0.327 *	0.385 **			
	0.054	*0.169*	*0.173*			
Terms-of-Trade Volatility				-0.205 *	-0.987 **	-1.189 **
				0.113	*0.421*	*0.410*
Degree of the Exchange Flexibility		-0.068	-0.826		-0.853 **	-2.748 **
(Reinhart and Rogoff classification)		*1.226*	*0.658*		*0.392*	*1.179*
Financial Development	1.039 **	0.783 *	0.285	0.681 *	0.722 *	-1.178
(private domestic credit/GDP, in logs)	*0.463*	*0.395*	*0.192*	*0.378*	*0.411*	*0.755*
Initial Output per Worker	-0.526	-0.644 *	-0.702	-0.396	-0.173	-0.061
(log(initial output per worker))	*0.460*	*0.381*	*0.465*	*0.404*	*0.455*	*0.514*
Flexibility *Terms-of-Trade Growth		-0.107 **	-0.136 **			
		0.044	*0.062*			
Flexibility *Terms-of-Trade Volatility					0.394 **	0.476 **
					0.197	*0.191*
Flexibility*Financial Development			0.357 **			0.525 *
			0.159			*0.283*
Control Variables:						
Education	1.740 **	2.301 **	2.301 **	1.541 **	1.457 **	1.166 *
(secondary enrollment, in logs)	*0.517*	*0.467*	*0.571*	*0.529*	*0.642*	*0.687*
Trade Openness	0.652	1.493	1.385 *	1.339	1.734 **	1.832 **
(structure-adjusted trade volume/GDP, in logs)	*0.746*	*1.074*	*0.706*	*0.962*	*0.878*	*0.931*
Government Burden	-0.770	-0.762	-0.707	-0.136	-0.977	-0.810
(government consumption/GDP, in logs)	*1.248*	*1.191*	*0.982*	*[1.049]*	*0.930*	*0.930*
Lack of Price Stability	-2.620 **	-4.354 **	-3.560 **	-2.805 *	-1.997 *	-1.900 *
(inflation rate, in log [100+inf. rate])	*1.260*	*1.784*	*1.432*	*1.567*	*0.989*	*1.020*
Intercept	13.700 **	20.450 **	20.000 **	13.886	13.388	17.756
	6.310	*12.850*	*9.815*	*7.358*	*14.469*	*15.327*
No. Countries / No. Observations	83/615	79/562	79/562	83/615	79/494	79/494
SPECIFICATION TESTS (*p* -values)						
(a) Sargan Test:	0.335	0.420	0.680	0.670	0.840	0.830
(b) Serial Correlation :						
First-Order	0.000	0.000	0.000	0.000	0.000	0.000
Second-Order	0.499	0.450	0.450	0.610	0.510	0.480

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

Table 5

Growth Effects of the Flexibility of Exchange Rate Regime

Endogeneity Issues and Alternative Set of Instruments

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:	1970-2000	1970-2000	1970-2000	1975-2000	1975-2000	1975-2000
Unit of observation:	Non-overlapping 5-year averages			Non-overlapping 5-year averages		
	[5.1]	[5.2]	[5.3]	[5.4]	[5.5]	[5.6]
Degree of the Exchange Flexibility	-1.742 **	-2.527 **	-2.357 **	-3.090 **	-3.124 **	-3.090 **
(Reinhart and Rogoff clasisification)	*0.745*	*1.197*	*1.179*	*1.453*	*1.500*	*1.453*
Financial Development	-0.800	-0.725	-0.819	-2.055	-1.962	-2.055
(private domestic credit/GDP, in logs)	*0.666*	*0.907*	0.918	*1.455*	*1.359*	*1.455*
Initial Output per Worker	0.132	-0.150	-0.076	0.102	0.147	0.178
(log(initial output per worker))	*0.378*	*0.564*	*0.572*	*0.540*	*0.824*	*0.917*
Flexibility * Financial Development	**0.428 ****	**0.553 ****	**0.513** **	**0.751 ****	**0.766 ****	**0.642 ***
	0.229	***0.246***	***0.261***	***0.321***	***0.376***	***0.339***
No. Countries / No. Observations	79/421	79/421	79/416	79/352	76/343	76/342
SPECIFICATION TESTS (p-values)						
(a) Sargan Test:	0.596	0.285	0.26	0.269	0.298	0.245
(b) Second Order Serial Correlation :	0.125	0.319	0.89	0.619	0.543	0.487

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

Source: Authors' estimations

<u>Notes</u>

The specification of the regressions is identical to regression 2, Table 1. The coefficients for the other control variables - secondary Schooling, Inflation, Openness to Trade and Government Size - are not reported

Regression [5.1] is the same as Regression [1.2], Table 1, estimated over 1970-2000

Regression [5.2] is the same as Regression [5.1] with all internal instrument lagged by one time-unit

Regression [5.3] is the same as Regression [5.1] with VetoPoint introduced as external instrument

Regression [5.4] is the same as Regression [1.2], Table 1, estimated over 1975-2000

Regression [5.5] is the same as Regression [5.4] with Creditor Rights introduced as external instrument

Regression [5.6] is the same as Regression [5.4] Creditor Rights and VetoPoints introduced as external instruments

Table A 1
Growth Effects of the Flexibility of Exchange Rate Regime
Robustness: Different Time Windows
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:	1970-2000	1975-2000	1960-1980	1970-1990	1980-2000
Unit of observation:	Non-overlapping 5-year averages				
	[1]	[2]	[3]	[4]	[5]
Degree of the Exchange Flexibility	-1.742 **	-3.090 **	-1.189	-2.381 *	-3.366 **
(Reinhart and Rogoff clasisification)	*0.745*	*1.453*	*2.010*	*1.126*	*1.540*
Financial Development	-0.800	-2.055	0.080	-2.040	-2.110
(private domestic credit/GDP, in logs)	*0.666*	*1.455*	*0.126*	*1.280*	*1.550*
Initial Output per Worker	0.132	0.102	0.002	0.240	0.698
(log(initial output per worker))	*0.378*	*0.540*	*0.371*	*0.480*	*0.540*
Flexibility * Financial Development	**0.428 ****	**0.751 ****	**0.330**	**0.493 ***	**0.749 ****
	0.229	***0.321***	***0.340***	***0.274***	***0.353***
No. Countries / No. Observations	79/421	79/352	78/273	78/275	79/282
SPECIFICATION TESTS (*p* -values)					
(a) Sargan Test:	0.596	0.269	0.279	0.162	0.155
(b) Second Order Serial Correlation :	0.125	0.619	0.153	0.269	0.47

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

Table A 2
Growth Effects of the Real Effective Exchange Rate Volatility
Robustness: Different Time Windows
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:	1970-2000	1975-2000	1960-1980	1970-1990	1980-2000
Unit of observation:	Non-overlapping 5-year averages				
	[1]	[2]	[3]	[4]	[5]
Real Exchange Rate Volatility	-4.002 **	-4.493 **	-3.561	-5.231 **	-3.934 **
	0.464	*1.587*	*2.720*	*1.630*	*1.326*
Financial Development	-1.747	-2.566 *	-1.064	-3.325 **	-2.501 **
(private domestic credit/GDP, in logs)	*1.159*	*1.373*	*2.396*	*1.265*	*1.149*
Initial Output per Worker	-0.374	1.009 *	-0.949	0.486	0.928
(log(initial output per worker))	*0.474*	*0.606*	*0.855*	*0.522*	*0.664*
Exchange Rate Volatility * Financial Development	**1.030 ****	**1.077 ****	**0.716**	**1.249 ****	**0.939 ****
	0.464	***0.464***	***0.464***	***0.412***	***0.401***
No. Countries / No. Observations	83/475	83/398	83/307	83/318	83/319
SPECIFICATION TESTS (*p* -values)					
(a) Sargan Test:	0.14	0.11	0.22	0.41	0.10
(b) Second Order Serial Correlation :	0.17	0.66	0.96	0.72	0.61

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

Note: The specification of the regression is identical to regression 2, Table 1 and 2. The coefficients for the other control variables - secondary Schooling, Inflation, Openness to Trade and Government Size - are not reported

Table A 3
Growth Effects of the Flexibility of Exchange Rate Regime
Robustness: Different Exchange Rate Regime Classifications
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:	1970-2000	1970-2000	1970-2000	1970-2000
Unit of observation:	Non-overlapping 5-year averages			
Exchange Rate Classification	De Facto (RR Fine)	De Facto (Gosh and al.)	De Facto (Initial LYS)	De Facto (Modified LYS)
Degree of the Exchange Flexibility	-0.863 **	-2.280 **	1.628	-2.795 **
	0.390	*0.954*	*1.660*	*1.207*
Financial Development	-1.270	-0.740	-0.462	-1.017
	0.963	*0.990*	*0.500*	*1.100*
Initial Output per Worker	-0.085	-0.180	-0.391	-1.076 *
(log(initial output per worker))	*0.430*	*0.489*	*0.630*	*0.639*
Flexibility * Financial Development	**0.215 ****	**0.830 ****	**-0.462**	**0.688 ****
	0.080	***0.435***	***0.501***	***0.335***
No. Countries / No. Observations	79/421	79/401	79/418	79/388
SPECIFICATION TESTS (*p* -values)				
(a) Sargan Test:	0.24	0.585	0.31	0.35
(b) Second Order Serial Correlation :	0.565	0.114	0.59	0.41

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

Note: The specification of the regression is identical to regression 2, Table 1 and 2. The coefficients for the other control variables - secondary Schooling, Inflation, Openness to Trade and Government Size - are not reported
Exchange Rate Flexibility Annual Coding:
De Facto (RR Fine) : 13 ways Reinhart and Rogoff Fine Classification (1: Fix to 13: Float)
De Facto (Gosh and al.): 3 ways Consensus Classification 1=Fix and Peg Regime , 2 = Intermediated Regime, 3 = Floating Regime
De Facto (Levy-Yeyati and al.): 4 ways Classification coded as (1: Fix; 2: Peg ; 3 Managed Float; 4 Float)

Table A4
Growth Effects of Real Effective Exchange Rate Volatility
Robustness: Alternative Measure of Effective Exchange Rate Volatility
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:	1960-2000				1975-2000			
Unit of observation:	Non-overlapping 5-year averages				Non-overlapping 5-year averages			
	[A4.1]	[A4.2]	[A4.3]	[A4.4]	[A4.5]	[A4.6]	[A4.7]	[A4.8]
Real Exchange Rate Volatility	-0.968 **		-3.28 **		-0.831 **		-3.985 **	
	0.294		*0.92*		*0.269*		*1.112*	
Nominal Exchange Rate Volatility		0.037		-0.134		-0.277		-2.491 *
		0.264		*0.858*		*0.279*		*1.163*
Financial Development	0.209	0.678	-1.576 *	0.186	0.227	0.168	-2.64 **	-2.017 **
(private domestic credit/GDP, in logs)	*0.529*	*0.543*	*0.811*	*0.658*	*0.45*	*0.692*	*1.024*	*0.763*
Initial Output per Worker	-0.605	-0.719 **	-0.52	-0.702	0.574 *	0.975 *	1.081 **	1.363 **
(log(initial output per worker))	*0.502*	*0.539*	*0.489*	*0.564*	*0.33*	*0.596*	*0.411*	*0.382*
Real Exchange Rate Volatility * Financial Development			**0.672 ****				**0.739 ****	
			0.24				***0.273***	
Nominal Exchange Rate Volatility * Financial Development				**0.065**				**0.699 ****
				0.265				***0.32***
No. Countries / No. Observations	74/421	82/603	74/421	82/603	73/335	82/603	73/335	82/392
SPECIFICATION TESTS (*p* -values)								
(a) Sargan Test:	0.75	0.14	0.65	0.1	0.74	0.61	0.32	0.52
(b) Second Order Serial Correlation :	0.22	0.17	0.25	0.31	0.32	0.98	0.26	0.67

Note: The specification of the regression is identical to regression 1 and regression 2, Table 2. The coefficients for the other control variables - secondary Schooling, Inflation, Openness to Trade and Government Size - are not reported

Table A 5

Growth Effects of the Flexibility of Exchange Rate Regime

Robustness: Different Measures 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:	1970-2000	1970-2000
Unit of observation:	Non-overlapping 5-year averages	
Degree of the Exchange Flexibility	-1.530 **	-1.602 **
(Reinhart and Rogoff clasisification)	*0.510*	*0.489*
Financial Development	-1.630	
(liquid liabilities/GDP)	*1.210*	
Financial Development		-3.510 *
(deposit money banks assets/GDP)		*1.970*
Initial Output per Worker	0.410	0.860
(log(initial output per worker))	*0.489*	*0.604*
Flexibility * Financial Development	**0.670 ** **	**1.172 * **
	0.290	***0.707***
No. Countries / No. Observations	77/400	77/404
SPECIFICATION TESTS (*p* -values)		
(a) Sargan Test:	0.342	0.523
(b) Second Order Serial Correlation :	0.121	0.122

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

Source: Authors' estimations

Note: The specification of the regression is identical to regression 3, Table 1. The coefficients for the other control variables - secondary Schooling, Inflation, Openness to Trade and Government Size - are not reported

Table A 6

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:	1960-2000		
Unit of observation:	Non-overlapping 5-year averages		
	[1]	[2]	[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*	*1.102*	*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 *
(banking or currency crisis dummy)	*1.064*	*1.184*	*1.050*
Intercept	30.217 **	20.266 **	46.119 **
	6.837	*7.668*	*16.205*
No. Countries / No. Observations	79/562	83/615	83/615
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	12063.4	16047
s.e.	*2321*	*5329*	*6477*

Table A 7
Growth Effects of the Flexibility of Exchange Rate Regime
Robustness: Omission of a Continent
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)

Continent Omitted	East Asia and Pacific	Europe and Central Asia	Latin America and the Caribbean	Middle East and North Africa	North America	South Asia	Sub-Saharan Africa
Period:				1970-2000			
Unit of observation:				Non-overlapping 5-year averages			
	[1]	[2]	[3]	[4]	[5]	[6]	[7]
Degree of the Exchange Flexibility	-1.608*	-1.944*	-2.003**	-1.931*	-2.200*	-2.373*	-1.442*
(Reinhart and Rogoff clasisification)	*0.702*	*1.136*	*0.621*	*0.959*	*0.859*	*0.998*	*0.801*
Financial Development	-0.921	-1.091	-0.907	-0.488	-0.736	-1.437*	-0.73
(private domestic credit/GDP, in logs)	*0.580*	*0.836*	*0.707*	*0.635*	*0.643*	*0.668*	*0.500*
Initial Output per Worker	-0.273	0.703	0.013	0.376	-0.509	0.668*	0.351
(log(initial output per worker))	*0.388*	*0.541*	*0.455*	*0.405*	*0.387*	*0.378*	*0.532*
Flexibility * Financial Development	**0.43****	**0.338***	**0.253****	**0.36***	**0.461****	**0.442***	**0.293***
	0.202	***0.191***	***0.126***	***0.227***	***0.229***	***0.247***	***0.17***
No. Observations	364	321	315	376	409	403	338
No. Countries	69	62	59	71	77	76	60
SPECIFICATION TESTS (*p*-values)							
(a) Sargan Test:	0.61	0.65	0.7	0.53	0.46	0.46	0.66
(b) Second Order Serial Correlation :	0.11	0.08	0.24	0.64	0.18	0.11	0.24

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

Table A 8
Growth Effects of the Real Effective Exchange Rate Volatility
Robustness: Omission of a Continent
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)

Continent Omitted	East Asia and Pacific	Europe and Central Asia	Latin America and the Caribbean	Middle East and North Africa	North America	South Asia	Sub-Saharan Africa
Period:				1970-2000			
Unit of observation:				Non-overlapping 5-year averages			
	[1]	[2]	[3]	[4]	[5]	[6]	[7]
Real Exchange Rate Volatility	-3.324*	-4.139*	-3.606*	-4.484*	-2.448*	-5.247**	-1.828
	1.573	*1.884*	*1.731*	*1.876*	*1.374*	*1.691*	*1.627*
Financial Development	-2.076*	-1.475	-0.819	-1.672	-0.06	-2.543**	-0.315
(private domestic credit/GDP, in logs)	*1.259*	*1.344*	*1.296*	*1.405*	*0.897*	*1.247*	*1.127*
Initial Output per Worker	0.092	0.599	-0.112	0.452	-0.393	-0.215	-0.417
(log(initial output per worker))	*0.515*	*0.659*	*0.553*	*0.511*	*0.531*	*0.493*	*0.615*
Exchange Rate Volatility * Financial Development	**0.852****	**0.811****	**0.763***	**1.029****	**0.635***	**1.353****	**0.628**
	0.427	***0.305***	***0.43***	***0.522***	***0.343***	***0.501***	***0.446***
No. Observations	412	367	349	428	463	451	380
No. Countries	72	65	62	74	81	79	65
SPECIFICATION TESTS (*p*-values)							
(a) Sargan Test:	0.37	0.47	0.65	0.19	0.24	0.15	0.48
(b) Second Order Serial Correlation :	0.15	0.44	0.83	0.53	0.47	0.23	0.02

Note: The specification of the regression is identical to regression 3, Table 1 and 2. The coefficients for the other control variables - secondary Schooling, Inflation, Openness to Trade and Government Size - are not reported

Table A9

Growth Effects of the Flexibility of Exchange Rate Regime

Robustness: Crises and Regime Switching

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:	1970-2000	1970-2000
Unit of observation:	Non-overlapping 5-year averages	
	[1]	[2]
Degree of the Exchange Flexibility	-1.742 **	-1.757 **
(Reinhart and Rogoff clasisification)	*0.745*	*0.828*
Financial Development	-0.800	-0.679
(private domestic credit/GDP, in logs)	*0.666*	*0.628*
Initial Output per Worker	0.132	-0.150
(log(initial output per worker))	*0.378*	*0.564*
Flexibility * Financial Development	**0.428 ****	**0.381 ****
	0.229	***0.191***
No. Countries / No. Observations	79/421	79/421
SPECIFICATION TESTS (p-values)		
(a) Sargan Test:	0.596	0.285
(b) Second Order Serial Correlation :	0.125	0.319

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

Notes

Regression [A11.1] is the same as Regression [1], Table A1

Regression [A11.2] is the same as Regression [1], Table A1, with the exchange rate regime recoded (see subsection 3.5.7)

Table A10

Growth Effects of the Flexibility of Exchange Rate Regime

Robustness against Alternative Non-Linear Hypotheses

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:	1970-2000	1970-2000	1970-2000
Unit of observation:	Non-overlapping 5-year averages		
	[1]	[2]	[3]
Degree of the Exchange Flexibility	-2.893 **	-4.118 **	-1.091 **
(Reinhart and Rogoff clasisification)	*1.158*	*2.155*	*0.353*
Degree of the Exchange Flexibility Squared		0.246 *	
(Reinhart and Rogoff clasisification)		*0.392*	
Financial Development	-0.388	-1.233	-0.254
(private domestic credit/GDP, in logs)	*1.984*	*0.842*	*0.680*
Financial Development Squared	-0.144		
(private domestic credit/GDP, in logs)	*0.322*		
Initial Output per Worker	-0.107	-0.350	-0.232
(log(initial output per worker))	*0.702*	*0.578*	*0.543*
Flexibility * Financial Development	**0.580 ****	**0.599 ****	
	0.299	***0.299***	
Flexibility Residuals * Financial Development Residuals[1]			**1.476 ****
			0.676*
No. Countries / No. Observations	79/421	79/421	79/21
SPECIFICATION TESTS (p-values)			
(a) Sargan Test:	0.24	0.29	0.25
(b) Second Order Serial Correlation :	0.137	0.125	0.169

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

Note:

1/For the construction of residuals, see subsection 3.5.8

Appendix B: List of 83 Countries

Algeria
Argentina*
Australia*
Austria
Bangladesh
Belgium
Bolivia
Botswana
Brazil*
Burkina Faso
Canada
Chile
China
Colombia
Congo, Dem. Rep.
Congo, Rep.
Costa Rica
Cote d'Ivoire
Denmark
Dominican Republic
Ecuador
Egypt, Arab Rep.
El Salvador
Finland
France*
Gambia, The
Germany*
Ghana
Greece
Guatemala
Haiti
Honduras
Iceland
India
Indonesia
Iran, Islamic Rep.
Ireland
Israel
Italy*
Jamaica
Japan*
Jordan
Kenya
Korea, Rep.
Madagascar
Malawi
Malaysia
Mexico
Morocco
Netherlands*
New Zealand
Nicaragua
Niger
Nigeria
Norway
Pakistan
Panama
Papua New Guinea
Paraguay
Peru
Philippines
Portugal
Senegal
Sierra Leone
Singapore*
South Africa*
Spain*
Sri Lanka
Sweden
Switzerland
Syrian Arab Republic
Thailand
Togo
Trinidad and Tobago
Tunisia
Turkey
Uganda
United Kingdom*
United States*
Uruguay
Venezuela, RB
Zambia
Zimbabwe

* Major trading partner

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.	Global 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 and Levine (1999).
Terms-of-Trade Growth	Growth Rate of Terms of Trade Index. Terms of Trade Index shows the national account exports price index divided by imports price index with a 1995 base year.	World Development Network (2002) and The World Bank (2002).
Terms-of-Trade Volatility	Standard Deviation of Term of Trade Growth in five-year interval	World Development Network (2002) and The World Bank (2002).
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
Index of Creditor Protection		Djankov and al. (2006)

VetoPoints	Variable referred to the extent of institutionalized constraints on the decision-making powers of chief executive.	Levy-Yeyati and al. (2006)
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).
Period-specific Shifts	Time dummy variables.	Authors' construction.

APPENDIX D : DESCRIPTIVE STATISTICS

SAMPLE ANNUAL SUMMARY STATSITICS (1960-2000)

Variable	Observations	Mean	Std. Deviation	Min	Max
Flexibility of Exchange Rate	3224	1.84	0.91	1.00	4.00
Private Credit/ GDP	3587	34.88	36.07	0.01	236.98
Ouput per Worker	3801	13277.66	18389.82	123.39	86957.22
Secondary Schooling	3974	46.83	31.91	0.82	140.10
Adjusted Openness to Trade	3377	0.00	0.57	-2.82	1.83
Rate of Inflation	3651	15.03	34.93	-49.81	553.91
Government Expenditures to GDP	3945	14.58	6.38	0.91	76.22
Dummy Banking or Currency Crisis	3403	0.09	0.29	0.00	1.00

SAMPLE ANNUAL CORRELATION (1960-2000)

	Flexibility of Exchange Rate	Private Credit/ GDP	Ouput per Worker	Secondary Schooling	Adjusted Openness to Trade	Rate of Inflation	Government Expenditures to GDP	Dummy Crisis
Flexibility of Exchange Rate	1.00							
Private Credit/ GDP	0.18	1.00						
Ouput per Worker	0.10	0.74	1.00					
Secondary Schooling	0.11	0.32	0.42	1.00				
Adjusted Openness to Trade	-0.02	0.09	-0.07	0.19	1.00			
Rate of Inflation	0.17	-0.20	-0.18	-0.07	-0.12	1.00		
Government Expenditures to GDP	0.06	0.28	0.44	0.35	0.24	-0.08	1.00	
Dummy Banking or Currency Crisis	0.09	0.06	-0.07	0.07	0.06	0.08	-0.05	1.00

SAMPLE CORRELATION OF EXCHANGE RATE MEASURES (1960-2000; DATA IN FIVE-YEAR AVERAGE)

	Exchange Rate Flexibility	Real Effective Exchange Rate Volatility*	Real Effective Exchange Rate Volatility**	Nominal Effective Exchange Rate Volatility**	Real Overvaluation
Exchange Rate Flexibility	1.00				
Real Effective Exchange Rate Volatility*	0.22	1.00			
Real Effective Exchange Rate Volatility**	0.23	0.70	1.00		
Nominal Effective Exchange Rate Volatility**	0.36	0.53	0.38	1.00	
Real Overvaluation	0.09	0.13	0.11	-0.05	1.00

** based on Penn World Table (see Appendix A)*

***based on International Financial Statistics (see Appendix A)*

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*

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

Variable	Full 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 Ch	7.59	7.53

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