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ABSTRACT

This paper documents large cross-country differences in the long run volatility of the real exchange rate. In particular, it shows that the real exchange rate of developing countries is approximately three times more volatile than the real exchange rate in industrial countries. The paper tests whether this difference in volatility can be explained by the fact that developing countries face larger shocks (both real and nominal) and recurrent currency crises or by different elasticities to these shocks. It finds that the magnitude of the shocks and the differences in elasticities can only explain a small part of the difference in RER volatility between developing and industrial countries. Results from ARCH estimations confirm that there is a substantial difference in long term volatilities between these two sets of countries and indicate that there is also a much higher persistence of deviations of the variance of the RER from its long run value when the economy suffers shocks of various kinds.

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1. Introduction

Developing countries are more volatile than industrial countries. This is true when we look across countries at differences in the volatility of output, consumption, interest rates, or exchange rates. The purpose of this paper is to document cross-country differences in long run volatility of the real exchange rate (RER). We show that the real exchange rate tends to be much more volatile in developing countries than in industrial countries, even at long horizons, and that this difference in volatility cannot be attributed to standard explanations based on the fact that developing countries face larger shocks (either real or nominal), or that they are more sensitive to these shocks. The paper finds that part of the explanation lies in the fact that volatility swings are more persistent in developing countries.

Since the seminal contribution by Cassel (1922), Purchasing Power Parity (PPP) has been one of the most studied topics in international economics. In its simplest form, PPP implies that the price level of consumption baskets across countries is the same. This is the absolute version of PPP which, by expressing all variables in logs, can be written as:

$$p_t = p_t^* + s_t$$

where p_t is the price of the domestic consumption basket, p_t^* is the price of the foreign basket, and s_t represent the exchange rate. The idea is that if goods are traded freely then deviations from PPP would imply flow of goods to arbitrage the differences. Absolute PPP is only satisfied under very strong assumptions and the presence of non-tradable goods, transportation costs, and monopolistic competition are among the main reasons used in the literature to account for deviations from absolute PPP. Relative PPP entails weaker assumptions and, rather than requiring price equalization across consumption baskets, it only assumes that changes in the price of those consumption baskets are arbitraged away. Formally, relative PPP requires that:

$$\Delta p_t = \Delta p_t^* + \Delta s_t$$

Both absolute and relative PPP have implications for the behavior of the real exchange rate. Absolute PPP implies that the real exchange rate is always equal to one, while relative PPP implies that deviations of the real exchange rate from its steady state are zero.

$$\Delta q_t = \Delta s_t + \Delta p_t^* - \Delta p_t$$

PPP is an appealing theory. So much so, that it is one of the most important building blocks of the models in international economics. PPP, however, was never meant to characterize the short-term dynamics of countries. Prices do not adjust to monthly fluctuations of the exchange rate, and in most countries, not even to yearly movements. Dornbusch's (1976) seminal paper explained exchange rate overshooting in the short run as the consequence of differential arbitrage speeds between the fast financial markets and the slower goods markets. In all these theories, arbitrage in the goods markets will eventually take place and PPP can be thought as a the long run characteristic of a mean reverting process. There are, however, theoretical models that by assuming permanent real shocks can account for an RER that follows a random walk.

In fact, most of the attention of the empirical literature on PPP has focused on testing whether the RER is better described by a random walk or by a mean reverting process. In most cases this is done by concentrating on the stochastic properties of real exchange rate deviations from some trend and by estimating variations of the following regression:

$$\Delta q_t = \alpha \Delta q_{t-1} + \varepsilon_t \tag{1}$$

where the focus of the analysis has tended to concentrate on the coefficient α.

While a survey of the extensive literature on the empirics of PPP is beyond the purpose of this paper, it is worth noting that Froot and Rogoff (1995) find that the consensus in the literature is that PPP holds in the long run, and that the half-life of the deviations ranges between 3 and 4 years. [1] It should be pointed out that this is a consensus, not an agreement (Kilian and Zha, 2002). For example, the area continues to be investigated and recently Imbs, et.al. (2002) suggest that the average half-life is smaller than a year. They argue that the longer estimates found in the previous literature were due to aggregation bias. Their findings, however, have been recently challenged by Chen and Engel (2004).[2]

While the literature has mostly concentrated on the serial correlation coefficient α in equation (1), this paper studies cross-country differences in the variance of the innovations to the

[1] Froot and Rogoff (1995), Rogoff (1996), and Chen and Engle (2004) offer excellent surveys of the empirical and theoretical literature. The survey of economists reporting the consensus view was conducted by Kilian and Zha (2002).

[2] There are important small sample problems in the estimation of auto correlation models. There are two alternatives: one is to use extremely long data sets and the other one is to perform the estimation on a panel. Abuaf and Jorion (1990), Diebold, Husted, and Rush (1991), Frankel (1986, 1990), Glen (1992), Lothian and Taylor (1996), and Mark (1995), look at very long data sets. Frankel and Rose (1996), Lothian (1997), Oh (1996), and Wu (1996) estimate the autoregressive coefficient using panels. Recently, some papers have studied non-linearities (Obstfeld and Taylor, 1997, Taylor, Peel and Sarno, 2001, and Taylor and Peel, 2000).

PPP equation ε.[3] We find that some countries have innovations whose variance is more than 20 times larger than others. And more importantly, we find that these differences are only very partially explained by the higher variance of their terms of trade, monetary and output shocks, by differences in the sensitivities to these shocks or by differences in exchange rate regimes. These differences are also not accounted for by different speeds of mean reversion in the PPP equation.

We consistently find that industrialized economies have, on average, a lower standard deviation of the innovations to the RER (developing economies are 2.5 times more volatile than industrial countries).[4] Controlling for various shocks and allowing for different parameters by country groups explains a very small fraction of the RER volatility. Estimating country-by-country equations can explain up to 60 percent of the variance in the long run RER. However, none of these equations can reduce the ratio of the residual long run RER volatilities, which remains between 2 and 2.5.

We also find that the difference in residual RER volatility is strongly associated with the level of development (either economic, as measured by GDP per capita, or institutional, as measured by rule of law) and to a lesser extent to the degree of exports diversification, as measured by the Hirschman-Herfindahl concentration indexes.

Further investigation suggest that differences in long run RER volatility are not due to the magnitude or frequency of the shocks but to differences in persistence of the volatility indicating that the way in which the RER adjusts to shocks tend to imply more persistent swings in volatility.

The paper is organized as follows. Section 2 shows the basic facts about cross-country differences in RER volatility and tests different theories aimed at explaining these differences. Section 3 uses an ARCH model to show that part of the difference in RER volatility between developing and industrial countries can be explained by differences in persistence. Section 4 concludes.

[3] While there is a large literature that uses cross country data to gauge the consequences of RER volatility (especially on trade, for a recent survey see Hau, 2002), there are almost no papers that use cross-country data to study the causes of long run RER volatility. One exception is Hau (2002) who focuses on how openness affects RER volatility.

[4] In a paper that is somewhat related to ours, Cashin and McDermott (2004) find that the speed of reversion to PPP is faster for developed countries than for industrial countries.

2. The Puzzle

The purpose of this section is to document the presence of large cross-country differences in real effective exchange rate (RER) volatility and show that in developing countries the real exchange rate tends to be much more volatile than in industrial countries, even after controlling for differences in external and domestic shocks.

Our sample covers up to 74 industrial and developing countries for which we have annual data on real effective exchange rate over the 1980-2000 period.[5] We start with the simplest possible measure of volatility: the standard deviation of the growth rate of the RER. Formally, our first measure of volatility is given by:

$$VOL_i = \frac{SD\left(\ln(RER_{i,t}) - \ln(RER_{i,t-n})\right)}{\sqrt{n}} \qquad (2)$$

We focus on both one year (n=1) and five-year (n=5) volatility (the upper bound for standard estimates of the real exchange rate half-life is 4 years, Froot and Rogoff, 1995). Figure 1 plots five-year volatility for our sample of countries (the data have been normalized so that the cross-country average is equal to one). It clearly shows that industrial countries (the light bars) tend to have levels of real exchange rate volatility that are much lower than those of emerging market and developing countries (dark bars). Portugal is the industrial country with the highest level of volatility and its volatility is just above the cross-country average; no other industrial country has levels of volatility that are above the cross-country average. We also find very few emerging market or developing countries in the left part of Figure 1. The few we find tend to be very small (Papua New Guinea, St. Vincent, and The Bahamas). The only large emerging market countries that are characterized by low levels of real exchange rate volatility (i.e., less than half the cross-country average) are Israel and Taiwan, two rather advanced economies.

Table 1 reports average values for one-year and five-year volatility for the whole sample of countries and for developing and industrial countries (not normalized to one) and tests whether

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[5] The real exchange rate data are from J.P. Morgan and the IMF International Financial Statistics. We use J.P. Morgan data whenever they are available and complement them with IMF data for countries that are not included in the J.P. Morgan dataset. All the results are robust to using the IMF as main source or to restricting the sample to only J.P. Morgan or IMF data. In all cases, we focus on the annual average of the real exchange rate index (the results are robust to using end of period data). An increase in the RER index reflects a real appreciation of the currency.

the difference in volatility between these two groups of countries is statistically significant. It shows that five-year volatility is only ten percent lower than one-year volatility and that volatility in developing countries is always at least 2.5 times larger than volatility in industrial countries. The last two rows of the table show that we can always reject the hypothesis that the two groups of countries have the same level of volatility. The last four columns of the table also show that differences in volatility are not due to a specific sub-period. In fact, we obtain similar results when we restrict our analysis to the 1980s or to the 1990s (even though the difference between developing and industrial countries was slightly larger in the 1980s).

We also look at the third and fourth moments to check whether differences in volatility are due to large devaluation or real appreciation episodes. Table 2 reports the skewness and kurtosis of RER changes. The first two columns show that the distribution of the real exchange rate is skewed to the left in both developing and industrial countries, indicating that large depreciations are more common than large appreciation. While column 1 indicates that skewness is significantly larger (in absolute value) in developing countries (indicating that large depreciation are more common in this group of countries), column 2 shows that when we focus on five-year periods there is no significant difference between the two samples of countries. This suggests that large depreciations and currency crises (that are more common in developing countries) cannot explain why five-year RER volatility is higher in developing countries.

The last two columns of Table 2 show that if we focus on one-year volatility, we find that the distribution of RER tends to have fatter tails in the sample of developing countries. However, the difference in kurtosis between these two groups of countries disappears when we focus on five-year volatility. Again, this suggests that extreme episodes cannot fully explain the fact that five-year RER volatility is much higher in developing than in industrial countries.

2.1. Trying to Explain the Puzzle

Why are developing countries more volatile? Clearly this suggests a misspecification error in the AR(1) representation of the real exchange rate – i.e., there are unobservable shocks that are more volatile in one sub-sample than in the other. These forms of misspecification should have been expected. In fact, several of them are implied by the theories we already have available.

There are six standard explanations based on the different types of shocks and responses[6]: (i) Developing countries are subject to larger terms of trade shocks. (ii) Developing countries are

[6] The higher volatility of developing countries and its potential causes in terms of external shocks and institutional failings is discussed in Inter-American Development Bank (1995), Hausmann and Gavin

subject to large volatility in GDP growth because of their limited ability to conduct counter-cyclical monetary and fiscal policies. (iii) Developing countries are subject to large nominal shocks because they have non-credible monetary institutions and weak fiscal position. (iv) Developing countries are subject to sudden stops in capital flows that lead to currency crisis. (v) Differences in volatility are due to the fact that developing countries are not as open as industrial countries. (vi) Differences in volatility are due to different exchange rate arrangements and in particular to the adoption of non-credible pegs.

To check whether these theories can help us in explaining away the difference in RER volatility between developing and industrial countries we start by running various subsets of the following regression:

$$
\begin{aligned}
DEV_{i,t} &= SHOCK_{i,t}\beta + +\delta Crisis_{i,t} + CC_{i,t}\lambda + SHOCK_{i,t} * CC_{i,t}\gamma + \\
&+ \sum_{n=1}^{2} \alpha_n DEV_{i,t-n} + \mu_i + \varepsilon_{i,t}
\end{aligned}
\qquad (3)
$$

Where the variable DEV is the first difference of the real exchange rate deviation from its long run equilibrium level (computed as a log-linear trend).[7] Notice that expressing the dependent variable in terms of deviation from its long run trend is equivalent to including a country specific trend in Equation (2). Such a country specific trend controls for the fact that, because of the Balassa-Samuelson effect, some countries may experience trend appreciation or depreciation.

SHOCK is a matrix that includes various measures of shocks. *Crisis* is a dummy variable aimed at capturing the effect of currency crisis. *CC* is a matrix of country characteristics (openness, exchange rate regime, level of development) that may affect the RER response to shocks. Finally, we include two lags of the dependent variable to control for the possibility that differences in volatility are driven by differences in persistence. μ_i is a country fixed effect.

After running regression (3), we recover the error term ($\varepsilon_{i,t}$) and use it to compute country's *i* one-year and five-year residual RER volatility as:

(1996), De Ferranti et al. (2000), Aizenman and Pinto (2004). The role of sudden stops and openness is discussed in Calvo et al (2003).

[7] Formally, $DEV_{t,i} = (\ln RER_{t,i} - \ln TREND_{t,i}) - (\ln RER_{t-1,i} - \ln TREND_{t-1,i})$. As $(\ln TREND_{t,i} - \ln TREND_{t-1,i})$ is a constant, the standard deviation of $DEV_{t,i}$ is equal to the one-year volatility as computed in Equation (1). As we run fixed effect estimations, we would obtain exactly the same results if we were to define our dependent variable as $\ln RER_{t,i} - \ln RER_{t-1,i}$

$$RESVOL_{i,n} = \frac{SD\left(\sum_{j=0}^{n-1} \varepsilon_{i,t+j}\right)}{\sqrt{n}} \quad (4)$$

Clearly, when *n=1* (one-year volatility), the residual volatility is just equal to the country-specific standard deviation of the regression's residuals. When *n=5* (five-year volatility), the residual volatility is equal to the standard deviation of the five year average of the residuals.

Next, we use RESVOL to check whether, after controlling for all the variables included in Equation 2, there is still a difference between the unexplained volatility of the real exchange rate in developing and developed countries.

2.2. The Role of Shocks

In Table 3, we explore whether shocks can help in explaining away the difference in RER volatility between developing and industrial countries. In column 1, we control for terms of trade shocks (*dtot* measures the change in terms of trade and *ldtot* its lagged value). While we find that terms of trade shocks are positively and significantly correlated with changes in the RER (indicating that positive TOT shocks lead to an appreciation of the RER), the low R-squared (0.03) suggests that terms of trade shocks can only explain a very small fraction of the variance of the real exchange rate. Columns 1 of Tables 4 and 5 report the residual (after controlling for terms of trade shocks) one-year and five-year volatility. They show that the residual volatility is basically identical to the unconditional volatility. In the case of developing countries, the one-year volatility goes from 0.112 to 0.109 and the five-year volatility goes from 0.103 to 0.099. In the case of industrial countries, one-year volatility goes from 0.044 to 0.042 and five-year volatility goes from 0.041 to 0.040. Hence, differences in the magnitude of terms of trade shocks do not explain the difference in RER volatility between developing and industrial countries. Developing countries remain 2.5 times more volatile than industrial countries and the difference between the two groups remains highly significant.

In the second column of Table 3, we control for output shocks by including GDP growth (*growth*). Clearly, GDP growth shocks are not exogenous and may be jointly determined with RER innovations. However, this dual causation cleads the regression to overstate the explanatory power of GDP growth shocks and hence to leave a smaller residual than is warranted. This biases the results against the point we are making. This comment is valid for other endogenous variables that we consider below as well. Remember that the problems of endogeneity will affect the estimation and interpretation of the coefficients in equation (1). We are, on the other hand, concentrating on the properties of the residuals regardless of their sources.

While GDP growth (we use real local currency GDP growth) has a positive and statistically significant coefficient (indicating that positive output shocks are associated with real appreciations), the R-squared of the regression remains extremely low (0.05) and columns 2 of Tables 4 and 5 show that controlling for GDP growth neither reduces RER volatility nor reduces the difference in RER volatility between developing and industrial countries.

In the third column of Table 3, we include the change in log inflation (*dinf*) to control for nominal shocks. While inflation is not statistically significant, column 3 fits the data better than the two previous columns (the R-squared goes to 0.09) and somewhat reduces five-year volatility (in developing countries it goes from 0.099 to 0.092). However, this is due to the fact that, when we include inflation in the regression, we lose about 300 observations. In any case, columns 3 of Tables 4 and 5 show that the difference between developing and industrial countries remains large and highly significant.

In column 4 of Table 3, we include a dummy variable that takes value 1 during currency crises. The Crisis dummy takes value one when, in any two-year period, the RER depreciates by more than two standard deviation of the cross-country sample (according to this definition there are no currency crisis in industrial countries). As this variable is built using the left hand-side of the regression, it has a negative and highly significant coefficient and greatly increases the fit of the regression (the R-squared jumps to 0.3). However, controlling for currency crisis does not explain away the difference in volatility between developing and industrial countries. Columns 4 of Tables 4 and 5 still show that developing countries are at least twice as volatile as industrial countries. This suggests that the difference in volatility between industrial and developing countries is not due to the presence of a few large depreciations. This is consistent with our finding that there is no significant difference between the five-year skewness of developing and industrial countries.

Column 5 of Table 3 controls for changes in exports (*dexp*) in order to check whether movements in the real exchange rate are due to sudden jumps demand for a country's exports. It finds that the coefficient of *dexp* is negative and not statistically significant. Column 6 controls for openness and Column 7 interacts openness with output (*grop*), terms of trade shocks (*dtop* and *ldtop*), and changes in exports (*dexpop*). The rationale for including these interaction terms is that more open economies could be better equipped to face external shocks. In particular, Calvo et al. (2003) show that the real depreciation brought about by a sudden stop in capital flows is negatively correlated with the degree of openness.[8] We find that neither openness nor the interaction terms are statistically significant. We also find that the R-squared remains low (at 0.10) and that the difference in volatility between developing and industrial countries remains large and highly significant (columns 6 and 7 of Tables 4 and 5).

In column 8 of Table 3, we interact the shock variables with an industrial country dummy to control for the possibility that shocks may have a different effect on the real exchange rate in each of the country sets. We find that the interaction terms are rarely significant. The only exception is the change in exports which is correlated with real depreciations in developing countries and real appreciations in industrial countries. In any case, controlling for these interactions neither reduces the level of real exchange rate volatility, nor the difference in volatility between industrial and developing countries (column 8 of Tables 4 and 5).

In columns 9, 10, and 11 of Table 3, we check whether differences in RER volatility can be explained away by the interaction between shocks and the exchange rate regime (Broda, 2001 shows that countries with a flexible exchange rate regime are better able to smooth-away terms of trade shocks). In column 9, we include two dummies based on the *de facto* measure of the exchange rate regime assembled by Levy-Yeyati and Sturzenegger (2000). *Lys02* takes value one for countries with an intermediate regime and *Lys03* takes value one for countries with a fixed exchange rate regime (the excluded dummy is for countries with a floating regime). In column 10, we interact these dummies with the output, terms of trade, and inflation shocks discussed above. In column 11, we also include a dummy (switch) that takes value one when a country moves to a more flexible exchange rate regime (from intermediate to floating or from fixed to intermediate or floating). We find that, compared with countries with floating and fixed exchange rate regime, terms of trade shocks tend to have a larger effect on the RER in countries with an intermediate regime (all the other variables are not significant). Controlling for the exchange rate regime reduces the sample by approximately 200 observations and increases the R-squared of the regression to 0.20. However, columns 9, 10 and 11 of Tables 4 and 5 show that controlling for the role of the exchange rate regime and its interaction with shocks does not explain away the difference in RER volatility between developing and industrial countries.

The last three column of Table 3 interact shocks with both exchange rate regime and growth. As one may expect, we find that terms of trade shocks have a smaller effect on the RER during periods of high growth (*grdtot* is negative) but, again, this does not explain away the

[8] Obstfeld and Rogoff (2000) find that in models with nominal rigidities, more open economies should exhibit lower RER volatility. We test this hypothesis in subsection 2.4.

difference in volatility between developing and industrial countries (columns 12, 13, and 14 of Tables 4 and 5).

2.3. The role of Persistence

As we found that shocks cannot explain away the difference in volatility between developing and industrial countries, we now explore the role of persistence by augmenting the regression with lagged values of the dependent variable and allowing for different persistence in developing and industrial countries. The idea is that the variance of the observed variable could be different across groups because countries have different persistence and not necessarily because the innovations have different variances. This section explores this possibility.

In the first column of Table 6, we include two lags of the dependent variable. Both lags have a negative coefficient (statistically significant for the second lag). While the negative coefficients suggest that, after a shock, the RER tend to revert to its long run trend, the coefficients are rather small indicating that shocks tend to be persistent. The typical estimate in the table implies an autoregressive coefficient of about 0.8.[9] This is consistent with the PPP literature that has found average half-lives of about 3 to 4 years. Columns 1 of Tables 7 and 8 show that, allowing for persistence does not reduce our measure of RER volatility and does not eliminate the difference in volatility between industrial and developing countries.

In the second column of Table 6, we interact the lagged values of the dependent variable with an industrial country dummy and thus allow persistence to differ across the two groups of countries. Interestingly, we find that the coefficient on the first lag becomes positive in industrial countries suggesting that exchange rate shocks are more persistent (at least in the short run) in this group of countries. This result is also consistent with some evidence of non-linearity of PPP deviations. In the data developing countries have larger deviations and if the relationship is non-linear we should expect these countries to return to the mean faster (Obstfeld and Taylor 1997). However, for the purpose of this paper, allowing for different degrees of persistence does not affect our basic result that RER is more volatile in developing countries (column 2 of Table 7 and 8).

In columns 3 through 9 we introduce the variables discussed above (shocks, crisis, openness, and exchange rate regime). Again, we find that none of these variables can explain

[9] Remember that we are estimating an AR(2) which means that the value of 0.8 reported in the text is the implied coefficient if we were to fit an AR(1). Or put it in other terms, the half-lives of the estimated AR(2) is the same as an AR(1) with an autoregressive coefficient of 0.8.

away the difference in volatility between developing and industrial countries (see columns 3-9 of Tables 7 and 8).

In column 10, we allow both the shocks and persistence to have a differential effect in developing and industrial countries. Column 11 controls for the exchange rate regime and columns 12 through 16 allows for interactions between shock and exchange rate regime and shocks and growth. The results are similar to those of Table 3 and show that none of the specifications of Table 6 can explain away differences in RER volatility between industrial and developing countries.[10]

The results of the exercises described above are remarkable. After controlling for a very ample set of shocks and interacting the shocks with different country characteristics, we could, in the best of cases (when we interact shocks with the exchange rate regime in columns 10, 11, 13 and 14 of Table 3 or include our crisis dummy which is built using the left hand side variable, column 4) reduce the residual five-year RER volatility in developing countries by 30 percent (from 0.103 to 0.07). Even in these cases, volatility in developing countries remains 1.7 times higher than the RER volatility in industrial countries (and the difference is statistically significant at the 1 percent confidence level). In all other cases, our set of explanatory variables can reduce developing countries five-year volatility by at most 20 percent. Interestingly, these explanatory variables account for a smaller reduction in residual volatility at 5-year horizons than at 1 year .

As a final robustness check, we look at whether our results are driven by aggregation bias or by non-linearities. We start by running a set of regressions where all the shocks are interacted with country fixed effects. This eliminates any aggregation bias because this is equivalent to running the regression country by country. After running these regressions, we recover the errors in the two groups, compute the residual volatility, and compare industrial with developing countries. The results are reported in Table 9. They show that even after running a separate regression for each country, we still get that the residual volatility of the RER in developing countries is more than twice as large as the residual volatility in industrial countries (the ratios between the volatilities of the two groups of countries range between 2.4 and 2.9). Table 10, reports results of country by country regressions where we also control for non-linearities by entering the squares of various shocks. Again, this does not eliminate differences in RER volatility between developing and industrial countries and the ratio between the volatility of the two group of countries remains in the 2.3-2.7 range.

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[10] To check the robustness of our results, we also reestimated the specifications of Table 6 by using the GMM estimator developed by Arellano and Bond (1991) and obtained results that are essentially identical to those of Table 6.

In Figure 2 we illustrate the real exchange rate volatility puzzle in yet another way. We plot summary statistics of all the regressions we have estimated thus far. For each specification we plot the R-squared of the equation separately for industrial and for developing countries, shown respectively in dark and light color bars (measured from the left axis). The idea is to measure how much can be explained by the shocks and interactions we are including in the regressions. Note that as we include more explanatory variables, the R squares go up. However, in general, the equations do a significantly better job in explaining the within country volatility among industrial countries than among developing countries. Note also that as more variables are included, the R-square increases, especially after equation 33 when we run country by country equations (this should be expected because the country by country regressions have less than fifteen degrees of freedom).

However, the line depicted in the figure indicates the ratio of the residual volatilities between developing and industrialized countries is very stable. Notice that the ratio fluctuates between 2 and 2.5 regardless of the specification. Therefore, the puzzle is, then, that independently of how much of the RER volatility we can explain, we are unable to make any progress in explaining the relative residual volatilities of these two sets of countries.

2.4. Going beyond the industrial-developing split

So far we compared volatility between developing and industrial countries without asking whether there is any specific characteristic of these two groups of countries that may explain the differences in volatility we just documented. In what follows we use the one-year residual volatility obtained by running the country by country regressions that includes all controls and two lags of the dependent variable (column 8 of Table 9) and regress these volatilities over a set of country characteristics (measured as averages for the 1980-2000 period unless otherwise noted). In the first column, we control for the log of GDP per capita (to control for differences in the level of development), the volatility of terms of trade, and the degree of openness. As expected, we find that more developed countries have lower residual RER volatility (the coefficient of LGDPPC is negative and statistically significant) and, as suggested by Obstfeld and Rogoff (2000) and Calvo et al. (2003), we also find that more open countries have lower residual RER volatility. At the same time, we find that terms of trade volatility is not correlated with residual RER volatility (this should not be surprising because in computing residual RER volatility we already netted out the effect of terms of trade shocks). In the second and third columns, we also control for GDP growth volatility and volatility of exports and find an insignificant relationship (again, this was expected because in computing residual volatility we already netted out the effect of GDP and export shocks). In the fourth column, we control for rule of law (measured over the 1996-2002 period) and we find that this variable has the expected negative sign but that it is not statistically significant. We also find that once we include rule of law, GDP per capita is no longer significant (and the coefficient drops from 0.01 to 0.005).[11] This is due to the fact that GDP per capita and rule of law are highly correlated (the correlation coefficient is 0.89) and a Wald test indicates that the two variables are jointly significant with a p-value of 0.001. In the fifth and sixth columns we control for export concentrations at the 4 and 10 digits (the idea is that countries with less diversified export structures might experience higher volatility). We use data on US imports by country and calculate Hirschman-Herfindahl indexes of concentration at the 4 (CONC4) and 10 (CONC10) digit levels (the concentration indexes are measured as averages over the 1990-2000 period). As expected, the coefficients are positive and marginally significant in the case of CONC10. Columns 7, 8, 9 control for country size (measured by total GDP) and two measures of financial development (DC_GDP is an average over the 1990-2000 period) and find that none of these variables are significantly correlated with residual volatility (when we control for total GDP we find that openness is no longer significant). [12]

Equations 11 through 13 put several of the explanatory variables together. The main message of these equations is that a measure of development – whether GDP per capita or rule of law – is robustly related to the difference in residual RER volatility. In addition, export concentration is also robust to the inclusion of other variables. In particular, it is robust to the inclusion of openness and size, two variables with which it is related.[13] However, neither of these two latter variables are robustly related to RER volatility.[14]

Table 12 uses the equations estimated in Table 11 to account for the difference in average residual RER volatility between industrial countries (2.3 percent) and developing countries (5.6 percent). The estimated equations when applied to the average characteristics of industrial and developing countries can allow for a decomposition of the residual volatilities. The equations

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[11] It should be pointed out that, as rule of law is measured in the late 1990s rather than for the whole period, this variable is "more endogenous" than GDP per capita.

[12] Larger economies tend to be more closed and country size and openness have a negative correlation of 0.5 in our dataset. Our results are in contrast with the finding of Hau (2002) who find that openness is a robust predictor of long run RER volatility. One difference between our and his empirical strategy is that we focus on residual volatility and, in the cross-country analysis, we also control for country size and export concentration.

[13] There is a relatively high and negative correlation between CONC10 and LGDP of -0.41 in our dataset and there is no correlation between CONC10 and openness (0.05). Inclusion of both size as measured by LGDP and CONC10 makes openness no longer statistically significant.

[14] These results are robust to estimation techniques that put less weights on outliers.

'explain' between 71 and 100 percent of the difference. In general, the level of development, measured either as LGDPPC or as the index of Rule of Law or in tandem, can explain between 80 and 100 percent of the difference, depending on the specification. Differences in export concentration can account for about 18 percent of the difference. Differences in openness do not help explain the differences, as developing countries are on average more open than developed countries. Differences in size also do not explain the RER puzzle as larger countries tend to have more residual RER volatility. Hence, the level of development and of export concentration seems to be involved in any explanation of why residual RER volatility is higher in developing countries.

3. Another way to look at persistence and a possible answer to the puzzle

So far we compared RER volatility between industrial and developing countries by testing the difference between average volatility in the two groups of countries or by regressing residual volatility on a series of country characteristics. We now estimate an ARCH model that allows us to use a proper regression set up to test whether there is indeed a difference between long-run RER volatility in developing and industrial countries. We also use the ARCH model to check whether the difference in RER volatility between developing and industrial countries can be explained by differences in persistence in the ARCH component of the regression.

Formally, we jointly estimate the following two ARCH (2) equations:

$$DEV_{i,t} = SHOCK_{i,t}a + IND_i b + SHOCK_{i,t} * IND_i c + \\ + (1 + d * IND) * \sum_{n=1}^{2} g_n DEV_{i,t-n} + u_{i,t} \tag{5}$$

$$h_{i,t} = \varphi + SHOCK_{i,t}\alpha + IND_i\beta + SHOCK_{i,t} * IND_i\gamma + \\ + (1 + \delta * IND) * \sum_{n=1}^{2} \lambda_n DEV_{i,t-n} + \\ + \psi_1 h_{i,t-1} + \psi_2 h_{i,t-2} + \phi_1 IND * h_{i,t-1} + \phi_2 IND * h_{i,t-2} + \varepsilon_{i,t} \tag{6}$$

The first equation (mean equation) measures how shocks and persistence affect the level of the dependent variable (in our case the change of the real exchange rate). The second equation – the variance equation – describes the evolution of the variance and allows us to measure the difference in the long run variance between developing and industrial countries.

Equation 1 in Table 13 estimates the above model by setting *c* and *d* equal to zero in the mean equation and $\alpha, \gamma, \delta, \lambda_1, \lambda_2, \psi_1, \psi_2, \phi_1, \phi_2$ equal to zero in the variance equation. In this case, the constant (0.0132) measures the long run variance in developing countries and the constant plus β (0.0132-0.0118=0.0014), the long run variance in industrial countries. Hence, the fact that the industrial country dummy has a negative and highly significant coefficient indicates that the conditional variance of the real exchange rate is significantly higher in developing countries. Note that these numbers reflect the estimated variances, which are the squares of the standard deviations. By taking the square roots of the estimated long run variances we obtain 11.5 percent for developing countries and 3.7 percent for industrial countries, numbers which are in line with the results obtained in the previous sections (Equation 1 of Table 13 is comparable to Equation 4 of Table 6; the residual 5 year volatility of this latter equation is 1.09 percent in developing countries and 3.5 percent in industrial countries).

In Equation 2, we explore whether the two sets of countries have the same persistence in the variance equation. We address this issue by adding two ARCH terms to the previous equation. The estimated long run variances of these equations are given by $h_{NONIND} = \dfrac{\varphi}{1-\psi_1-\psi_2}$ for developing countries and by $h_{IND} = \dfrac{\varphi+\beta}{1-\psi_1-\psi_2}$ for industrial countries, the estimated ratio between the long run variance of industrial and developing countries is given by $\dfrac{\varphi}{\varphi+\beta}$ =5.125 (i.e., long run RER volatility is five times higher in developing countries). Taking square roots of this ratio we obtain 2.264, which is in line with our estimated relative residual volatilities of the previous section.

Equation 3 allows the variance of developing and industrial countries to have different persistence and shows that persistence is stronger in developing countries. While the ARCH coefficients are positive and statistically significant, the interaction terms are negative and statistically significant and indicate that persistence in the variance of the real exchange rate of industrial countries is a small fraction of that in developing countries (0.55 vs. 0.20 for ARCH1 and 0.53 vs. 0.04 for ARCH2). In this case, the respective long run variances are given by: $h_{NONIND} = \dfrac{\varphi}{1-\psi_1-\psi_2}$ and $h_{IND} = \dfrac{\varphi+\beta}{1-\psi_1-\psi_2-\phi_1-\phi_2}$. Notice that $\psi_1+\psi_2$ is very close to one (1.09) indicating that the model could be misspecified because the variance of developing countries could be either negative or explosive.

In equation 4 we allow for various shocks and the lagged values of the real exchange rate to have an effect on the variance (i.e., we relax the assumption that $\alpha, \lambda_1, \lambda_2$ are equal to zero). In the variance equation we square all our explanatory variables, so that the coefficient of, say, terms of trade, should be interpreted as the effect of terms of trade shock (either positive or negative) on the variance of the RER. We find that past RER shocks increase RER volatility but we find no significant effect of terms of trade or output shocks (the estimated effects are positive but not significant). The long run variance of the RER in developing and industrial countries can be calculated in the same way as we did in Equation 2 yielding values of 0.00414 and 0.00072, which correspond to volatilities of 6.4 percent and 2.7 percent and a ratio of volatilities of 2.4.

In Equation 5, we reproduce equation 4 but now we allow for interaction in the mean equation (i.e., we relax the assumption that c and d are zero) this allows industrial and developing countries to have different slopes in the mean equation. None of the interaction terms is statistically significant indicating that there is no evidence that shocks affect the real exchange rate of developing countries differently from the way they affect the real exchange rate of industrial countries. We find almost identical results for the estimated long run RER volatilities and of the estimated persistence terms in the variance equation.

Finally in Equation 6, we also allow for different persistence in the two sets of countries of the effects of the RER, TOT and output shocks on the variance equation (i.e., relax the assumption that γ and δ are equal to zero). Several results are worth noting. First of all, the difference on the ARCH coefficient remains large and highly statistically significant indicating that persistence is lower in industrial countries, even after allowing the various shocks to have a differential effect in the two groups of countries. We find that terms of trade shocks and the second lag of the dependent variable have a smaller effect on the volatility of the RER in industrial countries. Also, we now find that the IND dummy in the variance equation is no longer significant. The estimated ratio of long run volatilities between industrial and developing countries now declines to 1.57, indicating that part of the long run variance of developing countries is explained by difference in persistence.

All this points to the fact that the difference in real exchange rate volatility documented in Section 2 is neither fully explained by differences in the magnitude of the shocks or by how shocks directly affect the level of the real exchange rate, or their volatilities. Part of the explanation is that the adjustment of the shifts in the variance tends to be slower in developing countries.

As a final robustness analysis, we augment the ARCH model with a further set of time invariant continuous variables that are likely to be correlated with the industrial country dummy.

The results are reported in Tables 14 through 16. The structure of the estimations is similar to that of Table 10.

In Table 14, we include a variable measuring the log of average (over the 1980-2000 period) GDP per capita (GDPPC). This is the best proxy for economic development and it is highly correlated with the IND dummy. Column 1 shows that even controlling for GDP per capita, the industrial dummy remains negative and significant. Columns 2, allows for differences in the ARCH terms between the two sets of countries. The estimated persistence in the industrial countries is close to nil, while it is large in developing countries. Moreover, allowing for a difference in persistence drastically reduces the value and significance of the coefficient on IND. This result is essentially repeated in the rest of Table 14 and in the subsequent tables. If we do not allow for differences in the ARCH terms between the two sets of countries, we usually get a large, negative and significant coefficient on IND. Once we allow for differences in the ARCH terms we find large differences in persistence between the two sets of countries. In addition, the coefficient on the IND term declines drastically and becomes insignificant. Tables 15 and 16 repeat these experiments using rule of law and financial development as continuous proxies for the industrial country dummy.

4. Final Remarks

The aim of this paper was to document the main facts about long run RER volatility. It showed that the long run RER of developing countries is between 2 and 2.5 times larger than that of industrial countries. We also show that these differences are only partially due to the fact that developing countries face larger shocks (both real and nominal) or to differences in the sensitivity of the RER to these shocks. In fact, after controlling for such shocks the ratio of the residual volatilities between the two sets of countries remains essentially unaffected. We also show that differences in residual volatility (i.e. after controlling for shocks and sensitivities) are strongly correlated with the level of development and to the degree of diversification of the economy (as measured by the concentration of its export basket).

In addition, we show that a significant part of the larger measured RER volatility in developing countries is associated with a much larger persistence of shocks to the variance of the RER itself, as captured by different ARCH coefficients.

Any model that attempts to explain the long run RER volatility puzzle would need to explain not only the potentially larger sensitivities of the RER to shocks in developing countries, but also the much longer persistence of shocks both to the level and volatility of the RER.

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5. Appendix

List of countries included in the full sample
Industrial: Australia, Austria, Belgium, Canada, Denmark, Finland, France, Germany, Greece, Iceland, Ireland, Italy, Japan, Malta, Netherlands, New Zealand, Norway, Portugal, Spain, Sweden, Switzerland, United Kingdom, United States.
Developing: Argentina, The Bahamas, Bahrain, Belize, Bolivia, Brazil, Burundi, Cameroon, Chile, China, Colombia, Costa Rica, Cote d'Ivoire, Cyprus, Dominican Republic, Ecuador, Fiji, The Gambia, Hong Kong, Hungary, India, Indonesia, Israel, South Korea, Kuwait, Lesotho, Malaysia, Mexico, Morocco, Nigeria, Pakistan, Papua New Guinea, Paraguay, Peru, Philippines, Romania, Saudi Arabia, Singapore, South Africa, St. Lucia, St.Vincent & Grenadines, Taiwan, Thailand, Togo, Trinidad and Tobago, Tunisia, Turkey, Uruguay, Venezuela, Zambia.

List and definition of variables

Variable Name	Definition	Source
Real Exchange Rate (RER)	Real Effective Exchange Rate Index (yearly average)	JP Morgan IMF International Financial Statistics
Terms of trade (TOT)	Index of terms of trade for goods and services (1995=100).	IMF
GROWTH	Real GDP per capita growth in local currency.	World Bank, WDI
Inflation (INFL)	Inflation measured as changes in CPI.	World Bank, WDI
CRISIS	Dummy variable that takes value one when, in any two-year period, the RER depreciates by more than two standard deviation of the cross-country sample.	Authors' calculations based on RER data from JP Morgan and IMF
Change in Exports (DEXP)	Percentage change in real exports in goods and services (measured in US$).	World Bank, WDI
OPEN	Openness defined as export plus imports divided by GDP.	Authors' calculations based on World Bank's, WDI data
LYS	Exchange rate regime. Lys01 takes value one for countries with a floating exchange rate (excluded dummy). Lys02 takes value one for countries with an intermediate regime. Lys03 takes value one for countries with a fixed exchange rate regime.	Levy-Yeyati and Sturzenegger (2001)

LGDPPC	Log of average (over the 1980-2000 period) GDP per capita measured in 1995 US$.	Authors’ calculations based on GDP per capita data from the World Bank’s WDI
VOL_TOT	Volatility of terms of trade over the 1980-2000 period. Computed as the standard deviation of the terms of trade index.	Authors’ calculations based on terms of trade data form the IMF
VOL_GROWTH	Volatility of local currency real GDP per capita growth. Computed as the standard deviation DEXP over the 1980-2000 period.	Authors’ calculations based on GDP per capita data from the World Bank’s WDI
VOL_EXP	Volatility of exports. Computed as the standard deviation GROWTH over the 1980-2000 period.	Authors’ calculations based on exports data from the World Bank’s WDI
RULE_WB	Rule of Law from Kauffman et al. (2003). Average over the 1996-2002 period.	Kauffman et al. (2003)
CONC4 and CONC10	Four and ten digits Hirschman – Herfindahl concentration of US imports by country of origin. Average over the1990-2000 period.	Trade Data Online from Industry Canada
LGDP	Log of average (over the 1980-2000 period) GDP measured in 1995 US$.	Authors’ calculations based on GDP data from the World Bank’s WDI
FIN_DEPTH	Private Credit over GDP average over the 1980-2000 period.	Beck et al. (2000)
DC_GDP	Domestic Credit over GDP. Average over the 1990-2000 period.	World Bank’s WDI.

Table 1: Real Exchange rate volatility in industrial and developing countries

	1 YR Volatility	5YR Volatility	1 YR Volatility 1980s	5YR Volatility 1980s	1 YR Volatility 1990s	5YR Volatility 1990s
Combined	0.089	0.083	0.099	0.074	0.072	0.070
Developing	0.112	0.103	0.125	0.094	0.088	0.085
Industrial	0.044	0.041	0.045	0.034	0.040	0.037
Difference	0.068	0.062	0.081	0.060	0.048	0.048
t-statistics	4.262	4.818	3.769	3.689	3.176	4.130
P (Dev>Ind)	1.000	1.000	1.000	1.000	0.999	1.000

Table 2: Skewness and kurtosis or RER changes

	Skewness 1YR	Skewness 5YR	Kurtosis 1YR	Kurtosis 5YR
Combined	-0.73	-0.24	4.12	2.40
Developing	-1.02	-0.21	4.74	2.37
Industrial	-0.14	-0.32	3.08	2.46
Difference	-0.88	0.11	1.65	-0.09
t-statistics	-4.40	0.89	2.54	-0.46
P (|dev|>|IND|)	1.000	0.19	0.99	0.33

Table 3: Panel Regressions, the Role of Shocks

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)	(13)	(14)
	fddev	fddev	fddev	fddev	fddev	fddev	fddev	fddev	fddev	fddev	fddev	fddev	fddev	fddev
dtot	0.130	0.163	0.242	0.199	0.262	0.262	0.383	0.281	0.315	0.087	0.063	0.338	0.179	0.331
	(4.75)***	(5.62)***	(6.72)***	(6.27)***	(6.64)***	(6.40)***	(4.10)***	(6.58)***	(6.60)***	(0.87)	(0.62)	(7.14)***	(1.76)*	(2.40)**
ldtot	0.117	0.103	0.150	0.084	0.158	0.164	0.072	0.176	0.167	0.060	0.044	0.170	0.063	0.166
	(4.24)***	(3.63)***	(4.26)***	(2.70)***	(4.42)***	(4.36)***	(0.83)	(4.53)***	(3.86)***	(0.69)	(0.49)	(3.96)***	(0.71)	(1.38)
growth		0.286	0.381	0.184	0.399	0.397	0.507	0.424	0.482	0.528	0.471	0.479	0.352	0.428
		(3.90)***	(4.33)***	(2.36)**	(4.26)***	(3.94)***	(2.74)***	(3.99)***	(3.91)***	(2.07)**	(1.82)*	(2.16)**	(1.22)	(1.38)
dinf			-0.001	0.008	0.000	-0.001	-0.001	-0.000	-0.001	0.006	0.006	-0.000	0.007	0.009
			(0.11)	(1.92)*	(0.05)	(0.20)	(0.30)	(0.02)	(0.12)	(0.50)	(0.46)	(0.02)	(0.57)	(0.62)
crisis				-0.256										
				(17.26)***										
dexp					-0.026	-0.041	-0.084	-0.077	-0.088	-0.104	-0.108	-0.082	-0.095	-0.261
					(0.89)	(1.35)	(1.61)	(2.28)**	(2.32)**	(2.77)***	(2.81)***	(2.17)**	(2.52)**	(3.68)***
open						-0.017	-0.011	-0.014	-0.007	0.011	0.016	0.001	0.012	0.042
						(1.06)	(0.58)	(0.85)	(0.41)	(0.32)	(0.47)	(0.04)	(0.33)	(1.12)
grop							-0.109							-0.053
							(0.61)							(0.23)
dtop							-0.179							-0.178
							(1.40)							(1.12)
ldtop							0.140							-0.120
							(1.18)							(0.83)
dexpop							0.039							0.110
							(0.77)							(1.79)*
INDdtot								-0.048						0.028
								(0.28)						(0.14)
INDldtot								-0.222						-0.198
								(1.41)						(1.07)
INDgrowth								-0.239						-0.093
								(0.69)						(0.21)
INDdinf								-0.004						-0.007
								(0.28)						(0.45)
INDopen								-0.016						-0.063
								(0.26)						(0.78)
INDdexp								0.191						0.332
								(2.37)**						(3.32)***
lys02									-0.026	-0.038	-0.035	-0.028	-0.042	-0.038
									(1.99)**	(1.54)	(1.40)	(2.03)**	(1.68)*	(1.53)
lys03									0.013	0.024	0.034	0.017	0.028	0.035
									(0.78)	(0.82)	(1.12)	(0.92)	(0.93)	(1.13)
lys02dtot										0.516	0.541		0.389	0.390
										(4.43)***	(4.60)***		(3.28)***	(3.27)***
lys03dtot										-0.058	-0.021		-0.099	-0.080
										(0.47)	(0.17)		(0.80)	(0.62)
lys02ldtot										0.170	0.196		0.167	0.114
										(1.52)	(1.71)*		(1.45)	(0.99)
lys03ldtot										0.108	0.142		0.116	0.114
										(1.00)	(1.28)		(1.05)	(1.00)

lys02gr										0.499	0.494		0.526	0.558
										(1.59)	(1.53)		(1.63)	(1.71)*
lys03gr										-0.438	-0.438		-0.384	-0.383
										(1.47)	(1.45)		(1.17)	(1.16)
lys02dinf										-0.001	0.002		-0.005	-0.003
										(0.04)	(0.13)		(0.29)	(0.16)
lys03dinf										-0.015	-0.015		-0.012	-0.014
										(1.04)	(1.02)		(0.82)	(0.84)
lys02open										0.011	0.010		0.013	0.008
										(0.36)	(0.32)		(0.42)	(0.27)
lys03open										-0.007	-0.012		-0.008	-0.010
										(0.20)	(0.34)		(0.24)	(0.27)
switch											0.002	-0.002	-0.001	-0.002
											(0.18)	(0.13)	(0.10)	(0.14)
grdtot												-6.463	-5.466	-5.464
												(6.59)***	(5.49)***	(5.48)***
grldtot												-1.969	-1.306	-1.353
												(1.91)*	(1.25)	(1.28)
grinf												-0.106	-0.168	-0.135
												(0.94)	(1.39)	(1.11)
gropen												-0.132	0.031	0.000
												(0.64)	(0.13)	(.)
Constant	0.000	-0.004	-0.003	0.012	-0.004	0.011	0.007	0.014	0.006	-0.008	-0.014	0.002	-0.006	-0.019
	(0.15)	(1.17)	(0.93)	(3.75)***	(1.00)	(0.87)	(0.46)	(0.79)	(0.34)	(0.33)	(0.53)	(0.12)	(0.24)	(0.66)
Observations	1387	1364	1066	1066	1038	949	949	949	768	768	741	741	741	741
R-squared	0.03	0.05	0.09	0.30	0.10	0.09	0.10	0.10	0.13	0.20	0.20	0.19	0.24	0.26

Absolute value of t statistics in parentheses

*significant at 10%; ** significant at 5%; *** significant at 1%

Table 4: Residual One year Volatility from Table 3

	(1)	(2)	(3)	(4)	(5)	(6)	(7)
Combined	0.087	0.087	0.085	0.075	0.084	0.085	0.085
Developing	0.109	0.109	0.106	0.092	0.106	0.106	0.105
Industrial	0.042	0.042	0.042	0.042	0.042	0.043	0.043
Difference	0.066	0.066	0.065	0.050	0.064	0.063	0.062
t-statistics	4.242	4.314	4.060	3.575	4.015	3.732	3.721
P(Dev>Ind)	1.000	1.000	1.000	1.000	1.000	1.000	1.000
	(8)	**(9)**	**(10)**	**(11)**	**(12)**	**(13)**	**(14)**
Combined	0.084	0.087	0.086	0.085	0.086	0.085	0.084
Developing	0.106	0.106	0.102	0.101	0.103	0.100	0.102
Industrial	0.040	0.048	0.052	0.052	0.050	0.052	0.045
Difference	0.066	0.058	0.051	0.049	0.053	0.049	0.057
t-statistics	3.957	3.409	3.141	2.936	3.252	3.059	3.676
P(Dev>Ind)	1.000	0.999	0.999	0.998	0.999	0.998	1.000

The volatilities are computed as the one-year standard deviation from the residuals obtained from the regressions in the corresponding columns of Table 3

Table 5: Residual Five year Volatility from Table 3

	(1)	(2)	(3)	(4)	(5)	(6)	(7)
Combined	0.079	0.079	0.073	0.061	0.071	0.070	0.070
Developing	0.099	0.099	0.092	0.073	0.089	0.087	0.087
Industrial	0.040	0.040	0.038	0.037	0.037	0.038	0.038
Difference	0.059	0.059	0.053	0.036	0.052	0.049	0.049
t-statistics	4.948	5.071	4.780	3.635	4.670	4.080	4.057
P(Dev>Ind)	1.000	1.000	1.000	1.000	1.000	1.000	1.000
	(8)	**(9)**	**(10)**	**(11)**	**(12)**	**(13)**	**(14)**
Combined	0.070	0.067	0.062	0.060	0.065	0.061	0.062
Developing	0.088	0.081	0.072	0.069	0.078	0.071	0.073
Industrial	0.036	0.038	0.041	0.041	0.037	0.040	0.039
Difference	0.051	0.043	0.030	0.028	0.040	0.030	0.034
t-statistics	4.342	3.418	2.571	2.377	2.946	2.435	2.780
P(Dev>Ind)	1.000	0.999	0.993	0.989	0.998	0.991	0.996

The volatilities are computed as the five-year standard deviation from the residuals obtained from the regressions in the corresponding columns of Table 3

Table 6: Panel Regressions, Shocks and Persistence

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)	(13)	(14)	(15)	(16)
	fddev	fddev	fddev	fddev	fddev	fddev	fddev	fddev	fddev	fddev	fddev	fddev	fddev	fddev	fddev	fddev
fddev1	-0.036	-0.064	-0.078	-0.069	-0.088	-0.258	-0.100	-0.119	-0.118	-0.126	-0.158	-0.160	-0.155	-0.146	-0.153	-0.167
	(1.29)	(2.09)**	(2.58)**	(2.29)**	(2.80)***	(9.19)***	(3.12)***	(3.58)***	(3.53)***	(3.77)***	(4.28)***	(4.40)***	(4.19)***	(3.99)***	(4.22)***	(4.61)***
fddev2	-0.132	-0.138	-0.132	-0.122	-0.127	-0.098	-0.135	-0.131	-0.128	-0.133	-0.185	-0.168	-0.166	-0.166	-0.159	-0.158
	(4.83)***	(4.60)***	(4.46)***	(4.12)***	(4.12)***	(3.73)***	(4.30)***	(4.01)***	(3.92)***	(4.08)***	(4.73)***	(4.39)***	(4.14)***	(4.16)***	(4.04)***	(4.03)***
INDL1		0.325	0.301	0.308	0.312	0.488	0.312	0.341	0.330	0.458	0.354	0.376	0.371	0.372	0.392	0.503
		(2.39)**	(2.25)**	(2.31)**	(2.34)**	(4.31)***	(2.31)**	(2.44)**	(2.36)**	(3.15)***	(2.30)**	(2.51)**	(2.44)**	(2.44)**	(2.63)***	(3.28)***
INDL2		-0.053	-0.025	-0.027	-0.025	-0.075	-0.032	-0.063	-0.074	-0.014	-0.011	-0.003	-0.003	-0.045	-0.019	0.077
		(0.41)	(0.19)	(0.21)	(0.19)	(0.68)	(0.24)	(0.46)	(0.54)	(0.10)	(0.07)	(0.02)	(0.02)	(0.29)	(0.13)	(0.51)
dtot			0.173	0.168	0.239	0.203	0.255	0.261	0.408	0.282	0.326	0.166	0.141	0.347	0.271	0.393
			(4.91)***	(4.78)***	(6.33)***	(6.34)***	(6.14)***	(6.09)***	(4.03)***	(6.32)***	(6.48)***	(1.56)	(1.31)	(6.93)***	(2.50)**	(2.72)***
ldtot			0.131	0.115	0.169	0.125	0.174	0.176	0.115	0.197	0.189	0.067	0.033	0.196	0.063	0.179
			(3.70)***	(3.25)***	(4.42)***	(3.88)***	(4.48)***	(4.39)***	(1.22)	(4.76)***	(4.10)***	(0.75)	(0.36)	(4.24)***	(0.69)	(1.39)
growth				0.328	0.370	0.098	0.378	0.396	0.444	0.404	0.426	0.483	0.436	0.450	0.301	0.318
				(3.70)***	(3.89)***	(1.20)	(3.77)***	(3.66)***	(2.21)**	(3.54)***	(3.24)***	(1.83)*	(1.62)	(1.89)*	(1.00)	(0.99)
dinf					-0.001	0.005	-0.001	-0.001	-0.001	-0.001	-0.001	0.003	0.002	-0.001	0.005	0.000
					(0.16)	(1.37)	(0.12)	(0.18)	(0.19)	(0.17)	(0.22)	(0.25)	(0.19)	(0.17)	(0.42)	(0.00)
crisis						-0.300										
						(19.39)***										
dexp							-0.030	-0.051	-0.118	-0.088	-0.113	-0.128	-0.131	-0.103	-0.116	-0.317
							(0.97)	(1.57)	(1.98)**	(2.46)**	(2.78)***	(3.18)***	(3.17)***	(2.52)**	(2.88)***	(3.79)***
open								-0.016	-0.015	-0.013	-0.002	0.015	0.020	0.008	0.012	0.036
								(0.92)	(0.77)	(0.69)	(0.11)	(0.43)	(0.55)	(0.36)	(0.35)	(0.96)
grop									-0.034							0.063
									(0.17)							(0.25)
dtop									-0.209							-0.117
									(1.52)							(0.69)
ldtop									0.097							-0.132
									(0.73)							(0.82)
dexpop									0.069							0.141
									(1.16)							(1.88)*
INDdtot										-0.023						-0.008
										(0.12)						(0.03)
INDldtot										-0.361						-0.318
										(2.12)**						(1.60)
INDgrowth										-0.098						0.129
										(0.27)						(0.28)
INDdinf										-0.001						0.003
										(0.04)						(0.17)
INDopen										-0.009						-0.059
										(0.14)						(0.72)
INDdexp										0.213						0.407
										(2.38)**						(3.67)***
lys02											-0.028	-0.045	-0.045	-0.034	-0.053	-0.048
											(2.10)**	(1.77)*	(1.72)*	(2.38)**	(2.09)**	(1.85)*
lys03											0.014	0.025	0.028	0.012	0.023	0.033
											(0.82)	(0.85)	(0.91)	(0.62)	(0.73)	(1.07)

lys02dtot												0.422	0.446		0.284	0.307
												(3.44)***	(3.59)***		(2.27)**	(2.45)**
lys03dtot												-0.133	-0.099		-0.198	-0.183
												(1.02)	(0.74)		(1.49)	(1.34)
lys02ldtot												0.226	0.271		0.221	0.177
												(1.95)*	(2.27)**		(1.83)*	(1.48)
lys03ldtot												0.108	0.158		0.145	0.147
												(0.95)	(1.35)		(1.25)	(1.25)
lys02gr												0.475	0.466		0.507	0.530
												(1.47)	(1.40)		(1.52)	(1.58)
lys03gr												-0.494	-0.503		-0.575	-0.589
												(1.57)	(1.57)		(1.67)*	(1.71)*
lys02dinf												-0.003	-0.000		-0.008	-0.001
												(0.20)	(0.01)		(0.47)	(0.07)
lys03dinf												-0.010	-0.010		-0.009	-0.004
												(0.70)	(0.66)		(0.60)	(0.21)
lys02open												0.017	0.015		0.018	0.011
												(0.53)	(0.45)		(0.57)	(0.34)
lys03open												-0.004	-0.009		-0.005	-0.010
												(0.12)	(0.26)		(0.13)	(0.29)
switch													-0.008	-0.011	-0.012	-0.012
													(0.53)	(0.76)	(0.89)	(0.86)
grdtot														-6.106	-5.652	-5.641
														(5.90)***	(5.42)***	(5.40)***
grldtot														-2.586	-1.986	-1.945
														(2.31)**	(1.71)*	(1.66)*
grinf														-0.116	-0.222	-0.195
														(1.00)	(1.80)*	(1.58)
gropen														-0.188	0.091	0.000
														(0.82)	(0.36)	(.)
Constant	0.000	0.000	0.001	-0.005	-0.004	0.015	-0.003	0.011	0.011	0.010	0.005	-0.009	-0.010	0.005	0.001	-0.010
	(0.08)	(0.06)	(0.19)	(1.42)	(0.95)	(4.61)***	(0.88)	(0.79)	(0.68)	(0.57)	(0.26)	(0.36)	(0.35)	(0.23)	(0.03)	(0.34)
Observations	1314	1152	1152	1151	1006	1006	981	899	899	899	730	730	704	704	704	704
R-squared	0.02	0.03	0.06	0.07	0.12	0.37	0.12	0.13	0.13	0.14	0.18	0.24	0.24	0.22	0.28	0.30

Absolute value of t statistics in parentheses
* significant at 10%; ** significant at 5%; *** significant at 1%

Table 7: Residual One year volatility from table 6

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
Combined	0.088	0.087	0.087	0.087	0.084	0.073	0.084	0.084
Developing	0.110	0.110	0.110	0.109	0.106	0.090	0.106	0.106
Industrial	0.043	0.041	0.041	0.040	0.040	0.040	0.040	0.041
Difference	0.067	0.069	0.069	0.069	0.066	0.050	0.066	0.065
t-statistics	4.108	4.254	4.479	4.532	4.209	3.922	4.174	3.960
P(Dev>Ind)	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000
	(9)	**(10)**	**(11)**	**(12)**	**(13)**	**(14)**	**(15)**	**(16)**
Combined	0.084	0.083	0.086	0.085	0.085	0.086	0.085	0.084
Developing	0.106	0.106	0.105	0.102	0.101	0.103	0.101	0.102
Industrial	0.041	0.037	0.047	0.051	0.052	0.049	0.052	0.045
Difference	0.065	0.069	0.058	0.051	0.049	0.054	0.050	0.057
t-statistics	3.958	4.270	3.623	3.287	3.059	3.472	3.278	3.891
P(Dev>Ind)	1.000	1.000	1.000	0.999	0.998	1.000	0.999	1.000

Table 8: Residual Five year volatility from Table 6

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
Combined	0.086	0.086	0.086	0.085	0.078	0.069	0.076	0.075
Developing	0.108	0.110	0.110	0.109	0.101	0.087	0.099	0.097
Industrial	0.042	0.035	0.036	0.035	0.034	0.033	0.033	0.033
Difference	0.065	0.075	0.074	0.074	0.067	0.054	0.066	0.064
t-statistics	4.767	5.418	5.541	5.648	5.148	4.374	5.044	4.384
P(Dev>Ind)	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000
	(9)	**(10)**	**(11)**	**(12)**	**(13)**	**(14)**	**(15)**	**(16)**
Combined	0.075	0.074	0.073	0.069	0.066	0.070	0.067	0.066
Developing	0.096	0.098	0.091	0.082	0.079	0.087	0.081	0.083
Industrial	0.034	0.029	0.036	0.039	0.039	0.034	0.037	0.031
Difference	0.062	0.069	0.055	0.043	0.041	0.054	0.044	0.052
t-statistics	4.292	4.833	3.368	2.975	2.824	3.341	3.087	3.751
P(Dev>Ind)	1.000	1.000	0.999	0.998	0.997	0.999	0.998	1.000

Table 9: Residual Volatility from country by country regressions

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
				One year				
Combined	0.076	0.072	0.062	0.056	0.070	0.064	0.055	0.045
Developing	0.097	0.091	0.078	0.070	0.088	0.081	0.068	0.056
Industrial	0.035	0.033	0.031	0.028	0.032	0.031	0.028	0.023
Difference	0.062	0.057	0.048	0.043	0.056	0.050	0.040	0.033
t-statistics	4.693	4.473	4.045	4.228	4.375	4.203	3.691	3.663
P(Dev>Ind)	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000
	(9)	**(10)**	**(11)**	**(12)**	**(13)**	**(14)**	**(15)**	**(16)**
				Five-year				
Combined	0.067	0.052	0.115	0.047	0.061	0.054	0.045	0.038
Developing	0.086	0.066	0.148	0.061	0.077	0.068	0.057	0.048
Industrial	0.030	0.024	0.053	0.022	0.027	0.026	0.022	0.020
Difference	0.056	0.043	0.096	0.039	0.050	0.042	0.036	0.028
t-statistics	5.740	5.240	5.240	4.693	4.514	4.247	4.165	3.213
P(Dev>Ind)	1.000	1.000	1.000	1.000	1.000	1.000	1.000	0.999

Columns 1 and 9 only control for TOT, Columns 2 and 10 control for TOT and Growth, Columns 3 and 11 control for TOT, Growth, and inflation, Columns 4 and 12 control for TOT, Growth, inflation, and export growth, Columns 5 and 13 only control for TOT + two lags of the dependent variable Columns 6 and 14 control for TOT and Growth + two lags of the dependent variable, Columns 7 and 15 control for TOT, Growth, and inflation + two lags of the dependent variable, Columns 8 and 16 control for TOT, Growth, inflation, and export growth + two lags of the dependent variable

Table 10: Residual volatility with country by country regressions and non-linearities

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
				One year volatility				
Combined	0.048	0.053	0.051	0.053	0.037	0.042	0.041	0.040
Developing	0.061	0.066	0.063	0.066	0.046	0.052	0.050	0.049
Industrial	0.024	0.026	0.027	0.025	0.019	0.022	0.022	0.021
Difference	0.037	0.040	0.036	0.041	0.027	0.030	0.027	0.028
t-statistics	3.740	3.862	3.733	4.075	3.087	3.152	3.044	3.208
P(Dev>Ind)	1.000	1.000	1.000	1.000	0.999	0.999	0.998	0.999
	(9)	**(10)**	**(11)**	**(12)**	**(13)**	**(14)**	**(15)**	**(16)**
				Five year volatility				
Combined	0.042	0.047	0.043	0.044	0.032	0.038	0.036	0.033
Developing	0.054	0.060	0.055	0.057	0.040	0.048	0.045	0.042
Industrial	0.021	0.022	0.021	0.020	0.016	0.020	0.020	0.017
Difference	0.033	0.038	0.034	0.036	0.023	0.028	0.025	0.024
t-statistics	4.116	4.079	4.135	4.403	2.972	2.776	2.755	2.972
P(Dev>Ind)	1.000	1.000	1.000	1.000	0.998	0.996	0.996	0.998

These are the residuals of country by country regressions that TOT, Growth, inflation, and export growth, columns 5, 6, 7, 8 and 13, 14, 15, 16 also include two lags of the dependent variables. In columns 1, 5, 9, 13 TOT shocks are also entered squared, in columns 2, 6, 10, 14 growth is entered squared, in columns 3, 7, 11, 15 inflation is entered squared, in columns 4, 8, 16 and 16 export growth is also entered squared.

Table 11: Cross Country Regressions

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)	(13)
	VOL_P	VOL_P	VOL_P	VOL_P	VOL_P	VOL_P	VOL_P	VOL_P	VOL_P	VOL_P	VOL_P	VOL_P	VOL_P
LGDPPC	-0.011	-0.013	-0.006	-0.005	-0.010	-0.009	-0.016	-0.013	-0.012	-0.011	-0.000	-0.010	
	(3.10)***	(3.00)***	(2.10)**	(0.58)	(3.27)***	(3.19)***	(2.59)**	(2.39)**	(2.36)**	(3.10)***	(0.04)	(2.84)***	
VOL_TOT	0.033									0.033			
	(0.60)									(0.60)			
OPEN	-0.015	-0.016	-0.018	-0.012	-0.018	-0.017	-0.010	-0.016	-0.016	-0.015	-0.008	-0.009	-0.008
	(2.47)**	(2.45)**	(2.75)***	(2.00)*	(2.66)**	(2.77)***	(1.46)	(2.47)**	(2.56)**	(2.47)**	(1.20)	(1.63)	(1.19)
VOL_GROWTH		-0.027											
		(0.11)											
VOL_EXP			0.283										
			(1.42)										
RULE_WB				-0.014							-0.017		-0.017
				(1.59)							(2.13)**		(3.83)***
CONC4					0.073								
					(1.57)								
CONC10						0.090					0.101	0.098	0.102
						(1.80)*					(2.13)**	(2.04)**	(2.12)**
LGDP							0.003				0.004	0.005	0.004
							(1.11)				(1.37)	(1.55)	(1.37)
FIN_DEPTH								0.001					
								(0.05)					
DC_GDP									-0.006		-0.007	-0.016	-0.007
									(0.47)		(0.53)	(1.20)	(0.53)
Constant	0.147	0.164	0.075	0.102	0.126	0.122	0.152	0.162	0.157	0.147	0.009	0.085	0.007
	(4.02)***	(3.74)***	(1.73)*	(1.54)	(4.52)***	(4.41)***	(4.82)***	(3.62)***	(3.77)***	(4.02)***	(0.16)	(1.97)*	(0.19)
Observations	60	60	60	53	53	53	60	60	60	60	53	53	53
R-squared	0.34	0.33	0.45	0.37	0.45	0.47	0.34	0.33	0.33	0.34	0.53	0.50	0.53

Robust t statistics in parentheses
* significant at 10%; ** significant at 5%; *** significant at 1%

Table 12: Share of difference explained by regressions

Share explained by	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)
LGDPPC	79.7%	94.2%	43.5%	36.2%	72.5%	65.2%	116.0%	94.2%	87.0%		72.5%	
VOL_TOT	6.5%											
OPEN	-6.9%	-7.3%	-8.3%	-5.5%	-8.3%	-7.8%	-4.6%	-7.3%	-7.3%	-3.7%	-4.1%	-3.7%
VOL_GROWTH		-2.0%										
VOL_EXP			35.4%									
RULE_WB				72.0%						87.5%	0.0%	87.5%
CONC4					13.7%							
CONC10						16.1%				18.0%	17.5%	18.2%
LGDP							-22.9%			-30.5%	-38.2%	-30.5%
FIN_DEPTH								-1.3%				
DC_GDP									10.3%	12.0%	27.5%	12.0%
TOT EXPLAINED BY REGRESSION	79.3%	84.9%	70.7%	102.8%	77.9%	73.5%	88.5%	85.6%	89.9%	83.3%	75.1%	83.5%

Table 13: ARCH Estimations

	1		2		3		4		5		6	
					Mean Equation							
RER(-1)	0.8078		0.8533		0.8759		0.9630		0.9737		0.9844	
	55.5258	***	32.8036	***	34.9352	***	33.7198	***	28.0731	***	28.5951	***
RER(-2)	-0.2025		-0.2803		-0.2940		-0.2904		-0.2743		-0.2815	
	12.1422	***	14.8160	***	17.0880	***	11.3483	***	9.7926	***	9.3137	***
TOT	0.0945		0.0817		0.0886		0.0920		0.0758		0.0757	
	5.9043	***	5.0893	***	5.9312	***	4.7080	***	2.6945	***	2.6403	***
G	0.1662		0.1341		0.1151		0.1098		0.1202		0.1269	
	4.0782	***	4.6520	***	4.1516	***	3.4109	***	3.0098	***	3.1642	***
IND	-0.0017		0.0074		0.0081		0.0000		-0.0004		-0.0003	
	0.3350		2.3364	**	2.5894	**	0.0114		0.1103		0.1015	
RER(-1)*IND									-0.0235		-0.0073	
									0.3620		0.1142	
RER(-2)*IND									-0.0580		-0.0732	
									0.7918		1.0797	
TOT*IND									0.0214		-0.1180	
									0.5251		2.6969	***
G*IND									-0.0336		0.0107	
									0.4935		0.1505	
C0	-0.0002		-0.0090		-0.0093		-0.0008		-0.0004		0.0015	
	0.0335		3.2004	***	3.6999	***	0.2989		0.1342		0.5349	
					Variance Equation							
CC	0.0132		0.0041		0.0032		0.0013		0.0013		0.0012	
	42.7116	***	16.6781	***	11.9595	***	5.3670	***	5.3222	***	5.4703	***
IND	-0.0118		-0.0033		-0.0022		-0.0006		-0.0005		-0.0003	
	35.7181	***	13.4456	***	7.3904	***	2.1942	**	2.0687	**	1.5380	
RER(-1)							0.1155		0.1182		0.1433	
							4.8322	***	4.8926	***	5.5479	***
RER(-2)							0.0990		0.0974		0.1264	
							11.1969	***	11.1622	***	12.4810	***
TOT							0.0251		0.0281		0.0453	
							1.5531		1.6181		2.3819	**
G							0.0624		0.0636		0.0375	
							1.5613		1.5529		0.8320	
RER(-1)*IND											-0.0153	
											0.2921	
RER(-2)*IND											-0.1340	
											4.1150	***
TOT*IND											-0.0733	
											3.5613	***
G*IND											0.0355	
ARCH1			0.4051		0.5492		0.3464		0.3443		0.2650	
			7.7760	***	7.0169	***	6.8953	***	6.8776	***	7.0531	***
ARCH2			0.3622		0.5329		0.3399		0.3461		0.2715	
			9.1353	***	8.7162	***	5.2305	***	5.1714	***	4.7033	***
ARCH1 *IND					-0.3484		-0.3074		-0.3029		-0.1161	
					3.0319	***	3.6385	***	3.4681	***	1.4825	
ARCH2*IND					-0.4917		-0.3512		-0.3664		-0.2776	
					5.8929	***	4.1644	***	4.3373	***	4.2525	***

Table 14: ARCH Estimations. The effect of GDP per capita

	1		2		3		4	
			Mean Equation					
RER1	0.9688		0.9441		0.9634		0.9963	
	31.08	***	31.31	***	26.46	***	28.32	***
RER-SQUARED	-0.2986		-0.2762		-0.2753		-0.2803	
	10.57	***	10.88	***	10.43	***	9.97	***
TOT	0.1145		0.1172		0.1354		0.1286	
	5.57	***	5.94	***	4.54	***	4.21	***
G	0.1478		0.1328		0.1035		0.1238	
	4.06	***	3.77	***	2.43	**	2.98	***
IND	-0.0007		-0.0006		-0.0006		-0.0014	
	0.17		0.14		0.14		0.34	
GDPPC	0.0063		0.0068		0.0070		0.0046	
	2.04	**	2.20	**	2.30	**	1.46	
RER1*GDPPC					-0.0104		-0.0181	
					0.68		1.29	
RER-SQUARED*GDPPC					-0.0080		-0.0063	
					0.48		0.39	
TOT*GDPPC					-0.0146		-0.0187	
					1.44		1.86	*
G*GDPPC					0.0181		0.0216	
	0.00		0.00		1.08		1.30	
CONST	-0.0247		-0.0276		-0.0282		-0.0174	
	2.11	**	2.34	**	2.44	**	1.46	
			Variance Equation					
CONST	0.0030		0.0023		0.0023		0.0010	
	4.49	***	3.18	***	3.10	***	1.25	
IND	-0.0012		-0.0005		-0.0004		-0.0003	
	3.24	***	1.23		1.14		0.78	
GDPPC	-0.0003		-0.0003		-0.0003		0.0000	
	1.99	*	1.54		1.50		0.04	
RER1	0.1275		0.1029		0.1051		-0.3827	
	5.81	***	3.95	***	3.89	***	2.35	**
RER-SQUARED	0.0792		0.0849		0.0831		0.5498	
	6.47	***	6.24	***	6.29	***	9.77	***
TOT	0.0257		0.0225		0.0102		0.4964	
	1.31		1.01		0.45		4.24	***
G	-0.0045		0.0038		0.0101		-0.1906	
	0.11		0.09		0.24		0.75	
RER*GDPPC							0.1293	
							3.15	***
RER-SQUARED*GDPPC							-0.1295	
							8.48	***
TOT*GDPPC							-0.1238	
							4.33	***
G*GDPPC							0.0493	
							0.75	
ARCH1	0.2725		0.3518		0.3587		0.3305	
	6.25	***	5.30	***	5.26	***	4.95	***
ARCH2	0.2176		0.4076		0.4273		0.4125	
	3.87	***	4.76	***	4.94	***	5.32	***
ARCH1*IND			-0.3187		-0.3174		-0.2775	
			3.36	***	3.25	***	2.86	***
ARCH2*IND			-0.3514		-0.3803		-0.2497	
			2.59	**	2.83	***	1.72	*

Table 15: ARCH Estimations. The effect of Rule of Law

	1		2		3		4	
			Mean Equation					
RER1	0.9668		0.9447		0.9932		1.0484	
	31.80	***	32.39	***	28.31	***	5473.87	***
RER-SQUARED	-0.2890		-0.2672		-0.2458		-0.3109	
	9.79	***	10.48	***	9.60	***	2547.06	***
TOT	0.1153		0.1125		0.0772		0.0953	
	5.85	***	5.92	***	2.81	***	470.51	***
G	0.1650		0.1449		0.1161		0.1364	
	4.65	***	4.23	***	2.86	***		
IND	-0.0011		-0.0012		-0.0015		-0.0020	
	0.16		0.21		0.26			
ROL	0.0021		0.0026		0.0022		-0.0001	
	0.64		0.86		0.72			
RER1*ROL					-0.0690		-0.1411	
					1.91	*		
RER-SQUARED*ROL					-0.0460		0.0048	
					1.22			
TOT*ROL					0.0068		-0.0343	
					0.34			
G*ROL					0.0523		0.0438	
					1.33			
CONST	-0.0011		-0.0022		-0.0010		0.0011	
	0.35		0.71		0.31			
			Variance Equation					
CONST	0.0021		0.0015		0.0014		0.0011	
	6.08	***	4.22	***	4.12	***	8.06	***
IND	-0.0006		-0.0001		0.0000		0.0002	
	1.22		0.13		0.07		1.38	
ROL	-0.0005		-0.0004		-0.0004		-0.0007	
	2.31	**	1.76	*	1.75	*		
RER1	0.1171		0.0954		0.1017		0.1414	
	5.67	***	3.78	***	3.82	***	8.55	***
RER-SQUARED	0.0932		0.1017		0.0910		0.1129	
	9.32	***	9.57	***	7.77	***	27.87	***
TOT	0.0271		0.0196		0.0140		0.0542	
	1.44		0.91		0.63		4.93	***
G	-0.0183		-0.0046		-0.0020		-0.0077	
	0.48		0.11		0.05		0.76	
RER*ROL							-0.0238	
							2.81	***
RER-SQUARED*ROL							-0.0750	
							34.60	***
TOT*ROL							-0.0549	
							9.17	***
G*ROL							0.0171	
							3.31	***
ARCH1	0.2441		0.3182		0.3147		0.2671	
	6.37	***	5.44	***	5.32	***	4.97	***
ARCH2	0.1834		0.4078		0.4885		0.2879	
	3.63	***	4.72	***	5.18	***	4.81	***
ARCH1*IND			-0.2869		-0.2806		-0.0987	
			3.35	***	3.26	***	1.83	*
ARCH2*IND			-0.4030		-0.4942		-0.3093	
			3.60	***	4.37	***	5.17	***

Table 16: ARCH Estimations. The effect of Financial Development

	1		2		3		4	
			Mean Equation					
RER1	0.9674		0.9428		0.9761		1.0096	
	31.25	***	31.77	***	26.94	***	28.73	***
RER-SQUARED	-0.2966		-0.2708		-0.2667		-0.2961	
	10.45	***	10.87	***	10.27	***	10.14	***
TOT	0.1117		0.1131		0.1150		0.1022	
	5.48	***	5.77	***	3.86	***	3.29	***
G	0.1548		0.1402		0.1102		0.1238	
	4.36	***	4.09	***	2.64	***	2.96	***
IND	-0.0021		-0.0029		-0.0029		-0.0011	
	0.30		0.45		0.45		0.17	
FD2	0.0026		0.0032		0.0029		0.0007	
	0.97		1.29		1.20		0.28	
RER1*FD2					-0.0072		-0.0144	
					1.09		2.28	**
RER-SQUARED*FD2					-0.0041		-0.0004	
					0.57		0.06	
TOT*FD2					-0.0043		-0.0029	
					1.00		0.75	
G*RFD2					0.0089		0.0093	
	0.00		0.00		1.21		1.32	
CONST	-0.0219		-0.0274		-0.0248		-0.0054	
	1.04		1.41		1.28		0.27	
			Variance Equation					
CONST	0.0037		0.0031		0.0031		0.0011	
	2.68	***	2.20	**	2.24	**	0.73	
IND	-0.0010		-0.0002		-0.0002		-0.0004	
	2.06	**	0.51		0.36		0.91	
FD2	-0.0002		-0.0002		-0.0002		0.0000	
	1.34		1.29		1.36		0.07	
RER1	0.1103		0.0858		0.0907		0.0812	
	5.12	***	3.27	***	3.31	***	0.60	
RER-SQUARED	0.0858		0.0934		0.0908		0.4692	
	6.90	***	7.10	***	7.33	***	8.22	***
TOT	0.0274		0.0207		0.0108		0.3812	
	1.35		0.92		0.47		3.75	***
G	-0.0163		-0.0043		-0.0003		-0.0314	
	0.45		0.11		0.01		0.12	
RER*FD2							0.0037	
							0.23	
RER-SQUARED*Fd2							-0.0481	
							6.68	***
TOT*FD2							-0.0420	
							4.12	***
G*FD2							0.0039	
							0.13	
ARCH1	0.2597		0.3379		0.3363		0.2338	
	6.23	***	5.27	***	5.21	***	5.15	***
ARCH2	0.2326		0.4453		0.4722		0.3710	
	4.10	***	5.11	***	5.32	***	5.06	***
ARCH1*IND			-0.3048		-0.2925		-0.1341	
			3.40	***	3.18	***	1.77	*
ARCH2*IND			-0.3857		-0.4236		-0.2977	
			2.86	***	3.14	***	2.56	**

Figure 1: Five-Year Volatility of Real Exchange Rate

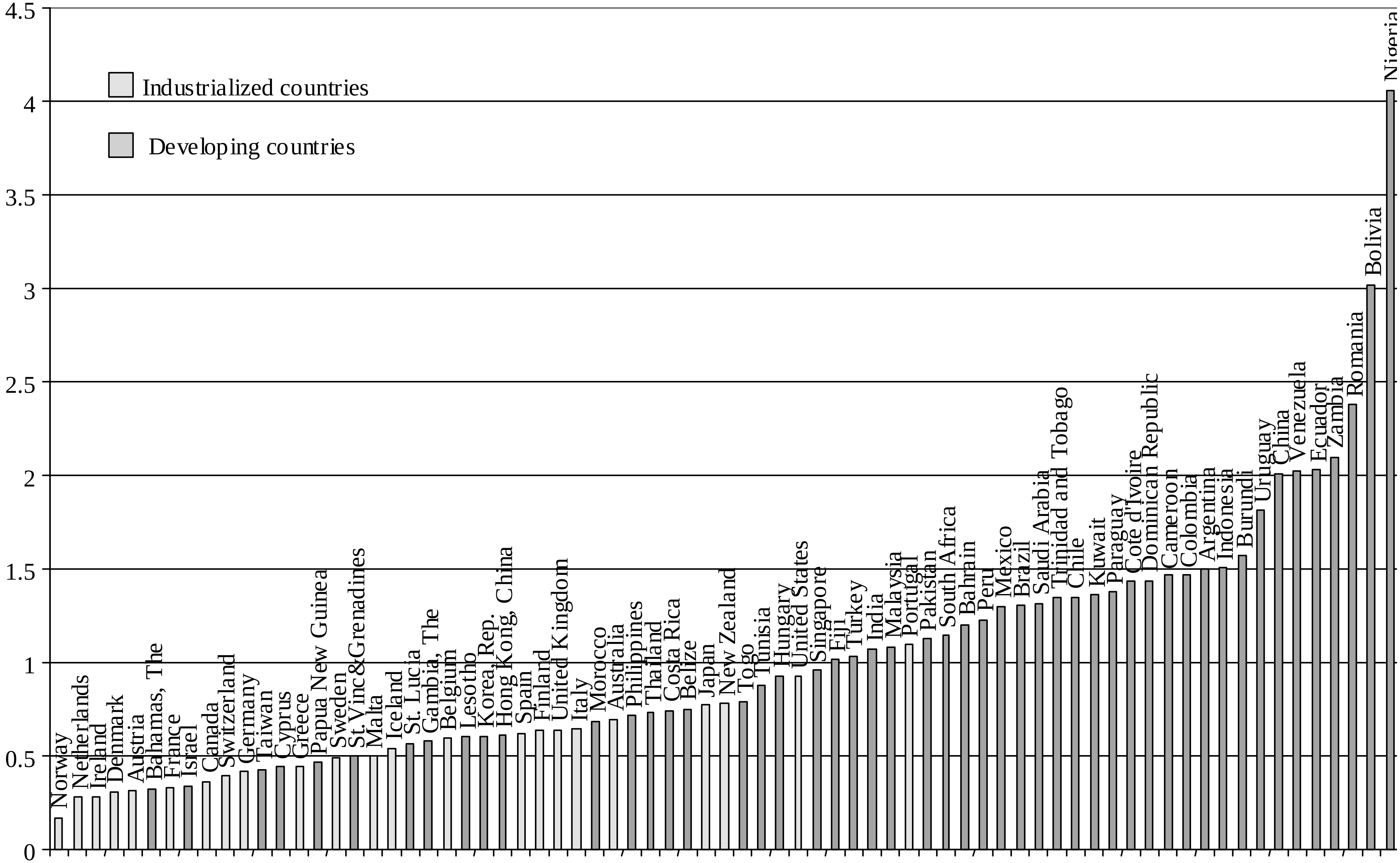

Figure 2: Five-Year Volatility Ratio and R-squares of the regressions.