

## **Growth from International Capital Flows:**

### **The Role of Volatility Regimes**

Ashoka Mody and Antu Panini Murshid<sup>†, ‡</sup>  
*International Monetary Fund, Research Department, 700 19th Street, N.W.,*

*Washington, D.C. 20431*

*University of Wisconsin-Milwaukee, Department of Economics, 3210 North Maryland Avenue,*

*Bolton Hall 868, Milwaukee, WI 53211, USA*

#### **Abstract**

Recent commentary has downplayed the growth dividend from international financial integration, highlighting the possibly negative correlation between capital inflows and long-run growth. This paper presents new evidence consistent with standard economic theory and a more benign interpretation of cross-border private capital flows. The key observation is that a country's growth volatility changes over time. With volatility below a threshold, an inflow of foreign capital has promoted growth. However, during periods of volatile growth, more flows have been associated with slower growth. Volatility levels and changes reflect an interaction of domestic production and institutional structures with global factors.

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<sup>†</sup> E-mail addresses: [amody@imf.org](mailto:amody@imf.org) (Ashoka Mody), [amurshid@uwm.edu](mailto:amurshid@uwm.edu) (Antu Panini Murshid).

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## I. INTRODUCTION

Developing countries, being short of capital by definition, stood to benefit from the large flows of international capital that came online in the 1980s and 1990s. But apparently that did not happen. In their survey, Kose, Prasad, Rogoff, and Wei (2006) find little robust evidence for long-run growth benefits from global capital inflows. They suggest that international financial integration brings collateral benefits—greater financial development and better macroeconomic policies—but these do not necessarily or immediately translate into superior growth outcomes. Prasad, Rajan, and Subramanian (2006) go one step further. They emphasize the negative correlation between growth and capital flows into developing countries, and conclude that international capital may even hurt economic growth in poor countries. Figure 1, which shows that a larger current account surplus (capital outflow) is associated with higher growth, illustrates their point. This “stylized fact” is now the cornerstone of a growing theoretical literature (Gourinchas and Jeanne, 2007; Alfaro, Kalemli-Ozcan, and Volosovych, 2008; Devereux and Sutherland, 2009; Sandri, 2010).<sup>1</sup>

Yet some are not persuaded by the emerging consensus. They seek to identify the conditions that generate social value in moving capital from rich to poor countries. Eichengreen (2007, p. 1) has remarked, “...capital flows are something about which it is especially hard to make unconditional statements.” The effectiveness of capital flows may

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<sup>1</sup> China as the example for high growth with capital outflows is misleading because Chinese growth is well above the norm implied by the regression line (the same is true of other East Asian economies, Korea and Malaysia). This reflects a variety of factors that have contributed to the extraordinary Chinese growth. When that extraordinary dimension is controlled for, China growth is higher with capital inflows, as we show below.

increase steadily with some conditioning characteristic: for example, Arteta, Eichengreen, and Wyplosz (2003) conclude that greater policy reform allows more gains from capital account liberalization. Alternatively, the effectiveness of inflows may increase discretely beyond certain conditioning thresholds. The search for such non-linearities, however, has been elusive, as, Kose, Prasad, and Taylor (2009, p. 9) conclude: “The empirical literature has reported many interesting results but the robustness of these results and the estimated thresholds vary widely.” From their own research, no decisive thresholds emerge. They do conclude that institutional quality and financial development are most likely to promote productive use of foreign capital.

We make three contributions to promote the thresholds’ research agenda. First, growth volatility is a robust threshold variable. Second, sharper results are obtained by distinguishing country regimes instead of merely differentiating countries, as is the usual practice. In the low volatility regime, the positive relationship predicted by standard economic theory is clear; this disappears in the high-volatility regime.<sup>2</sup> Such regime analysis supports Pritchett (2000) and Jerzmanowski (2006) who show that countries fall in and out of regimes, with distinct changes in the nature and determinants of growth. Conflating regimes is, therefore, potentially misleading. Finally, shifts in a country’s growth volatility are primarily the outcome of external factors.

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<sup>2</sup> Sandri (2010) develops a model where countries facing strong financial frictions (and therefore higher volatility) grow by increasing precautionary saving and running current account surpluses, while countries with developed financial markets (which also experience less volatility) grow by running current account deficits. Thus the model has similar implications for the relationship between the current account, growth and volatility, although the causality runs from exogenous growth opportunities to the current account, rather than the other way around.

There are good reasons to expect that high volatility periods will be associated with smaller foreign capital inflows and their growth effects. The greater uncertainty is likely to deter investors, reducing, as we find, the inflows of private capital. When volatility is high, investment in equipment and technology will tend to be deferred with greater planning errors.<sup>3</sup> Higher macroeconomic volatility also depresses complimentary investment in human capital (Krebs, Krishna, and Maloney, 2010). Thus, regime shifts change both the extent of capital inflow and their productivity. The implication also is that the “long-term” effects of capital flows for an individual country are not precisely defined where countries do not stay in the same regime.

Using growth over 5-year periods as the unit of observation, volatility (the standard deviation of growth) varies between a low of 0.27 percent and a high of 25.65 percentage points, similar to the range observed by Ramey and Ramey (1995). On the basis of Hansen (1996 and 2000), we find that a GDP growth volatility of 5.35 percent distinguishes low and high volatility regimes. Of our core sample of 61 countries, 59 were in the low volatility regime for at least one of the 5-year periods covered by our analysis, 1980-2003; 35 were in the high volatility regime for at least one period.

With that set up, we separately analyze the determinants of growth for observations in the low and high volatility regimes. We conclude that the finding of no relationship between capital inflows and growth is driven principally by the breakdown of that

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<sup>3</sup> Across countries, high volatility is associated with lower growth (Ramey and Ramey, 1995, and Burnside and Tabova, 2010). Jerzmanowski (2006) finds this inverse relationship over time within a country. Similarly Zarnowitz and Moore (1986) report that periods of low growth in the United States have been marked by higher volatility. Bachmann, Elstner, and Sims (2010), using U.S. and German data, find that increased uncertainty is associated with medium-term reductions in manufacturing output and employment.

relationship in high volatility regimes. In contrast, when countries are in the lower volatility zone, they receive capital flows largely in the form of private capital and the higher capital inflows are, in fact, associated with higher growth. This relationship holds in the cross-section and in GMM models that potentially account for endogeneity.

Interestingly, the aggregate capital inflows/GDP ratio has not necessarily been lower in the high volatility regime: rather, in high volatility regimes, capital arrives mainly in the form of official aid, which (as Deaton, 2010 summarizes) is not associated with higher growth.

Much of the empirical literature on capital flows-growth performance has focused on institutional quality as the differentiating variable. However a formal analysis based on threshold regressions suggests that capital inflows are not necessarily more effective in countries with stronger institutions. This finding is initially puzzling, since volatility has been linked to the quality of institutions (Acemoglu, Johnson, Robinson, and Thaicharoen, 2003). But it helps to note that while volatility changes significantly over time, institutions are slow moving. Hence, institutions are less able to track regime changes within a country. A careful analysis shows that the quality of institutions is just one of a constellation of factors that combine to determine the overall volatility in a country. A country's volatility arises from the interaction of its location and institutional features with global factors. Location is associated with production diversity, creating varying degrees of potential volatility (Malik and Temple, 2008). Conditional on these country characteristics, the level and changes in volatility are the consequence of factors external to a nation, including US interest rates and commodity prices (Burnside and Tabova, 2010). Volatility—and with it the effectiveness of capital inflows—can thus change for exogenous reasons.

The remainder of this paper is organized as follows. To persuade the reader that our results are not the outcome of a particular sample or methodology, in Section II, we trace the evolution of results from the benchmark regression of Prasad, Rajan, and Subramanian (2006) through variations that highlight the role of volatility, and conclude that a pooled cross-country regression misspecifies the relationship between capital inflows and growth. In particular, as distinct from the standard OLS regression, maximum likelihood estimates support a strongly positive role for capital inflows. This occurs because maximum likelihood estimates place lower weight on high growth-volatility observations, reducing their influence in the determination of the coefficients. But since maximum likelihood is expected to increase efficiency and not correct for bias, we interpret the difference between the OLS and maximum likelihood results to signal a misspecification.

The economic intuition for this statistical finding is developed in Section III by identifying a volatility threshold that differentiates two regimes: one where volatility is low and foreign capital is productive, and one where volatility is high and foreign capital has little growth impact. We also report that the conventional distinction between good and bad institutions does not differentiate the productivity of international capital. In Section IV, GMM results are used to address the endogeneity concern. This section also reports results for private and official flows. The distinction between low and high volatility regimes continues to be robust.

In Section V, we examine the determinants of growth volatility, based on two recent papers—Malik and Temple (2008) and Burnside and Tabova (2010). The analysis identifies structural characteristics that are important for understanding cross-country

differences in volatility. Conditional on these characteristics, growth volatility is a function of external drivers, which are largely exogenous. Section VI offers concluding remarks.

## II. SPECIFYING THE GROWTH-CAPITAL FLOWS RELATIONSHIP

The empirical basis for the capital flows-growth relationship is the standard cross-country growth equation:

$$g_i = x_i' \beta + \theta k_i + \varepsilon_i \quad (1)$$

Here  $g_i$  is the average long-run growth rate of real GDP per capita in country  $i$ ,  $x_i$  is a set of controls, and  $k_i$  is a measure of the average capital inflow in country  $i$ . In Prasad, Rajan, and Subramanian (2006) the measure of capital flow is the size of the current account surplus. When countries run a current account surplus, they export capital and when they run a deficit, they receive foreign capital to finance that deficit. Foreign capital inflows may take the form of private investment, portfolio equity, or credit flows; supplemented by loans from official agencies. The controls for other growth determinants are the usual suspects—initial income, life expectancy, trade openness, fiscal balance, and institutional quality.

We begin quite simply by trying to reproduce the Prasad, Rajan, and Subramanian (2006) findings before considering a number of extensions. Since a current account surplus measures an outflow of capital, a positive coefficient on the current account implies that larger capital outflows are associated with higher growth. There are two main differences between our replication effort and the Prasad, Rajan, and Subramanian (2006) baseline. First, we focus on a 24-year period from 1980 to 2003, while they covered the period, 1970-2000; we omit their first ten years because the emergence of sizeable global capital flows is a characteristic of the post-1980s. Second, we increase country-coverage by

measuring openness using the average volume of trade (sum of exports and imports normalized by GDP) as opposed to the initial value of the Sachs and Warner dummy. Thus, while our coefficient on trade openness is not directly comparable with theirs, all other coefficient estimates are, including that on the current account. The data sources are listed in Table A.1 in the Data Appendix.

Column 1 in Table 1 reports the Prasad, Rajan, and Subramanian (2006) results and column 2 reports our version of their specification. The comparable coefficients are of similar magnitudes, differences in statistical significance notwithstanding. They find that a decline in the current account-to-GDP ratio of one percent (i.e. an increase in the capital inflows-to-GDP ratio) is associated with a 0.1 percentage point drop in the average annual growth rate. From this they conclude that capital inflows hurt rather than help growth. Although with a smaller t-statistic, we find a coefficient of 0.06, supporting their result.

The adverse relationship between capital flows and growth is particularly characteristic of heavily aid-dependent countries, which tend to be developmentally-weak states (Deaton, 2010). In column 3, we omit countries where the average aid-to-GDP ratio over the time span of the study exceeded ten percent of GDP. That brings the sample down from 87 to 61 countries (listed in Table A.2 of the Data Appendix), and the significance of the current account coefficient disappears. Yet, while capital flows no longer appear detrimental to a country's growth prospects, they do not appear to promote growth either.

#### *Dealing with heteroscedasticity reveals misspecification*

Typically, when estimating cross-country growth regressions, the average growth rate over the entire period of time is regressed against initial values or averages of explanatory variables. But is averaging necessary for identifying long-run relationships and



is it necessarily the most efficient use of data? When the data are heteroscedastic, the answer should be “no.” Growth datasets are panels, providing a time dimension (as well as one that spans countries), and therefore a basis exists for directly estimating the heteroscedasticity in the errors. It is surprising then that ordinary least squares and not generalized least squares is the standard econometric framework for growth-analysis.

A notable exception to the common approach is the important contribution by Ramey and Ramey (1995). In their study on the link between output volatility and growth, volatility matters not only because it is a determinant of long-run growth, but also because it suggests scope for improving estimation efficiency. To this end, they regress *annual* growth rates against a set of country-specific growth determinants using a maximum likelihood procedure that simultaneously exploits the time series variation in growth (to estimate growth volatility) as well as the cross-country variation in explanatory variables.

We adapt the Ramey and Ramey (1995) framework to estimate the following model:

$$g_{i,t} = x_i' \beta + \theta k_i + \varepsilon_{i,t} \quad (2a)$$

$$\varepsilon_{i,t} \sim N(0, \sigma_{i,j}) \quad (2b)$$

where  $g_{i,t}$  is the annual growth rate in country  $i$  for  $i = 1, 2, \dots, 61$  at time  $t$  for  $t = 1980, 1981, \dots, 2003$ . The explanatory variables retain their cross-sectional nature: hence the growth determinants,  $x_i$ , vary only across countries, and, thus,  $k_i$  is the average size of the current account balance for country  $i$ . The innovations to growth,  $\varepsilon_{i,t}$ , are assumed to be normally distributed with mean zero and standard deviation,  $\sigma_{i,j}$ , which, as in Ramey and Ramey (1995), varies across countries but—distinctively in our case—also over time. We allow for five non-overlapping time intervals:  $j=1980-84, 1985-89, 1990-94, 1995-99$ , and  $2000-03$ . Volatility is allowed to change from one interval to another but stays the same

within each interval. The assumption of normality is not essential; however, it allows us to estimate equations (2a) and (2b) jointly using maximum likelihood.<sup>4</sup>

To help the reader appreciate the evolution of the results, we present these in a number of steps in columns 4 through 6. With 24 observations for each country, there are now 1464 observations in total. Although the dependent variable varies from year to year, the variation in the independent variables is purely cross-sectional, and, hence, OLS yields coefficients that are identical to those reported in column 3 (where the dependent variable is average growth rate for each country).<sup>5</sup> However, when the dependent variable is annual growth data, the standard errors will in general be biased downward, making a correction for clustering (by country groups) necessary. The resulting corrected standard errors in column 4 are smaller than in column 3, although only marginally so. In columns 5 and 6, we present the maximum likelihood estimates as in Ramey and Ramey (1995), i.e., allowing volatility to vary *only* across countries. Now, the sign on the coefficient on the current account balance, suggestively, does change. However, the relationship appears little more than statistical noise. Note that our results are consistent with Ramey and Ramey's finding that higher volatility is associated with lower growth.

The important departure is in Table 2 where we estimate the system 2(a)-(b)

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<sup>4</sup> Alternatively we could estimate (2a) using iterated feasible GLS. Since the parameter estimates are not sensitive to the method of estimation, we report only our results based on MLE.

<sup>5</sup> This is by construction. The regression using pooled annual data can be thought of as two separate regressions; in the first step, for each country  $i$ , we minimize the within sum of squared errors and in a second step we minimize the between group sum of squared errors. Because our controls exhibit no within country variation, the first stage is, in effect, a regression of the annual growth rate,  $y_i$ , against a constant, such that,  $\hat{y}_i = \bar{y}_i$  for each  $i$ , which means that in the second step we would simply be regressing the mean growth rate in each country (the fitted value from the first step) against our controls.

allowing volatility to vary not only across countries but also over five-year intervals. In column 1, the covariates are retained as country averages or initial values. The coefficients on income, life expectancy, trade openness and institutional quality are comparable to the earlier regressions. The effect of the current account, however, is very different: the negative coefficient has a larger absolute size and is marginally significant at the 10 percent level. In columns 2 to 4, the covariates also vary across the five-year periods.<sup>6</sup> Unlike the earlier emphasis on long-run growth-determinants, these specifications are consistent with a more medium-term perspective on growth. Now, capital inflows show a strong relationship with higher growth, one that is significant at the conventional 5-percent level. Thus capital inflows may actually help, as the simplest economic theory leads us to expect.

But why are these results so different from those of Prasad, Rajan and Subramanian (2006)? Two aspects of our approach create the differences: estimation by maximum likelihood and allowing for time-varying volatility. In maximum likelihood estimation, each observation is weighted by the reciprocal of volatility (exactly as in generalized least squares). Such a transformation should generate efficiency gains since high volatility episodes, which contain less information, are rendered less influential. It is unlikely, however, that efficiency gains can explain the large difference between the coefficient estimates. Notice, for example, that the other explanatory variables do not change sign, always retain their statistical significance, and change modestly in quantitative terms

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<sup>6</sup> Since the institutional quality index (taken from Hall and Jones, 1999) is measured around 1985, this variable is unchanging over time. Also, due to paucity of annual fiscal-balance data, we use a country average for this variable. Thus both our measures of institutional quality and fiscal imbalances are country-specific and do not exhibit any variation over time.

through the various exploratory exercises. It is only the current account coefficient that changes steadily from positive to negative (and significant). Thus, we might conjecture that the models relating capital flows and growth are misspecified in some way, which imparts a bias to the estimates. In particular, these results suggest that the relationship between the current account and growth is a function of the volatility of growth. Hence, an estimator that places more weight on observations for which the conditional variance of growth is low will tend to isolate a relationship that only holds during those country-periods.

Moreover, volatility can change significantly within countries. This is evident from between- and within-country breakdowns of volatility reported in Table 3.<sup>7</sup> If volatility is time varying and if a positive relationship between capital flows and growth only holds when volatility is low, then a division of the sample along country lines will not isolate the capital flows-growth relationship. This is evident from maximum likelihood regressions (Table 1, columns 5 and 6) where we allow volatility to vary only across countries. Some countries receive greater weight, while others with higher average volatility receive lesser weight. The relationship between capital flows and growth is not revealed precisely because capital does not always have a beneficial growth impact in a particular country. This contrasts sharply with the results in Table 2, where volatility is allowed to vary over time and the coefficient on the current account is negative and significant.

To be sure, the inference from the above exercise should not be about the

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<sup>7</sup> For developing countries, Burnside and Tabova (2009) find that external factors (such as U.S. GDP growth, the U.S. interest rate, and commodity prices) account for about 70 percent of GDP fluctuations in developing economies. Since these external factors have a high degree of time variation, it stands to reason that country volatility will also be time-varying. For developed economies, Zarnowitz and Moore (1986) and, more recently, Bachmann, Elstner, and Sims (2010) also find such time variation.

appropriate methodology. Rather the findings are suggestive that the specification of the growth equation is suspect. In particular *time-varying* volatility should belong in this equation as a variable that conditions the impact of capital flows.

#### *Alternate specification*

If the issue is one of misspecification, then re-specifying the model to account for the variation in the relationship between the current account and growth should yield consistent results, even when the method of estimation is OLS. Below we consider such an approach. In particular, we estimate a model where we regress the *average* growth rate,  $g_{i,j}$ , in country  $i$  in period  $j$  (for  $j=1980-84, 1985-89, 1990-94, 1995-99,$  and  $2000-03$ ) against average and initial values of our controls, the average size of the current account balance,  $k_{i,j}$ , as well as a measure of volatility,  $\sigma_{i,j}$ , and a term that interacts the current account with volatility. The measure of volatility is obtained from the model estimated in column 4 in Table 2. The results are presented in Table 4.

Simply interacting the current account with growth-volatility does not reveal a statistically meaningful relationship (column 1). This could be because the proper specification of the interaction may be nonlinear. Hence, in columns 2 to 4, we consider interactions between the average size of the current account balance and dummies for whether volatility lies below the 25<sup>th</sup> percentile (column 2), below the 50<sup>th</sup> percentile (column 3) and below the 75<sup>th</sup> percentile (column 4). The evidence does suggest that when volatility is high, the capital flows-growth relationship is weaker. This differentiation is most evident when the top quartile (comprising the highest 25 percent volatility outcomes) is contrasted with the bottom three quartiles. For the top quartile, growth is *positively* correlated with the current account, i.e. countries exporting more capital grow faster (a

one-percentage point increase in the capital inflows-GDP ratio is associated with 0.16 percentage points lower growth). However, countries in the bottom three quartiles benefit from additional flows: a one percent point increase in the capital inflows-to-GDP ratio is associated with a growth rate that is 0.07 percentage points higher (Table 4, column 4). The relevant coefficients are significant at the 7-8 percent confidence level rather than the conventional 5 percent level.

In sum, the evidence presented in this section leads to two significant considerations. First, time-varying volatility conditions the relationship between capital flows and growth. Second, the variation in volatility is particularly germane when volatility exceeds a (relatively high) threshold: volatility must be in the top quartile to influence that relationship, but then it does so in a significant way. These results are consistent with threshold effects in the current account-growth-relationship. They are not, however, based on a formal statistical test for such a hypothesis. In the next section, we provide a more rigorous treatment of threshold effects.

### III. VOLATILITY THRESHOLDS

To test if the capital flows-growth relationship is characterized by threshold effects in volatility, we estimate the following nonlinear growth model:

$$g_{i,j} = x'_{i,j}\beta + \theta_1 k_{i,j} [1 - I(\sigma_{i,j} > \tau)] + \theta_2 k_{i,j} [I(\sigma_{i,j} > \tau)] + \varepsilon_{i,j} \quad (3)$$

This specification allows the effect of the current account,  $k_{i,j}$ , on average growth,  $g_{i,j}$ , to vary with growth-volatility,  $\sigma_{i,j}$ . As before the subscript  $i$  indexes countries and  $j$  denotes one of the following five time periods:  $j=1980-84, 1985-89, 1990-94, 1995-99, \text{ and } 2000-03$ .  $I(\sigma_{i,j} > \tau)$ , is an indicator function that allows the relationship between  $g_{i,j}$  and  $k_{i,j}$  to shift when  $\sigma_{i,j}$  exceeds a threshold,  $\tau$ . Although  $\tau$  is unknown it can be estimated using a

concentrated least square estimator (see Hansen, 1996; 2000 for details). However under a null hypothesis of no threshold,  $\tau$  is not identified. Accordingly the asymptotic distribution of classical test statistics is non-standard. Nevertheless a test of the null can be formed and p-values can be computed by bootstrap (see Hansen 1996; 2000).

Below we test this null, i.e. the hypothesis  $H_0: \theta_1 = \theta_2$  against the alternative  $H_a: \theta_1 \neq \theta_2$ . Since our focus is on a threshold in the *current account-growth* relationship, we have imposed the restriction that other model parameters are constant across regimes. This restriction is in the spirit of the empirical results reported above, which show that only the capital inflows-growth relationship changes in a meaningful way with volatility.<sup>8</sup>

The evidence strongly favors a split based on volatility; the null hypothesis of no threshold can be rejected with a p-value of 0.02. The split occurs when the standard deviation of growth crosses 5.35 percent of real GDP per capita (Table 5). This is a high threshold; only 25 percent of observations in our data belong to the high volatility regime. The low- and high-volatility group regressions are jointly estimated with the threshold using OLS, i.e., there is now no weighting of observations by time-varying volatility as was the case in our exploratory exercise above. In the low-variance regime, an inflow of capital of one percent of GDP is associated with a 0.094 percent increase in average annual growth rates. In the high-volatility regime capital inflows accompany a sharp reduction in growth. These results are depicted also in Figure 2. Notice that while China is an “outlier” in cross-

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<sup>8</sup> We follow Hansen (1999) in constraining the slope coefficients on a subset of the model variables to be the same across the regimes. This focuses attention on the variable of interest, i.e. the current account. Thus any evidence of a threshold is based solely on the additional explanatory power provided when we allow the effect of the current account to change across regimes.

sectional regressions, indicating some omitted factors that explain Chinese performance, once these are put into the black box of country fixed effects, Chinese growth is positively correlated with capital inflows in the low growth regime and negatively correlated with capital flows in the high growth regime. Thus, not taking into account China's special growth drivers, leads to misinterpretation of that country's relationship with capital flows.

If instead, we separate countries by an institutional threshold (columns 3 and 4), the coefficient on capital flows is not significant at the 5 percent level in either the low or the high institutions regime. Thus, institutions do not appear to differentiate countries by the productivity of capital flows. Indeed, the statistical test for a threshold provides essentially no evidence of a threshold. The bootstrapped p-value for the F-test of no threshold is 0.54. By contrast, the case for a threshold in income is somewhat stronger although the regimes are not sufficiently different to reject the null hypothesis of no threshold in income (p-value is 0.2). In poor countries, where per-capita income is less than \$2350, capital flows have negative effects on growth; and this relationship is statistically significant. In richer countries, the relationship between capital inflows and growth is unclear.

The quality of institutions and average per-capita income are only marginally lower in the high volatility group [see Panel A of Table 6 where we sort the 298 observations (=61 countries\*5 periods-7 missing observations) by low and high volatility]. A large number of countries fall in *both* low and high volatility regimes over the 24-year span of our data. Slow-moving variables such as institutions and income do not change with these large volatility movements. While private capital flows are clearly higher in the low volatility regime, total capital inflows across the regimes are similar (in fact, aggregate



capital flows are somewhat larger in the high volatility regime) because of the size of official flows in the high volatility regime.<sup>9</sup>

Another helpful differentiation of countries is by the number of periods spent in the high-volatility regime [Panel B of Table 6 and Figure 3(a)]. In our 61-country sample, 26 countries were in the low volatility regime throughout. Of the other 35 that experienced high volatility for at least one period, Suriname had four periods of high volatility and the Republic of Congo and Zimbabwe experienced high volatility throughout. Thus, the bulk, 32 countries, experienced high volatility in three periods or less. The incidence of high volatility was not disproportionately concentrated in any specific time period [Figure 3(b)].

Countries in a high volatility regime for fewer periods are richer and have better institutions (the exception are countries with only one period of high volatility which perform better on some dimensions than countries with zero periods of high volatility.) As the number of volatility periods increases, the ratio of *private* capital flows to GDP decreases; the exception in this case is the last group of three countries with either 4 or 5 periods of volatility where private capital flows are rather high. In this group, Suriname and the Republic of Congo, have large commodity-producing sectors that attract sizeable private capital flows. However, their heavy reliance on commodities implies that private investment is directed to small enclaves while the broader economy remains relatively underdeveloped and subject to high volatility. Finally, the group with zero periods of high

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<sup>9</sup> In countries that are reliant on foreign assistance, continued assistance may reinforce neo-patrimonial tendencies, and retard the development of already weak growth-institutions (Djankov, Montalvo, Reynal-Querol, 2006; Easterly, 2007; Moyo, 2009).

volatility has somewhat high foreign aid flows but, thereafter, the ratio of aid flow-to-GDP increases with the number of periods of volatility.

We present a second set of regressions, where observations are organized by the number of periods a country falls into the high volatility regime (Table 7). Column 1 includes only countries with zero periods of high volatility. Here simple OLS suggests that capital inflows are associated with higher growth; moreover, the maximum likelihood estimates (which weight the observations) are virtually identical to the OLS estimates. In this group, there is, thus, no evidence of misspecification. When we add countries with one period of high volatility, the OLS result becomes fuzzy and it takes the maximum likelihood estimates to reveal the positive relationship between capital inflows and growth. The same conclusion applies to the samples that include two and three periods of high volatility.

In summary, we have presented evidence of a break in the reduced form relationship between capital flows and growth when volatility increases beyond a high threshold. Capital inflows are associated with higher growth only in the low volatility regime. This regime also attracts more private capital and, therefore, stimulates productive investment. A high volatility regime, on the other hand, attracts smaller private capital flows and has greater dependence on foreign aid; in this regime, increased capital flows are associated with reduced growth. We pursue the distinctions between private and official flows in the next section, where we also consider the issue of endogeneity of capital flows.

#### **IV. PANEL REGRESSIONS AND ENDOGENEITY**

Our results are subject to the concern that causality may run from growth to capital flows. In the cross-sectional setting, this challenge is not easy to confront. Isolating an

exogenous source of variation for capital flows has proved particularly difficult. The key difficulty is finding a variable that is correlated with capital flows but does not belong in the growth equation itself. Wei and Wu (2002) and Portes and Rey (2005) use distances between nations as an instrument for the volume of bilateral capital flows, the idea being that proximity provides informational advantages to investors and is therefore associated with the volume of capital movements. While distance is a plausible instrument for bilateral capital flows, it is less clear how one might instrument for the average size of the current account balance, which is a measure of the overall net inflow or outflow of capital into a country. Alfaro, Kalemli-Ozcan, and Volosovych (2008) propose a measure of “distantness” or “remoteness”—a weighted average of the distances from the capital city of a particular country to the capital cities of other countries. Unfortunately, we found this variable to be weakly correlated with the average size of current account imbalances and thus not a suitable instrument.

We attempt to address the issue of identification within a panel framework. This also allows us to control for country-specific effects. We estimate our models using the system-GMM estimator outlined in Arellano and Bover (1995) and later fully developed in Blundell and Bond (1998). As Bond, Hoeffler, and Temple (2001) point out, this estimator is particularly well suited for handling endogenous variables when they exhibit a large degree of persistence—a characteristic common to many macro panels.<sup>10</sup> We report results based on the one-step variant of this estimator, since the standard errors in the two-step estimator are downward biased in finite samples.

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<sup>10</sup> Bond, Hoeffler, and Temple (2001) also note that the estimator mitigates the measurement error problem.

Using the threshold level of volatility reported in Table 5, we split the data into high- and low-volatility samples (Table 8). While we report fixed effects estimates, which are known to be biased, we rely on the Arellano-Bover estimates in drawing inferences.<sup>11</sup> Fiscal imbalances and institutional quality are omitted from these regressions due to the lack of time-series variation in these data.<sup>12</sup> Our finding above is confirmed for the low volatility regime. In fact, the relationship in the low volatility setting is stronger within countries than across them. A one percent increase in the current account deficit relative to GDP is associated with a 0.18 percent increase in average annual growth rates, which compares with a 0.09 percent increase in the OLS results. In the high volatility regime, the GMM point estimate on the capital flows coefficient is indistinguishable from zero—thus, while capital does not foster growth in the high volatility regime, it also does not hurt growth as implied by the OLS (and fixed-effects) estimates. Possibly, negative shocks to growth attract capital inflows to smooth the effects of those shocks. Bluedorn (2005), for instance, finds that a shock valued at one year’s GDP pushes the current account into deficit by 5 percent.

#### *Breakdown by type of flows*

Next, we distinguish between private and official forms of external financing in the low and high volatility regimes (Table 9). We measure flows as the average net inflow of private capital and the average inflow of foreign aid over each of the five-year periods.

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<sup>11</sup> Following Arellano and Bond (1991) we are unable to reject the null of the validity of the over-identifying restrictions [Table 7, columns (2) and (4)]. Also second-order serial correlation is absent.

<sup>12</sup> While annual data on fiscal balances are available. For some countries there are large gaps in these data. Calculating five-year averages of this variable would therefore sharply reduce the sample. For this reason we have omitted the fiscal balance variable from our analysis.

Because of difficulty in distinction, the estimates of private capital flows from the *World Economic Outlook* may, in some cases, include a small element of official flows. This limitation is not easy to overcome since better estimates are not available. Our estimates of foreign aid, as is conventional, are not just the estimates of official flows on the capital account but also those such as grants, which are included in the current account. Hence the sum of the private capital flows and the official inflows does not equal the current account deficit.<sup>13</sup> In the benchmark specification, we regress growth against flows, initial period income, life expectancy, the average volume of trade flows and time period dummies; a more extended specification also includes population growth, average educational attainment, financial development, and financial integration as additional controls.

Inflows of private capital are associated with higher growth in the low volatility regime. In the Arellano-Bover estimates, a one percent increase in private capital inflows relative to GDP could raise growth between 0.14 and 0.24 percent annually (Table 9, columns 2 and 4). Private capital flows and growth are also positively correlated with growth in the high volatility regime (Table 9, columns 5 and 6); however this relationship is not statistically significant or robust (Table 9, column 7).

Foreign aid appears to retard growth during periods of low volatility, but not in a statistically significant manner. The negative coefficients on the aid variable are somewhat larger in the high volatility regime but they are also never significant at the 5 percent level.

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<sup>13</sup> We were not able to replicate the Alfaro, Kalemli-Ozcan, and Volosovych (2010) estimate of private capital flows based on subtracting the official flows, as reported by the World Bank's *World Development Indicators* from the current account balance. We believe the reason for this is that some part of the official flows is already part of the current account balance and hence a subtraction of aggregate official flows overstates the official financing of the current account deficit.

Moreover, the size of the coefficient is sensitive to the inclusion of Suriname and the Republic of Congo—absent these two countries, the size of the coefficient falls even further. Thus, whether in the low or high volatility regimes, inflows of official flows do not have a significant effect on growth (as Rajan and Subramanian, 2009, conclude).

## **V. DETERMINANTS OF VOLATILITY**

Our finding that the effect of flows varies across a volatility threshold raises the further question: what exactly does volatility represent? It could be that volatility proxies for a “mysterious” combination of factors that make some economies operate well and others not. So it may not be volatility, per se, that deters foreign investors and creates a poor response to foreign investment. Rather, factors that raise volatility hurt the investment climate.

In considering the determinants of growth volatility, we base our analysis on two recent papers. Malik and Temple (2008) distill from a Bayesian analysis the most robust variables that help explain cross-country variations in volatility. While weak institutions contribute to higher growth volatility, Malik and Temple (2008) also highlight an important role for the geographical features of an economy, which, in turn, are associated with production structures that create high volatility conditions. In contrast, Burnside and Tabova (2010) compute a summary metric of volatility generated by time-varying global (external) shocks interacting with an indirect characterization of domestic structural features. We find the Burnside and Tabova (2010) metric to be a surprisingly good proxy for the determinants of country volatility, both in the cross-section (as they report) and within-countries over time, as in our extension.

To obtain their proxy for exposure to external volatility, for each country, Burnside and Tabova begin by regressing the annual GDP growth rate on six global factors. Three of these—US growth, the three month T-Bill rate corrected for inflation, and excess returns on US stock markets—are related to the phase of the US business cycle, and the other three are shocks to commodity price indexes. We estimate a similar set of equations:

$$g_{i,j} = \alpha_i + x_j' \beta_i + \varepsilon_{i,j}.$$

The dependent variable,  $g_{i,j}$ , is the annual per-capita GDP growth rate in country  $i$  in each year  $j = 1980, \dots, 2003$ , and  $x_j$  includes the six global factors in Burnside and Tabova's specification along with the median growth rate in our 61-country sample as a proxy for developing-country-growth trends.<sup>14</sup> The correlation between the median growth rate and errors in the country-specific growth equation can be assumed to be negligibly small; as such, all explanatory variables can be treated as exogenous.

Growth responds in each country to these exogenous influences in varying ways. That is, for each country, the regressions generate a specific set of  $\beta$ 's, which reflect structural features of that country (such as for instance whether it is an oil importer, its relationship to the US, and so on). Although these growth equations often do not have high explanatory power, the volatility of *predicted* growth rates from the country-specific growth equations is cross-sectionally highly correlated with the actual growth volatilities of countries. This is the basis for the Burnside and Tabova conclusion that, conditional on domestic structures, the variation in growth generated by external factors picks up much of

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<sup>14</sup> We also considered the mean growth rate in our sample as a regressor, as well as the base Burnside and Tabova specification without the developing-country growth rate term. The alternatives generated qualitatively robust results.

the actual variation in cross-country growth rates. In our re-estimation of their results (for a different country set and time period), a regression of actual growth-volatilities,  $\sigma_i$ , on the volatility of predicted growth rates,  $\hat{\sigma}_i$ , the coefficient on  $\hat{\sigma}_i$  is 1.48, with a t-statistic of 7.3 and an R-squared of 0.72 (Table 10, column 1);<sup>15</sup> this is very similar to the Burnside and Tabova (2010) result, confirming the robustness of their original finding.

In columns 2 and 3 of Table 10, we assess to what extent the Burnside and Tabova (2010) summary volatility measure is capturing standard determinants of volatility. Malik and Temple (2008) consider geographical characteristics that measure a country's remoteness to external markets, the volatility of terms of trade shocks, ethnic fractionalization, the incidence of external war, an index of institutional quality, and a characterization of government type. Geographical "remoteness" matters for volatility according to Malik and Temple (2008) since it is associated with undiversified export bases, which makes countries susceptible to volatility.

Our coefficient estimates are generally consistent with the Malik and Temple (2008) results. For instance, output is more volatile in smaller countries and volatility rises (although non-linearly) as a country's distance from the coast increases. We considered three measures of institutions—the Hall and Jones index of government anti-diversion policies, the composite ICRG risk rating and a measure of constraints on the executive branch of government in 1980. All three measures of institutions appear to matter in specifications that

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<sup>15</sup> Burnside and Tabova (2010) estimate the actual volatility of growth as the standard deviation of the annual real GDP growth rate. To stay consistent with our earlier analysis, we follow Ramey and Ramey (1995) and estimate the volatility of innovations to growth jointly in a maximum likelihood regression of annual growth rates on country-specific determinants of growth, where we allow the volatility to vary across countries in our sample (see the discussion in section II). Specifically our estimate of growth volatility is obtained from the regression equation reported in Table 1, column 6.



exclude a proxy for a country's degree of democracy. When democracy is included, volatility is found to be lower in democracies (Weede, 1996; Henisz, 2000), and the other institutional variables become insignificant. Thus political institutions appear to dominate the other measures of institutional quality. Ethnic fractionalization and external wars combine to raise country volatility and in some specifications terms of trade volatility is significant. Together, however, the Malik and Temple (2008) variables explain only about 45 percent of the cross-country variation in growth volatility.

In column 3, when we add the Burnside and Tabova measure as an additional regressor in the equation, there is evidence of overlap. The Burnside and Tabova measure has now a smaller point estimate than when entered by itself, but remains highly statistically significant. The Malik and Temple variables retain their signs and significance but are less influential. The interesting conclusion is that the inclusion of the Malik and Temple variables adds little explanatory power, since the Burnside and Tabova variable by itself explains 72 percent of the cross-country variation in growth volatilities, with the R-squared rising to 79 percent following the inclusion of the Malik and Temple variables.

For our purpose, it is also important to evaluate the determinants of changes in a country's volatility over time. These changes create the potential for a regime change. It is natural to focus on the Burnside and Tabova measure, which is clearly salient in the cross-section and also has a natural time variation arising from the variation in external factors. The inclusion of country dummies to account for country-specific effects implies, in any

case, that the bulk of the Malik and Temple variables drop out.<sup>16</sup> In column 4, we report results of within-country estimates of actual volatility regressed on predicted volatilities. After adding time dummies, the variations in actual volatility almost exactly mirror the variations in predicted volatility, implying that the volatility of external influences strongly conditions the changes in a country's volatility.

Finally, there exists the possibility that capital inflows themselves raise volatility. Such a correlation would undermine our finding of a positive relationship between capital flows and growth since the implication would be that beyond a certain size, capital inflows actually hurt growth through their volatility-inducing effects. In columns 5 to 8, we include the average size of current account balances, average net private flows and foreign aid, over five-year windows as regressors in our equation. The results suggest that an inflow of capital, i.e. a current account deficit, is unrelated to output volatility. Private capital flows are negatively associated with volatility and official flows are positively associated; but, given the low statistical significance of these findings, not much can be read from them.

We thus reach a number of conclusions. Externally-induced volatility differentiates country volatility: but, as the Burnside and Tabova method implies, the level of volatility is a function of the domestic structure. The Malik and Temple approach helps identify some of these structural factors: geographical remoteness being particularly important. However, the considerably greater explanatory power of the Burnside and Tabova variable suggests that additional structural features are at play. Our new finding is that changes in volatility

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<sup>16</sup> Terms of trade volatility does vary over time but is largely captured by variation in the Burnside and Tabova measure. Institutional variations are captured in the ICRG measure and do show that improved institutions are associated with reduced volatility (results not reported).

over time within a country, conditioned by unchanging structural features, are largely dependent on changes in global drivers. And, finally, capital flows in the aggregate (or private and official flows separately) are not correlated with country growth volatility.

Thus, for those countries that stay in a particular regime over time, their structural and institutional characteristics matter. Weak institutions do raise volatility: but there is much more going on. This explains why institutions are not a good proxy for volatility. Geographical remoteness is an important additional feature and other, as yet unidentified, country features also amplify global shocks. In this sense, volatility is an inclusive measure that encompasses several country features that deter international capital flows and render them less effective. Our results, however, also highlight that the movement of a country in and out of a volatility regime is most likely to be due to global factors that can be considered largely exogenous to domestic influences.

## **VI. CONCLUSION**

The failure to find the expected growth enhancing role of foreign capital has led some to accept this as a stylized fact. Others have continued an elusive search for non-linearities in that relationship. This paper offers a new perspective on the capital inflows-growth relationship. We conclude that non-linearities are important: with countries differentiated by their level of growth volatility. Some countries tend to stay in a volatility regime; but in others, movement from one regime to another causes shifts in the productivity of capital inflows.

We have tried to persuade the reader that our results are not the consequence of a particular sample or methodology. We did so by tracing out the evolution of our result,

from a benchmark, where capital flows are negatively correlated with growth—a popular current view—to our final specification where capital flows and growth are positively correlated during periods of low volatility. We find that growth volatility (the standard deviation of growth) of 5.35 percent of real GDP per-capita demarcates low and high volatility regimes. In the high regime, capital inflows are negatively correlated with growth, which also drive the negative correlation between capital inflows and aggregate growth when all countries are pooled. Thus, a failure to distinguish between volatility regimes leads to an unwarranted conclusion that capital inflows are damaging in all situations.

Even when growth and capital flows are positively correlated, the possibility exists that growth causes capital flows. Recognizing the limitations of GMM estimates in dealing with endogeneity, the results suggest that capital inflows do spur growth.

The action in our results comes mainly from private capital flows. In low volatility regimes, countries are able to attract larger private capital flows and gain a growth dividend from these flows; in high volatility settings, private capital flows diminish and have an insignificant relationship with growth. Aid flows increase in high volatility regimes but whether in a low or high volatility period, aid has a negative relationship with growth.

That a volatility threshold should distinguish the productivity of foreign capital seems natural. Low volatility conditions are more conducive to investment. They thus tend to attract more private capital.<sup>17</sup> And, in that setting, private capital can undertake more medium-term and riskier investments enhancing growth. In high volatility conditions,

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<sup>17</sup> Some heavily commodity-reliant economies do attract private capital that is large in relation to the economy but being of an enclave nature has limited impact on growth or in mitigating the volatility of that economy.

reliance on foreign aid is greater, which has had a poor record of accelerating growth.

Our exploration of the determinants of volatility showed that structural features, that include geographical remoteness, distinguish levels of a country's growth volatility. Weak institutions do raise volatility, but are only part of the explanation and hence do not, by themselves distinguish capital flow-growth regimes. Our findings also imply that the shift from one regime to another is largely a function of changes in global factors.

A final implication of our findings is that statements about "long-run" effects of foreign capital do not apply when countries move in and out of regimes. As noted, only 26 of the 61 countries in our sample were in the low volatility regime throughout the period analyzed. For the other 35 countries, the effective long-run relationship between capital inflows and growth will be a combination of the effects in low and high volatility regimes.

## Appendix A

**Table A.1. Descriptions of Variables and Data Sources**

<i>Variable</i>	<i>Description</i>
	<i>Dependent Variable</i>
Growth	Calculated as the log difference of chained real GDP ( $\times 100$ ) (series rgdpch, Penn World Tables 6.2). In a number of regressions the dependent variable is the annual growth rate. In others, it is the average, either over the entire sample period 1980 to 2003, or over the following non-overlapping periods: 1980-84, 1985-89, 1990-94, 1995-99, and 2000-03.
	<i>Explanatory Variables</i>
Current Account	Expressed as a percent of GDP (series BCA, <i>World Economic Outlook</i> ). In our regressions the current account appears as an average per country, either over the entire sample period or from 1980-84, 1985-89, 1990-94, 1995-99, and 2000-03.
Ethnic Fractionalization	Computed as one minus the Herfindahl index of ethnolinguistic group share, reflecting the probability that two randomly selected individuals from a population belonged to different groups (Alesina, Devleeschauwer, Easterly, Kurlat and Wacziarg, 2003).
Financial Development	Private credit as a percent of GDP intermediated through the financial sector (World Bank, <i>Financial Structure Database</i> ).
Financial Integration	Sum of stocks of (the absolute value of) external assets plus external liabilities as a percentage of GDP (Lane and Milesi-Ferretti, 2007).
Fiscal Balance	General government balance expressed as a percent of GDP (series GGB, <i>World Economic Outlook</i> ). Due to the paucity of these data, this variable appears only in our cross-country regressions as an average for the entire sample period.
Foreign Aid	Net official development assistance, (series DT.ODA.ALLD.CD, <i>World Development Indicators</i> , 2008). In our regressions, we take the average of this variable, either over the entire sample period, or over the following periods: 1980-84, 1985-89, 1990-94, 1995-99, and 2000-03.
Government Type	Calculated as the difference between democracy and autocracy scores (Polity IV project).
Institutional Quality	A measure of government anti-diversion policies (Hall and Jones, 1999), which, following Knack and Keefer (1995), is constructed as an average of five ICRG variables that reflect the security of private property and the enforceability of contracts: "Corruption in Government," the "Rule of Law," "Expropriation Risk," "Repudiation of Contracts by Government," and "Quality of the Bureaucracy." This variable is measured for each country around 1985.
Initial Income	Log of real per capita GDP adjusted for differences in purchasing power (series rgdpl, Penn World Tables 6.2). In our regressions this variable is either the 1980 value, or the initial value in each of the following periods: 1980-84, 1985-89, 1990-94, 1995-99, and 2000-03.

Life Expectancy	Measured in years (series SP.DYN.LE00.IN, <i>World Development Indicators</i> , 2008). In our regressions it is either the 1980 value, or the initial period value in each of our five non-overlapping periods.
Land Area from Coast	The proportion of a country's total area within 100 km of the ocean or ocean navigable river (Gallup, Sachs and Mellinger, 1999).
Landlocked	Dummy for landlocked country (Gallup, Sachs and Mellinger, 1999).
Openness	Total volume of trade flows expressed as a percent of GDP (series NE.TRD.GNFS.ZS, <i>World Development Indicators</i> , 2008). In our regressions, we take the average of this variable, either over the entire sample period, or over following periods: 1980-84, 1985-89, 1990-94, 1995-99, and 2000-03.
Population	The logarithm of the initial population in 1980 (series SP.POP, <i>World Development Indicators</i> , 2008).
Population Growth	Population growth (series SP.POP.GROW, <i>World Development Indicators</i> , 2008). In our regressions, we take the average of this variable over the following periods: 1980-84, 1985-89, 1990-94, 1995-99, and 2000-03..
Private Capital	The sum of net direct investment, net portfolio flows, and other net private capital flows (series BFXP, <i>World Economic Outlook</i> ). Because of data limitations "other private capital flows, net" are calculated by subtracting liabilities to official creditors from total other investment. As such, these data <i>may</i> include <i>some</i> official investment. In our regressions, we take the average of this variable over the following periods: 1980-84, 1985-89, 1990-94, 1995-99, and 2000-03.
Primary Commodities Price Indexes	Oil, metals, and agricultural products price indices, converted to relative prices using the US PPI (Burnside and Tabova, 2010).
US Real GDP Growth	Calculated as the log difference of US real GDP per capita in constant 2000 dollars ( $\times 100$ ) (Burnside and Tabova, 2010).
US Real Interest Rates	Difference between the 3 month T-bill rate and the rate of inflation of the US producer price index (Burnside and Tabova, 2010).
US Excess Returns	Excess return on the US stock market (Burnside and Tabova, 2010, original source: <a href="http://mba.tuck.dartmouth.edu/pages/faculty/ken.french/data_library.html">http://mba.tuck.dartmouth.edu/pages/faculty/ken.french/data_library.html</a> ).
Volatility of Terms of Trade	The standard deviation from 1980 to 2003 of the log difference in net terms of trade ( $\times 100$ ) (series TT.PRI.MRCH.XD.WD, <i>World Development Indicators</i> , some gaps filled using data from <i>International Financial Statistics</i> ).
War	Dummy for whether a country had an external war between 1960 and 1985 (Gallup, Sachs and Mellinger, 1999).

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**Table A.2. List of Countries: Main Sample**

<b>61 Country Sample</b>	
<b>East Asia and the Pacific</b>	<b>Middle East and North Africa</b>
China	Algeria
Fiji	Egypt
Hong Kong	Iran
Indonesia	Israel
Korea	Malta
Malaysia	Morocco
Philippines	Oman
Thailand	Saudi Arabia
<b>East and Central Europe</b>	Syria
Hungary	Tunisia
Poland	<b>South Asia</b>
Romania	India
Turkey	Pakistan
<b>Latin America and the Caribbean</b>	Sri Lanka
Argentina	<b>Sub-Saharan Africa</b>
Bahamas	Botswana
Barbados	Cameroon
Bolivia	Republic of Congo
Brazil	Cote d' Ivoire
Chile	Ethiopia
Colombia	Ghana
Costa Rica	Kenya
Dominican Republic	Mauritius
El Salvador	Namibia
Guatemala	Nigeria
Haiti	South Africa
Honduras	Swaziland
Jamaica	Zimbabwe
Mexico	<b>Western Europe</b>
Panama	Cyprus
Paraguay	
Peru	
Suriname	
Trinidad & Tobago	
Uruguay	
Venezuela	



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**Table 1. Cross-Country Current Account-Growth Relationship in Developing Countries**

Dependent Variable: Average of Annual Growth Rates 1970/1980 to 2000/2003; Annual Growth Rates 1980 to 2003						
	OLS				Maximum Likelihood	
	Prasad et. al. (2006)	Replicating Prasad et. al. (2006)	Dropping Aid Dependent Countries	Dependent Variable is Annual Growth Rate	Ramey and Ramey (1995)	Ramey and Ramey (1995) excluding volatility
	(1-1)	(1-2)	(1-3)	(1-4)	(1-5)	(1-6)
Current Account Balance	0.098 (2.13)	0.060 (1.45)	0.012 (0.13)	0.012 (0.15)	-0.013 (-0.14)	-0.027 (-0.27)
Initial Income	-1.257 (-6.19)	-1.584 (-4.22)	-1.782 (-3.72)	-1.782 (-4.77)	-2.248 (-4.79)	-2.168 (-4.07)
Initial Life Expectancy	0.032 (1.33)	0.138 (3.56)	0.111 (2.32)	0.111 (2.91)	0.091 (2.16)	0.082 (2.24)
Openness	1.879 (2.90)	0.005 (1.30)	0.008 (1.84)	0.008 (2.23)	0.013 (4.54)	0.013 (5.90)
Institutional Quality	4.252 (2.77)	5.084 (2.99)	6.745 (3.58)	6.745 (4.07)	7.644 (4.68)	7.666 (4.36)
Fiscal Balance	0.023 (0.52)	0.066 (0.89)	0.043 (0.56)	0.043 (0.65)	-0.012 (-0.17)	-0.043 (-0.65)
Volatility					-0.24 (-1.85)	
Number of Countries	60	87	61	61	61	61
Number of Observations	60	87	61	1464	1464	1464

Notes: In column 1, which reproduces the results reported in Prasad et. al. (2006), the dependent variable is the average real per capita GDP growth rate from 1970 to 2000. The current account and fiscal balance, are averages over the same period. Life expectancy, income and openness—the Sachs and Warner dummy—are measured in 1970 (or the earliest available date), and institutional quality, which is taken from Hall and Jones (1999), is measured around 1985. In regressions 2 to 6, the sample period is from 1980 to 2003 and openness is measured using the average trade volumes (relative to GDP) over this sample period. In columns 2 to 3 the dependent variable continues to be the average growth rate of real GDP per-capita although the sample period is now from 1980 to 2003. The regressions in columns 4 to 6 are based on a pooled panel of observations. The dependent variable in these cases is the annual growth rate of real GDP from 1980 to 2003 for each country in our sample however the covariates continue be sample-period averages and initial period-values of our controls. The numbers in parentheses below the coefficients are t-statistics. In columns 1 to 3 these t-statistics are based on robust standard errors. In columns 4 to 6, we make allowance for within country cluster dependence, by adjusting the standard errors using the Rogers (1993) approach. In columns 5 to 6, estimation is by maximum likelihood.

**Table 2. Current Account-Growth Relationship in Developing Countries: Weighted Regressions**

Dependent Variable: Average of Annual Growth Rates 1970/1980 to 2000/2003; Annual Growth Rates 1980 to 2003				
	Maximum Likelihood			
	Explanatory Variables: 24-Year Averages and Initial Values	Explanatory Variables: Five-Year Averages and Initial Values, Except Institutional Quality and Fiscal Balance		
	(2-1)	(2-2)	(2-3)	(2-4)
Current Account Balance	-0.082 -(1.66)	-0.068 -(1.99)	-0.070 -(2.01)	-0.091 -(3.38)
Initial Income	-1.763 -(3.22)	-2.186 -(3.45)	-1.986 -(2.70)	-2.247 -(2.88)
Initial Life Expectancy	0.068 (1.83)	0.127 (3.37)	0.115 (2.30)	0.126 (2.45)
Openness	0.013 (5.47)	0.014 (5.39)	0.015 (4.89)	0.153 (5.42)
Institutional Quality	7.882 (4.83)	9.613 (5.08)	9.741 (4.88)	10.510 (5.48)
Fiscal Balance	-0.062 -(1.14)		-0.069 -(1.34)	-0.730 -(1.46)
Number of Countries	61	61	61	61
Number of Observations	1464	1429	1429	1429

Notes: The regressions are based on a pooled panel of observations. The dependent variable in each case is the annual growth rate of real GDP from 1980 to 2003 for each country in our sample however the covariates are sample-period averages and initial period-values of our controls. In regression (1), averages are taken over the entire sample period from 1980 to 2003, and initial values are measured in 1980. In the remainder of the regressions averages are taken over five- (and four-year) periods, while income and life expectancy are initial period values. In regression (2-4) we include time period dummies, although the coefficients are not reported here. The models are estimated using maximum likelihood, where the specification assumes that the volatility can vary across countries as well as within countries over five-year (and four-year) intervals. The numbers in parentheses below the coefficients are t-statistics corrected for cluster dependence.

**Table 3. Within and Between Country Variation in Volatility**

	Overall	Between	Within
Mean	4.43		
Standard Deviation	3.26	2.38	2.23
Minimum	0.27	1.24	-4.23
Maximum	25.65	13.99	17.17

Notes: The negative value for the minimum within volatility is not an error; the “within” is showing the variation of volatility within countries around the global mean.

**Table 4. Current Account, Growth and Volatility: Interactions**

Dependent Variable: Average Growth Rate, 1980 to 1984; 1985 to 1989; 1990 to 1994; 1995 to 2000; 2000 to 2003				
	(4-1)	(4-2)	(4-3)	(4-4)
Current Account Balance	-0.042	0.058	0.089	0.159
	-(0.82)	(0.86)	(1.07)	(1.75)
Volatility*Current Account Balance	0.010			
	(1.18)			
Low Volatility*Current Account Balance		-0.112		
		-(1.71)		
Medium Low Volatility*Current Account Balance			-0.151	
			-(1.77)	
Medium High Volatility*Current Account Balance				-0.234
				-(2.54)
Initial Income	-2.145	-2.183	-2.197	-2.259
	-(4.08)	-(4.25)	-(4.40)	-(4.22)
Initial Life Expectancy	0.130	0.138	0.128	0.126
	(2.83)	(3.14)	(3.04)	(3.03)
Openness	0.012	0.011	0.011	0.013
	(3.34)	(2.91)	(3.17)	(3.86)
Institutional Quality	8.570	8.859	8.732	8.604
	(4.23)	(4.44)	(4.15)	(4.10)
Fiscal Balance	0.068	0.074	0.102	0.097
	(0.88)	(0.99)	(1.35)	(1.16)
Volatility	-0.076			
	-(0.64)			
Low Volatility (< 2.54%)		0.600		
		(1.95)		
Medium Low Volatility (<3.86%)			0.896	
			(2.22)	
Medium High Volatility (<5.35%)				1.064
				(2.42)
Impact of current account in low /mid-low /mid-high regime		-0.053	-0.062	-0.075
		-(1.66)	-(1.83)	-(1.89)
Number of Countries	61	61	61	61
Number of Observations	298	298	298	298

Notes: In each case, the dependent variable is the *average* real GDP per capita growth rate over the following non-overlapping intervals: 1980-84, 1985-89, 1990-94, 1995-99, and 2000-03. Income and life expectancy are initial period values and openness is the period average. Fiscal balance however continues to be measured using an average for the entire sample period and institutional quality is measured around 1985. Our estimate of volatility was obtained from the regression reported in Table 2, column 4, where it was estimated jointly with the growth equation as a model parameter. Dummies for low, medium-low and medium-high volatility indicate whether volatility lies in the lowest 25<sup>th</sup> percentile, in the lowest 50<sup>th</sup> percentile or the lowest 75<sup>th</sup> percentile. In each specification, we include time period dummies, though the coefficients on these variables not reported. The numbers in parentheses below the coefficients are t-statistics corrected for cluster dependence. At the bottom of the table, in addition to the number of countries and sample size, we report the magnitude of the relationship between the current account and growth in each of the volatility regimes, along with the corresponding t-statistic.



Table 5. Threshold Effects

Dependent Variable: Average Growth Rate, 1980 to 1984; 1985 to 1989; 1990 to 1994; 1995 to 2000; 2000 to 2003						
	Low Regime $\sigma \leq$	High Regime $\sigma >$	Low Regime institutions $\leq$	High Regime institutions $>$	Low Regime income $\leq$	High Regime income $>$
	5.35	5.35	0.614	0.614	7.76	7.76
	(5-1)	(5-2)	(5-3)	(5-4)	(5-5)	(5-6)
Current Account Balance	-0.094	0.177	-0.029	0.115	0.189	-0.034
	-(2.86)	(2.07)	-(0.44)	(1.80)	(2.13)	-(0.75)
Initial Income	-2.299	-2.299	-2.175	-2.175	-2.211	-2.211
	-(6.10)	-(6.10)	-(5.86)	-(5.86)	-(5.80)	-(5.80)
Initial Life Expectancy	0.136	0.136	0.136	0.136	0.114	0.114
	(3.85)	(3.85)	(3.79)	(3.79)	(3.21)	(3.21)
Openness	0.013	0.013	0.011	0.011	0.012	0.012
	(3.76)	(3.76)	(3.03)	(3.03)	(3.66)	(3.66)
Institutional Quality	8.916	8.916	9.378	9.378	9.086	9.086
	(5.97)	(5.97)	(5.78)	(5.78)	(6.30)	(6.30)
Fiscal Balance	0.095	0.095	0.065	0.065	0.071	0.071
	(1.61)	(1.61)	(1.08)	(1.08)	(1.22)	(1.22)
Volatility	-0.052	-0.052	-0.135	-0.135	-0.099	-0.099
	-(0.43)	-(0.43)	-(1.18)	-(1.18)	-(0.87)	-(0.87)
Threshold	5.35		0.61		7.76	
95% confidence interval	(3.21, 6.96)		(0.24, 0.79)		(6.13, 10.34)	
p-value	(0.02)		(0.54)		(0.20)	
Number of observations	225	73	202	96	55	243
Number of countries	59	35	41	20	15	55
Joint R-square	0.26		0.23		0.24	

Notes: The dependent variable is the average growth rate over the following non-overlapping intervals: 1980-84, 1985-89, 1990-94, 1995-99, and 2000-03. Income and life expectancy are initial period values and openness is the period average. Fiscal balance however continues to be measured using an average for the entire sample period and institutional quality is measured around 1985. Our estimate of volatility was obtained from the regression reported in Table 2, column 4, where it was estimated jointly with the growth equation as a model parameter. All the specifications include time-period dummies (coefficients not reported). Threshold regressions were performed using a Gauss code adapted from Hansen (2000). In columns 1 and 2 the threshold variable is the volatility of growth, in columns 3 and 4 the threshold variable is the Hall and Jones (1999) institutions measure, in columns 5 and 6 the threshold variable is income. At the bottom of the table, we report in parentheses the p-values associated with Hansen's test of threshold significance, which were generated by bootstrap using 1000 replications. Also reported are the number of observations and countries that constitute each regime.

Table 6. Descriptive Statistics by Regime

Panel A											
		Growth	Current Account	Private Flows	Official Flows	Income	Life Expectancy	Trade Volume	Institutions	Fiscal Balance	Volatility
Low Volatility Regime		1.88	-1.85	1.64	2.14	8.54	66.35	71.75	0.58	-3.26	3.07
		(2.23)	(4.04)	(4.06)	(2.83)	(0.76)	(7.34)	(45.79)	(0.12)	(3.75)	(1.36)
High Volatility Regime		-0.10	-2.06	0.92	3.64	8.27	62.05	68.28	0.53	-4.90	8.61
		(4.64)	(6.38)	(4.61)	(3.98)	(0.86)	(8.49)	(39.97)	(0.12)	(4.64)	(3.82)
Panel B											
	Countries with	Growth	Current Account	Private Flows	Official Flows	Income	Life Expectancy	Trade Volume	Institutions	Fiscal Balance	Volatility
Full Sample	zero periods of high volatility	1.75	-2.22	1.92	2.21	8.64	66.54	72.32	0.57	-3.91	2.68
Low Volatility Regime		1.75	-2.22	1.92	2.21	8.64	66.54	72.32	0.57	-3.91	2.68
High Volatility Regime		NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
Full Sample	one period of high volatility	2.73	-1.44	1.24	1.34	8.54	69.46	84.50	0.61	-1.58	3.43
Low Volatility Regime		2.73	-1.44	1.56	2.14	8.54	69.46	84.50	0.61	-1.58	3.43
High Volatility Regime		0.53	-2.01	-0.04	2.19	8.61	69.07	87.95	0.61	-3.12	7.26
Full Sample	two periods of high volatility	-0.37	-1.36	1.15	1.74	8.44	61.69	67.23	0.55	-2.70	5.34
Low Volatility Regime		0.98	-2.18	1.76	1.69	8.41	61.74	61.98	0.56	-2.36	3.82
High Volatility Regime		-1.98	-0.26	0.31	1.79	8.48	61.61	73.46	0.54	-3.14	7.41
Full Sample	three periods of high volatility	0.88	-1.96	0.81	3.98	8.13	60.61	53.86	0.52	-2.57	6.32
Low Volatility Regime		1.17	-0.67	0.03	3.92	8.14	61.69	52.72	0.52	-1.18	3.63
High Volatility Regime		0.69	-2.82	1.32	4.02	8.12	59.89	54.63	0.52	-3.27	8.12
Full Sample	four/five periods of high volatility	-0.17	-2.33	1.54	6.08	8.03	59.69	81.88	0.45	-10.83	11.86
Low Volatility Regime*		-0.94	-5.64	1.64	5.88	8.44	66.45	117.62	0.39	-15.23	5.88
High Volatility Regime		-0.11	-2.10	1.53	6.09	8.00	59.20	79.33	0.46	-10.28	12.32

\* Only one observation available.

Notes: Observations are separated into low and high volatility regimes using a threshold value for the volatility of real GDP growth of 5.35 percent. This estimate of volatility was obtained from the regression reported in Table 2, column 4. Income and life expectancy are initial period values and openness is the period average. Fiscal balance however continues to be measured using an average for the entire sample period and institutional quality is measured around 1985.

**Table 7. Current Account-Growth Relationship in Countries By Incidence of High Volatility**

Dependent Variable: Annual Growth Rates 1980 to 2003												
	0 Periods High Volatility			0 or 1 Periods of High Volatility			0, 1, or 2 Periods of High Volatility			0, 1, 2, or 3 Periods of High Volatility		
	OLS	Maximum Likelihood		OLS	Maximum Likelihood		OLS	Maximum Likelihood		OLS	Maximum Likelihood	
	(7-1)	(7-2)	(7-3)	(7-4)	(7-5)	(7-6)	(7-7)	(7-8)	(7-9)	(7-10)	(7-11)	(7-12)
Current Account Balance	-0.099	-0.111	-0.097	0.001	-0.083	-0.095	-0.012	-0.087	-0.109	0.030	-0.072	-0.092
	(-2.01)	(-3.45)	(-2.60)	(0.02)	(-3.01)	(-3.52)	(-0.22)	(-2.66)	(-4.24)	(0.67)	(-2.11)	(-3.54)
Initial Income	-2.289	-2.578	-2.707	-1.801	-1.931	-2.193	-2.155	-2.062	-2.261	-2.076	-1.930	-2.188
	(-4.78)	(-5.41)	(-5.14)	(-2.53)	(-2.32)	(-2.75)	(-3.32)	(-2.74)	(-2.82)	(-3.89)	(-2.62)	(-2.80)
Initial Life Expectancy	0.091	0.084	0.116	0.087	0.071	0.094	0.132	0.114	0.128	0.127	0.107	0.118
	(2.97)	(2.87)	(4.31)	(2.09)	(1.14)	(2.01)	(2.80)	(2.10)	(2.63)	(2.96)	(2.01)	(2.26)
Openness	0.017	0.023	0.021	0.011	0.016	0.016	0.012	0.016	0.016	0.013	0.015	0.016
	(6.29)	(6.07)	(6.44)	(2.66)	(4.51)	(5.43)	(2.98)	(4.43)	(5.52)	(3.12)	(4.69)	(5.48)
Institutional Quality	9.716	11.771	11.591	9.470	10.342	10.995	9.290	9.871	10.435	8.850	9.639	10.462
	(5.79)	(19.00)	(10.60)	(3.71)	(6.76)	(7.27)	(3.83)	(5.02)	(5.77)	(4.50)	(4.73)	(5.66)
Fiscal Balance	-0.053	-0.078	-0.075	-0.011	-0.075	-0.068	0.004	-0.086	-0.091	0.048	-0.073	-0.076
	(-0.76)	(-1.41)	(-1.46)	(-0.14)	(-1.12)	(-1.07)	(0.06)	(-1.37)	(-1.49)	(0.63)	(-1.35)	(-1.50)
Number of Countries	26	26	26	41	41	41	48	48	48	58	58	58
Number of Observations	604	604	604	959	959	959	1117	1117	1117	1357	1357	1357

Notes: The dependent variable in each case is the annual growth rate of real GDP from 1980 to 2003 for each country in our sample however the covariates are sample-period averages and initial period-values of our controls. Income and life expectancy are initial period values and openness is the period average. Fiscal balance however continues to be measured using an average for the entire sample period and institutional quality is measured around 1985. Specifications (7-3), (7-6), (7-9), and (7-12) include time-period dummies (coefficients not reported). The numbers in parentheses below the coefficients are t-statistics where we make allowance for within country cluster dependence, by adjusting the standard errors using the Rogers (1993) approach. Each regression was estimated using maximum likelihood.

**Table 8. Panel Regressions**

Dependent Variable: Average Growth Rate, 1980 to 1984; 1985 to 1989; 1990 to 1994; 1995 to				
	Low Regime		High Regime	
	Fixed Effects	Arellano-Bover	Fixed Effects	Arellano-Bover
	(8-1)	(8-2)	(8-3)	(8-4)
Current Account	-0.112	-0.184	0.251	0.000
	-(2.99)	-(2.33)	(2.19)	(0.00)
Initial Income	-1.986	-0.871	-6.880	-6.247
	-(2.74)	-(1.03)	-(1.76)	-(2.08)
Initial Life Expectancy	0.051	0.097	0.342	0.638
	(0.95)	(1.02)	(1.47)	(4.74)
Openness	0.017	0.029	0.041	-0.052
	(2.76)	(3.66)	(0.80)	-(1.45)
Number of Countries	59	59	35	35
Number of Observations	225	225	73	73
First order serial correlation		(0.00)		(0.29)
Second order serial correlation		(0.77)		(0.18)
Sargan test		(0.23)		(0.98)
Number of Instruments		41		27

Notes: The dependent variable is the average growth rate over the following non-overlapping intervals: 1980-84, 1985-89, 1990-94, 1995-99, and 2000-03. Income and life expectancy are initial period values and openness is the period average. Each specification also includes time dummies (coefficients not reported). The low regime includes all observations for which volatility of growth was less than or equal to 5.35 percent; the high volatility regime includes all observations for which volatility exceeded this figure. The numbers in parentheses below the coefficients are robust t-statistics.

**Table 9. Breakdown by Type of Flow**

Dependent Variable: Average Growth Rate, 1980 to 1984; 1985 to 1989; 1990 to 1994; 1995 to 2000; 2000 to 2003								
	Low Regime				High Regime			
	Fixed Effects	Arellano-Bover	Fixed Effects	Arellano-Bover	Fixed Effects	Arellano-Bover	Fixed Effects	Arellano-Bover
	(9-1)	(9-2)	(9-3)	(9-4)	(9-5)	(9-6)	(9-7)	(9-8)
Private Flows	0.098	0.242	0.064	0.144	0.193	0.166	0.003	-0.007
	(2.54)	(2.76)	(1.63)	(2.29)	(0.98)	(1.55)	(0.02)	-(0.05)
Foreign Aid	-0.099	-0.113	-0.086	-0.072	-0.563	-0.210	-0.482	0.134
	-(1.09)	-(0.74)	-(0.96)	-(0.67)	-(1.68)	-(0.64)	-(1.15)	(0.48)
Initial Income	-2.000	-0.413	-3.044	-1.593	-6.037	-8.258	-1.671	-7.110
	-(2.66)	-(0.53)	-(2.83)	-(2.82)	-(1.53)	-(3.77)	-(0.37)	-(6.48)
Initial Life Expectancy	0.044	0.011	0.027	0.085	0.333	0.618	0.525	0.690
	(0.78)	(0.16)	(0.48)	(1.80)	(1.26)	(6.80)	(1.95)	(5.55)
Openness	0.016	0.030	0.007	0.011	0.037	-0.085	0.096	0.025
	(2.45)	(2.86)	(0.92)	(2.02)	(0.73)	-(2.73)	(1.70)	(1.19)
Population Growth			0.408	-1.066			-2.921	-1.696
			(1.26)	-(2.64)			-(1.75)	-(1.90)
Financial Development			0.008	0.024			-0.041	0.015
			(0.70)	(2.87)			-(0.36)	(0.21)
Financial Integration			-0.004	-0.001			0.008	-0.027
			-(1.48)	-(0.52)			(0.26)	-(2.40)
Number of Countries	58	58	54	54	35	35	32	32
Number of Observations	216	216	194	194	73	73	64	64
R-squared (within)	(0.20)		(0.24)		(0.35)		(0.42)	
First order serial correlation		(0.00)		(0.00)		(0.34)		(0.63)
Second order serial correlation		(0.85)		(0.17)		(0.21)		(0.19)
Hansen test		(0.57)		(1.00)		(1.00)		(1.00)
Number of Instruments		50		77		29		29

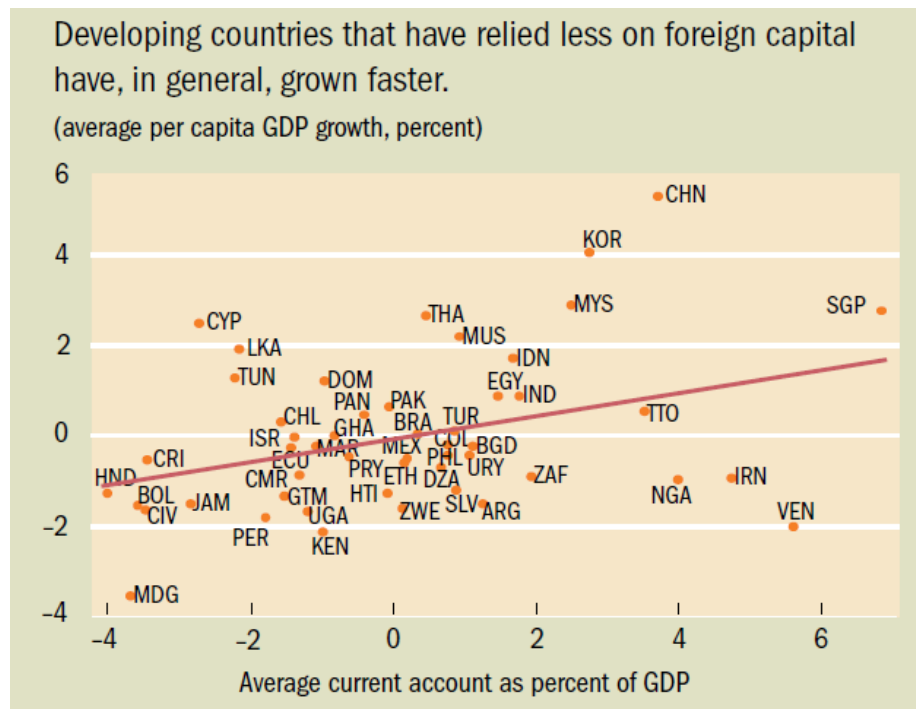
Notes: The dependent variable is the average growth rate over the following non-overlapping intervals: 1980-84, 1985-89, 1990-94, 1995-99, and 2000-03. Income and life expectancy are initial period values. Flows, openness, population growth, financial development and financial integration are period averages. Each specification also includes time dummies (coefficients not reported). The low regime includes all observations for which volatility of growth was less than or equal to 5.35 percent; the high volatility regime includes all observations for which volatility exceeded this figure. The numbers in parentheses below the coefficients are robust t-statistics. In the bottom of the table the numbers in parentheses are p-values.

**Table 10. Determinants of Volatility**

	Dependent Variable: Volatility 1980 to 2003			Dependent Variable: Volatility Five		
	(1)	(2)	(3)	(4)	(5)	(6)
Standard Deviation of Predicted Growth	1.469 (7.92)		1.128 (6.79)	1.024 (10.46)	1.009 (9.39)	1.036 (8.73)
Initial Population		-0.416 (-2.15)	-0.103 (-1.03)			
Percent of Land Area 100 km from Coast		-0.117 (-2.66)	-0.044 (-1.87)			
Percent of Land Area 100 km from Coast <sup>2</sup>		0.001 (2.69)	0.000 (1.70)			
Landlock		-1.012 (-0.96)	-0.002 (0.00)			
Volatility of Terms of Trade		0.056 (0.97)	0.031 (0.83)			
War		-7.006 (-3.35)	-2.738 (-2.10)			
Ethnic Fractionalization		-0.004 (-0.29)	0.006 (0.69)			
Ethnic Fractionalization*War		0.126 (3.14)	0.047 (1.64)			
Institutional Quality		1.277 (0.51)	-0.735 (-0.44)			
Government type		-0.103 (-2.19)	-0.054 (-1.78)			
Current Account					-0.061 (-0.93)	
Private Flows						-0.029 (-0.64)
Official Flows						0.031 (0.30)
Number of observations	61	53	53	298	298	266
Number of Countries	61	53	53	61	61	54
R-squared within				0.25	0.26	0.26
R-squared between				0.74	0.73	0.73
R-squared	0.76	0.45	0.81	0.50	0.50	0.50

Notes: In columns 1 to 3 the dependent variable is an estimate of the volatility of growth between 1980 and 2004 obtained from Table 1, column 6. Population, institutional quality and government type are 1980 values. The volatility of terms of trade is the standard deviation of terms of trade shocks between 1980 and 2003. All other variables are country-specific. In columns 4 to 8, the dependent variable is our estimate of volatility over the following non-overlapping intervals: 1980-84, 1985-89, 1990-94, 1995-99, and 2000-03. The current account deficit and private and official flows are averages over the same periods. The specifications in columns (4) to (8) include time dummies (coefficients not reported). The numbers in parentheses below the coefficients are t-statistics where we make allowance for within country cluster dependence, by adjusting the standard errors using the Rogers (1993) approach.

Figure 1: The Paradox of Capital

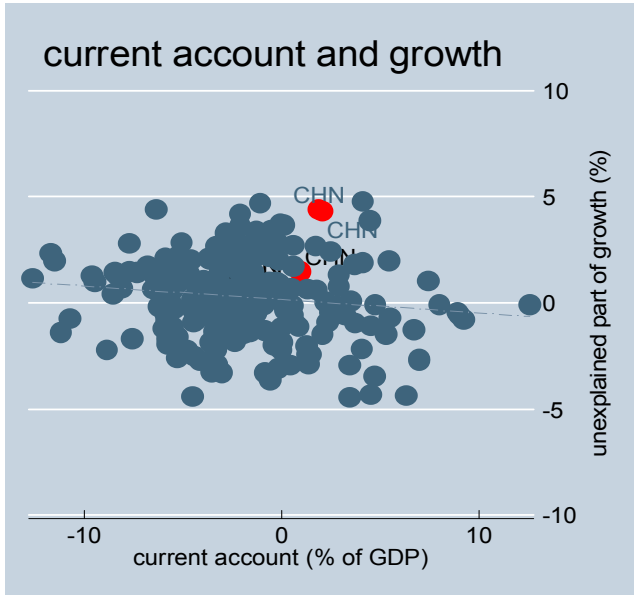


Source: Prasad, Rajan, and Subramaniam (2007).

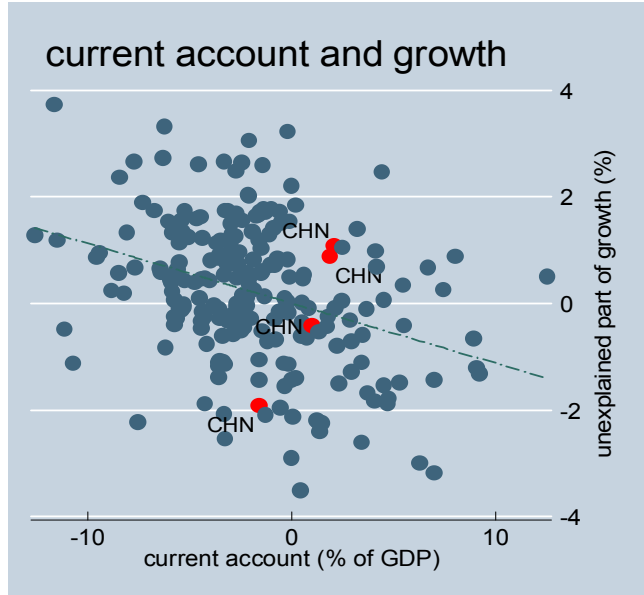
Figure 2: Current Account and Growth: Volatility Regimes

Low Volatility Regime

Cross-Sectional Regression



Fixed Effects Regression



High Volatility Regime

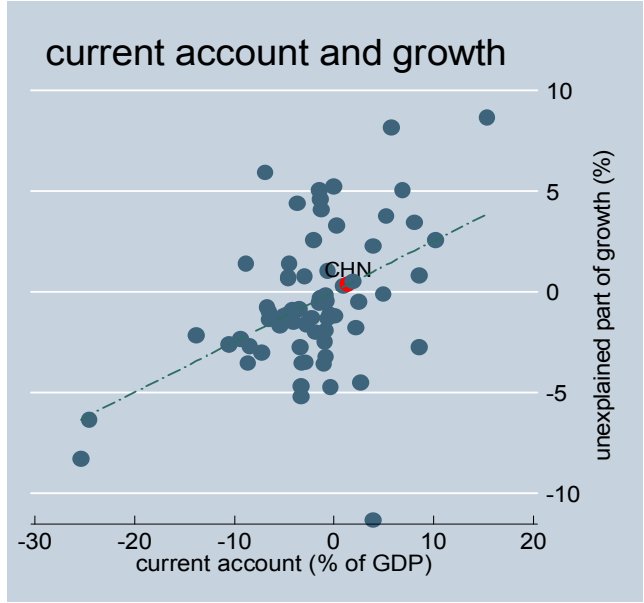
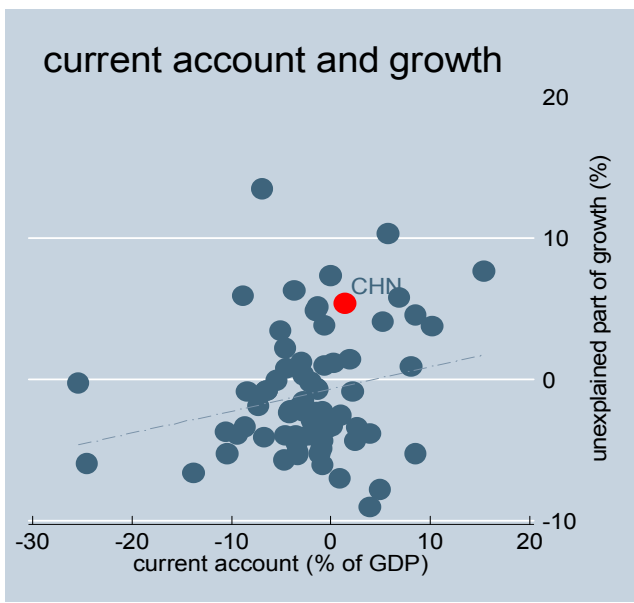
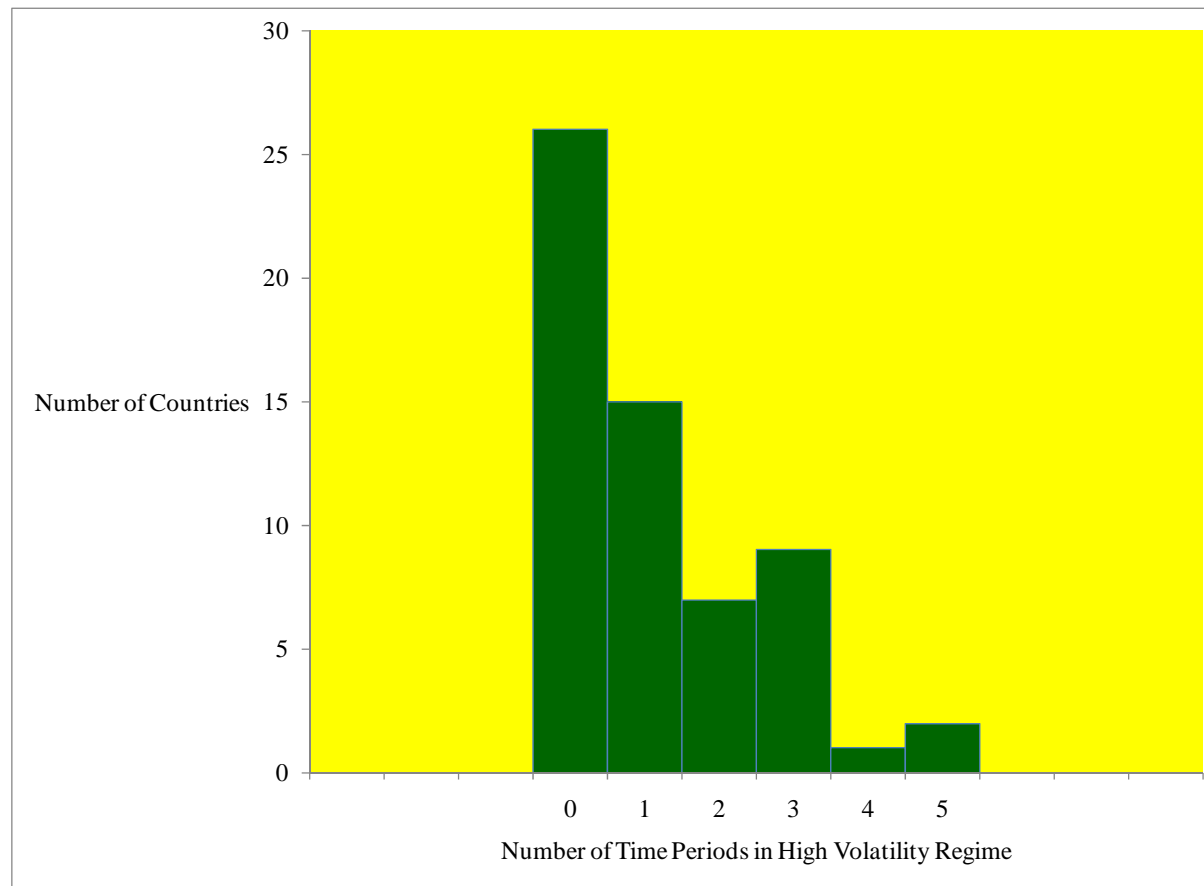




Figure 3. A: Histogram of the Number of Times Countries Experienced High Growth Volatility



**Figure 3. B: Histogram of the Number of Times Countries Experienced High Growth Volatility by Time Period**

