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DOES OPENNESS IMPLY GREATER VULNERABILITY?

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Resumen

Este artículo evalúa empíricamente la vulnerabilidad externa mediante métodos de datos de panel para una muestra de países de todo el mundo. Controlando por las condiciones internas, se analizan los efectos en la volatilidad del crecimiento asociados a medidas de apertura comercial y financiera, así como a cuatro tipos de shocks externos: variaciones de los términos de intercambio, las tasas de crecimiento de los socios comerciales, variaciones de las tasas de interés y entrada neta de capitales regionales. El documento analiza la posibilidad de no linealidades permitiendo que los efectos de la apertura sobre la volatilidad del crecimiento varíen con el nivel de desarrollo económico, y permitiendo que los efectos de los shocks externos dependan del grado de integración comercial y financiera. Los resultados de la integración internacional son mixtos: mientras la apertura comercial tiende a aumentar la volatilidad del crecimiento, la apertura financiera la reduce directa e indirectamente pues aminora los efectos de los shocks externos.

Abstract

This paper provides an empirical evaluation of external vulnerability using panel data methods for a worldwide sample of countries. Controlling for domestic conditions, the paper examines the growth volatility effects of outcome measures of trade and financial openness as well as four types of foreign shocks: terms of trade changes, trading partners' growth rates, international real interest rate changes, and net regional capital inflows. The paper analyzes the possibility of non-linearities by allowing the growth volatility effects of openness to vary with the general level of economic development and by letting the effects of foreign shocks depend on the degree of trade and financial integration. The results are mixed regarding international integration: while trade opening tends to increase growth volatility, financial opening reduces volatility directly and indirectly by dampening the effects of external shocks.

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I. Introduction

A key economic development of recent times is the trend toward larger financial and trade openness observed in most industrial and developing economies. Financial openness has increased from a world median of 5% of GDP in 1970 to 45% of GDP in 2000 and trade openness has grown from a world median of 44% of GDP in 1970 to 70% of GDP in 2000 (see Figure 1 for annual data and definitions).

More openness implies higher integration of world goods and capital markets, contributing to potential gains in growth and welfare. However, more international integration could also lead to heightened external exposure, measured by the sensitivity of economic growth volatility to openness and foreign shocks. This vulnerability may be particularly important in poor countries, due to their production specialization, non-diversified sources of income, unstable policies, incomplete financial markets, and/or weak institutions.

A growing empirical literature is addressing the links between openness and macroeconomic performance, uncovering complex relationships but offering only partial perspectives on them. This paper attempts to contribute to this literature by providing a systematic empirical analysis of the relationship between financial and trade openness, financial- and trade-related foreign shocks, and macroeconomic volatility. It does so by analyzing the experience of a large sample of developed and developing countries in the decades spanning 1970-2000.

The plan of the paper is the following. Section II provides a comprehensive review of the relevant literature. Section III presents the empirical contribution of the paper, including its methodology, worldwide data sample, and panel-data regression results. In this section we report first the simple linear effects of measures of trade and financial openness as well as four types of foreign shocks: terms of trade changes, trading partners' growth rates, foreign real interest rate changes, and net regional capital inflows. Second, we analyze empirically the possibility of non-linearities by allowing for quadratic effects of trade and financial openness. Third, we continue the analysis of non-linearities by assessing the dependence of the effects of trade and financial openness on the level of per capita income. And fourth, we measure the amplification or dampening of the effects of

external shocks depending on the degree of trade and financial openness. Section IV concludes.

II. Review of the Empirical Literature

In this section we proceed to review briefly the analytical underpinnings and existing empirical results on the core relations that are the focus of this paper: those between financial openness, trade openness, foreign shocks, and GDP growth volatility.

A. Financial Openness, Trade Openness, and Growth Volatility

Easterly, Islam, and Stiglitz (2000) explore the sources of GDP growth volatility in industrial and developing countries (Table 2). They find that higher TO leads to larger growth volatility, especially in developing countries. However they do not find a significant impact of FO on output volatility. O'Donnell (2001) finds that larger FO is associated with lower (higher) output volatility in OECD (non-OECD) countries. His results also suggest that countries with more developed financial sectors are able to reduce output volatility through financial integration.

Kose et al. (2003) reports that none of four FO and TO measures has any robust effect on GDP volatility. However terms of trade volatility, financial depth, and M2 volatility raise output volatility in the world. Bekaert et al. (2004) provide cross-section and time-series evidence of the relationship between FO and GDP growth volatility. Using two indicators of capital account openness, they find considerable evidence of lower GDP volatility after capital account liberalization in the world sample, with somewhat weaker results for developing countries.

Cavallo (2005) presents evidence that suggests that TO lowers output volatility in net terms. According to the author, this is due to two countervailing effects. Larger TO raises growth volatility through the terms-of-trade channel but this is more than offset by the finding that TO lowers growth volatility due to lower financial vulnerability to external shocks, sudden stops, and currency crashes.

Finally, regarding the influence of openness on the effect of growth volatility on growth levels, we mentioned above the result by Kose et al. (2005) that both FO and TO

turn the latter negative effect into a positive one. Hnatkovska and Loayza (2004), however, reject an ameliorating influence of TO on the negative volatility-growth effect.

B. Foreign Shocks and Growth Volatility

Foreign shocks – measured as deviation of a foreign variable from its trend or average level, or as the standard deviation of the variable – have been shown to be significant in determining business-cycle fluctuations of GDP or GDP volatility.

Kose (2002) evaluates the importance of fluctuations in world prices —fluctuations in the prices of primary, capital, and intermediate goods, and in the world interest rate— in driving business cycle fluctuations in small open developing countries (Table 2). He finds that roughly 88% of aggregate output fluctuations can be explained by world price shocks. Rodrik (2001) shows that GNP volatility in Latin America and the Caribbean is driven by both external shocks and domestic policy failures – with the terms of trade and capital flows as key contributors on the external front.

Mendoza (1995) was among the first attempts to evaluate the quantitative importance of terms of trade shocks in explaining business cycles, using a stochastic dynamic small open economy model. He found that terms of trade disturbances explain 56% of output variation.

Early research found that world interest rates do not have a significant role in explaining the dynamics of small open economies, including output fluctuations (Mendoza, 1991, Correia et al. 1992, 1995, Schmitt-Grohe 1998). However, using a dynamic stochastic small open economy model, Blankenau et al. (2001) find that world real interest rate shocks explain 33% of Canada's output variation. The above mentioned research by Kose (2002) finds that world interest rate shocks account for roughly 1% of output volatility in developing countries. Neumeyer and Perri (2004) report large effects of country risk fluctuations and small effects of world interest rate fluctuations on the high volatility of output in emerging economies.

Finally, Rodrik (2001) suggests that the instability of private capital flows has been the most important determinant of macroeconomic volatility in Latin America and the Caribbean during the 1990s. Together with per capita income, capital flow volatility

accounts for close to half of the cross-national variation in GNP volatility in the region during the 1990s, compared to 20% in the 1980s.

III. Empirical Analysis

Our empirical analysis consists of explaining the volatility of economic growth as a function of international openness, external shocks, and domestic conditions. The objective is, first, to study the simple effects of trade and financial openness as well as of various external shocks; second, to examine how the effects of trade and financial openness vary with the level of per capita income; and third, to consider whether the effects of external shocks are amplified or reduced by the degree of trade and financial openness. By conducting these exercises, we aim to provide a comprehensive empirical assessment of openness and external conditions for macroeconomic volatility.

Sample and Methodology

We work with a pooled data set of cross-country and time-series observations. It consists of 76 countries and, for each of them, at most 6 non-overlapping five-year periods spanning the 1970-2000 period. See Appendix 1 for the list of countries in the sample. Appendix 2 provides full definitions and sources of all variables used in the paper, and Appendix 3 presents basic descriptive statistics for the data used in the growth volatility regressions.

We use an estimation method that is suited to panel data, deals with static or dynamic regression specifications, controls for unobserved time- and country-specific effects, and accounts for some endogeneity in the explanatory variables. This is the generalized method of moments (GMM) for dynamic models of panel data developed by Arellano and Bond (1991) and Arellano and Bover (1995).

The general regression equation to be estimated is the following

$$y_{i,t} = \beta' X_{i,t} + \mu_t + \eta_i + \varepsilon_{i,t} \tag{1}$$

where the subscripts i,t represent country and time period, respectively. y is the dependent variable of interest, that is, growth volatility. X is a set of time- and country-varying explanatory variables, including proxies of trade and financial openness, measures of various external shocks, interaction terms, and control variables. Finally, μ_t is an unobserved time-specific effect, η_i is an unobserved country-specific effect, and ε_{it} is the error term.

The method deals with unobserved time effects through the inclusion of period-specific intercepts. Dealing with unobserved country effects cannot follow the same procedure given that the model may contain endogenous explanatory variables. To be precise, we relax the assumption of strong exogeneity of the explanatory variables by allowing them to be correlated with current and previous realizations of the error term ε . Unobserved country effects are controlled for by time differencing. Then, the method relies on time-precedence instrumentation to control for joint endogeneity. Specifically, parameter identification is achieved by assuming that future realizations of the error term do not affect current values of the explanatory variables, that the error term ε is serially uncorrelated, and that *changes* in the explanatory variables are uncorrelated with the unobserved country-specific effect. As Arellano and Bond (1991) and Arellano and Bover (1995) show, this set of assumptions generates moment conditions that allow estimation of the parameters of interest. The instruments corresponding to these moment conditions are appropriately lagged values of both levels and differences of the explanatory variables. Since typically the moment conditions over-identify the regression model, they also allow for specification testing through a Sargan-type test.

Growth volatility, the dependent variable, is measured as the standard deviation of annual real per capita GDP growth, calculated over each 5-year period. The control variables represent some of the main sources of domestically induced volatility and are calculated over the same periods. They are the standard deviation of annual inflation, an average index of real exchange rate overvaluation, and the average number of years under systemic banking crisis. The volatility regression equation also allows for both unobserved time-specific and country-specific effects.

The explanatory variables of interest are measures of openness and external shocks. Given that we want to evaluate the effects of the economy's actual contact with

international markets, we work with *outcome* measures of trade and financial openness. These measures are related to policies but are also the result of structural characteristics of the economy, such as size, natural and social endowments, and public infrastructure. The outcome measures we use are the ratio of exports and imports to GDP in the case of trade, and the ratio of portfolio and FDI liabilities to GDP in the case of financial openness.

We consider four types of external shocks; the first two primarily related to trade in goods and the latter two mainly related to financial transactions. All of them are defined so that they can be considered as exogenous to the country in question. In order to match the measure of the dependent variable (the *volatility* of GDP growth), the relevant measure related to each external shock is given by its volatility. For this reason, we use the *standard deviation* of each external shock as the measure of interest. Specifically, they are the standard deviation of terms-of-trade growth, the standard deviation of weighted output growth rate of trade partners, the standard deviation of the amount of capital flows to the region where the country is located, and the standard deviation of the change in the international interest rate. Whereas the first two variables vary by country and time period, the third varies only by *region* and period, and the fourth varies only by time period.

Simple Effects of Openness and External Shocks

In the basic case, the effects of openness and shocks on growth volatility are independent from each other and independent from other characteristics of the economy. The regression equation we estimate in this case is the following,

$$y_{i,t} = \beta_0' CV_{i,t} + \beta_1' OPE_{i,t} + \beta_2' EXT_{i,t} + \mu_t + \eta_i + \varepsilon_{i,t} \quad (2)$$

Where, *CV* is the set of control variables, *OPE* is the set of openness variables, and *EXT* is the set of foreign-shock variables. We also consider the possibility of quadratic effects by the openness measures,

$$y_{i,t} = \beta_0' CV_{i,t} + \beta_1' OPE_{i,t} + \beta_2' OPE_{i,t}^2 + \beta_3' EXT_{i,t} + \mu_t + \eta_i + \varepsilon_{i,t} \quad (3)$$

The estimation results are presented in Table 1. In the first column, we consider only linear effects. We find that whereas an increase in financial openness tends to reduce growth volatility, larger trade openness increases it. A possible explanation for these contrasting results is that financial openness may promote production diversification (which would lead to lower GDP volatility), while trade openness, at least initially, may induce production concentration and specialization (through comparative advantage).

In column three, we consider quadratic effects of trade and financial openness. In both cases, the linear terms carry negative coefficients and the quadratic terms, positive ones. How is this consistent with the linear results? Figure 2 helps elucidate the issue. For both trade and financial openness, higher levels are associated with larger volatility effects. However, in the case of financial integration, the effect on growth volatility remains negative, even at its highest levels; whereas for trade openness, the effect on volatility goes from negative to positive in the middle of the distribution (and is positive in average).

The effects of external shocks on growth volatility are all significant and similar to each other. Thus, we find that an increase in the volatility of terms of trade changes, of the growth rate of trade partners, of capital flows to the region, and of international real interest rates produce a statistically significant increase in the volatility of economic growth. As expected, then, countries facing a more volatile external environment would, on this account, undergo higher volatility.

All control variables carry positive and significant coefficients, as expected. The Sargan and serial-correlation specification tests do not reject the null hypothesis of correct specification, lending support to our estimation results. This is also the case in all remaining volatility regressions presented below.

The Effect of Openness Depending on the Level of Income

Increasingly there is the notion that the effect of openness may not be homogeneous across countries. Indeed, in part motivated by the work of Klein and Olivei (2000) in the case of financial openness, researchers have lately considered the possibility that the effect of opening the economy may depend on country characteristics such as income and institutional quality (see Edwards 2001 and Klein 2003). In the framework of our panel-data methodology, we now reassess this possibility by allowing the volatility effect of each

measure of openness to vary with the level of real per capita GDP, which serves as a proxy for overall development. We do this by interacting each openness measure with linear and quadratic per capita GDP (*Inc*) in each country at the start of the corresponding period. The regression equation we estimate in this case is the following,

$$y_{i,t} = \beta_0' CV_{i,t} + \beta_1' OPE_{i,t} + \beta_2' EXT_{i,t} + \beta_3' OPE_{i,t} * Inc_{i,t} + \beta_4' OPE_{i,t} * Inc_{i,t}^2 + \mu_t + \eta_i + \varepsilon_{i,t} \quad (4)$$

The estimation results are presented in Table 2. We consider the interaction between per capita GDP and the financial and trade openness variables one at a time; we do this in order to both simplify the interpretation of the results and do not overextend the parameter requirements on the data. Thus, column 1 shows the results when financial openness is interacted with income, and column 2, when trade openness is interacted with income. There is a remarkable degree of similarity in the pattern of coefficients related to financial and trade openness indicators (but not so in the total effect, as discussed below). The coefficient on the corresponding measure of openness by itself is negative, and the coefficients on the linear and quadratic interaction terms are positive and negative, respectively. All the interaction terms are statistically significant. Their coefficients indicate that the volatility effect of a change in both types of openness varies convexly with income.

The total volatility effect of a change in openness can be positive or negative depending on the size of the coefficients, and in this regard the effect of financial openness is different from that of trade openness. To illustrate this, Figure 3 shows what the estimated pattern of coefficients implies for the change in growth volatility produced by an increase in each openness measure. Specifically, Figure 3 plots the volatility effect of a one-standard-deviation increase in openness as a function of per capita GDP for the full range of the sample. Correspondingly, the volatility effect is measured in terms of standard deviations of growth volatility in the sample.

As Figure 3 shows, our coefficient estimates indicate contrasting results of trade and financial openness. Whereas trade openness has a positive and stable effect on growth volatility along the per capita GDP distribution, financial openness has a negative and rapidly declining effect on volatility for middle and high per capita GDP countries.

Regarding the size of the volatility effect, the beneficial impact of financial opening is larger than the detrimental effect of trade opening. This is important to keep in mind when financial and trade opening are undertaken together and their joint effects on vulnerability are considered.

Figure 3 (a) shows that a rise in trade openness leads to an increase in volatility at all levels of national income. Poorest countries are the most vulnerable to the volatility inducing impact of trade openness. This effect decreases gradually as national income rises. For instance, a one-standard-deviation increase in the degree of trade openness would lead to higher volatility by: (a) 0.14 standard deviations of growth volatility for country observations at the 25th percentile of the sample distribution of output per capita during the 1970-2000 period (corresponding approximately to Zimbabwe in the mid 1990s), (b) 0.13 standard deviations for the median country in the sample (Tunisia around 1995), (c) 0.1 standard deviations for observations at the 75th percentile (Korea around 1995), and (d) 0.09 standard deviations for countries at the 95th percentile (Belgium around 1995).

Figure 3 (b) shows that a rise in financial openness leads to a decrease in volatility at all income levels. The volatility reducing effect of financial opening is smallest in low-income countries and increases in magnitude as we move to the right of the cross-country income distribution. For instance, a one-standard-deviation increase in the degree of financial openness will generate a decrease in growth volatility of 0.11 standard deviations for countries at the 25th percentile of the sample distribution of output per capita, 0.19 for the median country in the sample, 0.42 for countries at the 75th percentile, and 0.55 for countries at the 95th percentile of the world distribution of output per capita.

The Interaction between Openness and External Shocks

The previous exercises analyze the potential effect that openness can have on growth volatility, controlling for various external shocks. Here we focus on whether openness makes the economy more or less responsive to external shocks.

We address this question by considering interaction terms between each of the shocks and the openness variables. The regression equation we estimate in this case is the following,

$$y_{i,t} = \beta_0' CV_{i,t} + \beta_1' OPE_{i,t} + \beta_2' EXT_{i,t} + \beta_3' OPE_{i,t} * EXT_{i,t} + \mu_t + \eta_i + \varepsilon_{i,t} \quad (5)$$

There are a large number of possibilities for these interactions, but in order to avoid overextending the parameter requirements on the data, we consider the interactions between financial and trade openness indicators with the external shocks *one shock at a time*. This will also allow us to simulate the effect of each shock independently. The results are presented in Table 3, with each column devoted to the interactions with each of the four external shocks.

An interesting pattern of coefficients emerges. For the two “real” shocks -- related to terms of trade and foreign growth-- larger trade openness tends to magnify the effect of shock volatility on economic growth volatility, while larger financial openness tends to dampen this effect. The magnifying effect of trade openness is likely to be a size effect in the sense that a higher volume of trade implies a larger share of economic activities that the terms of trade and foreign growth can influence. The stabilizing effect of financial openness regarding real shocks may be the result of the production diversification that it induces. Loayza and Raddatz (2007) arrive to the same results using a different methodology, one based on semi-structural vector auto regressions.

For the two “financial” shocks --related to international interest rates and regional capital inflows--, trade and financial openness operate in the same direction. Increases in either trade or financial openness magnify the effect of the volatility of international interest rates, while both dampen the effect of the volatility of capital flows. There are here two issues that deserve attention. The first is why both types of openness interact similarly with financial shocks, and contrarily with regards to real shocks. A possible explanation is that in the case of financial shocks, trade and financial openness share the same mechanisms dealing with (the relaxation or tightening of) budget constraints. The second is why the interaction (of both types of openness) with interest rate shocks is the opposite as that with capital flow shocks.

Since the volatility effect of a shock now depends on three coefficients plus the levels of trade and financial openness, it is not immediately clear what the net effect is. Figures 4-7 help to make this assessment by graphing the growth volatility effect of one-

standard-deviation increase in each shock as a function of, first, trade openness (panel a) and, then, financial openness (panel b). Each figure corresponds to the effect of one of the four external shocks under consideration. As before, the volatility effect is measured in terms of standard deviations of growth volatility in the regression sample. When simulating the shock volatility effect as function of trade openness, we use the sample average of financial openness in the calculation of the partial effects; analogously, when simulating the effect as function of financial openness, the sample average of trade openness is used.

The last column of Table 3 considers the interaction between trade and financial openness and a composite external shock. This is a linear combination of the four external shocks, with weights given by their corresponding effect on growth volatility (taken from Table 1, column 1). Figure 8 (a) and (b) graph the volatility effect of this composite shock as a function of trade and financial openness, respectively. The volatility effect of the composite external shock is positive throughout the range of both types of openness, as expected. However, the volatility effect increases with trade openness while it decreases with financial openness. This contrasting result is consistent with the results on the interactions with individual shocks: trade openness has a magnifying impact for three of the four shocks, whereas financial openness has a dampening effect also in three of the four cases.

We can use the results regarding the composite external shock to draw some quantitative implications. First let's consider the volatility effects at various levels of trade openness and given the sample average level of financial openness (corresponding approximately to those of Kenya and India in the late 1990s). A one-standard-deviation increase in the volatility of the composite external shock would lead to an increase in growth volatility of 0.42 standard deviations for country observations at the 25th percentile of the sample distribution of trade openness (level of Niger in the late 1990s), 0.49 standard deviations for the median country (approximately Spain, 1996-2000), and 0.56 standard deviations for country observations at the 75th percentile (approximately Paraguay and Nigeria in the late 1990s). Similarly, let's consider the volatility effects at various levels of financial openness and given the sample average level of trade openness (approximately corresponding to Ecuador in the late 1990s). A one-standard-deviation increase in external

shocks' volatility would generate an increase in growth volatility of 0.49 standard deviations for country observations at the 25th percentile of the sample distribution of financial openness (approximately Madagascar, 1996-2000), 0.48 standard deviations for the median country (close to El Salvador, 1996-2000), and 0.47 standard deviations for countries at the 75th percentile (approximately Norway and Israel in the late 1990s). The differences in the volatility effects mentioned here are rather small. This is due to the fact that the distribution of financial openness is concentrated around the inter-quartile range.

IV. Conclusions

This paper tries to shed light on the question as to whether international integration increases a country's external vulnerability. There are two sides to this question. The first is whether openness by itself hurts macroeconomic performance by increasing its volatility. The second one is whether openness magnifies the impact of adverse foreign shocks, thus exacerbating the contagion of external volatility. The cross-country and over-time empirical evaluation conducted in the paper provides some answers to these questions, and around them we organize these concluding remarks.

First, while trade opening tends to increase growth volatility, financial opening reduces it. Whereas trade openness has a positive and stable effect on growth volatility along the per capita GDP distribution, financial openness has a negative and rapidly declining effect on volatility for middle and high income countries. Considering the size of the volatility effect, the beneficial impact of financial opening is larger than the detrimental effect of trade opening. Thus, while financial and trade opening present some trade-offs, they are mostly in favor of international integration particularly as per capita GDP increases.

Second, on whether financial and trade openness magnify the growth volatility effect of adverse external shocks, the evidence is again mixed. In general, trade openness tends to exacerbate the contagion of external volatility whereas financial openness tends to dampen it. This is clear in the case of the two "real" shocks -- related to terms of trade and foreign growth: larger trade openness magnifies the impact of shock volatility on economic growth volatility, while larger financial openness dampens this effect. Likewise, trade

opening increases the impact of interest rate shocks, while financial opening reduces the effect of capital inflow shocks. The magnifying effect of trade openness is likely to be a size effect in the sense that a higher volume of trade implies a larger share of economic activities that the terms of trade and foreign growth can influence. The stabilizing effect of financial openness regarding real shocks may be the result of the production diversification that it induces. The stabilizing effect of financial openness may be related to its positive influence on production diversification; while the opposite effect of trade openness may be given by the production concentration and specialization that it induces.

The results presented here offer a partial evaluation of international integration. Partial because it refers to macroeconomic volatility alone. A full evaluation would also consider the effects of trade and financial openness on other aspects of economic performance, most notably economic growth. Therefore, this paper should be read in conjunction with those that analyze other effects of international integration. For future research, there remains to understand the mechanisms through which development affects the link between openness and volatility and the channels by which integration prepares the economy to deal with external instability.

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Table 1
Growth Volatility, Openness and Foreign Shocks: Baseline Regression

Sample of 75 Countries, 1970-2000 (5-year period observations)

Dependent Variable: Standard Deviation of Growth in Real GDP per capita

Estimation Method: GMM-IV System Estimator (Arellano and Bover, 1995; Blundell and Bond, 1998)

Variables	[1]	[2]	[3]
<u>Control Variables</u>			
Inflation Volatility (S.D. annual log differences of CPI)	0.120 ** (0.03)	0.064 ** (0.03)	0.088 ** (0.03)
RER Overvaluation (Proportional index, overvaluation if >100)	0.001 ** (0.00)	0.001 ** (0.00)	0.001 ** (0.00)
Systemic Banking Crises (Frequency of years under crises: 0-1)	0.299 ** (0.06)	0.316 ** (0.07)	0.366 ** (0.07)
<u>Openness:</u>			
Trade Openness (TO) (Real Exports and Imports to GDP, in logs)	0.218 ** (0.05)	0.188 ** (0.04)	-1.853 ** (0.58)
Trade Openness, Squared (TO**2)	...	...	0.261 ** (0.07)
Financial Openness (FO) (Stock Equity-related Foreign liabilities to GDP, logs)	-0.036 ** (0.01)	-0.030 ** (0.01)	-0.025 ** (0.01)
Financial Openness, Squared (FO**2)	...	...	0.001 ** (0.00)
<u>Volatility of Foreign Shocks</u>			
Volatility of Foreign Shocks (aggregate) 1/ (weighted volatility of trade/financial shocks)	...	1.088 ** (0.10)	...
Volatility of Terms of Trade Changes (S.D. annual log differences of ToT)	0.133 ** (0.03)	...	0.168 ** (0.03)
Volatility of Foreign Growth Volatility (S.D. annual log differences of Foreign Growth)	0.451 ** (0.07)	...	0.317 ** (0.05)
Volatility of World Real Interest Rate (S.D. annual log differences of G-7 Interest Rates)	0.284 ** (0.08)	...	0.265 ** (0.08)
Volatility of Regional Capital Inflows (S.D. ratio of Regional Capital Flows to GDP)	0.215 ** (0.03)	...	0.168 ** (0.04)
<u>Period Shifts</u>			
- 81-85 Period:	-0.206 **	-0.251 **	-0.153 **
- 86-90 Period:	0.068	0.042	-0.003
- 91-95 Period:	0.206 **	0.186 **	0.207 **
- 96-00 Period:	0.051	0.013	-0.033
Countries / Observations	75 / 364	75 / 364	75 / 364
Specification Tests (p-values)			
- Sargan Test	(0.30)	(0.29)	(0.29)
- 2nd. Order Correlation	(0.26)	(0.28)	(0.32)

Numbers in parenthesis are robust standard errors. Regressions include constant and time dummies. * (**) denotes statistical significance at the 10 (5) percent level.

1/ Our measure of the aggregate volatility of external shocks is calculated using the regression coefficients of the volatility of terms of trade shocks, foreign growth, world real interest rate fluctuations, and capital inflows to the region (as percentage of GDP) in [1]:

Volatility of External Shocks = 0.488 + 0.133 (Volatility of Terms of Trade Changes) + 0.451 (Volatility of Foreign Growth) + 0.284 (Volatility of world real interest rate fluctuations) + 0.215 (Volatility of Regional Capital Inflows).

Table 2**Growth Volatility, Openness, Foreign Shocks and the Level of Income per Capita***Sample of 75 Countries, 1970-2000 (5-year period observations)**Dependent Variable: Standard Deviation of Growth in Real GDP per capita**Estimation Method: GMM-IV System Estimator (Arellano and Bover, 1995; Blundell and Bond, 1998)*

Variables	[1]	[2]
Constant	-0.264 (0.39)	-0.241 (0.31)
<i>Control Variables</i>		
Inflation Volatility (S.D. annual log differences of CPI)	0.091 ** (0.04)	0.086 ** (0.04)
RER Overvaluation (Proportional index, overvaluation if >100)	0.001 ** (0.00)	0.001 ** (0.00)
Systemic Banking Crises (Frequency of years under crises: 0-1)	0.260 ** (0.08)	0.242 ** (0.08)
<i>Openness:</i>		
International Trade	-0.214 (0.19)	0.169 ** (0.06)
International Trade * Income per capita (ypc)	0.114 ** (0.05)	...
International Trade * ypc squared	-0.008 ** (0.00)	...
International Finance	-0.026 ** (0.01)	-0.751 ** (0.30)
International Finance * Income per capita (ypc)	...	0.206 ** (0.08)
International Finance * ypc squared	...	-0.014 ** (0.01)
<i>Volatility of Foreign Shocks</i>		
Volatility of Terms of Trade Changes (S.D. annual log differences of ToT)	0.111 ** (0.03)	0.102 ** (0.03)
Volatility of Foreign Growth Volatility (S.D. annual log differences of Foreign Growth)	0.370 ** (0.07)	0.367 ** (0.07)
Volatility of World Real Interest Rate (S.D. annual log differences of G-7 Interest Rates)	0.232 ** (0.08)	0.268 ** (0.08)
Volatility of Regional Capital Inflows (S.D. ratio of Regional Capital Flows to GDP)	0.160 (0.04)	0.178 ** (0.04)
Volatility of Foreign Shocks (aggregate) ^{1/} (weighted volatility of trade/financial shocks)	...	...
<i>Period Shifts</i>		
- 81-85 Period:	-0.133 ** (0.05)	-0.096 * (0.05)
- 86-90 Period:	0.083 (0.07)	0.121 * (0.07)
- 91-95 Period:	0.194 ** (0.09)	0.282 ** (0.09)
- 96-00 Period:	-0.002 (0.12)	0.091 (0.13)
Countries / Observations	75 / 364	75 / 364
Specification Tests (p-values)		
- Sargan Test	(0.47)	(0.56)
- 2nd. Order Correlation	(0.30)	(0.33)

Numbers in parenthesis are robust standard errors. Regressions include constant and time dummies. * (**) denotes statistical significance at the 10 (5) percent level.

^{1/} Our measure of the aggregate volatility of external shocks is calculated using the regression coefficients of the volatility of terms of trade shocks, foreign growth, world real interest rate fluctuations, and capital inflows to the region (as percentage of GDP) in [1]:
Volatility of External Shocks = 0.488+0.133 (Volatility of Terms of Trade Changes) + 0.451 (Volatility of Foreign Growth) + 0.284 (Volatility of world interest rate fluctuations) + 0.215 (Volatility of Regional Capital Inflows).

Table 3
Growth Volatility and the Interaction between Openness and the Volatility of Foreign Shocks

Sample of 75 Countries, 1970-2000 (5-year period observations)
 Dependent Variable: Standard Deviation of Growth in Real GDP per capita
 Estimation Method: GMM-IV System Estimator (Arellano and Bover, 1995; Blundell and Bond, 1998)

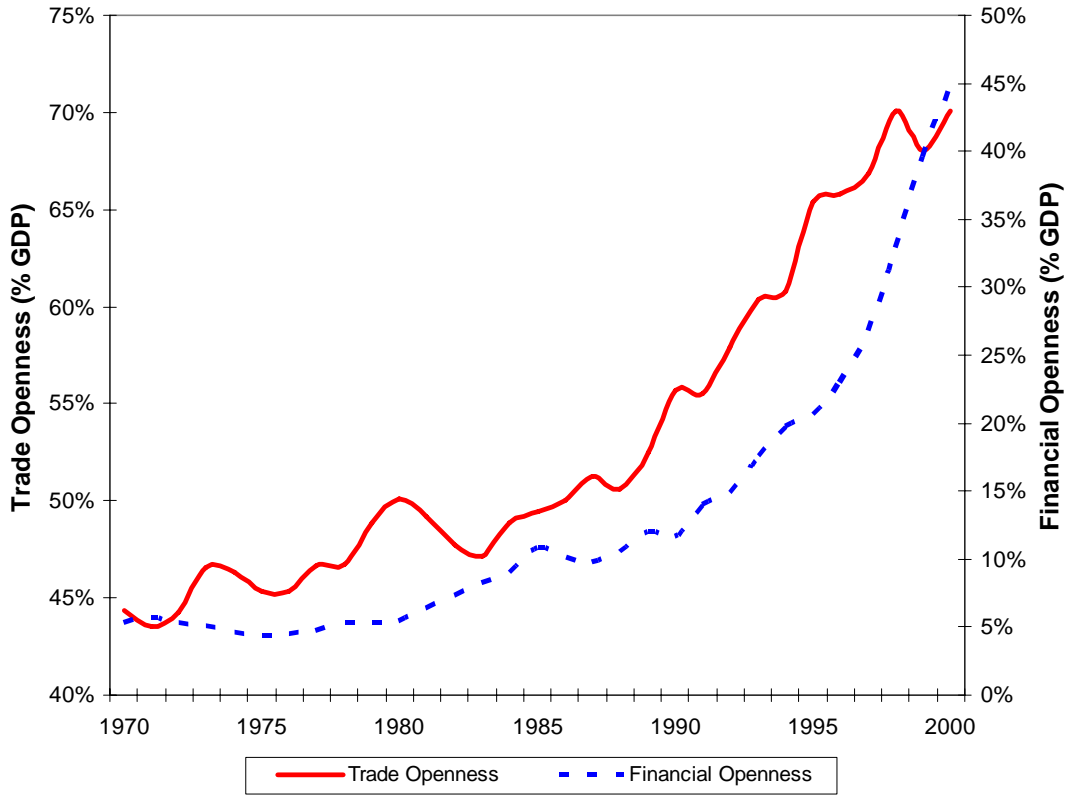
Foreign Shock:	[1] Terms of Trade Changes	[2] Foreign Growth	[3] World Interest Rate Changes	[4] Regional Capital Inflows	[5] External Shocks (aggregate)
<u>Control Variables</u>					
Inflation Volatility (S.D. annual log differences of CPI)	0.169 ** (0.02)	0.169 ** (0.04)	0.123 ** (0.03)	0.114 ** (0.03)	0.084 ** (0.02)
RER Overvaluation (Proportional index, overvaluation if >100)	0.001 ** (0.00)	0.001 ** (0.00)	0.002 ** (0.00)	0.001 ** (0.00)	0.002 ** (0.00)
Systemic Banking Crises (Frequency of years under crises: 0-1)	0.200 ** (0.04)	0.254 ** (0.06)	0.240 ** (0.04)	0.214 ** (0.05)	0.280 ** (0.05)
<u>Openness:</u>					
Trade Openness (TO) (Real Exports and Imports to GDP, in logs)	-0.103 (0.16)	0.242 ** (0.05)	0.140 ** (0.04)	0.172 ** (0.03)	-0.056 (0.08)
Financial Openness (FO) (Stock Equity-related Foreign liabilities to GDP, logs)	-0.015 * (0.01)	-0.036 ** (0.01)	-0.041 ** (0.01)	-0.043 ** (0.00)	-0.005 (0.01)
<u>Volatility of Foreign Shocks</u>					
Volatility of Foreign Shocks (aggregate) 1/ (weighted volatility of trade/financial shocks)	...	...	...	...	-0.584 * (0.34)
Volatility of Terms of Trade Changes (S.D. annual log differences of ToT)	-0.633 ** (0.25)	0.127 ** (0.02)	0.130 ** (0.02)	0.129 ** (0.02)	...
Volatility of Foreign Growth Volatility (S.D. annual log differences of Foreign Growth)	0.429 ** (0.05)	0.015 (0.26)	0.417 ** (0.04)	0.398 ** (0.05)	...
Volatility of World Real Interest Rate (S.D. annual log differences of G-7 Interest Rates)	0.297 ** (0.07)	0.282 ** (0.08)	-0.646 ** (0.26)	0.276 ** (0.07)	...
Volatility of Regional Capital Inflows (S.D. ratio of Regional Capital Flows to GDP)	0.200 ** (0.03)	0.203 ** (0.04)	0.207 ** (0.03)	0.706 ** (0.22)	...
<u>Interaction: Openness and Volatility of Foreign Shock</u>					
TO * Volatility (Foreign Shock)	0.184 ** (0.06)	0.118 ** (0.06)	0.219 ** (0.07)	-0.122 ** (0.06)	0.421 ** (0.08)
FO * Volatility (Foreign Shock)	-0.008 ** (0.00)	-0.010 ** (0.00)	0.019 ** (0.01)	-0.026 ** (0.01)	-0.026 ** (0.00)
<u>Period Shifts</u>					
- 81-85 Period:	-0.257 **	-0.241 **	-0.247 **	-0.212 **	-0.224 **
- 86-90 Period:	0.069 *	0.071	0.016	0.037	0.032
- 91-95 Period:	0.227 **	0.221 **	0.170 **	0.219 **	0.162 **
- 96-00 Period:	0.065	0.119	0.048	0.104	-0.006
Countries / Observations	75 / 364	75 / 364	75 / 364	75 / 364	75 / 364
Specification Tests (p-values)					
- Sargan Test	(0.48)	(0.33)	(0.34)	(0.35)	(0.25)
- 2nd. Order Correlation	(0.26)	(0.27)	(0.22)	(0.34)	(0.24)

Numbers in parenthesis are robust standard errors. Regressions include constant and time dummies. *(**) denotes statistical significance at the 10 (5) percent level.

1/ Our measure of the aggregate volatility of external shocks is calculated using the regression coefficients of the volatility of terms of trade shocks, foreign growth, world real interest rate fluctuations, and capital inflows to the region (as percentage of GDP) presented in column [1] of Table 1:

Volatility of External Shocks = 1.137+0.081 (Volatility of Terms of Trade Changes) + 0.241 (Volatility of Foreign Growth) + 0.347 (Volatility of world real interest rate fluctuations) + 0.331 (Volatility of Regional Capital Inflows).

Figure 1
Trends in Openness, 1970-2000

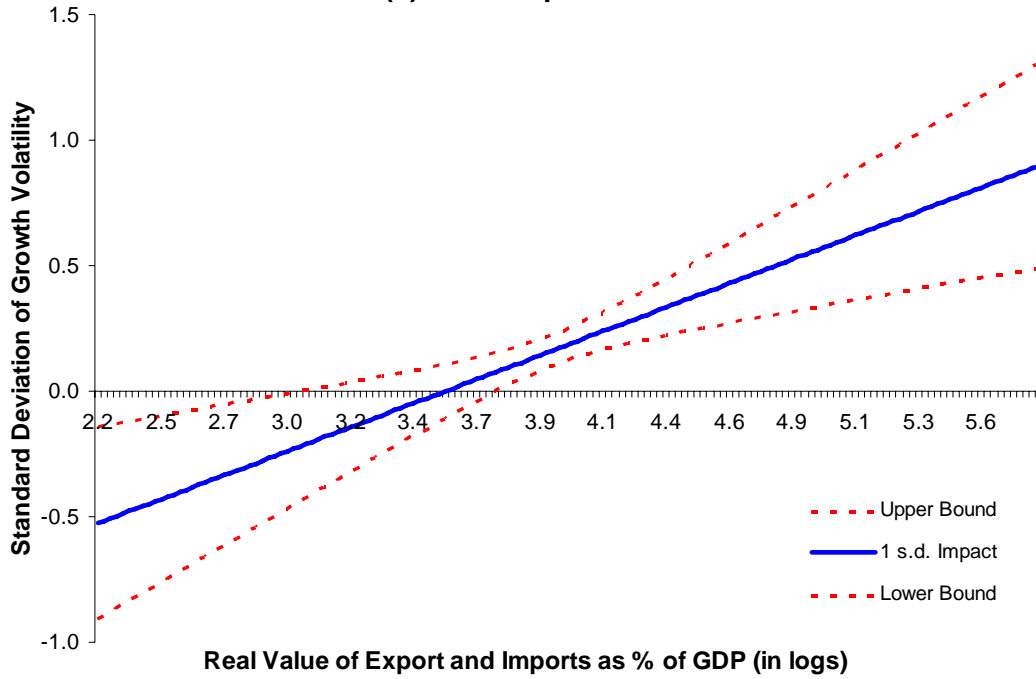


Note: Openness measures are defined as the ratio of real exports and imports to GDP (trade) and the ratio of equity-based foreign liabilities to GDP (financial).

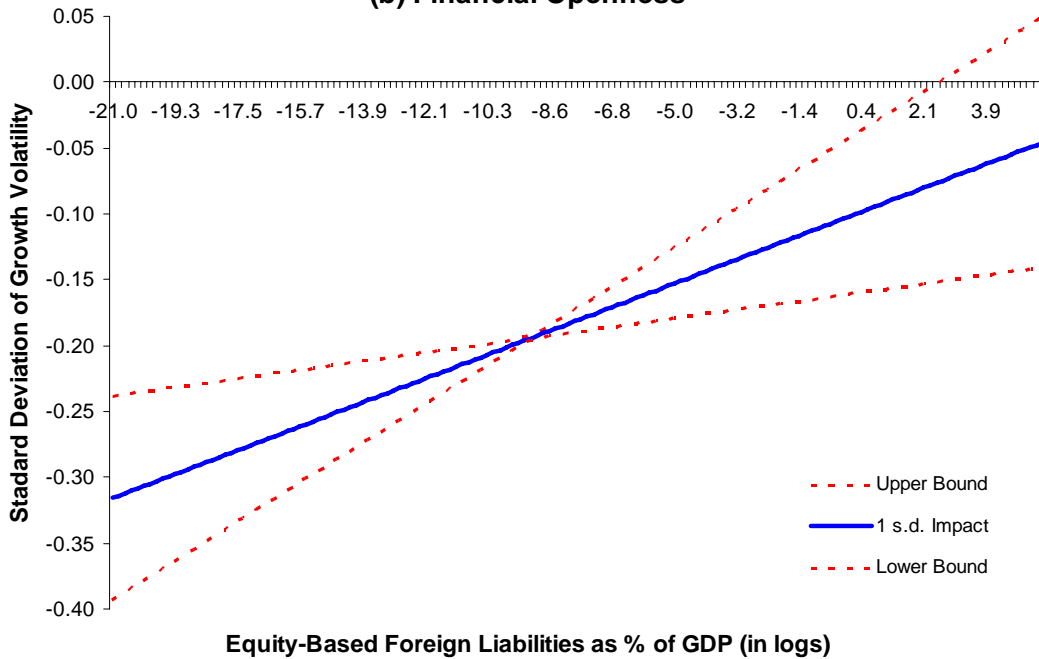
World medians are calculated from the data used in the regression analysis.

Figure 2
Volatility Effects of Openness – Quadratic Specification
(Impact of a one-standard-deviation increase in openness)

(a) Trade Openness

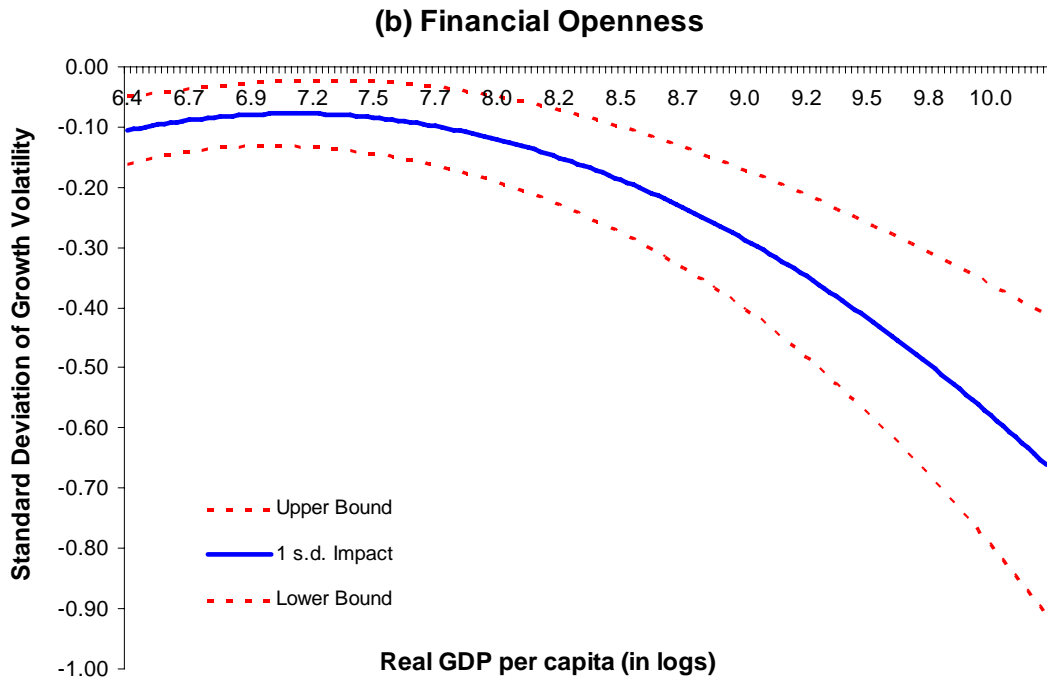
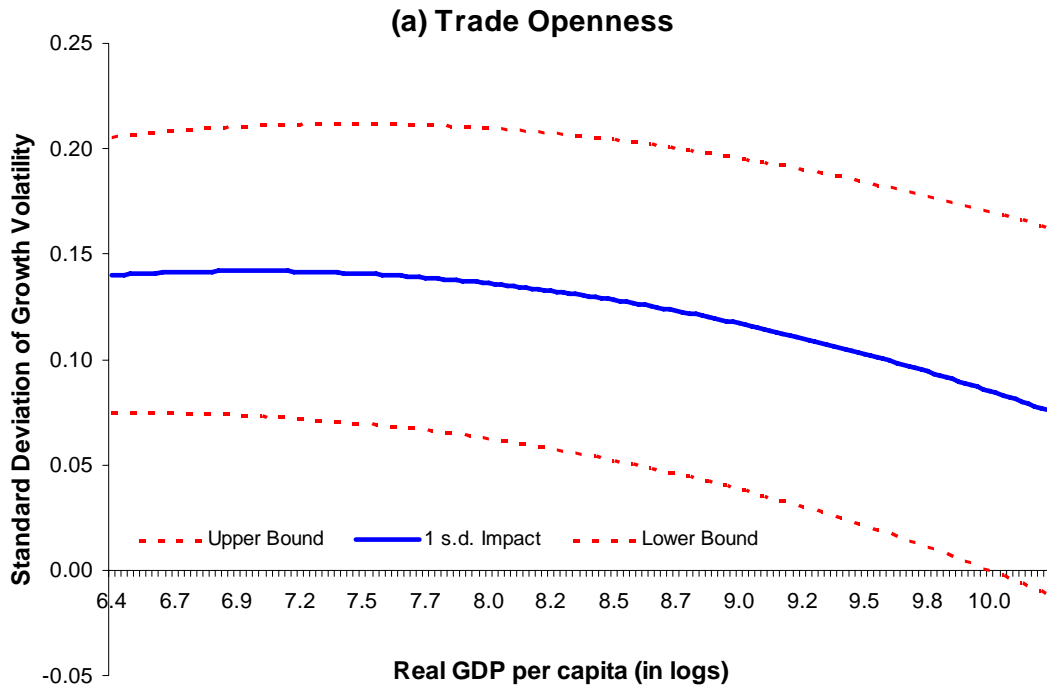


(b) Financial Openness



Note: The regression coefficients used are those reported in Column [3] of Table 1.

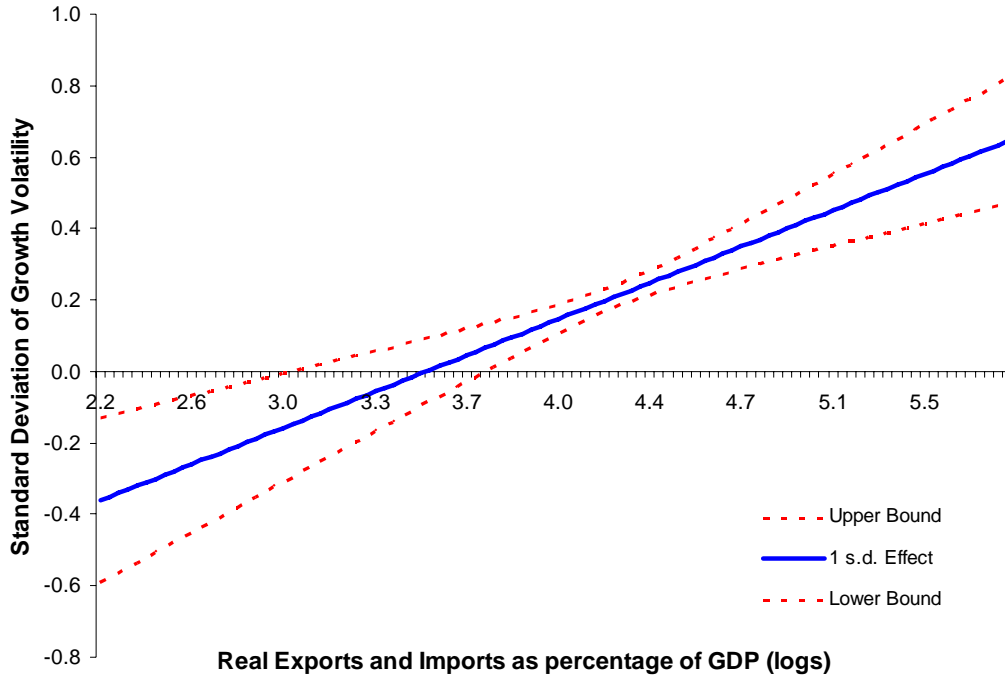
Figure 3
Volatility Effects of Openness as a Function of Real Output per Capita
(Impact of a one-standard-deviation increase in openness)



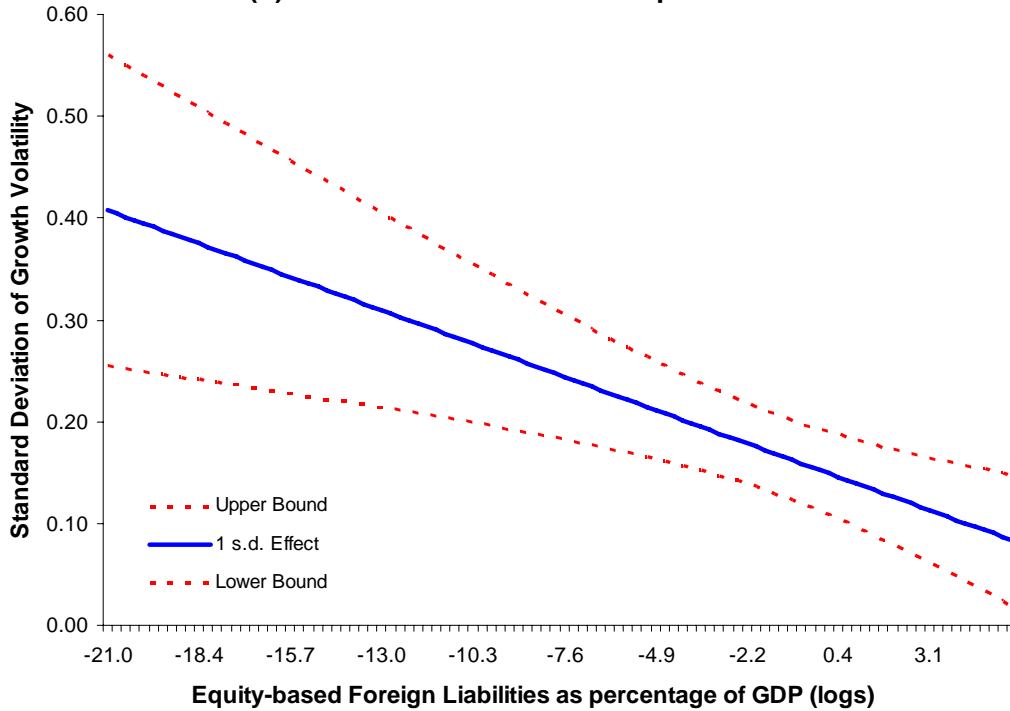
Note: The regression coefficients used in (a) and (b) are those reported in Columns [1] and [2] of Table 2, respectively.

Figure 4
Growth Volatility Effects of Terms of Trade Fluctuations
(Impact of a one-standard-deviation increase in Terms of Trade Volatility)

(a) Conditional on Trade Openness

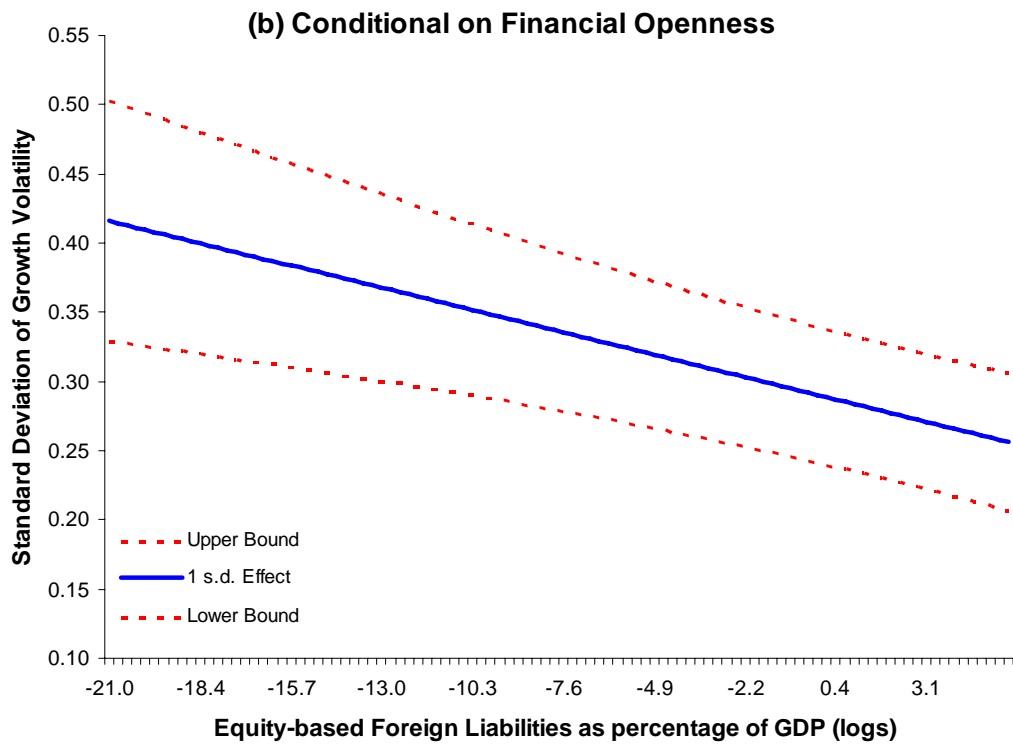
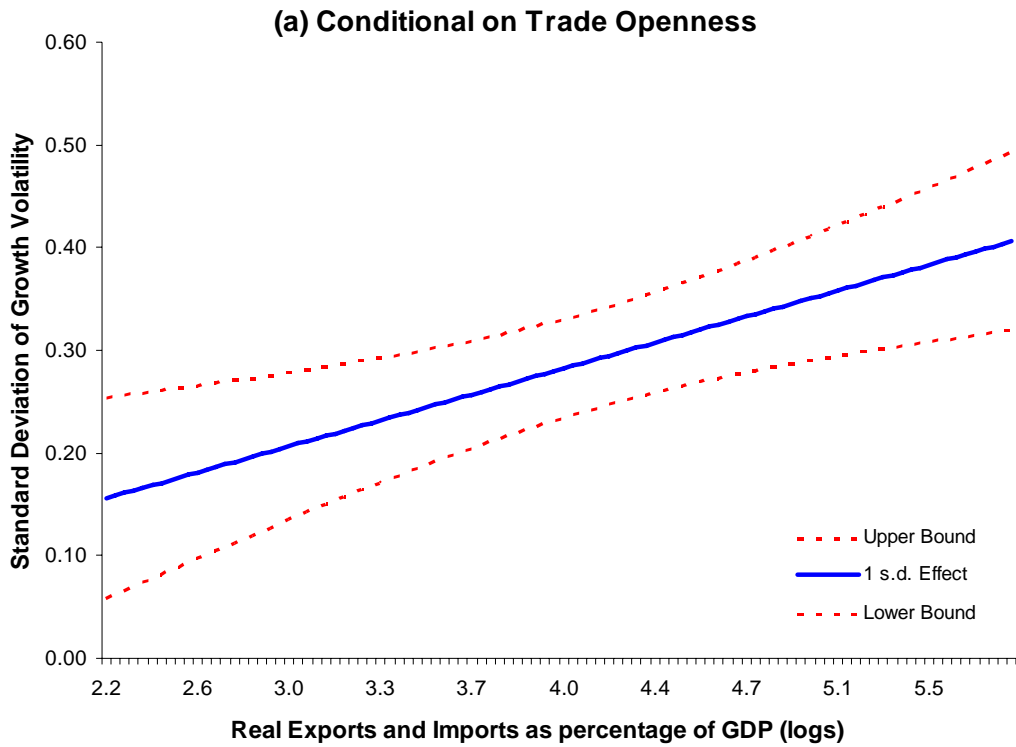


(b) Conditional on Financial Openness



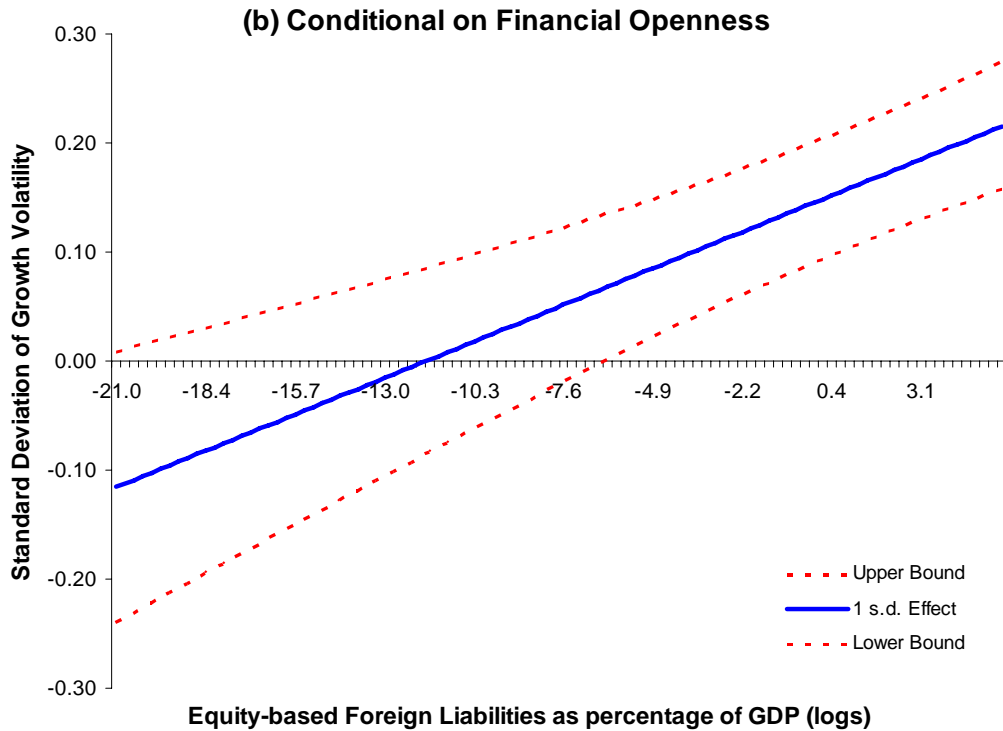
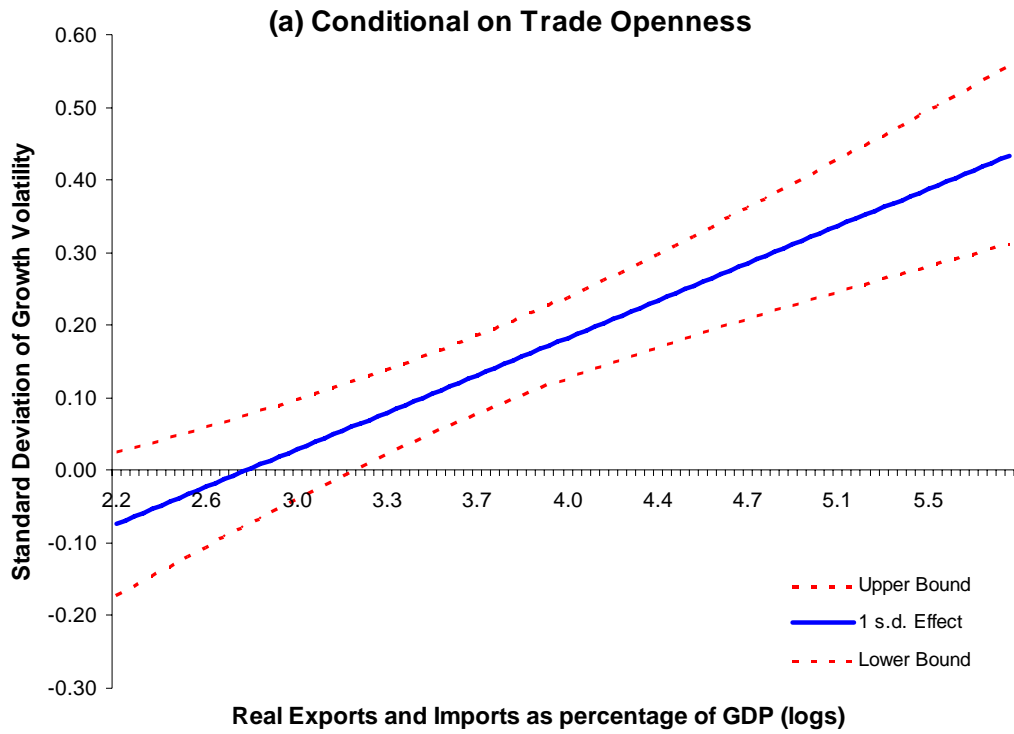
Note: The regression coefficients used are those reported in Column [1] of Table 3.

Figure 5
Growth Volatility Effects of Fluctuations in Foreign Growth
(Impact of a one-standard-deviation increase in Foreign Growth Volatility)



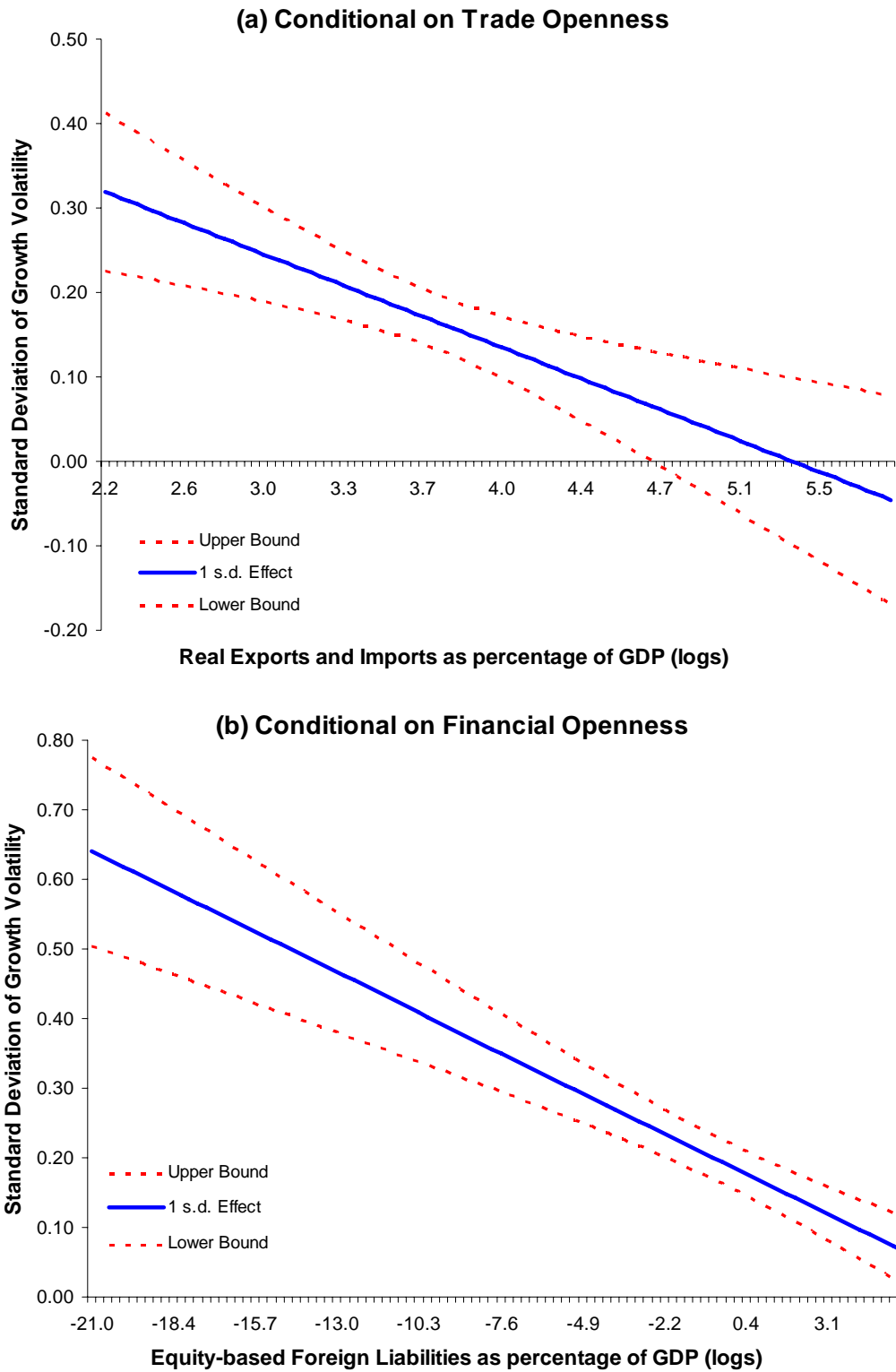
Note: The regression coefficients used are those reported in Column [2] of Table 3.

Figure 6
Growth Volatility Effects of Fluctuations in World Real Interest Rates
(Impact of a one-standard-deviation increase in World Interest Rate Volatility)



Note: The regression coefficients used are those reported in Column [3] of Table 3.

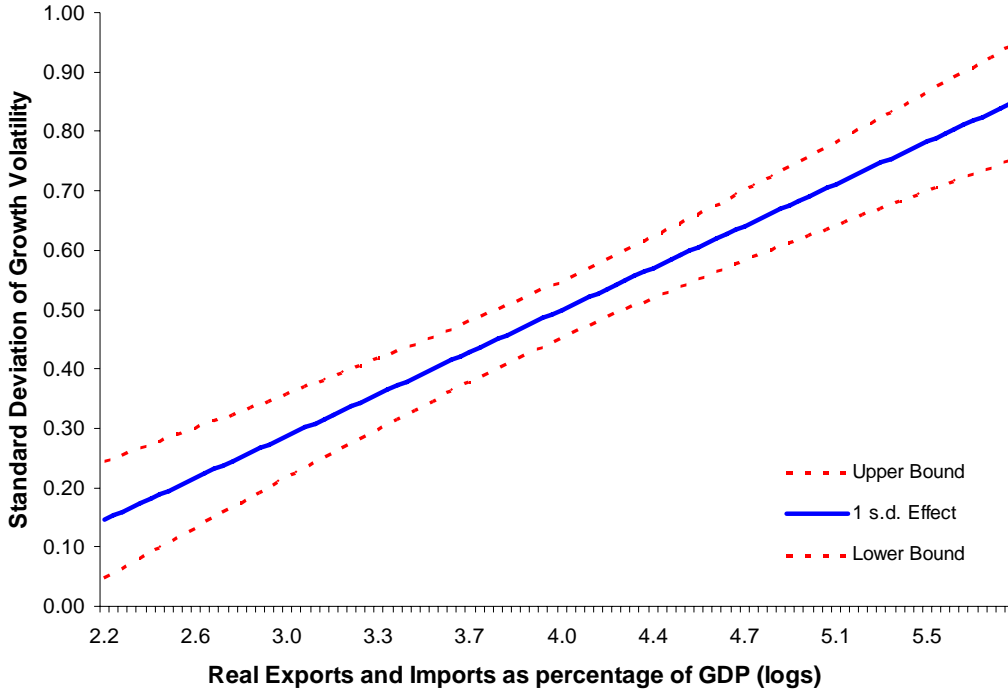
Figure 7
Growth Volatility Effects of Fluctuations in Regional Capital Inflows
(Impact of a one-standard-deviation increase in the volatility of regional capital flows)



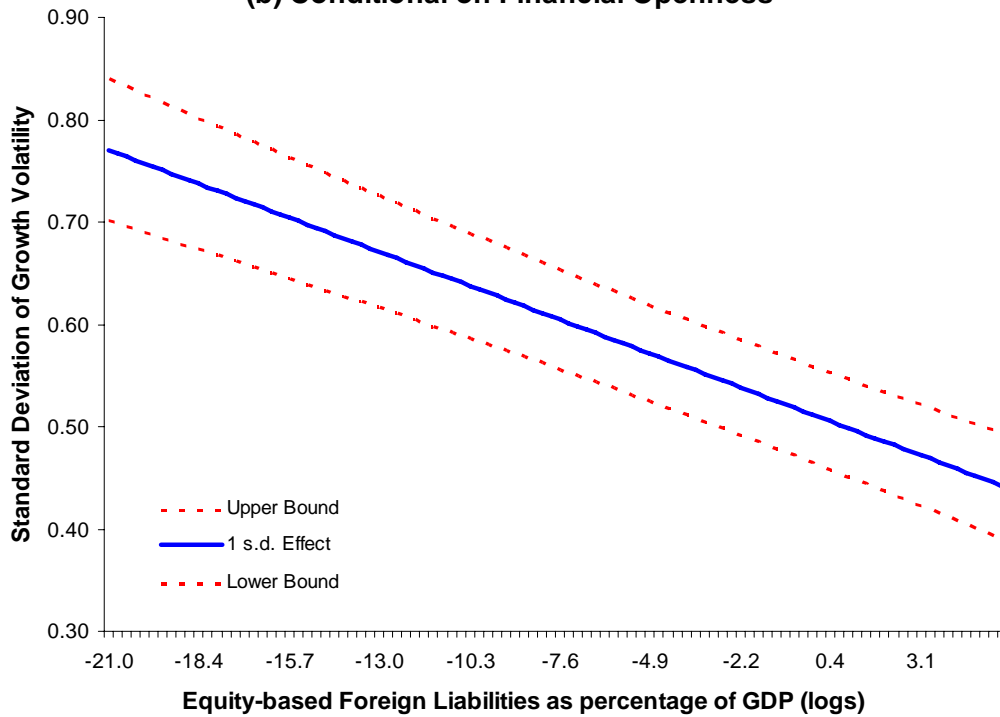
Note: The regression coefficients used are those reported in Column [4] of Table 3.

Figure 8
Growth Volatility Effects of Fluctuations in External Shocks
(Impact of a one-standard-deviation increase in the volatility of external shocks)

(a) Conditional on Trade Openness



(b) Conditional on Financial Openness



Note: The regression coefficients used are those reported in Column [5] of Table 3.

Appendix 1: Sample of Countries

I. Industrial Economies (22 countries)		
Australia	Greece	Portugal
Austria	Iceland	Spain
Belgium	Ireland	Sweden
Canada	Italy	Switzerland
Denmark	Japan	United Kingdom
Finland	Netherlands	United States
France	New Zealand	
Germany	Norway	
II. Latin America and the Caribbean (20 countries)		
Argentina	El Salvador	Panama
Bolivia	Guatemala	Paraguay
Brazil	Haiti	Peru
Chile	Honduras	Trinidad and Tobago
Colombia	Jamaica	Uruguay
Costa Rica	Mexico	Venezuela, RB
Ecuador	Nicaragua	
III. East Asia and the Pacific (7 countries)		
China	Papua New Guinea	Thailand
Korea, Rep.	Philippines	
Malaysia	Singapore	
IV. Middle East and North Africa (8 countries)		
Algeria	Israel	Tunisia
Egypt, Arab Rep.	Jordan	Turkey
Iran, Islamic Rep.	Morocco	
V. South Asia (3 countries)		
India	Pakistan	Sri Lanka
VI. Sub-Saharan Africa (15 countries)		
Botswana	Madagascar	Sierra Leone
Cote d'Ivoire	Malawi	South Africa
Gambia, The	Niger	Togo
Ghana	Nigeria	Zambia
Kenya	Senegal	Zimbabwe

Appendix 2: Definitions and Sources of Variables Used in Regression Analysis

Variable	Definition and Construction	Source
GDP per capita	Ratio of total GDP to total population. GDP is in 1985 PPP-adjusted US\$.	Authors' construction using Summers and Heston (1991) and The World Bank (2003).
GDP per capita growth	Log difference of real GDP per capita.	Authors' construction using Summers and Heston (1991) and The World Bank (2003).
Trade Openness	Log of the ratio of exports and imports (in 1995 US\$) to GDP (in 1995 US\$).	World Development Network (2002) and The World Bank (2003).
Financial Openness	Log of the Stock of Equity-based Foreign Liabilities to GDP (both expressed in 1995 US\$). Following Eichengreen and Irwin (1998), we add the value of 1 to the stock in order to include the cases where the stock of foreign liabilities is 0.	Lane and Milesi-Ferreti (2001, 2003), IMF's Balance of Payments Statistics
CPI	Consumer price index (1995 = 100) at the end of the year	Author's calculations with data from IFS.
Inflation rate	Log differences of CPI	Author's calculations with data from IFS.
Real Exchange Rate Overvaluation	Real Effective Exchange Rate, with the level adjusted such that the average for 1976-85 equals Dollar's (1992) index of overvaluation (based on the ratio of actual to income-adjusted Summers-Heston purchasing power parity comparisons).	Easterly (2001)
Terms of Trade	Net barter terms of trade index (1995=100)	World Development Network (2002) and The World Bank (2003).
Terms of Trade Changes	Log differences of the terms of trade index	Authors' construction using The World Bank (2003).
Foreign Growth	Growth of main trading partners calculated as the trade-weighted growth for the main trading partners of the corresponding country.	Authors' construction using Summers and Heston (1991), The World Bank (2003), and the IMF's Direction of Trade Statistics.
World Nominal Interest Rate	G-3 (U.S., Germany and Japan) Money Market Rate (period average)	Author's calculations with data from IFS.
World Inflation	G-3 (U.S., Germany and Japan) Consumer Price Index (CPI) Inflation rate	Author's calculations with data from IFS.
World Real Interest Rate	World Nominal Interest Rate adjusted by World Inflation.	Author's calculations with data from IFS.
Regional Capital Inflows	(Gross) Capital Inflows (FDI, portfolio-equity, loans) to the region of the corresponding country, as a percentage to the corresponding GDP.	Author's calculations with data from the IMF's Balance of Payments Statistics.
Inflation Volatility	Standard deviation of the annual log differences of CPI	Authors' construction using The World Bank (2003).
Systemic Banking Crises	Number of years in which a country underwent systemic banking crisis, as a fraction of years in the corresponding period.	Author's calculations using data from Caprio and Klingebiel (1999), and Kaminsky and Reinhart (1998).
Volatility of External Shocks (Aggregate)	Aggregate index of the standard deviation of 4 foreign shocks: terms of trade changes, foreign growth, world real interest rate changes, and regional capital flows to the region.	Authors' construction following aggregate methodology applied by Burnside and Dollar (2000)
Volatility of Terms of Trade Changes	Standard deviation of the annual log differences of the terms of trade.	Authors' construction using The World Bank (2003).
Volatility of Foreign Growth	Standard deviation of the trade-weighted annual growth of the main trading partners of the corresponding country.	Authors' construction using Summers and Heston (1991), The World Bank (2003), and the IMF's Direction of Trade Statistics.
Volatility of World Real Interest Rates	Standard deviation of the trade-weighted average of real G-7 interest rate fluctuations.	Author's calculations with data from the IMF's Balance of Payments Statistics.
Volatility of Regional Capital Inflows	Standard deviation of the capital inflows to region of the corresponding country relative to its regional GDP.	Author's calculations with data from the IMF's Balance of Payments Statistics.
Period-specific Shifts	Time dummy variables.	Authors' construction.

Appendix 3: Descriptive Statistics for Growth Volatility Regressions

Data in 5-year period averages, 75 countries, 364 observations

(a) Univariate

Variable	Mean	Std. Dev.	Minimum	Maximum
Growth Volatility (in logs)	0.81	0.74	-1.16	2.78
Output per capita (in logs)	8.56	1.00	6.43	10.24
Inflation Volatility (in logs)	1.34	1.17	-1.62	5.12
RER Overvaluation	107.67	44.46	47.19	555.03
Systemic Banking Crises	0.14	0.29	0.00	1.00
Trade Openness (in logs)	3.961	0.571	2.249	5.781
Financial Openness (in logs)	2.068	3.053	-21.044	5.536
Volatility of External Shocks (aggregate) (in logs)	0.753	0.348	-0.909	1.688
Volatility of Terms of Trade Changes (in logs)	1.684	1.139	-9.381	4.031
Volatility of Foreign Growth (in logs)	-0.096	0.444	-1.543	0.891
Volatility of World Int. Rate Changes (in logs)	0.185	0.484	-0.703	1.230
Volatility of Regional Capital Inflows/GDP (in logs)	0.153	0.623	-1.973	1.492

(b) Bivariate Correlations between Growth Volatility and Determinants

Variable	Growth Volatility	Inflation Volatility	RER Overvaluation	Systemic Banking Crises	Trade Openness	Financial Openness	Volatility of Terms of Trade Changes	Volatility of Foreign Growth	Volatility of World Int. Rate Changes	Volatility of Regional Capital Inflows/GDP
Growth Volatility	1.00									
Inflation Volatility	0.42	1.00								
RER Overvaluation	0.05	0.05	1.00							
Systemic Banking Crises	0.11	0.27	0.04	1.00						
Trade Openness	0.00	-0.24	0.08	-0.12	1.00					
Financial Openness	-0.26	-0.21	-0.14	0.03	0.06	1.00				
Volatility of Terms of Trade Changes	0.36	0.48	0.05	0.10	-0.12	-0.20	1.00			
Volatility of Foreign Growth	0.25	0.15	-0.04	0.02	-0.14	-0.07	0.07	1.00		
Volatility of World Int. Rate Changes	0.21	0.20	-0.05	-0.08	-0.15	-0.16	0.29	0.43	1.00	
Volatility of Regional Capital Inflows/GDP	0.08	0.06	0.12	0.15	0.03	0.12	-0.10	-0.02	-0.37	1.00

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