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Growth and Volatility in an Era of Globalization

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We extend the analysis in Kose, Prasad, and Terrones (2005) to provide a comprehensive examination of the cross-sectional relationship between growth and macroeconomic volatility over the past four decades. We also document that while there has generally been a negative relationship between volatility and growth during this period, the nature of this relationship has been changing over time and across different country groups. In particular, we detect major shifts in this relationship after trade and financial liberalizations. In addition, our results show that volatility stemming from the main components of domestic demand is negatively associated with economic growth. [JEL E32, F36, F43]

During his distinguished tenure as the Economic Counselor of the IMF and Director of its Research Department, Michael Mussa made many important contributions to the literature on globalization and its implications for both industrial and developing countries. Having been at the Fund during the trying periods of the Asian and Russian crises, Mussa had a special appreciation for the challenges faced by emerging market economies in trying to balance the benefits and risks of globalization. Many of his writings on this topic have focused on how developing countries could attain the growth benefits of globalization while minimizing their susceptibility to financial and balance of payments crises.

Indeed, the broader issue of understanding the complex relationship between macroeconomic volatility and economic growth has long been a challenge for economists. During the 1980s, it was generally accepted that the impact of volatility on

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economic growth and welfare was at most minor and that, therefore, volatility was hardly anything to be feared.[1] Research in the 1990s (for example, Ramey and Ramey, 1995) reached a strikingly different conclusion—that macroeconomic volatility may actually reduce long-term growth.[2] This was an important result since it implied that policies and economic shocks that increased volatility could have significant longer-term negative effects on economic welfare by reducing growth.

The causes and consequences of macroeconomic volatility have also received renewed attention because of the financial crises experienced by a number of developing countries over the past two decades. Such crises are extreme manifestations of volatility, but they have clearly highlighted its costs, including the consequences of large episodes of volatility in terms of increases in inequality and poverty. Many of these crises have been associated with the rapid opening-up of some developing economies to global trade and financial linkages—a phenomenon broadly referred to as globalization. While facing episodes of high-output volatility on account of these crises, this group of developing economies, often referred to as "emerging markets," has also posted much better average growth rates during the period of globalization than other developing economies.

The ongoing debate about the benefits and costs of globalization has prompted a resurgence of interest in analyzing the relationship between volatility and growth, particularly since the Ramey and Ramey (1995) results are based on a data set that ends in 1985, just when the pace of trade and financial integration started to gain momentum. Some recent papers show that the negative relationship between growth and volatility persisted into the 1990s (for example, Fatás, 2002; Aizenman and Pinto, 2005; and Hnatkovska and Loayza, 2005). Other empirical studies focus on how the relationship between growth and volatility is affected by a particular source of volatility, including volatility stemming from fluctuations in government expenditures and the terms of trade (see, for example, Mendoza, 1997; Turnovsky and Chattopadhyay, 2002; and Fatás and Mihov, 2003). Recent research also considers various channels linking macroeconomic volatility to long-term growth (for example, Aizenman and Marion, 1999; and Martin and Rogers, 2000).

In Kose, Prasad, and Terrones (2005), we analyze how the growth-volatility relationship has been influenced by different aspects of globalization. Our main result in that paper is that, while the growth-volatility relationship was preserved on average in the 1990s, both trade and financial openness appear to attenuate this negative relationship. In other words, even though economies that are more integrated into the global economy might be subject to more volatility, they do not necessarily suffer lower growth than less integrated economies as a result of that additional volatility.

[1] In addition, Lucas's (1987) work suggested that the welfare costs associated with business-cycle fluctuations were small, bringing into question the desirability of stabalization policies aimed at smoothing out these fluctuations.

[2] Lucas's finding about the direct adverse welfare effects of volatility has also been challenged since then (see Pallage and Robe, 2003; and Barlevy, 2004). Recent empirical research also finds that volatility has a significantly negative impact on poverty (Laursen and Mahajan, 2005).

This paper extends the scope of our research program by analyzing the growth-volatility relationship in several dimensions. First, we provide a more detailed descriptive account of the evolution of the dynamics of growth and volatility over time and across countries. We then analyze the role of globalization in this process by employing an event-study analysis to examine how growth and volatility change before and after trade and financial liberalizations. We also examine the implications of the negative relationship between volatility and growth in the context of a regional case study on sub-Saharan Africa (SSA). In addition, we analyze the empirical importance of various components of aggregate output in influencing the relationship between volatility and growth.

To set the stage for this analysis, it is useful to begin with a characterization of how pervasive the forces of globalization have been in recent decades. The increase in international trade and financial linkages since 1985 has indeed been quite remarkable. For example, between 1985 and 2000, the share of emerging market countries in our data set that had liberalized their trade regimes increased from 30 percent to almost 85 percent. The share of countries with open financial accounts rose from 20 percent to about 55 percent over this period. Spurred by these liberalizations, the volume of international trade has registered a dramatic increase, with the ratio of world exports and imports to world GDP rising from 75 percent in the mid-1980s to more than 150 percent by the end of the 1990s. Private capital flows from industrialized to developing economies have also increased dramatically since the mid-1980s, with the bulk of these flows going to emerging market economies.[3]

Why is it important to consider these dramatic changes in trade and financial linkages in analyzing the relationship between growth and volatility? While both trade and financial integration probably have their distinct roles in explaining the changes in the dynamics of this relationship, financial integration, in particular, is likely to have been an important factor influencing the relationship during the past 20 years, especially as increased international financial flows appear to have precipitated episodes of high volatility in many developing economies. This raises an interesting question about whether the high growth rates in emerging markets that are presumably fueled in part by international financial flows come at the cost of higher volatility associated in part with the vagaries of these flows.

The change over time in the relative vulnerability of industrial and developing economies to external crises also raises questions about whether the growth-volatility relationship is influenced by the "growing pains" seemingly associated with rising trade and financial integration. To be more specific, are the level of a country's development and the extent of its integration into international markets important in determining the conditional validity of this relationship? In this context, while there appears to be a consensus that trade openness stimulates domestic growth, it also seems to be the case that such openness increases an economy's vulnerability to external shocks, including highly volatile terms-of-trade shocks. The

[3]See Lane and Milesi-Ferretti (2001 and 2003) for a detailed analysis of the increase in global financial flows, including among industrial countries. The main increase in gross capital flows to developing countries has been in terms of foreign direct investment (FDI) and portfolio flows, while the relative importance of bank lending and other official flows has declined over time.

effects of financial integration are less obvious in theoretical and empirical studies. And the theoretical literature is largely inconclusive on how trade and financial integration, in addition to the factors discussed above, affect the growth-volatility relationship. A more detailed empirical analysis of this issue is therefore warranted.

I. What Do We Learn from Recent Theoretical and Empirical Studies?

Effects of Globalization on Growth

A number of theoretical models have been developed to analyze the importance of trade and financial openness in promoting economic growth. Some of these theoretical models focus on static gains, including the gains derived from comparative advantage considerations. Others consider knowledge spillovers and changes in the growth dynamics of productivity and investment associated with international trade (Grossman and Helpman, 1991; Levine and Renelt, 1992; and Baldwin and Seghezza, 1998).[4]

There are various direct and indirect theoretical channels through which increased financial flows can enhance growth. The direct channels include augmentation of domestic savings, reduction in the cost of capital through better global allocation of risk, development of the financial sector (Levine, 1996; and Caprio and Honohan, 1999), and transfer of technological know-how. The main indirect channels are associated with promotion of specialization (Kalemli-Ozcan, Sorensen, and Yosha, 2003) and inducement for better economic policies (Gourinchas and Jeanne, 2003).

There is a large empirical literature studying the role of openness to trade and financial flows in economic growth. For example, using a variety of methods, several researchers, including Sachs and Warner (1995), Frankel and Romer (1999), Dollar and Kraay (2002) and Wacziarg and Welch (2003), show that trade openness helps promote economic growth. Rodriquez and Rodrik (2000) challenge the robustness of some of these findings and argue that several of these studies suffer from problems associated with model misspecification and with the use of openness measures that may capture other policy or institutional features.

In contrast to the literature on trade and growth, recent empirical research is unable to establish a clear link between financial integration and economic growth. Most empirical studies find that financial integration has no effect or at best a modest effect on economic growth (see the survey by Prasad and others, 2003). Another set of empirical studies suggests that the composition of capital flows determines the effects of financial integration on economic growth (Reisen and Soto, 2001; and Goldberg, 2004). In particular, these studies conclude that FDI flows tend to be positively associated with output growth in those countries that have a sufficient level of human capital (Borenzstein, De Gregorio, and Lee, 1998) and well-developed

[4]Berg and Krueger (2003), Baldwin (2003), and Winters (2004) provide extensive surveys of the literature on trade and growth.

domestic financial markets (Alfaro and others, 2004). Other studies focus on the impact of equity market liberalization on the growth rates of output and investment, typically finding a positive effect (Henry, 2000; and Bekaert, Harvey, and Lundblad, 2001).

Effects of Globalization on Volatility

The theoretical impact of increased trade and financial flows on output volatility depends on various factors, including the composition of these flows, patterns of specialization, and the sources of shocks. For example, if trade openness results in increased specialization of countries' production structures (at the industry level) and if industry-specific shocks are important in driving business cycles, it could lead to an increase in output volatility. However, if rising trade flows are associated with increased vertical specialization across countries, the volatility of output growth could decline (Kose, Prasad, and Terrones, 2003a).

In theory, financial integration could help lower the volatility of macroeconomic fluctuations in capital-poor developing countries by providing access to capital that could help them diversify their production base. Rising financial integration, however, could also lead to increasing specialization of production based on comparative advantage considerations, thereby making economies more vulnerable to industry-specific shocks (Kalemli-Ozcan, Sorensen, and Yosha, 2003).

There is little consensus in the literature about the empirical relationship between the intensity of trade linkages and macroeconomic volatility. While some studies find no significant relationship between an increased degree of trade interdependence and domestic macroeconomic volatility (Buch, Döpke, and Pierdzioch, 2002), others find that an increase in the degree of trade openness leads to higher output volatility, especially in developing countries (Karras and Song, 1996; Easterly, Islam, and Stiglitz, 2001). Kose, Prasad, and Terrones (2003a) find that while trade openness increases the volatility of output and consumption growth in emerging market economies, it reduces the volatility of consumption growth relative to that of income growth, implying that trade flows improve risk-sharing possibilities. They also document that financial integration does not have a statistically significant impact on the volatility of output growth. They find some evidence that financial integration could actually increase the volatility of consumption growth relative to that of income growth but argue that this relationship is a nonlinear one—rising financial integration is associated with rising relative volatility of consumption only up to a certain threshold.

The Relationship Between Growth and Volatility

Several papers in the stochastic dynamic business-cycle literature have typically propounded the view that the distinction between trend and cycles is an artificial one, since both growth and fluctuations are driven by the same set of shocks. However, there is no clear implication that can be derived from these models about the relationship between volatility and growth (Jones, Manuelli, and Stacchetti, 1999; and Jovanovic, 2004).

Various theoretical channels that can lead to a negative relationship between growth and volatility are discussed in the literature. For example, some theoretical models argue that the link between growth and volatility depends on the dynamics of investment (Bernanke, 1983; Pindyck, 1991; and Aizenman and Marion, 1993). A few papers emphasize the importance of costs associated with learning (Martin and Rogers, 2000; and Blackburn and Galindev, 2003), while others consider the importance of terms-of-trade fluctuations (Mendoza, 1997). There are some theoretical studies arguing that macroeconomic volatility could have a beneficial impact on economic growth (Aghion, Banerjee, and Piketty, 1999; Aghion, Bacchetta, and Banerjee, 2000; Blackburn, 1999; and Blackburn and Pelloni, 2004). Ranciere, Tornell, and Westermann (2003) and Tornell, Westermann, and Martinez (2003) find that credit market imperfections in financially open economies could lead to increased volatility and higher growth.

Kormendi and Meguire (1985) and Grier and Tullock (1989) are among the earliest papers to directly examine the growth-volatility relationship. These papers report that the relationship is positive. On the other hand, in an influential contribution that has since acquired the status of conventional wisdom, Ramey and Ramey (1995; henceforth referred to as RR) conclude that growth and volatility are negatively related. Using a data set comprising 92 countries and covering the period 1950–85, they show that the relationship is robust after introducing various control variables, including the share of investment in GDP, population growth, human capital, and initial GDP.

Recent papers include Martin and Rogers (2000), who find evidence similar to that of RR. Fatás (2002) explores the effects of using different control variables and different measures of volatility and concludes that the negative growth-volatility relationship is robust.[5] Hnatkovska and Loayza (2005) study the growth-volatility relationship using a sample of 79 developed and developing countries over the period 1960–2000. They confirm that the relationship is robustly negative when numerous controls from the growth literature are incorporated into their regression framework. Both Fatás (2002) and Hnatkovska and Loayza (2005) also control for trade openness in their regressions, but their results indicate that the trade openness variable has no significant impact on the relationship between volatility and growth. None of these studies has examined the effects of financial integration.

II. Understanding the Basic Stylized Facts About Growth and Volatility

This section first describes the data set used in the analysis. Next, it presents some stylized facts about the evolution of growth and volatility over time and across different groups of countries. It then provides a brief descriptive analysis of the dynamics of growth and volatility before and after financial and trade liberalizations.

[5]In a recent paper, Imbs (2002) attempts to reconcile the positive relationship between growth and volatility at the sectoral level with the negative relationship at the country level. He notes that how this relationship at the sectoral level translates into the relationship at the aggregate level depends on the degree of synchronicity of fluctuations across sectors and on the relative importance of aggregate versus sector-specific shocks.

Data Set

We examine the relationship between growth and volatility using a large data set that includes industrial as well as developing countries. While the basic data set we use is the latest version of the Penn World Tables (Heston, Summers, and Aten, 2002), we supplement that with data from various other sources, including databases maintained by the World Bank and IMF. Our data set comprises annual data over the period 1960–2000 for a sample of 85 countries—21 industrial and 64 developing. The group of industrial countries corresponds to a subsample of the Organization for Economic Cooperation and Development (OECD) economies for which data used in the empirical analysis are available. For the descriptive analysis in the next two sections, we divide developing countries into two coarse groups—more financially integrated (MFI) economies and less financially integrated (LFI) economies. There are 23 MFI and 41 LFI economies in our sample. The former essentially constitute the group of emerging markets and account for a substantial fraction of net capital flows from industrial to developing countries in recent decades.

In our analysis, we use two measures of trade integration. The first is a binary measure based on the dates of trade liberalization and is taken from Wacziarg and Welch (2003), who extend the data set constructed by Sachs and Warner (1995). This measure takes a value of one when a country's trade regime is liberalized, and a value of zero otherwise. The trade liberalization dates were based on a detailed examination of country case studies of liberalization. The second measure of trade integration is a continuous one used widely in the literature—the ratio of the sum of imports and exports to GDP.

To measure the degree of financial integration, we again employ both a binary and a continuous measure. Our binary measure takes a value of one when the equity market is officially liberalized; otherwise, it takes a value of zero. Most of the dates of official financial liberalization for individual countries are taken from Bekaert, Harvey, and Lundblad (2002) and Kaminski and Schmukler (2002). Our second financial integration measure—the ratio of gross capital flows to GDP—is analogous to the trade openness ratio.[6]

Evolutions of Growth and Volatility

The first column of Table 1 presents, for different country groupings, the cross-sectional medians of the level and volatility of the growth rates of output and its main components over the past four decades. Volatility is measured by the standard deviation of the growth rate of each variable. Over the full sample period, output

[6]A detailed description of the data set and sources is provided in Kose, Prasad, and Terrones (2005). Our binary indicators can be regarded as measures of de jure trade and financial integration, while the continuous measures capture de facto integration. The distinction is of particular importance in understanding the effects of financial integration, since many economies that have maintained controls on capital account transactions have found them ineffective in many circumstances, particularly in the context of episodes of capital flight. Financial-flows data are available for some countries for only a shorter period. In our regressions, we use cross-sectional data that are based on averages over shorter time spans for some countries. For the sample of countries we study, the problem is mostly for the 1960s, when financial flows to developing countries were quite limited anyway.

Table 1. Growth and Volatility: Descriptive Statistics
(Medians for each group of countries)

	Full Sample	Decade			
	1961–2000	1960s	1970s	1980s	1990s
Output					
Growth					
Industrial countries	2.80	3.75	2.75	2.09	1.88
	[0.24]	[0.49]	[0.38]	[0.17]	[0.26]
Developing countries	1.57	2.46	2.06	0.32	1.39
	[0.21]	[0.22]	[0.40]	[0.36]	[0.38]
MFIs	2.61	3.06	2.80	1.76	2.45
	[0.41]	[0.53]	[0.99]	[1.18]	[0.70]
LFIs	1.23	2.25	1.77	–0.27	0.83
	[0.25]	[0.36]	[0.56]	[0.36]	[0.67]
Volatility					
Industrial countries	2.59	2.18	2.78	2.12	1.79
	[0.36]	[0.27]	[0.26]	[0.22]	[0.28]
Developing countries	4.90	4.62	4.83	3.89	3.39
	[0.30]	[0.46]	[0.58]	[0.24]	[0.30]
MFIs	4.07	3.29	3.35	3.56	3.27
	[0.42]	[0.57]	[0.43]	[0.64]	[0.51]
LFIs	5.38	4.82	6.40	4.05	3.39
	[0.61]	[0.56]	[0.52]	[0.31]	[0.37]
Consumption					
Growth					
Industrial countries	2.71	3.33	3.02	2.44	1.82
	[0.26]	[0.62]	[0.38]	[0.40]	[0.36]
Developing countries	1.26	1.93	2.00	0.25	1.48
	[0.20]	[0.37]	[0.33]	[0.42]	[0.35]
MFIs	1.89	2.88	2.89	0.92	2.25
	[0.52]	[0.46]	[0.70]	[1.08]	[0.53]
LFIs	0.82	1.15	1.63	–0.76	0.83
	[0.19]	[0.33]	[0.28]	[0.37]	[0.54]
Volatility					
Industrial countries	3.32	2.32	2.30	2.47	1.58
	[0.62]	[0.39]	[0.25]	[1.09]	[0.71]
Developing countries	6.91	5.70	6.29	6.23	5.15
	[0.43]	[0.34]	[0.51]	[0.47]	[0.48]
MFIs	5.63	5.13	5.54	4.70	4.73
	[0.64]	[0.56]	[0.91]	[0.67]	[0.73]
LFIs	7.99	6.35	7.21	7.19	5.58
	[0.66]	[0.45]	[0.92]	[0.55]	[0.64]
Investment					
Growth					
Industrial countries	2.78	5.00	1.49	2.67	2.10
	[0.36]	[1.14]	[0.88]	[0.38]	[0.65]
Developing countries	2.03	4.61	4.06	–1.71	2.02
	[0.36]	[0.52]	[1.13]	[0.82]	[0.94]
MFIs	2.68	4.63	4.55	1.71	2.64
	[0.78]	[0.99]	[1.50]	[1.35]	[0.93]
LFIs	1.31	4.30	4.06	–3.00	2.02
	[0.47]	[0.76]	[1.82]	[0.85]	[1.26]

(*continued*)

Table 1. *(Concluded)*

	Full Sample	Decade			
	1961–2000	1960s	1970s	1980s	1990s
Volatility					
Industrial countries	9.16	7.40	10.53	8.36	7.11
	[0.90]	[0.86]	[1.29]	[1.55]	[0.72]
Developing countries	18.37	18.24	18.24	16.27	15.14
	[1.27]	[1.66]	[1.38]	[1.37]	[1.10]
MFIs	15.76	14.48	11.32	13.27	14.18
	[1.74]	[3.00]	[2.73]	[3.26]	[2.37]
LFIs	21.80	19.12	20.28	17.40	15.14
	[1.42]	[1.77]	[1.62]	[1.10]	[1.24]
Exports					
Growth					
Industrial countries	5.27	7.07	4.96	4.33	5.60
	[0.38]	[0.92]	[0.53]	[0.28]	[0.71]
Developing countries	2.55	2.77	3.23	2.23	3.47
	[0.49]	[0.54]	[0.94]	[0.66]	[0.73]
MFIs	4.95	2.60	5.21	4.35	6.04
	[1.03]	[0.77]	[1.01]	[1.32]	[1.39]
LFIs	1.82	3.25	2.20	1.11	1.94
	[0.40]	[1.16]	[1.05]	[0.99]	[1.00]
Volatility					
Industrial countries	4.67	3.95	5.26	3.51	3.89
	[0.42]	[0.84]	[0.37]	[0.54]	[0.45]
Developing countries	11.85	9.88	12.23	10.08	7.73
	[0.65]	[0.93]	[1.29]	[0.70]	[0.57]
MFIs	9.20	8.51	10.36	8.28	6.76
	[1.09]	[1.69]	[1.52]	[0.74]	[0.75]
LFIs	13.71	11.56	14.79	10.84	9.02
	[0.88]	[1.21]	[1.66]	[1.70]	[1.23]
Imports					
Growth					
Industrial countries	5.16	7.59	4.05	3.92	5.07
	[0.40]	[0.81]	[0.61]	[0.42]	[0.40]
Developing countries	2.46	3.14	4.28	−0.58	3.41
	[0.46]	[0.56]	[0.61]	[0.97]	[0.85]
MFIs	3.61	3.07	5.56	1.43	6.17
	[0.85]	[0.93]	[1.08]	[2.35]	[1.07]
LFIs	1.82	3.14	3.74	−1.75	1.56
	[0.54]	[0.78]	[1.04]	[1.09]	[1.02]
Volatility					
Industrial countries	6.07	5.76	8.02	5.09	4.93
	[0.56]	[1.13]	[0.77]	[0.65]	[0.35]
Developing countries	14.12	11.59	13.18	14.44	11.86
	[0.82]	[0.41]	[0.72]	[0.94]	[0.91]
MFIs	13.84	12.04	12.72	12.75	11.86
	[1.32]	[1.86]	[1.02]	[2.21]	[1.50]
LFIs	15.21	11.23	13.18	15.44	11.48
	[1.26]	[0.58]	[1.12]	[0.94]	[1.29]

Source: Authors' calculations.

Notes: Standard errors are in brackets. MFI (LFI) stands for More (Less) Financially Integrated countries.

growth is highest on average for industrial countries, followed by MFI economies and then the LFI economies. The order is reversed for output volatility. Thus, at a very coarse level, one can already discern a negative cross-sectional relationship between growth and volatility.

Kose, Prasad, and Terrones (2005) show that this is confirmed by a cross-sectional plot of growth against volatility. In effect, this is the updated version of the basic RR result. The relationship is, however, different across the three groups of countries. Like RR, Kose, Prasad, and Terrones (2005) find a positive relationship between growth and volatility among industrial countries and a negative one among developing countries. But the relationship also differs among the developing countries. While it is strongly negative for LFI economies, it is positive among the group of MFI economies. These results suggest the need to clearly discriminate among these different groups of countries in further analysis.

Next, we provide some basic stylized facts from a time-series perspective. An examination of changes in patterns of macroeconomic volatility over time (Table 1, columns 2–5) shows that average output growth and volatility have both declined in industrialized countries over the 1980s and 1990s.[7] Both MFI and LFI economies saw a decline in their average output growth rates in the 1980s and a subsequent rebound in the 1990s, although growth remained below the corresponding levels in the 1970s. The evolution of volatility is less similar across these two groups, with MFI economies experiencing a small increase in volatility in the 1980s, while LFI economies had a significant decline in volatility in each of the past two decades. From this broad perspective, it is difficult to detect a stable time-series relationship between growth and volatility that is consistent across different country groups.

The results for the levels and volatility of consumption growth, reported in the second panel of Table 1, show a similar pattern in the sense that industrialized countries have the highest average consumption growth rate, followed by MFI and LFI economies; for the volatility of consumption growth, the order is reversed. However, while both industrialized and LFI economies experience a decline in the volatility of consumption growth in the 1990s, MFI economies show no such improvement. This suggests that MFI economies do not appear to benefit from financial integration in terms of being able to use international capital markets to better share their income risk and smooth growth of consumption.[8]

The results for investment are also different from those for output in some respects. For example, one key difference is that average investment growth for industrial economies picks up significantly in the 1980s, after dipping sharply in the 1970s, and then settles back slightly in the 1990s. For both groups of developing economies, average investment growth slows markedly in the 1980s before rebounding in the 1990s. Interestingly, while the volatility of investment growth declines slightly in the 1980s and 1990s for both industrial and LFI economies, it rises gradually but noticeably for the MFI economies.

[7]The steady decline in the volatility of macroeconomic aggregates in industrialized countries since the 1970s has been documented extensively (see, for example, Stock and Watson, 2002).

[8]See Kose, Prasad, and Terrones (2003b) for a more detailed analysis of this issue.

In the cases of exports and imports, the basic growth-volatility relationship is preserved over the full sample period across the three groups of countries. On average, industrial countries display the highest level of growth and lowest volatility, with MFI and LFI economies following in the usual order. However, the patterns of growth and volatility across decades again reveal some differences. During the 1990s, MFI economies become the group with the highest levels and volatility of import growth rates. Again, the relationship between growth and volatility of these macroeconomic variables has been changing over time even within country groups, implying that no clear pattern emerges from this analysis.[9]

Growth and Volatility Before and After Liberalizations

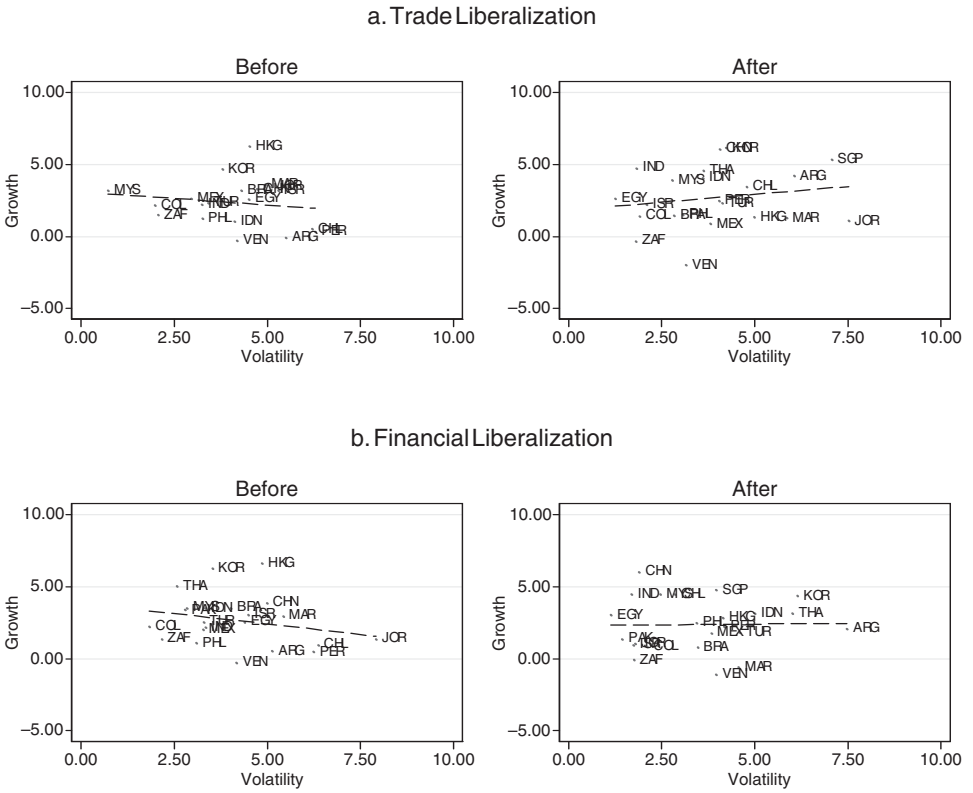
A different approach to exploring the effects of globalization on the growth-volatility relationship is to examine if this relationship has shifted during the period of globalization. As a first cut, we split the sample into two periods—1960–85 and 1986–2000. We picked this break point because, as noted earlier, capital flows across industrial countries as well as between industrial and developing countries surged dramatically starting in the mid-1980s. The results did not show a sharp shift in the relationship across the two periods. For industrial economies, the relationship looks strongly positive in both periods. For developing economies, it appears to become more strongly negative in the second period. One potential problem with this approach is that because trade and financial liberalization occurred at different times, especially among the developing economies, the choice of an identical break point in the sample for all countries could influence the results.

To overcome this problem, we turn our attention to the group of MFI economies, which faced the most dramatic shifts in openness to trade and financial flows during the past 20 years. Figures 1a–1b (taken from Kose, Prasad, and Terrones, 2005) show the relationship for this group of economies before and after trade and financial liberalization, respectively. The results indicate a major change in the growth-volatility relationship after liberalizations. For example, the relationship is strongly negative in the period before trade liberalization and positive after that. The difference between the pre- and postfinancial liberalizations periods follows a similar but somewhat less striking pattern. These plots suggest that trade and financial integration might have a considerable effect on how volatility and growth are associated.

To explore this finding further, we conduct an event study analysis for the MFI economies and examine the dynamics of growth and volatility before and after the different measures of liberalization. Table 2 presents the cross-sectional mean and median values of average levels and volatility of growth for the MFI sample before and after trade and financial liberalizations. There is a sharp increase in the average

[9]To examine whether the results discussed above could be distorted by the use of decade averages, we plotted the growth and volatility of each variable for different groups of countries using 10-year rolling windows for both the growth and volatility measures. The qualitative features of the results in Table 1 were generally preserved, indicating that the use of decade averages is not driving or distorting either the cross-sectional or time-series results.

Figure 1. Growth and Volatility in MFI Countries
(*Simple correlation, before and after liberalizations*)

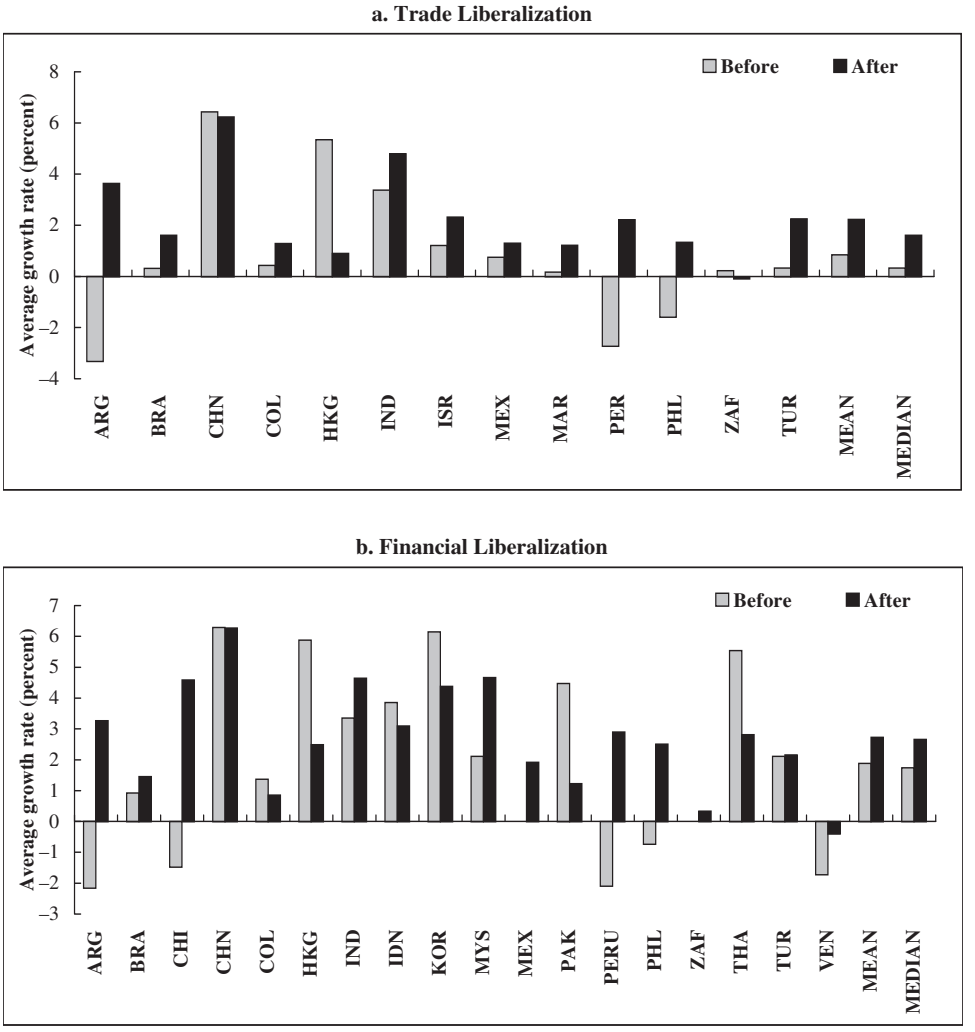


Source: Authors' calculations. MFI stands for More Financially Integrated countries.

growth rates of output and its components after trade liberalizations. Financial liberalizations are also associated, on average, with improvements in the growth performance of the MFI economies. Figures 2a–2b show that these results are not just driven by a small set of countries. For most of the countries in our sample, average growth rates of output increase after trade liberalization. The results are similar, but weaker, for financial liberalization. The lower panel of Table 2 indicates that there is only a modest reduction in the average volatility of output growth after trade or financial liberalizations, a result that is echoed by the country-specific results in Figures 3a–3b. Table 2 also shows that a similar result holds for the volatility of consumption growth. Interestingly, however, the volatility of the growth rates of the other components of output do appear to decline significantly after trade liberalizations, although the picture is much more mixed in pre- and postfinancial liberalization comparisons.

We now turn to a more detailed study of the time profiles of growth and volatility in MFI economies before and after liberalizations. We first compute the level and standard deviation of average growth rates of output, consumption, investment, exports, and imports for each MFI economy over an eight-year rolling window. We

Figure 2. Output Growth: Before and After Liberalizations



Source: Authors' calculations.
Note: See Table 2 for information about sample coverage.

then examine the behavior of sample median volatility and growth over this window before and after the liberalization dates.

Figure 4a displays the evolutions of the cross-sectional medians of average growth rates of output and its components for eight years before and eight years after a trade liberalization event. It appears that trade liberalizations often take place around the time of an economic slowdown and are, in general, followed by a substantial expansion in economic activity in the succeeding eight-year period. Changes in the growth rate of consumption closely follow those in output. After trade liberalization, investment growth on average rises more than output growth, implying a substantial increase in the rate of investment (investment/output). On average, the

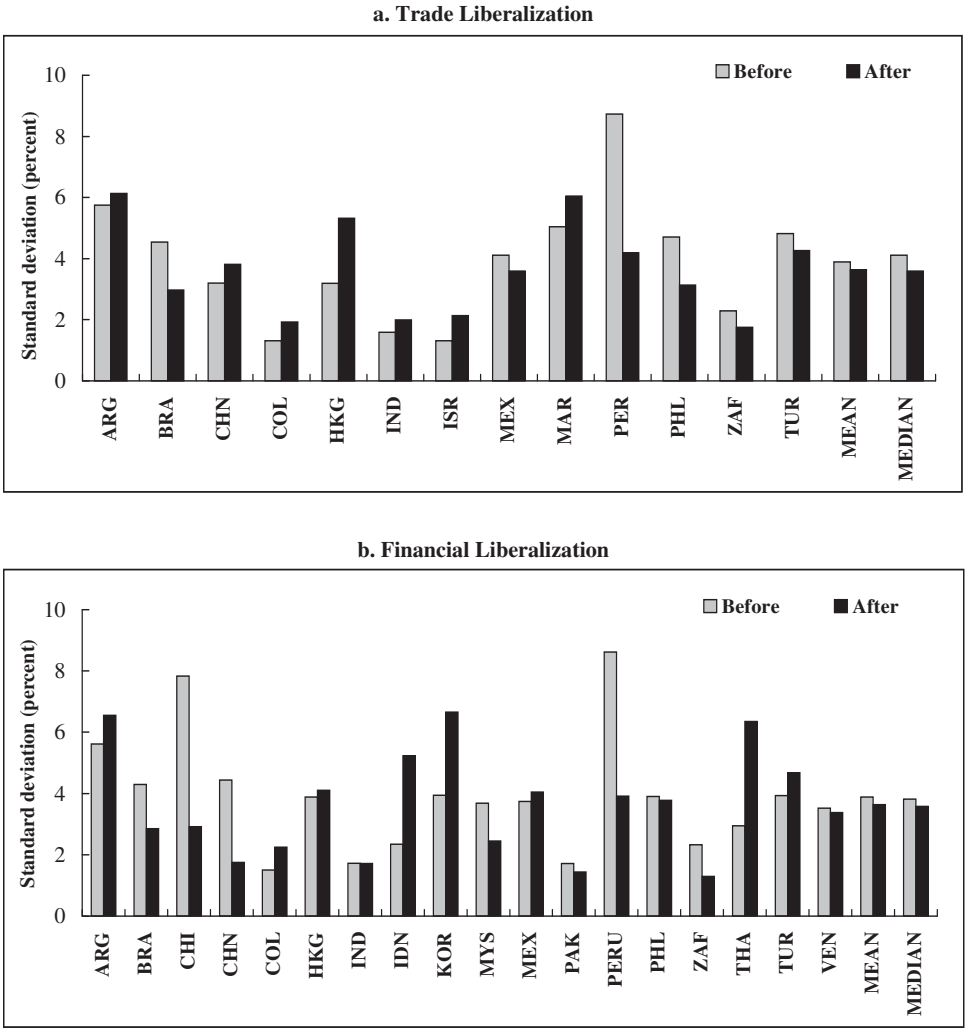
Table 2. Growth and Volatility: Descriptive Statistics Before and After Liberalization
(Sample means and medians for the MFI countries)

	Before	*After*	Before	*After*	Before	*After*	Before	*After*	Before	*After*
					Growth					
	Output		Consumption		Investment		Exports		Imports	
Trade liberalization										
Mean	0.84	*2.23*	0.91	*2.01*	−1.51	*3.46*	5.03	*5.91*	2.22	*6.57*
Median	0.33	*1.61*	0.07	*1.57*	−2.57	*3.06*	2.87	*4.99*	−0.54	*5.20*
Financial liberalization										
Mean	1.88	*2.73*	1.60	*2.45*	1.75	*2.73*	4.71	*6.70*	2.58	*7.13*
Median	1.74	*2.66*	0.64	*2.62*	2.28	*3.53*	4.01	*6.92*	2.46	*7.69*
					Volatility					
	Output		Consumption		Investment		Exports		Imports	
Trade liberalization										
Mean	3.88	*3.63*	4.92	*4.20*	17.13	*12.76*	9.98	*6.98*	16.54	*11.15*
Median	4.10	*3.59*	4.46	*3.83*	14.06	*12.81*	9.26	*6.65*	14.95	*10.00*
Financial liberalization										
Mean	3.87	*3.62*	5.10	*4.78*	16.73	*15.94*	9.15	*6.69*	15.73	*12.43*
Median	3.80	*3.56*	4.00	*4.60*	13.45	*15.19*	8.88	*6.67*	13.58	*11.94*

Source: Authors' calculations.

Notes: The period of analysis is 1980 to 2000. Countries with fewer than five observations, either before or after liberalization have been dropped from the sample. MFI stands for More Financially Integrated countries.

Figure 3. Output Volatility: Before and After Liberalizations

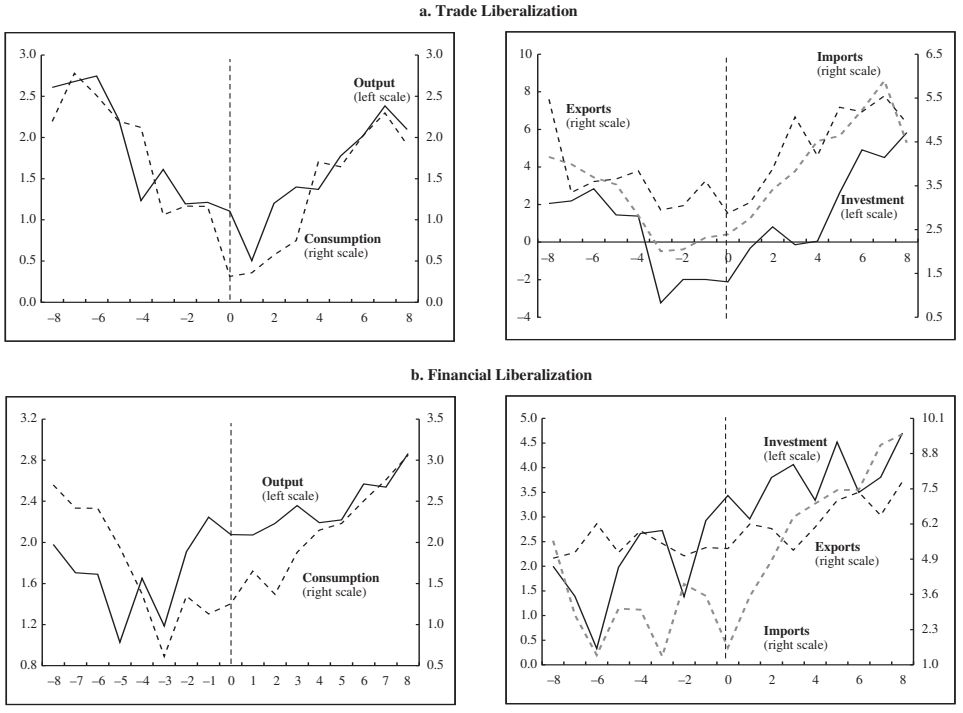


Source: Authors' calculations.
Note: See Table 2 for information about the sample coverage.

growth rates of imports and exports also register noticeable increases following trade liberalization. Figure 4b shows the median growth rates before and after financial liberalizations. Financial liberalizations are also associated with a pickup in output growth, but the increase in the cross-sectional average of output growth rates is smaller than in the case of trade liberalizations. After financial liberalizations, there is typically also a substantial increase in the growth rates of investment and imports.

How can we explain the V-shaped behavior of the growth performance of MFI economies around liberalization episodes? First, many of the liberalization programs were probably undertaken following an economic slowdown or crisis. Indeed, Tornell (1998) argues that economic reforms generally take place in the aftermath of

Figure 4. Growth: Before and After Liberalizations
(8-year rolling windows)



Source: Authors' calculations.

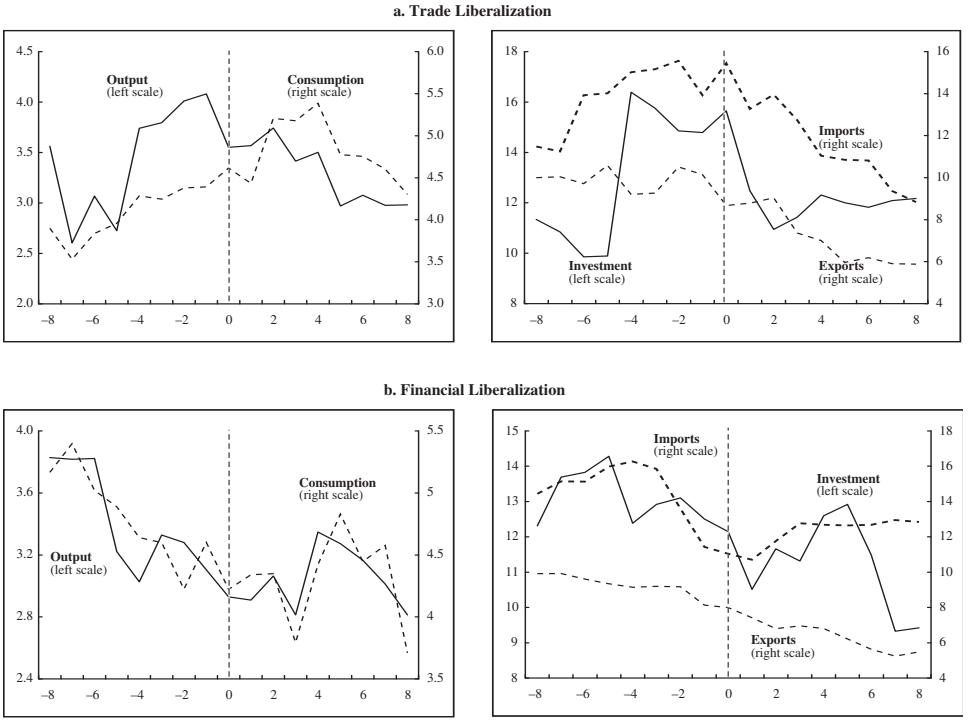
Notes: 0 (zero) indicates the year of liberalization. In each panel, the sample median of eight-year rolling window of the average growth rate of respective variable is plotted.

economic and/or political crises and documents that between 1970 and 1995, almost 60 percent of trade liberalizations were implemented during periods of economic turmoil. Second, implementation of liberalization programs could signal a change in the nature of economic policies, which in turn leads to increased credibility. In the case of financial liberalizations, this probably increases both foreign financial flows and domestic investment, which results in an increase in economic growth. In the case of trade liberalizations, there could be an increase in domestic investment growth because of the fall in the cost of foreign capital goods and intermediate inputs. The export sector would also be expected to expand faster following trade liberalization, owing to increased access to foreign markets. Both of these could boost output growth in the aftermath of trade liberalization programs.

Figures 5a–5b show how the cross-sectional medians of the volatility of the growth rates of output and its components evolve before and after trade and financial liberalizations, respectively. Neither type of liberalization leads to a decisive change in the volatility of output and consumption growth. However, growth rates of investment, exports, and imports do appear to become somewhat less volatile after trade and financial liberalizations.

Some of these results are consistent with other findings in the literature. For example, Wacziarg and Welch (2003) document that trade liberalizations are asso-

Figure 5. Volatility: Before and After Liberalizations
(8-year rolling windows)



Source: Authors' calculations.

Notes: 0 (zero) indicates the year of liberalization. In each panel, the sample median of the eight-year rolling window of the standard deviation of the average growth rate of the respective variable is plotted.

ciated with increases in the average growth rate of output and the investment rate. Bekaert, Harvey, and Lundblad (2001) find that equity market liberalizations on average produce a 1 percent increase in the growth rate of output over a five-year period and lead to an increase in the investment rate. However, in the case of the impact of financial liberalizations on volatility, our results are somewhat different from those of Bekaert, Harvey, and Lundblad (2002), who employ a larger sample of countries than in our data set. They find that after equity market liberalizations, there is generally a significant decrease in the volatility of output and consumption growth.

A Regional Case Study: Growth and Volatility in Sub-Saharan Africa

In previous sections, we documented a negative relationship between growth and volatility in developing countries. In addition, recent research concludes that output volatility could have a negative impact on poverty. Among the poorest regions of the world, Sub-Saharan Africa (SSA) has always been a stark example of the negative relationship between volatility and growth and the adverse effects of volatility on poverty and welfare. The average growth rate of output in the region has been the

slowest of any region over the past three decades, while its volatility has been the highest. This section briefly analyzes the relationship between growth and volatility in SSA.[10]

Figure 6a shows the negative relationship between volatility and growth in sub-Saharan Africa over the period 1970–2004. The countries in SSA, in addition to being poor, share several other features that further magnify the negative effects of volatility on growth. In particular, the strength and composition of economic linkages with the global economy play a major role in explaining the negative relationship between volatility and growth in the region. For example, SSA's trade linkages with the global economy remain relatively weak, limiting the region's ability to cope with the adverse impact of volatility on growth. Despite recent improvements in the region as a whole, the trade policy regimes of several countries in SSA are highly restrictive, reflecting the presence of high and dispersed tariffs and widespread use of nontariff barriers.

Sub-Saharan African trade linkages with the global economy are weak in some respects when compared, for instance, with the emerging market countries in Asia. (Figure 6b). As we show using various regression models in the next section, weak trade linkages could be one of the major factors driving the negative association between volatility and growth in the region. Moreover, sub-Saharan African economies depend on a narrow range of commodities for their export earnings. In particular, primary goods constitute close to 90 percent of total exports in these countries, which is more than double that in emerging Asia. Mainly because of this, terms-of-trade fluctuations are very volatile in the sub-Saharan African countries, adversely affecting growth. Consistent with the stylized facts we documented earlier, the average growth is much higher in emerging Asian countries than in sub-Saharan Africa, while volatility in emerging Asia is roughly half of that in the SSA region (Figure 6c).

III. Regression Analysis

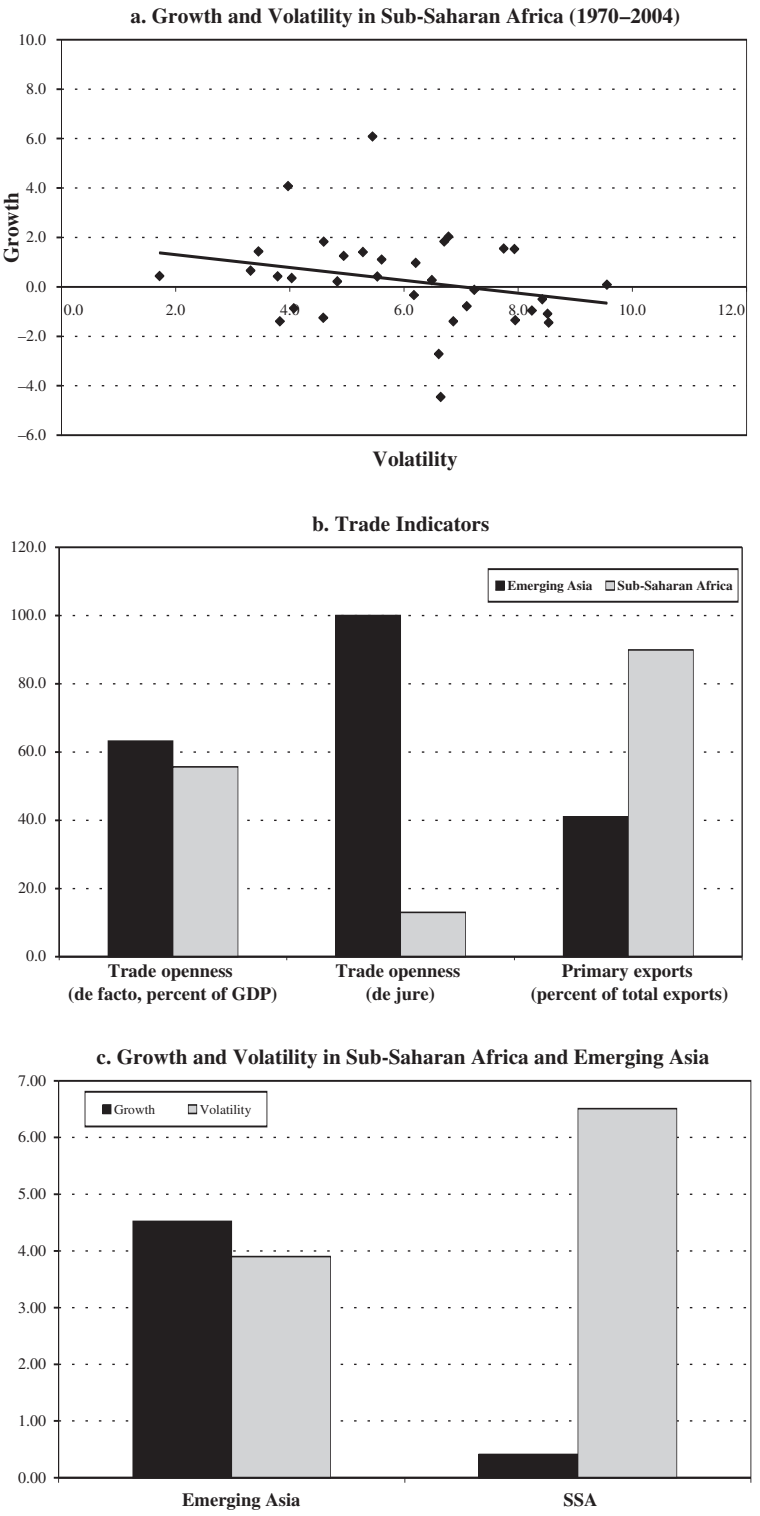
This section turns to a more formal empirical analysis of the growth-volatility relationship. We first reexamine the validity of the basic RR results in our longer (and slightly different) sample covering the period 1960–2000. Next, we analyze the impact of globalization on this relationship by interacting volatility with the measures of economic integration in our regressions. We also provide a brief discussion of how different types of financial flows could affect the growth-volatility relationship. We then turn our attention to the effects of volatility stemming from different components of demand on this relationship. Finally, we examine the impact of numerous additional control variables and conduct some robustness tests of our main results.

The Basic Relationship Between Growth and Volatility

The first regression that RR report in their paper is a cross-sectional bivariate regression of mean output growth on its standard deviation for a 92-country sample

[10]Some of the material in this subsection is drawn from research conducted by two of the authors of this paper for the IMF's *World Economic Outlook* (see Kose and Terrones, 2005).

Figure 6. Growth and Volatility: A Regional Perspective



Source: Authors' calculations.
Notes: In each figure, volatility refers to the standard deviation of growth rates of per capita values. All other statistics are averages of respective variables over the comparable periods.

over the period 1962–85. They report that the coefficient on output volatility is significantly negative. We run a similar cross-sectional regression of output growth, measured as the average growth rate of per capita GDP, on volatility, measured as the standard deviation of output growth. We reestimate this basic RR regression for our sample of 85 countries over the period 1960–2000. As shown in Table 3, we get a statistically significant coefficient of –0.23 (column 1), which is close to the one reported in RR, confirming that their basic result is preserved in our sample.

Does the relationship remain valid for different country groups? As column 2 shows, a similar regression based on our subsample of 21 industrial countries yields a significantly positive coefficient of 0.42. RR find that in their sample of 24 OECD economies, the coefficient on volatility is positive but not significantly different from zero. One potential explanation of the difference between these two results is that the positive association between volatility and economic growth among industrial countries has become stronger over time. Other reasons could be the difference in sample coverage (21 industrial countries in ours versus 24 in theirs) and data revisions in the Penn World Tables.

We find a negative and statistically significant relationship between growth and volatility for the developing country subsample (column 3). We then analyze how the growth-volatility relationship differs across industrial, MFI, and LFI countries. To do this, we interact volatility with dummies for the three groups of countries.

Table 3. Growth and Volatility: Cross-Section Regressions

	Full Sample [1]	Industrial Countries [2]	Developing Countries [3]	Full Sample: with interaction terms [4]
Volatility	–0.228	0.420	–0.182	
	[0.076]***	[0.210]*	[0.094]*	
Volatility × Industrial				0.363
				[0.162]**
Volatility × MFI				0.239
				[0.146]
Volatility × LFI				–0.112
				[0.074]
Number of observations	85	21	64	85
Adjusted R-squared	0.09	0.11	0.04	0.32
Is the volatility coefficient equal across country groups? (P-values)				
H0: Industrial = MFI				0.257
H0: Industrial = LFI				0.000
H0: MFI = LFI				0.001
H0: Industrial = MFI = LFI				0.000

Source: Authors' calculations.

Notes: The dependent variable is the growth rate of GDP per capita. Industrial, MFI, and LFI denote country group dummy variables. MFI (LFI) stands for More (Less) Financially Integrated countries. Robust significance standard errors are reported in brackets. The symbols *, **, and *** indicate statistical at the 10 percent, 5 percent, and 1 percent levels, respectively. All regressions include an intercept.

We again find a statistically significant positive relationship between volatility and growth for industrial countries (column 4). The results suggest that there is a weak positive association between volatility and growth (borderline significant at the 10 percent level) for MFI economies, whereas it is negative (but not statistically significant) for LFI countries. In addition, the coefficient associated with LFI economies appears to be significantly different from those of other groups of economies.

Three main findings from this exercise stand out. First, the unconditional negative cross-sectional relationship between growth and volatility documented by RR is preserved in our sample. Second, the basic relationship is sensitive to the choice of country groups. In particular, the results indicate that while there is a significant positive relationship for industrial countries, the relationship is significantly negative for developing countries. Third, the association between growth and volatility appears to differ across the groups of MFI and LFI economies. The latter two results suggest that levels of trade and financial integration might have an influence on the growth-volatility relationship.

However, these bivariate regressions set aside the issue of additional controls that could explain growth. To address this issue, we follow the RR study and include a set of standard controls commonly used in the growth literature, including the log level of initial per capita income, the fraction of the population with at least a primary education, the share of investment in GDP, and the average population growth rate. We present the results of regressions with additional controls in Table 4 (column 2). The results indicate that these additional controls are statistically significant with their expected signs. The education variable has a significantly positive impact on growth, and initial per capita income has a significant and negative impact (which has been interpreted as evidence of conditional convergence). More importantly, the nature of the relationship between growth and volatility is not affected by the inclusion of the growth controls. In particular, while the coefficient on volatility becomes smaller, it retains its statistical significance.[11] We then estimate the regressions using the industrial and developing country subsamples (columns 3 and 4). The results are broadly consistent with those from the full sample. Interestingly, for the industrial country subsample, the coefficient on volatility is almost the same as that in the RR regression (–0.385 in RR and –0.379 in ours; both are statistically significant).

These findings indicate that the growth-volatility relationship documented by RR persisted into the 1990s. However, the unconditional correlations in Table 3 also suggest that there could be a nonlinear relationship between growth and volatility, since the correlation is negative for developing countries and positive for industrial countries. To further analyze the nature of this nonlinearity, we now examine directly the roles of trade and financial linkages.

[11]These results are consistent with the findings in Hnatkovska and Loayza (2005), but they differ from those in Fatás and Mihov (2003). The latter study reports that while the unconditional growth-volatility relationship is significantly negative, it becomes insignificant when these authors introduce the additional growth controls.

Table 4. Growth and Volatility: Cross-Section Regressions

	[1]	[2]	[3]	[4]	[5]	[6]	[7]	[8]
Volatility	−0.228***	−0.157**	−0.379**	−0.184**	−0.152*	−0.232**	−0.090	−0.230***
	[0.076]	[0.073]	[0.142]	[0.073]	[0.077]	[0.089]	[0.087]	[0.086]
Volatility × Trade integration						0.119***		0.162***
						[0.044]		[0.052]
Volatility × Financial integration							−0.128	−0.637**
							[0.588]	[0.318]
Trade integration (binary)					0.012***	0.011*	0.012**	0.012***
					[0.004]	[0.005]	[0.005]	[0.004]
Financial integration (binary)					0.013	0.003	0.005	0.009
					[0.011]	[0.011]	[0.013]	[0.010]
Trade integration (percent of GDP)					0.009***			
					[0.003]			
Financial integration (percent of GDP)					−0.026***			
					[0.009]			
Initial income (log)		−0.009***	−0.026***	−0.006***	−0.010***	−0.010***	−0.010***	−0.010***
		[0.002]	[0.005]	[0.002]	[0.002]	[0.002]	[0.002]	[0.002]
Primary education		0.022***	0.041	0.014**	0.024***	0.024***	0.025***	0.023***
		[0.005]	[0.025]	[0.007]	[0.007]	[0.005]	[0.006]	[0.005]
Investment rate (percent of GDP)		0.111***	−0.016	0.133***	0.055**	0.063**	0.083***	0.056**
		[0.028]	[0.030]	[0.028]	[0.027]	[0.026]	[0.030]	[0.027]
Population growth		−0.005***	−0.004*	−0.007**	−0.004**	−0.004**	−0.003*	−0.004**
		[0.002]	[0.002]	[0.003]	[0.002]	[0.002]	[0.002]	[0.002]
Number of observations	85	85	21	64	85	85	85	85
Adjusted R-squared	0.09	0.54	0.80	0.53	0.62	0.60	0.56	0.62

Source: Authors' calculations.

Notes: The dependent variable is the growth rate of GDP per capita. Robust standard errors are reported in brackets. The symbols *, **, and *** indicate statistical significance at the 10 percent, 5 percent, and 1 percent levels, respectively. For the interaction terms, trade integration is defined as the ratio of total trade to GDP, and financial integration is defined as the ratio of capital flows to GDP. All regressions include an intercept.

Understanding the Role of Globalization

We now analyze how different aspects of globalization affect the growth-volatility relationship by introducing various measures of integration into the cross-section regression. Interestingly, when we introduce measures of trade and financial integration, the coefficient on volatility remains negative and statistically significant (Table 4, column 5). The coefficients on both trade integration variables are statistically significant and positive, indicating that trade integration has a positive impact on economic growth even after controlling for the effect of volatility. However, the coefficient on the financial openness variable is negative. As noted in Section I, several papers suggest that there is no robust correlation between financial integration and economic growth, and, in some of these, the coefficient on financial openness has a negative sign, similar to the result reported here.

We then interact volatility with the integration variables to examine if the relationship between growth and volatility is linked to the degree of integration. When we interact the volatility variable with measures of integration, we always use continuous rather than discrete measures of the latter. These continuous measures capture variations over time in the degree of trade and financial integration better than the binary ones, as they more accurately reflect the changes in annual trade and financial flows.

Column 6 of Table 4 shows that the interaction between volatility and trade integration is significantly positive. The coefficient on volatility is also significant and negative. The positive interaction term indicates that the greater the degree of trade integration, the weaker the negative relationship between volatility and growth. In other words, for a given level of volatility, economies with a higher degree of trade integration appear to suffer smaller negative effects on growth than those with a lower degree of trade integration. Column 7 reports results for the measures of financial integration. The basic relationship between growth and volatility disappears, and only the binary measure of trade integration has a positive and statistically significant coefficient.

We now turn our attention to the roles played by trade and financial integration together to get a better grasp of how different aspects of globalization affect the relationship between growth and volatility. When we include both the trade and financial interaction terms, the positive coefficient on the interaction with trade integration stays statistically significant, while the coefficient on the financial integration interaction term turns negative and significant (column 8). Thus, once trade integration is accounted for, financial integration appears to have a negative impact on the growth-volatility relationship. This result is similar and could be related to the sign of the coefficient on the financial integration variable in column 3.

One interpretation of these results is that higher trade openness brings with it benefits in terms of higher growth even though it may also expose an economy to more volatility arising from external shocks. This is consistent with a large body of literature showing that trade integration is good for growth (Baldwin, 2003; Berg and Krueger, 2003; and Winters, 2004) but is typically associated with higher volatility (Kose, Prasad, and Terrones, 2003a). What are the mechanisms through which openness to trade could mitigate the adverse impact of volatility on growth?

While our present paper does not attempt to address this question, recent research suggests several possible mechanisms. For example, trade integration could help a developing economy export its way out of a recession, since a given exchange rate depreciation could have a larger impact on its export revenues than in an economy with weaker trade linkages. Stronger export revenues could also help service external debt, which is quite substantial in a number of developing countries (see Catão, 2002). These factors also suggest that openness to trade flows could make developing countries less vulnerable to sudden stops of international capital flows (see Cavallo and Frankel, 2004).[12]

Could the results for the financial openness variable be driven by highly volatile portfolio flows? As discussed in Section I, some studies find that different types of financial flows may have different effects on economic performance. In particular, these studies consistently indicate that FDI flows tend to be positively associated with economic growth. While other forms of capital inflows could also have a positive association with economic growth, their impact tends to be smaller and less robust (Prasad and others, 2003; Reisen and Soto, 2001). Another important feature that has been documented in the literature is that different types of capital flows differ substantially in terms of their volatility. For example, FDI flows constitute the least volatile category of financial flows to developing countries, which is not surprising given their long-term and relatively fixed nature. Portfolio flows tend to be far more volatile and prone to abrupt reversals (Wei, 2001).

To further analyze the impact of financial integration on the growth-volatility relationship, we now compare the impacts of different types of financial flows. We focus on two broad categories: FDI flows and all other categories of flows, including portfolio flows and bank lending.[13] The first panel of Table 5 shows the results of cross-section regressions when volatility is interacted with financial integration, now measured by the ratio of gross flows of FDI to GDP. The coefficients associated with the interaction terms suggest that FDI flows have a significant and positive impact on the relationship between growth and volatility (columns 1, 2, and 3). When both interaction terms are employed, the coefficient on the trade openness interaction, while still positive, turns insignificant (column 4). Interestingly, the interaction term on financial integration becomes positive and significant, suggesting that FDI flows could dampen the adverse impact of volatility on economic growth.

When volatility is interacted with the other financial integration measure, which is based on gross non-FDI capital inflows and outflows as a ratio to GDP, the interaction term on financial integration again turns negative (columns 5–7). Moreover, when the trade openness interaction is included, the interaction coefficient associated with financial integration becomes significantly negative (column 8). The interaction term-on-trade integration, on the other hand, again becomes positive and

[12]Kose, Meredith, and Towe (2005) analyze the impact of the North American Free Trade Agreement on the dynamics of volatility and growth in Mexico and argue that trade integration has made the Mexican economy more resilient to shocks and may have contributed to Mexico's faster recovery from the 1994–95 peso crisis than from the 1982 debt crisis.

[13]Non-FDI flows could include official flows. However, in our data set, it is difficult to distinguish between official grants/loans and other types of non-FDI flows. Hence, the results below using non-FDI flows should be interpreted with some caution.

Table 5. Growth and Volatility: Cross-Section Regressions
(Different types of financial flows)

	FDI Flows				All Other Flows			
	[1]	[2]	[3]	[4]	[5]	[6]	[7]	[8]
Volatility	–0.142*	–0.232**	–0.141*	–0.200**	–0.144*	–0.232**	–0.078	–0.216**
	[0.079]	[0.089]	[0.079]	[0.090]	[0.078]	[0.089]	[0.085]	[0.087]
Volatility × Trade integration		0.119***		0.062		0.119***		0.127***
		[0.044]		[0.047]		[0.044]		[0.043]
Volatility × Financial integration			1.517***	1.114**			–0.425	–0.487***
			[0.345]	[0.493]			[0.37]	[0.174]
Trade integration (binary)	0.013***	0.011*	0.015***	0.014***	0.013***	0.011*	0.014***	0.013***
	[0.005]	[0.005]	[0.005]	[0.005]	[0.004]	[0.005]	[0.005]	[0.004]
Financial integration (binary)	–0.001	0.003	–0.001	0.000	0.010	0.003	0.006	0.006
	[0.012]	[0.011]	[0.011]	[0.011]	[0.010]	[0.011]	[0.011]	[0.010]
Trade integration (percent of GDP)	0.004				0.008***			
	[0.004]				[0.003]			
Financial integration (percent of GDP)	0.042				–0.023***			
	[0.031]				[0.006]			
Initial income (log)	–0.010***	–0.010***	–0.010***	–0.010***	–0.010***	–0.010***	–0.010***	–0.010***
	[0.002]	[0.002]	[0.002]	[0.002]	[0.002]	[0.002]	[0.002]	[0.002]
Primary education	0.024***	0.024***	0.024***	0.023***	0.024***	0.024***	0.025***	0.023***
	[0.006]	[0.005]	[0.006]	[0.006]	[0.006]	[0.005]	[0.006]	[0.005]
Investment rate (percent of GDP)	0.067**	0.063**	0.067**	0.061**	0.057**	0.063**	0.078**	0.057**
	[0.026]	[0.026]	[0.026]	[0.026]	[0.027]	[0.026]	[0.030]	[0.027]
Population growth	–0.003**	–0.004**	–0.003*	–0.003*	–0.004**	–0.004**	–0.003*	–0.004**
	[0.002]	[0.001]	[0.002]	[0.002]	[0.002]	[0.002]	[0.002]	[0.002]
Observations	85	85	85	85	85	85	85	85
Adjusted R-squared	0.61	0.60	0.62	0.62	0.62	0.60	0.58	0.62

Source: Authors' calculations.

Notes: The dependent variable is the growth rate of GDP per capita. Trade integration is the ratio of total trade to GDP. Financial integration is the ratio of FDI flows to GDP in columns 1 through 4 and the ratio of portfolio and other flows to GDP in columns 5 through 8. Robust standard errors are reported in brackets. The symbols *, **, and *** indicate statistical significance at the 10 percent, 5 percent, and 1 percent levels, respectively. All regressions include an intercept.

significant. These findings suggest that portfolio and other flows, which are relatively more volatile than FDI flows, tend to intensify the negative relationship between volatility and growth, while trade openness appears to weaken it.

Roles Played by Different Components of Aggregate Demand

Section I discussed the potential roles played by various components of demand and different types of shocks in linking the volatility of output to economic growth. We now examine how the volatility of the growth rates of different components of demand affect the growth rate of output. This could help explain the nature of the relationship between the amplitude of macroeconomic fluctuations and economic growth as emphasized by some studies. For example, some theoretical models argue that the link between growth and volatility depends on the dynamics of investment. Bernanke (1983) and Aizenman and Marion (1993) construct models in which irreversibilities and/or the presence of asymmetric adjustment costs in investment could lead to higher volatility and lower investment, which in turn reduces economic growth.[14]

To shed light on this issue, we regress the growth rate of output on the volatility of each demand component within the same regression framework used so far. In particular, we focus on the roles played by consumption, investment, and government expenditure.[15] The results in Table 6 show that the unconditional correlation between growth and volatility remains significantly negative when we include the volatility of the demand components except for government expenditures (columns 1, 4, and 7). We then reestimate the same relationship after introducing additional growth controls (columns 2, 5, and 8). There is a significant and negative relationship between output growth and the volatility of each demand component, indicating the importance of each of these components in accounting for the overall negative relationship between growth and volatility.[16]

Next, we analyze how globalization affects the growth-volatility relationship by interacting the volatility of each demand component with the measures of integra-

[14]Aizenman and Marion (1999) find a negative correlation between aggregate volatility and private investment in developing countries. RR find little evidence in support of theories that attribute the negative link between volatility and economic growth to investment dynamics. Balassa (1978), Feder (1983), Moran (1983), and Basu and McLeod (1992) examine the relationship between export instability and economic growth.

[15]We also examined the roles played by the volatility of the growth rates of exports and imports. Those results are not reported here, since those two components of GDP do not appear to be important in driving the growth-volatility relationship.

[16]For example, investment plays a critical role in transmitting the negative impact of volatility to growth in Africa. While sub-Saharan Africa's low rate of investment has always been a major impediment to economic growth, the high volatility of investment in the region has been particularly damaging (see Fischer, Hernández-Catá, and Khan, 1998). The average growth rate of investment in sub-Saharan Africa has been the slowest of any region over the past three decades, while its volatility has been the highest. Sub-Saharan African countries also suffer from the detrimental effects of highly volatile and procyclical fiscal policies on economic growth. Government revenues in sub-Saharan Africa are dependent on extremely volatile commodity exports, which results in large fluctuations in these revenues (Dehn, Gilbert, and Varangis, 2005). Recent research shows that highly volatile and procyclical fiscal policies often lead to an increase in the amplitude of macroeconomic fluctuations and lower economic growth (Fatás and Mihov, 2003).

Table 6. Growth and Volatility: Cross-Section Regressions
(Components of Demand)

	Consumption			Investment			Government Expenditure		
	[1]	[2]	[3]	[4]	[5]	[6]	[7]	[8]	[9]
Volatility	–0.136***	–0.100**	–0.187***	–0.077***	–0.042***	–0.058***	–0.031	–0.045*	–0.060**
	[0.046]	[0.039]	[0.049]	[0.014]	[0.013]	[0.019]	[0.032]	[0.024]	[0.025]
Volatility × Trade integration			0.120**			0.043			0.042
			[0.048]			[0.026]			[0.027]
Volatility × Financial integration			–0.431			–0.171			–0.180
			[0.400]			[0.136]			[0.140]
Trade integration (binary)			0.012**			0.012**			0.016***
			[0.005]			[0.005]			[0.004]
Financial integration (binary)			0.008			0.010			0.007
			[0.011]			[0.01120]			[0.011]
Trade integration (percent of GDP)									
Financial integration (percent of GDP)									
Initial income (log)		–0.009***	–0.010***		–0.008***	–0.010***		–0.008***	–0.010***
		[0.002]	[0.002]		[0.002]	[0.002]		[0.002]	[0.002]
Primary education		0.024***	0.026***		0.019***	0.020***		0.022***	0.025***
		[0.006]	[0.006]		[0.006]	[0.006]		[0.006]	[0.006]
Investment rate (percent of GDP)		0.106***	0.053*		0.097***	0.055**		0.110***	0.061**
		[0.029]	[0.027]		[0.026]	[0.023]		[0.025]	[0.026]
Population growth		–0.005***	–0.004**		–0.005***	–0.003**		–0.006***	–0.004**
		[0.002]	[0.002]		[0.002]	[0.002]		[0.002]	[0.002]
Observations	85	85	85	85	85	85	85	85	85
Adjusted R-squared	0.10	0.56	0.63	0.25	0.56	0.61	0.00	0.54	0.61

Source: Authors' calculations.

Notes: The dependent variable is the growth rate of GDP per capita. Volatility is measured by the volatility of consumption in columns 1 through 3, by the volatility of investment in columns 4 through 6, and the volatility of government expenditure in columns 7 through 9. Trade integration is the ratio of total trade to GDP. Robust standard errors are reported in brackets. The symbols *, **, and *** indicate statistical significance at the 10 percent, 5 percent, and 1 percent levels, respectively. All regressions include an intercept.

tion in our regressions (columns 3, 6, and 9). Our results are broadly consistent with the benchmark findings reported in Table 4. For all three demand components, trade integration appears to weaken the negative relationship between growth and volatility, but the interaction term on trade integration is statistically significant only for the volatility of consumption growth. There are a couple of possible reasons why the results with consumption are most similar to our benchmark findings. First, consumption fluctuations could be better at tracking the fluctuations in output simply because consumption is the largest component of output in most of the countries in our sample. Moreover, among the components of domestic demand, the growth rate of consumption has the highest correlation with output growth. In the case of the financial integration variable, the results indicate that the interaction term is again negative, but not statistically significant, in all of these specifications.

Robustness Tests

We conducted a variety of robustness tests of our main results. To conserve space, we only summarize our main findings here.[17] We took the benchmark specification (Table 4, column 8) and added a number of additional controls (one per regression—we did not include all of these additional controls simultaneously). These additional controls included measures of financial development (ratios of broad money and private sector credit to GDP), real exchange rate overvaluation, the composition of output (share of the agricultural sector in GDP), indicators of institutional quality, and the skewness of output growth (one way of capturing the effects of large episodes of volatility on the growth-volatility relationship). We also checked the sensitivity of our results to alternative regression frameworks. To address the concern that the key results could be driven by outliers, we reestimated the benchmark specification using a least-absolute deviation regression.[18]

In virtually all of these specifications, the negative coefficient on volatility and the positive coefficients on the trade integration and volatility*trade integration interaction variables were preserved. The coefficients on financial integration and volatility*financial integration proved to be somewhat fragile, however, losing their statistical significance in a few of the specifications. In short, many of the key results of our paper—especially those related to trade integration—are reasonably robust. In particular, the role of trade integration in dampening the negative association between growth and volatility is significant across all these robustness experiments.

IV. Conclusions

This paper has provided a comprehensive examination of the relationship between growth and volatility. We first documented the basic stylized facts about the evolution of the growth and volatility relationship over time and across countries. The

[17]Tables with detailed results are available from the authors upon request.

[18]Another potential concern is endogeneity of the trade and financial integration variables. This is a much bigger concern for panel data estimation. In our earlier paper (Kose, Prasad, and Terrones, 2005), where we use growth and volatility measures over 10-year periods and conduct panel estimation, we run instrumental variables regressions to address this problem explicitly.

results indicate that this relationship has been changing over time and across different country groups in response to increased trade and financial flows. In particular, evidence suggests that the nature of this relationship differs even among developing countries, depending on the level of their integration into the global economy. Results from the event-study analysis suggest that there tends to be a major shift in the growth-volatility relationship after trade and financial liberalizations. For example, among MFI economies, the relationship is strongly negative in the period before trade liberalizations and positive after that. The difference between the pre- and post-financial liberalizations periods follows a similar but less definitive pattern. These findings suggest that trade and financial integration could have a considerable effect on the association between volatility and growth.

We then provided a more formal analysis of the relationship between growth and volatility using various cross-section regression models. Several interesting results from this analysis stand out. First, when we include the data for the 1990s, the negative relationship between volatility and growth appears to survive, but with some important qualifications. Trade integration seems to attenuate the negative growth-volatility relationship, as the estimated coefficients on interactions between volatility and trade integration are significantly positive. This suggests that countries that are more open to trade flows could face a less severe trade-off between growth and volatility. Financial integration, however, seems to strengthen the negative relationship between growth and volatility.

We then examined whether the latter finding could be driven by highly volatile portfolio flows. Our results indicate that portfolio and other capital flows, which are relatively more volatile than FDI flows, do intensify the negative relationship, while FDI flows dampen the adverse impact of volatility on economic growth. We also found that volatility stemming from various components of aggregate demand—including consumption, investment, and government expenditure—is negatively associated with overall economic growth.

Does the result about the role of financial integration imply that the adverse impact of macroeconomic volatility on growth is further exacerbated in more financially integrated economies? Such a strong conclusion may not be warranted simply on the basis of the cross-section regressions presented in this paper, which do not utilize the marked variation over time in the measures of integration. As briefly documented above, trade linkages have increased substantially over the past four decades. Moreover, these changes over time are particularly important in the context of financial integration, which has risen greatly since the mid-1980s. In our earlier paper (Kose, Prasad, and Terrones, 2005), we provided a panel regression analysis of the relationship between volatility and growth that is aimed at capturing the effects of the significant changes over time in the volume of trade and financial flows. That analysis indicates that both trade and financial integration attenuate the negative growth-volatility relationship. This finding suggests that it is necessary to consider the temporal patterns as well as cross-sectional changes in the dynamics of financial flows in order to account for the impact of financial integration on the relationship between volatility and growth. While the results for trade integration are very similar to those reported here, our earlier paper also documents that the results for the interaction of financial integration with volatility are smaller and less robust in terms of statistical significance across different specifications.

The finding that FDI flows may have different effects than the other types of capital flows is intriguing. However, before drawing any firm conclusions, a deeper analysis of this issue is warranted. In future work, we also plan to examine how capital account openness and domestic financial sector liberalization jointly affect an economy's growth rate and exposure to macroeconomic volatility.

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