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MANAGING VOLATILITY AND CRISES:  
A PRACTITIONER'S GUIDE OVERVIEW

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Managing Volatility and Crises: A Practitioner's Guide Overview

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**ABSTRACT**

This overview introduces and summarizes the findings of a practical volume on managing volatility and crises. The interest in these topics stems from the growing recognition that non-linearities tend to magnify the impact of economic volatility, leading to large output and economic growth costs, especially in poor countries. In these circumstances, good times do not offset the negative impact of bad times, leading to permanent negative effects. Such asymmetry is often reinforced by incomplete markets, sovereign risk, divisive politics, inefficient taxation, procyclical fiscal policy and weak financial market institutions — factors that are more problematic in developing countries. The same fundamental phenomena that make it difficult to cope with volatility also drive crises. Hence, the volume also focuses on the prevention and management of crises. It is a user-friendly compilation of empirical and policy results aimed at development policy practitioners divided into three modules: (i) the basics of volatility and its impact on growth and poverty; (ii) managing volatility along thematic lines, including financial sector and commodity price volatility; and (iii) management and prevention of macroeconomic crises, including a cross-country study, lessons from the debt defaults of the 1980s and 1990s and case studies on Argentina and Russia.

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# Managing Volatility and Crises Overview

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## Introduction

This overview introduces and summarizes the findings of a practical volume on managing volatility and crises. The interest in these topics stems from the growing recognition that non-linearities tend to magnify the impact of economic volatility, leading to large output and economic growth costs, especially in poor countries. The same fundamental phenomena that make it difficult to cope with volatility also drive crises. Hence, the volume also focuses on the prevention and management of crises. The chapters included in the volume are listed below and may be found using the following link:

<http://www1.worldbank.org/economicpolicy/mv/mvcguide.html>

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2. Volatility and Growth *Viktoria Hnatkovska and Norman Loayza*
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4. Finance and Volatility *Stijn Claessens*
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### Analytical Toolkit

## What is Volatility?

To a world still recovering from the bursting of the internet bubble in 2001, the image most immediately conjured up by the word “volatile” might be that of an unstable stock market; or, in view of the balance-of-payments crises of the late 1990s, of unpredictable capital flows driven by fickle market sentiment to emerging market countries. But the adjective could equally be applied to the weather. In India, for example, even though the share of agriculture in national output has dropped from one-half in the 1960s to one-quarter today, a good monsoon can still make a significant difference to GDP growth. “Volatile” can also be used to describe a political climate, such as that prevailing in Iraq or Haiti; or the procyclical response of fiscal policy to fluctuations in the price of oil for an oil exporter such as Nigeria; or even the behavior of a crowd in downtown Buenos Aires, Argentina, protesting the *corralito* or freeze on bank deposits in December 2001.

Depending upon how one looks at it, volatility in mainstream economics has either been around for a long time or else is of more recent vintage. The first view would assert that volatility dates to the time that the study of business cycles began—although it might be more correct to say that the concern there was more with decomposing economic growth into a cyclical and trend component than with volatility per se. The second view is that volatility began to develop into an independent field of inquiry in macroeconomics only over the last decade. Up to then, it was regarded as an oscillation around an independent growth trend, a second-order issue of interest mainly to industrial economies concerned about smoothing the fluctuations of the business cycle. It is now beginning to occupy a central position in development economics.

What has catapulted volatility into this prominence? First, following the seminal paper of Garey Ramey and Valerie Ramey in 1995,<sup>1</sup> cross-country studies have consistently found that volatility exerts a significant negative impact on long-run (trend) growth, which is exacerbated in poorer countries. Second, the inclusion of volatility in the growth literature can be regarded as a continuation of the trend that began in the mid-1980s with endogenous growth theory. This theory linked technological progress to the capital stock in an attempt to explain why returns to capital may not diminish in rich, capital-abundant countries, and thereby perpetuate income gaps between rich and poor countries. More recently, attention has turned to the so-called “deep determinants of growth”: geography, trade openness, and institutions, and their impact on total factor productivity. “Institutions” refers to the quality of governance, the integrity of the legal system, and property rights. Financial market institutions, including creditor and shareholder rights and vigilant supervision, are accorded particular prominence. Empirical investigation increasingly shows that weak policies and institutions in developing countries could magnify the negative effects of volatility on growth and lead to permanent setbacks relative to richer countries. Therefore, understanding the nature of volatility and anticipating and managing its consequences should be of considerable interest to policymakers in developing countries.

### ***Defining and Calculating Volatility***

In common parlance, making a distinction among volatility, uncertainty, risk, variability, fluctuation, or oscillation would be considered splitting hairs; but, going back to Frank Knight’s classic 1921 work, *Risk, Uncertainty, and Profit*, there is a subtle difference in economics. *Uncertainty* describes a situation where several possible outcomes are associated with an event, but the assignment of probabilities to the outcomes is not possible.<sup>2</sup> *Risk*, in contrast, permits the assignment of probabilities to the different outcomes. *Volatility* is allied to risk in that it provides a measure of the possible variation or movement in a particular economic variable or some function of that variable, such as a growth rate. It is usually measured based on observed realizations of a random variable over some historical period. This is referred to as *realized volatility*, to distinguish

it from the *implicit* volatility calculated, say, from the Black-Scholes formula for the price of a European call option on a stock.<sup>3</sup>

Realized volatility, or more simply, volatility, is most commonly measured by a standard deviation based on the history of an economic variable. In this volume, there will always be either an explicit or implicit reference to an underlying probability distribution for the variables of concern. Hence it will abstract from Knightian uncertainty. However, if components or trends in the underlying variable are predictable, then calculating volatility based on measured ex post total variability may overestimate risk. For example, one could regard total variability as the sum of predictable variability and pure risk.<sup>4</sup> This presents two options for computing volatility: it can be measured by the standard deviation (s.d.) of total variability or on the s.d. of pure risk, which can be obtained as the residual from a forecasting equation for total variability.<sup>5</sup>

An additional question arises. Is the volatility (variance or s.d.) of the pure risk component constant, or does it vary over time? The idea that volatility tends to cluster--- that is, that there may be serial correlation in it---and modeling this in a tractable way using autoregressive conditional heteroskedasticity, were among the contributions leading to the Nobel Prize in economics for Robert F. Engle in 2003.<sup>6</sup> In general, the empirical work in this book will focus on volatility measured by the standard deviation of total variability, although there are exceptions. For example, chapter 2 on growth uses two different measures of volatility, and chapter 5 on commodity price volatility isolates shocks based on the unpredictable component of price movements. The discussion now turns to shocks and crisis.

### ***Volatility, Shocks and Crisis***

Since part of the variability in an economic variable may be anticipated, the residual, which captures pure risk or uncertainty, is by definition unanticipated, and constitutes a “shock.” Speaking practically, however, economists usually concentrate only on large or extreme shocks, which are defined as those residuals, positive and negative, exceeding a certain cut-off point in magnitude.<sup>7</sup> The size and persistence of shocks can pose major challenges to economic management. A large negative shock is typically more serious than a small one because of credit constraints, or exhausting a finite buffer stock, which then has knock-on effects. For example, a country may use up its foreign exchange reserves defending a fixed exchange rate following a large negative terms-of-trade (ToT) shock and then be forced to float the currency, leading to additional, possibly disruptive, costs associated with balance sheet currency mismatches for banks and firms. Likewise, a more persistent adverse shock is going to be more costly. A coffee-exporting country, for example, may be able to cope with a one-time ToT shock of 10 percent. If the ToT does not subsequently recover, however, and a large negative shock persists say, for three years, the capacity of the country to cope may be exhausted and lead to severe economic disruption.

The preceding examples raise a fundamental question: are there any links between volatility and crises? This volume argues that there are good reasons to consider volatility and crises together. First, the literature tends to compute volatility over long periods of time, such as the standard deviation of real per capita GDP growth from 1960 to 2000. Such computation tends to lump what may be regarded as “normal” and “crisis” volatility together. The distinction between the two is largely one of size; normal output oscillations versus what might be regarded as large swings in output, with declines being defined as “crises”. Disentangling the two shows that crisis volatility matters more for the negative impact on growth explored in depth in chapter 2. This result is reinforced by a casual examination of economic history. As William Easterly, Roumeen Islam, and Joseph Stiglitz (2002, p. 191) note:

*Crises have been a constant of market capitalism – from the bursting of the British South Sea bubble and the French Mississippi bubble in 1720 (which at least one economic historian claims delayed the industrial revolution by 50 years), to the depressions of the 1870s and 1930s in the industrial economies, to the debt crises of the middle-income Latin American countries and low-income African countries in the 1980s, the collapse of output in the formerly socialist economies in the 1990s, and the East Asian financial crisis in 1997--98.*

Second, volatility and crises are driven by the same fundamental phenomena. Consider a situation where weak fiscal institutions and inconsistent macroeconomic policies magnify output volatility. It may well be that such circumstances tend to attract short-term, speculative capital inflows, creating a vulnerability to a “sudden stop”<sup>8</sup> and hence a crisis down the road. Thus volatility could evolve into a crisis. As another example, the asymmetry argument---presented in the next section to explain why volatility tends to have permanent negative effects in less developed economies---wields much greater force when shocks are larger and the ability to cope with them smaller. If permanent negative effects cumulate, then a country might set itself up for a future crisis. Conversely, a crisis may serve as a catalyst for change: for example, in countries where weak fiscal institutions and politics either increase inequality or lead to procyclical fiscal policies and the excessive build-up of government debt. In this case, a by-product of a crisis might be stronger fiscal institutions and greater transparency (see chapter 10, on Russia).

### **How Volatility Affects Growth**

The consistent empirical finding that volatility exerts a negative impact on growth has prompted research on the precise channels through which this effect operates. Channels identified in chapter 1 include factor accumulation, trade, the financial system, and even politics. For example, macroeconomic uncertainty can affect growth through investment. For developing country oil exporters, the effects of a price boom are typically transmitted through fiscal policy, which could enhance real exchange rate appreciation and volatility and thus reduce investment in the non-oil traded goods sector, notably, agriculture and manufacturing. The resultant reduced diversification of production would increase the vulnerability to future ToT shocks, magnifying the long-run costs of ToT volatility. ToT shocks get transmitted through trade links and are proportional to the degree of openness, which is usually measured as the ratio of exports plus imports to GDP. A rise in U.S. interest rates might result in reduced capital flows to an emerging market Latin American country. This effect would be transmitted through the financial system, and the shock could be amplified by vulnerable bank and corporate balance sheets; recession could set in if large-scale bankruptcies occurred. The precise nature of how various channels work and reinforce one another is a topic of ongoing research. Two concepts help to explain the impact of volatility on growth: *concavity* and *asymmetry*. These are considered in turn below.

#### ***Why Volatility Is of First-Order Importance: Concavity***

Nonlinearity, of which concavity is a specific instance, explains why volatility should be of first-order importance. Suppose the reduced form of the association between real GDP growth ( $g$ ) and a productivity shock ( $\varepsilon$ ) is summarized by  $g = g(\varepsilon)$ , where the expected value of the shock is zero. Imposing a linear structure as is often done in economics for simplicity would lead to an equation of the form  $g = a + b \cdot \varepsilon$ , where  $a$  and  $b$  are the coefficients that the econometrician would estimate. Assume that  $a$  and  $b$  are both positive. Then taking expectations yields:

$$E(g) = a + b \cdot E(\varepsilon) = a + b \cdot 0 = a$$

That is, the expected value of growth is  $a$ , or expressed equivalently, growth fluctuates around a trend value of  $a$  and is above (below) it when  $\varepsilon$  is greater (less) than zero. In this case, the variance of  $\varepsilon$  is relevant only to the extent that it influences the size of the variation above or below

$a$ ; it does not affect trend growth itself. In other words, the expected growth rate is *independent* of volatility measured by the variance of  $\varepsilon$ ; it is of second-order importance.

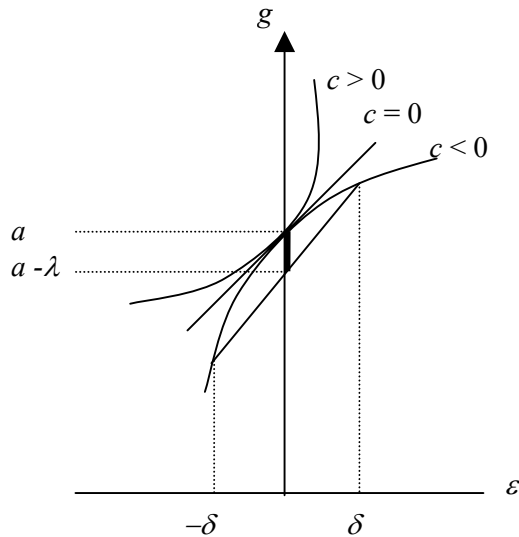
A better approximation would allow for nonlinear effects:  $g = a + b \cdot \varepsilon + c \cdot \varepsilon^2$ . Further, when the association between the shocks and growth is concave, that is, when  $c < 0$ , this results in a negative impact of volatility on growth. In this case,

$$E(g) = a + b \cdot E(\varepsilon) + c \cdot E(\varepsilon^2) = a + b \cdot 0 + c \cdot V(\varepsilon) = a + c \cdot V(\varepsilon) < a,$$

where  $V(\varepsilon)$  is the variance of  $\varepsilon$ . In this case, trend growth is less than  $a$  because of nonlinearity and concavity ( $c < 0$ ); volatility is now a matter of first-order importance. The discussion below will review several possible channels leading to such concavity.

Figure 1 illustrates this for the simplest case, where the shock has only two possible values, plus or minus  $\delta$ , with equal probabilities, and the realized growth would be either  $g(\delta)$  or  $g(-\delta)$ . The empirical evidence suggests a concave association ( $c < 0$ ), implying that the volatility of the shock reduces the expected growth below  $a$  by the bold segment,  $\lambda$ .<sup>9</sup> Had we estimated the growth with a linear specification, we would fail to detect this effect and conclude that it is not worth making an effort to reduce volatility or manage its consequences.<sup>10</sup> But the realization that eliminating volatility would raise growth by  $\lambda$  (which would call for a nonlinear specification) would create an incentive to take volatility more seriously.

Figure 1. *Shocks, Growth, and Welfare*



While the discussion above focused on the *empirical* challenges associated with identifying volatility, similar considerations impact the *theoretical* discussions. A useful analytical methodology is linearizing complex models around the equilibrium. This is frequently done in neoclassical frameworks, which rely on Leonard Savage’s (1954) expected utility paradigm. That is, only the first moment of the distribution matters; the second, which would bring volatility into the picture, is minuscule and therefore irrelevant. Imposing this structure allows tractable reduced-form solutions of more complex problems; but it *a priori* rules out large first order effects of volatility on welfare, saving, and optimal buffer stocks. For example, David Newbery and Joseph Stiglitz (1981) showed that for a consumer maximizing the conventional expected utility, the gains from optimal buffer stocks are very small, and may not be worth the cost. This result does not hold

if agents are loss-averse: namely, if they attach a greater weight to the utility loss from a drop in consumption than to the utility gain from a comparable increase in consumption. In this case, the welfare gain from optimal buffer stocks is sizable, making the improvement of insurance and capital markets a high priority.<sup>11</sup>

Why should volatility have a particularly negative impact on developing countries compared to industrial countries? One way of thinking about this is in terms of the determinants of  $c$  in the nonlinear growth-shock specification. Two key determinants of  $c$  are likely to be the ability to conduct countercyclical fiscal policy and the state of financial sector development. In industrial countries, both would tend to lower  $c$  and thereby raise the expected value of growth for a given shock process. Both are symptomatic of *institutional development*, a key factor explaining why volatility matters and why its effects may be exacerbated in developing countries. If a country is able to expand deficits during a downturn by, say, maintaining government expenditure while tax revenues contract, this would help dampen the impact of a downturn; but this ability depends fundamentally upon access to credit markets and sovereign risk for given inflation targets. Similarly, well-developed financial systems may help to de-couple consumption from output volatility, allowing consumption to be smoothed over time and thereby helping to preserve aggregate demand during a negative output shock.

#### ***Why Shocks Have Permanent Effects: Asymmetry***

The concave association between shocks and growth may stem from interactions among various structural factors that result in an asymmetric response to good times versus bad times. Good times do not offset the negative effects of bad times, so that shocks tend to have a permanent negative effect. Examples of asymmetry, frequently reinforced by concavity, include:

- Example 1: **Weak institutions and the investment channel.** The quality of institutions may not matter in good times; but in bad times countries suffering from institutional deficiencies are likely to suffer more from adverse shocks of the same magnitude than countries that have strong institutions, as argued by Dani Rodrik (1999). Weak institutions, manifested in poorly enforced contracts and property rights, low protection of creditors and inadequate supervision of the financial system, may inhibit the formation of financial markets (de Soto 2000). In financing investment, firms can turn to *external* sources, such as bank loans, equity or corporate bonds, or rely on *internal* funds, such as retained earnings; but capital markets would tend to be thin or nonexistent when institutions are weak, constraining investment to be funded internally, or by banks. As was shown by Robert Townsend (1979) and Ben Bernanke and Mark Gertler (1989), more costly verification and enforcement of contracts--- symptomatic of weak institutions---and higher economic volatility would increase the cost of external funds, thereby reducing investment.<sup>12</sup> And when recessions occur, internal funds drop, leading to a greater contraction of investment than would occur with well-functioning capital markets, thus inducing concavity in the association between shocks and investment.

Garey Ramey and Valerie Ramey (1995) found investment unimportant as a channel for the impact of volatility on growth. Joshua Aizenman and Nancy Marion (1999) applied Ramey and Ramey's methodology to the case where investment is disaggregated into private and public components. They found that, unlike public investment, volatility has large adverse effects on private investment, which turns out to be an important channel for the negative effects of volatility on growth.<sup>13</sup>

- Example 2. **Incomplete capital markets and sovereign risk.** Limited integration with the global capital market may induce asymmetries over the business cycle. A simple example is when the aggregate savings schedule is elastic at small levels of debt but becomes vertical at a particular

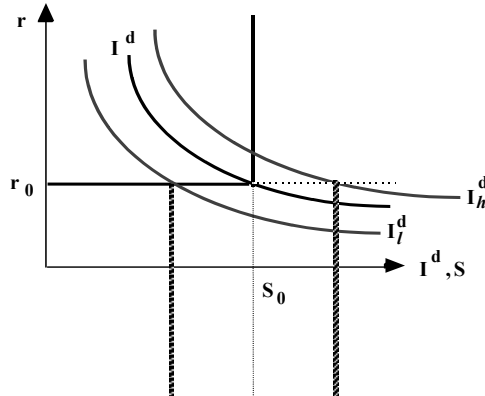


credit ceiling, reflecting sovereign risk: the country can borrow freely at the prevailing interest rate, but only up to a point. In this case, the higher the volatility of investment demand, the lower is expected investment: the increase in investment in good times is constrained relative to the drop in bad times.<sup>14</sup>

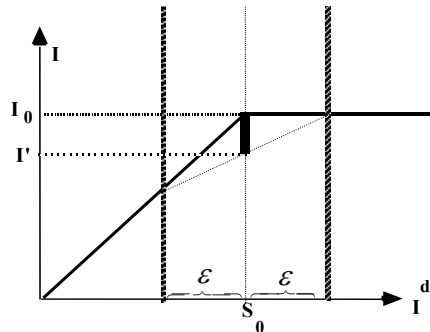
To illustrate this channel, suppose the supply of credit facing a country is given by an inverted L-shaped graph, shown in figure 2, panel A, where  $S_0$  is the credit ceiling. Let  $I^d$  be the demand for investment. Actual investment is given by  $I = \text{Min}\{I^d(r_0), S_0\}$ , where  $I^d(r_0) \equiv I_0$  is investment demand at  $r = r_0$ . Suppose the demand for investment fluctuates between a high state,  $I_h^d = I_0 + \varepsilon$ , and a low state,  $I_l^d = I_0 - \varepsilon$ , while the credit ceiling remains  $S_0$ . Realized investment is plotted in figure 2, panel B. The credit ceiling hampers investment expansion in the high demand state without moderating the drop in investment in the low demand state. Thus volatile investment demand reduces average investment in the presence of credit rationing. In the example, if the probability of each state of nature is 0.5, volatility reduces expected investment from  $I_0$  to  $I' = I_0 - 0.5\varepsilon$ , which is smaller the higher  $\varepsilon$  is (see figure 2, panel B).<sup>15</sup>

Figure 2: Investment in the Face of a Credit Ceiling

Panel A. Saving, Investment Demand, and the Interest Rate



Panel B. Actual Investment and the Investment Demand



The eventual growth effects of volatility transmitted by investment may be dealt with more comprehensively in endogenous growth models. While the ultimate effects of volatility on growth in such models are ambiguous, one can identify circumstances under which the association would be negative. For example, if riskier technologies are associated with higher productivity but the markets for risk-sharing are imperfect, higher economic volatility would induce the adoption of safer but (on average) less productive technologies in endogenous growth models.<sup>16</sup> Alternatively, with a binding credit ceiling, policy-induced uncertainty impacting the tax on capital would tend to reduce growth (Aizenman and Marion 1993). In these models, stabilization of shocks may lead to a higher growth rate.

- Example 3. **Volatility, income inequality, and growth.** Uncertainty tends to increase income inequality.<sup>17</sup> Income inequality in turn may affect growth through several channels. For example, investment in human capital is frequently self-financed, due to the inability to use future earnings as traded collateral against which to borrow. Hence the ability to finance investment in human capital is tied to the wealth of the household. A household with low net worth will find that the credit ceiling is binding, investing less than that warranted without such a ceiling. This leads to a concave dependency of investment in human capital on the credit ceiling facing a household. In the absence of complete insurance markets, greater volatility will tend to increase the dispersion of income among households, leading to a drop in average investment because more households face credit ceilings, reducing thereby the accumulation of human capital and ultimately, growth.<sup>18</sup>

These results are summarized in the following interaction:

Volatile shocks → greater inequality → more credit constraints for poorer people (an effect magnified by bad institutions) → adverse effects on human capital → lower growth.

Inadequate investment in human capital would inhibit the diversification of production, which in turn would tend to increase the impact of shocks. This would reinforce the adverse effects of volatility on growth and could create a vicious cycle.

- Example 4. **Divisive politics, inefficient taxation and procyclical fiscal policy.** To cite another complex interaction, weak institutions and non-cooperative behavior among competing pressure groups frequently imply inefficient tax systems. Policymakers may have short horizons, either because they may lose the next election or because there is no internalization of the welfare of unborn generations (as is frequently the case in overlapping-generations models). In countries where distributional conflicts are important, the political process may produce policies that tax investment and growth-promoting activities so as to redistribute income in favor of groups linked to the political incumbents. A common feature of developing countries is the scarcity of fiscal instruments, which leads to the inflation tax and customs tariffs as "easy" ways of raising revenue. Alex Cukierman, Sebastian Edwards, and Guido Tabellini (1992) pointed out that the backwardness of the tax structure itself may be the outcome of distributional conflicts between competing political groups. Their menu of taxes includes income taxes, associated with distortions and collection costs, and seigniorage, associated only with distortions. They consider the case where the government is formed by two competing parties that prefer two different types of public goods. As a result of implementation lags, the current tax system was determined a period ago. If the current government has a low probability of survival, it has the incentive to jeopardize the ability of the future government to spend on the public goods that it does not value. A way to accomplish this is to adopt a narrow tax base, not to include income tax, in order to restrict the revenue of the future administration. Applying this logic, one concludes that countries with more unstable and polarized political systems rely more heavily on seigniorage and import tariffs as a source of revenue than do more stable and homogenous societies. The resultant distortions (high

inflation, under-investment because of costly imports of capital goods, and currency substitution that further diminishes the tax base) may ultimately lead to lower private investment and lower growth. Conversely, greater stability and lower polarization would induce countries to replace the inflation tax and customs tariffs with income and value added taxes, thereby widening the tax base.

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Procyclical fiscal policy can be interpreted as a byproduct of underdeveloped fiscal systems and sovereign risk, implying that the decline in the output growth rate during recessions would tend to exceed the increase during expansions, inducing another concave association between shocks and growth. These results are summarized in the following interaction:

Weak institutions + noncooperative behavior → inefficient tax system and sovereign risk → procyclical fiscal policy → concave association between shocks, investment, and growth.

### ***Empirical challenges***

The nonlinearities described above and the interactions among the various channels leading to a concave link between shocks and growth impose challenges to empirical investigations:

- The attempt to identify stable associations between uncertainty and growth using regressions is not easy. This is both because of the difficulty of adequately measuring relevant fundamental variables (including the quality of institutions and capital market imperfections), and the presence of nonlinearities.
- One expects a robust positive association between most volatility measures. Hence the estimations of the impact of each source of volatility would tend to be imprecise.
- The association between volatility and growth may go both ways. Volatility may reduce growth, and lower growth may increase volatility, as would be the case if lower growth intensifies fights about the division of the national pie. In these circumstances, volatility and growth may be endogenously and simultaneously determined. The impact of volatility on growth can be accurately ascertained only if one is able to identify the exogenous component of volatility (that is, the volatility component that is independent of the growth rate). Isolating this exogenous component may be accomplished by relying on instrumental variables (IV). Ideal IV should explain volatility, while at the same time impacting long-run growth only through volatility and the other control variables. Hence identifying the impact of volatility would require using variables that are correlated with volatility, but uncorrelated with the residual from the growth regression that measures the association between volatility and the conventional controls and growth. Short of having ideal IV (that is, instrumental variables that meet the above stringent criteria), one should interpret econometric results cautiously.

### ***Impact on Welfare***

The ultimate cost of volatility is determined by the interaction between volatility and the structure of the market, and the eventual impact on consumption. Considerations like the completeness of financial markets, the depth of insurance markets, and consumer preferences would determine the ultimate welfare cost of uncertainty. Hence there is no one-to-one transformation from the empirical results to the welfare cost of volatility. For example, with complete insurance markets, and with full integration into international capital markets, a risk-averse consumer living in a commodity-exporting country would be fully insured against terms of trade shocks. Hence, volatility and ToT trends would not influence the consumer's consumption patterns. In practice, sovereign risk and shallow financial markets preempt this rosy scenario. In

these circumstances, the ultimate welfare cost of ToT uncertainty hinges on the consumers' valuation of this exposure.

As Robert Shiller (1993, 2003) has argued, the lack of deep insurance markets has adverse welfare consequences even in the OECD countries. One expects these effects to be substantially greater in developing countries, where the insurance markets are underdeveloped, and frequently missing. The position of developing countries is further compromised by the inability to borrow externally in their own currency (the "original sin" point articulated by Barry Eichengreen and Ricardo Hausmann 2003), and by their limited access to the capital market due to sovereign risk.

Some of the deficiencies imposed by the lack of insurance markets may be overcome by self-insurance. This self-insurance may take various forms, such as hoarding international reserves at the country level (Aizenman and Marion 2003) or hoarding gold at the household level. Yet these solutions are costly, and may be inhibited in countries characterized by weak institutions. As was illustrated by Ricardo Caballero and Stavros Panageas (2003), insuring macroeconomic shocks at the global level is not feasible, and would require developing large new financial markets. Needless to say, we are far from understanding the obstacles preventing quicker formation of such markets.

A complete assessment of the welfare cost of volatility would require a structural model, and possibly further advances in modeling economic behavior. To elaborate, recall that Garey Ramey and Valerie Ramey (1995) suggest that the welfare costs are of first-order magnitude, in contrast to Robert Lucas (1987), who argues that they are second-order. As concisely illustrated by Robert Lucas's 2003 presidential address to the American Economic Association, eliminating the cost of business cycle volatility in a typical neoclassical model leads to welfare gains that are akin to the Arrow-Pratt risk premium. In terms of figure 1, suppose that the utility of the risk-averse agent consuming  $(1 + \varepsilon)$  is  $U = U(1 + \varepsilon)$ , where  $\varepsilon$  is a random variable. In these circumstances, the utility is represented by the concave curve,  $U \cong a + b \cdot \varepsilon + c \cdot \varepsilon^2$ , with  $c < 0$ .<sup>20</sup> Suppose that the business cycle leads consumption to fluctuate between high and low levels, say one plus or minus  $\delta$ , with equal probability, which gives  $EU = U(1) + c\delta^2 = U(1) - \lambda$ . The gain from stabilizing these fluctuations is the bold segment  $\lambda$  corresponding approximately to the Arrow-Pratt risk premium.<sup>21</sup> These gains are trivial using conventional measures of risk aversion. The calibration puts these gains at 0.0005 of average consumption (see equation 4 in Lucas 2003).<sup>22</sup>

Applying a similar rationale to Lucas (1987), one may conclude that the gains from optimal buffer stocks may not be worth the cost (Newbery and Stiglitz, 1981, Chapter 29). The potential redundancy of stabilization policies is consistent with studies that show that competitive firms with full access to the capital market would welcome volatility, as it would increase expected profits and investment.<sup>23</sup> The finding about the trivial cost of business cycle fluctuations has led to two polar interpretations. Lucas (1987) inferred that stabilization policies are redundant. Alternatively, it may suggest the need to amend our models of behavior under risk, in order to capture a more complex environment where the costs of economic fluctuations are not captured by the Arrow-Pratt risk premium.

The complexity of modeling the welfare effects of volatility is illustrated by the elusive effects of uncertainty on investment in neo-classical models. Ricardo Caballero (1991) noted that "the relationship between changes in price uncertainty and capital investment under risk neutrality is not robust... It is very likely that it will be necessary to turn back to risk aversion, incomplete markets, and lack of diversification to obtain a sturdier negative relationship between investment and uncertainty." Box 1 provides further technical detail. Caballero's insightful closing remarks

outline a useful agenda for advancing the research about the welfare effects of volatility, which are closely linked to consumption and hence output dynamics as influenced by investment behavior. The empirical research reported in this book validates the importance of accomplishing this task.

### **Box 1. On the Link Between Uncertainty and Expected Investment**

This box illustrates the conflicting forces shaping the association between uncertainty and investment.

**Investment under irreversibilities** ( McDonald and Siegel 1986, Pindyck and Solimano 1993, Dixit and Pindyck 1994) .

*Irreversible investment* arises where investment involves irreversible costs, and the firm cannot disinvest, and some investment expenditure cannot be recuperated even if the producer can resell his plant. *Uncertainty* implies that in certain states of nature the firm finds itself with too much capital ex post. Ex ante, the firm internalizes this and requires the expected marginal profit of capital to exceed the marginal cost of investment.

*Investment and the option value of waiting*: To induce investment, the expected marginal profit of capital should exceed the cost of investment by the value of the option to postpone investment. A key result of the literature is that the option value of waiting increases with uncertainty. The greater the uncertainty, therefore, the higher the productivity of capital required to justify investment.

*Uncertainty and expected investment*: The implications of this for the average level of investment, however, are ambiguous. Higher volatility may delay investment, but when the investment actually takes place, its magnitude is adjusted to reflect the delay and the irreversibility. Hence the net effect of volatility on *average* investment is determined by elasticity considerations. Volatility would reduce average investment only if the increase in realized investment when the productivity of capital is above the threshold leading to investment does not compensate on average for the lower frequency of investment.

*Conclusion*: The association between uncertainty and expected investment is ambiguous in the presence of irreversibilities.

**Uncertainty, investment and market power** (Caballero 1991).

The ultimate effect of a mean-preserving increase in volatility on the profits of a risk-neutral producer is determined by the curvature of the profit function. With constant employment and relative prices, the profit function of a producer using labor and capital with a CRS technology is linear with respect to capital. Employment expansion in good times works to further increase the revenue, inducing convexity of the revenue function, whereas the drop in the relative price due to the higher production level works toward reducing the increase in revenue, inducing concavity of the revenue function. The employment expansion effect is more powerful the greater the flexibility of production, as captured by the share of the variable input. The downward price adjustment effect is larger the smaller the demand elasticity. Ultimately, the balance of these two effects determines the curvature, and thereby the investment effects of volatility.

*Conclusion*: Perfect competition and constant returns to scale induce a positive association between volatility and investment, whereas decreasing returns to scale or imperfect competition or both induce a negative association.

## **Overview of the Volume**

Box 2 sets the stage by providing a list of key empirical studies in the volatility literature. A chapter-by-chapter description of this volume follows.

### Box 2. Key Empirical Studies on Volatility

The selection of studies presented here illustrates distinct stages in the understanding of the nature and impact of volatility.

**Ricardo Caballero (1991)** highlighted the fragility of the theoretical relationship between uncertainty and capital investment, pointing out the need to turn back to risk aversion, incomplete markets, and lack of diversification to obtain a sturdier negative relationship between investment and uncertainty. Caballero (2003) surveys the desirable features of insurance and hedging instruments against capital flow volatility, and discusses steps to facilitate the creation of these markets.

**Joshua Aizenman and Nancy Marion (1993)** showed that policy uncertainty is negatively associated with private investment and growth in developing countries.

**Garey Ramey and Valerie Ramey (1995)** were the first to show the negative association between growth and volatility in a comprehensive study that included the OECD and the developing countries, linking volatility [OK?] to the debate about the cost of the business cycle.

A detailed 1995 study of Latin America and the Caribbean by the **Inter-American Development Bank (IDB 1995)** led by Ricardo Hausmann and Michael Gavin explored the underlying causes and sources of volatility, its costs, and corrective policy regimes.

**Dani Rodrik (1999)** identified weak institutions and latent social conflict as the main reason for the negative impact of volatility on growth. He examined the drop in growth for various sets of countries between 1960--75 and 1975--89 and found that shocks themselves are secondary as an explanation, as are various measures of government policy. What matters ultimately is the capacity to respond to shocks in terms of fiscal adjustment and relative price changes. This is critically influenced by the strength of domestic institutions of conflict management: strong institutions dampen volatility, while weak ones enhance its negative consequences.

**William Easterly, Roumeen Islam, and Joseph Stiglitz (2000)** honed in on the financial system as the prime factor in growth volatility. They found that up to a point, greater financial depth is associated with lower growth volatility; but as financial depth and leverage grow, the financial sector could become a source of macro-vulnerability.

**Daron Acemoglu, Simon Johnson, James Robinson, and Yunyong Thaichoren (2003)** took the primacy of institutions a step further by arguing that crises are caused by bad macroeconomic policies, which increase volatility and lower growth; but bad macro policies in turn are the product of weak institutions. In order to avoid problems with endogeneity and omitted variables, they develop a technique to isolate the “historically determined component of institutions” based on the colonization strategy pursued by European settlers, and show that this is the critical factor in explaining volatility, crises, and growth.

As befits the topic, the empirical results are also volatile and not always consistent across studies; but the trend indicates that paying attention to volatility and crises has become critical for development.

### *Chapter 1. Volatility: Definitions and Consequences*

Chapter 1 by Holger Wolf is organized around the question, “What is volatility, and why should we care?” The chapter starts with a set of graphs showing that, across countries, a higher volatility of real per capita GDP growth (measured by the standard deviation of the growth rate) is associated with lower average growth rates and greater income inequality.<sup>24</sup> The chapter then discusses alternative definitions of volatility and addresses measurement issues. It also provides a simple framework for analyzing volatility and uses it to discuss various origins of volatility, its welfare consequences, and options for managing it. The material in this overview overlaps in part with chapter 1.

### ***Chapter 2. Volatility and Growth***

Developing countries (where development is measured by per capita income, financial depth, trade openness, institutional development, or the ability to conduct countercyclical fiscal policy) are undeniably more volatile than more developed ones (where volatility is measured either by the standard deviation of the output gap or that of per capita GDP growth).<sup>25</sup> But what is the relationship between volatility and long-run growth? Attempting to answer this question in chapter 2, Viktoria Hnatkovska and Norman Loayza use a framework inspired by the new growth literature, augmented with measures of volatility. The sample includes 79 countries and the period covered is 1960-2000. They explore four central questions. The first is whether the volatility-growth link depends on country and policy characteristics, such as the level of development or trade openness. The second is whether this link goes beyond an association to capture a statistically and economically significant causal effect from volatility to growth. The third examines the stability of this relationship over time. The fourth is whether the volatility-growth connection captures the impact of crises, rather than the overall effect of cyclical fluctuations.

An analysis of cross-country data yields a negative association between macroeconomic volatility and long-run economic growth. This is exacerbated in countries that are poor, institutionally underdeveloped, undergoing intermediate stages of financial development, or unable to conduct countercyclical fiscal policies.

Furthermore, using instrumental variables regressions to isolate the exogenous, causal impact of volatility on growth reveals an even stronger, more harmful effect of volatility on growth. This is true for a worldwide sample of countries, and particularly for low- and middle-income economies. This negative effect has been present since the 1960s, but has intensified over the last two decades, coinciding with the drop in growth rates observed during the 1980s and 1990s compared to the 1960s and 1970s.

When volatility is decomposed into a crisis component that captures the effect of deep recessions and a component that captures normal cyclical fluctuations, the regressions show it is crisis volatility that truly harms long-run growth. These results place a premium on financial, fiscal, and institutional development and the avoidance of crisis as key factors in alleviating the negative impact of volatility on growth.

The study yields a telling quantitative measure of the exogenous impact of volatility on growth. An increase in volatility by one standard deviation of sample volatility (that is, one worldwide, cross-country standard deviation of volatility) causes a sizable 1.3 percentage point drop in the growth rate. This drop deteriorates further to 2.2 percentage points of the per capita GDP growth rate for the same increase in volatility during the 1990s or under a crisis situation.

### ***Chapter 3. Volatility, Income Distribution and Poverty***

Volatility can affect poverty either through growth or inequality. In fact, changes in poverty rates can be broken up into a growth and an inequality component. Most cross-country studies have focused on growth and poverty, finding that faster growth reduces poverty, but has no systematic effect on inequality. A 1995 work by the Inter-American Development Bank (IDB 1995) found that higher volatility was associated with both lower growth and higher inequality, with the latter tending to be highly persistent. The impact of volatility on inequality was transmitted mainly through educational attainment.

In chapter 3, Thomas Laursen and Sandeep Mahajan analyze the links between volatility and inequality, including both trend, or normal, volatility and an analysis of the effects of large

swings in income. Inequality is measured by the income share of the poorest quintile. Based on cross-country data, a regression of the natural logarithm of the share of income of the poorest quintile, LQ1, on its lagged value and GDP volatility shows that across countries, volatility and the income share of the poor are negatively correlated. Introduction of dummy variables for regions show that regional features do not alter this result. However, when dummy variables are included by country income level groupings per the World Bank's definition of low-, middle-, and high-income countries (LICs, MICs, and HICs), the negative impact of volatility on LQ1 is the largest and most statistically significant for LICs. Moreover, this link became significant and intensified over the 1980s and 1990s. A test of the hypothesis that dependence on primary exports exacerbates the link shows that this is not the case, although primary exporters exhibit higher inequality albeit with higher convergence. By and large, the qualitative results using OLS are retained when IV regressions are used to control for endogeneity. However, the magnitude of the coefficients is much higher, suggesting a highly negative causal relationship between volatility and income shares of the poor.

When transmission mechanisms are investigated, it is found that inflation, public expenditure on social security, and financial sector depth (proxied by M2/GDP) each enter the regression with a significant coefficient (inflation reduces the income share of the poor, while financial sector depth and public expenditure on social security tend to increase it). But in the process, they weaken the significance of the coefficient on GDP volatility. This suggests that at least some of the impact of GDP volatility on income of the poor may be flowing through each of these transmission channels. Public expenditure on education and health, the unemployment rate, and real exchange rate volatility do not appear to play a significant transmission role.

An examination of boom ("upswings") and bust ("downswings") semi-cycles, financial crises and ToT shocks finds negative impacts on the poor, which could result from inflation and disproportionate cuts in pro-poor social spending on health, education, and social security during downswings. The poorer segments of society tend to suffer during crises because of lower overall income levels and the crisis-induced reduction in public spending on education. Inequality tends to worsen especially during ToT shock episodes, and inflation seems to be the major conduit for increased inequality.

In principle, shocks can be cushioned by the financial system --through insurance or borrowing opportunities-- and labor market institutions --by offering unemployment insurance and various employment programs. However, both are often poorly developed in low-income, highly volatile countries. In any case, they tend to be of limited value to people on the subsistence minimum. Thus, government intervention is warranted by imperfect domestic insurance markets that lead individuals to inefficient self-insurance decisions. Such intervention needs to take the form of permanent policies and programs to automatically protect the poor from short-term fiscal adjustments and income shocks. To ensure that resources are available in case of a crisis, a fund could be set up to accumulate resources during normal years. Adequate and flexible social safety nets should be in place before a crisis hits. A last point is that while targeted programs have been successful in targeting the poor, programs tend to contract in response to local political economy factors that seek to protect non-poor spending from budget cuts. A case study of Mexico finds that geographical targeting and greater attention to the most vulnerable (young and elderly) would have worked well in alleviating the effects of the 1994 crisis.

#### ***Chapter 4. Finance and Volatility***

In theory, the financial system should help to mobilize and allocate resources efficiently, while also providing mechanisms to share and manage risks. In practice, the financial system can also increase volatility: for example, by intensifying a credit cycle in real estate by providing funds



on too-easy terms, imperfectly monitoring how firms use borrowed funds, or amplifying macroeconomic cycles through the so-called credit channel. In other words, access to funding can be procyclical. Likewise, financial sector policy can be a source of volatility, as when a country decides to liberalize the financial sector to reap the benefits of better resource mobilization and allocation but does not have adequate supervision in place. Systemic financial crises can be particularly damaging because of their impact on the real sector and public finances in the event of government bailouts.

Chapter 4 by Stijn Claessens examines the links between finance and volatility. In general, greater financial development (measured by credit to the private sector as a ratio of GDP) is associated with lower growth volatility. Interestingly, so long as supporting institutions are strong, financial structure---that is, whether the financial system is primarily bank-based or capital market-based---does not make a difference. Both structures can provide effective risk management, provided legal underpinnings (importantly, equity and creditor rights) and other elements (such as accounting standards) are strong. The results on international financial integration are more controversial. Many studies find positive benefits from liberalization and increased integration with world financial markets at the micro (firm) level for investment and growth. Some have found little benefit, however, with volatility potentially rising, especially when financial and institutional development are weak.

How can countries move from financially repressed systems to more liberalized, market-oriented ones without increasing risks? Theory and empirics in these areas are still young. While evidence suggests that individual firms stand to benefit from equity market liberalization, asset price volatility also increases. The possibility of contagion---that is, spillovers from other markets---also goes up, especially when there is a common international lender or investor base. This in part arises as there are forces at play that restrict gains for the country from international integration, such as the absence of the equivalent of an international bankruptcy court. Capital inflows can also aggravate domestic credit booms, as domestic asset prices rise and lead to currency mismatches when the domestic financial system is not functioning well. In the case of East Asia, a desire to sterilize capital inflows kept interest differentials high. This, in conjunction with an implicit exchange rate guarantee, led to currency mismatches for banks and corporations. Such a configuration could create a vulnerability to a sudden stop, with severe knock-on effects because of the balance sheet mismatches. If in addition public debt dynamics are unsustainable (as in Argentina in the late 1990s) and banks hold a large fraction of their assets in government paper, a sovereign default could trigger a huge financial and real crisis. In Argentina, “bad macro policy” trumped the “good financial sector regulation” the country was reputed to have.

In discussing crisis prevention and management, the chapter notes that crises are difficult to predict, and outlines reasons for why Early Warning Systems may not be much better than naïve forecasts. A recent initiative has involved the development of analytical tools to assess macro-financial risks, based on stress-testing the financial system under different assumptions on exchange rates, interest rates, and growth, in part under the World Bank/IMF Financial Sector Assessment Program. While such exercises can help identify risks, trigger preventive responses and enhance transparency, they are hampered by poor data quality and the difficulty of analytically specifying the necessary relationships. Hence financial crises are going to remain a fact of life.

Responding to a financial crisis can be divided into three phases: containment, an initial period, during which attempts may be made to stabilize the situation and limit the size and costs of the crisis; restructuring of financial institutions and corporations; and structural reforms. In all three phases, politics poses major problems, as does the difficulty in separating unviable from viable entities.

The key issue during the containment phase is the tradeoff between restoring confidence and containing fiscal costs. A study of the fiscal cost of 40 crises in industrial and developing economies from 1980 to 1997 found no obvious tradeoff between fiscal costs incurred to contain the crisis and subsequent economic growth. Countries that used policies such as liquidity support, blanket guarantees, and particularly costly forbearance--- that is, the relaxing of prudential standards---did not recover faster. Rather, liquidity support appears to lengthen the recovery period and increase output losses. This suggests that during the containment phase, it is important to limit liquidity support and not to extend guarantees.

During the restructuring phase, the two major issues are how to allocate costs among shareholders, creditors, workers, the government, and taxpayers; and how to get the financial and real sectors up and running as soon as possible. This must be done in conjunction with macroeconomic reform, because of the many inter-dependencies. Evidence suggests that it is not necessary for governments to assume all losses; these can be shared with shareholders and large depositors in the case of banks, for instance.

One major objective is that banks should emerge well-capitalized from the process and properly regulated and supervised, or they may engage only in cosmetic corporate restructuring rather than writing off debts. The restructuring of firms needs to take place alongside that of financial institutions. The question is how to decide which firms are worth restructuring. In an individual case, the decision will be made by the concerned private agents--- but what about in a systemic crisis? One step the government can take is to improve the enabling environment. The crisis will typically provide an opportunity to improve bankruptcy legislation, make the judicial system more efficient, liberalize entry for foreign investors, harden budgets for enterprises, and improve corporate governance---structural reforms which are important for efficient financial and real sectors in any case. But the problem of how to restructure firms and who will lead the process in a way that minimizes fiscal costs and quickly re-establishes going concerns remains a complicated one. Several proposals are discussed in this regard.

A related topic is the creation of a supportive macroeconomic environment. The fiscal-monetary policy mix must be conducive to restructuring, but may be constrained by the indebtedness and balance sheet mismatches of banks and firms, as well as the level of public debt. Raising interest rates to defend the currency could hurt indebted firms, as well as public debt dynamics. Letting the exchange rate go could be problematic if liabilities are denominated in foreign currency and hedges are unavailable. Similarly, liquidity support, especially to insolvent institutions could both increase fiscal costs and contribute to a free fall of the currency if the liquidity made available is used to buy the central bank's foreign exchange reserves. On the other hand, a credit crunch may deprive firms of working capital and slow restructuring. There are no easy answers; but the empirical evidence shows quite clearly that lowering the risks of a financial crisis in the first place---by emphasizing macroeconomic fundamentals, creditor and property rights, and proper and adequate regulation and supervision ---is well worth it.

### ***Chapter 5. Commodity Price Volatility***

Traded agricultural commodities continue to be an important component of exports, government revenue, and income for poor farmers in many developing countries, especially in Sub-Saharan Africa.<sup>26</sup> In chapter 5, Jan Dehn, Christopher Gilbert, and Panos Varangis discuss how a growing body of empirical and policy-oriented work has contributed to a change in thinking away from attempting to stabilize prices in international markets toward living with and managing commodity price and yield risks. The authors illustrate this change in approach with new and sometimes experimental programs, with special emphasis on those sponsored by the World Bank.

The authors measure commodity price variability for countries by using Deaton-Miller (D-M) indices, which are geometric averages of commodity export prices using weights in some base year. Calculations lead the authors to conclude that commodity price variability increased over the final decades of the last century.<sup>27</sup> Deflating the nominal indices by dollar import unit values only reinforces the finding that commodity prices have become much more volatile after 1972. Over the entire 1959--97 sample, real variability was highest in Laos and lowest in South Africa. Of the 110 countries considered, 31 experienced real volatilities in excess of 20 percent per year; 54, between 10 and 20 percent; and the remaining 25, less than 10 percent. The 31 high-volatility countries include most of the major oil exporters, but also some very poor non-oil exporting countries (Bhutan, Haiti, Laos, and Uganda). These countries exhibit high export concentration. The 25 low-volatility countries are composed of countries that are net oil importers but are well-diversified. This group includes some countries that are normally considered as suffering from commodity price variability (Cameroon, Fiji, and Ghana) as well as some very large countries (Brazil and India).

The authors identify shocks as the difference between the actual and predicted percentage change in nominal D-M indices and then focus on those shocks exceeding a cut-off point that would for a standard normal distribution correspond to the  $\pm 2.5$  percent of the tails. Positive shocks predominate; there are nearly twice as many over 1959--1997, (179, compared to 99 negative ones). Extreme shocks affect sufficiently many countries to dispel the notion that shocks affect only a narrow group of countries, such as oil producers.

Are the odds stacked against commodity exporters? The authors review the Prebisch-Singer hypothesis put forward in the 1950s, which argued for various reasons—including organized union power for workers in manufactures and low income elasticity for commodities—that commodity producers were doomed to face a declining terms of trade. Whether they intended it or not, this idea was used to argue for import-substituting industrialization behind protective barriers in many developing countries. Empirically, the IMF index of primary commodity prices deflated by the U.S. producer price index shows a trend decline at 1.20 percent per year over 1960--2000, although this estimate is sensitive to the choice of sample dates. Moreover, the trend decline in the price of agricultural exports—a component of primary commodities—relative to manufactured exports may just be an artifact of not properly accounting for price rises stemming from quality improvements. Such improvements are likely to be more pronounced for manufactures (such as automobiles) than agricultural commodities (such as coffee). The authors side with this view.

What is the impact of price volatility? In surveys, rural households, which face several sources of risk, including from the weather, crop disease, and illness, tend to rank price risks as the most important. In attempting to manage (ex ante, for example, through activity diversification) and cope with risk (ex post, for example, by running down savings, or informal risk-sharing), rural households face severe constraints. They may not have access to credit during downturns, which is when they most need it. Even during good times, they may lack collateral. They could self-insure, for example, by running down precautionary savings or turning to other households; but the first option may be constrained by limited resources to begin with, while the second option may work only when the shock is idiosyncratic and not systematic (such as a macroeconomic crisis affecting everyone). Diversification of activities away from the farm is a common response of farmers; but this too is often constrained by lack of education, skills, or access to working capital.

In looking at member countries of the International Coffee Organization, the authors find the share of coffee in total export revenues for these countries declined substantially over the 1990s. This reflects lower coffee prices, but, in many countries, increased agricultural diversification and growth in the non-agricultural sector. However, several poor countries remain

highly dependent on coffee exports: notably Ethiopia, Rwanda, and Uganda in Africa; and El Salvador, Guatemala, Honduras, and Nicaragua in Latin America. Further analysis shows that while Latin American countries have generally managed to reduce the dependence of government revenues on coffee through diversification and market liberalization over 1990--2000, the same is not true for Africa. Four countries in particular have increased their reliance on coffee: Ethiopia, Madagascar, Rwanda, and Uganda.

Concern about the negative effects of commodity price volatility on welfare and growth prompted both developing and developed country governments, as well as multilateral agencies, to attempt to stabilize prices through most of the 20<sup>th</sup> century; but with limited success, if not outright failure. As a result, starting in the mid-1980s, the policy focus has been undergoing a dramatic shift toward living with volatile market prices and risks (rather than attempting to control them) and exploring risk management tools (such as use of the futures markets, and possible issue of commodity bonds). Markets have been liberalized. However, as the authors note, this is not enough to address two central issues, which form the heart of the current policy discussion: how to get governments to manage expenditures and revenues prudently in a volatile environment; and how to shield vulnerable rural households. Diversifying tax bases and developing institutions to support counter-cyclical fiscal policy (that is, saving during booms to have a cushion during busts) are identified as fruitful areas for policy assistance from development agencies in relation to the first issue. Regarding the second, the most accessible risk-coping mechanisms for rural households are diversifying activities and informal risk-sharing across households. The former often forces households into low-risk, low return activities, while the latter may break down when most needed: during a systematic crisis. Access to formal markets for risk insurance is impeded by a number of factors, including economies of scale, transactions costs, and the maturity and liquidity of contracts. There is therefore a role for public safety nets. The authors also summarize experience from an on-going World Bank initiative in collaboration with numerous other donor and multilateral agencies (the International Task Force on Commodity Risk Management) to facilitate the access of small developing country farmers to risk management instruments available on international markets.

A noteworthy aspect of the new thinking about countries still dependent upon commodities (almost exclusively in Sub-Saharan Africa) is that the issue is not so much a “commodity problem” as a more general challenge of economic and rural development aimed at enabling these countries diversify away from traditional exports.

### ***Chapter 6. Managing Oil Booms and Busts***

While natural resources should be a boon that provides the means for underpinning long-run economic development and greater human welfare, this has not always happened in practice. Nigeria’s real per capita GDP in 2000 was not much higher than in 1965, even it was a big beneficiary of the two oil price shocks of 1973--74 and 1979--80. Venezuela, another big oil exporter, found itself mired in debt and economic stagnation in the mid-1980s after the two oil shocks. In contrast, Chile and Norway are widely regarded as having managed their natural resource wealth to the benefit of their citizens. Botswana is also considered a success story, while Malaysia has managed to grow impressively and diversify away from oil. In chapter 6, Julia Devlin and Michael Lewin note that explanations for the poor performance of oil exporters fall into two categories. The first emphasizes governance, including corruption and rent-seeking. The second focuses on the economic effects: that is, on Dutch disease<sup>28</sup> and the potential for minimizing it through policies and institutional mechanisms. The chapter surveys this latter set of issues in order to provide policy guidance.

The Dutch disease effects of oil revenues are transmitted via two key variables: the real exchange rate, and fiscal policy. A real appreciation is to be expected as part of the equilibrium

response to an oil price boom. The demand for non-traded goods goes up. Since these by definition cannot be imported, their relative price must rise to draw the resources in for greater production. This leads to a shrinkage of the non-oil traded goods sector. In most developing countries, the government, as guardian of the natural resource wealth, becomes the conduit through which the higher oil revenues flow into the economy through higher public spending, which is often concentrated on the non-traded goods sector. This would not be a problem if the increased oil revenues lasted forever; but typically they do not. Oil prices are notoriously volatile. Now consider a government that responds to a boom by effectively treating it as permanent, even borrowing to finance additional expenditure over and above that permitted by the higher oil revenue. When oil prices subsequently collapse, two problems arise: the government might find it no longer has access to the capital markets; and the agricultural and manufacturing sectors, which atrophied during the oil boom, do not instantaneously and miraculously reappear because of so-called hysteresis or persistence effects stemming from adjustment costs, including lost skills and lost markets. This creates a vicious circle, intensifying the dependence of the economy on oil and increasing its vulnerability to future oil price shocks and hurting overall economic growth: the “resource curse.”<sup>29</sup>

Not surprisingly in view of the above, the authors note that fiscal policy---in particular, a combination of expenditure restraint and revenue management---is the key to managing booms. They proceed to survey country experiences with oil revenue (“stabilization”) funds and fiscal policy rules, mechanisms for self-insurance and asset diversification, and policies to catalyze diversification in the real sector.

The authors stress that de-linking fiscal expenditures from current revenue is the key to insulating the economy from oil revenue volatility. Oil funds can help achieve this, but are not a panacea. The oil fund can be subverted, by using it to save during a boom but then borrowing against this saving. Thus what needs to be monitored is the consolidated debt/asset position of the government. What an oil fund can do if well-designed and governed is to increase transparency and accountability. It can stabilize oil revenue flows to the budget within the context of an overall fiscal framework focused on the consolidated net asset position of the government with control over the non-oil deficit (spending minus non-oil revenues), to ensure there is genuine saving during booms. This will permit expenditure to be maintained during busts and help minimize real exchange rate volatility. The authors proceed to summarize the mixed empirical evidence on the usefulness of oil funds. They emphasize that if a country decides to establish a fund, its design and operation should be based on transparent integration into the budgetary process to avoid off-budgetary spending. Parliamentary/legislative oversight should be included to avoid sole discretionary powers by the executive over the fund’s resources.

Implementing an oil fund and/or fiscal rules can stabilize revenue transfers to the budget and help keep the deficit under control but require some assumption about how oil prices will behave. Medium-term budgeting requires that the oil price path be forecast, which is not easy to do. The decision to add to an oil fund or deplete it must rely on some notion of a long-term reference price: when oil prices exceed this, the surplus revenue should be added to the fund; when prices fall below it, the deficit in revenue should be compensated by withdrawals from the fund. This raises complex issues about the stochastic process governing oil prices: to what extent price changes are permanent or temporary and whether prices are mean-reverting or not. One way of dealing with this is by using the information from futures and swap markets.

The authors also discuss how both exchange-traded and over-the-counter (OTC) risk management instruments can be used to reduce and manage oil price risk; but note that in practice, risk management programs are rarely implemented for a variety of reasons, including lack of

familiarity with instruments and unwillingness of public officials to face a situation where say, they authorized a futures contract to lock in the oil price and prices subsequently rose. Simulation exercises suggest that remaining unhedged might lead to higher expected revenue; but also higher volatility (the standard mean-variance tradeoff one would expect if the market is pricing risk efficiently). This could be costly for the economy if it translates into higher budget deficits. Hence while using risk management instruments to lower the volatility of the received oil price might lower expected revenues, this might be well worth it if it helps execute more prudent and stable fiscal policy.

A key policy issue pertains to the need to maintain a diversified economy with a strong non-oil traded goods sector. The authors stress that it would be a mistake to subsidize specific manufacturing activities directly because of the possible rent-seeking this would generate, not to mention the familiar difficulty of selecting “winners”. While deciding how to go depends upon individual country circumstances, a guiding principle is that government expenditure to enhance productivity in the non-oil traded goods sector is likely to be the most effective when focused on public goods such as infrastructure, health, and education.

### ***Chapter 7. Managing Macroeconomic Crises: Policy Lessons***

In the last decade, macroeconomic crises have successively hit Mexico, Thailand, Korea, Indonesia, Malaysia, Russia, Brazil, Turkey, and Argentina. Which policies for crisis prevention or crisis management seem to work, and which do not? Using the probability of a currency crisis and the total output lost during crises as the criteria of economic performance, Jeffrey Frankel and Shang-Jin Wei attempt answer this question in chapter 7 by linking key lists of macroeconomic variables to models of crisis probability.

These lists of variables are inspired by the “three generations” of crisis models. The *first generation* model attributes balance of payments crises to budget deficits financed by domestic credit in a fixed exchange rate regime with perfect capital mobility. This leads to current account deficits and a steady loss of reserves at a rate equal to the pace of credit creation; but a speculative attack resulting in a discrete exhaustion of remaining reserves occurs *before* these would have been used up based on credit expansion alone. A float will then be forced.<sup>30</sup> Such macroeconomic overexpansion and overvaluation were the standard diagnoses of balance of payments crises in developing countries before 1995, and were the basis of most adjustment programs administered by the International Monetary Fund. The international debt crisis of the 1980s is an important example.

The *second generation* argues that there are “crisis” and “no-crisis” multiple equilibria consistent with unchanged fundamentals. This approach was inspired the European Exchange Rate Mechanism (ERM) crises of 1992--93. The speculative attack on France in 1993 was puzzling, because the government had over the preceding years succeeded in attaining a level of macroeconomic discipline comparable to that of Germany, its partner in the ERM. Moreover, after the bands were widened, the crisis passed without a substantial further depreciation of the franc, even though there had been no tightening of macroeconomic policy in the meantime. How then could the fundamentals have been responsible for the earlier speculative pressure? The second generation argument is most simply illustrated by a “prisoners’ dilemma.” Consider two speculators. Each realizes that if the other sells, the resulting depreciation will reduce the value of his holdings of domestic currency. Neither wants to stand pat if the other might sell. One equilibrium is for both to sell, even though the economy may be worse off after the devaluation.

The *third generation* developed as an explanation of the East Asian crisis of 1997--98, where expansionary macroeconomic policy did not seem to be a factor, but a different kind of

weakness in fundamentals appeared: structural distortions in the financial system combined with implicit exchange rate guarantees. The phrase “crony capitalism” became popular in 1997 to describe flaws in the structure of Asian financial systems. Well-connected banks and businessmen are able to borrow from abroad to finance risky projects such as real estate development or construction of new factories in the already-glutted steel industry. They are aware of the risk, but confident they will be bailed out by the government if things go badly. The timing of the attack again stems from the calculations of speculators who worry that if they wait too long, there will not be enough foreign exchange reserves to go around. But there is a key difference from the first generation model, where reserves fall in the run-up to crisis. In this case, liabilities artificially encouraged by moral hazard rise to a point at which investors suddenly cash in their investments, fearful that if they wait any longer, they might not be able to get their money out. The speculative attack, as usual, then forces the central bank to abandon the exchange rate.

The data set is based on macro variables over the period 1990—2002, driven by four sets of considerations: definition of crisis, which is based on a foreign exchange market pressure index defined as the percentage fall in reserves plus the percentage fall in the foreign exchange value of the currency; measures of performance, including number of crises, output lost, and average rate and standard deviation of growth during the period; crisis prevention policies, which prompts consideration of the “deep determinants” of performance, such as institutions/governance, the choice of exchange rate regime, the capital account regime, trade openness, and the composition and use of capital inflows; and those linked to crisis management policies, such as monetary contraction measured by the change in the real interest rate relative to the change in the real exchange rate, and the relative importance of fiscal contraction by the change in the budget surplus relative to the change in the trade balance. The question is whether there exists some combination of these policies that enables a country to increase its trade balance in response to a sudden stop in capital flows that avoids an output contraction. Perhaps a contraction becomes unavoidable if the period of sudden stop—which might consist of several months rather than a single instant, as models suggest—has already been spent running down reserves to low levels and switching the composition of liabilities toward short-term dollar loans. The formulation here is based on the textbook framework of adjusting to an external imbalance through some combination of expenditure reduction and real devaluation, which remains among the most useful models for developing countries.

A casual inspection of the data for countries that had the most visible crises during the period 1994--2002 and selected non-crisis “control cases” suggests that it may not be possible to neatly separate the crises into first, second, or third generation; elements of all three models played a role. Nor is it easy to take any single variable regarded as crucial and show that it is *the* one driving crisis. For example, crises occurred with hard pegs (Argentina), floating (Brazil after January 1999), and intermediate exchange rate regimes (Mexico, Thailand, Korea, Russia, Turkey). Likewise, while Indonesia scores much higher on corruption than Argentina, both experienced severe crises.

The authors next use probit analysis to search for robust correlates of crisis based on a sample of 62 developing countries. Only two variables qualify as “very likely” contributors: the ratio of short-term external debt to foreign exchange reserves, and expansionary monetary policy (inflation). Two additional variables satisfy the generous definition for a “likely” determinant of crisis: the ratio of FDI and equity inflows to gross foreign liabilities, estimated to decrease the chance of a crisis; and intermediate exchange rate regime, less likely to be associated with crisis than the floating exchange rate regime.

To allow for non-linear “threshold” effects, regression tree analysis is employed to potentially nest all threshold and interactive effects. When the ratio of short-term debt to reserves exceeds 157 percent and inflation exceeds 17 percent, there is a 50 percent probability of a crisis. This is the only combination, from the universe of all the variables considered, that would generate a crisis probability of 50 percent or higher. Even in scenarios in which the short-term debt to reserve ratio is below the threshold of 157 percent, a combination of high inflation (exceeding 25 percent per year) and a high ratio of external debt to GDP (exceeding 80 percent) would also place a country in jeopardy. Therefore, the regression tree analysis identifies three variables---the ratio of external debt to GDP, in addition to the ratio of short-term debt to reserves and inflation---as the most important variables that can help classify country-years into high versus low probabilities of crisis.

Equally telling is what was not chosen by the regression tree analysis: financial openness and institutional quality. If there is a hump-shaped relationship between financial openness and currency crisis, or if there is a particular combination of weak institutions, exchange rate regime and high financial openness that would enhance a country’s vulnerability, the analysis suggests that these relationships are either not robust or quantitatively unimportant (assuming that these variables are well-measured). Similarly, no decade dummies are selected by the regression tree, implying a lack of strong evidence that one decade is more crisis-prone than any other.

A major issue is that the above variables are endogenous and do not clearly map into an optimal choice of policies. Debt and inflation are endogenous to fiscal and monetary policy. High levels of external debt may not lead to crises on their own, if debt is long-term or used (in part) to bolster reserves. But the composition of inflows is also endogenous. No policymaker deliberately wishes to borrow short term and in dollars. It may be the result of a deeper cause, such as crony capitalism or original sin. Or an adverse shift in composition may result from the response to a sudden stop: for example, a refusal to devalue or raise domestic interest rates after the speculative attack is launched. Such procrastination could result in a country’s entering a crisis with a higher proportion of short-term and dollar-denominated debt, which could then lead to a steep recession---no matter what policies are followed.

Some insight into these factors is sought by looking at the effect of the crisis prevention variables on output lost during a crisis. Macro variables, such as debt/GDP and inflation, do not appear to be significant; nor is capital account openness. But non-corruptness is significant with the expected sign. Overall, countries tend to have fewer or less severe crises if they are free from corruption, and tilt the composition of their capital inflows away from dollar-denomination. When the corners hypothesis (hard peg or float) was tested, it was rejected: that is, corner regimes are not less crisis-prone and intermediate regimes may work better.<sup>31</sup> Nor does exchange rate flexibility systematically reduce crises. Using average growth over 1990--2002 as the performance variable, a high ratio of short-term debt to equity and FDI shows a statistically significant negative effect. When interaction effects are explored (once again, with crisis output lost as the dependent variable), it is difficult to find support for any of the supposedly “deadly” combinations: namely, open capital markets and high fiscal deficits; open capital markets and short-term debt; or open capital markets and currency mismatch. But the variable that interacts open capital markets and initial income shows a positive sign and is significant at the 95 percent level. This might be rationalized by the possibility that open capital markets can lead to heavy borrowing and thereby to crises in middle-income countries, but are less dangerous in poor countries.

When crisis management (as opposed to prevention) is examined, the first interesting finding is that the average length of the sudden stop (the interval between the month that reserves peak and adjustment to crisis starts) varies between 6 and 13 months, depending upon the



definition used.<sup>32</sup> The point is: this is sufficiently long for the policy response to the sudden stop to have a significant impact on key variables such as the composition of capital flows, and thereby on the range of policy options available when the crisis actually hits. To take an important example, whatever the composition of the capital inflows a year or two earlier, if on the day when the crisis occurs the debt is substantially dollar-denominated and short-term, then the country is in trouble regardless what mix of policies it chooses as the means of adjustment. Either a short-term increase in interest rates or a devaluation, or any combination of the two, will sharply worsen the balance sheets of debtor firms and banks, and thereby contribute to bankruptcies and contraction in output and employment. While econometric evidence on this is inconclusive, the authors cite country examples from Mexico and Brazil to make their point.

Perhaps the most interesting question of crisis management is the mix between adjustment by real devaluation versus expenditure reduction. For fiscal policy, the authors found that countries where the fall in government consumption constituted a large share of the adjustment in the trade balance suffered a smaller output loss, other things equal. The effect, however, was not generally significant at the 95 percent level. For monetary policy, the authors found that countries that relied heavily on high real interest rates (either absolutely or relative to the preceding year) suffered larger output losses than those that relied on big real depreciations of the currency, a highly significant result statistically.

#### ***Chapter 8. Default Episodes of the 1980s and 1990s***

Chapter 8 by Punam Chuhan and Federico Sturzenegger distills lessons from the debt default episodes of the 1980s and 1990s. Not surprisingly, the evolution of debt crises has paralleled--and likely motivated--the development of the three-generations of crisis models reviewed in chapter 7. In this context, the authors note that the 1980s crisis, which came about as a result of recycling petro-dollars by the money center banks to emerging market countries, took over a decade to resolve and was treated as an issue of liquidity, rather than one of solvency for most of this time. The crisis began when Mexico declared a debt moratorium in 1982 following a substantial interest rate hike in the United States. It spread to eventually encompass 47 rescheduling agreements for 27 countries, covering \$130 billion in debt over 1982--84. The initial concern was how to contain the systemic risk posed to the international financial system, which appeared vulnerable to collapse. The exposure of U.S. money center banks to countries restructuring debt was 215 percent of banks' capital and 260 percent of equity at end-1982; that of UK and Canadian banks was 275 percent and 195 percent of their respective equity. Only in the third phase (1985--89) of restructuring, when the Baker Plan--named for U.S. Treasury Secretary James A. Baker III--took hold, was the need for fostering growth recognized. The Baker Plan advocated structural adjustment and market-oriented policies, increased lending by commercial banks, and greater participation of the IMF and World Bank.

While systemic risk to the international financial system was contained, growth did not resume in the defaulting countries and the combination of relatively short-term rescheduling and new money--which fell short of targets---only exacerbated the debt burden. Two related theoretical concepts developed during this time: the debt overhang; and the debt Laffer curve. The *debt overhang* was the notion that when external debt is very high and servicing it depends upon future growth and taxes, this may actually discourage investment today, because the debt in effect raises the marginal tax rate on investment. If this leads to a situation where the marginal ability to repay debt actually falls with the level of debt---that is, a *debt Laffer curve* develops---then beyond a point, reducing debt could actually increase repayments and thus benefit both the countries and their creditors. Such reasoning might have played a role when the United States unveiled the Brady Plan (named for then-U.S. Treasury Secretary Nicholas F. Brady) in March 1989, officially recognizing for the first time the need for debt reduction. The Brady Plan presented a menu

approach, with a range of instruments to give both cash flow and debt relief; these are discussed in the chapter. The Plan also gave banks a chance to write down debt against taxes, while reducing the risk of the new instruments issued against bank loans through various forms of collateral of principal and interest. The development of a secondary market in Brady bonds (of which the principal was collateralized) also increased liquidity and permitted those banks that wished to do so to exit.

The Brady Plan, which was implemented for 18 countries restructuring \$200 billion of bank loans into \$154 billion of bonds, was considered a success. However, in the ten years after it was launched, the world has witnessed a series of new debt crises starting with Mexico in 1994 and continuing with East Asia, Russia, Turkey, and Argentina, among others. From a debt restructuring perspective, the story is different now, as it involves a large number of diverse, anonymous bondholders rather than a few large banks; and these crises have been approached on a case-by-case basis, in contrast to the large, multi-country, officially sponsored debt workouts of the 1980s. However, several countries have undertaken bond exchanges quite smoothly. This may be regarded as good news in a situation of about \$500 billion in emerging market bonds, of which about 80 percent is public and publicly guaranteed.

One needs to be circumspect, however, because bond exchanges fall into two groups: voluntary, market-based swaps; and involuntary exchanges. As a general rule, the ones that have worked smoothly fall into the first group. This should not be surprising because, as the term “market-based swaps” suggests, existing bondholders can effectively bid on the terms of the new exchange, which might involve a lengthening of maturities or a change in currency denomination or both; but no debt reduction in a present value sense, assuming that the market is pricing maturity and currency risks consistently. But involuntary debt restructuring, which typically involves a debt write-down, is quite another matter, as demonstrated by the on-going debt restructuring negotiations for Argentina stemming from its December 2001 default. In contrast, Russia’s involuntary restructuring of ruble-denominated debt instruments and debt owed to the London Club following the 1998 crisis went relatively smoothly even though substantial write-downs were involved; but as chapter 10 notes, special considerations applied.

Even for market-based exchanges, complexities may arise. In situations where fiscal constraints are severe and the country is at its market-imposed credit limit, a market-based swap may not just be neutral, but could actually bring crisis forward. This could happen for a variety of reasons, including if the new instruments have perceived seniority over existing claims, or imply greater dollarization of liabilities, thereby increasing expected depreciation and raising interest differentials (opposite to the intended effect), or interact negatively with existing exposures of investors, or simply worsen public debt dynamics because interest rates go up visibly. In the case of Argentina, for example, not only did the \$29.5 billion mega exchange of June 2001 worsen the debt dynamics, but as the crisis deepened, the new bonds were eventually defaulted upon, together with all other debt instruments.<sup>33</sup>

The recognition that crises are costly has spurred considerable debate on whether suitable mechanisms can be developed to achieve a quick resolution that would benefit both creditors and countries. Two proposals discussed by the chapter are the Sovereign Debt Restructuring Mechanism (SDRM); and collective action clauses (CACs).<sup>34</sup> The SDRM is part of the IMF’s effort to improve the international financial architecture. It would seek to address the problem of creditor coordination in debt workouts through a statutory approach analogous to that used for corporate bankruptcies, while facilitating collective action. An insolvent country would activate the SDRM on request; all external debt owed to private creditors would be aggregated. A supermajority of creditors would be able to negotiate a debt restructuring that would be binding for

all creditors. Proceeds from litigation would be shared, and disputes would be adjudicated by independent bankruptcy tribunals. While the SDRM has not yet taken root, CACs, which address the creditor holdout problem, have begun appearing in recent sovereign bond issues. In February 2003, Mexico became the first major emerging market borrower to issue a bond with CACs under New York law. The CAC would allow a majority of 75 percent of bondholders to make wide-ranging changes to the terms of the bond contract in the event of a restructuring. While CACs address the creditor coordination problem for individual bond issues, they do not solve the problem of such coordination across bond issues (the so-called aggregation problem) or the problem of creditor coordination for an existing stock of debt (the so-called transition problem). Thus it remains to be seen whether CACs will be sufficient to resolve debt crises or whether additional mechanisms will be needed.

While future sovereign debt crises might differ in the method of resolution from the bank loans crisis of the 1980s, many of the basic questions remain the same. Debate is likely to persist on the nature of the crisis: that is, whether the crux of the matter is confidence and liquidity problems, or fundamentals; and whether or not public debt is on an unsustainable course. While CACs might help avoid creditor holdouts, this still requires that an agreement with a majority of creditors be reached in the first place.

### ***Chapter 9. Evaluating Price Signals from the Bond Markets***

Sovereign bond issues by emerging market countries in Latin America and elsewhere are largely a phenomenon of the 1990s and after. An important feature of these bonds is that they are continuously traded in the secondary markets. In chapter 9, John Merrick discusses how bond prices can be used to gauge market sentiment and in particular, how yield spreads can be interpreted as signals of default probability. He notes that emerging market bond spreads can be thought of as determined by four sets of factors: macroeconomic fundamentals; debt instrument and country characteristics; interest rates in “benchmark” countries, particularly the United States; and market sentiment. A noteworthy finding in empirical studies quoted in the chapter is that while in “normal” times economic fundamentals explain spreads across countries quite well, volatile market sentiment and herd behavior explain short-run variations in such spreads at times of crisis better than shifts in fundamentals.<sup>35</sup> Whatever the determinants of spreads, pricing theory suggests that the way emerging market bonds are priced is informative about how the market views the chances of default.

Consider a simple example based on the chapter: a one-period emerging market country bond with a coupon of 10 percent and principal or face value of \$100 due after one year. Assume that this bond is priced at \$96.38. Its yield, denoted  $Y$ , is simply the discount rate, which equates the present value of the promised future cash flows of the bond—in this case, \$110 after one year—with its price: that is,  $96.38 = 110 / (1 + Y)$ . This gives  $Y = 14.13$  percent.

Now assume the one-year U.S. Treasury zero coupon bond yield is  $y = 5$  percent.<sup>36</sup> This is in effect the yield on a default- or risk-free bond. The spread on the emerging market bond can be obtained as:  $1 + s = (1 + Y) / (1 + y)$ , which yields a spread  $s = 8.7$  percent, or 870 basis points.<sup>37</sup> A positive spread arises precisely because there is no guarantee that the promised \$110 will actually be paid; let  $p$  denote the probability of repayment. In a risk-neutral framework, this discounting problem can be equivalently written as  $96.38 = p(110) / (1 + y)$ , where the risk-free rate is now used to discount the *expected* cash flow (as opposed to the *promised* one). By comparing this equation with the one above, one can see that  $p / (1 + y) = 1 / (1 + Y)$ , and combining this with the expression for the spread,  $s$ , yields  $p = 1 / (1 + s)$ . This gives a payment probability of 92 percent and a default probability of 8 percent. But as Merrick cautions, this interpretation holds if and only if the assumed recovery value in the event of default is zero. In this case, and assuming a per period

default rate of 8 percent, the chances that default would occur on a 10-year bond would be almost 57 percent!<sup>38</sup>

Merrick then shows that the simple interpretation above linking  $s$  and  $p$  no longer holds once a positive default recovery value is assumed. This can be seen immediately by assuming a recovery value of  $R > 0$ . In this case,

$$96.38 = p \frac{110}{1+y} + (1-p) \frac{R}{1+y},$$

and setting  $R=0$  gives the previous case. There is now no longer a simple one-to-one mapping between  $s$  and  $p$  *even though* the quoted  $Y$  and  $s$  remain the same, at 14.13 percent and 870 basis points, respectively. Assuming  $R=50$ , this new equation can be solved to give  $p=85$  percent: that is, the default probability almost doubles from 8 to 15 percent. Alternatively, if  $p$  were kept fixed at 92 percent, the fair price of the bond would be 100.19 ( $=0.92[110/1.05] + 0.08[50/1.05]$ ), reflecting improved perceived treatment in the default state. In this case, the new yield linking the price and promised cash flow would fall from 14.13 percent to 9.8 percent. This 9.8 percent would be the yield quoted by the market; but it is actually a blend of the risk-free rate of 5 percent and the appropriate risky sovereign rate of 14.13 percent. This can be seen by writing the price of the bond  $V = (p)110/(1+y) + (1-p)R/(1+y)$ , which as already seen, gives  $V=100.19$ , when  $p=0.92$ ,  $y=0.05$  and  $R=50$ . The right-hand-side of this equation can be re-arranged to give:  $V = p(110 - R)/(1+y) + R/(1+y)$ . Given  $R=50$  and defining  $p/(1+y) = 1/(1+Y)$ , this reduces to  $V = (110 - 50)/(1+Y) + 50/(1+y)$ .

Thus the “risky” component of the cash flow, which picks up true sovereign risk, is effectively discounted at 14.13 percent, while the “riskless” recovery value is discounted at the risk-free rate. Once again, the true sovereign yield of 14.13 percent can be linked to the default probability of 8 percent. But here is where the problem arises, as Merrick notes. All one would actually observe would be the blended yield of 9.8 percent, the bond’s price of 100.19 and the promised cash flows. The probability of default cannot be inferred without knowing what default recovery value the market is assuming, which is not directly observable.

Merrick extends the above formulation to the  $n$ -period bond case and presents a methodology to extract measures of the market’s implied recovery value and payment (default) probabilities based on promised cash flows and market bond prices. He applies this to Republic of Argentina eurobonds during the market collapse prior to the December 2001 default and contrasts the results with those obtained through a similar exercise covering August to December 1998. The 2001 results are also compared with those that would be obtained assuming zero percent recovery value, based on the observed sovereign spreads. The latter depict a much lower default probability than that yielded by the simultaneous extraction of implied recovery values and default probabilities using Merrick’s methodology.

### ***Chapters 10 and 11. The Russian and Argentine Crises***

Russia and Argentina both suffered severe macroeconomic crises in recent years: Russia in 1998, and Argentina in late 2001 and still unresolved.<sup>39</sup> In both cases, public debt dynamics became unsustainable and eventually led to sudden stops in capital inflows. In both cases, there was a re-profiling of public debt through market-based swaps, which eventually failed to avert crisis, and might even have accelerated it. Further, with the wisdom of hindsight, significant real exchange rate overvaluation had also been a problem in both cases. And both involved defaults. But the aftermath has turned out to be very different. Russia rebounded very quickly, growing the very next year, and was able to achieve a substantial debt restructuring. Argentina is now showing signs of recovery, but is far from resolving its debt crisis. The first main difference is the speed

with which the fixed exchange rate was let go, and the related balance sheet currency mismatch. Argentina took much longer to do so and had a severe mismatch, which plunged its banks and corporates into deep trouble when convertibility was finally abandoned.<sup>40</sup> The second main difference pertains to special circumstances that made it much easier for Russia to restructure its debt, which are discussed in chapter 10.

Russia: The Russian meltdown occurred in August 1998 only six months after single-digit inflation was attained and less than a month after a big rescue plan put together by the international financial institutions (IFIs) took effect in July 1998. A unique feature of the plan was an upfront liquidity injection from the IFIs and a debt swap out of short-term ruble treasury bills (GKOs) into long-term dollar eurobonds in an attempt to boost market confidence and avoid a devaluation. Preserving the fixed exchange rate band was seen as vital for credibility and retaining stabilization gains. The rescue plan was abandoned following a government announcement of emergency measures on August 17, 1998. These included an immediate devaluation with a forced restructuring of ruble-denominated public debt maturing up to the end of 1999. The suspension of the rescue surprised those who believed Russia was “too big to fail” and that an IFI-led bailout would proceed regardless. Another surprise was that the Russian economy recovered much faster than anyone expected, with the crisis becoming a positive turning point in Russia’s transition.

In chapter 10, Brian Pinto, Evsey Gurvich and Sergei Ulatov use a four-part framework: an analysis of fundamentals, especially fiscal and growth; market signals; potential crisis triggers; and moral hazard issues, to argue that what happened in Russia was not that surprising after all. Indeed, had a decision to let the exchange rate go been made in May instead of August 1998, Russia would have used up \$16 billion less of foreign exchange resources (reserves plus new debt) in its futile defense of the ruble: some 8 percent of post-crisis 1999 GDP. This illustrates two of the key ideas from chapter 7. First, sudden stops are not that sudden. Russia’s lasted for about 10 months. Second, the avoidance of procrastination through early decisive action can be beneficial to the economy and to the balance sheets of the government and private sector. Quite apart from the politics, the key to early decisive action is a shared economic assessment of the nature of the crisis, and even this appears hard to achieve.<sup>41</sup>

The authors ascribe the surprising constancy of the public debt to GDP ratio over the 1995-97 to the strong real appreciation that accompanied the exchange rate-based stabilization program. This led to large capital gains on the dollar-denominated debt of the government, which masked the effect of large deficits and poor growth. By the beginning of 1998, with inflation approaching single-digit levels and the real exchange rate flattening out, public debt dynamics began reflecting their true determinants: namely, high primary deficits and real interest rates, and weak economic growth. By mid-May 1998, the marginal real interest rate was 27 percent under the macroeconomic program assumptions, compared to zero growth expectations, and public debt was on an explosive path.

Why did growth not accompany stabilization? First, the real sector was facing a punishing combination of high real interest rates and significant real appreciation that accompanied the stabilization. Second, a unique structural issue arose in the form of the so-called nonpayments problem. Manufacturing enterprises were allowed to run large arrears on their energy and tax dues, which were then settled through various noncash, barter-based means at off-market prices that incorporated significant discounts. Not politically permitted to disconnect nonpaying customers, the energy monopolies became delinquent on their own tax payments, adding to a consistent revenue shortfall for the government and leading to larger debt issues---thereby creating a direct, if hidden, link between nonpayments and public debt dynamics. Why did the government tolerate and even participate in the nonpayments system and its use of noncash settlements? One reason

was the high real interest rates. A second, ironically, may have been the fear that the punishing macroeconomic environment would lead to mass bankruptcy and social chaos.

Was the real appreciation an equilibrium phenomenon? The authors note that the real appreciation preceding the 1998 crisis was not accompanied by rising productivity in the traded goods sector and occurred alongside, indeed masked, increasingly unsustainable debt dynamics. Besides, the real exchange rate remained appreciated because of the high real interest rates that accompanied stabilization, followed by the interest rate defense of the ruble after speculative attacks that started in late October 1997. Thus in spite of current account balance, the real appreciation was not an equilibrium phenomenon. Indeed, the biggest threat to the real exchange rate by May 1998 was the possibility that the deficit might have to be monetized and debt inflated away: real interest rates were far higher than expected growth; debt was being frantically rolled over to hold on to inflation gains; and markets were signaling that Russia might have reached its credit ceiling—the classic Sargent-Wallace (1981) conditions.

The authors develop a simple technique for extracting market signals on default and devaluation risk and track their evolution during the months before the meltdown, showing how default risk rose continually during this period. By May 1998, it was clear that Russia was in danger of a fundamentals-based speculative attack. But Russia procrastinated for another 10 weeks. Eventually, the crisis was triggered by a combination of deteriorating liquidity, the vulnerability of banks, and the GKO-eurobond swap.<sup>42</sup>

Did moral hazard play a role in prolonging the defense of the ruble at great cost after May 1998? The authors suggest that only the prospect of an IFI bailout permitted Russia to increase its dollar-denominated debt by \$16 billion between June 1 and the meltdown. The implications are potentially serious for the a country. External, hard currency borrowing headroom could be used up in defense of an unsustainable peg rather than to support reforms or defray the social costs of a crisis. And the debt burden becomes more severe when the exchange rate eventually collapses.

While the expectation was that Russia was headed for a political and economic disaster after the August 17, 1998 devaluation and default, it rebounded much faster than anyone expected and grew by over 5 percent in real terms the very next year. The two immediate factors according to the authors were the large real depreciation, which switched demand toward domestic goods, and the hardening the government's budget constraint by the default (which shut it out of the capital markets), leading eventually to the dismantling of the costly nonpayments system. Macro policy objectives moved away from low inflation per se to maintaining a competitive real exchange rate and placing public debt on a stable long-run trajectory. While rising oil prices after 1999 helped, the proceeds were used to rebuild reserves and pay down public debt. Improvements in the quality of fiscal institutions also played a big role, including the implementation of the new treasury system, a new budget code, and elimination of all noncash settlements by 2001.

The authors conclude with a list of lessons. Three are mentioned here. First, it is very difficult to design a package to deal with confidence (liquidity) and fundamentals at the same time, especially in the context of a fixed exchange rate. If public debt is on an unsustainable course and the market is signaling high levels of default risk, attempts to bolster liquidity with loans from the IFIs could actually trigger a crisis. More junior debt holders (such as GKO -- ruble treasury bills--holders, in the case of Russia) could seize the opportunity to exit, and the temporary increase in liquidity as the result of the IFI loan provides the exit opportunity.

Second, inflation reduction should be viewed with suspicion if it is achieved in an environment of weak growth prospects, an appreciating real exchange rate, and stubbornly large

fiscal deficits. This combination can only mean that public debt is either on an obvious or latent explosive trajectory that will eventually cause a collapse in stabilization.

Third, Russia's problem with nonpayments also has lessons for other economies: that macroeconomic stabilization is eventually unsustainable without hard budgets for enterprises.

Argentina: Seldom has an economy gone so rapidly from being the "darling of emerging market finance to the world's leading deadbeat"---to use Michael Mussa's (2002) expression--- as Argentina did during the 1990s. Its economy grew rapidly following the adoption in April 1991 of parity with the U.S. dollar under a currency board system, as part of the Convertibility Plan to reverse decades of macroeconomic instability and declining per capita income. It handily survived the "tequila crisis" following the Mexican devaluation of 1994, and continued to perform well until the Russian crisis in 1998 and Brazil's subsequent devaluation. Argentina then plunged into recession and meltdown over 1999--2001.

Luis Servén and Guillermo Perry analyze the reasons why in chapter 11. It starts by delineating competing hypotheses, illustrating how difficult it is to identify the basic cause(s) of a crisis even ex post. In distinguishing between bad luck and bad policies, it compares the major external shocks suffered by Argentina in the second half of the 1990s with other Latin American countries. Three key sources of vulnerability are then examined: the straitjacket imposed by the hard peg, the destabilizing fiscal policy stance, and the fragilities hidden in the financial system.

The first surprising conclusion that emerges is that the external shocks suffered by Argentina, including the terms of trade, the impact of global economic slowdown during 2001, and the sudden stop in capital flows triggered by the Russian crisis, were either comparable to or milder than in other Latin American comparators. However, Argentina also suffered from two significant country-specific shocks stemming from the appreciation of the U.S. dollar against the euro and the devaluation of the Brazilian *real* in 1999. These prompted a large real appreciation, which the hard-peg straitjacket could do little to alleviate, adding to the real appreciation that had already occurred earlier during the 1990s as a result of the exchange rate-based stabilization.<sup>43</sup> The authors note the inadvisability of choosing a hard peg to the U.S. dollar based on Optimal Currency Area arguments: trade with the United States was only one-fifth of Argentina's total trade, and the hard peg left Argentina without the flexibility to adjust to shocks that might require a different monetary policy response from the United States.

The question is whether or not the real appreciation of the peso, which occurred alongside a growing dollarization in the financial system encouraged by the hard peg, was an equilibrium phenomenon. The authors conclude that the real exchange rate started diverging from its equilibrium level in 1998 and was 45 percent more appreciated than the equilibrium level by 2001. Correcting this was complicated by the hard peg and could explain the slowdown in Argentine growth after 1999.

On the fiscal side, both the federal and provincial governments ran persistent deficits throughout the 1990s. The growing fiscal deficit was the driving force behind the large current account deficits of the 1990s, which led to the steady erosion of Argentina's foreign asset position and to an overvalued real exchange rate. Not surprisingly, public debt rose, from 25 percent of GDP in 1992 to over 60 percent in 2001. Moreover, a major expansion in fiscal policy during the boom years compelled a contraction during the downturn which began in 1999, further hurting growth. Lower growth meant lower taxes, and in conjunction with rising interest rates, worsened public debt dynamics. Moreover, correcting for the overvaluation in the real exchange rate would have raised the debt/GDP ratio from the measured 60 percent to 90 percent in 2001, with a huge 7

percent of GDP primary *surplus* required to keep the debt/GDP ratio constant, compared to an actual primary *deficit* of 1.4 percent of GDP for that year.

One of the more painful lessons from Argentina pertains to the financial sector. The authorities undertook ambitious prudential and regulatory reforms to build a resilient financial sector, mostly based on dollar-denominated deposits and loans. Absent a lender of last resort (which was ruled out by the currency board), large prudential liquidity buffers were built into the system, sufficient to withstand sizeable liquidity and solvency shocks—including a flight of more than one-third of the system’s deposits, as well as a sudden and complete default in up to 10 percent of the loan portfolio—without endangering Convertibility.

But the exchange rate guarantee under Convertibility had encouraged large mismatches in balance sheets. By the late 1990s, 70 percent or more of firms’ outstanding debt was dollar-denominated, and the degree of dollarization was particularly high for firms in the nontraded sector. Nearly 80 percent of outstanding mortgage credit was dollar-denominated as well. Time and saving deposits showed also a high (and increasing) degree of dollarization. These large mismatches in the balance sheets of banks’ debtors—dollar debts of households and nontraded-sector firms—meant that a nominal devaluation would have rendered many debtors insolvent, and thus wrecked the banking system. But so would a real devaluation, regardless of whether Convertibility was maintained, by hampering the repayment capacity of those with earnings from the nontraded sector. Thus while the authorities may have been in an awkward position to signal the vulnerability to a nominal devaluation (because of the fears of creating a self-fulfilling prophecy), the failure to recognize the risks posed to the nontraded sector by a real devaluation was a major weakness. To add to this, as the government ran into growing difficulties to finance its deficit through market borrowing, it began increasingly to place its debt with banks after 1998, exposing them to sovereign default risk.

One lesson from Argentina may simply be that a hard peg is not consistent with unsustainable public debt dynamics, along the lines of first generation crisis models. Another pertains to the need to build up a fiscal reserve during boom times that will permit a countercyclical expansion during an adverse shock, such as the global slowdown of 2001, and thereby help to support economic growth. Yet another is about the financial system. While financial sector policy may have been exemplary, it was derailed by the dollarization encouraged by the hard peg and eventually the placing of public debt with financial institutions; bad macro policy trumps good financial sector policy. Finally, the combination of a hard peg, procyclical fiscal policy, and balance sheet mismatches makes it virtually impossible to address serious real exchange rate overvaluation without a crisis. An exit policy needs to be crafted during “good times,” appropriately supported by fiscal policy and financial sector prudential regulation that recognizes the risk to the nontraded goods sector in the event a real depreciation is needed.

### **Concluding Remarks**

The economist’s penchant for linearizing models around equilibria and relying on linear regressions may have obscured the negative impact volatility exerts on growth, uncovered by empirical studies over the past decade. Volatility also has a negative impact on poverty, through growth as well as inequality. These effects are the most damaging in poor countries, where the capacity to manage volatility and shocks is limited by shallow financial sectors and impediments to implementing countercyclical fiscal policy. The impediments include credit constraints as well as political economy factors. These impediments could also interfere with attempts to self-insure, for example, by saving during booms as a cushion for busts.



The problem becomes even more serious when countries tend to depend upon just a few agricultural commodities for both exports and taxes, as exemplified by certain Sub-Saharan African countries. Agricultural commodity price volatility presents challenges in terms of smoothing government spending and shielding vulnerable rural households from negative terms of trade shocks and macroeconomic crises. Diversifying tax bases is of considerable importance—even more so as governments slash customs duties, reduce inflation, and give up the implicit gains from financial repression in pursuit of more efficient financial sectors. Technical assistance in this regard would be fruitful. Likewise, designing and funding social safety nets is also important. The key point is to have adequate social safety nets in place *before* a crisis hits to avoid permanent damage. With regard to agricultural commodity exporters in particular, the latest thinking is that it may not be so much a “commodity problem” as a more general challenge of economic and rural development eventually leading to greater diversification.

The by-now familiar problem of how to manage booms and busts comes back with a vengeance in the case of oil exporters, which as a group have suffered from the natural resource curse, exemplified by Nigeria and Venezuela. Oil funds could help, but are not a panacea. For instance, countries could be accumulating money in an oil fund when prices are high, but borrowing against this as collateral—which defeats the purpose. Eventually, it is the fiscal and government debt situation in totality, and the transparency with which public spending decisions are made, that matters. The key challenges are to run a countercyclical fiscal policy that will smooth the path of the real exchange rate, while using some of the oil proceeds to provide those services in particular that will help the manufacturing and agricultural sectors as a whole, including power, transport, trade-related infrastructure, and access to information.

In principle, a liberalized, market-oriented financial sector should help with resource allocation and be a shock absorber; but it can also act to amplify shocks and trigger crises. The question for developing countries therefore is how to liberalize their financial sectors while managing the attendant risks. Various ideas have been spawned by the high-profile crises of the late 1990s on how to deal with asset bubbles and procyclicality in financing; but rectifying microeconomic distortions and creating a robust financial and regulatory system may ultimately be the “best” solution. However, even good financial sector regulation may be trumped by bad macroeconomic policy, as the Argentine crisis showed. There are no easy answers; but taking steps to lower the risks of a financial crisis --by emphasizing macroeconomic fundamentals, creditor and property rights, and adequate regulation and supervision --could lay the foundation for substantial long run benefits.

The preceding discussion illustrates the harmful effects of volatility for poor countries, which also happen to be at a lower stage of development measured by income levels, quality of institutions, financial development, trade openness or the ability to conduct countercyclical fiscal policy. One might therefore legitimately ask how focusing on volatility alters any of the standard development prescriptions. The answer is that is that fortunately it does not, but instead reinforces the need for financial, fiscal, and institutional development. The key insight yielded by this wide-ranging look at volatility is that a country does not necessarily have to wait for a crisis to begin reforming institutions: developing countries are more volatile, and this volatility reduces long-run growth and increases inequality irrespective of whether a crisis occurs.

The perspective this volume offers is that of dealing with missing insurance markets. While all countries may benefit from adding such markets, the cost of missing markets is incomparably higher for developing countries. Volatility of the type impacting the OECD countries may induce occasional recessions and unemployment, and temporarily reduce growth rates---whereas volatility of the type afflicting developing countries may lead to famines, riots,

stagnation, and long-run economic decline. To develop this thought further, recall that how volatility affects a country depends on the channels through which it is transmitted and how it interacts with policies and institutions. The empirical evidence quite clearly shows that developing countries are at a disadvantage here. Combining this evidence with the asymmetry result---namely, that positive shocks do not cancel out the deleterious effects of negative shocks, so that there could be permanent setbacks to growth--- yields yet another reason for why income levels in poor countries may not converge to those in rich countries. Not only do the latter have an advantage stemming from the endogeneity of technological progress, they also reap a persistent advantage from having better coping mechanisms for dealing with volatility. And repeated bouts of volatility will perpetuate the gap in income levels between developed and developing countries.

More volatile countries are also likely to be more pre-disposed to crisis, which can be thought of as large shocks to growth. While crises may spur improvements in fiscal, financial, and judicial institutions, they are also costly and disruptive; as chapter 2 shows, “crisis” volatility does most of the damage to growth. In conjunction with the pioneering study of Dani Rodrik (1999) on latent social conflict, shocks, and growth, this finding suggests that addressing the management of “normal” volatility needs to be given a higher profile. And the importance of developing “social capital” and conflict resolution mechanisms clearly becomes important.

Turning to exchange rate crises, the empirical analysis highlights two variables in particular as enhancing vulnerability: a high ratio of short-term external debt to reserves (well above 1), and moderately high two-digit inflation rates. Two other variables also receive some prominence: external debt to GDP,<sup>44</sup> and the choice of exchange rate regime (intermediate regimes are less crisis-prone). Countries tend to have fewer or less severe crises if they are free of corruption and tilt the composition of their capital inflows away from dollar denomination. In particular, foreign direct investment and equity are preferable to dollar-denominated external debt.

A review of the debt default episodes of the 1980s and 1990s suggests that in certain cases, bond restructurings have proceeded smoothly in spite of the coordination problem posed by a multitude of small, anonymous investors. However, the experience needs to be interpreted carefully. For example, both the Russian GKO-eurobond exchange of July 1998 and the Argentine ‘mega’ bond swap of June 2001 were hailed as successes; but Russia suffered a meltdown the very next month, defaulting on most of its GKOs, and Argentina’s default in December 2001 included the restructured bonds of June 2001. Such cases show that “market friendly debt restructurings”---that is, those where the terms of the exchange are determined by bids placed by the existing investors---may be relatively easy to execute; but do not help countries with fundamental public finance problems or preclude more messy restructurings in the future, as also illustrated by the ongoing Argentine experience. The only recent innovation is that of including collective action clauses (CACs) in bond issues, but it remains to be seen how effective these will be.

In conclusion, volatility and crises have particularly damaging effects on growth and on poor people, especially in low-income countries. Their ability to cope is limited by shallow financial sectors and the inability to conduct countercyclical fiscal policy, because of credit constraints and political economy considerations. Understanding the best ways to deal with missing insurance markets, including the development of suitable financial instruments to help low and middle-income countries, remains a formidable agenda. Short of a generic solution, promising avenues include promoting fiscal, financial, and judicial institutions; and helping build social capital to minimize conflict. These improvements may facilitate the formation of deeper markets and allow existing markets to provide more self-insurance opportunities. Another priority is to gain more insight into the pre-emption and easier resolution of debt crises in the brave new world of bond issues.

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<sup>1</sup> At about the same time, the Inter-American Development Bank (IDB 1995) conducted a pioneering study of volatility in Latin America under the leadership of Ricardo Hausmann and Michael Gavin.

<sup>2</sup> The Bayesian approach would deal with this situation by assigning a uniform prior to the possible outcomes.

<sup>3</sup> A European call option confers the right (without any obligation) to buy a stock on a given date at a pre-determined price, called the strike price. Among other variables, its premium or price depends on the volatility of the stock price.

<sup>4</sup> As noted, this volume abstracts from Knightian uncertainty and instead takes a Bayesian approach, occasionally using pure risk and uncertainty interchangeably. See Epstein and Wang (1994) and the references there for recent developments in modeling Knightian uncertainty.

<sup>5</sup> Serven (1998) uses this approach when examining the effects of macroeconomic uncertainty on private investment.

<sup>6</sup> An interesting account of Engle's contributions is contained in Diebold (2004).

<sup>7</sup> This is the approach taken in chapter 5.

<sup>8</sup> Calvo and Reinhart (2001).

<sup>9</sup> It is easy to show that  $\lambda = -c\delta^2 > 0$ , where  $\delta^2 = V(\varepsilon)$ .

<sup>10</sup> The heavy reliance on log linear modeling and estimation may also explain why earlier literature "conveniently" overlooked the possible adverse growth effects of volatility.

<sup>11</sup> See Aizenman (1998) and Bowman, Minehart, and Rabin (1999). See also Obstfeld (1994) for analysis of the potential growth gains from diversification of shocks.

<sup>12</sup> See Aizenman and Powell (2003) for more on the impact of volatility on investment with costly state verification and limited enforceability of contracts

<sup>13</sup> This result is consistent with the finding that the marginal impact of public investment on growth in developing countries is much lower than that of private (see Khan and Kumar 1997; Bouton and Sumlinski 2000; and Everhart and Sumlinski 2001). A possible explanation for this finding is that in countries characterized by weak institutions, public investment is inflated by rent-seeking and corruption.

<sup>14</sup> This result holds even with stochastic supply of savings, as long as the correlation between the supply of and the demand for saving is less than one.

<sup>15</sup> This result is not modified even if one allows for stochastic credit ceilings and investment where the realized investment is given by  $\text{Min}\{I_r, S_r\}$ . Provided the correlation of shocks affecting the supply of credit and demand for investment is less than 1, volatility will reduce expected investment, with a larger drop the lower the correlation.

<sup>16</sup> Obstfeld (1994) presents an endogenous model growth illustrating this. For further discussion, see Jones, Manuelli, and Stacchetti (1999) and Barlevy (2003).

<sup>17</sup> Higher uncertainty raises income inequality in the presence of specific factors of production (like specific capital), and in the absence of complete asset markets that allow pooling and risk diversification. See also chapter 3.

<sup>18</sup> For more details, see Galor and Zeira (1993). See also Flug, Spilimbergo, and Wachtenheim (1998) for empirical confirmation of the adverse impact of volatility on investment in human capital.

<sup>19</sup> While trade taxes and seigniorage are associated with zero (or low) collection costs, these taxes frequently end up with higher distortions and narrower tax bases than income and valued added taxes. The narrowness results from growing smuggling and currency substitution. The development pattern of the United States is similar to the OECD countries, where in the 20th century public finances switched away from trade taxes to income and sales taxes.

<sup>20</sup> The proper interpretation of the parameters is  $a = U(1); b = U'$ ;  $c = 0.5U''$ , corresponding to a second order Taylor approximation of  $U$  around 1.

<sup>21</sup> The risk premium is  $0.5\gamma\sigma^2$ , where  $\gamma$  is the Arrow-Pratt relative risk aversion measure

( $\gamma = -U''/U'$ ), and  $\sigma$  is the standard deviation of the shocks: in our example,  $\sigma = \delta$ .

<sup>22</sup> Hence the calibration predicts that the consumer would be willing to pay only a trivial sum (0.05 percent of his or her average consumption) for the benefit of insuring against business cycle risk.

<sup>23</sup> To illustrate, note that the producer surplus has a triangular shape, whose area is a quadratic function of the price facing the producers. (That is, the surplus is proportional to the square of the price of the product, corresponding to the case where in figure 1, the curve corresponding to  $c > 0$  plots the association between the price and profits.) In these circumstances, the profit function is convex with respect to the price of the product, and higher price volatility would increase expected profits, supporting higher investment. See Hartman (1972) and Abel (1983).

<sup>24</sup> This chapter draws upon two country datasets: results on volatility and growth use the same dataset as chapter 2, while results for volatility and inequality use the same dataset as chapter 3. The appendixes to chapters 2 and 3 describe the datasets and sources.

<sup>25</sup> The empirical results in chapter 2 suggest a non-linear relationship between financial depth and the volatility-growth link. Trade openness does not significantly alter it. See chapter 2.

<sup>26</sup> According to the International Task Force on Commodity Risk Management in Developing Countries (ITF 1999), 78 countries had primary commodities accounting for more than 50 percent of total export revenues in 1997 (39 African, of which 35 Sub-Saharan African; 15 Middle East and Asian; 17 Latin American and Caribbean; and 12 European and Central Asian). Excluding fuels, the number drops to 59 (32 African, of which 31 Sub-Saharan African; 8 Middle East and Asian; 10 Latin American and Caribbean; and 9 European and Central Asian).

<sup>27</sup> The authors calculate volatility by using standard deviation of the first difference in logs of the annual nominal dollar D-M indices) averaged across countries for various regions for three periods: 1958--72, 1973--84, and 1985--97.

<sup>28</sup> The term originated in Holland in the 1970s. It was used to describe the appreciation of the real exchange rate and the “de-industrialization” that resulted from the discovery of North Sea gas, which made manufactured imports much cheaper. More generally, it refers to the tendency of the manufacturing and agricultural (non-oil traded goods) sectors to atrophy in response to a real exchange rate appreciation fueled by a booming natural resource sector.

<sup>29</sup> Of course, corruption and favoritism (rent-seeking) in the allocation of oil revenues would make the problem much worse, which has been the case for many oil exporters.

<sup>30</sup> The basic insight of the Krugman (1979) and Flood-Garber (1984) models was to show that the speculative attack would happen when remaining reserves are exactly equal to the reduction in the demand for real domestic money balances that occurs when the fixed peg is abandoned. The reduction in money demand would be determined by the rise in the inflation rate (equal to the rate of currency depreciation when the float is forced) needed to generate the seignorage (inflation tax) necessary to finance the fiscal deficit.

<sup>31</sup> The corners hypothesis, also known as the bipolar view or two-corner solution, argues that for countries open to international capital flows, “intermediate regimes between hard pegs and free floating are unsustainable” (Fischer 2001). The two corners are free floats and hard pegs, while intermediate regimes include all adjustable pegs and everything else in between, although Stanley Fischer’s warning about unsustainability seems to apply only to soft pegs.

<sup>32</sup> Adjustment is defined as starting in the month of devaluation or a substantial fiscal contraction, or the signing of an IMF agreement.

<sup>33</sup> For a formal analysis of why market based debt exchanges may not work when fiscal fundamentals are weak – motivated by the Russian 1998 debt swap and the Argentine 2001 debt swap -- see Aizenman, Kletzer and Pinto (2002). The Russian debt swap is described in Chapter 10 and also analyzed in Kharas, Pinto and Ulatov (2001) as a factor triggering the 1998 Russian crisis.

<sup>34</sup> The collective action problem refers to a situation where a small minority of creditors stays out of an agreement reached with the majority: that is, they hold out in the hope of securing a better deal for themselves. In the oft-cited case of Elliott Associates versus Peru, Elliott sued for full payment after Peru had reached an agreement with 180 creditors, obtaining a restraining order on restructured payments in the process. Rather than default on its restructured debt, Peru settled out-of-court, paying Elliott \$56 million in 2000 for unstructured debt that had been purchased in the secondary market for \$11 million in 1996.

<sup>35</sup> But of course there could be shifting perceptions about fundamentals!

<sup>36</sup> A zero-coupon bond is one that pays a lump sum at maturity without any intermediate payments.

<sup>37</sup> The reason for doing this geometrically rather than arithmetically is that it makes it easier to interpret while discounting. Note that 1 percentage point = 100 basis points.

<sup>38</sup> The probability of default is the sum of default in period 1 plus no default in 1, and default in 2 plus no default in 1 and 2, but default in 3, up to 10, which eventually gives a probability of  $1-p^{10}$ .



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<sup>39</sup> The Convertibility Plan, under which Argentina had a hard peg at parity with the U.S. dollar, was effectively abandoned in December 2001 when, following runs on banks, withdrawals were restricted under the infamous *corralito*.

<sup>40</sup> Indeed, the presence of a severe mismatch was one of the reasons the Argentines were reluctant to abandon their hard peg.

<sup>41</sup> Indeed, it might be impossible to separate it from the politics.

<sup>42</sup> For an analysis of the destabilizing impact of the swap, see Chapter 10 and Kharas, Pinto, and Ulatov (2001).

<sup>43</sup> Using the exchange rate as an anchor to bring inflation down from very high levels commonly leads to a large real appreciation, as inflation tends to come down more slowly than the rate of depreciation, which goes instantaneously to zero with the fixing of the exchange rate.

<sup>44</sup> Specifically, chapter 7 identified the threshold of vulnerability as a combination of a ratio of short-term external debt to reserves exceeding 157 percent and inflation exceeding 17 percent per annum. External debt in excess of 80 percent of GDP could also pose vulnerability in combination with inflation exceeding 25 percent. While these thresholds are sample-specific, they reflect general vulnerabilities. Of course, these are not policy choices but endogenous outcomes determined by a combination of country circumstances and track record, and investor preferences.