OVERVIEW

Managing Economic Volatility and Crises: A Practitioner's Guide

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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 nonlinearities tend to magnify the impact of economic volatility, leading to large output and economic growth costs, especially in poor countries. Good times tend not to offset the negative impact of bad times, which leads to permanent negative effects. Such asymmetry is 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 phenomena that make it difficult to cope with volatility also drive crises. Hence, this 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 and is divided into four modules: (i) the basics of volatility and its impact on growth and poverty; (ii) managing commodity price volatility, including agricultural commodities and oil; (iii) the financial sector, and its roles both as an absorber and amplifier of volatility and shocks; and (iv) the management and prevention of macroeconomic crises, including a cross-country study, case studies on Argentina and Russia, and lessons from the debt default episodes of the 1980s and 1990s. A Technical Appendix is also available.

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 "volatile" 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,[1] 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 may 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.[2] *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.[3]

[1] 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.

[2] The Bayesian approach would deal with this situation by assigning a uniform prior to the possible outcomes.

[3] A European call option confers the right (without any obligation) to buy a stock on a given date at a predetermined price, called the strike price. Among other variables, its premium or price depends on the volatility of the stock price.

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.[4] This presents two options for computing volatility: it can be measured by the standard deviation (std.dev.) of total variability or on the std.dev. of pure risk, which can be obtained as the residual from a forecasting equation for total variability.[5]

An additional question arises. Is the volatility (variance or std.dev.) 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.[6] 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 4 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.[7] 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 credit constraints may prevent it from being financed, or it may exhaust 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 onetime ToT shock of 10 percent. If the ToT does not subsequently recover, however, and a large negative shock persists say,

[4] 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.

[5] Servén (1998) uses this approach when examining the effects of macroeconomic uncertainty on private investment.

[6] An interesting account of Engle's contributions is contained in Diebold (2004).

[7] This is the approach taken in Chapter 4.

for three years, the capacity of the country to cope may be exhausted and lead to 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"[8] 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 developing 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 buildup of government debt. In this case, a byproduct of a crisis might be stronger fiscal institutions and greater transparency (see Chapter 9, 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

[8] Calvo and Reinhart (2001).

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 (ε) 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 ε is greater (less) than zero. In this case, the variance of ε 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 ε; it is of second-order importance.

A better approximation would allow for nonlinear effects: $g = a + b.\ \varepsilon + c \cdot \varepsilon^2$. 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 ε. 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 δ, 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, λ.[9] 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

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

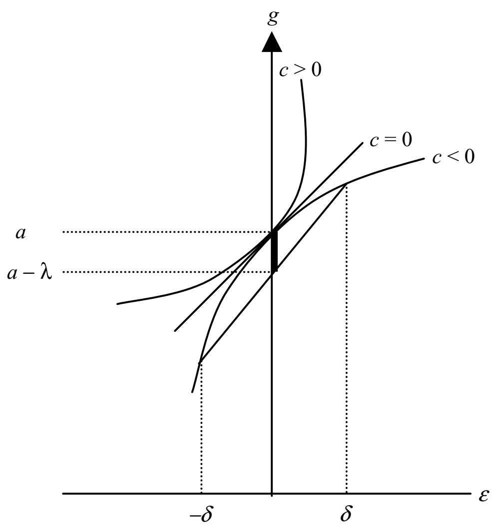

Figure 1. Shocks, Growth, and Welfare.

reduce volatility or manage its consequences.[10] But the realization that eliminating volatility would raise growth by λ (which would call for a nonlinear specification) would create an incentive to take volatility more seriously.

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 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.[11]

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

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

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

to lower *c* and thereby raise the expected value of growth for a given shock process. Both reflect institutional development, which is 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 decouple 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 tend to be thin or nonexistent when institutions are weak, constraining investment to be funded internally, or by banks. Robert Townsend (1979) and Ben Bernanke and Mark Gertler (1989), have shown that more costly verification and enforcement of contracts – symptomatic of weak institutions – and higher economic volatility can increase the cost of external funds, and thereby reduce investment.[12] And when recessions occur, internal funds drop, which leads 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 pubic 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.[13]

[12] See Aizenman and Powell (2003) for more on the impact of volatility on investment with costly state verification and limited enforceability of contracts.

[13] 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

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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.[14]

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 $I = Min\{I^d(r_0), S_0\}$, 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 ε is (see Figure 2, Panel B).[15]

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.[16] Alternatively, with a binding credit ceiling, policy-induced uncertainty that has an impact on 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.[17] Income inequality in turn may affect growth through several channels. For example, investment in human capital is frequently

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.

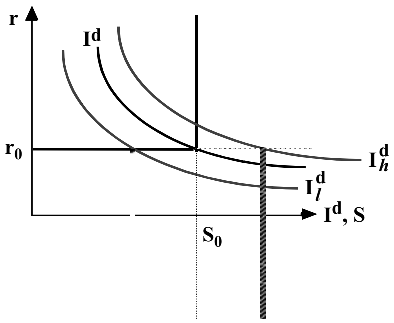
14 This result holds even with a stochastic supply of savings, as long as the correlation between the supply of and the demand for savings is less than one.

15 This result is not modified even if one allows for stochastic credit ceilings and investment where the realized investment is given by 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.

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

17 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.

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



Panel B. *Actual Investment and the Investment Demand*

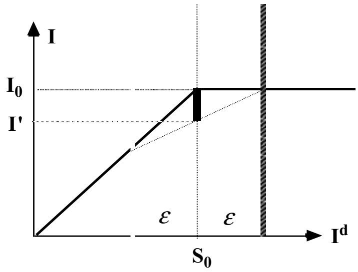


Figure 2. Investment in the Face of a Credit Ceiling.

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 tends to increase the dispersion of income among households, leading to a drop in average investment because more households face credit ceilings, thereby reducing the accumulation of human capital and, ultimately, growth.[18]

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.

[18] 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.

EXAMPLE 4. DIVISIVE POLITICS, INEFFICIENT TAXATION, AND PROCYCLICAL FISCAL POLICY. To cite another complex interaction, weak institutions and noncooperative 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 one political 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, underinvestment 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.[19] 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.

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[19] 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.