Explaining Growth Volatility

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"If there are two or more ways to do something,
and one of those ways can result in a catastrophe,
then someone will do it."

The economic history of the world is replete with recessions and depressions. 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 industrial depressions of the 1870s and 1930s, to the Latin American middle income debt crisis, African low income debt crisis, ex-Communist output collapse, and East Asian financial crisis, crises have been a constant of market capitalism.[2] Add to that the collapses that have accompanied non-economic shocks like wars, hurricanes, earthquakes, volcanoes, fires, pests, droughts, and floods, and it is a wonder that anyone in the world has economic security.

More recently, economic crises have often tended to go hand in hand with financial crises whose frequency and severity in developing countries has increased over the past quarter century. The causes and nature of these crises have differed. For example, those that characterized the debt crises of the 1980s were precipitated by profligate governments with large cash deficits and uncontrolled monetary policies. The more recent ones have occurred in countries which, for the most part, were following prudent macroeconomic policies, some of which had quite sophisticated institutional arrangements. The marked differences in the downturns in Latin America in the early 1980s and in East Asia in the late 1990s (and the Mexico crisis of 1994-95) means that we need a general framework for thinking about macroeconomic fluctuations—one that can encompass differences among countries. Furthermore, economic volatility is of importance not just because of the short run adverse effects on the poor. It has been shown to be negatively correlated with economic growth. There are thus ample reasons for trying to understand better the determinants of economic volatility.

[2] The historical references are from Kindleberger (1978) pp.212-213.

This paper attempts to set forth a framework for thinking about growth volatility which is general enough to incorporate the important structural, institutional, and policy variations among countries which might account for differences in their macroeconomic performance. And it focuses particularly on the role of the financial sector. The paper is divided into 2 sections. The first discusses the importance of short run dynamic effects in determining long run outcomes, and the role of the financial sector, elements which to date, have not been sufficiently incorporated in traditional macroeconomic analysis. The second looks at the data, which reveal some interesting aspects of the determinants of volatility, namely the importance of the financial sector.

Dynamics, Financial Variables, and the Standard Competitive Model

The starting point of modern macroeconomics is the competitive equilibrium model, in which not only are all resources fully employed, but they are deployed efficiently. Fluctuations in output, therefore, reflect changes in inputs (say the desire of workers to work) or changes in technology, the relationship between inputs and output. While these real business cycle theories provide plausible explanations for variability in the rate of growth, they have a hard time providing persuasive explanations of economic downturns in a large, closed economy such as the United States. Does one really believe that the Great Depression, or even the Reagan recession, was caused by these factors? That the reduced employment was a sudden desire of workers to enjoy more leisure, which quickly changed once again a couple of years later? For small *open* economies, adverse terms of trade shocks can have much the same effect as a negative technology shocks, and this is one of the important differences between macroeconomics in these economies and that which underlies some of the traditional closed economy models.

Employment and output fluctuations inevitably relate to shocks and to the manner in which the economy copes with those shocks. They are determined by the extent to which the individually rational actions of firms and households, and the policy interventions of governments, add up to collective behavior which either brings the economy quickly back to full employment and efficient resource utilization or does not. These issues are particularly complicated, because what is viewed to be individually rational on the part of households and firms depends on their beliefs both about the behavior of each other and the policy regime of the government. The policy regime in turn may depend on the government's beliefs about their

behaviors. And, the shocks themselves are, to some extent at least, endogenous, determined by outsiders' beliefs about the economic structures. Thus modern macroeconomics is concerned with the dynamics of quite complex systems.

Classical business cycle theory, provides a different perspective: it sees the economy as described by a set of difference or differential equations, which exhibits cyclicality. The most famous examples among these are Samuelson's multiplier accelerator model and Hicks business cycle theory. The fundamental objection to these mechanistic approaches—beyond the lack of persuasiveness of some of the underlying technological assumptions (e.g. the accelerator)—is that if they were true, downturns would be predictable. Governments could, through monetary and fiscal policy, take countervailing measures.

For nearly a half century, attention was centered on the downward rigidity in money wages and prices as a possible explanation of economic fluctuations. Rigid real wages provided an easy explanation of unemployment—a leftward shift in the demand curve for labor immediately turned into unemployment. And the leftward shift in the demand for labor could be explained by the falling demand for goods, itself explained by rigidities in intertemporal prices. For example, rigidities in the interest rate, which monetary policy seemingly could not bring down, or bring down enough to stimulate consumption and investment.

Subsequent work has focused on amplifying the reasons for nominal and real wage rigidities (menu costs, efficiency wage theory, portfolio theories of adjustment) and it has focused also on finding deeper explanations beyond the liquidity trap for the failure of monetary policy to bring down interest rates, (e.g. risk averse behavior of banks, especially when confronted with excessively tight regulatory oversight).

Dynamics

Even within that traditional frame however, much of the standard analysis, has not emphasized some important first order effects, e.g. the *dynamic* consequences of wages and prices falling. These may result in short run adverse effects that appear earlier and more dominant than the comparative static effects, which have until now been the primary focus of attention. The difference is not just a matter of exposition: the dynamics of adjustment may have the opposite effect from that predicted by a comparative static analysis. For instance, it is usually asserted that a fall in prices will raise consumption through the real balance effect. The more precise statement is, "a lower level of prices would be associated with a higher

level of consumption." But typically, there is not an instantaneous jump in prices. Falling prices mean that, at any level of the nominal interest rate, real interest rates are increased —and presumably investment falls (and overall demand may fall!). Similarly, it is often stated that a lower level of wages may be associated with a higher level of employment. But to go from one level of wages to another (lower) level, wages need to be falling. If falling wages lead workers to reduce consumption, then the net effect on aggregate demand and employment could even be negative!

Some strands of research (recent as well as pre-dating Keynes) have focused, for instance, on *differences* in adjustment *speeds*,[3] as well as on distributive effects that arise from price changes, especially those against which individuals cannot be insured (reflecting incomplete contracts). We are increasingly aware that income effects arising from distribution changes can often overwhelm substitution effects arising from price changes. This is especially so when there are asymmetries in the adjustments of real variables. For example, it is easier, less risky, or less costly to contract the utilization of some inputs than to expand them.[4]

The importance of financial institutions

There has been a growing recognition that wage (and price) rigidities may not be the only, or even the most important departure from the standard competitive equilibrium model, relevant for explaining the nature of economic fluctuations. Models based on price and wage rigidities become unpersuasive if countries have both more flexible wages and prices and *still* exhibit high volatility in growth output. We need to ask :whether this high level of volatility can be explained simply by the fact that the countries are exposed to more shocks (or have a less diversified economy), or are there other aspects of their structure or policy regimes which explain this volatility or relative stability?

This leads us to a second difference between the new perspective and traditional macro-analyses. In the latter, institutions (other than labor market institutions which give rise to wage rigidities) play no role. It is one of the central theses of this paper that previous studies have not paid sufficient attention to dynamic effects arising from firm and financial institution (banks, securities markets) wealth and cash flow

[3] See, e.g. J.E. Stiglitz, 1999.

[4] Note that traditional Keynesian theory focused on asymmetries in adjustment of wages and prices; here we argue that asymmetries in adjustments of real variables are every bit as important.

constraints (Under neoclassical theory, these simply do not exist.) Financial market institutions have profound effects on firm behavior (on how, for instance, firms cope with shocks); and vice versa.

Firm wealth effects

When negative net worth shocks are large enough (such as when there are interest rate shocks) firms may go into distress, i.e. be on the verge of, or in, bankruptcy.[5] Because of the complex credit interrelationships among firms—most firms supply credit to customers and/or suppliers—bankruptcy of one firm can set off a "bankruptcy chain," weakening other firms that depend on it, and possibly pushing some into bankruptcy itself. Thus, the likelihood of bankruptcy becomes a variable of systemic concern (see Orszag and Stiglitz, 1999) and negative effects on output/growth may materialize. As more firms go into distress, the number of non-performing loans increases, and thus the financial position of financial institutions deteriorate.[6] Theory[7] and evidence[8] both support the hypothesis that firms act in a risk averse manner, and that the effective degree of risk aversion is affected by their wealth, e.g. how close the firm is to bankruptcy. Adverse net worth shocks to financial institutions lowers their ability and willingness to bear risk—that is, lowers the amount that they are willing to lend at any interest rate. Certain groups of borrowers may actually be excluded from the market and these actions may further exacerbate the economic downturn.

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[5] Technically, a firm is in bankruptcy only if its creditors have gone to the courts to seek redress, or the firm has gone to the courts to seek protection from creditors. We use the term distress more generically to refer to situations where either the firm's net worth is negative, or its cash flow (including what creditors are "voluntarily" willing to lend or roll over) is insufficient to meet its debt obligations.

[6] Note that these unpaid liabilities inhibit both the activities of firms and of their creditors. The debt overhang is a liability to firms, yet it is not really an asset to financial institutions, which necessarily must take a conservative position in discounting the likelihood of being repaid.

[7] This is because imperfections in equity markets (which themselves can be explained by informational imperfections; in the case of most developing countries, few would question the hypothesis of limitations in equity markets) limit the extent to which risks can be shared and shifted; and because agency problems in large corporations lead to incentive schemes which induce risk averse behavior in managers. See, e.g. Leland and Pyle, 1977; Stiglitz, 1982; Greenwald and Stiglitz, 1991.

[8] There is a large catalogue of firm behavior which is hard to reconcile with the standard neoclassical model with risk neutral firms but which are consistent with the theory of the risk averse firm (see the discussion above and the papers by Stiglitz 1982 and Greenwald and Stiglitz 1991).

Cash Flow Constraints Matter: Credit, Equity Rationing, and Interest rate effects

In standard economic theory, cash flow (or liquidity) constraints simply do not exist: anyone with good future prospects can get access to funds. In practice, however, there is evidence, especially for small firms, that cash flows do have large effects on firm decisions, e.g. investment, and in extreme cases, even production. Similarly to the case for credit rationing, imperfections in the equity market (both adverse selection and incentive concerns) lead to what may be thought of as equity rationing—or at the very least, the costs of issuing new equity may be very high, making firms reluctant to engage in this form of finance, even when they cannot obtain loans.[9] Equity rationing also implies that firms cannot diversify their risk well—making them act in a more risk averse manner.

An important determinant of the magnitude of this "financial sector" effect is the extent of integration of the economy into global capital markets. Weaknesses in the country's own financial market institutions may matter little if firms in the country have easy access to banks abroad. While high degrees of openness of capital accounts could, in principle, serve to smooth the adjustment of a country to a shock, it may also expose it to another adverse source of dynamic reaction. Investors observing the weakening condition of firms and financial institutions within the country in response to a shock, may decide to pull their (short term) money out of the country and put it elsewhere, thus further weakening both firms and financial institutions (e.g. by further weakening the currency), and possibly inducing a crisis. A negative shock to the capital account will have adverse effects on the terms at which firms can get access to funds (note this affects both liquidity and net worth adversely) and may be exacerbated by the presence of credit rationing. The increased uncertainty about different firms' balance sheet, caused by the economic disturbance, may lead to a greater prevalence of credit rationing and to further

[9] See Myers and Maljuf, 1984, Greenwald, Stiglitz, and Weiss, 1984, and Helmann and Stiglitz, 2000.

contractions in demand (investment, including inventories), as firms attempt to increase their liquidity.

By under-emphasizing the financial sector, and particularly the dynamics within the sector, the standard stories leave out much of the richness of the macroeconomic adjustment process, and they perhaps leave out much that is of first order importance. Many of the seeming anomalies we observe in the real world [10] can be explained by a model that incorporates a variety of the effects discussed here. For instance, consider the seeming anomaly of fluctuations in output in small open economies for which aggregate demand should not be a central problem.[11] We can explain this phenomenon by focusing on factors such as interruptions in the flow of credit, and high interest rates which can combine to force many firms into bankruptcy, shifting the market supply curve to the left.

Endogeneity of Institutions and Shocks

Views which recognize the importance of institutions and the dynamics also emphasize the *endogeneity* of many factors that were previously taken to be exogenous—including institutions and "shocks." Thus, countries (such as those in East Asia or modern Western Europe) may have more financial depth partly because they experience less shocks. Had these countries faced the level of shocks experienced elsewhere, firms would not have been willing to undertake the risks associated with high debt strategies, households would not have been willing to save in financial assets, and governments might not have been willing to provide the implicit or explicit insurance which made those risks that much more bearable. But countries in which firms have sufficiently high debt equity ratios and in which financial institutions are highly leveraged may themselves "invite" shocks, that is, for instance, they may be highly susceptible to changes in perceptions, e.g. of the country's economic future.

[10] By anomalies we mean deviations from model predictions.

[11] As long as the exchange rate is reasonable.

But clearly, not everything can be endogenous—or at least cannot be perceived that way by the policy economist. Governments can be thought of as adopting a *policy regime,*[12] for instance, whether and when to open up the capital account or to engage` in trade liberalization. Governments can decide whether to deregulate financial institutions. They may be able to decide—within constraints—on the macroeconomic regime. Decisions about these policy regimes should be sensitive to the specific characteristics of the economy—and the subtleties of dynamics. Certain forms of liberalization[13] may, under certain circumstances, promote economic growth and stability, but similar policies, pursued under other circumstances, may slow growth and contribute to instability. More flexible wages and prices may, under certain circumstances, increase the stability of the economy;. But under other circumstances, moves to enhance wage flexibility could actually exacerbate an economic downturn. On average greater openness may be good, but in particular circumstances it may increase volatility.

To ascertain which of the effects discussed are more important—and how they compare with those factors which have traditionally been emphasized (wage and price rigidities) we must turn to the data.

What Do the Data Show?

We begin with some descriptive statements and a paradox. Table 1 shows that mean growth is lower in developing countries than in OECD economies, and the volatility of growth is much higher. These two datapoints fit the empirical studies that have shown that the partial correlation between growth and volatility of growth is negative.[14] We also see that employment is much more volatile in developing than in developed economies.

The paradox appears in Table 2, where we see that developing countries have greater volatility in real wages than do OECD economies. If our explanation of employment and output fluctuations is based purely on nominal wage rigidities, there is little to support such an explanation in the OECD-LDC

[12] Though from the perspective of political economy, even the policy regime can be thought of as endogenous.

[13] For instance, eliminating certain restrictions on investment in real estate in a well regulated banking system in which all banks have large net worth relative to their assets.

[14] Ramey and Ramey, 1995, for example. Studies also show how instability in the terms of trade, climactic and political situations lowers growth rates (Guillaumont et al, 1999 in the African context, Barro and Sala-i-Martin, 1994, and Mendoza, 1994. The InterAmerican Development Bank (1995) estimated that the effects of greater volatility in the terms of trade, the real exchange rate, and monetary and fiscal policy in Latin America have translated into a reduction in growth rates of around 1% per year relative to the industrial economies.

comparison – real wages are more flexible in LDCs yet they have greater output and employment volatility. This may suggest that the demand effects of real wage changes dominate the supply effects, or there could be reverse causation from output volatility to real wage volatility (which we will address in the regressions below).

TABLE 1: REAL OUTPUT GROWTH AND VOLATILITY IN REAL GROWTH AND EMPLOYMENT

	non-OECD		OECD			
Variable	mean	n	mean	n	t-stat	sig-t
growth	0.007	163	0.027	23	-5.659	0.000
s.d. growth	0.061	163	0.026	23	9.779	0.000
(median s.d. growth)	0.052		0.022			
s.d. employment	0.098	83	0.035	21	6.652	0.000

What could explain then the higher growth volatility in developing countries? There is little empirical or theoretical work on what might determine volatility in growth rates. [15] Theoretical considerations suggest that greater openness to trade may expose the country to more external shocks, but leave it less vulnerable to internally generated shocks. Greater openness of the capital account might in principle provide a mechanism by which a country could smooth shocks, but at the same time could expose it to greater volatility, as exogenous shifts in those capital flows disrupt economic activity. Greater dependence on credit might make a country more vulnerable. In most of these cases, the results are, on theoretical grounds alone, ambiguous, and only a closer look at the data can reveal which effect dominates.

Table 2 shows some of the many candidates for explaining the higher volatility of LDCs. Money growth, private capital flows, inflation, fiscal balances and terms of trade are all more volatile in non-OED countries than in OECD countries. We will consider these factors more systematically below.

[15] For the Latin American region, the Inter American Development Bank (1995) and Hausmann et al (1996) have shown that external shocks (to the terms of trade and to capital flows) and the volatility of economic policy are associated with volatility in growth rates. The report also argues that weaknesses in the region's financial systems as well as exchange rate policies that have been chosen (pegging the exchange rate instead of choosing a more flexible regime tends to be associated with increased volatility in output) have been important determinants of growth volatility.

Table 2 : Some empirical differences between developed and developing countries

	non-OECD		OECD			
Variable	mean	n	mean	n	t-stat	sig-t
s.d. real wage index	2.119	90	1.883	21	0.833	0.410
s.d. real wage changes	1.197	85	0.321	21	8.116	0.000
s.d. fiscal balance	3.916	111	2.438	23	3.978	0.000
cred priv sect / gdp	25.280	148	64.023	22	-6.441	0.000
s.d. cps / gdp	9.179	148	21.206	22	-5.101	0.000
M3 / gdp	38.065	148	65.805	21	-4.766	0.000
s.d. m3 / gdp	10.572	148	12.320	21	-0.785	0.440
(m+x) / gdp	79.285	154	60.972	24	2.399	0.022
s.d. inflation	0.219	148	0.043	23	6.234	0.000
priv cap flows / gdp	1.722	146	0.372	22	2.743	0.009
s.d. pcf / gdp	2.662	138	2.311	22	0.808	0.420
s.d. ToT changes	0.123	117	0.041	23	9.688	0.000
s.d. money growth	0.219	148	0.077	20	6.757	0.000

In Table 3 we broaden our analysis to the variation in the entire cross-country sample. Table 3 shows the variables of interest –those relating to openness, financial sector development, price and wage flexibility and policies and their bivariate correlations with per capita growth volatility.

Table 3 indicates that terms of trade volatility, openness to trade, and volatility in capital flows are associated with increased volatility in per capita growth rates. All indicators of financial sector development are associated with reduced volatility, while the volatility of M3/GDP is associated with higher growth volatility. Wage and price flexibility and inflation variability are associated with greater variability in growth rates. Policy variability, whether it relates to fiscal or to monetary policy, is associated with higher volatility.

Table 3: Bivariate Correlations of Per Capita GDP Growth Volatility and Independent Variables of Interest

Variable	coefficient	t-stat	sig-t	R2	n
Trade and financial openness					
Standard deviation of terms of trade changes	0.12006	3.284	0.001	0.073	139
(Imports + exports) / GDP	0.00013	2.040	0.043	0.023	177
Standard deviation of (imports + exports)/GDP	0.00106	3.661	0.000	0.072	176
Standard deviation of private capital flows/GDP	0.00237	3.834	0.000	0.086	159
Standard deviation of all capital flows/GDP	0.00214	3.280	0.001	0.062	166
Financial system Development					
Change in private credit/gross dom. investment	-0.17660	-8.633	0.000	0.315	164
Standard deviation of M3/GDP	0.00106	3.015	0.003	0.052	169
Stock market value traded/GDP	-0.04741	-1.819	0.072	0.036	92
Credit to private sector/GDP	-0.00041	-3.336	0.001	0.063	169
Long-term private debt issues/GDP	-0.17815	-2.166	0.037	0.113	39
Private bond market/GDP	-0.03451	-3.615	0.001	0.272	37
Public bond market/GDP	-0.02361	-2.626	0.013	0.165	37
Price variability and flexibility					
Inflation	0.03331	4.298	0.000	0.101	167
Standard deviation of real wage index	0.00368	1.654	0.101	0.025	109
Standard deviation of real wage changes	0.01127	3.481	0.001	0.106	104
Policy Volatility					
Standard deviation of fiscal balance/GDP	0.00215	2.327	0.021	0.039	134
Standard deviation of inflation	0.04166	4.722	0.000	0.119	167
Standard deviation of money growth	0.06865	5.380	0.000	0.149	167
Other					
Per capita growth	-0.58696	-7.036	0.000	0.211	187
Dummy for OECD countries	-0.03515	-4.144	0.000	0.085	186

To assess the relative impact of these factors we regressed growth volatility (the standard deviation of the per capita growth rate) against a range of independent variables. Depending on the specification, our sample includes observations on 60 to 74 countries in a panel created by aggregating over the periods 1960-78 and 1979-97. The results are presented in Table 4. [16] [17] [18] Using a standard Hausman test, we found two variables to be endogenous – credit to the private sector and the standard deviation of private capital flows. These were instrumented by a range of variables including indicators for French or

[16] We present robust standard errors for all results—that is, the variance of the error terms is allowed to vary systematically across countries but we assume that they are uncorrelated over time within countries.

[17] It was necessary to drop certain variables such as those relating to stock market development due to the limited number of observations.

[18] Several other specifications related to our hypotheses were tried but additional variables were found to be insignificant. For example, inflation variability, external debt, terms of trade volatility, various measures of fiscal policy volatility (various measures of institutional development) the volatility of nominal exchange rates, and relevant interaction or non linear terms were also added but were found to be significant. We also checked for size effects, but they were insignificant.

English legal origin, initial GDP per capita in each period, the urban share of the population, life expectancy, the standard deviation of terms of trade changes, indicators for oil and other commodity exporters, and a measure of political stability (the number of assassinations per million). The set of instruments is both valid and sufficient. A Sargan test confirmed that the instruments are exogenous to the error in the second-stage regression, and an overidentification test ensured that the model is adequately identified. The likelihood ratio test for heteroskedasticity indicated that the errors differ systematically across countries. We correct for both heterogeneity and endogeneity (correlation between the regressors and the idiosyncratic error) using the method suggested by Baltagi (1995).[19]The developing country dummy is significant only in the OLS specification, suggesting that we are capturing in the error-correction models some of the structural factors that make LDCs more volatile.

The results show that openness does expose a country to greater growth volatility.[20] Surprisingly, private capital flows and the standard deviation of private capital flows[21] do not affect growth volatility in the multivariate instrumental variables regressions. Also, surprisingly, volatility in real wages (indicating

[19] This is a generalized two-stage least squares procedure using the within effects (standard deviations) and between effects (country means) as instruments on data transformed by a weighted average of the within and between variance components. The elements of the omega (weighting) matrix are computed as $\Omega^{-1/2} = (P/s_{fe}) + (Q/s_{be})$, where Q and P refer respectively to the country variable means and standard deviations, and s_{fe} and s_{be} refer respectively to the standard errors from fixed-effects and between-effects regressions. See Over (1999) for further details.

[20] This is in line with a result by Easterly and Kraay (1999), who found that small states were more volatile when they were more open. However, openness still had a direct positive effect on mean growth which outweighed its effect through increasing volatility.

[21] Countries with greater access to private capital at any time may be expected to have lower income volatility. In the estimation, values of private capital flows adjusted for errors and omissions are also included, but the results are unaltered.

wage flexibility) does not seem to be statistically significantly associated with volatility in output. On balance, we find neither evidence for those who claim that wage-price rigidity is the problem causing fluctuations nor for those who argue that wage-price volatility increases output volatility through demand effects.

Table 4. Determinants of Growth Volatility

	Model and estimation method					
	OLS 1/		EC2SLS 1/ 2/ 3/		EC2SLS 1/ 2/ 3/	
Developing country dummy	0.008971	(2.37) **	0.001962	(0.41)	-0.001844	(0.35)
(M+X)/GDP	0.000062	(2.43) **	0.000068	(1.98) *	0.000081	(2.16) **
SD change log real wage index	0.005861	(0.13)	-0.001801	(0.04)		
SD M1 growth	0.020729	(2.17) **	0.017451	(1.87) *	0.019222	(2.13) **
Private capital flows / GDP	0.000133	(0.13)	0.000417	(0.31)	-0.000155	(0.11)
SD private capital flows / GDP	-0.001136	(0.88)	0.000230	(0.09)	0.000739	(0.36)
Credit to the private sector / GDP	-0.000200	(1.25)	-0.000789	(3.15) ***	-0.000968	(3.95) ***
CPSGDP squared	0.000001	(0.98)	0.000004	(2.62) **	0.000004	(2.98) ***
Intercept	0.028857	(4.20) ***	0.048315	(5.41) ***	0.056339	(6.08) ***
F-test of all parameters (df)	(9,89)	(7.93) ***	(9,59)	(8.51) ***	(8,71)	(13.15) ***
LR test for heteroscedasticity (df) 4/	(59)	(709.62) ***	(59)	(699.14) ***	(71)	(930.42) ***
Sargan test (df) 5/			(9,88)	(0.60)	(9,114)	(0.96)
Overidentification test (df) 6/			(19)	(0.00)	(21)	(0.00)
N (groups)		60		60		72
NT (observations)		98		98		124

Notes:

1/ Standard errors corrected for clustering within countries; * > 90, ** > 95, *** > 99 percent significance.

2/ Credit to the private sector, credit squared, and the standard deviation of private capital flows are endogenous. Instruments include dummies for French or English legal origin, period initial GDP per capita, the urban share of the population, life expectancy at birth, the standard deviation of terms of trade changes, dummies for oil and commodity exports, and the number of political assassinations.

3/ These results use the method suggested by Baltagi (1996) for error-correction 2SLS regressions.

4/ The null hypothesis is that the errors are homoscedastic across countries (Chi-squared).

5/ The null hypothesis is that the instruments are not correlated with the residual (F-test).

6/ The null hypothesis is that the instruments adequately identify the model (Chi-squared).

Our key result is on the financial sector variables. Greater credit or a deeper financial system is significantly associated with less volatility in all specifications, but the relationship appears to be nonlinear. The squared term is significant and enters with a positive sign. While developed financial systems offer opportunities for stabilization they also may imply higher leverage of firms, which implies more risk and lower stability. It appears that the consumption and production smoothing possibilities provided by the existence of a deep financial system might reduce growth volatility, particularly when shocks are small, on average, *but up to a limit*. As the financial system becomes larger relative to GDP, the increase in risk and the other factors mentioned in this paper become relatively more important, and act to reduce stability. Figure 1 shows the nonlinear relationship from the regression between credit to the private sector/GDP and the standard deviation of growth, holding the other variables at their means. Very large financial sectors (which are of course more rare) can serve to magnify shocks to the economy, similar to the way capital inflows and outflows can magnify boom-bust episodes.

Table 5 shows the same regression, but using initial GDP per capita instead of the LDC dummy. The results are basically similar. However, openness loses significance. The use of an interaction term with initial per capita GDP reveals that openness may increase growth volatility but that this effect is significantly attenuated in richer countries.

It is interesting that variables such as the standard deviation of private capital flows and in some specifications, private capital flows are not significant when variables representing the depth of the financial system are included. This may be because volatility in capital primarily affect the economy through their effect on the financial system and on financial variables. The significance of the credit variables is robust to various specifications.

Several regressions were run to test the significance of the financial variables when we include measures of institutional development or of governance. ICRG and BERI indicators of institutional development, indicators of democracy were all insignificant and their inclusion did not affect the results.[22]

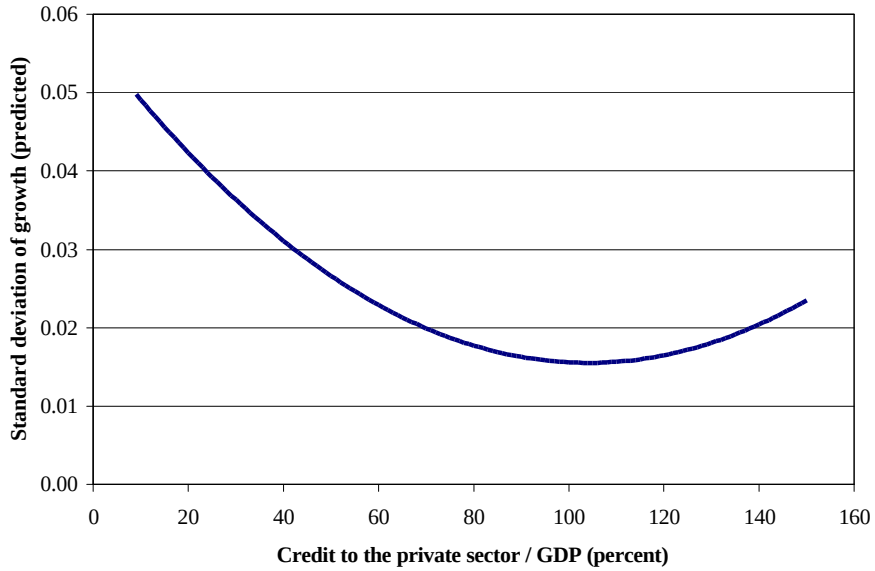
Table 5. Determinants of Growth Volatility, with initial GDP per capita

	Model (1)		Model (2)	
Initial GDP per capita	0.000311	(0.18)	0.005069	(2.07) **
(M+X)/GDP	0.000055	(1.34)	0.000986	(2.69) ***
(M+X)/GDP x initial GDP pc			-0.000107	(2.56) **
SD change log real wage index	0.003414	(0.06)	-0.015017	(0.30)
SD M1 growth	0.017042	(1.69) *	0.017335	(1.70) *
Private capital flows / GDP	0.000294	(0.20)	-0.000759	(0.51)
SD private capital flows / GDP	0.001198	(0.35)	0.002708	(0.82)
Credit to the private sector / GDP	-0.000846	(2.84) ***	-0.000866	(2.66) ***
CPSGDP squared	0.000004	(2.50) **	0.000004	(2.28) **
Intercept	0.048115	(3.66) ***	0.006441	(0.36)
F-test of all parameters (df)	(9,59)	(52.48) ***	(10,59)	(53.20) ***
LR test for heteroscedasticity (df) 4/	(59)	(6774) ***	(59)	(7103) ***
Sargan test (df) 5/	(8,89)	(0.44)	(8,89)	(0.43)
Overidentification test (df) 6/	(19)	(0.00)	(20)	(0.00)
N (groups)		60		60
NT (observations)		98		98

See table 4 for notes.

[22] These are available upon request.

Figure 1. Growth volatility and private sector credit



Downturns

As important as overall variability in output is, perhaps even more important are the large events—the economic downturns that occur periodically and have long characterized market economies. To address the question of what structural and institutional characteristics of economies might explain downturns, we perform a probit analysis on the same data set (see Table 6).[23] A downturn is defined as negative per capita growth, which takes on the value 1, while positive growth takes on the value 0. On average, countries experience declining real GDP roughly 20 percent of the time. Non-OECD countries experience a downturn 22% of the time, while OECD countries are in a downturn just above 9% of the time. [24] Not surprisingly, countries which are growing faster have a lower probability of an actual downturn—the change in growth rates required for a recession are larger, and hence the shocks that are required to put an economy into recession are large.

[23] In some of the specifications, such as those including measures of private debt, and stock market value traded, the data are only available from 1970 onwards. These financial variables were therefore excluded from the volatility equations.

The developing country dummy is significant – developing countries are far more likely to experience growth downturns than industrial economies, controlling for other variables. This again suggests that there is something about the structure of poor countries that makes them more vulnerable to growth crashes which is not captured by the right hand side variables. More open economies, while they have greater output variability due to a higher incidence of shocks, seem less likely to go into a growth downturn. We are not sure what to make of this mixed result.

Financial sector depth, as measured by the ratio of credit to GDP increases the likelihood of a downturn. But the squared term for financial sector depth is not significant in the probit regression. The role of equity markets has the predicted effect: such markets provide better risk diversification than do debt markets, and thus make the economy less vulnerable to an economic downturn. The coefficient of the variable measuring the depth of the equity market has the predicted sign and is highly significant. Combining this result with the previous result on the positive and marginally significant effect of credit on the likelihood of downturns, this suggests that financial systems that feature debt more prominently than equity are more vulnerable to growth collapses. Again, we stress the importance of financial variables in the analysis of volatility.[25]

[24] This is true both in the larger sample of 170 countries and in the smaller subsamples used in the regressions.

[25] External debt, was tested as an explanatory variable but was not significant

Table 6. Probability of a downturn

	Model					
	1/		2/		3/	
Developing country dummy	0.519350	(3.48) ***	0.481812	(3.12) ***	0.536428	(3.67) ***
Years since last downturn	0.019759	(1.56)	0.019814	(1.52)	-0.005692	(0.48)
5-year moving average growth	-0.268670	(6.30) ***	-0.263142	(6.15) ***	-0.047695	(1.55)
Credit to the private sector / GDP	0.016989	(1.74) *	0.016645	(1.63)	0.018288	(1.79) *
CPSGDP squared	-0.000071	(0.89)	-0.000080	(0.94)	-0.000072	(0.86)
Private capital flows / GDP	0.001520	(0.06)	-0.008840	(0.39)	-0.033246	(1.48)
Log change in real wages	-2.554385	(2.94) ***	-2.629325	(3.11) ***	0.530893	(0.87)
Capital restrictions	-0.175419	(0.94)	-0.163978	(0.87)	-0.344664	(1.80) *
(M+X) / GDP	-0.004631	(2.17) **	-0.004638	(2.18) **	-0.005904	(2.68) ***
Stock market value traded / GDP	-2.194500	(2.50) **	-2.241041	(2.12) **	-3.855537	(3.13) ***
Intercept	-0.982504	(2.76) ***	-0.925632	(2.61) ***	-1.070404	(2.91) ***
Chi-squared test of all parameters (10 df)		(124.99) ***		(101.79) ***		(53.03) ***
Chi-squared test of CPS/GDP and CPS squared		(6.71) **		(5.02) *		(9.43) ***
Log-likelihood		-198.59		-199.90		-229.58
N (countries)		54		54		54
NT (observations)		630		630		630

Notes:

1/ Contemporaneous values of credit to the private sector, credit squared, private capital flows, and stock market value traded. Dependent variable = 1 if growth negative fror

2/ Lagged values of credit to the private sector, credit squared, private capital flows, and stock market value traded. Dependent variable = 1 if growth negative from *t-1* to *t*.

3/ Contemporaneous values of credit to the private sector, credit squared, private capital flows, and stock market value traded. Dependent variable = 1 if growth negative fror

4/ Lagged values of credit to the private sector, credit squared, private capital flows, and stock market value traded. Dependent variable = 1 if growth negative from *t* to *t+1*.

The flexibility of real wages (as measured by the change in the log of real wages) decreases the likelihood of a downturn, but this result is not robust to different lag specifications. The fact that the length of expansion does not have a statistically significant effect on the probability of a downturn may be suggestive that there is no mechanical business cycle. This confirms work on the United States, where Furman and Stiglitz (1999), in unpublished work, have shown that there has been no regular business cycle (no dependence of the probability of a downturn on the length of the expansion) since World War II.[26]

Concluding comments

This paper can be thought of as a re-examination of the standard paradigm concerning economic stability. The paper began with the underlying hypothesis that a variety of dynamic effects and institutions, that are important for understanding volatility have traditionally been omitted or under emphasized in standard economic models, and some of the most important "omitted" variables were those relating to the financial sector. Analyses that do not look at this broader range of variables may be badly off course in predicting the short run performance of the economy. The empirical results of this paper support this hypothesis. Wage rigidities, at the center of traditional Keynesian analysis, seems on average, to play little role in explaining output variability. By contrast, financial variables consistently turn up significant both in explaining variability and the likelihood of a downturn. Of course, the volatility of an economy will also differ across countries according to the nature of the shocks they face, the structure of the economy, and the policy regime of the government. In this regard, the role of openness and of policy were also found to be significant determinants of growth volatility.

In terms of the institutional structures which affect macroeconomic outcomes, there are a host of micro-economic variables—variables like firm net worth and cash flows—which ideally we would have liked to have brought into the empirical analysis on volatility. Unfortunately, data on such variables is scanty, and available only for a few countries, over a limited period of time and for a small sample of firms. Yet the theoretical analyses suggesting their importance is consistent with many aspects of the evolution of the recent global financial crisis.

[26] See Stiglitz, 1997.

The results of our theoretical and empirical analyses, if correct, have strong policy implications, as illustrated by the following examples:

(a) Countries are often told to make labor institutions more flexible, to allow a more rapid lowering of real wages, so that the demand for labor can more rapidly adjust to supply. But there are aggregate demand effects of wage adjustments, and the adverse effects of these may more than offset the positive effects arising from wage flexibility. We find that on balance there is neither negative nor positive effects of real wage flexibility on volatility, controlling for other variables.

(b) Countries are told that opening the capital account will allow risk diversification, stabilizing the economy. In fact, benefits on this score can be offset by the fact that capital movements are highly variable—and can be highly pro-cyclical, in some cases inducing downturns, in others exacerbating fluctuations that arise from other sources. We do not find evidence either for the stabilizing or the exacerbating role of capital flows. The sensible thing would be for policy-makers to devise new financial strategies that hedge against the risks of sudden outflows while maintaining their access to finance.

(c) Openness enhances economic growth[27] and high economic growth reduces volatility and makes countries less subject to an economic downturn (as well as a direct effect of openness making downturns less likely). But we find that openness also contributes significantly to volatility of per capita GDP growth.

(d) Standard macroeconomic models give short shrift to financial institutions (often seeming to suggest that the whole sector can be embedded in a money demand equation). Our analysis confirms the central role that financial institutions play in economic volatility and downturns, namely that financial depth (as measured by private credit to GDP) reduces volatility up to a point, but too much private credit can increase volatility. The financial sector can also exacerbate periods of downturns, particularly if debt increases relative to equity.

[27] In the standard theoretical model, greater openness induces greater efficiency, a one time gain in productivity, but it does not lead to sustained increases in economic growth. But the conventional wisdom, and much of the econometric literature, argues that openness not only has one time efficiency effects, but long term growth benefits, perhaps as a result of the discipline provided by enhanced competition, or as a result of the increased awareness of new technologies, or as a result of the availability of a broader array of intermediate good inputs. Endogenous growth models also predict a significant effect of openness on growth.

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