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Growth dynamics: the myth of economic recovery

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Abstract

Using panel data for a large number of countries, we find that economic contractions are not followed by offsetting fast recoveries. Trend output lost is not regained, on average. Wars, crises, and other negative shocks lead to absolute divergence and lower long-run growth, whereas we find absolute convergence in expansions. The output costs of political and financial crises are permanent on average, and long-term growth is negatively linked to volatility. These results also imply that panel data studies can help identify the sources of growth and that economic models should be capable of explaining growth and fluctuations within the same framework.

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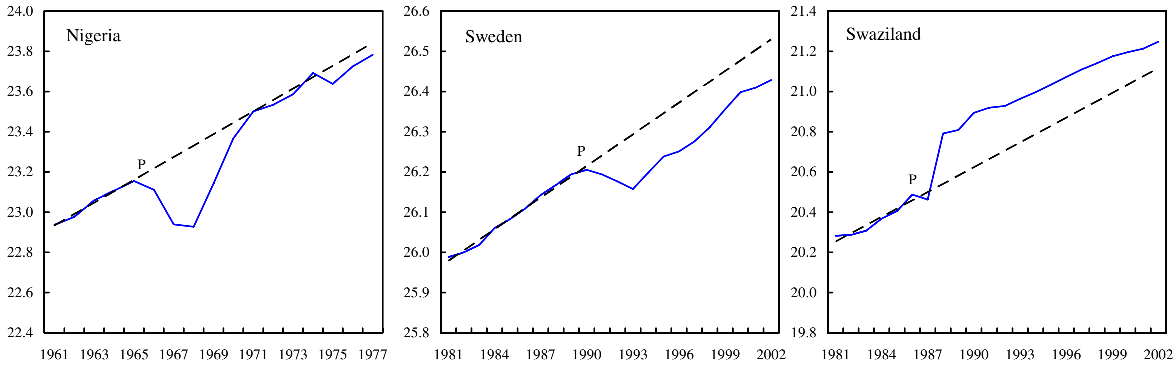
Growth dynamics: the myth of economic recovery

Valerie Cerra and Sweta Chaman Saxena[1] [2]

1. Introduction

The recent vast empirical literature on economic growth has focused primarily on cross-sectional growth regressions, with few studies exploiting the variation of growth over time. Therefore, very little attention has been paid to whether countries recover from their crises, shocks, and downturns. Although it is known that many crises are associated with recessions (Kaminsky and Reinhart, 1999), there is little research on whether the output losses are fully reversed.

Three examples illustrate the different types of recoveries from shocks that countries may experience. Following a steep recession from 1965-68, output in Nigeria recovered rapidly to its former trend line (passing through the pre-recession peak). Conversely, only a tiny fraction of the output loss from Sweden's banking crisis in the early 1990s was recuperated. At the opposite extreme, growth surged in Swaziland after a shallow recession in 1987. This paper investigates which of these recovery experiences is typical across countries and whether the type of recession or shock impacts the magnitude of recovery.



Do crises derail growth? If output does not fully recover from a contraction, as in the Swedish example, the proclivity to shocks may be responsible for the absolute divergence of incomes across countries. That is, if poor countries are hit by more shocks than rich countries, the output losses could accumulate over long periods, causing incomes to diverge. Poverty traps would be different in character than currently envisaged by some economists, with vastly different policy implications. Sachs and others (2004) argue that African countries are stuck

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in a poverty trap because their low incomes prevent them from generating sufficient savings and investment. According to this view, the trap operates even when economic conditions are favorable and governance is sound. Due to savings traps, capital thresholds, and demographic traps, a poor country is unable to generate high growth, and thus cannot pull itself out of poverty unless it is rescued by large infusions of aid from wealthy nations. If, however, growth is thwarted by political and financial crises rather than poverty traps, the implication is that institutions and policies would need to be transformed so as to achieve stability and set the conditions for strong long-term growth.

Understanding how countries recover from shocks is also important for several other reasons and is linked to different debates in the literature. First, the welfare costs of volatility are much larger when the output loss is not recovered. They are, in fact, permanent. Lucas (1987) showed that the welfare costs of economic instability in the postwar United States were only a minor problem relative to the costs of modestly reduced rates of economic growth. However, his calculation assumed that deviations from trend were temporary. If shocks have permanent output effects, the welfare costs of volatility and growth are intrinsically connected. Also, emerging market and developing countries have considerably higher volatility than the United States. Moreover, sharp and permanent drops in the level of output may lead to steep increases in unemployment and civil unrest, even when output drops to a level that was associated with stable and prosperous times only a few years earlier.

Second, the inference about the determinants of growth can be deceptive if crises and shocks have permanent effects and if recoveries resemble Sweden's pattern rather than that of Nigeria or Swaziland. For example, many critics of Sweden's welfare state policies have argued that such policies led to a drop in Sweden's GDP per capita relative to other OECD countries. Yet, a simple examination of the timing of the output loss relative to the OECD average makes it very clear that the slippage was associated with Sweden's severe banking crisis and recession in the early 1990s. Prior to this recession, Sweden's output had been growing roughly parallel to the OECD average. The banking crisis resulted in a sharp decline in output below the prior trend and below the OECD average and this wedge persisted in the subsequent "recovery." By comparing only the 30-year or 40-year growth rate to that of the OECD average, the critics misinterpret the slippage as due to welfare state policies as the long-term growth correlate.[3]

Third, if output losses associated with crises and shocks don't dissipate, it becomes critical to link time-varying growth rates with time-varying policies and country characteristics. Crises, shocks, and changes in policies can be ignored only if their output consequences are transitory. The copious body of growth literature searching for policies to boost income levels[4] has largely used a single average growth rate over a span of several decades for each country and a set of average or initial policies and country characteristics. Growth is not, however, a steady process. The variation across time is about as large as the variation across countries. Easterly and others (1993) note that, "with a few famous exceptions... countries are success stories one period and disappointments the next." Rodrik (1999) and Hausmann, Pritchett, and Rodrik (2004) document a large number of shifts in trend growth and try to explain episodes of growth collapses and growth accelerations, respectively. Pritchett (2000) provides examples of patterns ranging from rapid steady growth to plateaus and valleys. Cross-section regressions ignore the considerable variation in the data across time. As illustrated above for the case of Sweden, the inference from such regressions can

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3 See Cerra and Saxena (2005b) for an elaboration of this case study.

4 See Barro (2003) and Barro and Sala-i-Martin (2004) for comprehensive analysis.

be questionable. Moreover, explanatory variables that are constant or change very little over the sample are unlikely to be the sources of the shifts in trend growth.

The optimal data frequency for growth regressions is controversial, but permanent output loss would tip the balance in favor of higher frequency panels. Potential growth correlates are abundant, possibly larger than the number of countries. Cross-country regressions have been fragile, with the coefficients subject to change depending on the presence of other variables in the equation (Levine and Renelt, 1992). Some recent papers contend with sample size limitations and multicolinearity by sampling potential explanatory variables to find the set of variables with coefficients that are reasonably robust when combinations of other variables are present in the regression. For example, Sala-i-Martin (1997) ran two million cross-country regressions and Doppelhofer, Miller, and Sala-i-Martin (2000) used a Bayesian approach to test the robustness of growth correlates. However, many policy and other variables change over time. Ignoring this source of variation throws away valuable information. Exploiting a panel of time series, cross-country growth rates can take advantage of temporal and cross-sectional variation, thereby increasing the sample size and reducing multicolinearity. Yet, this approach has received much less attention than cross-section regressions, with the few extant panel studies (eg, Islam, 1995) focusing mostly on tests of convergence. Pritchett (2000) argues against using annual panel data with fixed effects for a variety of technical reasons. But panel data techniques are rapidly improving and can combine constant and time-varying regressors. If shocks have permanent output effects, these new techniques become indispensable.

The optimal frequency in panel data studies is linked to a fourth controversy: whether output follows a deterministic or stochastic trend. The emerging literature that studies growth using panel data tends to use five- or ten-year averages of growth based on an apparent view that shocks are temporary and one can separate "business cycles" from deterministic trends.[5] However, the evidence that fluctuations are transitory has yet to be demonstrated. Nelson and Plosser (1982) challenged the prevailing assumption that US output follows a deterministic trend, and the nature of US business cycles continues to attract an active debate. In emerging markets, some recent studies (eg, Cerra and Saxena, 2005a) document that financial crises lead to long-run losses in the level of output of the affected countries. If recessions or growth collapses are not followed by faster-than-average growth, there may be no sense of "averaging out" over a business cycle. The recessions or growth collapses may themselves be responsible for lower average long-run growth, and the determinants of contractions may differ from those of expansions. The conditional expectation for the level of income at a distant future horizon would be unaffected by a current recession only if output reverts to trend. If output follows a stochastic trend, then every shock changes the conditional expectation of the future income level, one for one.

Finally, the paper contributes to research on the relationship between growth and volatility, upon which the extant empirical evidence is mixed. Some cross-section studies using international data find a positive link between mean growth and its standard deviation (Kormendi and Meguire, 1985; Grier and Tullock, 1989), while others (Ramey and Ramey, 1995) find the opposite relationship. Siegler (2005) reports a negative correlation between the standard deviation of real GDP and growth for a panel of 12 countries using decade averages over the period 1870 to 1929. Dawson and Stephenson (1997) find no association between output volatility and growth across US states, and dispute the findings of Ramey and Ramey. They argue that countries with low growth tend to be the countries whose data contain large measurement errors, resulting in a spurious negative relationship between

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5 See Barro (1997). Lack of data provides another justification for using decade averages, as some of the regressors are measured through infrequent surveys.

volatility and growth. By examining the recovery from shocks, this paper makes use of the within-country variation.

The paper proceeds as follows. In the next section, we discuss the predictions of theoretical models of growth and crises. Section III describes the data. In Section IV, we test whether negative shocks have a long-term impact on income levels in a broad sample of countries. We also ask if negative shocks contribute to unconditional divergence across countries (Section V). We investigate sources of recessions (Section VI), and test whether the speed of recovery depends on the type of shock (Section VII).

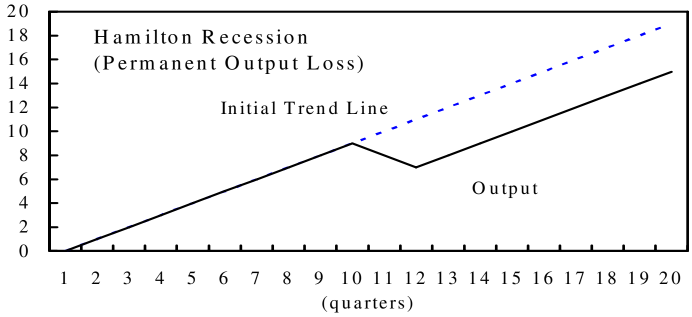
2. Theories of crises and growth

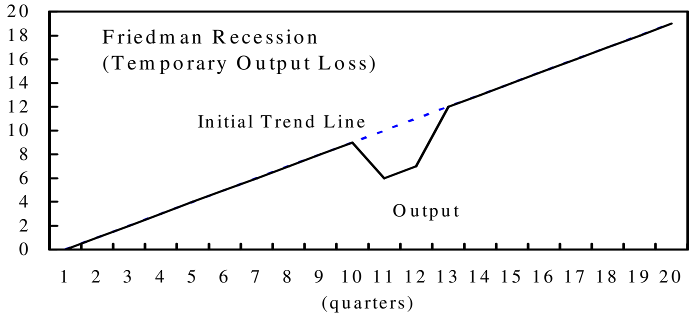
Crises and other negative shocks may, in theory, impose only a temporary restraint on output, but lead to strong future growth that offsets the initial decline. First, crises may facilitate beneficial political or economic reforms. Corrective policies could spur an economic recovery above the original trend line if they reduce inefficiencies. Second, following on the idea of Schumpeter's (1942) creative destruction, recessions may cleanse the economy of inefficient firms, leading to higher productivity and output growth (see Caballero and Hammour, 1994). If either of these theories holds, crises or contractions may benefit long-term growth, and we should be able to find evidence of strong recoveries following downturns. Using a structural vector auto regression for US data, Gali and Hammour (1993) find evidence that recessions lead to higher productivity growth in the medium to long term. However, Caballero and Hammour (2005) find evidence that recessions reduce rather than increase the cumulative amount of restructuring in US manufacturing firms. In general, if the "business cycle" implies that output reverts to trend, then there should be a fast growth recovery phase following a contraction. Reverting to the original path could occur, for instance, if a recession leads to a temporary disruption to economic conditions or a temporary fall in capacity utilization or employment, which is reversed as good times return.

Output loss from a balance of payments crisis is more difficult to generate from theoretical models. Chari, Kehoe, and McGrattan (2005) show that in a standard general equilibrium model, a decline in output cannot be accounted for by a tightening of a country's collateral constraint on external borrowing. The sudden stop of capital inflows leads to an increase in output, not a drop. The sudden stop must be coupled with other frictions, such as an advance-payment constraint on intermediate goods, in order to generate output loss.

Some endogenous growth theories would support a negative relationship between volatility and growth. Martin and Rogers (1997) show that if future benefits of learning by doing are not fully internalized by workers, then recessions are periods in which opportunities for acquiring experience are foregone. Permanent output loss could also be characteristic of a reduction in productivity. Even if productivity growth resumes after a recession, there would be a permanent wedge in the level compared to a pre-recession forecast.

As a counterpart to the theoretical debate, there are opposing statistical views of economic fluctuations that have vastly different implications for welfare. In Hamilton (1989), output is modelled as a stochastic trend that undergoes Markov switching between positive and negative drift rates. Since the regime switch occurs in the growth rate of the permanent component of output, a negative state results in output loss that is persistent. After a recession, output resumes growth with positive drift, but remains on a parallel path below the original trend. Thus, a country hit by a negative shock would be worse off in the long run relative to one that was never hit by the shock. In the Friedman (1993) plucking model, output springs back to the original trend during a fast growth recovery phase. Mean reversion implies the shock has no long-run impact. Both models involve "V-shape" growth recoveries, except that the Friedman model suggests that growth would be temporarily higher during the recovery than during a normal expansion (see figure below).





In this paper, we investigate whether output returns to the original trend path following a recession. Thus, we are testing whether there is a reversion to trend in the aftermath of economic contractions, including those related to financial and political crises.

The statistical response of output to shocks can also be compared to predictions of endogenous and exogenous growth models to distinguish between these models.

Exogenous growth models produce a steady-state relationship between capital per effective worker *(k)*, output per effective worker *(f(k))*, the savings rate *(s)*, population growth rate *(n)*, depreciation *(d)*, and exogenous technological progress *(x)* as described by the following equation:

$$s\, f(k^*) = (n + d + x)\, k^*$$

The steady-state level of capital and output per effective worker are determined by *s*, *n*, *d*, and *x*. The growth rate of aggregate capital and output depend on population growth and labor-augmenting technological change.[6]

The key feature of an exogenous growth model is that the production function exhibits diminishing returns to capital. If a negative shock reduces capital (per effective worker) below its steady-state level, the boost in the marginal product would lead to a high investment spurt. Growth in capital and output would be strong but diminishing as capital approaches the steady state. This theoretical response to a shock to capital would imply reversion of capital and output to trend, as in the Friedman model, and positive serial correlation in growth rates. Other sources of shock in an exogenous growth model include a change in the savings rate, population growth rate, depreciation rate, and growth of labor-augmenting productivity. For example, a decline in the savings rate would reduce the steady-state level of capital and output per effective worker. If the initial capital stock was above the new steady state, capital would decline until it reached the new steady state, implying that growth would be serially correlated. A sharp fall in capital per effective worker induced by a substantial decline in the steady state could more than offset the positive population and productivity growth rates, and aggregate capital and output could contract. Growth would return to normal (at population

[6] See Barro and Sala-i-Martin (2004) for an elaboration of the models.

and productivity growth rates) once the steady state was reached. Thus, this type of negative shock would induce a recession that gradually petered out, turning into a weak recovery.

Endogenous growth models have different implications for transition and steady-state growth in response to shocks. The long-term growth rate is determined by deep structural parameters of preferences and technology and by policy variables. In these models, the production function exhibits constant returns to capital per effective worker. Thus, shocks to capital will have a lasting influence on the level of output. Shocks to the structural parameters or policy variables would have a lasting impact on the growth rate.

In both types of growth models, the level of productivity is a summary measure of all non-rival inputs in production. Given that productivity enters linearly in the production functions of both models, the persistence of a productivity shock on output will mirror the process of persistence for productivity itself.

This paper thus tests the statistical properties of recoveries and compares them to the theoretical models of growth and volatility discussed above. We also test whether volatility has an impact on the convergence of income levels across countries.

3. Descriptive statistics

Table 1 shows average and median growth rates in the two datasets (the World Bank and the Penn World Tables). Growth averages 3.7 percent per year in the World Bank dataset, and falls to 2.1 percent in Penn World Tables due to population growth. Average growth for expansion years in the World Bank dataset is 5.7 percent, very similar to expansion growth rates immediately preceding and subsequent to a recession. Median growth rates in expansions are lower than average rates due to some positive skewness. Median growth rates in the year and three years immediately following a trough are about ½ percentage point lower than in a typical expansion year. In the Penn World Tables data, the expansion years surrounding a recession average slightly higher growth, but the median growth rates are the same or lower. In comparing the two datasets, it should be noted that for a common country and sample period, the Penn World Tables data could include more episodes of "recession" to the extent that output growth in a particular year, although positive, was insufficient to outpace population growth. In Table 1, the three-year average growth rate immediately before and after a recession is higher than the average growth rate because, by definition, a peak year and the year after a trough are expansion years.

For the sample of World Bank and Penn World Tables growth rates, we calculated the average cumulative loss and average length of recessions (defined as years of negative growth). The descriptive statistics and total number of recessions for each sample are shown in Table 2. The recession statistics are further broken into income groups and regions, as well as recessions corresponding with crises, wars, new governments, and countries that have liberalized their trade or financial systems.

The cumulative output loss in a recession averages 7½ percent for the full sample of countries in both datasets, and recessions last 1.6-1.8 years on average. Recessions are much shallower and shorter for high-income countries – about 3-4 percent cumulative loss over 1.4 years – than for any other group. Civil wars, changes in government regime, and banking crises correspond with the deepest and most prolonged recessions. Countries that are most open to international capital flows and, more generally, countries that have the most liberal financial systems tend to have shallower and shorter recessions. Countries that have partially liberalized financial systems have somewhat deeper and longer recessions than those with more complete liberalization, although the loss and duration are lower than the average of all countries. Transition countries have the deepest recessions of the regional groups, partly because data are available only from the early 1990s when most began their transitions.

4. Down and out

Following an economic downturn, is there a high-growth recovery phase?

This section searches for a high-growth recovery using a variety of analytical tools and econometric tests. Through the use of a "timeline," we illustrate the typical behavior of output in the years leading up to a peak, through the recession, and for several years after the trough. Turning to econometric analysis, we test for a fast-growth recovery following a recession for the full sample of countries and for samples containing different regions and income levels. We test whether the amplitude and duration of an expansion is influenced by the amplitude or duration of its preceding recession, and we also test whether booms impact the depth and length of subsequent recessions. Finally, we examine if the statistical properties of output in the panel more closely follow stochastic or deterministic trends.

Figures 1 and 2 present timelines depicting the average behavior of the level (in logs) of output for a boom-bust-recovery episode in the full World Bank and Penn World Tables datasets as well as various subsamples. A peak (trough) year is defined as a year of positive (negative) growth followed by a year of negative (positive) growth. To construct the timeline, we align the peak years for all episodes in a given sample and show the level of output in a 12-year window around the peak. We compute the average growth rate of expansion years occurring prior to the peak, with the peak year defined as time $t = 0$. We set the level of output equal to 100 in the peak year of the timeline and use the average growth rate to construct the level of output in years $t - 1$, ..., $t - 6$. We use the average length and average cumulative output loss of the recessions in the data to determine the level and date of the trough on the timeline. The output levels following the trough are constructed using the average growth rate of expansions occurring in the countries following their troughs. The timelines are intended to illustrate the typical behavior of all peak-recession-recovery episodes, thus a country's growth rates will necessarily be double counted to the extent that it has multiple peaks and troughs within a 12 year window.[7]

Timelines are shown for boom-bust-recoveries in the full sample of countries (using both World Bank and Penn World Tables datasets) and in countries classified by income groups. Timelines are also shown for recessions corresponding to currency crises, banking crises, civil wars, and new governments, and for subsets of recession episodes in which the country maintained a liberal trade regime, capital account, or financial system.

The timelines illustrate that output declines with the recession, but in the ensuing recovery, it does not recoup the level associated with the linear extrapolation of the original trend. In the World Bank dataset, a few percentage points of the output lost during the recession are recuperated in the recovery for episodes associated with civil wars and banking crises, but the gap widens for all other samples. Recessions lead to permanent losses in the level of output for all samples, at least through the end of five years after a trough.

Individual country episodes disproportionately resemble Hamilton recoveries (Figures 3-5). The Asian crisis countries, OECD countries, and many other episodes display output losses that appear to persist. Very few cases of complete Friedman recoveries can be found. One exception is the 1995 Mexican crisis, in which output appears to revert to the original pre-crisis trend line. The Mexican crisis is one of the better known and explored case studies, and this may explain the general unfamiliarity in the literature with the phenomenon of permanent output loss during a financial crisis. Cases of partial Friedman recovery are shown in Figure 5, including several African countries. These cases illustrate that even if growth is rapid immediately following a contraction, output may not fully revert to trend.

We also test formally for the difference in growth rates during an average expansion year and an expansion year occurring in the immediate aftermath of recessions. We define a "trough" nonparametrically as a year of negative growth that is followed immediately by a year of positive growth. That is, troughs are dated according to the calculus rule so as to be consistent with turning points in output:[8]

$$Trough_{it} = \begin{Bmatrix} 1 & g_t \leq 0 \text{ and } g_{t+1} > 0 \\ 0 & g_t \leq 0 \text{ and } g_{t+1} \leq 0 \\ 0 & g_t > 0 \end{Bmatrix}$$

[7] This procedure insures that the sample remains representative of all its country members. However, the timelines are observationally identical if we truncate each country's data so that only the expansion years immediately around a peak-trough episode are included.

[8] See Morsink, Helbling, and Tokarick (2002) for use of a similar dating algorithm, and Harding and Pagan (2002) for generalizations to quarterly and monthly data.

The "recovery phase" is the one or more years of positive growth after the trough. Dummy variables are constructed corresponding to the years in the recovery phase.[9]

The econometric specifications exploit the time variation of growth within each country. Restricting the sample to expansion years, we test the magnitude of the growth rate *(g)* in a recovery phase following a trough. We allow the average rate of growth to differ across countries by imposing heterogeneous intercepts (using fixed effects) in the panel of annual growth rates. Although each country is allowed a different growth rate, we pool information on growth in the recovery phase by imposing a homogeneous slope. Pooling has two advantages. First, several countries have insufficient data to estimate an individual slope coefficient, and the information could not be used unless pooled with other country episodes. Second, the pooled estimate provides summary information about the typical response, even if we can expect a variation around it. Since the growth rate in the year following a trough is a positive by definition, we condition the dependent variable on positive growth to compare the strength of recovery to the average growth during expansions. Thus, our basic equation has the following specification:

$$(g_{i,t} / g_{i,t} > 0) = \alpha_i + \beta * Trough_{i,t-1} + \varepsilon_{i,t}$$

where $Trough_{i,t-1}$ is a lag of the indicator dummy variable described above. In alternative specifications, the variable *Trough (-x,-y)* indicates that the dummy variable will take the value of unity for any year in a given country if a trough occurred either *x* or *y* years prior. The regressions are corrected for heteroskedasticity using feasible generalized least squares, which weights equations by the inverse of their variances. This procedure should also help reduce the potential for measurement error in driving the results. We also use the White (1980) heteroskedasticity consistent covariance matrix estimator.

Proof of "recovery" or reversion to trend, as in Friedman's (1993) model, would require a significant positive coefficient on the dummy variables for the year or years following the trough. A coefficient of zero would be consistent with the Hamilton (1989) model, implying that output drifts up at its normal expansion rate.[10]

Following a recession, growth rebounds at a rate significantly below that of an average expansion year. Given the failure of output to revert to trend line, countries experiencing many shocks tend to fall behind. We find that output does not rebound in the year immediately after a trough and for several years after a trough. Refer to Cerra and Saxena (2005c) for a detailed discussion of these results.

What if it takes longer than a few years to regain lost output?

We also look at complete recessions (from peak to trough) and expansions (from trough to peak). For each of the datasets, we select all episodes of a complete recession (bounded at the beginning and end by at least one year of positive growth) followed by a complete expansion (bounded at the beginning and end by at least one year of negative growth). The

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9 It is more natural to interpret a period of negative growth as a recession than a period of growth that is below average at, say, 3 percent. Negative growth implies the destruction of existing inputs–knowledge, capital, and labour that had previously been used to produce output. Consider productivity growth, for instance: slower than average productivity growth may simply reflect that the invention rate of new knowledge has slowed down. Negative productivity growth would seem to imply that existing knowledge (of technology or production processes) had been forgotten. These two scenarios would appear to require different economic explanations, so it would be difficult to define some countries' recessions as negative growth and others as positive growth.

10 Measurement error in the level of output or output per capita would bias the results toward finding a fast recovery, as it would artificially induce reversion to trend.

World Bank dataset contains 469 pairs of complete recession and expansion episodes, and the Penn World Tables dataset contains 747 pairs (Table 3). We calculate the amplitude (absolute value of the cumulative output change) and the number of years in duration of the recession and subsequent expansion. We test whether the amplitude or duration of the recession influences the amplitude or duration of the subsequent expansion. If, after a deep recession, output were to rebound back to the original trend path, we would expect to find that the amplitude of a recession is positively associated with the amplitude of the following expansion.

For each pair of complete recessions and expansions, we also verify whether the amplitude or duration of the recession leads to a significant change in the steepness (amplitude/duration) of the subsequent expansion compared with the steepness of the prior expansion. A significant change in the steepness of an expansion following a deep or prolonged recession would provide some evidence of a rebound in output or a growth takeoff following a negative shock, even if the rebound occurs over several years.

The results are not consistent with rebound or growth takeoff following severe recessions. Contrary to Friedman's plucking model, Table 3 shows that expansions are weaker when preceding recessions are longer, and expansions are shorter when preceding recessions are longer and deeper. The depth of the recession is not significantly related to the strength of the subsequent expansion. The change in the steepness of expansions is not significantly related to the amplitude and duration of the prior recession. Thus, a deep or prolonged recession does not lead to a rebound or growth takeoff.

Are deep recessions preceded by strong, unsustainable booms?

If a recession is triggered as an adjustment to an excessively strong economic boom, then there may be no need for a strong recovery following the recession. This hypothesis could explain the scarcity of strong recoveries in the data. We tested this hypothesis in two ways. First, we checked whether recessions were in fact preceded by stronger than average growth. We formed dummy variables that picked up expansion years for the three years immediately preceding a recession and tested whether growth was higher than in a typical expansion year. The evidence, shown in Table 4, suggests that the years immediately prior to recessions tend to experience significantly lower growth. This result contradicts the hypothesis that strong booms trigger recessions. Second, we calculated the amplitude (cumulative growth) and duration of each complete expansion, and tested whether either of these factors could explain the amplitude or duration of the subsequent recession. As shown in Table 4, the amplitude of an expansion has a negative, but insignificant, impact on the amplitude (depth) of the subsequent recession. Strong expansions precede significantly shorter recessions. Prolonged expansions precede significantly shorter and shallower recessions. Thus, this evidence is contrary to the hypothesis that strong booms are the cause of deep or long-lasting recessions.

Persistence of shocks

An alternative way to evaluate the persistence of shocks to output is to test between stochastic and deterministic trend models as the data generating process. These tests do not specifically focus on the recovery phase of the growth process, but provide information about the overall behavior of output. We test for unit roots in output and per capita output using the Hadri panel unit root test (Table 5). For both datasets, we can reject the null hypothesis of no unit root, in favor of the alternative hypothesis of a unit root. A problem with Hadri and many other unit root tests is that they fail to account for dependence among the cross-sections. Pesaran (2003) proposes a simple panel unit root test in the presence of cross-section dependence. The test adds the cross-section averages of lagged levels and first-differences of the individual series to a standard Dickey-Fuller regression (cross-section augmented Dickey-Fuller or CADF). The average of the t-statistics (CIPS) in individual CADF regressions is compared to the critical values tabulated for the three main specifications of the deterministic variables: no intercepts or trends, individual-specific intercepts, and intercepts and incidental linear trends. In the World Bank and Penn World Tables datasets, all three specifications produced average test statistics smaller (in absolute value) than the critical values. The test statistics for the World Bank dataset are –1.09, –1.33, and –1.86 for models with no intercepts or trends, with an intercepts only, and with intercepts and trends, respectively compared to critical values of approximately –1.43, –2.0, and –2.5 at the 10 percent level for a panel with T between 30 and 50 and N between 100 and 200. The test statistics for the Penn World Tables dataset are –1.22, –1.56, –1.99, respectively. Thus, the null of a unit root cannot be rejected.[11]

We find that growth and growth per capita exhibit statistically significant positive serial correlation. Table 6 presents estimates for a fixed effects specification. The lagged dependent variable is significantly persistent, particularly for the World Bank data. Although the fixed effects estimation eliminates endogeneity between the lagged dependent variable regressor and the country effect, the specification introduces correlation between the lagged dependent variable and the averaged error term used for the fixed effect. The coefficient estimate would be biased downwards on the order of 1/T. Therefore, we also estimate a differenced equation and use the second lagged level of the dependent variable as the instrument.[12] The magnitude of serial correlation in the growth rate increases somewhat for each sample.

We conduct Monte Carlo experiments for different output processes to verify their conformity with the properties of the data found above. In particular, we generate artificial samples approximately matched to the first two moments of the actual data and the dimensions of the panel observations. We base the experiments on a data generating process (DGP) that follows a stochastic trend with positive serial correlation in the growth rates, and on a DGP that follows a deterministic trend with serial correlation in the growth rates.

The stochastic trend model is given by the following equation:

$$y_{it} = y_{it-1} + \mu + \phi\,\Delta y_{it-1} + \varepsilon_{it} \qquad \varepsilon_t \sim i.i.d.\,N(0,\sigma^2)$$

The deterministic trend model can be represented as:

$$y_{it} = y_{i0} + a\,t + \phi\,\Delta y_{it-1} + \varepsilon_{it} \qquad \varepsilon_t \sim i.i.d.\,N(0,\sigma^2)$$

To broadly match moments of the data, we set $\mu = a = 0.03$, $\phi = 0.2$, and $\sigma = 0.07$.

We test the artificial panels for the magnitude of growth in a recovery following a trough. The Monte Carlo study shows that data generated as a stochastic trend yield a significantly negative coefficient on the dummy for an expansion year after a trough, whereas the data generated as a deterministic trend yield a significantly positive coefficient (Table 7). In addition, estimates for serial correlation in the growth rate are positive and significant for the stochastic trend data, regardless of whether it is estimated in levels using fixed effects or in differences with the second lag of growth as the instrument. Estimates of serial correlation in growth for data generated with a deterministic trend are negative regardless of estimation specification. Thus, the stochastic trend DGP is consistent with the properties of the data, but the deterministic trend DGP shows results opposite to the data.

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[11] The results for the unit root would be interesting to present also for the case of broken-deterministic trends, if there were available for panel data.

[12] Using the large set of moment conditions of Arellano and Bond (1991) is not computationally feasible for this dataset, and additional lags do not appear to affect the results appreciably.

Which aspects of business cycle and growth models are consistent with the empirical results?

The main properties of the data are: (1) negative shocks to the level of output don't dissipate, and (2) growth is positively serially correlated. Which theories of business cycles and exogenous or endogenous growth models are consistent with these properties of the data?

Business cycles driven by temporary shocks to capacity utilization and the unemployment rate, stemming from demand innovations for instance, would not be consistent with the data. Such temporary shocks would be trend-stationary, and growth would exhibit negative serial correlation. At the other extreme, productivity shocks could generate the results in the data provided they are persistent and productivity growth is serially correlated.

In an exogenous growth model, a reduction in the capital stock, holding constant the determinants of the steady state, should elevate growth. Yet, the lackluster recoveries in the data are not consistent with this source of disturbance, except for low-income or African countries, where there is some evidence of fast recovery. However, shocks leading to a decline in the steady state below the level of the capital stock prevailing at the time would match the patterns observed in the data. Capital per effective worker would decline until the new steady state was attained. If the shock is large enough, aggregate capital and output would also decline until offset by population and productivity growth. This pattern would produce a weak recovery, consistent with the data. A financial crisis could be a source of reduction in the savings rate, one determinant of the steady state, if it increased the risk premium from borrowing externally to finance investment. The crisis could also have a more immediate impact on output if a loss in external financing made it difficult to purchase intermediate inputs from abroad, thus directly depressing the production of output.

Turning to endogenous growth models, the balanced growth rate is a function of preference and production parameters and policy variables. Permanent innovations in these variables would raise or depress the rate of growth. Although growth rates are serially correlated, they do not appear to have a unit root. Thus, innovations to the variables influencing the growth rate could only be consistent with the data if they are temporary. In contrast, innovations to capital would be persistent since production is linear in capital (broadly defined). Nevertheless, empirical literature's findings of conditional convergence would cast some doubt on the linearity assumption.

5. Divergence: it's the crises, stupid

Are contractions partly responsible for absolute divergence?

Convergence is a property of exogenous growth models resulting from diminishing private returns to the factors that can be accumulated (various forms of capital).[13] Countries with low levels of capital stock would be expected to grow faster than capital-rich countries, holding constant the factors that determine the steady state level of capital. However, empirical studies have found that countries with low initial income (eg in 1960) have grown more slowly on average than countries that started off rich (see Barro and Sala-i-Martin, 2004). Absolute convergence holds only for countries or regions that started off at somewhat similar levels, such as the OECD countries, US states, and Canadian provinces. Convergence across a broad set of countries has been obtained only when conditioning on factors that could influence the steady state (such as the savings rate).

[13] It could also be a feature of an endogenous growth model with knowledge spillovers across countries.

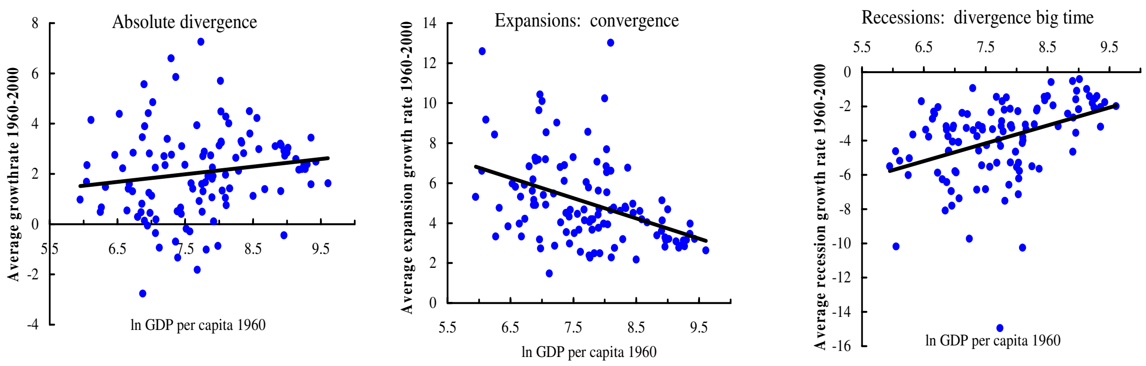
Given the striking result that a negative shock permanently reduces the level of output on average, we wondered if susceptibility to shocks could be contributing to the absolute divergence found in the cross-country growth literature. An exogenous growth model predicts that the capital stock per effective worker in capital-poor countries should rise rapidly relative to that of capital-rich countries. From a position below its steady state level, capital per effective worker should continue to grow toward the steady state. Aggregate capital would further expand due to the exogenous increases in population and technology.

How would we account for years of negative growth in output? If output reverted to a deterministic trend in response to demand-based business cycles, it might be unnecessary to worry about recessions in applying convergence tests. However, the persistent impact of negative shocks on output casts doubt on this portrayal of recessions. Explanations within the growth framework could include reductions in the country's population or technological knowledge, destruction of the capital stock for an exogenous reason or unusually high depreciation experience, or an investment collapse induced by a fall in the steady state. We would only expect to find convergence between countries experiencing these negative shocks and others that aren't experiencing them if the recessions are caused by destruction of capital with a sufficient period of adjustment to regain lost ground. We find evidence for a growth rebound only in the low-income and African countries. Even for this sample, the rebound does not appear to be strong enough to completely regain lost ground. Thus, the ceteris paribus conditions for observing absolute convergence do not appear to hold. That is, we would not expect to find convergence if, for example, capital-poor countries experienced shocks that reduced their steady states during the sample period.

To explore the impact of shocks on convergence, we compare a standard convergence regression to one in which convergence is conditioned on expansion phases rather than on average long-run growth rates, which include episodes of negative shocks.

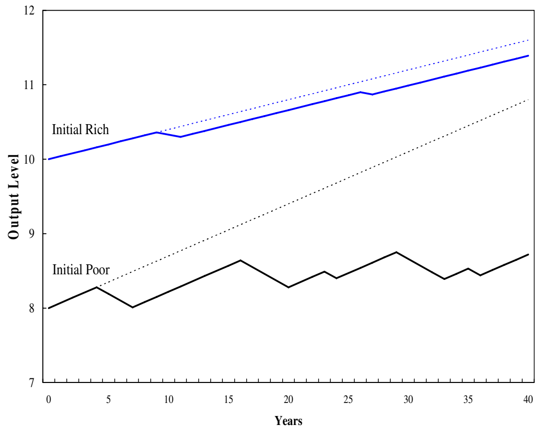
There is statistically significant evidence of convergence if conditioning on the expansion rate of growth for each country.

We first test the standard hypothesis of beta convergence in a cross-country regression and find the standard results of absolute divergence across countries. However, we then calculate the average expansion growth rate for each country. When the test is confined to the expansion phase only, we find strong evidence of convergence (Table 8). The divergence of incomes across countries is thus a function of the crises and shocks, which have two effects on poor country incomes. First, an average recession year is more severe for countries that start out initially poor, leading to the highly significant divergence when the sample is confined to recession years. Second, the poor countries receive a significantly higher proportion of recession years. These results alone do not necessarily distinguish between trend-stationary and stochastic trend processes, as convergence conditional on expansion could be consistent with either data process given appropriate assumptions. However, in the previous section, we found that the data are *not* consistent with volatility around a deterministic trend.



The results provide evidence of conditional convergence complementary to that found in the literature. Standard convergence regressions attempt to condition on factors that would lead to different steady states across countries. Typically, the factors will be measured at their initial values. However, if the steady state changes during the sample period, there is no reason to expect convergence. Our test conditions on shocks that could change the steady state or level of productivity, as identified by their impact on output. The findings further demonstrate the consequences of negative shocks and point to a higher frequency of these occurring in poor countries.

The figure below provides a stylized illustration of the main findings. In the Penn World Tables data, countries that are poor at the beginning of the sample period experience stronger expansions than the initially rich countries. If not for the recession years, the poor countries would converge toward the rich. However, the countries that are initially poor suffer from more frequent and deeper recessions than the initially rich, which lead to divergence.



This evidence argues that shocks do indeed derail growth. Poor countries show rather respectable expansions, which by themselves would propel their incomes to converge with those of rich countries. This finding casts doubt on the savings trap view, which is based on the inability to save and invest, even in good times. The possibility that political and financial crises disrupt growth would be consistent with the literature that finds deep-rooted institutional quality as an important determinant of both the frequency of crises (Acemoglu, Johnson, Robinson, and Thaicharon, 2003) and long-run growth (Acemoglu, Johnson, and Robinson, 2001), although there could be other causes of the instability. The results here point to the link between crises and long-term growth through the negative persistent impact of crises on the level of output.[14]

[14] Causation is always difficult to establish. However, our evidence suggests that recessions are not purely random statistical events driven by low growth. Instead, the paper shows that they are associated with a variety of political and economic crises.

6. Wars, crises, and regime change, oh my!

Given the detrimental impact of contractions on the long-term level of output, what are some potential sources of such disturbances?

We investigate some of the likely suspects for economic contractions: civil wars, financial crises, political instability as measured by regime change, and negative terms-of-trade shocks. Given the richness of the panel dataset, we also look at the impact of trade liberalization on subsequent growth. We regress growth on dummy variables for wars, crises, and regime change.

Civil wars, financial crises, and changes in government regime have large and significant negative impacts on the growth rate.

In Table 9, we estimate the impact of financial crises on growth. We use two different dating conventions to check for robustness. The first set of currency crises and banking crises dates provides a large number of countries and observations. We construct the currency crises dates and take banking crises dates from Caprio and Klingebiel (2003). We use Kaminsky and Reinhart's (1999) sample for the second set of dates. Table 10 shows the detrimental impact of civil wars and changes in government regime on growth.

Financial and political instability have strong associations with recessions. Financial crises coincide with more than one-third of years of negative growth. Half of all recession years coincide with crises, regime change, civil war, or some combination of these variables.

Percentage of negative growth years	
Explained by:	
Civil war	13
New government	17
Currency crisis	37
Any of above	51

We also include measures of openness to trade in the list of variables as openness may influence vulnerability to external shocks. We find that trade liberalization has a significant positive effect on growth. Terms-of-trade movements have the expected positive correlation with growth, but the magnitude is negligible. The explanation likely owes to the poor quality of data on terms of trade. Data are difficult to obtain, and although we have patched together information from several sources, large gaps remain for many countries.

7. How shocks interact with recoveries

Does the strength of the recovery depend on the source of the negative shock?

We interact the disturbance variables that are associated with recessions, as discussed above, with the dummies for the expansions immediately following troughs, controlling for the lower than average growth in the year after the trough. A negative coefficient on an interaction variable would imply a weaker than normal recovery even after taking into account that growth in the recovery phase of an expansion is lower than growth in an average year of expansion. To maximize the number of observations, we use all available countries and time periods, and we focus on pooled estimates. However, some of the interaction regressors are available for only a subset of the countries.

Financial crises lead to weak recoveries

Table 10 shows that recoveries are weak when the output contraction is associated with a financial crisis. Both banking and currency crises lead to significantly lower growth in the aftermath of a recession linked with them. Two lags of currency crises are shown because these crises often occur just before or during the early stage of a recession and therefore may not always coincide with the trough. We also interact the recovery year with measures of the extent of liberalization of the capital account regime and overall financial markets, and find that recoveries are weak in countries with more liberalized capital accounts and financial markets. This result suggests that lack of access to financing may be one of the mechanisms that prevents the recovery of output to its prior trend. Higher inflows of aid as a share of gross national income boost growth in the recovery.

The impact of openness and trade liberalization on the speed of recovery is mixed. Openness, measured as exports plus imports relative to GDP, could facilitate adjustment by promoting rapid export growth after a depreciation. However, the coefficient is negative and statistically significant in the World Bank data. The results indicate that recoveries are marginally weaker for open countries, although the economic significance is trivial. As an alternative measure of openness, we used dates on trade liberalization available from Wacziarg and Welch (2003). Recessions that occur after a country has liberalized its trade regime (measured as a dummy variable) display significantly weaker recoveries. However, in the World Bank dataset, liberalized trade regimes contribute to strong recoveries after controlling for their interaction with liberalized capital account regimes. Thus, an open trade regime helps countries to adjust, except in countries with liberalized capital accounts, possibly due to financing constraints on imported intermediate inputs to trade.[15]

8. Conclusions

Using panel data for broad datasets of countries, this paper documents that recessions are typically not followed by high-growth recovery phases, either immediately following the trough, over several years of the subsequent expansion, or even over the complete expansion that follows a complete recession. Indeed, for most countries, growth is significantly lower in the recovery phase than in an average expansion year. Thus, when output drops, it tends to remain well below its previous trend.

The results can help distinguish between different theoretical models of growth and business cycles, and suggest directions for future research that link volatility and growth. For example, recoveries in the data are not consistent with creative destruction, at least at the level of aggregate GDP. These results would also cast some doubt on the importance of shocks to capital stock as the source of recessions (as in the exogenous growth models), but would be consistent with productivity shocks or changes in the determinants of steady-state levels.

The results of this paper highlight the importance of panel studies for identifying for the timing of growth and taking advantage of the temporal variation in the data. Cross-section

[15] For a discussion of results on political change and recoveries, with special attention to Africa, refer to Cerra and Saxena (2005c).

regressions (even two million of them) that average growth across decades can mask determinants of turning points and make it more difficult to distinguish between explanatory variables. Thus, panel regressions that control for the timing of shocks or policy changes offer a better chance of explaining sources of growth than cross-section regressions.

The paper also highlights that political and financial crises are costly at all horizons. Crises contribute to half of the episodes of negative growth, and there is no evidence that they typically lead to economic reforms or policy adjustments that restore output to trend. Change to a more democratic government system, on the other hand, improves the rebound from a recession. We also find evidence that while trade liberalization increases the long-run growth rate, it can weaken recovery from recession. However, such weak recoveries tend to occur in combination with liberalized capital account regimes, possibly as a result of restricted access to financing for imported intermediate inputs as the confidence of international investors is slow to return following a recession.

When shocks derail growth, incomes diverge. Poor countries have respectable expansions, and therefore do not appear to be stuck in a poverty trap. However, many poor countries do appear to be mired in a crisis trap. Countries that experience many negative shocks to output tend to get left behind and their long-term growth suffers. Thus, while standard growth theory may work well in explaining expansions, a fruitful direction for future research would be to explain the proclivity to wars, crises, and other negative shocks.

Table 1

Average growth rates

	World Bank		Penn World Tables	
Growth rates	**Average**	**Median**	**Average**	**Median**
All years	3.7	3.9	2.1	2.2
Expansions	5.7	4.7	4.9	3.8
Contractions	–5.1	–2.9	–4.4	–2.8
Peak year and one year after trough				
Peak year	5.8	4.8	5.1	3.5
Post-trough				
Three-year average, expansion years only				
Pre-peak	5.6	4.5	5.1	3.8
Post-trough	5.6	4.2	5.2	3.7
Three-year average, all years				
Pre-peak	4.0	3.6	2.8	2.5
Post-trough	4.0	3.4	3.0	2.5

Table 2

Characteristics of recessions

	World Bank			Penn World Tables		
Classification category	**Cumulative loss (percent of GDP)**	**Duration (years)**	**No Obs**	**Cumulative loss (percent of GDP PC)**	**Duration (years)**	**No obs**
All country episodes	–7.5	1.62	637	–7.5	1.78	928
Low income	–7.1	1.58	259	–9.2	1.99	388
Low-middle income	–10.0	1.84	163	–7.9	1.84	237
Upper-middle income	–8.6	1.67	97	–6.7	1.54	151
High income	–4.1	1.38	118	–3.4	1.40	152
Crisis	–6.8	1.64	182	–8.2	1.87	213
Banking crisis	–11.7	2.19	104	–12.7	2.50	117
Trade liberalization	–7.6	1.79	141	–6.0	1.76	230
New government	–12.8	2.08	74	–12.1	2.11	95
Civil wars	–17.4	2.42	60	–15.4	2.47	55
Financial liberalization	–3.1	1.23	43	–4.0	1.56	62
International capital flows	–3.6	1.32	53	–5.1	1.76	76
Partial financial liberalization	–5.6	1.58	24	–5.8	1.86	42
Partial capital liberalization	–6.0	1.53	43	–7.0	2.15	61
Africa	–6.6	1.52	243	–9.6	1.94	397
Asia	–6.0	1.39	93	–4.9	1.54	90
Industrial country	–2.2	1.38	74	–2.9	1.47	133
Latin America	–6.0	1.55	74	–6.1	1.84	154
Middle East	–11.1	1.40	47	–8.8	1.61	49
Transition	–21.0	2.96	53	–12.0	1.96	46
Western Hemisphere island	–7.2	1.81	53	–7.1	1.68	59

Table 3

Tests of amplitude, duration, and steepness of complete expansions

Dependent variable	Amplitude of expansion		Duration of expansion		D (steepness of expansion)	
	World Bank					
Amplitude of prior recession	–0.05 –0.40		–0.05*** –4.10		0.02 0.60	
Duration of prior recession		–3.27*** –3.60		–0.54*** –4.10		–0.13 –0.50
Total no of obs	469	469	469	469	347	347
	Penn World Tables					
Amplitude of prior recession	0.14 1.30		–0.06*** –4.50		0.04 1.00	
Duration of prior recession		–1.98*** –5.70		–0.35*** –5.60		–0.08 –0.50
Total no of obs	747	747	747	747	660	660

Note: T-stats are below the coefficients.

Table 4

Tests of strong boom prior to recession

Dependent variable	Expansion growth rates	Amplitude of recession		Duration of recession	
	World Bank				
P3	–0.27 *** –2.70				
Amplitude of prior expansion		–0.01 –0.60		–0.003 *** –3.000	
Duration of prior expansion			–0.25 ** –2.50		–0.02 ** –2.50
Total no of obs	4589	466	466	466	466
	Penn World Tables				
P3	–0.27*** –2.60				
Amplitude of prior expansion		–0.002 –0.100		–0.004 ** –2.200	
Duration of prior expansion			–0.26 *** –3.80		–0.01 –0.90
Total no of obs	3148	771	771	771	771

Note: T-stats are below the coefficients; P3 refers to a dummy for peak year and previous two years. The first column of regression is for available data in the period 1960-2001, using GLS and fixed effects with robust standard errors.

Table 5

Panel unit root test

	ln (GDP) – WB				ln (GDP per capita) – PWT			
	Statistic	**Prob****	**Cross-sections**	**Obs**	**Statistic**	**Prob****	**Cross-sections**	**Obs**
Exogenous variables: Individual effects								
Hadri Z-stat	53.5	0.0	182	6136	49.0	0.00	154	5161
Heteroskedastic consistent Z-stat	42.7	0.0	182	6136	33.3	0.00	154	5161
Exogenous variables: Individual effects, individual linear trends								
Hadri Z-stat	29.1	0.0	182	6136	30.4	0.00	154	5161
Heteroskedastic consistent Z-stat	28.3	0.0	182	6136	29.7	0.00	154	5161

**Probabilities are computed assuming asympotic normality.

Note: Automatic selection of maximum lags and automatic selection of lags based on SIC: 0 to 9. Newey-West bandwidth selection using Bartlett kernel.

Table 6

Serial correlation of growth rates

Dependent variable	**Growth rate**		**D (growth rate)**	
	WB	**PWT**	**WB**	**PWT**
Growth rate (–1)	0.29*** 12.0	0.12*** 5.70		
D (growth rate (–1))			0.37*** 7.70	0.17*** 4.40
Estimation method	FE	FE	IV	IV
Sample period	1962-2001	1962-2000	1963-2001	1962-2000
Total no of obs	5811	4824	5620	4746

Note: T-stats are below the coefficients; sample uses available data from 1962-2001.

Table 7

Monte Carlo results

Dependent variable	Positive growth rate		Growth rate		D (growth rate)	
	ST	**DT**	**ST**	**DT**	**ST**	**DT**
Dummy for post-trough	–0.007***	0.02***				
	–5.20	8.70				
Growth rate (–1)			0.15 ***	–0.31***		
			10.40	–23.40		
D(growth rate (–1))					0.21***	–0.01
					8.30	–0.60
Estimation method	FE	FE	FE	FE	IV	IV
Total no of obs	3215	2894	4625	4625	4500	4500

Note: T-stats are below the coefficients; ST refers to stochastic trend and DT refers to deterministic trend.

Table 8

Phase conditional convergence

Dependent variable

	Average growth rate 1960-2000			
	All years	**Expansion years only**	**Recession years only**	**Proportion of recession years**
In RGDP per capita in 1960	0.30**	–1.02 ***	1.04***	–0.085***
T-stat	2.20	–5.20	5.80	–6.40
Adjusted R-squared	0.02	0.16	0.15	0.20
No of countries	112	112	112	112

Table 9

Crises and growth

Dependent variable is growth rate

	C-S and C-K dates								K-R dates			
	WB				**PWT**				**WB**		**PWT**	
Currency crisis			–0.8*** –5.8	–0.8*** –5.7			–1.0*** –3.8	–0.9*** –3.5	–2.2*** –5.7	–1.7*** –4.4	–2.3*** –5.6	–1.9*** –4.5
Currency crisis (–1)	–1.0*** –8.6	–1.0*** –8.5		–1.0*** –7.1	–0.9*** –6.6	–1.0*** –7.1		–1.3*** -4.4		–1.9*** –4.5		–2.1*** –4.8
Currency crisis (–2)	–0.5*** –5.3	–0.6*** –5.3		–0.4 –3.3***	–0.4*** –3.3	–0.4*** –2.9		0.0 0.1		0.04 0.1		0.05 0.10
Currency crisis (–3)		–0.4*** –3.3				–0.4*** –2.6						
Banking crisis			–1.5*** –9.7	–1.4*** –6.3			–2.4*** –5.8	–2.1*** –4.9	–2.4*** –4.3	–2.5*** –4.2	–2.0*** –3.0	–2.3*** –3.2
Banking crisis (–1)				–0.6** –2.1				–1.1** –2.2		–3.0*** –5.1		–2.5*** –4.5
Banking crisis (–2)				0.7*** 3.4				1.0* 1.8		–1.4*** –2.6		–1.3** –2.1
Sample period	63-01	64-01	74-01	76-01	63-00	64-00	74-00	76-00	69-01	71-01	69-00	71-00
Total no of obs	4731	4575	2732	2506	4080	3940	2526	2302	726	682	704	660

Note: T-stats are below the coefficients: GLS panel regression with fixed effects and robust standard error. C-S and C-K dates refer to the authors' dates for currency crisis and Caprio-Klingebiel dates for banking crisis.

Table 10

Recovery conditional on financial crises and liberalization

Dependent variable is growth rate in expansion

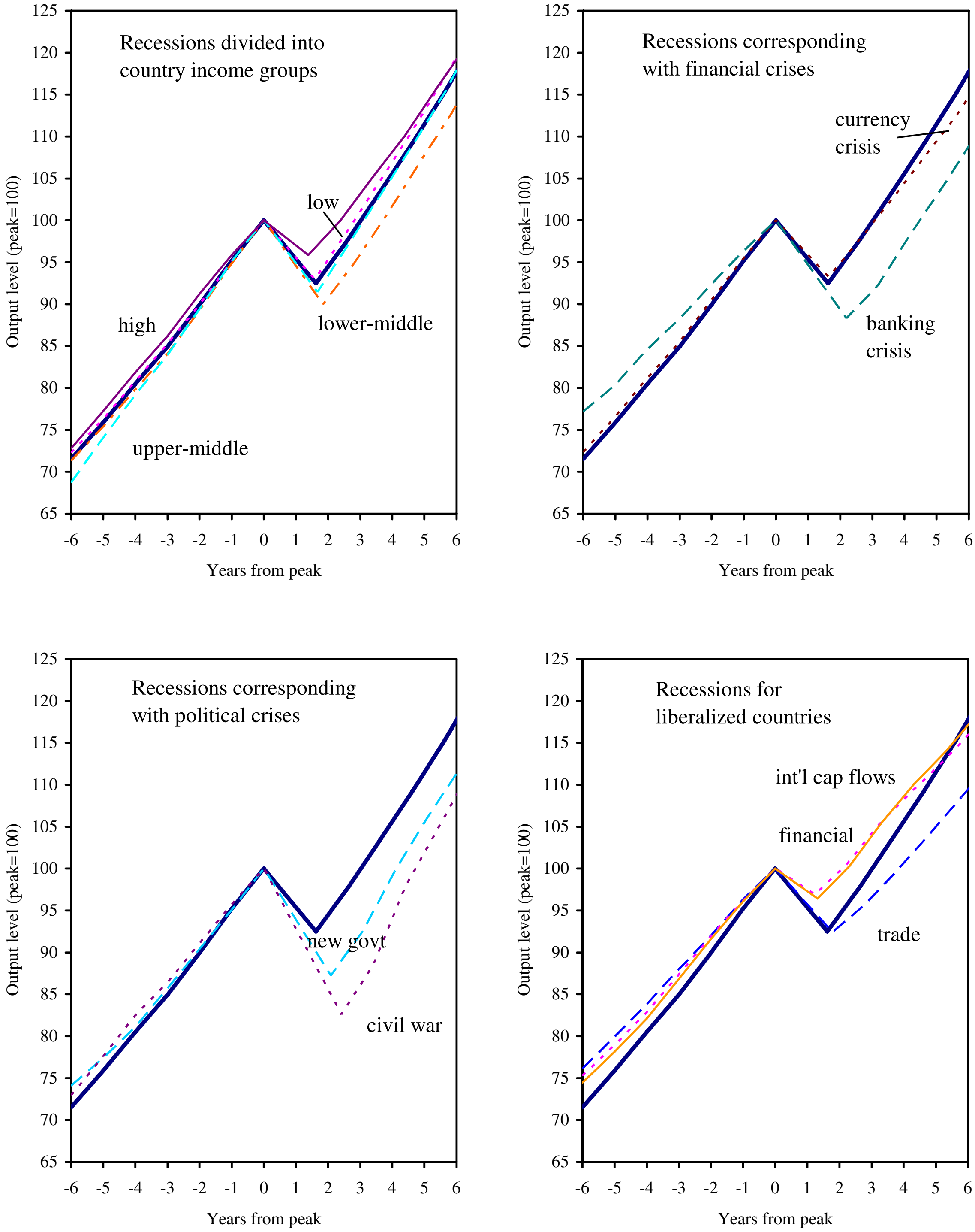
	World Bank			Penn World Tables		
	Coefficient	**Number of observations**	**Number of countries**	**Coefficient**	**Number of observations**	**Number of countries**
Trough (–1)	–0.30	2303	124	–0.01	1713	115
	–1.50			0.00		
Trough (–1) * Bank crisis (–1)	–0.96***			–0.71***		
	–3.30			–3.10		
Trough (–1)	–0.19	3893	177	0.06	2845	141
	–0.90			0.40		
Trough (–1) * Currency crisis (–1)	–0.58**			–0.40*		
	–2.10			–1.70		
Trough (–1) * Currency crisis (–2)	–0.61**			–0.30		
	–2.10			–1.20		
Trough (–1)	0.10	948	41	0.20	851	42
	0.20			0.60		
Trough (–1) * Capacctlib (–2)	–0.46**			–2.21		
	–2.20			–1.50		
Trough (–1)	0.11	948	41	0.54	824	42
	0.20			1.60		
Trough (–1) * finlib (–2)	–0.09**			–0.08***		
	–2.10			–2.80		
Trough (–1)	–1.10***	3074	160	–0.56***	1863	122

	–5.10			–2.80		
Trough (–1) * Aid2GNI (–1)	0.06***			0.08***		
	4.20			3.50		
Trough (–1)	0.15	3860	153	–0.23	3487	149
	0.50			–1.00		
Trough (–1) * open (–1)	–0.01***			0.00		
	–3.90			0.60		
Trough (–1)	–0.29	3051	108	0.14	2632	106
	–1.10			0.70		
Trough (–1) * tradelib (–1)	–0.96***			–0.55**		
	–3.00			–2.30		
Trough (–1)	–0.96**	965	40	0.01	839	41
	–2.10			0.00		
Trough (–1) * tradelib (–1)	1.93**			0.20		
	2.20			0.30		
Trough (–1) * tradelib (–1) * capacctlib (–1)	–0.68**			–0.21		
	–2.40			–1.00		

Note: T-stats are below the coefficients; GLS panel regression with fixed effects and robust standard errors. Sample is all available data from 1960-2001.

Figure 1

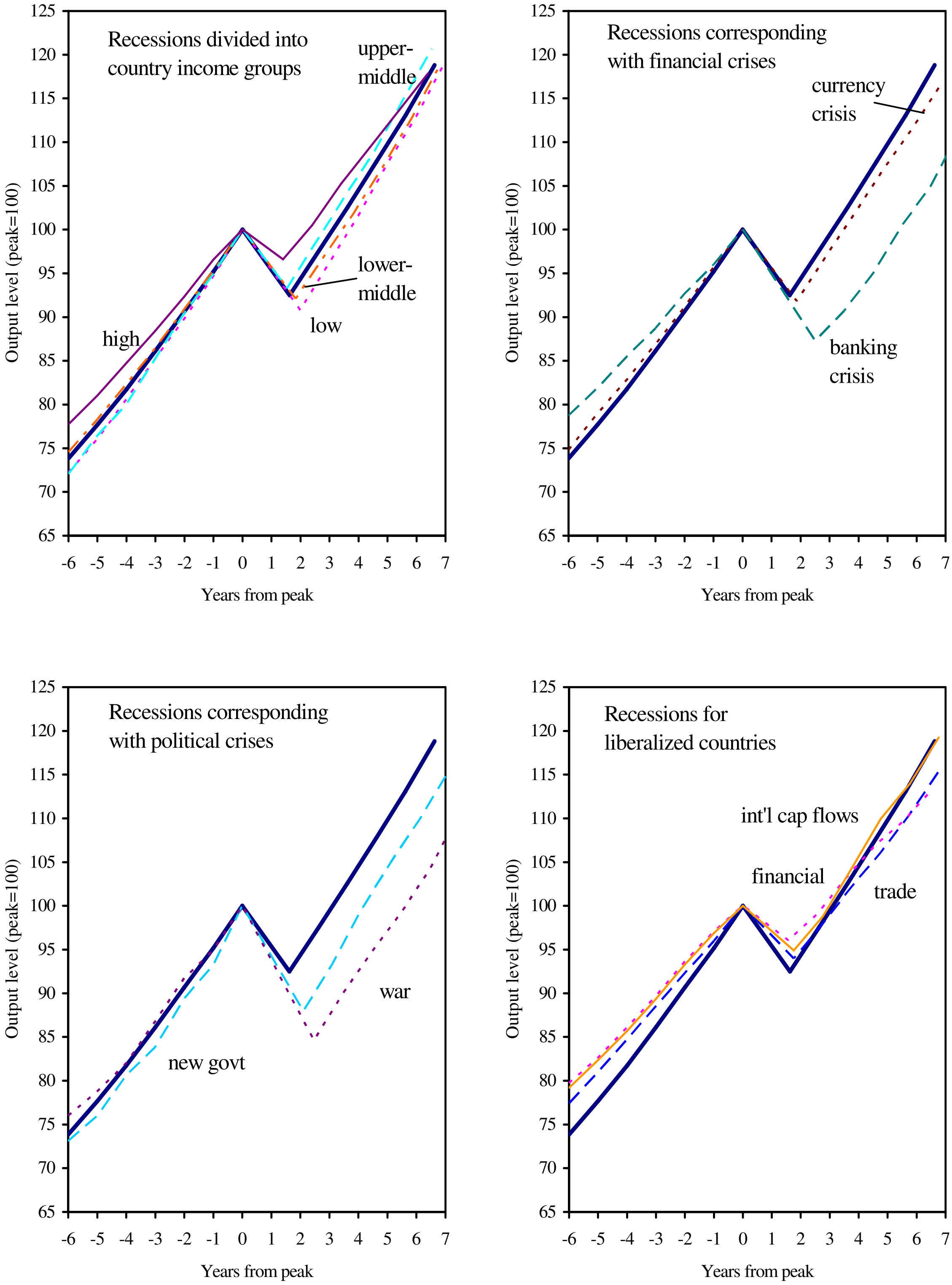
Timeline of recession: World Bank data



Sources: World Bank, World Development Indicators; authors' calculations.

Figure 2

Timeline of recession: Penn World Tables data



Sources: Penn World Tables; authors' calculations.

Figure 3

Episodes of no recovery in selected crisis and Asian countries

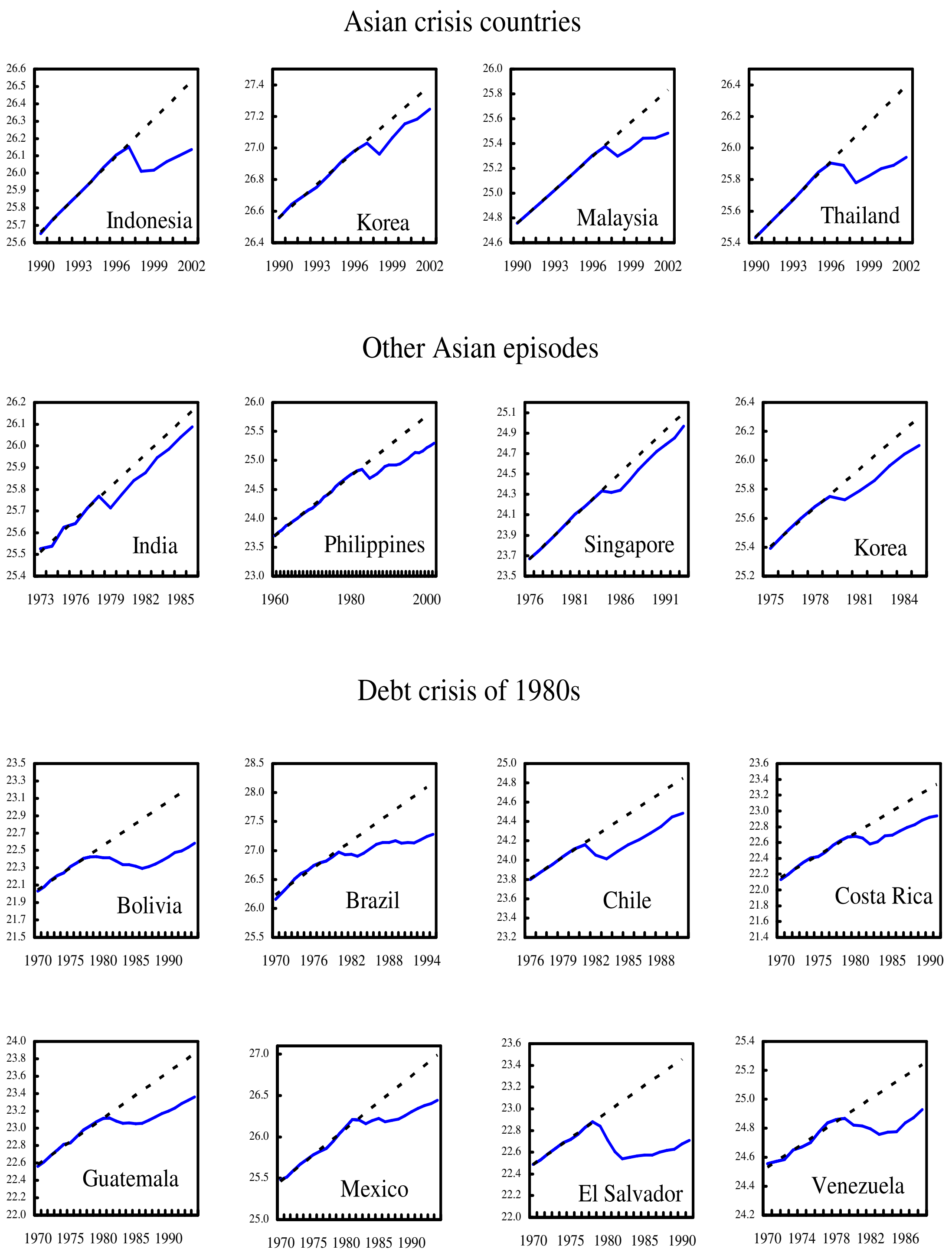
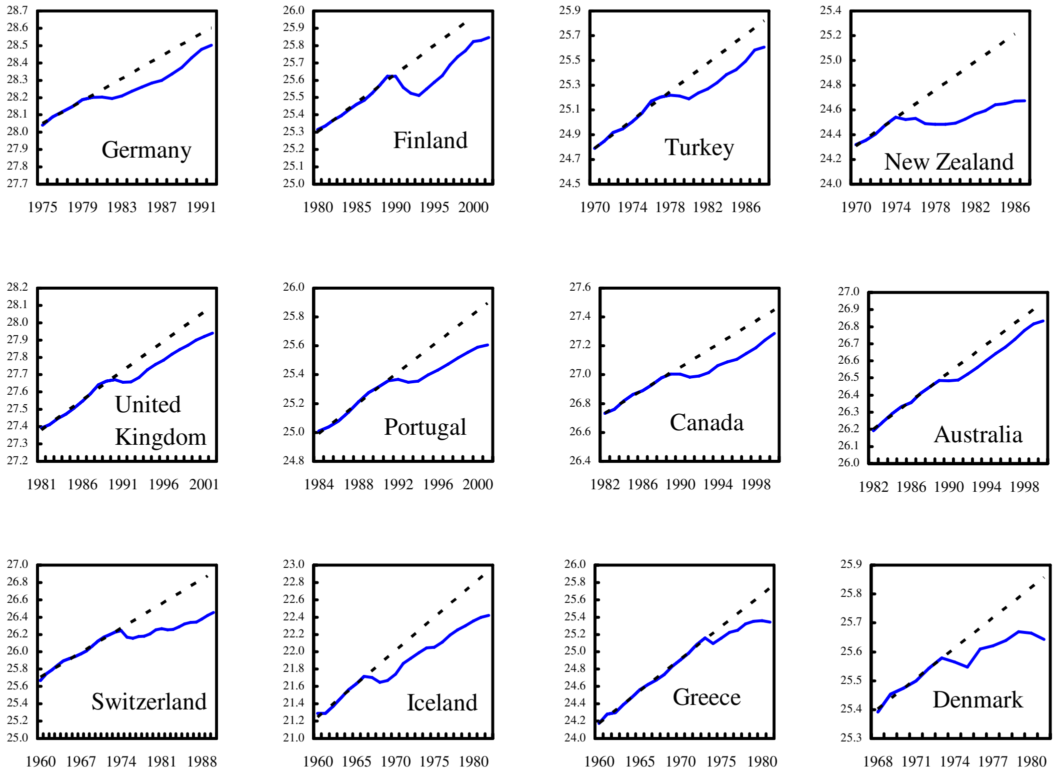


Figure 4

Episodes of no recovery in developed and other countries

Developed countries



Other episodes

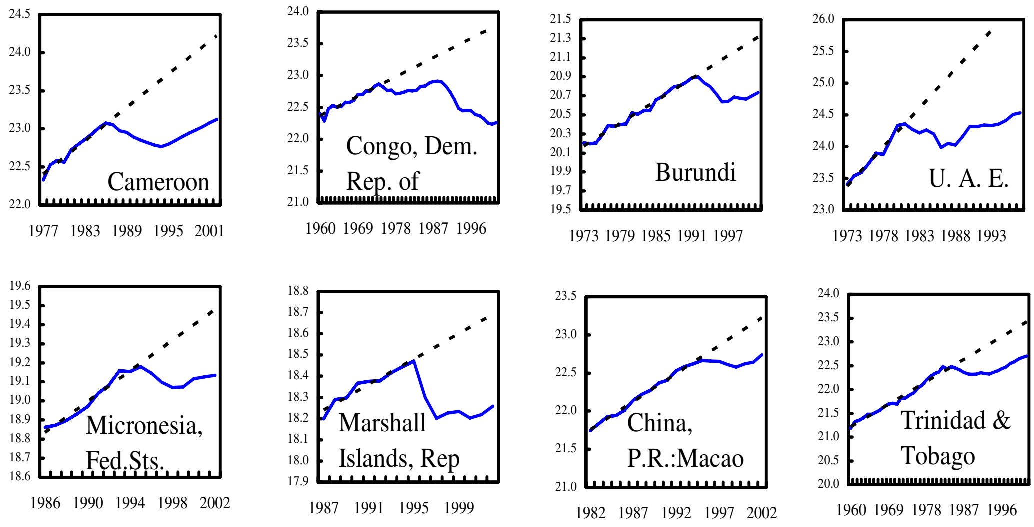
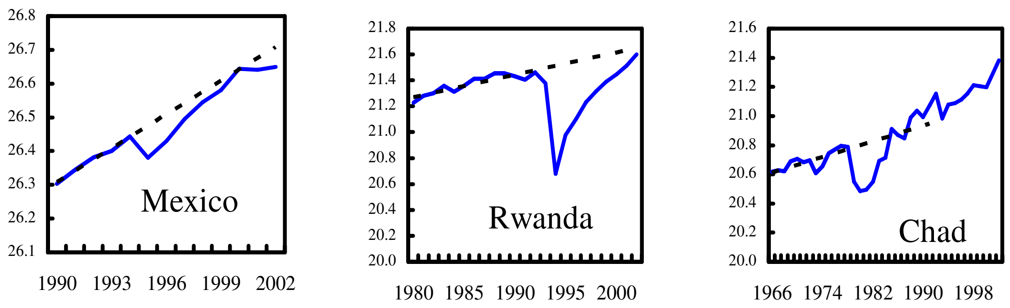


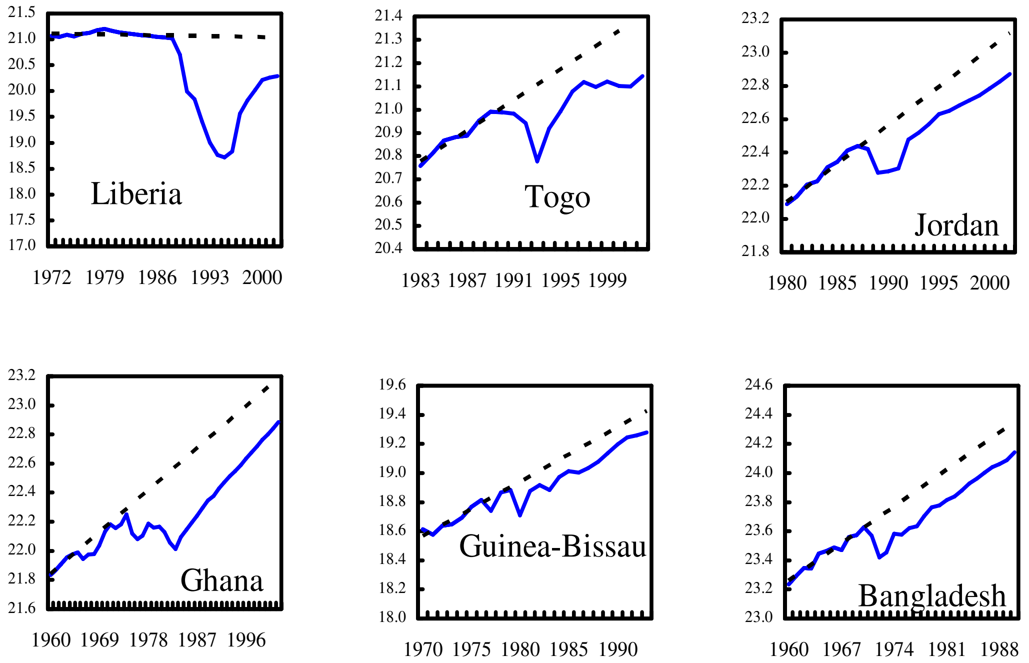
Figure 5

Episodes of complete and partial recovery

Complete Friedman recoveries



Partial Friedman recoveries



Annex: Data sources

The main focus of the paper is the empirical behavior of aggregate GDP and its growth rate. As our primary data source, we use GDP growth rates from the World Bank's World Development Indicators (WDI). This dataset contains the largest sample of countries. As a secondary analysis, we study growth per capita and we also test for the convergence in the level of income per capita. For this analysis, we use the Penn World Tables database (Heston, Summers, and Aten, 2002), which is a mainstay of the growth literature due to its comparable levels of GDP per capita. The WDI contains separate series with comparable levels of GDP per capita, but these are available only from 1980. Thus, our data consist of unbalanced panels of annual observations spanning 192 countries from 1960 to 2001 for the World Bank dataset, and 154 countries from 1960 to 2000 for the Penn World Tables dataset. These are the two broadest datasets available and common in the literature.

We also investigate the sources of negative shocks to growth. Potential explanations for recessions include financial crises, civil wars, changes in government regimes, and changes in the terms of trade. We also expect that the extent of a country's trade and financial openness may impact its growth and recovery from recession, although the sign (positive or negative) of the impact is uncertain.

Crises are defined in two ways. First, we obtain banking and currency crisis dates from Kaminsky and Reinhart's (1999) influential study on twin crises. However, the drawback of this source is that there are only 23 countries included in the study. Second, we construct an exchange market pressure index (EMPI) for each country as the percentage depreciation in the exchange rate plus the percentage loss in foreign exchange reserves. This formulation makes indices comparable across countries.[16] A dummy variable for a crisis is formed for a specific year and country if the EMPI is in the upper quartile of all observations across the panel. The construction of the dummy variable allows us to identify a recession episode that coincides with a currency crisis for comparison to a recession corresponding with a non-crisis episode. We obtain banking crisis dates on a large set of countries from Caprio and Klingebiel (2003).

The data for civil wars are obtained from Sarkees' (2000) Correlates of War Intra-State War Data, 1816–1997 (v 3.0) (at http://www.correlatesofwar.org/), which updates the work of Singer and Small (1994). The dataset identifies the participants in intrastate wars. We form a dummy variable for internal conflict by assigning a value of unity for a country in the years of conflict and zero otherwise.

The dummy for trade liberalization is formed from the dates of trade liberalization available in Wacziarg and Welch (2003). We assign a value of zero to pre-liberalization years and unity to the year of trade liberalization and subsequent years. We obtain measures of financial liberalization from the Financial Reform database compiled by the IMF's Research Department (Omori, 2005). We use both the overall index of financial market liberalization and one of its components, capital account liberalization. The overall index also includes directed credit/reserve requirements, interest rate controls, entry barriers/pro-competition measures, banking supervision, privatization, and security markets. Along these various dimensions, countries can and sometimes do backtrack.

[16] The crisis literature often normalizes reserves and exchange rate movements by their standard deviations, but then the magnitudes of the EMPI are only comparable within countries. We dropped interest rates due to the scarcity of data.

The terms of trade-data-comes from two sources: the IMF's International Financial Statistics (IFS) unit price of exports and imports, and world commodity prices from COMTRADE. The index from the IFS source is a ratio of unit price of exports to unit price of imports. For the other source, we use the weights of the top three exports for 60 countries provided by Cashin, Cespedes, and Sahay (2002). We weight the world price of commodities to their share in exports of these countries to construct the TOT index. If the data for a country are available from both sources, we use the IFS unit prices.

The data on change in government come from Polity International. The regime durability variable measures the number of years since the most recent regime change, defined by a three point change in the polity score over a period of three years or less or the end of transition period defined by the lack of stable political institutions. We construct a dummy which takes a unitary value when the durability variable becomes zero. The polity score is derived from codings of the competitiveness of political participation, the openness and competitiveness of executive recruitment, and constraints on the chief executive. The polity scale ranges from +10 (strongly democratic) to –10 (strongly autocratic).

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