Inter-American Development Bank
Banco Interamericano de Desarrollo (BID)
Research Department
Departamento de Investigación
Working Paper #666

Output Collapses and Productivity Destruction

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January 2009

Cataloging-in-Publication data provided by the
Inter-American Development Bank
Felipe Herrera Library

Blyde, Juan S.

Output collapses and productivity destruction / by Juan S. Blyde, Christian Daude, Eduardo Fernández-Arias.

p. cm. (Research Department Working Papers ; 666)
Includes bibliographical references.

1. Recessions. 2. Industrial productivity. 3. Gross domestic products. I. Daude, Christian. II. Fernández-Arias, Eduardo. III. Inter-American Development Bank. Research Dept. IV. Title. V. Series.

HB3722 .B384 2009
338.542 B384----dc22

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Abstract[*]

This paper analyzes the long-run relationship between output collapses—defined defined as GDP falling substantially below trend—and total factor productivity (TFP), using a panel of 71 developed and developing countries during the period 1960-2003 to identify episodes of output collapse and estimate counterfactual post-collapse TFP trends. Collapses are concentrated in developing countries, especially African and Latin American, and were particularly widespread in the 1980s in Latin America. Overall, output collapses are systematically associated with long-lasting declines in TFP. The paper explores the conditions under which collapses are least or most damaging, as well as the type of shocks that make collapses more likely or severe, and additionally quantifies the welfare cost associated with output collapses.

JEL Classification: F43, O40
Key Words: Growth, recessions, productivity, recovery

[*] We would like to thank Guillermo Calvo, Eduardo Cavallo, Ernesto Talvi, seminar participants at the 2006 Annual Meetings of LACEA, and especially Peter Montiel for helpful comments and suggestions, as well as Maria Fernández Vidal for excellent research assistance. All remaining errors are our exclusive responsibility. The views expressed here are those of the authors and do not necessarily reflect those of the Inter-American Development Bank or of the OECD Development Centre. Corresponding author: Christian Daude Email: christian.daude@oecd.org Mail: 2 Rue André Pascal, 75775 Paris CEDEX 16, France. Tel: +33 (0) 1 4524 96 09.

1. Introduction

This paper assesses the evolution of long-run total factor productivity (TFP) dynamics after a significant collapse of GDP and its associated welfare impact, measured by the resulting gap between actual and counterfactual levels of TFP. We focus on the TFP gap instead of the GDP gap in order to leave aside gross output reductions associated with lower factor accumulation. Thus, the TFP gap is a measure of efficiency costs directly linked to welfare losses, net of investment costs in factor accumulation. Clearly, the potential welfare costs of a GDP collapse will depend critically on the persistence of the subsequent TFP gap: i.e., the faster the recovery in productivity, the lower the welfare cost. Given our focus on welfare costs, we are particularly interested in exploring the conditions and shocks under which a GDP collapse is associated with a very persistent—possibly permanent—decline in aggregate productivity.

This focus on TFP jibes well with the well-established finding that TFP is the main determinant of economic development in the long run (e.g,. see Easterly and Levine, 2001). For example, the empirical evidence of growth accounting exercises shows that a systematic shortfall in TFP growth is the main factor behind the widening gap in per capita income between Latin America and developed countries over the past 50 years (Blyde and Fernández-Arias, 2005). This is also consistent with the evidence compiled by Kehoe and Prescott (2007) that changes in TFP are the main driver of the 16 great depressions during the twentieth century studied in their book. While these papers basically perform an accounting exercise, in most cases the implicit causality goes from TFP shocks to output performance. A mechanical interpretation of our focus on the evolution of TFP after an output collapse could suggest an implicit causality in the opposite direction, but we acknowledge that causality could run both ways, as pointed out by Cerra and Saxena (2008).

While we explore the causal interpretation of growth collapses leading to persistent productivity effects by specifically looking at a subsample of collapse episodes generated by exogenous factors, by and large we take an agnostic approach.[1] Therefore, the main contribution

[1] An alternative approach to avoid some of these endogeneity problems would be to focus on TFP collapses. However, in our sample all output collapses would also classify as TFP collapses for the same threshold. Furthermore, given that TFP is computed as Solow residuals, it tends to be more volatile and noisy, such that for a given threshold there tend to be more “false” episodes, which makes the focus on output collapses more appealing. Finally, the literature the paper relates to has been focusing on the dynamics of macroeconomic variables after output collapses, such that for comparability it is useful to concentrate on output collapses.

of the paper is to explore the productivity dynamics after an output collapse and the transmission channels at work.

If collapses are associated with detrimental persistent effects on the level of TFP, then they may lead to a lower average growth rate of GDP over long periods of time. If so, output shocks may generate a widening income gap between those countries that experience many of them and those that do not on account of those countries with incomplete TFP recovery within the sampling period. In particular, a permanently lower level of TFP would translate into a permanent effect on the level of GDP and, therefore, a reduction in long-term growth rates. If sharp output collapses are associated with persistent declines in TFP, they could be an important factor behind the absolute income divergence that has been observed in the world according to Pritchett (1997).

Our methodological approach is based on a characterization of the anatomy of events and an exploration of some factors that have a significant correlation with the magnitude and duration of the decline in TFP. This alternative to the standard cross-country panel approach used in the empirical growth literature has received some attention in recent times due to the methodological shortcomings of cross-country regressions and their disappointing results in terms of policy evaluation. For example, Pritchett (2000) points out that systematic differences across countries in volatility and trends of GDP series make cross-country growth regressions essentially uninformative, while an approach that establishes some stylized facts by analyzing episodes and events associated with surges or collapses of output might be more enlightening (on growth accelerations see, among others, Hausmann, Pritchett and Rodrik, 2005, as well as Jones and Olken, 2008, on accelerations and decelerations).

From a theoretical point of view, once market equilibrium in factor accumulation and utilization is restored after an output collapse, the existence of permanent income effects depends on the resulting steady-state aggregate productivity or TFP. In fact, if steady-state productivity remains unchanged, then growth rates would be altered during the period of collapse and recovery but the (average) long-term growth rate over this cycle would not. Consequently, welfare costs would be limited, associated with the transitory cyclical downturn. By contrast, if the collapse is associated with a decline in steady-state TFP, that is to say, if there is "productivity destruction," then income would be reduced permanently and welfare costs would not be confined to a transition period but would continue accruing permanently.

In the framework of a neoclassical growth model, an output collapse may be caused by an exogenous collapse in TFP or by shocks to distortions on investment and utilization of physical capital and other inputs, called "wedges" in the literature (see Chari, Kehoe and McGrattan, 2007), with no permanent effect on productivity. By contrast, endogenous growth theory provides a better framework to understand the potential mechanisms by which output collapses, whatever their cause, could have a permanent impact on TFP. In these models, an output collapse may erode the fundamentals behind aggregate TFP, thus lowering trend GDP. Furthermore, in some endogenous growth models a collapse may actually diminish the steady-state rate of growth of TFP and consequently of GDP, further reducing trend GDP and increasing the welfare cost.[2]

A number of endogenous growth models could account for a permanent effect on TFP following an output shock. For example, in models of knowledge accumulation, like Romer (1990) and Grossman and Helpman (1991), a reduction in the fraction of the labor force engaged in Research and Development (R&D) could have permanent negative effects on the level of productivity. Moreover, if the production of new knowledge depends largely on the stock of existing knowledge, the growth rate of productivity could also be permanently affected. Therefore, in these models, shocks that affect the return of the factors engaged in R&D relative to those engaged in the production of final goods could have potential long-standing consequences on productivity. Martin and Rogers (1997) employ an endogenous growth model in which labor productivity is augmented through learning by doing to show that recessions are periods in which opportunities for acquiring experience and improving productivity are foregone. Even if productivity growth resumes after a recession, there would be a permanent wedge in the level of productivity.

There is a growing literature studying the role of policy distortions and TFP (see, for example, Parente and Prescott, 2000). Restuccia and Rogerson (2008), for example, develop a model of firm heterogeneity in which policies that distort the relative price faced by individual firms can result in large declines of aggregate productivity due to the misallocation of resources. Although not directly related to recessions, the model implies that if crises lead to an upsurge in those distortionary policies, aggregate TFP and output could be significantly affected in the long

[2] In addition, the steady-state TFP level usually is a determinant of the steady state growth rate in these models, such that a permanent level effect could potentially also have a deteriorating effect on the steady state growth rate of output.

run. The facts show that governments often use subsidies, tariffs and quotas, undervalued exchange rates or other policies after recessions to revitalize output and employment. Although such policies can ignite the economy in the short run, they may also hinder aggregate efficiency in the long run to the extent that they are not removed and lead to misallocation of resources. Furthermore, output collapses might be accompanied by institutional and social breakdowns, which may destroy the intangible "capital" needed for efficient economic cooperation.

There is another strand of the literature that shows that economic crisis may have positive impacts on TFP. Following Schumpeter's notion of creative destruction, Caballero and Hammour (1994), for example, show that recessions may cleanse the economy of inefficient firms, leading to higher productivity and output growth. A related idea is the "pit-stop" view of recessions, according to which recessions are seen as times when profitability is low and, therefore, much needed restructuring can be undertaken because of a temporarily low opportunity cost (Aghion and Saint-Paul, 1991).[3] Rancière et al. (2007) present evidence that countries which have suffered occasional crises—identified as a sharp collapse in credit growth—grow faster. They also present a model consistent with a positive correlation between risk and economic growth under certain conditions. In addition, there is also a political economy argument for a positive effect of crises on growth. For example, Tommasi and Velasco (1996) argue that economic crises facilitate economic reforms.[4]

As the discussion above shows, in theory it is possible that output collapses are associated with positive or negative effects on productivity that last for long periods of time or even permanently. As an empirical matter, there are a number of papers in the literature that address related issues. Cerra and Saxena (2008) use panel VAR techniques to show that GDP growth is significantly and persistently lower after financial crises and some types of political crises. Our work is complementary to their, given that they do not explore whether this persistent decline in growth is due to a decline in factor accumulation or mainly due to a lower TFP growth.

Jones and Olken (2008) identify episodes of GDP growth accelerations and collapses using a small-sample version of a structural break tests by Bai and Perron (1998, 2003) to detect

[3] Empirically, however, there is evidence that this restructuring process does not always occur. For example, using data on US manufacturing firms, Caballero and Hammour (2005) show that the restructuring process is *depressed*, not increased, by an aggregate recessionary shock.

regime changes. They identify 73 breaks in 48 countries using Penn World Table data, of which 43 are down-breaks and 30 up-breaks. Their results show interesting asymmetries between growth ignitions and collapses. In particular, while growth accelerations are associated with increased trade, without a significant change in investment rates, collapses in GDP growth are associated with a significantly lower investment, inflation, devaluations and internal conflict.

Our approach differs in various aspects from this paper. We concentrate on the question of whether TFP returns to it potential level taking into account initial conditions and the evolution of the TFP frontier. More than 62 percent of all the collapses identified by Jones and Olken (2008) occurred in the 1970s during the global productivity slowdown of the world economy. This suggests that—especially for developing countries—it is important to take into account what happens to the technological frontier in order to construct the level of TFP that would have prevailed in the absence of a crisis. Second, we focus on output collapses, defined as a large departure below the trend level of GDP, rather than growth collapses, which can be the natural consequence of an unsustainable boom, without implying a major crisis with destructive potential. Furthermore, we identify the events as a decline below a common threshold for all countries. This has the advantage that we capture all large events, rather than relying on a statistical identification of events that depends critically on the variability of the time series. This limitation explains why important crises, like the Argentinean, Uruguayan and Chilean currency and banking crises in the early 1980s, Argentina's collapse during the hyperinflation of 1989, or Chile's collapse around the rise and fall of the Allende regime, are not identified as episodes using Jones and Olken's methodology.

Several additional papers look at growth performance during extreme events, although without reference to productivity or other structural underpinnings relevant for long-run effects on income and welfare which are the focus of our paper. For example, similar to Jones and Olken (2008), Berg, Ostry and Zettelmeyer (2006) and Hausmann, Rodríguez and Wagner (2006) analyze the factors related to the duration of growth spells or collapses. Becker and Mauro (2006) analyze episodes of output drops but their main concern is on the nature of the shocks behind these drops rather than on the evolution of productivity. We use several of their classifications of shocks to analyze whether the evolution of TFP differs according to the type of

[4] In a related paper, Drazen and Easterly (2001) test the hypothesis that macroeconomic crises induce growth acceleration but fail to find significant effects.

shocks associated with the output collapse. Hong and Tornell (2005) analyze the recovery of GDP growth during currency crises. They find that growth rates rapidly return to pre-crisis levels but may not surpass them, thus possibly producing a persistent effect on GDP levels, but in contrast to our paper, they focus on cyclical GDP dynamics during currency crises. Finally, our paper is also somewhat related to Calvo, Izquierdo and Talvi (2006) on the dramatic recoveries that can follow systemic financial crises. However, their emphasis is on the short-run or cyclical performance of TFP during systemic sudden stops in capital flows to emerging markets, while we focus on the long-run or permanent consequences of a broader class of output collapses.

We look at a panel of 71 countries (listed in Table 1) during the period 1960-2003 to identify episodes of GDP collapses and estimate the counterfactual post-collapse TFP trend. We test whether output collapses are systematically associated with temporary or permanent declines of aggregate productivity and measure their welfare costs in terms of GDP forgone. Although results differ across countries and regions, the analysis shows that the losses from productivity destruction can be substantial. In addition, we characterize the types of shocks that are associated with output collapses and quantify the attendant welfare losses. For the sake of completeness, we also explore the behavior of factor accumulation after a collapse.

The paper is organized as follows. Section 2 describes the data and identifies the output collapses in the sample. The next section constructs the counterfactuals of trend TFP and tests whether the effects on productivity after collapses are temporary or permanent. It also analyzes how these effects differ across time and regions. In Section 4 we explore how productivity effects differ depending on the types of shocks associated with output collapses. Section 5 estimates the extent of the post-collapse loss in terms of the welfare costs as well as the reduction in GDP per capita due to productivity and investment effects. Section 6 concludes.

2. Identification of Output Collapses

The main focus of the paper is the behavior of TFP in the long run. Therefore, our sample comprises countries for which we could construct long series of GDP, physical capital, labor inputs and education. The sample consists of 71 countries, which is the maximum number of countries with available information, for the period 1960-2003. The real GDP (PPP-adjusted) and investment data are taken from the Penn World Table 6.2. Capital stocks are constructed using the perpetual inventory method, as it standard in the literature, following the parameterization of Easterly and Levine (2001). The labor input is measured by the labor force, also from the Penn World Table 6.2. We follow Hall and Jones (1999) and construct series for the relative efficiency of a unit of labor based on years of education. The data on education is taken from the Barro and Lee dataset (see Appendix A.1 for more details).

The TFP series are computed for each country as a residual from the following Cobb-Douglas production function:

$$Y = AK^{\alpha}(hL)^{1-\alpha} \quad , \qquad (1)$$

where Y represents domestic output, K physical capital, L labor force, h the average quality of the labor force and A is TFP.

Collapses in Output

There is no unique way to identify collapses in output. We consider that an economy has experienced a collapse when its output falls significantly below its potential or trend level.[5] An alternative approach would be to look at a collapse in the growth rate. However, a large negative growth rate of output is not necessarily an indication of a crisis, as the economy might be returning to its equilibrium after a period of unusually high growth. Our definition of collapse (a substantial negative gap between the observed output level and its potential or trend level) excludes these episodes. For example, if we define a growth collapse as a decline in real GDP growth by more than two standard deviations from the country's average growth rate, out of 80 episodes of this type in our sample only 27 are also output collapses in our definition.

In order to calculate the relevant output gap, we first de-trend GDP per capita on a country-by-country basis using the Hodrick-Prescott filter. Then we identify and select only output gaps that are 6% or larger,[6] which is also the average decline in GDP growth rates for the collapses identified by Jones and Olken (2008) using time-series structural break tests by country. As pointed out above, the advantage of a uniform threshold across countries is that this procedure makes sure that our events are "large" from an economic point of view. In contrast, if we were to consider extreme events from a statistical point of view on a country-by-country

[5] A similar definition is used in Bergoeing, Loayza and Repetto (2004).

[6] The selection of the threshold is somewhat arbitrary. However, we chose 6 percent after analyzing results with other thresholds. For example, with values larger than 6 percent some of the well-known episodes of collapses (like Argentina in 1982) were missed.

basis, e.g. events that fall below two or three standard deviations, economically small collapses in countries with very low volatility would be identified as events, while large crises might go undetected in countries with high output volatility.

Table 2 shows the collapses by countries and years. A total of 69 collapses were found, of which only two were in developed countries (Finland, 1992, and Iceland, 1969). All the other collapses were found in developing countries. Figure 1 shows the number of collapses by regions. Latin America (LAC) and Africa (AFR) were the regions with the greatest number of collapses, followed by the Asian countries (ASIA), OTHER (which includes developing countries in Europe and Israel) and, finally, the developed or industrial countries (IND). It should be pointed out that the average real GDP growth rate during a year where an output collapse takes place is –8.7 percent, such that if a growth episode were defined by a substantial negative growth rate, most output collapses would also fulfill this definition. In addition, there is only one output collapse that does not show a negative growth rate in the year of an output collapse: Cameroon in 1977.

Focusing on the subset of developing countries, Figure 2 shows the frequency of output collapses by region. We find that the typical Latin American country experienced almost two collapses over the course of four decades. A similar frequency is found in Africa. However, for the typical country in the other developing-country regions the frequencies is about half of that or even lower (as in the case of Asia). The 1980s is the decade with the greatest number of collapses (shown in Figure 3). The number of collapses during this decade more than doubles the number of collapses in the 1960s, 1970s or the 1990s. Figure 4 shows that this “anomaly” of the 1980s is mainly the result of a disproportionate occurrence of collapses in Latin American during this period. No other region experienced such a large difference in the number of collapses between the 1980s and other decades.

Another interesting insight can be found by exploring the relationship between output collapses and output booms. Applying our definition of collapses symmetrically, we consider booms as periods in which the economy experiences a rise in output to a level that is significantly above its trend. Thus, it is possible to analyze if collapses follow periods of booms. In context of our analysis, if collapses are systematically preceded by booms, one could argue that periods of unusually strong economic expansion could be potentially very disruptive to the economy down the road, and counterproductive in net terms. Some of the basic results on the relationship between booms and preceding collapses are shown in Table 3. Most of the output collapses are not preceded by booms, and the vast majority of booms are not followed by collapses. Nevertheless, this does not necessarily mean that booms are not a factor contributing to costly collapses, an issue we analyze later.

Now that we have identified the output collapses in the sample we are in a position to analyze how TFP behaves afterwards. This is done in the next section.

3. TFP after Output Collapses

The main objective of this section is to find out whether output collapses are associated with persistent, possibly permanent effects on aggregate productivity. Therefore, we construct counterfactuals of post-collapse TFP to compare with "actual", i.e. measured, TFP.[7] As we are interested in making predictions of what would have been the TFP of a country had the collapse not occurred, the models are estimated using only country data prior to the collapse.

The simplest counterfactual model would be linear growth forecasts of the TFP level over time *t* for each country *i* (which we refer to as the "linear model"):

$$\ln(TFP_{it}) = \alpha_i + \beta_i t + \varepsilon_{it} \qquad (2)$$

However, a counterfactual forecast based on such a model would fail to detect systemic changes over time in the rate of growth of world productivity that may influence each country's potential TFP. A slowdown or an acceleration of the productivity frontier that may have occurred after the collapse could influence the post-collapse evolution of TFP. In order to account for this effect, we augmented the linear model with a term that captures the evolution of the productivity frontier:

$$\ln(TFP_{it}) = \alpha_i + \beta_i t + \lambda \ln(TFP_t^f) + \varepsilon_{it} \qquad (3)$$

where TFP_t^f refers to the TFP of the productivity frontier and is proxied by the simple average of TFP for the 20 developed countries in the sample. This is our "baseline" model.

[7] In what follows we refer to measured TFP as "actual" TFP in order to distinguish it from its counterfactual.

Alternatively, we also consider a model that only includes the evolution of the productivity frontier allowing for country-specific absorption, in the spirit of Parente and Prescott (2005), and a model that includes an additional common time trend:

$$\ln(TFP_{it}) = \alpha_i + \lambda_i \ln(TFP_t^f) + \varepsilon_{it} \tag{4}$$

$$\ln(TFP_{it}) = \alpha_i + \beta t + \lambda_i \ln(TFP_t^f) + \varepsilon_{it} \tag{5}$$

We refer to these alternative models as the "country-specific absorption" and "country-specific absorption with trend" model, respectively.

Given that in all of these specifications we are assuming a trend-stationary process in order to compute the counterfactual for TFP, it is important to check whether this assumption is supported by the data. In order to do so, in Table 4 we perform several panel unit root tests considering alternative specifications. As can be seen in the table, considering the Maddala and Wu (1999) test, as well as Im, Pesaran and Shin (2003), Pesaran (2003) and Levin, Lin and Chu (2002), they all show that the TFP series are trend stationary at standard levels of confidence. Thus, the data support the type of counterfactual specified above.

Countries with more than one episode of output collapse should also have one counterfactual path for TFP for each collapse. Therefore, for the purpose of estimating the counterfactual models presented above, the index *i* refers to each episode, possibly in the same country. All the episodes are estimated using data from the beginning of the sample until the year prior to the collapse, which is consistent with the null hypothesis that collapses do not have persistent effects on TFP.

Because some of the collapses occurred very early in the sample period, the lack of adequate numbers of observations precluded our estimation of some of the counterfactuals. In some other cases, such as Argentina 2002, the collapse occurred only 1 or 2 years before the end of the sample period. For these particular cases, making a comparison after such a short period of time would bias the results towards a "lack of recovery" type of story. Therefore, we also eliminated episodes that took place within less than four years of the end of our sample. After these adjustments, we are left with 56 collapses for which we estimated counterfactuals. Table 5 shows the regression results for the alternative models of TFP corresponding to equations (2) - (5). Figures A.1 to A.36 in the Appendix depict all the cases when we use our baseline model (i.e., the predicted TFP levels based on the estimation of equation 3). We estimate the models by GLS using the Prais-Winsten correction to allow for first-order autocorrelation in the error term.

Given that we are interested primarily in long-run effects, we would like to compare the actual level of the TFP of a country that has collapsed with its counterfactual at the farthest possible moment of time after the collapse has occurred, that is, at the end of our sample period or just before another collapse occurred. Hence, for each episode we construct the log-difference of actual TFP versus its counterfactual and then test if on average this difference is significantly different from 0. The results are shown in Table 6. It is important to point out that the level of TFP in any specific year could be unusually high or unusually low because our measure of TFP is affected by the business cycle, which introduces noise to the tests. Therefore, we compare the counterfactual in a particular year not with measured TFP in that year but with its trend.[8]

The first column in Table 6 shows the case when counterfactuals are estimated with the baseline model. On average, actual TFP ratio is around 12 percentage points below its counterfactual at the end of the sample. In addition, the t-statistic shows that the null hypothesis of no significant difference is rejected at standard levels of confidence. Thus, typically TFP does not return to pre-collapse levels. It is worth noting that the end-of-sample period is, on average, 15.2 years after the collapses have occurred. Therefore, it is difficult to argue that the failure of TFP to return to its potential level is due to the lack of time to recover within the sample. In order to explore this issue further, in Figure 5 we plot the log-difference between actual and counterfactual TFP at the end-of-sample against the years left to reach the end of sample for each episode. As clearly seen in the scatter plot, there is a slightly positive correlation of 0.18, but it is not significant at conventional levels (its p-value is 0.23). Thus, a systematic bias due to sample truncation does not seem to be driving our results regarding lack of recovery in TFP. Furthermore, even if we were to consider the point estimates as significant, they imply that it would take around 45 years to close the gap between actual and counterfactual TFP.

The next three columns in Table 6 show the results for the alternative models for the computation of TFP counterfactuals. Although the values vary slightly, overall these alternative models confirm qualitatively the previous result. In all three cases, actual TFP ends up significantly below the level of TFP that would have prevailed if the collapse had not occurred.

[8] The trend is calculated with the Hodrick-Prescott filter applied to the entire TFP series, using a smoothing parameter of 6.25 suggested by Uhlig and Ravn (2002). The results do not change qualitatively when the original series are considered as alternative.

Therefore, when we consider all the models, the results indicate that output collapses have been followed by very persistent negative effects on productivity. This evidence is consistent with the findings of Aguiar and Gopinath (2007), which show a higher incidence of structural breaks in TFP trends in developing countries compared to industrialized countries.

Table 7 shows the same exercise by main regions of developing countries, Latin America, Asia, and Africa respectively. In the case of Latin America, all models to construct TFP counterfactuals clearly support the argument that TFP failed to return to its potential trend after an output collapse. For the cases of Asia and Africa, however, the results are mixed. In the case of Asia, we do not find any evidence of a permanent and significant permanent reduction of TFP, while for Africa it depends on the method used to compute TFP counterfactuals.[9] Thus, while we find strong evidence that collapses have generated long-run detrimental effects on productivity in Latin America, the evidence is somewhat inconclusive for Africa and rather weak for Asia.[10]

A sketch of TFP evolution around collapses in the three regions is shown in Figure 6. We plot the log difference between actual TFP relative to its counterfactual not only at the end of the sample period but also when this ratio reached its minimum. The graph shows the averages of these points for each of the regions. All three regions exhibit a similar pattern of falling TFP and subsequent recovery. The Latin American average, however, not only shows the smallest recovery (as already shown in the previous tables), but also the largest fall. The figure also shows that the aftermath of output collapses on productivity has been on average more destructive in Latin American than in the other regions at all times, which suggests that long-run consequences may require sufficiently deep crises to materialize.

Next, we explore some conditions under which collapses entail long-run TFP effects, which may explain why TFP destruction is more prevalent in Latin America. In order to do so, we first analyze whether there is a threshold effect so that TFP destruction materializes only when the collapse is sufficiently large. We explore whether, as suggested by Figure 7, the existence of a threshold effect helps explain the difference between the disruptive powers of

[9] Of course, the results for Asia might be partially explained by the reduced number of episodes in our sample which excludes the crises in the region during 1997/1998. However, the strong recovery of GDP per capita in most countries since the crises suggests that overall effect of these episodes on TFP levels in Asia are rather limited.

[10] Our results from the linear model, although not strictly comparable, are in line with those in Cerra and Saxena (2008). They find that after a recession, output does not recoup the level associated with the *linear* extrapolation of the original trend.

collapses in Latin America relative to other regions. Table 8 shows the results when we consider a threshold of a 20 percent collapse to separate the collapses into two groups: a) strong collapses, in which difference between actual TFP relative to its counterfactual reached its minimum at a value greater than 20 percent in absolute value, and b) mild collapses, those episodes in which the observed TFP maximum shortfall was less than 20 percent in absolute value. For each group we test whether the log-difference between actual TFP relative to counterfactual TFP at the end of the sample period is equal to zero.

The first column shows that there is evidence of a threshold effect: for the group of strong collapses we can reject the hypothesis that on average observed TFP recovers to its counterfactual level, but for the group of mild collapses we cannot reject it. Since most collapses in Latin America were strong (61 percent) while the opposite was true in Asia (only 20 percent) and Africa (47 percent), this threshold effect helps explain why Latin American collapses were found to be particularly destructive.

The next two columns in Table 8 formalize this insight showing the same exercise as in column 1 but discriminating between Latin American and non-Latin American collapses. The results confirm the presence of a threshold effect for each group of countries. Therefore, even though the results from Tables 6 and 7 show little indication of permanent effects in TFP in the non-Latin American collapses, Table 8 establishes that strong collapses lead to persistent or permanent destruction everywhere. However, mild collapses still have some long-lasting effects in Latin America but not in non-LAC countries, which suggests that Latin America is not only more prone to large output collapses but also less resilient.

Finally, we test whether a preceding output boom is relevant for the destructive power of output collapses. Table 9 shows the results. The table presents the tests that the log-difference between actual TFP and the counterfactual TFP at the end of the sample period is zero for the collapses preceded by booms (first panel) and for the collapses not preceded by booms (second panel).

While a preceding boom appears to be associated with less destructive collapses, this link is not the key to Latin America's particularly destructive collapses. In fact, the second and third columns of Table 9 show that splitting the samples according to the incidence of output booms does not alter the finding that Latin American collapses have been, on average, associated with permanent reductions in TFP, regardless of whether the collapses were preceded by booms. This is consistent with the evidence provided by Berg, Ostry and Zettelmeyer (2006) that growth accelerations usually have not been sustainable in Latin America, while in other regions, especially Asia, growth spells have a longer duration and have not ended in crises or reversals.

4. Exploring the Impact of Different Types of Shocks

In this section, we explore a series of shocks that have been identified in the literature as important causes or correlates with economic crises. In particular, we first focus on the evolution of TFP after systemic sudden stops (3S) introduced by Calvo, Izquierdo and Talvi (2006), hereafter referred to as CIT. These episodes are defined as a sharp current account reversal (more than two standard deviations) that also coincides with a spike in the aggregate spread of sovereign bonds over Treasuries (measured by JP Morgan's EMBI spreads) for all emerging markets. The systemic nature of this type of shocks ensures the exogeneity of the output collapse and therefore puts to the test whether the findings of the previous section are purely driven by endogenous collapses in TFP.

CIT focus on a group of emerging countries that are integrated into world capital markets and therefore potentially exposed to 3S events. Within this group they identify a sample of 16 episodes of output collapses that occurred in the context of 3S as defined in their paper.

It would be desirable to employ a sample of collapses that is as similar as possible to the one used in CIT. Our sample of collapses, however, only includes seven of the 16 episodes, primarily because CIT use a less stringent threshold for output drops than we do. To follow closely CIT, we also estimate counterfactuals for the other collapses in CIT for which we have data, which allows us to add five more episodes to reach 12.[11]

Next, we test whether these 12 collapses had, on average, temporary or permanent effects on productivity. Table 10 presents the results. For all four alternative measures of TFP counterfactuals, we find that TFP does not fully recover. With 95 percent confidence, we find that TFP fails to attain its pre-crisis path and therefore suffers permanent erosions.[12] Nevertheless, it should be kept in mind that for these episodes the average number of years after

[11] The 12 collapses are: Argentina 82, Argentina 95, Brazil 83, Chile 83, Ecuador 99, Malaysia 98, Mexico 86, Mexico 95, Peru 83, Venezuela 83, Uruguay 83 and Thailand 98. The other two collapses took place in Turkey and Indonesia, which are countries not included in our dataset because of lack of data on capital and/or educational variables to compute the TFP residuals.

[12] Nevertheless, even in this worst case the extent of recovery appears quite high (98 percent on average). A formal analysis may very well conclude that 3S collapses are milder than other types.

a collapse is slightly below nine years, almost half the length of the period of the average collapse studied before. However, when we compare with the case of recent collapses in our sample taking place after 1980, with a recovery period of less than 14 years, the effects of 3S appear quite similar. Thus, even if lack of recovery is partly due to truncation in the case of 3S events, they appear similar to our events at large and it seems safe to conclude that negative effects on TFP of 3S collapses are at least quite persistent.

In order to compare 3S episodes with other types of episodes more directly, we concentrate first on those events that are also an output collapse under our definition. There are seven episodes in our sample that are 3S and also an output collapse episode. As can be seen in the second panel in Table 9, the effects are slightly smaller under the baseline specification compared to the 3S cases analyzed before. In particular, at 95 percent confidence we cannot reject that these episodes are transitory, so that TFP returns to its previous level. However, this conclusion depends on the counterfactual model selected. For the other three models, TFP does not return to its counterfactual. With our metric, there is no "Phoenix miracle" for TFP.

More generally, we extend the analysis of 3S shocks and look at how our conclusions on productivity destruction following an output collapse may differ depending on various characteristics of shock triggering the collapse (apart from the 3S episodes already analyzed). In order to do so, we considered a series of shocks that have been identified by the literature as sources for serious macroeconomic disturbances. The definitions and sources are similar to the shocks used by Becker and Mauro (2006).

The first group of shocks we consider involves more exogenous economic shocks. First, we consider episodes of negative terms of trade shocks (TOT), represented by a dummy variable that takes the value of 1 when country's TOT growth rate falls below two standard deviations. In addition, we also consider global external shocks such as oil shocks and increases in international interest rates. Oil shock episodes are identified as years in which the price increase of crude oil is greater than one standard deviation. The resulting years when oil shocks took place are 1974, 1979, 1999 and 2002. International interest rate shocks are identified as years in which the effective Federal Funds rate increased by more than 150 basis points. Finally, the natural disaster dummy is constructed based on data from EMDAT[13] and takes the value of 1 if more than a 0.01 percent of the country's population was killed in the incident.

The second group of shocks involves macroeconomic shocks that might be triggered by external events, but potentially also some domestic determinants, such as currency crises, banking crises and sovereign debt crises. A currency crisis is defined following Fernández-Arias, Panizza and Stein (2002) as a situation in which the real exchange rate depreciated by more than 10 percent in any month, and is represented by a dummy variable taking the value of one in the year of the crisis.[14] For banking crises, we rely on episodes reported by Bell and Pain (2000), Caprio and Klingebiel (2003), Demirgüç-Kunt and Detragiache (2005), and Kaminsky and Reinhart (1999), while for the definition of the debt crisis we use episodes reported by Detragiache and Spilimbergo (2001), Manasse and Roubini (2005), and Reinhart, Rogoff and Savastano (2003).

Finally, a third group of variables includes political shocks such as wars and major regime changes (e.g., coups d'état). The war dummy takes the value of 1 if the country is involved in an internal or external war according to information from the Correlates of War database, while the political shock dummy is constructed as an event with a major regime change base on the Polity IV database.[15]

The degree of association of the different types of shocks with output collapses is shown in Table 11. With the above definition of shock, currency crises and international interest rate shocks are the most frequent shocks, while natural disasters and terms of trade shocks are the rarest events. However, when considering the conditional frequency of observing an output collapse given that a particular shock materializes, terms of trade shocks appear to be the most strongly associated with output collapses, while other types of shocks such as interest rate shocks are more noisy and less informative of a subsequent output collapse. This can also be seen when looking at the noise-to-signal ratio, which is defined as the ratio between false signals (proportion of times that a shock signals a crisis without an output collapse occurring) and good signals (proportion of times that a shock signals correctly a crisis). Clearly, it should be kept in

[13] They are available at www.em-dat.net.

[14] This definition follows the spirit of Frankel and Rose (1996) who consider nominal depreciations. It takes into account that in high-inflation environments a high nominal depreciation does not necessarily reflect pressure on the currency. We also tried different thresholds, e.g., considering a five percent depreciation, and the results did not change significantly.

[15] We define this shock as a deterioration of 3 or more points in the country's Polity index.

mind that the magnitudes of the different shocks are not strictly comparable. If these shocks were to be used to construct an early warning system, some normalization that would render the same conditional frequency of shocks would be needed. However, for our purpose of exploring the association with output collapses and the evolution of TFP, this is not strictly necessary.

In Table 12, we test whether the permanent effects on TFP associated with output collapses depend on the type of the shock associated with the collapse. In order to perform these tests, we associate a shock with a collapse when it takes place in a one-year window around that collapse.[16] As can be seen in the table, there are significant differences across types of shocks regarding the severity of the associated collapse as well as the degree of persistence of the effects on TFP, but in all cases the estimated effect on long-run TFP is negative. The evidence on currency crises, debt shocks, and sudden increases in international interest rates, as well as natural disasters and wars, is strong enough to conclude that the negative effect on TFP is permanent. In particular, wars and natural disasters have on average the strongest impact. Interestingly, these shocks do not only reduce GDP per capita by destroying physical and human capital (which is to be expected during civil wars), but they also have a permanent effect in lowering TFP. On the other hand, political shocks, terms of trade shocks (including oil shocks), and banking crises may have only a transitory effect. Finally, the six episodes in our sample that are not associated with any of these types of shocks have only a transitory effect on TFP.[17]

While exploring the particular mechanisms through which these different shocks affect TFP is beyond the scope of the paper, it is important to note that the evidence provided in this section allows us to make some causal connections between output collapses caused by external events and the evolution of TFP. In this sense, collapses related to international financial market turmoil, like 3S or hikes in international interest rates, have significantly negative effects on long-run TFP. Furthermore, some of the propagation of these shocks might be through large swings in the real exchange rate and triggering debt crises as the literature on sudden stops emphasizes (e.g., see Calvo and Talvi, 2005), which are the precisely the macroeconomic shocks associated with persistent TFP declines.

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[16] While this helps to increase the number of collapses for each test, it is reasonable given that there might be timing problems in the year to which a particular crisis/shock is assigned.

[17] It should be kept in mind that these shocks are not orthogonal to each other. For example, out of the 107 debt crises identified in our sample, 65 were preceded or coincided with an interest rate shock.

5. The Costs of Productivity Losses

In the previous sections we showed that output collapses are associated with persistent declines in aggregate productivity, particularly in Latin America. In this section we show that the costs of productivity drops in terms of GDP foregone can be substantial. Even if aggregate productivity recovers, the temporary productivity losses can be dear to the economy. Recovery from a collapse is a costly process that may require significant resource reallocation. Firms and entire sectors contract while others expand. Labor and capital are freed in some places to be used in others. All this transition may affect the aggregate efficiency of the economy until the process is completed. Therefore, even in the episodes in which aggregate TFP returns to its potential level the transition can be very costly. This is particularly true, of course, if the recovery takes a long period of time or never fully materializes, as appears to be the case in the Latin American experience.

We can measure the ex post welfare cost of output collapses as the consumption forgone due to the reduction in productivity. Since TFP enters as a multiplicative terms in our production function (with an exponent equal to one), any reduction in TFP (in percentage terms) implies the same reduction in GDP and, for given factor accumulation, in consumption.[18] We will conservatively neglect welfare costs associated with lower factor accumulation on account of the lower returns brought by lower productivity as well as the decrease in investment due to more investment distortions, given that they do not have first-order effects on welfare.[19]

First, we calculate the direct output loss using the estimated TFP gap for each year after the collapse until TFP attains its counterfactual path. For the collapses in which TFP never reaches its counterfactual level, the cumulative output loss is calculated until the end of the sample period, 2003.[20] We express the cumulative output loss as a percentage of the GDP in 2003.

Figure 7 shows the results. It is clear that some of the collapses have entailed very large costs to countries, particularly those collapses leading to a permanent TFP shortfall. But even if productivity eventually reached its potential trend, the losses during the transition period have been significant in many cases. For example, after the collapse that Uruguay experienced in

[18] The overall output forgone would amount to this direct output loss plus the indirect output foregone due to lower factor accumulation.
[19] This result follows directly from the envelope theorem.
[20] These cumulative losses are the simple sum, thus we do not compound or discount them.

1983, TFP returned to its potential trend after nine years (see Figure A.34) but still generated an accumulated loss to the country equivalent in value to its entire GDP in 2003.

The output foregone computed so far are ex post measures of the costs of output collapses. However, it could be argued that given the low probability of these events, the ex ante welfare loss is considerably lower.[21] In order to assess the *expected* welfare loss due to GDP collapses, we proceed as follows.[22] First, we use the frequency of episodes as an estimate of the probability of a GDP collapse by region, separating Latin America and the rest of the world (in consonance with the different behavior of TFP effects in Latin America documented above). These probabilities of output collapse in a given year are presented in the first column of Table 13. Next, we compute the discounted present value of the difference between actual GDP and counterfactual GDP assuming that the differences between actual and counterfactual TFP levels estimated in Tables 6 and 7 are maintained in the future. This assumption does not appear particularly restrictive given our previous analysis and upon inspection of TFP trajectories (see the Appendix). Then, we discount this loss by a real rate of 5 percent per annum.[23] Thus, the expected loss is computed as:

$$p\sum_{t=0}^{\infty}\left(\frac{1}{1+r}\right)^{t}\left(1-\frac{TFP_o}{TFP_c}\right)=p\,\frac{1+r}{r}\left(1-\frac{TFP_o}{TFP_c}\right), \qquad (6)$$

where p is the probability of a collapse, r is the real interest rate, and the final term is the direct GDP loss incurred every year due to the difference between the observed level of TFP after the collapse and its counterfactual level. It should be pointed out that this is actually a lower bound of the ex ante welfare cost of growth collapses because we are not considering the indirect effects of a lower level of TFP on profitable factor accumulation, investment distortions, and transition costs. In addition, the consideration of risk aversion would also increase the measured welfare loss.

The resulting magnitudes of multiplying this discounted present value by the probability of a collapse are presented in columns (2) – (4) of Table 14. The results indicate that the

[21] This argument would be in the spirit of Lucas (1987), who argues that welfare losses in the United States due to business cycle fluctuations are small in economic terms.
[22] The estimate we are obtaining should be interpreted as the average expected output cost for a GDP collapse of similar characteristics to those observed in our sample.
[23] Observe that for developed countries usually the standard discount rate is between 2 percent and 3 percent, such that our estimated welfare losses are rather conservative.

expected welfare losses are large. In terms of contemporaneous GDP, for the whole sample output collapses imply an expected loss equivalent to almost 8 percent of GDP. For Latin America, a region with deeper crises and a higher likelihood of occurrence of a collapse, this cost is almost twice as large, over 14 percent of GDP.

Clearly, these magnitudes are large. It is interesting to point out that our conservative estimates are similar to the welfare costs of rare disasters estimated by Barro (2006). Even neglecting transition and investment effects and without considering risk aversion, our welfare estimates of output collapses are larger than the standard welfare costs of eliminating fluctuations in consumption in developing countries, which according to Pallage and Robe (2003) are equivalent to around 0.34 percent of permanent consumption in developing countries.[24]

TFP reduction is a pure welfare cost, permanent in the case of TFP destruction and transitory if TFP eventually recovers after a transition. As mentioned earlier, lower investment commanded by lower TFP would not entail a net welfare cost as a first-order approximation. Similarly, lower investment on account of additional distortions to the incentives to invest (e.g., higher risk of expropriation) would also generate only second-order welfare costs measured in terms of consumption. Nevertheless, lower investment would have a first-order impact on output level and growth, traditional measures of countries' performance. It may be interesting therefore to have a sense of the magnitude of investment effects on output and compare them with the pure productivity effect.

Collapses and Investment

The long-run decline in output level directly produced by the long-run TFP gap after output collapse utilized in (6) is about 12 percent, and as large as 19 percent in Latin America. Clearly, negative effects on factor accumulation leading to lower long-run output could also be associated with output collapses. Actually, if only TFP declined during an output collapse, physical capital and probably also human capital would fall due to the lower level of productivity, even in the absence of any association between output collapse and additional distortions in factor accumulation. Thus, it is difficult to assess the effects on factors, due to their endogeneity with respect to TFP.

The investment shortfall associated with a reduction in TFP can be estimated in the neoclassical framework as follows. Following Klenow and Rodriguez-Clare (2005), the production function in equation (1) in per worker terms can be rewritten in "intensive" form, taking into account the indirect effect of TFP on physical capital accumulation as:

$$y = A^{\frac{1}{1-\alpha}}\left(\frac{K}{Y}\right)^{\frac{\alpha}{1-\alpha}} h \qquad (8)$$

Under the assumption that α = 1/3, the overall long-run output shortfall associated with a reduction in TFP is magnified to around 18 percent of GDP, and around 28 percent of GDP for the case of Latin America. In particular, the corresponding expected discounted output loss due to the endogenous investment reduction is about half of that directly associated with TFP: about 12 percent of GDP, or 22 percent in the case of Latin America (see the last column in Table 13).

One way to isolate pure effects on investment from these effects induced by productivity shifts is to look at the capital-output ratio or the steady-state investment-output ratio, which in the neoclassical growth model are independent of the level of TFP. In steady state, the following relationship holds (see Appendix A.2 for the derivation):

$$\frac{I}{Y} = \left(g + n + \delta\right)\frac{K}{Y}, \qquad (7)$$

where g is the steady state growth rate of TFP, n is the human-capital-adjusted population growth rate and δ the rate of depreciation of capital. Thus, an analysis of the behavior of the investment-output ratio after an output collapse is a simple test to see if factor accumulation plays a role beyond the indirect effects of TFP on factor accumulation.

We explore this possibility in Table 14. In particular, following the same methodology as for TFP, we test whether the HP-filtered investment to GDP ratios at the end of the sample are significantly different from the investment to GDP ratio in the year before the collapse. The results show an average decline in the investment/GDP ratio by almost 1.5 percentage points of GDP after an output collapse, although it is only marginally significant (p-value of 0.07). Furthermore, in Latin America and Africa the decline in the investment-output ratio after an

[24] In our metric the present discounted value (using a discount rate of 5 percent also) of these costs would be around 4.8 percentage points of GDP (assuming that consumption is around 70 percent of GDP).

output collapse is not significant. This result is particularly interesting because Latin America and Africa to a certain extent are the regions that underperform in terms of TFP, while the other regions do not exhibit significant declines in TFP.

If we accept the point estimate for this pure investment effect, assuming a growth rate of TFP of 2 percent per annum, population growth of 1 percent, a rate of depreciation of 7 percent and an initial capital-output ratio of 2, a decline in 1.5 percentage points of GDP in the investment-output ratio therefore implies a 15 percentage points, or 7.5 percent decline, in the capital-output ratio.

Assuming a value of α = 1/3, this 7.5 percent decline in the capital-output ratio would imply a decline in GDP per worker of 3.75 percent.

Overall, the results show that in addition to a persistent decline in TFP, output collapses have sometimes been accompanied as well by a decline in investment ratios, which could be linked to increases in investment distortions. However, the evidence on the latter is rather limited and their economic magnitude tends to be small. In particular, in Latin America TFP effects are very substantial (lower long-run GDP levels by 19 percent) and investment distortions effects are negligible.

6. Concluding Remarks

In this paper we analyze the dynamics of TFP after output collapses and estimate the implied welfare losses. Using a large panel of developed and developing countries we find that almost all of these collapses took place in developing countries. The typical Latin American country experienced about two collapses over the course of the four decades (similar to Africa but much higher than other regions).

We find strong evidence of persistent productivity destruction in Latin America: the output collapses during the debt crisis in the 1980s meant more than a “lost decade” to the region. The evidence on the enduring impact of collapses on productivity for the other regions is weaker.

We find empirical support to the notion of a threshold effect in the sense that TFP destruction materializes when the collapse is sufficiently large. Output collapses in Latin America have been particularly destructive of long-run productivity because they have been deeper than in other regions, not because aggregate productivity is less resilient.

These long-term TFP shortfalls after output collapses are not merely a reflection of productivity weaknesses prompting both. When we constrain the sample to output collapses caused by exogenous shocks, we still find a similarly negative impact on TFP. In particular, global capital market disruptions and domestic shocks related to sudden stops (such as real exchange rate and debt shocks) have the most destructive impact on TFP. The evidence suggests that there is irreversible productivity damage.

Our analysis also shows that the welfare costs of productivity losses can be very substantial. Permanent effects on productivity entail permanently lower GDP and lower long-term GDP growth. Even if the effects are temporary and aggregate productivity recovers after a period of decline, the costs associated with the temporary but persistent losses in productivity can be large for the economy. A conservative estimation of welfare cost associated with the possibility of an output collapse indicates that this contingency is more costly than the recurrent cost of business cycle fluctuations.

From a policy perspective, these large welfare costs associated with output collapses indicate the importance of focusing macroeconomic policies in developing and emerging economies on crisis prevention and risk management rather than reducing business cycle fluctuations. This paper suggests that there is a big premium on prudent and conservative policies against the risk of an extreme output downfall.

Finally, it is worth noticing that the prevalence of output collapses in Latin America and developing countries in general contributes to low long-run growth and lack of convergence. In fact, persistent productivity reduction after output collapse is responsible for long-run GDP levels that are 18 percent lower than they would be otherwise. Even without any additional deterioration from investment distortions, this reduction every 32 years (the observed frequency of output collapses) amounts to an average reduction of 0.6 percentage points of GDP per worker growth per annum.

References

Aghion, P., and G. Saint-Paul. 1998. "On the Virtues of Bad Times." *Macroeconomic Dynamics* 2(3): 322-244.

Aguiar, M. and G. Gopinath. 2007. "Emerging Market Business Cycles: The Cycle is the Trend." *Journal of Political Economy* 115(1): 69-102.

Bai, J., and P. Perron. 1998. "Estimating and Testing Linear Models with Multiple Structural Breaks", *Econometrica* 66(1): 47-78.

----. 2003. "Computation and Analysis of Multiple Structural Change Models." *Journal of Applied Econometrics* 18(1): 1-22.

Barro, R.J. 2006. "On the Welfare Costs of Consumption Uncertainty." NBER Working Paper 12763. Cambridge, United States: National Bureau of Economic Research.

Becker, T., and P. Mauro. 2006. "Output Drops, and the Shocks that Matter." IMF Working Paper WP/06/172. Washington, DC, United States: International Monetary Fund.

Bell, J., and D. Pain. 2000. "Leading Indicators of Banking Crises: A Critical Review." In: *Financial Stability Report: December 2000*. London, United Kindgom: Bank of England.

Berg, A., J.D. Ostry, and J. Zettelmeyer, J., 2006. "What Makes Growth Sustained?" Paper presented at the 2006 IMF conference "Economic Growth and Latin America: What Have We Learned?" Washington, DC, United States.

Bergoeing, R., N. Loayza, and A. Repetto. 2004. "Slow Recoveries." *Journal of Development Economics* 75(2): 473-506.

Blyde, J., and E. Fernández-Arias. 2005. "Why Latin America is Falling Behind." In: E. Fernández-Arias, R. Manuelli and J.S. Blyde, editors. *Sources of Growth in Latin America: What is Missing?* Washington, DC, United States: Inter-American Development Bank.

Caballero, R.J., and M.L. Hammour. 1994. "The Cleansing Effect of Recessions." *American Economic Review* 84(5): 1350-68.

----. 2005. "The Cost of Recessions Revisited: A Reverse-Liquidationist View." *Review of Economic Studies* 72(2): 313-341.

Calvo, G., A. Izquierdo and E. Talvi. 2006. "Sudden Stops and Phoenix Miracles in Emerging Markets." *American Economic Review* 96(2): 405-410.

Calvo, G.A., and E. Talvi. 2005. "Sudden Stop, Financial Factors and Economic Collapse in Latin America: Learning from Argentina and Chile." NBER Working Paper 11153. Cambridge, United States: National Bureau of Economic Research.

Calvo, G.A., A. Izquierdo and R. Loo-Kung. 2005. "Relative Price Volatility under SuddenCaprio, G., and D. Klingebiel. 2003. "Episodes of Systemic and Borderline Financial Crises." Washington, DC, United States: World Bank. Mimeographed document.

Cerra, V., and S.C. Saxena. 2008. "Growth Dynamics: The Myth of Economic Recovery." *American Economic Review* 98(1): 439-457.

Chari, V.V., P. Kehoe and E. McGrattan. 2007. "Business Cycle Accounting." *Econometrica* 75(3): 781-836.

Demirgüç-Kunt, A., and E. Detragiache. 2005. "Cross-Country Empirical Studies of Systemic Bank Distress: A Survey." IMF Working Papers WP05/96. Washington, DC, United States: International Monetary Fund.

Detragiache, E., and A. Spilimbergo. 2001. "Crises and Liquidity: Evidence and Interpretation." IMF Working Paper WP/01/2. Washington, DC, United States: International Monetary Fund.

Drazen, A., and W. Easterly. 2001. "Do Crises Induce Reform? Simple Empirical Tests of Conventional Wisdom." *Economics and Politics* 13: 129 – 157.

Easterly, W., and R. Levine. 2001. "It's Not Factor Accumulation: Stylized Facts and Growth Models." *World Bank Economic Review* 15(2): 177-219.

Fernández-Arias, E., U. Panizza and E. Stein. 2002. "Trade Agreements, Exchange Rate Disagreements." Washington, DC, United States: Inter-American Development Bank. Mimeographed document.

Frankel, J., and A. Rose. 1996. "Currency Crashes in Emerging Markets: An Empirical Treatment." *Journal of International Economics* 41: 351-366.

Grossman, G.M., and E. Helpman. 1991. *Innovation and Growth in the Global Economy*. Cambridge, United States: MIT Press.

Hall, J., and C. Jones. 1999. "Why Do Some Countries Produce So Much More Output per Worker than Others?" *Quarterly Journal of Economics* 114(1): 83-116.

Hausmann, R., L. Pritchett and D. Rodrik. 2005. “Growth Accelerations.” *Journal of Economic Growth* 10(4): 303-329.

Hausmann, R., F. Rodríguez and R. Wagner. 2006. “Growth Collapses.” Center for International Development Working Paper 136. Cambridge, United States: Harvard University.

Hong, K., and A. Tornell. 2005. “Recovery after a Currency Crisis: Some Stylized Facts.” *Journal of Development Economics* 76: 71-96.

Im, K., H. Pesaran and Y. Shin. 2003. “Testing for Unit Roots in Heterogeneous Panels.” *Journal of Econometrics* 115: 53-74

Jones, B.F., and B.A. Olken. 2008. “The Anatomy of Start-Stop Growth.” *Review of Economics and Statistics* 90(3): 582-587.

Kaminsky, G.L., and C.M. Reinhart. 1999. “The Twin Crises: The Causes of Banking and Balance-of-Payments Problems.” *American Economic Review* 89(3): 473-500.

Kehoe, T.J., and E.C. Prescott, editors, 2007. Great Depressions of the Twentieth Century. Minneapolis, United States: Federal Reserve Bank of Minneapolis.

Klenow, P.J., and A. Rodríguez-Clare, Andres. 2005. “Externalities and Growth.” In P. Aghion and St. Durlauf, editors. *Handbook of Economic Growth*. Volume 1B. Amsterdam, The Netherlands: North-Holland.

Levin, A., C-F. Lin and C-S. J. Chu. 2002. “Unit Root Tests in Panel Data: Asymptotic and Finite Sample Properties.” *Journal of Econometrics* 108: 1-24.

Lucas, R.E., 1987. *Models of Business Cycles.* New York, United States: Basil Blackwell.

Maddala, G.S., and S. Wu. 1999. “A Comparative Study of Unit Root Tests With Panel Data and a New Simple Test.” *Oxford Bulletin of Economics and Statistics* 61: 631-652.

Manasse, P., and N. Roubini. 2005. “‘Rules of Thumb’ for Sovereign Debt Crises.” IMF Working Papers WP/05/42. Washington, DC, United States: International Monetary Fund.

Martin, P., and C.A. Rogers. 1997. “Stabilization Policy, Learning-By-Doing, and Economic Growth.” *Oxford Economic Papers* 49(2): 152-66.

Parente, S. and E.C. Prescott, E.C., 2000. *Barriers to Riches.* Cambridge, United States: MIT Press.

----. 2005. "A Unified Theory of the Evolution of International Income Levels." In: P. Aghion and S. Durlauf, editors. *Handbook of Economic Growth.* Volume 1B. Amsterdam, The Netherlands: North-Holland.

Pallage, S., and M.A. Robe. 2003. "On the Welfare Cost of Economic Fluctuations in Developing Countries." *International Economic Review* 44(2): 677-698.

Pesaran, H. 2003. "A Simple Panel Unit Root Test in the Presence of Cross Section Dependence." Cambridge Working Papers in Economics 0346. Cambridge, United Kingdom: Cambridge University, Faculty of Economics (DAE).

Pritchett, L. 1997. "Divergence, Big Time." *Journal of Economic Perspectives* 11(3): 3-17.

----. 2000. "Understanding Patterns of Economic Growth: Searching for Hills among Plateaus, Mountains, and Plains." *World Bank Economic Review* 14(2): 221-250.

Psacharopoulos, G. 1994. "Returns on Investment in Education: A Global Update." *World Development* 22 (9): 1325-1343.

Ramey, G., and V.A. Ramey. 1995. "Cross-Country Evidence on the Link between Volatility and Growth." *American Economic Review* 85(5): 1138-1151.

Rancière, R., A. Tornell and F. Westermann. 2008. "Systemic Crises and Growth." *Quarterly Journal of Economics* 123(1): 359-406.

Reinhart, C.M., K.S. Rogoff and M.A. Savastano. 2003. "Debt Intolerance." *Brookings Papers on Economic Activity* 1: 1-62.

Restuccia, D., and R. Rogerson, R., 2008. "Policy Distortions and Aggregate Productivity with Heterogeneous Plants." *Review of Economic Dynamics* 11(4): 707-720.

Romer, P. 1990. "Endogenous Technological Change." *Journal of Political Economy* 98: S71-S102.

Tommasi, M., and A. Velasco. 1996. "Where Are We in the Political Economy of Reform?" *Journal of Policy Reform* 1: 187-238.

Uhlig, H., and M. Ravn, 2002. "On Adjusting the HP-Filter for the Frequency of Observations." *Review of Economics and Statistics* 84(2): 371-376.

Appendix

A.1. TFP Computation

We construct series for capital stock using data from the Penn World Tables, Version 6.2. Following the methodology presented in Easterly and Levine (2001) we use a perpetual inventory method. In particular, the capital accumulation equation states that:

$$K_{t+1} = K_t(1-\delta) + I_t\,, \qquad \text{(A.1)}$$

where K_t is the stock of capital in period t, I is investment and δ is the depreciation rate, which we assume equals 0.07. From the capital accumulation equation (A.1) and assuming that the country is in steady state, we can compute the initial capital-output ratio as:

$$k = \frac{i}{g+\delta}\,, \qquad \text{(A.2)}$$

where i is the average investment-output ratio for the first 10 years of the sample, and g is a weighted average between world growth (75 percent) of 4.2 percent and the average growth of the country for the first 10 years of the sample (25 percent). To obtain the initial capital stock K_0 we multiply k by the average output of the first three years of the sample.

The series for labor is computed as the ratio of real GDP (Chain) using the data and real GDP per worker from the Penn World Tables 6.2.

To estimate human capital, we follow Hall and Jones (1999) and consider h to be relative efficiency of a unit of labor with E years of schooling. Specifically, the function takes the form of:

$$h = e^{\phi(E)}\,, \qquad \text{(A.3)}$$

where the function $\phi(.)$ is such that $\phi(0) = 0$ and $\phi'(E)$ is the Mincerian return on education. In particular, we approximate this function by a piece-wise linear function. We assume the following rates of return for all the countries: 13.4 percent for the first four years of schooling, 10.1 percent for the next four years and 6.8 percent for education beyond the eighth year (based on Psacharopoulos, 1994). For each country we compute the average using the data on years of schooling in the population from the Barro-Lee database.[25]

Output per worker is given by:

$$\frac{Y}{L} = A\left(\frac{K}{L}\right)^{\alpha} h^{1-\alpha}, \qquad \text{(A.4)}$$

where A represents the total factor productivity (TFP) and α is 1/3. TFP is obtained by applying logs:

$$\ln(Y) - \ln(L) = \ln(A) + \alpha(\ln(K) - \ln(L)) + (1-\alpha)\ln(h) \qquad \text{(A.5)}$$

Operating yields:

$$\ln(A) = \ln(Y) - \ln(L) - \alpha(\ln(K) + \ln(L)) - (1-\alpha)\ln(h) \qquad \text{(A.6)}$$

Finally, computed TFP levels are given by:

$$A = \exp\left(\ln(Y) - \ln(L) - \alpha(\ln(K) + \ln(L)) - (1-\alpha)\ln(h)\right) \qquad \text{(A.7)}$$

A.2. Derivation of Steady-State Investment Equation

For simplicity let us use continuous time, such that the transition equation for the capital stock is given by:

$$\dot{K} = I - \delta K \qquad \text{(A.8)}$$

Dividing by output (Y) and rearranging yields:

$$\frac{I}{Y} = \frac{\dot{K}}{Y} + \delta\frac{K}{Y} \qquad \text{(A.9)}$$

Given the production function $Y=K^{\alpha}(AhL)^{1-\alpha}$, steady state output growth is given by:

[25] Linear extrapolations are used to complete the five-year data.

$$g_Y = \frac{\dot{Y}}{Y} = \alpha \frac{\dot{K}}{K} + (1-\alpha)(g+n) = g+n \tag{A.10}$$

where g is the growth rate of TFP and n is the growth rate of human-capital adjusted labor (hL). The second equality comes from the fact that on the balanced growth path, the capital-to-output ratio is constant, such that the capital stock grows at the same rate as output. This implies the following:

$$\frac{\dot{K}}{Y} = (g+n)\frac{K}{Y} \tag{A.11}$$

Plugging A.11 into A.8 yields:

$$\frac{I}{Y} = (g+n+\delta)\frac{K}{Y}\,. \tag{A.12}$$

Table 1. Countries in the Sample

Industrial	Latin America and Caribbean	Africa	Asia	Other
Australia	Argentina	Benin	Fiji	Cyprus
Austria	Bolivia	Botswana	Hong Kong	Greece
Belgium	Brazil	Cameroon	India	Hungary
Canada	Chile	Cote d'Ivoire	Korea, Dem. Rep.	Israel
Denmark	Colombia	Egypt, Arab Rep.	Malaysia	Portugal
Finland	Costa Rica	Ghana	Papua New Guinea	
France	Dominican Republic	Kenya	Pakistan	
Germany	Ecuador	Madagascar	Philippines	
Iceland	El Salvador	Malawi	Singapore	
Ireland	Guatemala	Morocco	Sri Lanka	
Italy	Haiti	Senegal	Thailand	
Japan	Honduras	South Africa		
Netherlands	Jamaica	Togo		
New Zealand	Mexico	Tunisia		
Norway	Nicaragua	Zimbabwe		
Spain	Panama			
Sweden	Paraguay			
Switzerland	Peru			
United Kingdom	Uruguay			
United States	Venezuela			

Table 2. Episodes of Output Collapses and Real GDP Growth Rates

Country	Year	Growth[1]	Country	Year	Growth[1]	Country	Year	Growth[1]
Argentina	1963	-5%	Ecuador	1970	-7%	Nicaragua	1973	-4%
Argentina	1982	-10%	El Salvador	1981	-8%	Nicaragua	1979	-27%
Argentina	2002	-12%	Fiji	1983	-6%	Panama	1977	-2%
Benin	1976	-5%	Finland	1992	-5%	Panama	1988	-23%
Benin	1989	-8%	Ghana	1966	-2%	Papua New Guinea	1990	-9%
Bolivia	1970	-2%	Ghana	1976	-5%	Papua New Guinea	1999	-5%
Bolivia	1986	-6%	Ghana	1982	-16%	Paraguay	1986	-4%
Botswana	1966	1%	Guatemala	1985	-4%	Peru	1983	-15%
Brazil	1983	-6%	Haiti	1992	-16%	Peru	1989	-19%
Brazil	1992	-3%	Hungary	1992	-6%	Philippines	1985	-8%
Cameroon	1977	1%	Iceland	1969	0%	Senegal	1969	-12%
Cameroon	1991	-10%	India	1966	-14%	Togo	1963	-4%
Chile	1975	-18%	Israel	1967	-1%	Togo	1983	-10%
Chile	1983	-8%	Jamaica	1980	-6%	Togo	1992	-14%
Costa Rica	1982	-11%	Kenya	1970	-19%	Uruguay	1983	-14%
Cote d'Ivoire	1982	-5%	Kenya	1985	-5%	Uruguay	2002	-12%
Cote d'Ivoire	1990	-10%	Madagascar	1976	-7%	Venezuela, RB	1983	-5%
Cote d'Ivoire	2003	-6%	Madagascar	2002	-16%	Venezuela, RB	1989	-14%
Cyprus	1964	-12%	Malawi	1964	-3%	Venezuela, RB	2002	-11%
Cyprus	1975	-17%	Malawi	1994	-14%	Zimbabwe	1977	-5%
Dominican Republic	1968	-2%	Malaysia	1986	-7%	Zimbabwe	1988	-10%
Dominican Republic	1991	-3%	Mexico	1986	-6%	Zimbabwe	2003	-1%

[1] Real GDP growth rate during the year where the episode takes place.

Table 3. Collapses and Booms

Collapses		
Total	Preceded by a boom 1, 2 or 3 years before	Not preceded by a boom
69	32	37
Percentage	*46.4%*	*53.6%*

Booms		
Total	Followed by a collapse 1, 2 or 3 years after	Not followed by collapses
161	32	129
Percentage	*19.9%*	*80.1%*

Table 4. Panel Unit Root Tests

	Fisher Test[1]	Fisher Test (Phillips-Perron)	Im, Pesaran and Shin Test	Pesaran Test	Levin, Lin and Chu Test[2]
Test-statistic	**190.46**	**175.67**	**-2.547**	**-2.985**	**-7.001**
Critical Value (5%)	175.20	175.20	-2.310	-2.560	-1.960
Critical Value (1%)	188.67	188.67	-2.360	-2.650	-2.576

All auxiliary specifications include one lag of the dependent variable and a trend.
[1] The test-statistic is distributed chi-squared (146) under the null hypothesis.
[1] The test-statistic is distributed normal (0,1) under the null hypothesis.

Table 5. Regressions for Counterfactual TFP

	Baseline	Linear Trend	Country-specific Absorption	Country-specific Absorption and Trend		Baseline	Linear Trend	Country-specific Absorption	Country-specific Absorption and Trend
TFP Frontier (logs)	0.9487				Trend			-0.0025	
	(0.0729)***							(0.0010)**	
Trends:					TFP Frontier (logs):				
Argentina`82	-0.009	-0.0001			Argentina`82			0.612	0.509
	(0.0049)*	(0.0059)						(0.4962)	(0.5006)
Argentina`89	-0.0131	-0.0054			Argentina`89			0.404	0.2884
	(0.0036)***	(0.0044)						(0.4398)	(0.4429)
Benin`76	-0.0164	-0.0042			Benin`76			0.4984	0.415
	(0.0070)**	(0.0081)						(0.5243)	(0.5286)
Benin`89	-0.0199	-0.0117			Benin`89			0.1938	0.0946
	(0.0036)***	(0.0044)***						(0.4398)	(0.4429)
Bolivia`70	-0.0016	0.0153			Bolivia`70			0.7893	0.6744
	(0.0112)	(0.0125)						(0.6720)	(0.6769)
Bolivia`86	0.0004	0.0079			Bolivia`86			0.7955	0.6596
	(0.0041)	(0.0049)						(0.4683)*	(0.4719)
Botswana`66	0.0034	0.0256			Botswana`66			1.3216	1.2272
	(0.0178)	(0.0191)						(0.8142)	(0.8178)
Brazil`83	0.0106	0.0178			Brazil`83			1.4667	1.3416
	(0.0047)**	(0.0056)***						(0.4948)***	(0.4991)***
Brazil`92	0.0012	0.0079			Brazil`92			1.1729	1.0251
	(0.0032)	(0.0039)**						(0.4281)***	(0.4310)**
Cameroon`77	0.0008	0.013			Cameroon`77			0.746	0.6339
	(0.0066)	(0.0076)*						(0.5133)	(0.5176)
Cameroon`91	0.0014	0.0084			Cameroon`91			0.6451	0.4801
	(0.0033)	(0.0040)**						(0.4295)	(0.4326)
Chile`75	-0.0084	0.0066			Chile`75			0.3913	0.2642
	(0.0075)	(0.0086)						(0.5479)	(0.5538)
Chile`83	-0.0103	-0.002			Chile`83			1.0725	0.9888
	(0.0047)**	(0.0056)						(0.4948)**	(0.4991)**
Costa Rica`82	-0.0057	0.0029			Costa Rica`82			0.9468	0.8379
	(0.0049)	(0.0059)						(0.4962)*	(0.5006)*
Cote d'Ivoire`82	0.0008	0.0094			Cote d'Ivoire`82			1.1873	1.067
	(0.0049)	(0.0059)						(0.4962)**	(0.5006)**
Cote d'Ivoire`90	-0.0111	-0.0031			Cote d'Ivoire`90			0.559	0.4288
	(0.0035)***	(0.0042)						(0.4307)	(0.4338)
Cyprus`75	0.0111	0.0251			Cyprus`75			1.4393	1.3042
	(0.0075)	(0.0086)***						(0.5479)***	(0.5538)**
Dominican Republic`68	-0.0028	0.0143			Dominican Republic`68			1.1528	1.05
	(0.0138)	(0.0151)						(0.7926)	(0.7972)
Dominican Republic`91	-0.0107	-0.003			Dominican Republic`91			0.7944	0.6766
	(0.0033)***	(0.0040)						(0.4295)*	(0.4326)
Ecuador`70	0.009	0.0259			Ecuador`70			1.1407	1.0222
	(0.0112)	(0.0125)**						(0.6720)*	(0.6769)
El Salvador`81	-0.0111	-0.0015			El Salvador`81			0.3597	0.2476
	(0.0052)**	(0.0062)						(0.4969)	(0.5014)
Fiji`66	-0.0193	0.0027			Fiji`66			0.5193	0.4271
	(0.0178)	(0.0191)						(0.8142)	(0.8178)
Fiji`83	-0.0021	0.0054			Fiji`83			1.0508	0.9465
	(0.0047)	(0.0056)						(0.4948)**	(0.4991)*
Ghana`66	-0.0326	-0.0102			Ghana`66			-0.3659	-0.4627
	(0.0178)*	(0.0191)						(0.8142)	(0.8178)
Ghana`76	-0.024	-0.0117			Ghana`76			0.4226	0.3547
	(0.0070)***	(0.0081)						(0.5243)	(0.5286)

	Baseline	Linear Trend	Country-specific Absorption	Country-specific Absorption and Trend		Baseline	Linear Trend	Country-specific Absorption	Country-specific Absorption and Trend
Ghana`82	-0.0161	-0.0069			Ghana`82			0.3015	0.2155
	(0.0049)***	(0.0059)						(0.4962)	(0.5006)
Guatemala`85	-0.0068	0.0006			Guatemala`85			0.7301	0.6159
	(0.0043)	(0.0051)						(0.4765)	(0.4803)
Haiti`92	-0.025	-0.0177			Haiti`92			-0.5617	-0.6603
	(0.0032)***	(0.0039)***						(0.4281)	(0.4310)
Hungary`92	0.0155	0.0227			Hungary`92			1.9719	1.7877
	(0.0032)***	(0.0039)***						(0.4281)***	(0.4310)***
India`66	-0.0383	-0.0166			India`66			-0.1807	-0.2718
	(0.0178)**	(0.0191)						(0.8142)	(0.8178)
Israel`67	0.0071	0.0269			Israel`67			1.6283	1.5294
	(0.0156)	(0.0169)						(0.7953)**	(0.7997)*
Jamaica`80	-0.0074	0.0026			Jamaica`80			0.5965	0.4771
	(0.0055)	(0.0065)						(0.4977)	(0.5021)
Kenya`70	0.0018	0.0183			Kenya`70			0.6096	0.4871
	(0.0112)	(0.0125)						(0.6720)	(0.6769)
Kenya`85	0.0046	0.0118			Kenya`85			0.5167	0.3662
	(0.0043)	(0.0051)**						(0.4765)	(0.4803)
Madagascar`76	-0.0265	-0.0143			Madagascar`76			-0.4669	-0.5569
	(0.0070)***	(0.0081)*						(0.5243)	(0.5286)
Malawi`94	-0.0073	-0.0003			Malawi`94			0.0312	-0.1085
	(0.0030)**	(0.0036)						(0.4280)	(0.4309)
Malaysia`86	0.0035	0.0108			Malaysia`86			1.1163	0.9865
	(0.0041)	(0.0049)**						(0.4683)**	(0.4719)**
Mexico`86	-0.004	0.0036			Mexico`86			0.8798	0.7581
	(0.0041)	(0.0049)						(0.4683)*	(0.4719)
Nicaragua`73	0.0001	0.0163			Nicaragua`73			1.1712	1.0531
	(0.0087)	(0.0098)*						(0.5979)*	(0.6038)*
Nicaragua`79	-0.0023	0.0088			Nicaragua`79			0.5942	0.4745
	(0.0058)	(0.0068)						(0.5088)	(0.5133)
Nicaragua`88	-0.021	-0.0126			Nicaragua`88			-0.3492	-0.4727
	(0.0038)***	(0.0045)***						(0.4514)	(0.4548)
Panama`77	0.0005	0.0124			Panama`77			0.9862	0.8756
	(0.0066)	(0.0076)						(0.5133)*	(0.5176)*
Panama`88	-0.0027	0.0054			Panama`88			0.7667	0.6264
	(0.0038)	(0.0045)						(0.4514)*	(0.4548)
Papua New Guinea`90	-0.0111	-0.0023			Papua New Guinea`90			0.7531	0.6314
	(0.0035)***	(0.0042)						(0.4307)*	(0.4338)
Paraguay`86	-0.008	-0.0007			Paraguay`86			0.3183	0.1971
	(0.0041)*	(0.0049)						(0.4683)	(0.4719)
Peru`83	-0.0057	0.0028			Peru`83			0.8926	0.7849
	(0.0047)	(0.0056)						(0.4948)*	(0.4991)
Peru`89	-0.0118	-0.0034			Peru`89			0.5678	0.4453
	(0.0036)***	(0.0044)						(0.4398)	(0.4429)
Philippines`85	-0.0123	-0.0049			Philippines`85			-0.0603	-0.1808
	(0.0043)***	(0.0051)						(0.4765)	(0.4803)
Senegal`69	-0.0042	0.0123			Senegal`69			0.779	0.6667
	(0.0124)	(0.0136)						(0.7605)	(0.7656)
Togo`63	-0.006	0.0019			Togo`63			1.2496	1.1482
	(0.0047)	(0.0056)						(0.4948)**	(0.4991)**
Togo`83	-0.0099	-0.0022			Togo`83			1.0415	0.9283
	(0.0032)***	(0.0039)						(0.4281)**	(0.4310)**
Togo`92	-0.0083	-0.0007			Togo`92			0.5125	0.4119
	(0.0047)*	(0.0056)						(0.4948)	(0.4991)
Uruguay`83	-0.0203	-0.012			Uruguay`83			0.5189	0.4308
	(0.0047)***	(0.0056)**						(0.4948)	(0.4991)
Venezuela, RB`83	-0.0217	-0.0127			Venezuela, RB`83			0.3235	0.226
	(0.0036)***	(0.0044)***						(0.4398)	(0.4429)
Venezuela, RB`89	0.0078	0.0189			Venezuela, RB`89			0.7896	0.6648
	(0.0066)	(0.0076)**						(0.5133)	(0.5176)
Zimbabwe`77	0.0034	0.0104			Zimbabwe`77			0.4467	0.2789
	(0.0038)	(0.0045)**						(0.4514)	(0.4548)
Constant	17.945	5.9913	7.0581	2.8112	Observations	1808	1808	1808	1808
	(9.7011)*	(11.5788)	(3.2688)**	(2.8575)	R-squared	0.99	0.99	0.98	0.98

Table 6. Actual TFP versus Counterfactual TFP (log-differences)

	Baseline		Linear Trend		Country-specific Absorption		Country-specific Absorption and Trend	
All Episodes: 55								
Average number of years after collapse: 15.2								
Mean	-0.121		-0.218		-0.153		-0.194	
95% Confidence interval	-0.181	-0.061	-0.281	-0.155	-0.216	-0.090	-0.257	-0.131
t-statistic	-4.054		-6.960		-4.857		-6.193	

Table 7. Actual TFP versus Counterfactual TFP (log-differences), by Region

	Baseline		Linear Trend		Country-specific Absorption		Country-specific Absorption and Trend	
LAC Episodes: 28								
Average number of years after collapse: 14.25								
Mean	-0.187		-0.259		-0.243		-0.284	
95% Confidence interval	-0.262	-0.112	-0.351	-0.167	-0.311	-0.176	-0.351	-0.216
t-statistic	-5.117		-5.785		-7.411		-8.598	
Asian Episodes: 5								
Average number of years after collapse: 15.8								
Mean	0.031		-0.052		-0.036		-0.079	
95% Confidence interval	-0.195	0.257	-0.139	0.036	-0.156	0.084	-0.203	0.044
t-statistic	0.382		-1.639		-0.837		-1.787	
African Episodes: 19								
Average number of years after collapse: 14.89								
Mean	-0.068		-0.183		-0.110		-0.150	
95% Confidence interval	-0.188	0.052	-0.296	-0.070	-0.234	0.015	-0.273	-0.026
t-statistic	-1.198		-3.392		-1.852		-2.548	

Table 8. Threshold Effects
Actual TFP versus Counterfactual TFP[1] (log-differences)

	ALL		NON-LAC		LAC	
Large Collapses	***13.82****		***12.18****		***14.88****	
Mean	-0.356		-0.359		-0.354	
95% Confidence interval	-0.424	-0.287	-0.469	-0.248	-0.456	-0.252
t-statistic	-10.986		-8.351		-7.747	
Smaller Collapses	***16.63****		***18.93****		***13.27****	
Mean	-0.016		0.036		-0.079	
95% Confidence interval	-0.070	0.038	-0.042	0.114	-0.147	-0.011
t-statistic	-0.591		0.957		-2.478	

* average number of years after collapse

[1] based on the baseline model   Large collapses are episodes where the TFP falls at least 20% or more compared to its counterfactual.

Table 9. The Effects of Booms
Actual TFP versus Counterfactual TFP[1] (log-differences)

	ALL		NON-LAC		LAC	
Episodes preceded by booms	***25***		***12***		***13***	
Average number of years after collapse	***14.56****		***13.75****		***15.30****	
Mean	-0.084		-0.021		-0.146	
95% Confidence interval	-0.189	0.011	-0.176	0.113	-0.310	-0.001
t-statistic	-1.819		-0.333		-2.256	
Episodes not preceded by booms	***30***		***15***		***15***	
Average number of years after collapse	***15.73****		***18.33****		***13.33****	
Mean	-0.147		-0.031		-0.190	
95% Confidence interval	-0.199	-0.042	-0.173	0.094	-0.260	-0.127
t-statistic	-2.944		-0.507		-6.874	

[1] Based on the baseline model

Table 10. 3S Collapses
Actual TFP versus Counterfactual TFP[1] (log-differences)

	Baseline		Linear Trend		Country-specific Absorption		Country-specific Absorption and Trend	
3S Episodes:12								
Average number of years after collapse: 8.9								
Mean	-0.161		-0.213		-0.159		-0.197	
95% Confidence interval	-0.295	-0.026	-0.400	-0.025	-0.250	-0.068	-0.289	-0.106
t-statistic	-2.630		-2.499		-3.833		-4.738	
3S iff Collapse Episodes: 7								
Average number of years after collapse: 11.3								
Mean	-0.123		-0.147		-0.193		-0.231	
95% Confidence interval	-0.300	0.053	-0.316	0.023	-0.300	-0.086	-0.329	-0.133
t-statistic	-1.710		-2.121		-4.421		-5.773	
Collapse Episodes post 1980: 36								
Average number of years after collapse: 13.8								
Mean	-0.149		-0.180		-0.201		-0.243	
95% Confidence interval	-0.231	-0.067	-0.260	-0.099	-0.285	-0.117	-0.327	-0.160
t-statistic	-3.720		-4.571		-4.918		-5.946	

[1] Based on the baseline model

Table 11. Shocks and Collapses

Type of Shock	Number of Events	Collapses	Freq. of shock	Freq. of collapse conditional on shock	Noise/Signal
Terms of trade shock	25	3	0.01	0.12	0.24
Int. interest rate shock	447	10	0.25	0.02	1.42
Oil price shock	133	3	0.07	0.02	1.40
Natural disaster	18	0	0.01	0.00	-
Currency shock	455	21	0.25	0.05	0.67
Banking crisis	133	5	0.07	0.04	0.83
Debt crisis	89	7	0.05	0.08	0.38
Political shock	49	2	0.03	0.04	0.76
War	110	6	0.06	0.05	0.56

Table 12. The Effects on TFP of different shocks
Actual TFP versus Counterfactual TFP[1] (log-differences)

Type of Shock	**Events**	**Mean**	**95% Confidence Interval**		**t-statistic**
Terms of trade shock	6	-0.131	-0.380	0.118	-1.353
Int. interest rate shock	24	-0.156	-0.254	-0.058	-3.299
Oil price shock	5	-0.180	-0.514	0.154	-1.498
Natural disaster	3	-0.215	-0.313	-0.117	-9.411
Currency shock	38	-0.134	-0.203	-0.064	-3.902
Banking crisis	15	-0.085	-0.215	0.045	-1.397
Debt crisis	16	-0.175	-0.272	-0.079	-3.863
Political shock	5	-0.154	-0.628	0.320	-0.901
War	11	-0.255	-0.377	-0.133	-4.662
No shock	6	-0.009	-0.261	0.243	-0.094

Table 13. Expected Output Loss

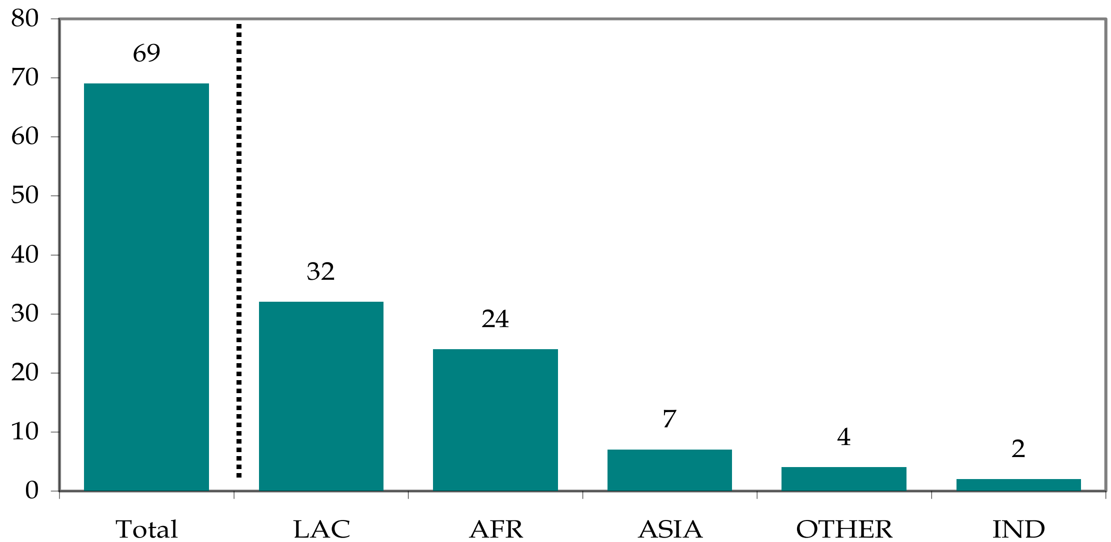
		Expected Output Loss				
	Probability of a collapse	Baseline	Linear trend	Country specific absorption	Country specific absorption and trend	Baseline incl. investment effect
All	3.15%	7.99%	14.40%	10.11%	12.82%	11.99%
LAC	3.72%	14.61%	20.24%	18.99%	22.19%	21.92%
NON LAC	2.78%	2.78%	9.06%	5.50%	7.87%	4.17%

Table 14. Output Collapses and Differences in Investment/GDP

Variable	**Sample**	**Episodes**	**Mean**	**95% Confidence Interval**		**t-statistic**
I/GDP (constant prices)	All	55	-1.486	-3.075	0.103	-1.887
I/GDP (constant prices)	LAC	28	-0.474	-2.421	1.472	-0.501
I/GDP (constant prices)	AFR	21	-2.342	-5.671	0.986	-1.485
I/GDP (constant prices)	Non-LAC	27	-2.578	-5.208	.0518	-2.023
I/GDP (current prices)	All	55	-2.097	-3.335	-0.860	-3.402
I/GDP (current prices)	LAC	28	-1.395	-3.173	.384	-1.612
I/GDP (current prices)	Non-LAC	27	-2.856	-4.652	-1.060	-3.282

Figure 1.

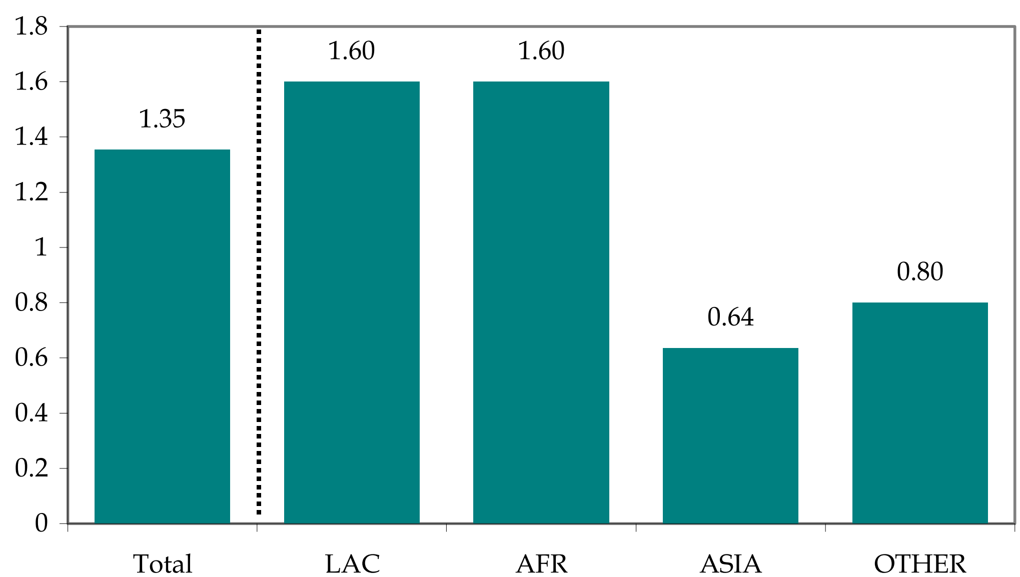
Number of collapses, 1960-2003



LAC: Latin America and Caribbean
AFR: Sub-Saharan Africa and North Africa
ASIA: South Asia, East Asia and Pacific
OTHER: Middle East and Europe (developing only)
IND: Industrial countries

Figure 2.

Average number of collapses in developing countries, 1960-2003



LAC: Latin America and Caribbean
AFR: Sub-Saharan Africa and North Africa
ASIA: South Asia, East Asia and Pacific
OTHER: Middle East and Europe (developing only)
IND: Industrial countries

Figure 3. Number of Collapses by Decade

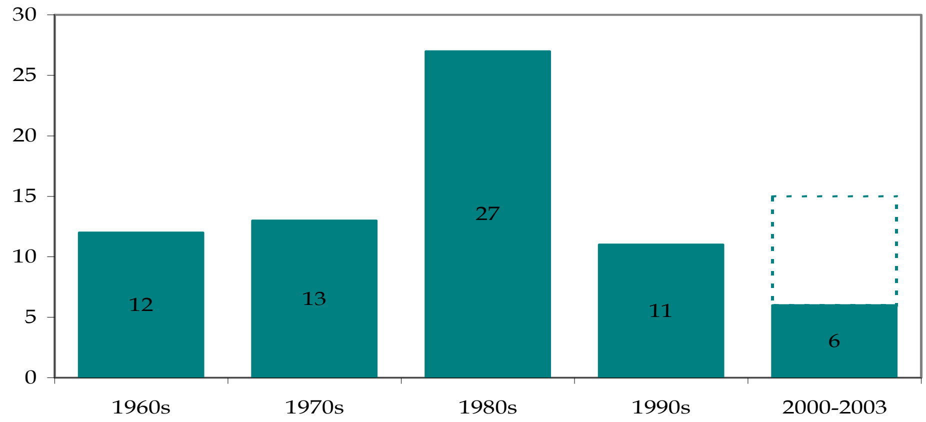


Figure 4. Number of Collapses by Decades and Regions

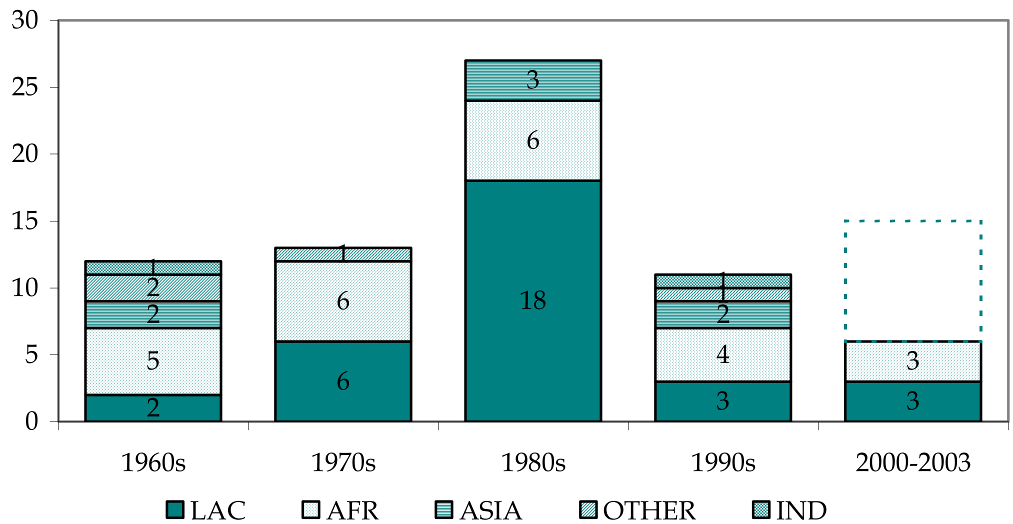


Figure 5. Magnitude of TFP Collapse and Years to End of Sample

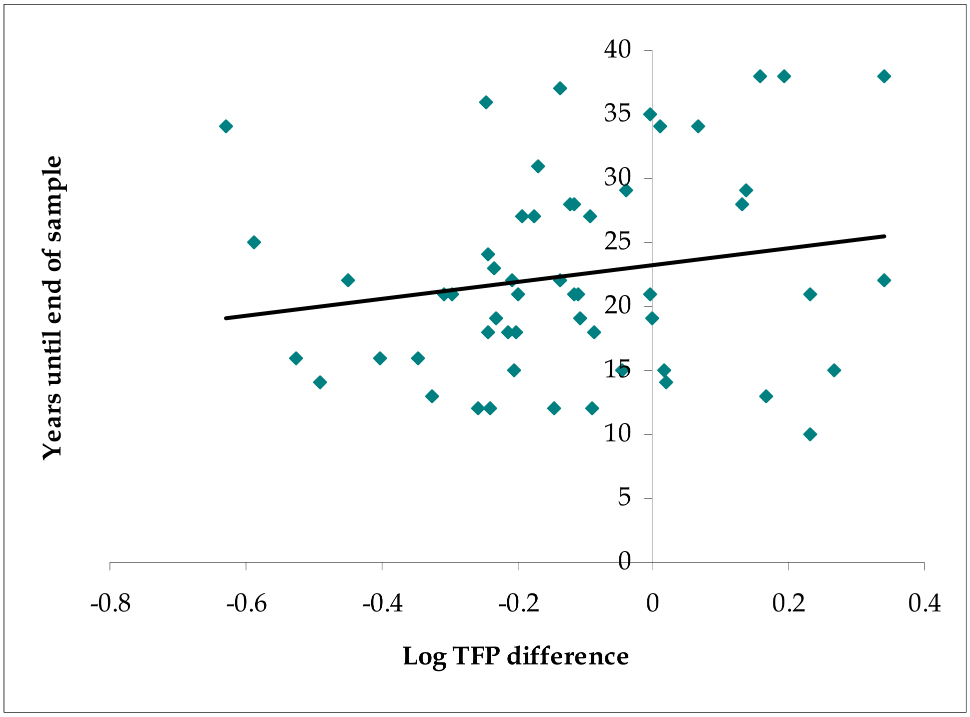


Figure 6. Observed TFP Relative to TFP Counterfactual by Regions

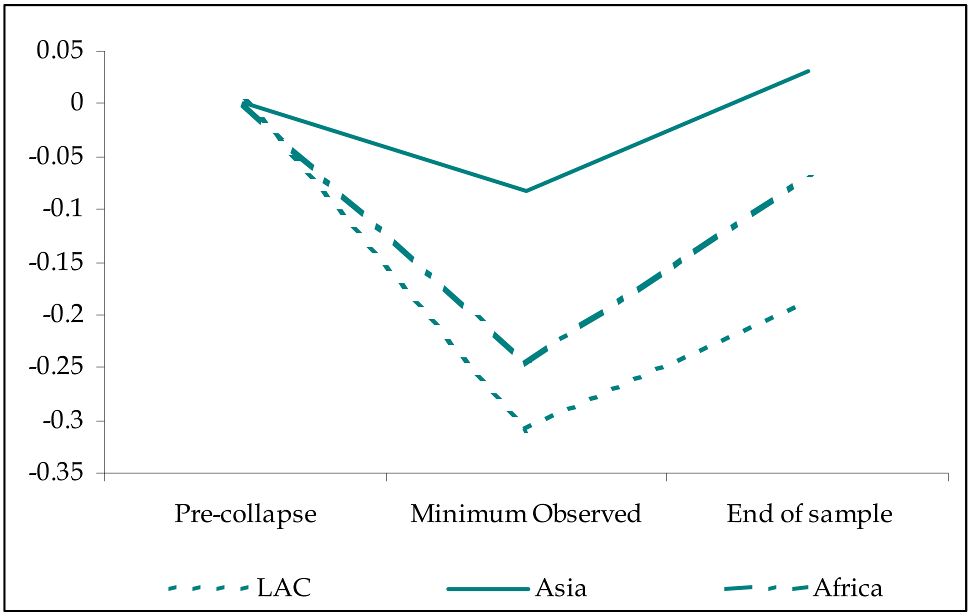
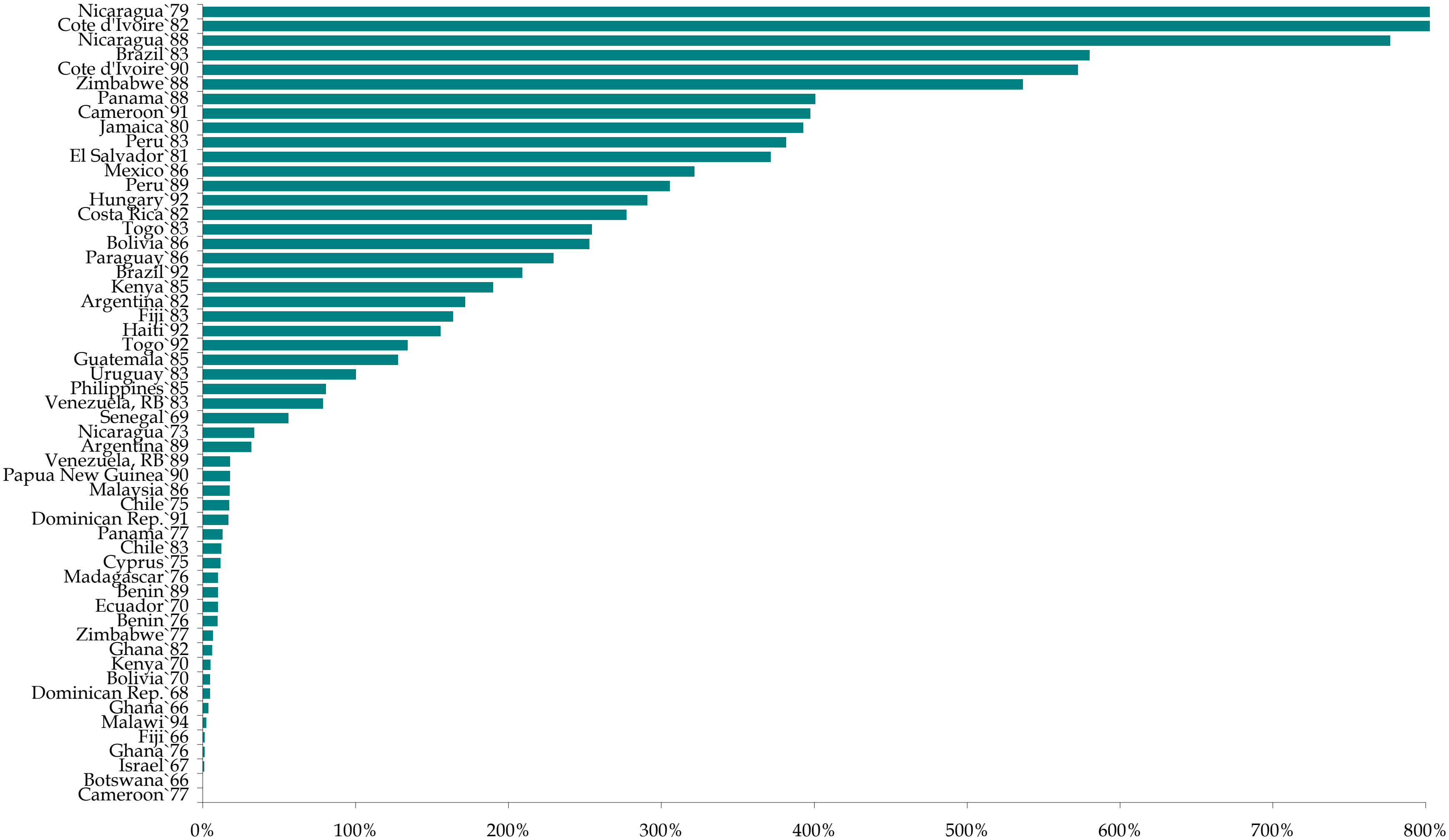
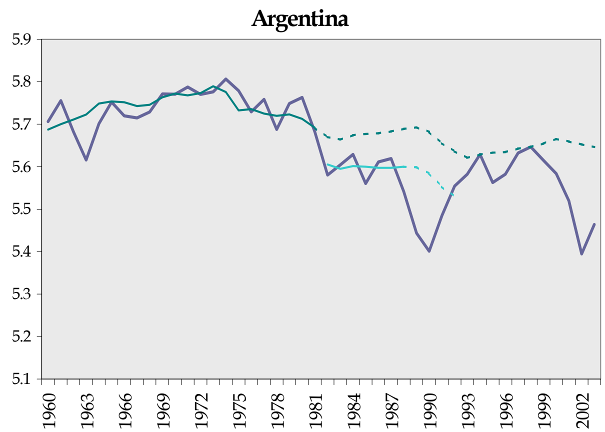
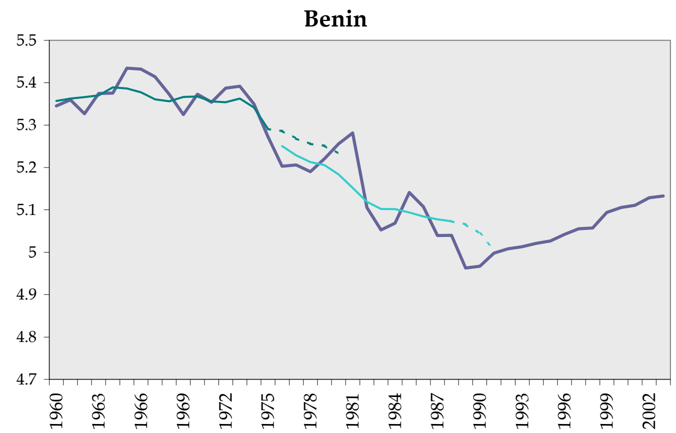


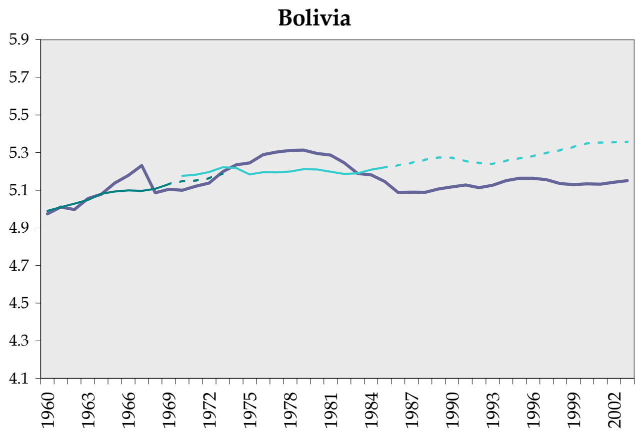
Figure 7. Total GDP Forgone / GDP 2003

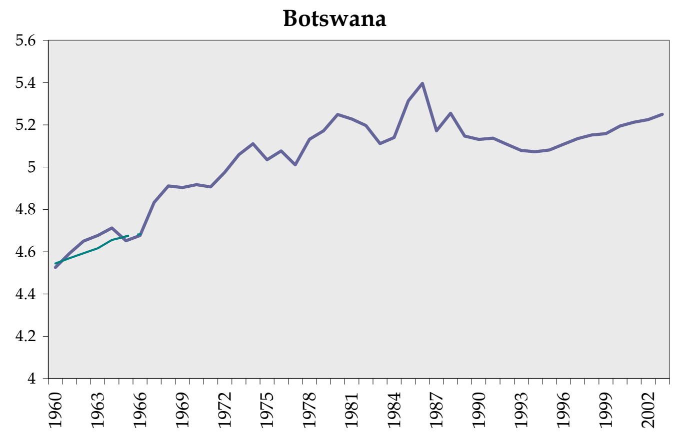


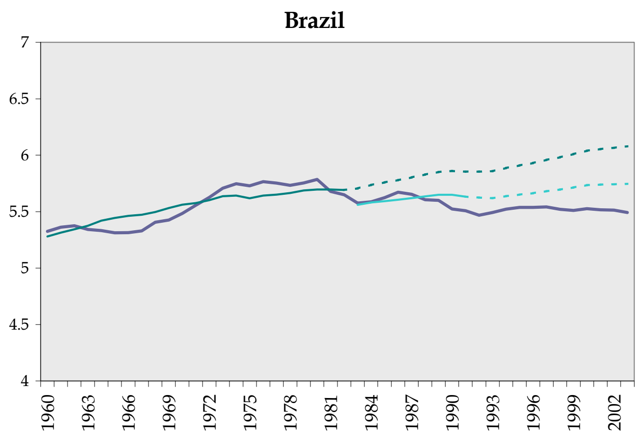
Appendix: Measured TFP and Counterfactuals (in logs)







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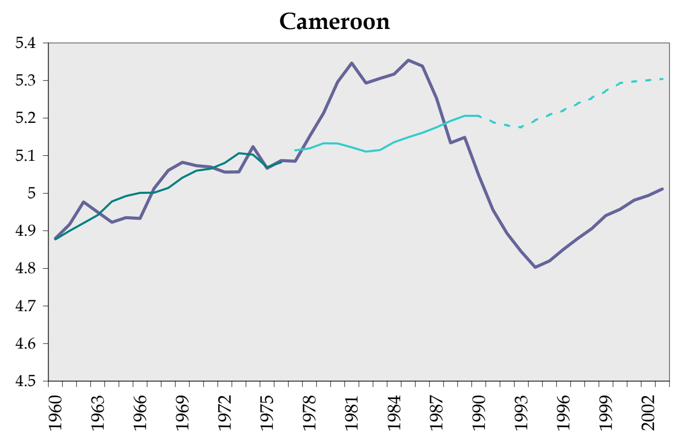
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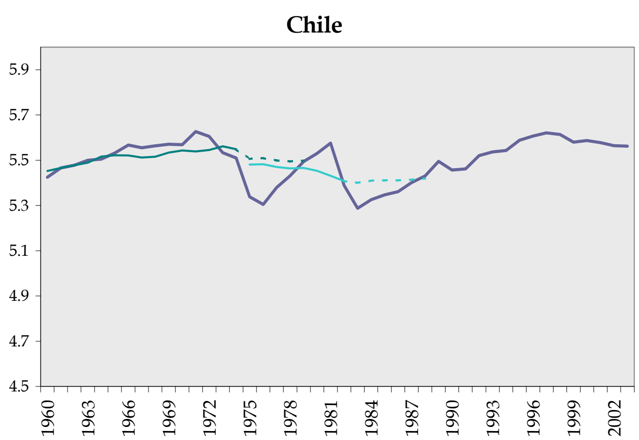
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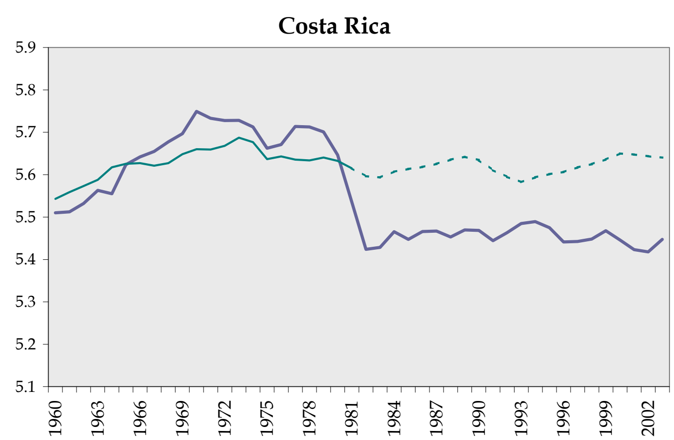
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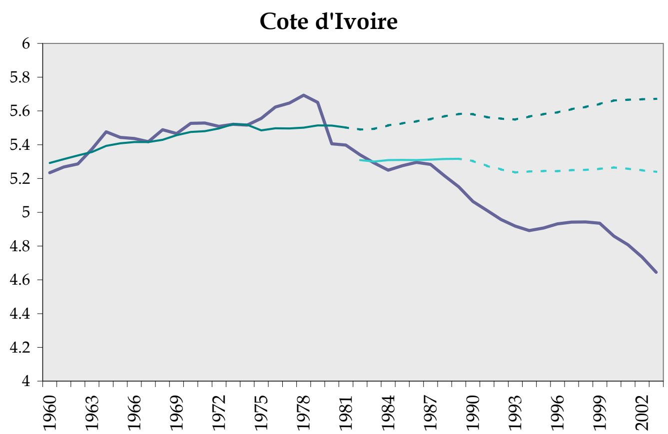
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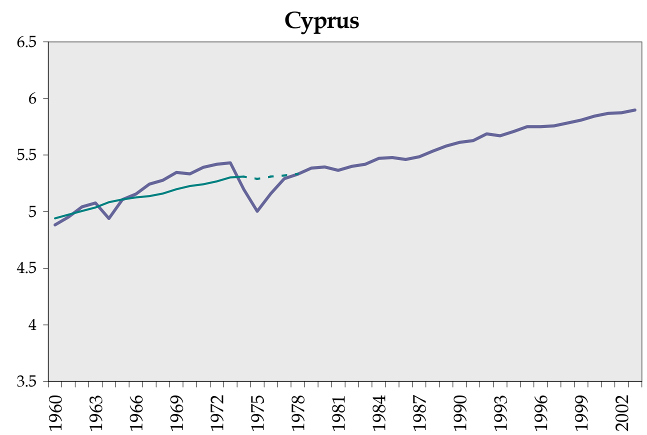
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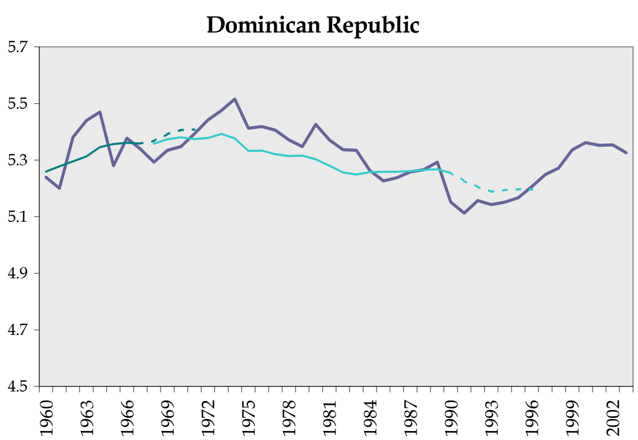
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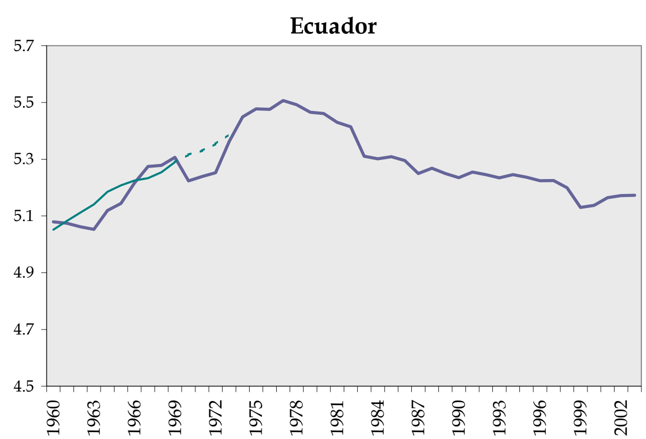
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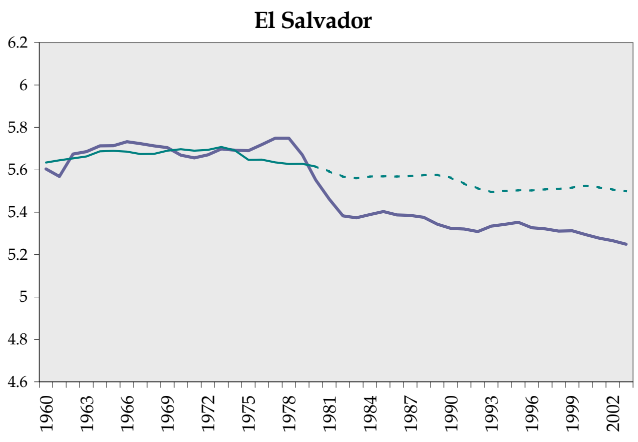
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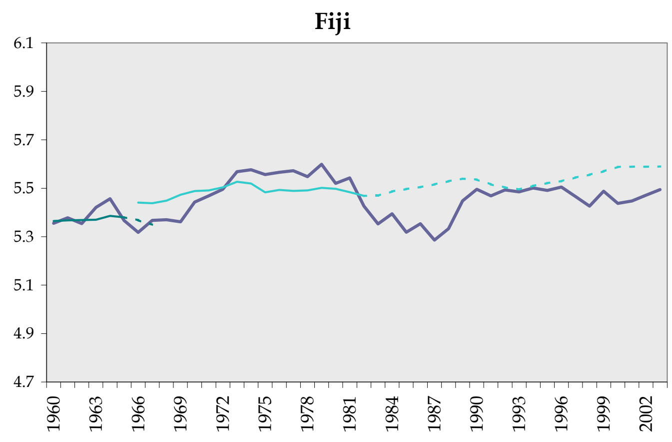
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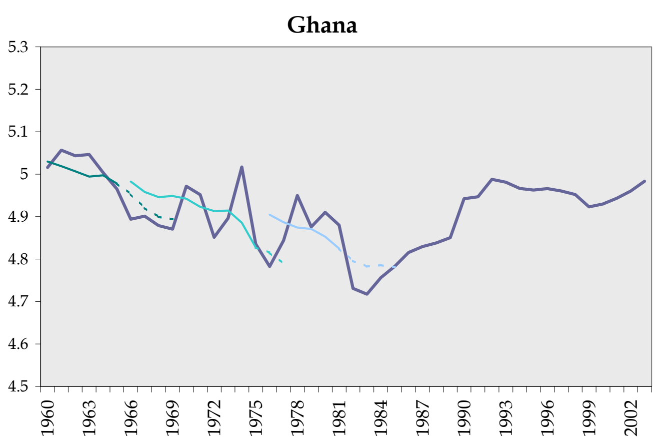
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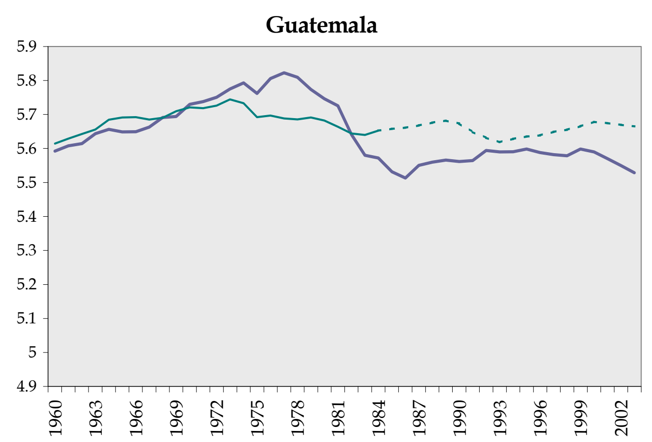
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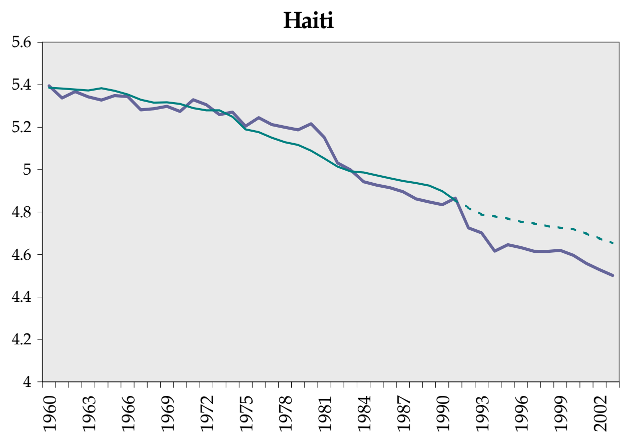
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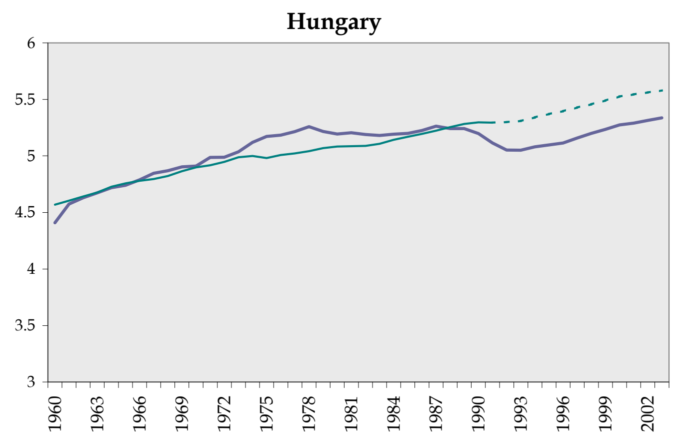
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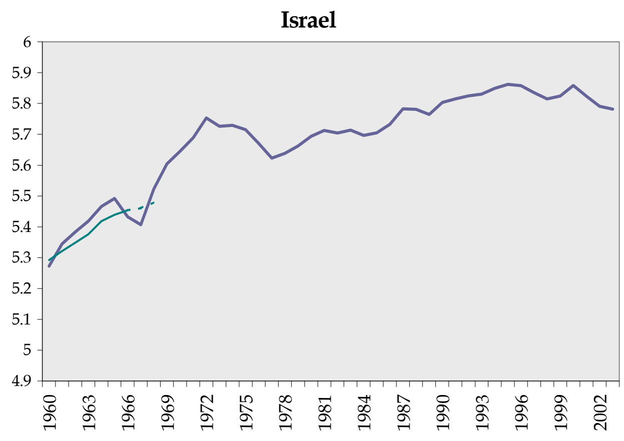
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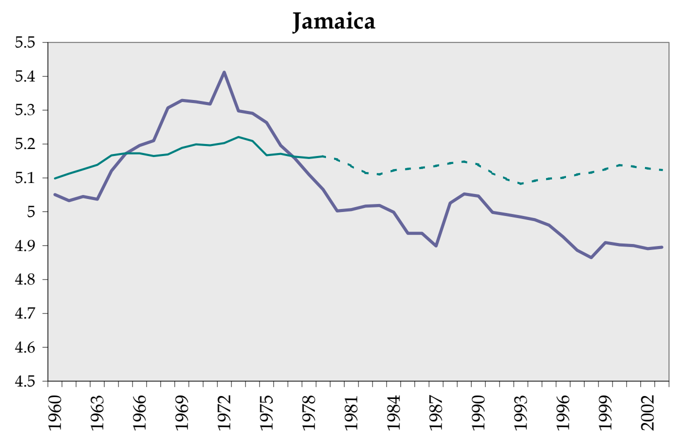
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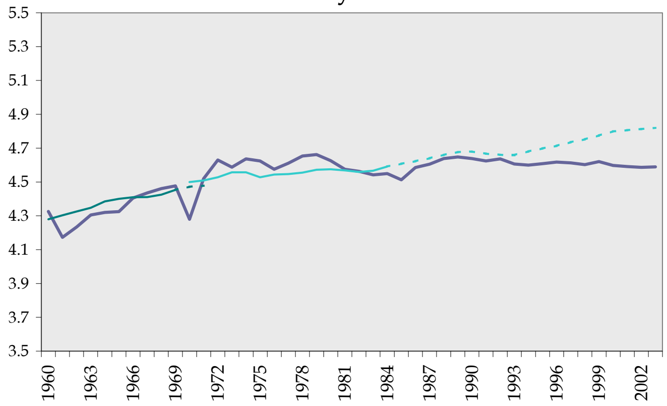

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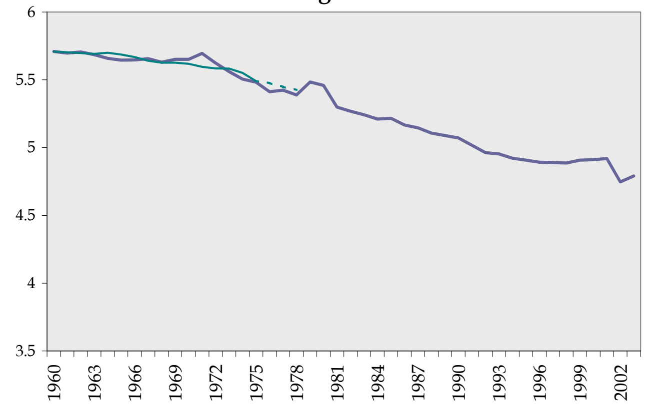

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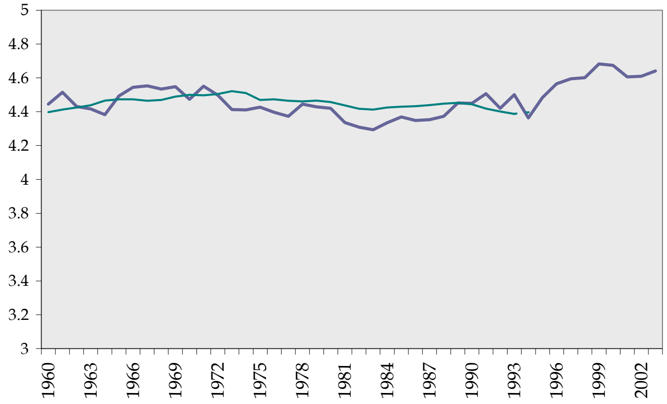

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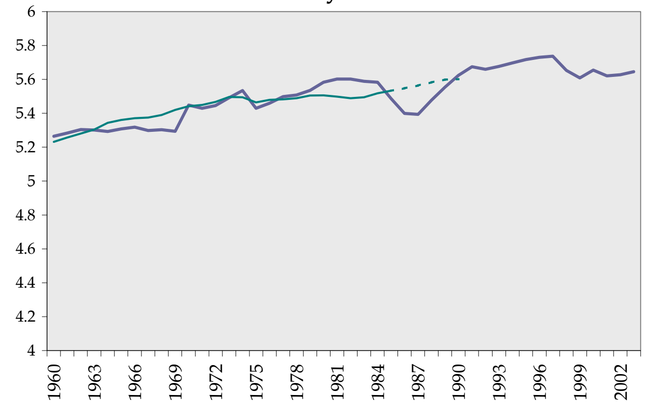

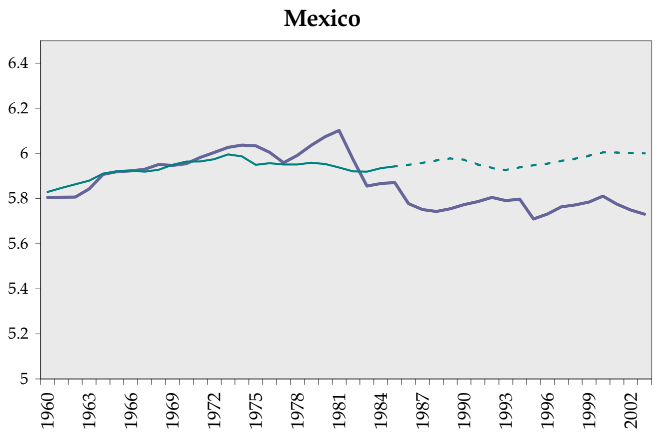
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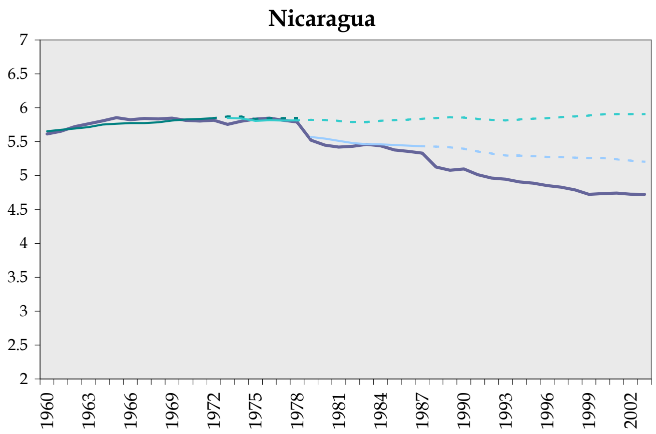
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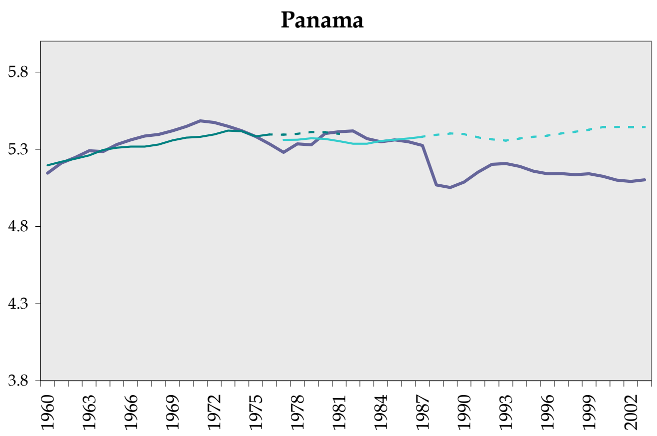
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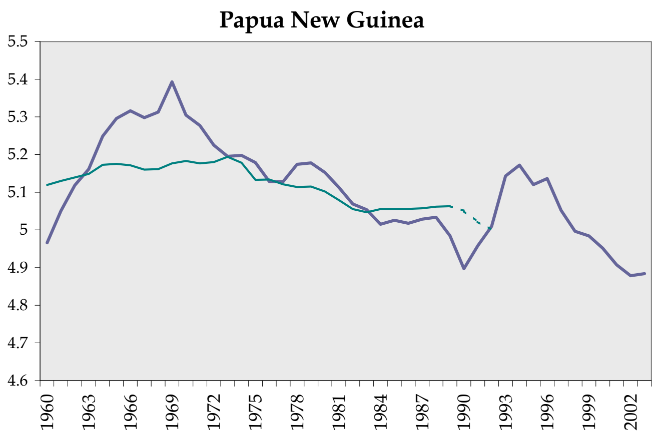
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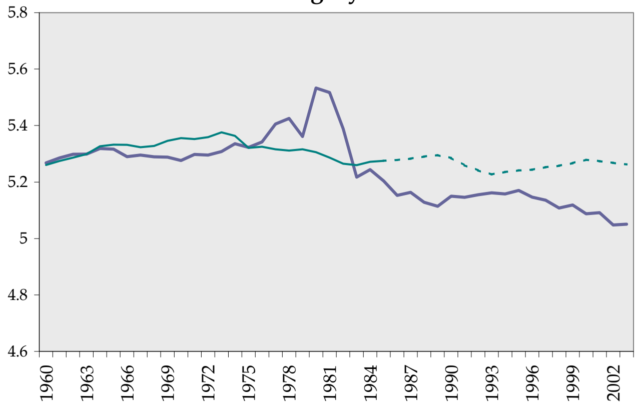

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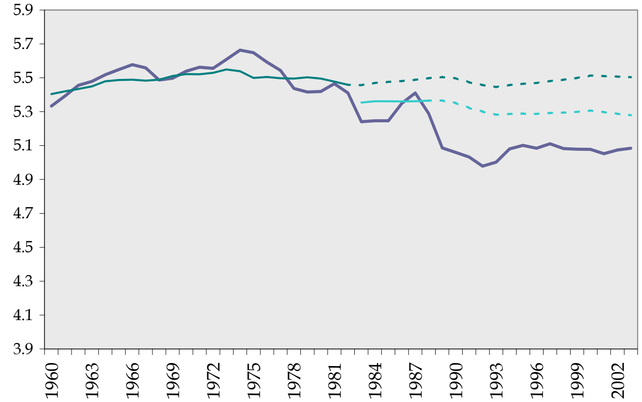

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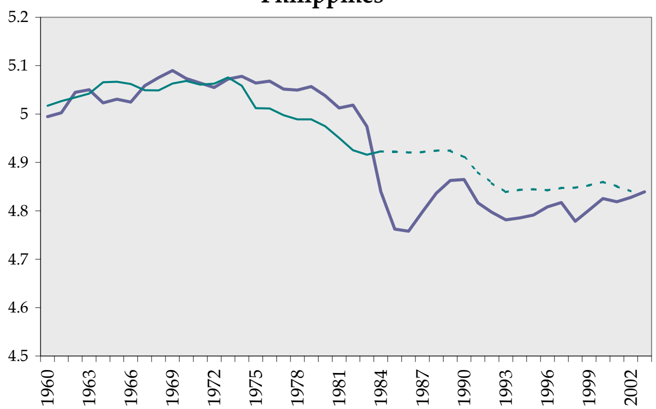

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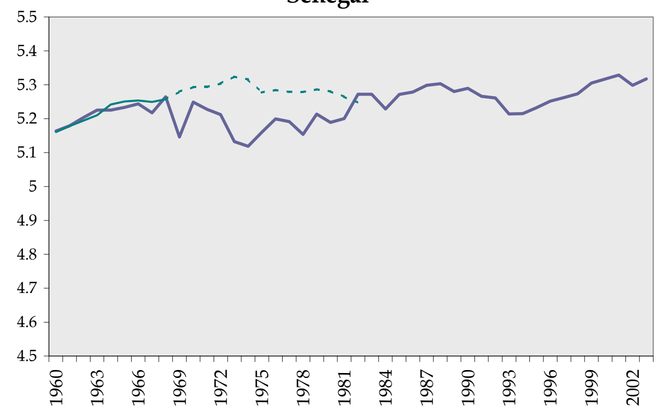

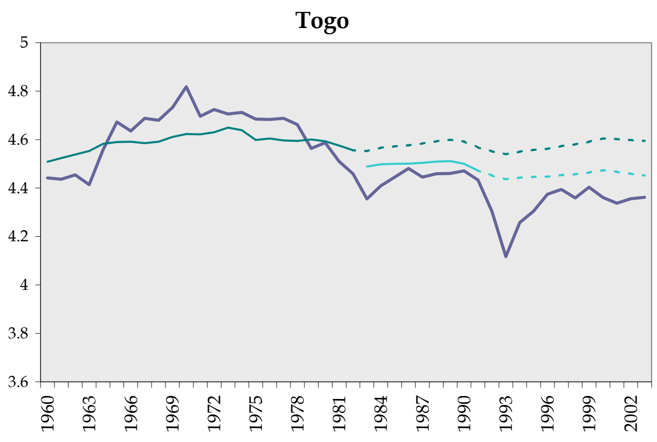
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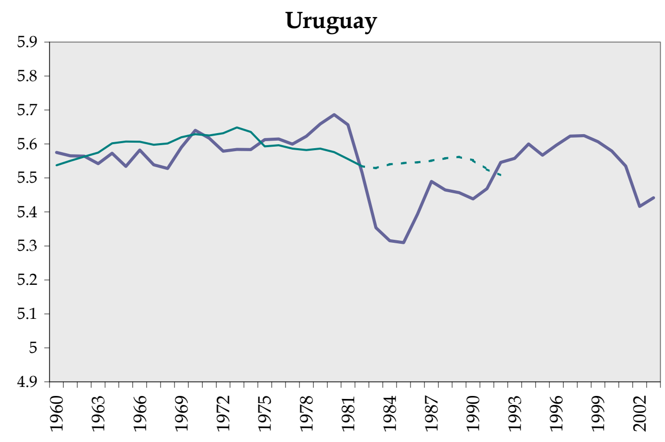
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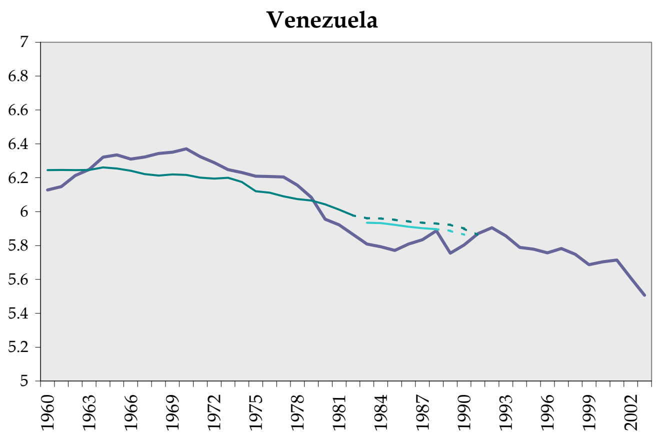
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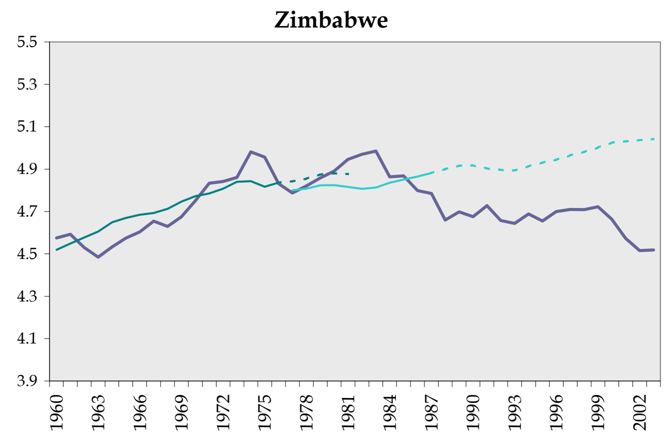
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