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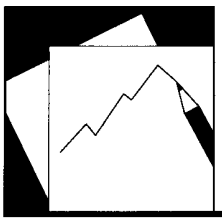

IMF Working Paper

Output Drops and the Shocks That Matter

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Output Drops and the Shocks That Matter

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Abstract

Output drops are usually associated with major disruption for the residents of affected countries, both directly and often through ensuing, prolonged growth slowdowns. Using a century of data, we document that output drops are more frequent in countries at a lower stage of economic development. We then turn to a more in-depth analysis of the post-1970 era, examining output drops in a large panel of countries, and systematically relating them to a variety of shocks. We compute the expected cost of each type of shock as a function of the shock's frequency, the likelihood that the shock will be associated with a drop in output, and the size of the output drop. The largest costs are associated with external financial shocks (notably, sudden stops in financial flows) for emerging markets, and with real external shocks (in particular, terms-of-trade shocks) for developing countries.

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I. MOTIVATION AND RELATED STUDIES

Output collapses often involve major upheaval for the residents of affected countries, as experienced by people who lived in the United States in the early 1930s, Cape Verde in the 1970s, Mexico in the 1980s, Indonesia in the late 1990s, and Argentina in 2001–02: such events are usually associated with job losses, difficulties in importing goods and services, widespread corporate bankruptcies, and, occasionally, breakdown of financial intermediation, riots, and political turmoil. When output drops are combined with disruption to the economic, financial, and political system, they are often followed by depressed growth extending many years beyond the initial crisis. Despite their importance, however, output drops remain an essentially unexplored phenomenon. To fill this gap, the present paper provides the first systematic analysis of output drops (defined more precisely in Section II), including their salient features and association with various types of shock.[2]

Under one reasonable view of the world, output drops might be considered part of the "normal" fluctuations around a steadily growing trend, perhaps suggesting that once one starts thinking about economic growth it becomes difficult to think about anything else (Lucas, 1987).[3] However, we think that the immediate consequences of output drops are sufficiently significant to merit systematic analysis. More important, recent studies have found evidence that, following the initial output drops, output growth is often lower for several years. Cerra and Saxena (2005) show that economic contractions are seldom followed by rapid offsetting recoveries. Relatedly, Aguiar and Gopinath (2004) find that, in emerging market countries, adverse output developments tend to represent declines in trend growth rather than fluctuations around a trend.

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[2] The most closely related previous study we are aware of is by Easterly and others (2000), who estimate a probit panel regression relating growth "downturns" (negative growth rates) to a set of structural features of the economy as well as some high-frequency variables. Our analysis is far more detailed: it covers a wide range of shocks, and allows the impact of shocks to differ across groups of countries. Moreover, we include country dummies in our panel probit regressions (Section V), thereby providing a sharper distinction between structural and high-frequency variables. In addition, we focus on the role of shocks in triggering the beginning of an output drop. Another somewhat related study by Hutchison and Noy (2006) analyzes the effects of currency crises and sudden stops on output growth in a panel of emerging markets.

[3] Lucas' approach applied to data on aggregate fluctuations for developing countries yields somewhat higher, but still relatively modest welfare costs from macroeconomic volatility (Pallage and Robe, 2003). However, the welfare cost of volatility is much greater if some individual economic agents are relatively poor, or if they find it difficult to borrow and are therefore unable to smooth consumption in response to declines in income (Imrohoroglu, 1989; and Krusell and Smith, 1999).

Indeed, our study is partly motivated by mounting evidence that volatility—and, especially, recessions or crises—may reduce long-run economic growth itself (Fatás, 2000 and 2002), implying in turn major welfare losses, as shown by Barlevy (2004). The traditional cross-country growth literature found growth to be significantly associated with output volatility (Ramey and Ramey, 1991) and macroeconomic volatility (Fischer, 1993).[4] More recently, some studies have reported evidence supporting the view that the negative impact of volatility on growth is especially strong in lower income countries, and that such impact results mostly from crises or large recessions rather than normal cyclical fluctuations (Hnatkovska and Loayza, 2004).[5]

More generally, the vast literature that studies the determinants of economic growth has paid relatively little attention to output drops, including episodes of prolonged decline. In the vein of Pritchett (2000), who suggests that "explaining Brazil's growth means explaining its 4.2 percent growth from 1965 to 1980 [and] its stagnation from 1980 to 1992, [...rather than simply] its 1960–92 average growth of 3.1 percent" (p. 222), we think that understanding the factors underlying output drops may ultimately help understand countries' long-run economic growth performance.[6] Pritchett goes on to argue that growth regressions (whether using cross-country long-run averages, panels on averaged data for 5-year periods that might not coincide with the beginnings or ends of interesting episodes, or panels on annual frequency data) fail to capture key turning points, and that research ought to focus instead on what initiates or halts episodes of growth.

In this paper, we document the frequency, duration, and overall cost of output drops for a large panel of countries, and investigate the empirical association of output drops with a variety of shocks. We provide descriptive statistics using output data for the past century, though—reflecting data quality and availability—our analysis of the correlates of output drops is far more detailed for 1970–2001. The shocks we consider include: real disturbances, such as terms of trade shocks or natural disasters; financial disturbances, such as sudden stops in capital flows and increases in global interest rates; and sociopolitical disturbances,

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[4] This is not to say that, on balance, all reforms that tend to increase volatility would necessarily be undesirable: for example, financial development and international financial and trade integration have been shown to raise not only the volatility of output, but also long-run growth (Rancière and others, 2005; Kose and others, 2005).

[5] A possible reason for these results is that lack of financial development and the inability to diversify away macroeconomic shocks imply widespread bankruptcies and major disruptions to production capacity, in addition to immediate declines in consumption (Acemoglu and Zilibotti, 1997; and Aghion and others, 2004).

[6] A simple cross-country scatter plot shows a significant negative correlation between the number of output drops and long-run economic growth. This suggests that output drops are unlikely to be merely one (negative) aspect of boom-bust cycles.

such as wars and episodes of political instability. For each type of shock, the paper assesses the unconditional frequency of the shocks and, conditional on the shocks' occurrence, the frequency and cost of an output drop. This is used to calculate the expected cost of various types of shock—a quantitative gauge of the shocks' importance.

Our main findings are:

On the descriptive statistics for output drops: Using data for 1900–2001 and subperiods, we show that output drops occur in countries at all income levels, but their frequency and (only during the more recent period) duration and overall cost are negatively associated with initial per capita GDP. In 1970–2001, emerging market countries (defined below) experienced an output drop, on average, once every 16 years; the median duration of the period it took for GDP per capita to return to its predecline level was 6 years. During this time, the cumulative loss compared to the predecline GDP per capita level was about 40 percentage points of GDP. For developing countries, the frequency of output drops was about the same, whereas duration and cumulative output loss were about twice as large.

On the relative importance of various correlates of output drops: External shocks play an important role for most countries, and a wide variety of financial, macroeconomic, real, and political shocks are relevant in both developing and emerging countries. This said, the level of development seems to help to determine exactly which types of shock matter the most. For emerging markets, the largest expected costs relate to financial and macroeconomic shocks—especially sudden stops in financial flows—though terms of trade shocks are also relevant. For developing countries, adverse changes in the terms of trade is the most costly type of shock.

Although this is the first systematic study of output drops—a topic that we find of interest in its own merit—the present effort is also related to, and of relevance for, existing strands of literature on five issues. First, we provide a broader perspective on the relative importance of various types of crisis that have been previously examined individually—such as banking, currency, and debt crises (see, for example, Dell'Ariccia and others, 2005; Milesi-Ferretti and Razin, 2000; and Frankel, 2005). However, we do not focus on the ultimate determinants of an individual type of crisis, partly because the predictive power of such "early warning systems" has been limited (Berg and others, 2004; and Manasse and Roubini, 2005). Second, we complement previous studies on the frequency of crises in different historical periods (Bordo and others, 2001), by analyzing a broader range of the correlates of output declines. Third, we build on studies that have sought to identify the factors underlying the volatility of economic growth (Easterly and others, 2000; and Pritchett, 2000), although we focus on the negative tail of the distribution. Fourth, we complement studies on accelerations and decelerations in economic growth (Easterly and others, 1993; Rodrik, 1999; Hausmann and others, 2005; and Jones and Olken, 2005) by focusing on sharp declines in output—events that, in our view, are related to, but distinct from, permanent changes in economic growth,

and possibly of even greater concern to the public at large.[7] Fifth, turning to the consequences of output crises, while we find that consumption drops are strongly associated with output drops, the decline in consumption for a given drop in output is lower for advanced countries than for emerging or developing countries. Thus, by focusing on extreme events, we provide a different perspective on previous findings that consumption is more volatile than output in countries that are financially integrated in the world economy (Kose and others, 2003).

II. OUTPUT DROPS

In principle, welfare should be measured as the net present value of the utility derived from all future consumption. Consumption possibilities in turn depend on the net present value of all future income, the volatility of income, and agents' ability to smooth consumption efficiently over time. However, measuring welfare accurately would require detailed data and specific assumptions regarding individual utility functions and/or aggregation methods. This paper will focus instead on GDP per capita as a practical and widely available proxy for welfare, and one that commands the attention of policy makers and the public.[8] As we show below, the main results—including those on the relative importance of various shocks—hold for income (which determines the choice set) or consumption. Consumption declines and output drops are closely associated in most countries—though the association is somewhat weaker for countries that are highly integrated in international financial markets. Indeed, during output drops, as shown in Section V, the elasticity of consumption with respect to output turns out to be substantially higher in developing and emerging countries than it is in advanced countries. This again reinforces the interest in output drops, particularly for developing and emerging countries.

A. Definitions

This paper presents a systematic empirical analysis of output drops—events of major significance for welfare—for advanced economies, emerging markets, and developing countries. More specifically, the "events" analyzed here are defined as starting in the first

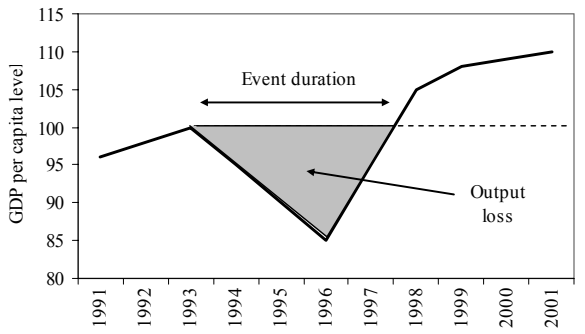
[7] If economic agents are liquidity-constrained or short-sighted, they may be more concerned about a decline in output than a slowdown in long-run economic growth that had a similar impact in net present value terms. Moreover, output drops become immediately apparent, whereas—especially in countries displaying high output volatility—it may take a number of years for one to be able to tell whether (trend) economic growth has declined in a lasting manner.

[8] Measures of income rather than output would be more appropriate, but present greater difficulties regarding data availability and reliability; moreover, for most countries the differences are small. Focusing on an aggregate measure requires a number of simplifications, notably the need to abstract from distributional effects.

year of a decline in GDP per capita and ending when GDP per capita returns to its pre-event level. Yearly losses are measured relative to pre-event GDP per capita and are cumulated over the duration of the event (shaded area in Figure 1). Two further conditions are imposed to filter out events that might result from measurement error or temporary growth spurts: (i) the duration of the event must be at least two years; (ii) the total output loss must be at least 5 percent of pre-event GDP per capita. The main results—notably the relative importance of various types of shock—hold using alternative thresholds, such as a duration of at least four years, or a loss of at least 3 percent of pre-event GDP per capita.[9] (Not reported for the sake of brevity—available upon request.)

If an event is completely observed within the sample period it is called a "concluded" event (Figure 1); this seems to correspond to the notion of a temporary, though costly, crisis. However, the data set also includes several "ongoing" events where GDP per capita has failed to recover to pre-event levels by the end of the sample. A number of these ongoing events in the sample are extremely long-lasting and associated with severe output losses and prolonged growth slowdowns. (Some of these events started in the 1970s and 1980s and relate to emerging markets and, especially, developing countries that experienced major domestic crises in the wake of adverse terms-of-trade changes or debt crises, from which they had not fully recovered by the end of the sample).[10] Finally, we also keep track of "sub-events," defined as new events starting before the end of a previous event. The various types of events display considerably different characteristics; in some exercises presented below, results will therefore be reported separately for "all" events (including concluded, ongoing and sub-events), concluded events (the subset that excludes sub-events and ongoing events), and ongoing events.

Figure 1. A "Concluded" Output Event



Note: The gray area is the cumulative output loss and in this example the event duration is 4 years.

[9] We prefer to focus on a threshold based on an absolute decline in GDP (measured in percentage points) rather than a given number of standard deviations, because the latter concept would be relative to the country's own experience and would likely identify a similar number of output events for the various countries, regardless of differences in the stability of output.

[10] To compute the duration and output loss associated with ongoing events (for which the end-date is unknown) it is assumed that the event ends in the first year after the end of the sample. This produces a lower bound on the duration and cost of these events.

Robustness to alternative definitions of output drops

Readers might be concerned that the baseline definition described above produces a conservative measure of the cost of output events, because it abstracts from trend growth during the event (though as shown below, the measured output losses are substantial). Another potential concern is that defining the start of events and associated costs with respect to pre-event GDP might lead to overstating event costs if boom-bust cycles are prevalent (though, as reported below, we try to control for this directly). To address both of these possible issues, an alternative approach is to define the start of an output event as output falling by a given threshold below a rolling Hodrick-Prescott (HP) filtered trend, and to identify the end of the event and the associated loss relative to this trend. We have checked that using this alternative definition (and a number of variants for the threshold), not surprisingly, durations and losses increase, but the thrust of the main results is similar: in particular, the relative importance of various types of shock remains broadly the same. As reported in Appendix I in greater detail, the list of events corresponds closely to those found through the simple approach used in the main text, though the HP filter approach tends to identify events with a lag compared with the approach used in the text.

B. Empirical Features of Output Drops

A preliminary look at one century of evidence

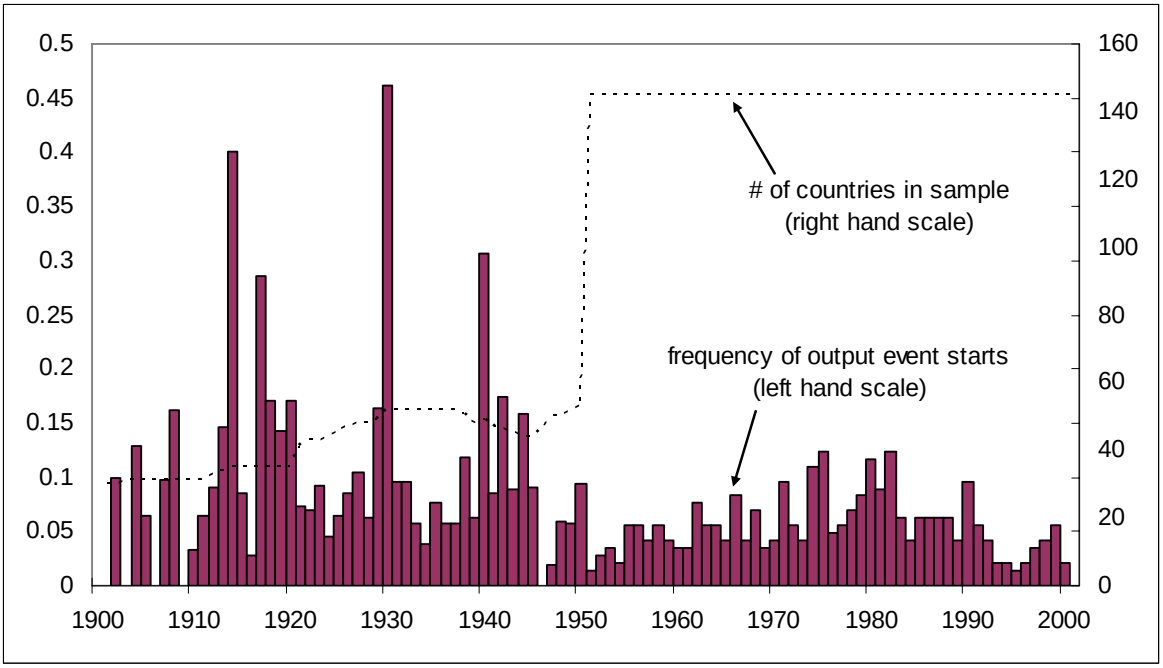
Output drops have occurred throughout the past hundred years, with peak frequencies reached at the time of the Great Depression and the two World Wars (Figure 2).[11] In this section, we seek to establish some broad stylized facts on the frequency, duration, and cumulative cost of output drops. We split the sample into five historical sub-periods (1900–1914, 1915–1928, 1929–1945, 1946–1969, and 1970–2001).[12] Descriptive statistics are provided for three groups of countries—somewhat akin to today's notion of (i) advanced, (ii) emerging market (or middle income), and (iii) developing (or low income). To avoid bias that might result from analyzing output drops while defining the categories on the basis of present day output, we define our groups on the basis of initial income for each period. Specifically, we define our "high-income" group to include all countries whose per capita income is as at least one half of the income of country with the highest income; we then define the country with the highest income among the remaining countries as the leader of

[11] The data are from Maddison (2003). Barro (2005) uses the same GDP data to define rare events in the context of investigating the equity premium puzzle.

[12] The periods are defined by the two world wars, the stock market crash of 1929, and (roughly) the Bretton Woods era. The qualitative results are also unchanged if the three peak years in Figure 2, associated with the Great Depression and the World Wars, are excluded. Similar results are obtained when the sample is split in four equal 25-year periods. Appendix Table A1 presents descriptive statistics decade by decade.

our "middle-income" group, which will include all countries with per capita income of at least one half of its leader; finally, our "low-income" group will include all remaining countries for which data are available.

Figure 2. A Century of Output Drops



Note: The frequency of output event starts is defined as the number of countries where an output event starts divided by the total number of countries in the sample in a given year.

For almost all sub-periods considered, and defining country groups on the basis of initial income rankings, the frequency of output drops tends to decline with income (Table 1). In other words, countries that are poorer to start with are also subject to more frequent output drops. Moreover, countries with low income levels were subject to more severe output drops as measured by median duration and loss in the post-World War II sub-periods,[13] though the opposite relationship held prior to 1945.[14]

[13] The relatively large mean losses for high income countries in 1970–2001 correspond to a few very costly and long lasting events in oil exporting countries whose GDP per capita levels began to fall in the late 1970s or early 1980s.

[14] This "reversal" is robust to omitting events triggered by the beginning of the world wars or the Great Depression. At the same time, it is worth noting that the sample almost triples in size after World War II, and that there is a debate on whether measurement error overstates the volatility of output for the advanced countries in the earlier period (see, for example, Backus and Kehoe, 1992; and Romer, 1986).

Table 1. Output Drops: Frequency, Duration and Loss, 1900–2001

	1900-14			1915-28			1929-45			1946-69			1970-2001		
	Hi inc.	Mid inc.	Low inc.	Hi inc.	Mid inc.	Low inc.	Hi inc.	Mid inc.	Low inc.	Hi inc.	Mid inc.	Low inc.	Hi inc.	Mid inc.	Low inc.
Frequency							(in percent of country-years)								
All events	8.6	8.6	13.1	7.6	9.2	14.1	10.2	13.4	15.5	3.8	1.3	3.6	3.3	4.7	6.7
Concluded events	8.1	7.1	10.7	3.6	6.1	8	9	9.8	9.2	2.9	0.8	2.5	1.6	2.1	2.5
Ongoing events	0	0	0	0	0	0	0	0	0	0	0	0	0.6	1.1	1.9
Median duration							(in years)								
All events	8	4.5	4	5	3	4	9	5.5	6	3	8	5.5	6	10	9
Concluded events	8	5.5	4	9.5	3	5	9	5.5	6	2	9.5	4	5	8	5
Ongoing events	...	...	...	...	...	...	...	...	...	...	...	...	...	14.5	20
Mean duration															
All events	7.5	6.8	3.9	6.9	4.8	4.7	8.2	8.8	8	4.3	9	8	11.1	10.6	11.7
Concluded events	7.4	7.5	4.2	10.1	5.5	5.4	8.6	9.3	9.4	4	9.5	7.6	5.1	8.9	6.5
Ongoing events	...	...	...	...	...	...	...	...	...	...	...	...	...	13.6	18.2
Median cumulative loss							(in percent of pre-event GDP per capita)								
All events	-52.9	-21.6	-15.7	-57.1	-25.4	-14.5	-80.1	-63.8	-42.4	-15.8	-29	-27	-23.5	-103.7	-66.3
Concluded events	-51.1	-23.5	-16.4	-97.7	-19.2	-19.1	-83.9	-63.8	-48	-15.8	-73.3	-20.4	-14.6	-82.8	-23.8
Ongoing events	...	...	...	...	...	...	...	...	...	...	...	...	...	-329.6	-340.3
Mean cumulative loss															
All events	-74.1	-53.4	-20.2	-75.8	-50.6	-25.4	-109.1	-140.5	-108.4	-23.6	-58.5	-69.5	-393.2	-201.3	-213.6
Concluded events	-75.4	-62.5	-22.6	-116.2	-57	-29.2	-111.7	-150.2	-129.8	-22.6	-73.3	-69.1	-18	-92.7	-46.7
Ongoing events	...	...	...	...	...	...	...	...	...	...	...	...	...	-462.9	-429.2
Expected cost based on median loss							(in percent of pre-event GDP per capita)								
All events	-4.5	-1.9	-2.1	-4.3	-2.3	-2.0	-8.2	-8.5	-6.6	-0.6	-0.4	-1.0	-0.8	-4.9	-4.4
Concluded events	-4.1	-1.7	-1.8	-3.5	-1.2	-1.5	-7.6	-6.3	-4.4	-0.5	-0.6	-0.5	-0.2	-1.7	-0.6
Ongoing events	...	...	...	...	...	...	...	...	...	...	...	...	...	-3.6	-6.5
Expected cost based on mean loss															
All events	-6.4	-4.6	-2.6	-5.8	-4.7	-3.6	-11.1	-18.8	-16.8	-0.9	-0.8	-2.5	-13.0	-9.5	-14.3
Concluded events	-6.1	-4.4	-2.4	-4.2	-3.5	-2.3	-10.1	-14.7	-11.9	-0.7	-0.6	-1.7	-0.3	-1.9	-1.2
Ongoing events	...	...	...	...	...	...	...	...	...	...	...	...	...	-5.1	-8.2

Source: Author's calculations based on Maddison (2003) data.

Note: Income groups are constructed for the initial year in the period. The first two groups are defined such that the country with the lowest income in the group has an income that is at least 50 percent of the income of the highest country in the group. The low income groups is the residual after the two first groups have been defined. "All" events include sub-events as well as concluded and ongoing events. The expected costs of output events are computed as the product of the frequencies of events and the associated losses. "..." indicates that the results are omitted because they are based on less than five events.

Recent evidence for advanced, emerging and developing countries

Having reported broad stylized facts using one century of evidence and defining country groups on the basis of initial income, we now turn to a more detailed analysis for 1970–2001, relying on present-day, standard definitions of country groups (advanced, emerging and developing) that are based on the degree of financial development and integration in world financial markets.[15] Nevertheless, all key results presented below—notably, those related to the relative importance of various types of shock for different country groups—hold using the three groups (high-income, middle-income, and low-income) defined on the basis of 1970 per capita income. In what follows, we begin by presenting descriptive statistics on the frequency and severity of output drops for these country groups. As the composition of these country groups is partly influenced by past economic performance, we then quickly turn to our main focus, namely, the relative importance of various types of shock for different country groups.

Output drops are more frequent, long-lasting, and costly for emerging markets and developing countries than they are for advanced economies (Table 2). On average, both emerging markets and developing countries have output drops starting about every 16 years; the events last for 6 years in emerging markets and twice as long in developing countries, with a total cumulative output loss over the event of around 40 and 90 percent of GDP per capita, respectively. (To illustrate, a total cumulative output loss of 40 percentage points of GDP per capita would correspond to the hypothetical case of a country whose output per capita fell by 10 percentage points, remained stable for 4 years, and then jumped back up to its initial level.) The large losses are accounted for, to a substantial degree, by long and costly ongoing events. (For both emerging markets and developing countries, the frequency, duration, and especially median loss of concluded output events is substantially lower than for all events.) To confirm that (initial) level of development is positively associated with the frequency of output drops, and negatively associated with mean duration and loss, kernel density plots are reported in Appendix II.

[15] For the modern sample periods in this paper, advanced countries are defined as in the IMF's *World Economic Outlook*, except for Korea which for the purpose of the empirical analysis is classified as emerging rather than advanced to capture the experience of its 1997–98 crisis; emerging market countries are countries included in either the (stock market based) International Financial Corporation's Major Index (2005) or JPMorgan's EMBI Global Index (2005) (which consists of countries that issue bonds on international markets), excluding countries classified as advanced by the WEO; remaining countries are classified as developing. The exact sample varies depending on data availability for each exercise. Real GDP is measured in PPP-adjusted dollars. The end of the sample period (2001) is determined by the availability of comparable data. All results presented in this section with reference to advanced, emerging, and developing economies are similar using an alternative classification of countries according to their level of financial development (high, intermediate, or low). More generally, as there is no universally accepted definition of "advanced," "emerging," and "developing" countries, we checked that the main results are robust to small changes in the country groupings.

Table 2. Output Drops: Frequency, Duration and Loss, 1970–2001

	Advanced economies	Emerging markets	Developing countries
Frequency	(in percent of country-years)		
All	1.9	6.5	6.7
Concluded	1.5	3.0	2.3
Ongoing	0.1	1.7	1.9
Median duration	(in years)		
All	4	6	12
Concluded	5	5	5
Ongoing	4	18	22
Median cumulative loss	(in percent of pre-event GDP per capita)		
All	15	41	89
Concluded	13	15	38
Ongoing	17	192	461

Source: Authors' calculation based on Maddison (2003) data.
Notes: "All" events include concluded, ongoing and sub-events. Concluded events are fully observed within the sample period. Ongoing events had not ended by 2001; the related duration and loss are calculated assuming that these events ended in 2002.

III. SHOCKS

A. Definitions and Relevance of the Shocks Considered

The shocks analyzed here include the following:[16]

- *financial and macroeconomic*—currency crises, banking crises, debt crises, and sudden stops in capital flows;
- *country-specific external*— disasters, changes in the terms of trade;
- *sociopolitical*—wars and political turbulence; and
- *global*—large increases in international interest rates and oil prices.

To reduce the possibility that we may be capturing boom-bust cycles, in some of the estimates we will also use the end of lending booms and growth booms as control variables (rather than shocks of interest, because their definition implies the likelihood of a growth decline). A detailed description of data sources, as well as the definitions of shocks—drawn mainly from previous studies—is provided in Appendix III. While some of these shocks (such as global, or country-specific external) are clearly exogenous, others (financial/macroeconomic, and perhaps even

[16] Volatility due to abrupt changes in aid flows, an important issue for developing countries, is not considered; but see Bulíř and Hamann (2003). We also analyzed changes in trading partner growth—another type of country-specific external shock—but found them to have little systematic relationship with output drops.

sociopolitical) might occasionally be triggered by developments in output (or perhaps other types of shock). This does not invalidate the accounting exercises we conduct below, though it has important implications for how one interprets the results—an issue to which we return in later sections.

The shocks considered are clearly relevant: two thirds of output drops coincide with at least one shock. Moreover, this is not an artifact that might result from considering shocks that occur rather often: the relevance the shocks holds when taking into account their frequency. In order to show this, we assess the extent to which the presence of a given type of shock increases the likelihood of an output event compared with years in which no shock occurs. More precisely, we compare the frequency of output drops in years in which a given type of shock takes place with the frequency in years without shocks. The ratio of these two frequencies is reported in Table 3. For developing countries and, especially, emerging markets, the shocks considered in the analysis are associated with substantial increases in the likelihood of output drops. This is particularly evident for financial and macroeconomic shocks, which increase the likelihood of an output event by at least a factor of five in emerging markets.

Table 3. Frequency of Output Event Conditional on Shock divided by Frequency of Output Event Conditional on No Shock
(All output events, 1970–2001)

	Advanced economies	Emerging markets	Developing countries
Financial and macroeconomic shocks			
Currency crisis	2.4	6.2	0.8
Banking crisis	0.0	5.2	0.9
Debt crisis	...	7.6	1.6
Sudden stops	1.6	6.0	0.6
Country specific external shocks			
Terms of trade shock	1.1	4.2	1.5
Disaster	...	6.0	0.6
Sociopolitical			
War	0.0	6.9	1.7
Political shock	...	4.1	1.6
Global shocks			
Global interest rate hike	0.5	1.5	1.1
Oil shock	0.0	2.3	1.1
The end of booms			
End of lending boom	0.0	1.2	1.0
End of growth boom	...	0.0	4.1

Sources: Authors' calculations based on sources and definitions in the Annex.
Notes: For a given type of shock and group of countries, "..." indicates that the results are not reported because the shock occurred less than 5 times; "0.0" implies that the shock was never associated with an output event as defined in the text.

B. The Expected Cost of Shocks

We now turn to summarizing the importance of a given type of shock through a measure of its expected cost or, equivalently, the ex-ante value of insurance against such shock (analogous to the value a risk-neutral homeowner would attach to fire insurance). In our view, the empirical associations we document may provide a useful gauge of the relative importance of the various types of shock, for different country groups. Nevertheless, for this initial exercise, two simplifying assumptions are worth highlighting. First, the analysis does not address the causes of the shocks; in particular, it does not ask whether the shocks cause declines in output rather than the other way around. Although causality cannot be determined conclusively, in Section V.B. we will report suggestive evidence that the shocks are unlikely to be systematically caused by output developments. Second, the analysis in this section does not separate the effects of individual shocks for those drops that are associated with more than one shock. In Section IV, we will estimate multivariate probit regressions. We report here the results of bivariate exercises in detail not only as a preliminary description, but also because they may help provide a gauge of the value of insuring against a particular shock. Suppose, for example, that insurance contracts were available to provide payments in the event of an adverse shock of a given type—say, a terms of trade shock—defined as in our paper. Then, the value of such insurance would be a meaningful concept regardless of the direction of causality or the correlation with other shocks.

The importance of a given type of shock may be summarized by its expected cost. Three inputs are needed, and are estimated on the basis of observed frequencies in 1970–2001, using the definition of "all" output events (Table 4): (i) the probability of the shock (how often a fire starts); (ii) the conditional probability that the shock will lead to a loss in output (the likelihood the house will burn down if a fire starts); (iii) and the output cost associated with the event (the cost of rebuilding the house):[17]

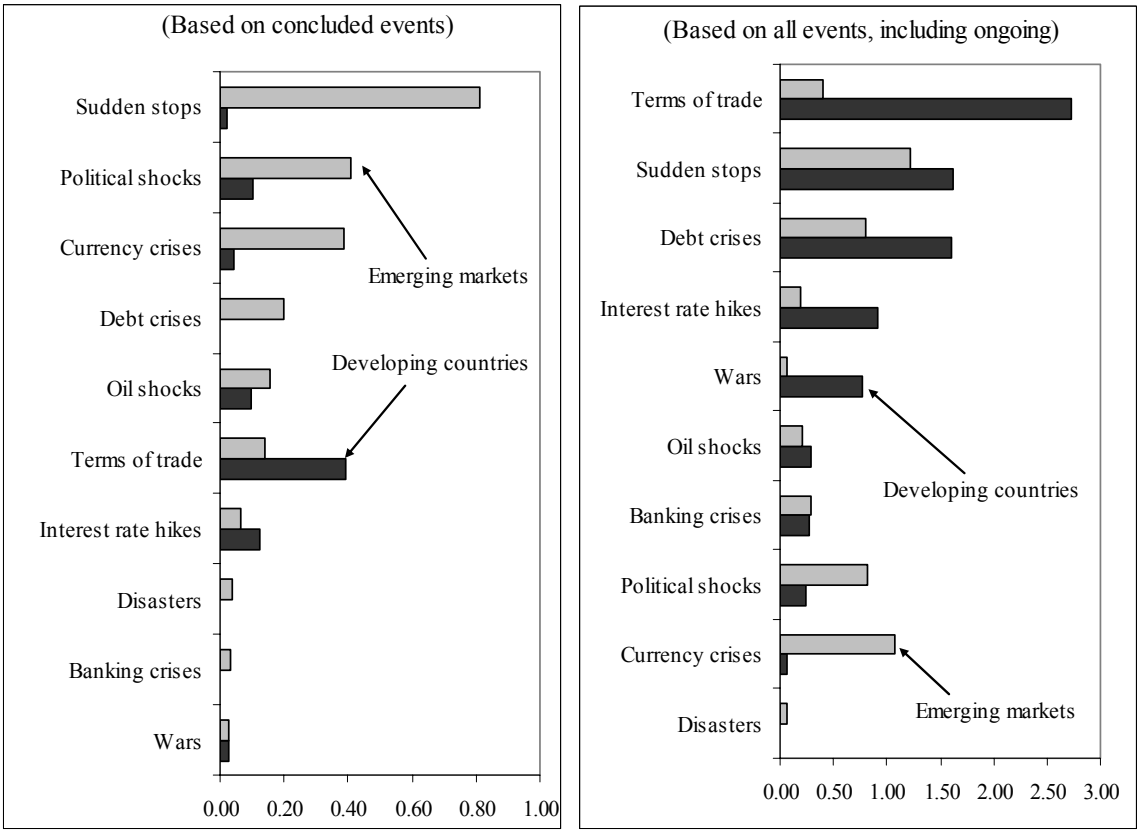
Expected cost = unconditional probability of a shock (left panel of Table 4) ×
probability of an output event given the shock (middle panel) ×
cost of the output event when it occurs (right panel).

As the expression above makes explicit, the expected cost of a given type of shock will be substantially lower than the ex-post cost of observed output drops, because the relevant probabilities are much lower than one.

[17] The results are relatively robust to how the shocks are defined. A more stringent definition of a shock (for example, a higher threshold for a "sudden stop") reduces the unconditional probability of the shock, but usually also increases both the conditional probability of an output event, and the costs associated with the event. It is also worth noting that this measure includes only the costs of output drops; it excludes, for example, the costs of slow growth that might result from policies seeking to postpone or avoid full-blown crises. These concerns can be mitigated by exploring alternative thresholds in defining the events.

As shown in Table 4, shocks occur more often, and are more likely to lead to output drops, in developing countries and emerging markets than advanced countries. The frequency of an output event given the presence of a financial shock (a debt, currency or banking crisis, or a sudden stop) is higher for emerging markets than for developing countries. Total output losses conditional on shocks are higher for developing countries than for emerging markets.[18]

Figure 3. Expected Cost of Shocks Based on Bivariate Analysis
(in percent of pre-event GDP per capita)



Note: The left-hand-side panel is based on concluded events only (i.e., excluding ongoing and sub-events), and the types of shock are sorted according to their cost for emerging markets. The right-hand-side panel is based on all events (including ongoing events and sub-events), and the types of shock are sorted based on their cost for developing countries. The large differences in expected costs between the two panels, especially for developing countries, reflect costly ongoing events, including very long-lasting events such as those triggered by the debt crisis of the 1980s.

[18] The difference is somewhat less pronounced considering concluded events only: ongoing events, whose costs are extremely large, have been more frequent in developing countries.

Table 4. Frequencies and Costs of Shocks
(All output events, 1970–2001)

	Unconditional Frequency of Shocks			Frequency of Output Event Conditional on Shocks			Cumulative Output Loss Conditional on Shocks		
	Advanced economies	Emerging markets	Developing countries	Advanced economies	Emerging markets	Developing countries	Advanced economies	Emerging markets	Developing countries
	(in percent of country-years)			(in percent)			(in percent of pre-event GDP per capita)		
Financial and macroeconomic shocks									
Currency crisis	3	9	6	5	17	5	6	68	23
Banking crisis	13	6	5	0	14	5	...	35	119
Debt crisis	0	4	2	...	21	9	...	101	1132
Sudden stop in capital flows	5	12	15	3	16	4	7	64	298
Country specific external shocks									
Terms of trade shock	6	14	21	2	12	8	27	24	152
Disaster	1	2	3	0	17	3	...	18	11
Sociopolitical									
War	2	3	3	0	19	10	...	10	259
Political shock	0	3	3	...	11	9	12	235	75
Global shocks									
Global interest rate hike	13	13	13	1	4	7	6	36	111
Oil price hike	13	13	13	0	6	6	...	27	38
The end of booms									
End of lending boom	2	4	4	0	3	6	...	13	26
End of growth boom	0	1	1	...	0	24	12	...	232

Sources and definitions: Authors' calculations based on output data from Maddison (2003). The dates for currency, banking, and debt crises, as well as lending booms are based on existing studies (see Appendix III). Sudden stops in capital flows are defined as a 5 percentage point of GDP decline in financial flows, drawn from the International Monetary Fund's *International Financial Statistics*. Terms-of-trade shocks are defined as a 10 percent worsening in the terms of trade of goods, drawn from the IMF's *World Economic Outlook* data bank. The dates of disasters, wars and political shocks are from CRED (www.em-dat.net), Correlates of War (www.correlatesofwar.com), and Marshall and Jaggers (2002), respectively. The global interest rate shock is defined as an increase in the U.S. Federal funds rate by more than 150 basis points in one year. The dates of the oil shocks are from IMF (2003). The three columns report how often the various types of shocks occur; how often the occurrence of a given type of shock leads to an output decline; and the median output losses for output events associated with each type of shock. Median (rather than average) output losses are used to make the estimates less sensitive to outliers. When the median loss is based on fewer than five output events, (associated with the given type of shock for the relevant group of countries), the number is in italics, to indicate its limited reliability.

Combining the components in Table 4, the expected cost of various types of shock is reported in Figure 3.[19] For several types of shock, the expected cost seems to be substantial.[20] Focusing on concluded events, financial and macroeconomic shocks—especially sudden stops—have the largest expected cost for emerging markets, equivalent to about 0.8 percent of GDP annually. For the developing countries, adverse changes in the terms of trade are the most costly type of shock.[21] Considering all events, adverse changes in the terms of trade have the largest expected cost for developing countries—amounting to 2.8 percent of GDP annually. For emerging markets, sudden stops and currency crises carry the largest expected costs. The results are robust to using alternative data sources, such as the Penn World Tables for GDP, as shown in Section V.A. They are also largely unchanged if countries are grouped according to initial income levels (Appendix Figure A1).

In interpreting the results, it is important to bear in mind that the expected cost refers to a given type of shock, regardless of whether it occurs in combination with other shocks. Thus, for example, for emerging markets the expected cost is 1 percentage point of GDP for currency crises and 0.8 percentage points of GDP for debt crises, but the expected cost of both shocks would be less than 1.8 percentage points of GDP, because currency and debt crises often occur simultaneously. Thus, the expected cost of an individual type of shock obtained through the univariate approach used in this section is an upper bound on the estimate. In the next section, we turn to multivariate regressions.

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[19] Figure 2 is based on contemporaneous correlations between shocks and output events. Similar results are obtained when we allow the shocks to affect output in the following year as well as contemporaneously. Allowing for a one year lag, the shocks coincide with more output events, but shocks are twice as frequent, and the conditional probabilities of having an output event given a shock declines. The figure omits advanced countries, because expected costs for this segment appear to be very low. This may be due to better diversified production structures or more resilient financial systems and political institutions. An additional factor, however, may be the focus on types of shock that seem to be more relevant for emerging and developing countries.

[20] Consistent with the definition provided above, the expected cost of a given type of shock is substantially smaller than the (infrequently) incurred ex-post cost of the output events presented in Table 2.

[21] Most of the identified interest rate hikes took place in the 1970s and 1980s, often in conjunction with oil price shocks. The limited output costs of disasters may reflect the impact of rapid reconstruction efforts; the analysis abstracts from the immediate loss in the capital stock.

IV. MULTIVARIATE PROBIT ANALYSIS

The analysis presented above has thus far abstracted from the fact that output drops are often associated with more than one type of shock occurring simultaneously. For example, sudden stops in financial flows, currency crises, debt crises, or banking crises occur together in a number of instances. To estimate the individual significance of each type of shock, this section turns to multivariate probit analysis.

Table 5. Marginal Effects of Shocks on the Probability of an Output Drop

	All events		Concluded events		Ongoing events	
	Marginal effect	p-value	Marginal effect	p-value	Marginal effect	p-value
			Emerging markets			
Financial and macroeconomic shocks						
Currency crises	5.36	0.01	3.58	0.02	3.70	0.02
Banking crises	2.28	0.39	0.24	0.91	-3.32	0.33
Debt crises	6.14	0.02	2.98	0.15	4.35	0.05
Sudden stops	4.31	0.04	4.21	0.01	-0.18	0.93
Country specific external shocks						
Terms of trade	3.54	0.04	4.16	0.00	0.56	0.72
Disasters	7.96	0.03	1.44	0.69	2.10	0.52
Sociopolitical						
Wars	8.51	0.00	5.20	0.01	0.80	0.78
Political shocks	5.09	0.13	5.98	0.04	1.11	0.70
Global shocks						
Interest rate hikes	-3.07	0.19	0.02	0.99	-2.95	0.22
Oil shocks	-0.11	0.96	-2.44	0.26	2.54	0.07
			Developing countries			
Financial and macroeconomic shocks						
Currency crises	-2.33	0.34	-3.68	0.32	-2.51	0.30
Banking crises	-1.55	0.67	...	...	0.02	1.00
Debt crises	2.56	0.53	1.48	0.67	4.14	0.10
Sudden stops	-5.53	0.02	-2.65	0.29	-1.77	0.37
Country specific external shocks						
Terms of trade	1.86	0.16	1.35	0.37	1.64	0.10
Disasters	-5.21	0.15	...	...	...	...
Sociopolitical						
Wars	1.58	0.56	2.18	0.49	-0.90	0.68
Political shocks	1.24	0.66	4.46	0.10	1.19	0.59
Global shocks						
Interest rate hikes	0.15	0.93	0.53	0.76	0.36	0.77
Oil shocks	-0.74	0.64	-0.17	0.93	-0.11	0.93

Note: The dependent variable is a dummy for the start of an output event. Estimates are based on multivariate panel probits with country fixed effects and controlling for the end of growth and lending booms. The *p*-values refer to the null hypothesis that the underlying coefficient estimates are equal to zero.

Table 5 shows the marginal effects that individual types of shock have on the probability of output drops.[22] For the emerging markets, considering all events, several types of shock (sudden stops, currency crises, debt crises, terms of trade changes, disasters, and wars) are significantly associated with a higher probability of an output drop. For the developing countries, where ongoing events are more relevant, debt crises and adverse changes in the terms of trade are positively and significantly associated with the likelihood of output drops, though only at the 10 percent level, and only for ongoing events. The marginal effects estimated through the panel probit regressions are smaller than those from the bivariate estimates based on conditional frequencies—as one might expect, given that a third of the output events are associated with more than one shock.

The next step is to analyze whether the cost of output events depends on the type of shock that caused the event. This is undertaken by regressing the cost associated with output events on all the types of shock.[23] If certain shocks are associated with particularly severe (or mild) output events, this should result in positive (negative) coefficients. The results are presented in Table 6 for all, concluded, and ongoing events, separately. For the emerging markets, the coefficient estimates vary by large amounts, but the estimates are imprecise and generally not statistically different from zero for individual shocks. Taken at face value, this implies that the severity of output drops can be measured by the constant alone, without adjusting this average cost for the type of shock that is associated with the event. For the developing countries, the cost of output drops associated with debt crises was significantly higher than for the typical output drop.

Having estimated (using multivariate regressions) how shocks affect the likelihood of output drops, as well as their associated costs, it is now possible to compute the expected cost of shocks (Table 7). For each type of event, the data in the first column are based on the point estimates of the shocks' marginal effect on the likelihood of an output drop (from Table 5), and on the point estimate of the shock-specific cost of an output drop, computed as the constant plus the shock-specific coefficient from Table 6. The second column only reports calculations that are based on statistically significant marginal effects from Table 5 and only adds statistically significant coefficients from Table 6 to the cost calculation.

Based on all output events, sudden stops in capital flows remain the most costly type of shock—together with terms-of-trade worsenings and currency crises—for emerging markets, with an estimated expected cost of 0.6 percent of GDP annually. Although the magnitude of the estimate is substantially smaller than in the univariate analysis, it is still economically significant.

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[22] Unlike most "early warning systems," we include individual country fixed effects in our analysis. (The estimates are obtained using LIMDEP version 8.0, whose estimator for panel probits with fixed effects is unbiased.)

[23] Given the limited number of events and the relatively large cross-section of countries, individual country fixed effects are not included in these regressions.

Table 6. The Cost of Output Events

	All output events			Concluded output events			Ongoing output events		
	Coefficient	s.e.	p-value	Coefficient	s.e.	p-value	Coefficient	s.e.	p-value
				Emerging markets					
Financial and macroeconomic shocks									
Currency crises	42	47	0.37	32	29	0.28	-114	205	0.59
Banking crises	-101	62	0.11	-17	39	0.67	2	310	1.00
Debt crises	-20	64	0.76	9	32	0.79	-22	205	0.92
Sudden stops	-31	51	0.55	15	31	0.63	-83	205	0.70
Country specific external shocks									
Terms of trade	-21	45	0.63	18	22	0.40	-115	186	0.55
Disasters	-104	82	0.21	-2	64	0.97	-39	337	0.91
Sociopolitical									
Wars	9	65	0.89	-29	31	0.36	329	350	0.37
Political shocks	176	88	0.05	207	52	0.00	491	326	0.17
Global shocks									
Interest rate hikes	57	69	0.41	-19	35	0.60	444	310	0.19
Oil shocks	0	60	1.00	-33	55	0.55	-91	160	0.58
Constant	124	29	0.00	28	17	0.12	260	88	0.02
R-squared	0.14			0.57			0.45		
Adj. R-squared	-0.01			0.39			-0.15		
Observations	75			34			20		
Cross-sections	33			24			20		
				Developing countries					
Financial and macroeconomic shocks									
Currency crises	-175	157	0.27	37	68	0.59	-869	506	0.09
Banking crises	-101	225	0.66	0	0	0.00	181	477	0.71
Debt crises	703	236	0.00	0	0	0.00	715	428	0.10
Sudden stops	-12	153	0.94	-33	43	0.44	-29	380	0.94
Country specific external shocks									
Terms of trade	-58	73	0.43	4	22	0.86	-380	210	0.08
Disasters	-256	226	0.26	-59	49	0.23	0	0	0.00
Sociopolitical									
Wars	62	143	0.67	-6	42	0.90	573	380	0.14
Political shocks	-134	151	0.37	-12	36	0.73	121	365	0.74
Global shocks									
Interest rate hikes	11	93	0.90	-13	32	0.70	211	253	0.41
Oil shocks	-130	92	0.16	-15	32	0.63	-294	193	0.14
Constant	329	40	0.00	67	13	0.00	682	84	0.00
R-squared	0.10			0.07			0.26		
Adj. R-squared	0.03			-0.11			0.06		
Observations	173			56			48		
Cross-sections	73			37			48		

Note: The dependent variable is the cost of output events. The end of growth and lending booms are included as control variables. No country fixed effects are included, owing to the limited number of observations relative to the number of countries.

For the developing countries, terms of trade shocks and debt crises are associated with significant expected costs (approximately 1 percent of GDP annually) when considering ongoing events.

In interpreting the results, one needs to bear in mind that, just as the results based on the univariate approach used in Section III are an upper bound on the true value of the expected cost of an individual shock, the results presented here are a lower bound. In fact, computing the marginal probability of an output event that is associated with an increase in the portion of one type of shock that is orthogonal to other types of shock implies that we are neglecting the portion of the shock that is common to more than one type of shock.

Table 7. Expected Cost of Shocks Based on Multivariate Estimates

	All output events		Concluded output events		Ongoing output events	
	Point estimates	Only significant estimates	Point estimates	Only significant estimates	Point estimates	Only significant estimates
			Emerging markets			
Financial and macroeconomic shocks						
Currency crises	0.81	0.60	0.19	0.09	0.49	0.87
Banking crises	0.03		0.00		-0.50	
Debt crises	0.24	0.29	0.04		0.40	0.43
Sudden stops	0.46	0.62	0.21	0.13	-0.04	
Country specific external shocks						
Terms of trade	0.52	0.63	0.27	0.16	0.12	
Disasters	0.03	0.21	0.01		0.10	
Sociopolitical						
Wars	0.36	0.34	0.00	0.05	0.15	
Political shocks	0.46		0.43	0.43	0.25	
Global shocks						
Interest rate hikes	-0.69		0.00		-2.60	
Oil shocks	-0.02		0.02		0.54	0.83
			Developing countries			
Financial and macroeconomic shocks						
Currency crises	-0.23		-0.25		0.30	
Banking crises	-0.16		0.00		0.01	
Debt crises	0.41		0.02		0.90	0.90
Sudden stops	-2.64		-0.13		-1.74	
Country specific external shocks						
Terms of trade	1.08		0.20		1.06	1.06
Disasters	-0.12		0.00		0.00	
Sociopolitical						
Wars	0.19		0.04		-0.34	
Political shocks	0.08		0.08	0.10	0.33	
Global shocks						
Interest rate hikes	0.06		0.04		0.40	
Oil shocks	-0.18		-0.01		-0.05	

Note: The first column is based on using point estimates for both the marginal effect a shock has on the probability of having an output event and the cost based on adding the shock specific cost coefficient to the constant, regardless of significance levels. The second column only shows the cost for shocks that have a positive and significant (at the 10 percent level) impact on the probability of an output event and only adjusts the constant cost of an output event if the shock-specific cost coefficient is significantly different from zero.

V. ROBUSTNESS AND EXTENSIONS

A. Alternative Data Sources and Definitions

In this section, we show that the key results are robust to changes in data sources and methodology. We begin by calculating the bivariate estimates of the expected cost of shocks using GDP data from the Penn World Table (PWT) 6.1 (instead of the data from Maddison, 2003, which have been used so far in order to maintain consistency with the pre-WWII

analysis). We also replicate the exercise using consumption data from the PWT to construct consumption drops (defined analogously to output drops). Table 8 reports the results for all events and concluded events broken down by emerging markets and developing countries. To highlight some of the results, we find that the expected cost of sudden stops in emerging markets is almost identical (at around 1 percentage point of GDP, for all events) regardless of data source or using consumption rather than output to define events. Furthermore, the cost of terms of trade shocks tops the list for developing countries in all cases.

Table 8. Robustness Checks: Expected Costs Using Alternative Data
(in percent of pre-event, per capita GDP or consumption)

	All events					
	Emerging markets			Developing countries		
	GDP/pop. Maddison	GDP/pop. PWT 6.1	Cons./pop. PWT 6.1	GDP/pop. Maddison	GDP/pop. PWT 6.1	Cons./pop. PWT 6.1
Financial and macroeconomic shocks						
Currency crises	1.07	0.81	1.19	0.07	0.02	0.07
Banking crises	0.28	0.19	0.29	0.28	1.03	0.30
Debt crises	0.81	0.86	1.05	1.60	0.00	0.23
Sudden stops	1.22	1.10	1.37	1.62	0.42	1.37
Country specific external shocks						
Terms of trade	0.40	0.69	0.66	2.73	1.61	3.07
Disasters	0.06	0.01	0.01	0.01	0.04	0.04
Sociopolitical						
Wars	0.06	0.28	0.42	0.77	0.58	1.46
Political shocks	0.82	0.46	0.15	0.25	0.96	0.87
Global shocks						
Interest rate hikes	0.19	0.74	0.24	0.91	0.96	1.20
Oil shocks	0.21	0.07	0.15	0.29	1.17	0.53
	Concluded events					
	Emerging markets			Developing countries		
	GDP/pop. Maddison	GDP/pop. PWT 6.1	Cons./pop. PWT 6.1	GDP/pop. Maddison	GDP/pop. PWT 6.1	Cons./pop. PWT 6.1
Financial and macroeconomic shocks						
Currency crises	0.39	0.57	0.81	0.04	0.01	0.01
Banking crises	0.03	0.04	0.05	0.00	0.00	0.00
Debt crises	0.20	0.27	0.38	0.00	0.00	0.02
Sudden stops	0.81	0.79	0.77	0.02	0.15	0.65
Country specific external shocks						
Terms of trade	0.14	0.09	0.23	0.39	0.26	0.68
Disasters	0.04	0.00	0.01	0.01	0.02	0.04
Sociopolitical						
Wars	0.03	0.00	0.27	0.03	0.06	0.18
Political shocks	0.41	0.00	0.15	0.10	0.32	0.00
Global shocks						
Interest rate hikes	0.07	0.09	0.21	0.12	0.04	0.35
Oil shocks	0.15	0.04	0.24	0.10	0.06	0.13

Sources: Authors' calculations based on Maddison (2003) and Penn World Tables 6.1.

Another robustness check is to investigate how cost estimates differ between cases with multiple shocks and cases where only a single shock occurs. The detailed results are presented in Appendix Table A2. In general, it is hard to perceive a systematic difference in the median cost of output events between the multiple shock cases and the pure single

shock—though, unsurprisingly, the expected cost is lower in the case of pure shocks. Given the relatively large number of shocks and many cases of multiple shocks, the results regarding the pure single shock cases are based on a small sample.

The results presented so far have focused on the association between shocks and output drops. As a robustness check, it is nevertheless of interest to analyze whether the shocks are associated with declines in growth rates more generally, that is, considering the entire growth distribution rather than only the tail. In panel regressions, the shocks identified as costly in the previous sections are associated with declines in contemporaneous growth rates of the growth rate (Table 9).

Table 9. Shocks and Growth Rates, 1970–2001

	Emerging markets			Developing countries		
	Coefficient	t-stat.	p-value	Coefficient	t-stat.	p-value
Financial and macroeconomic shocks						
Currency crises	-0.012	-2.48	0.013	-0.012	-1.90	0.058
Banking crises	-0.022	-3.32	0.001	-0.014	-1.42	0.155
Debt crises	-0.030	-3.96	0.000	-0.016	-1.27	0.203
Sudden stops	-0.024	-4.57	0.000	0.004	0.78	0.437
Country specific external shocks						
Terms of trade	-0.005	-1.20	0.229	-0.008	-2.08	0.038
Disasters	-0.012	-1.20	0.230	-0.012	-1.51	0.132
Sociopolitical						
Wars	-0.009	-1.15	0.249	-0.032	-3.79	0.000
Political shocks	-0.023	-2.84	0.005	-0.030	-3.47	0.001
Global shocks						
Interest rate hikes	0.013	3.09	0.002	0.000	-0.03	0.979
Oil shocks	-0.004	-0.90	0.368	0.009	1.96	0.050
Constant	0.024	13.28	0.000	0.007	3.52	0.000
R-squared	0.18			0.10		
Adj. R-squared	0.14			0.06		
Observations	1152			2464		
Cross-sections	36			77		

Notes: The dependent variable is the contemporaneous growth rate. The regressions include country fixed effects and controls for the end of lending and growth booms.

B. Causality

As mentioned above, establishing causality is an especially thorny issue in this exercise. Are output drops caused by exogenous shocks, are adverse shocks caused by expectations of output declines, or do both shocks and output drops result from a third, unidentified factor? As a research strategy, we could have chosen to focus our study on the impact of shocks that are clearly exogenous, such as natural disasters or changes in commodity prices. While such a strategy would have made it easier to establish causality, our impression (consistent with the associations we have documented) is that such clearly exogenous shocks are relevant for a subset of countries, mostly small developing countries. However, they seem to be far less

relevant for larger countries and emerging markets. We have thus opted for focusing on shocks that are of greater relevance to a broader range of countries, and for addressing possible questions regarding causality by using the limited data that are available to do so.

Our view is that while concerns regarding causality cannot be fully eliminated, a strongly suggestive case can be made that most output drops, including those associated with financial crises, are essentially unexpected.[24] In this subsection, we show that as late as a few months prior to the shock that triggered the output event, forecasts did not give any hint of impending declines in output. Consider, for example, the August 1998 sudden stop originating with the Russian crisis and rapidly transmitted to a host of other countries (partly via the Long Term Capital Management debacle). As late as July 1998, Consensus Forecasts gave essentially no indication that output would decline or that policies were becoming worse in Russia or other emerging markets. The view that a sudden stop in financial flows was caused by worsening expectations of output growth would need to make the case that news about declining economic performance were simultaneously revealed in all emerging markets in late July-early August 1998.

To analyze more systematically the extent to which output drops may have been expected, we look at forecasts of real GDP growth (measured in local currency) published in the International Monetary Fund's *World Economic Outlook* (WEO).[25] We use the WEO because it has greater country coverage than alternative publications such as *Consensus Forecasts*. In a comprehensive external evaluation of WEO forecasts, Timmermann (2006) finds that the performance of the WEO forecasts is similar to that of the Consensus forecasts. Although WEO forecasts for real GDP growth display a statistically significant tendency for systematic overprediction, with an estimated bias ranging from 0.36 percentage points for advanced countries to 1.48 percentage points for countries in Africa, forecast errors in times of output drops are far larger, suggesting that output drops are usually unexpected.

GDP forecast data are available from 1991 to 2001; during this period there are 39 concluded events. The questions to address are: were output events expected; did events coincide with expected declines in output; and are financial shocks predominantly associated with expected declines in output? To answer the first question we look at the forecast errors in the years

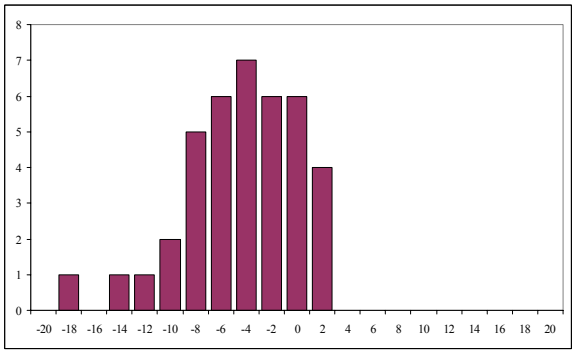
[24] Addressing causality issues through instrumental variables is unlikely to prove feasible in this case. In principle one could consider using "early-warning-system" (EWS) methods to analyze the ultimate determinants of, say, currency crises. In practice, however, EWS methods have little predictive power (Berg and others, 2005). Moreover, such predictive power often results from variables (such as reserves or short-term debt) that are not exogenous.

[25] This is a different GDP measure than the PPP adjusted GDP per capita that is used elsewhere in this paper; however, this is used as a proxy because there are no publications with forecasts of PPP adjusted GDP per capita. Although magnitudes of forecasts/forecast errors clearly depend on the measure, it seems unlikely that they would generate differences in terms of which output declines are expected and which are not.

when an output event starts. More specifically we look at the difference between the actual growth rate in the first year of an output event with the forecast done in October a year earlier. In 35 out of 39 cases, there is a negative surprise, meaning that part of the output decline was unexpected; on average, the forecast error is large (5.5 percentage points, Figure 4, top panel, 39 observations), far exceeding the mean forecast error observed in years when there are no output drops (0.4 percentage points, Figure 4, bottom panel, 1289 observations). This is consistent with previous studies showing that only a small fraction of recessions are predicted one year ahead (Loungani and Juhn, 2002).

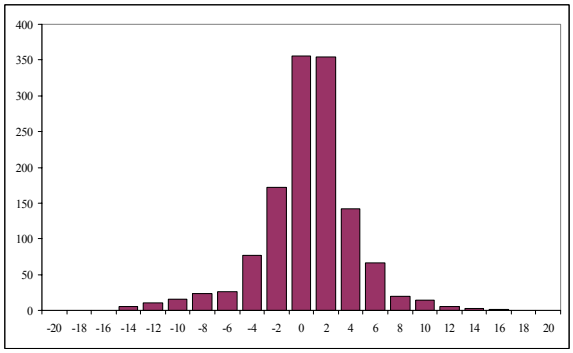
Figure 4. One Year Ahead Forecast Errors, 1990–2001

Times of Output Drops



Mean	-5.488
Median	-4.803
Maximum	1.470
Minimum	-19.327
Std. Dev.	4.586
Skewness	-0.893
Kurtosis	3.860
Jarque-Bera	6.388
Probability	0.041
Observations	39

Times without Output Drops



Mean	-0.424
Median	-0.200
Maximum	14.274
Minimum	-14.968
Std. Dev.	3.693
Skewness	-0.518
Kurtosis	5.361
Jarque-Bera	356.945
Probability	0.000
Observations	1289

Source: *World Economic Outlook*, International Monetary Fund, various issues.

In addition, there is little evidence that output was expected to decline (compared to the previous year): the year prior to what ex-post turns out to be an output drop, the average expected change in the growth rate is close to zero, with a relatively tight and symmetric distribution around zero. Furthermore, analyzing the cases that were associated with financial and macroeconomic shocks does not reveal that these events were expected (with one exception, namely the output per capita decline in Saudi Arabia in 1992, which was associated with a sudden stop in capital flows.) For emerging market and developing countries, almost all types of shock are associated with negative surprises in growth the following year (Table 10).

Table 10. Average Forecast Errors, 1990–2001

	May to next year			October to next year		
	Advanced	Emerging	Developing	Advanced	Emerging	Developing
Financial and macroeconomic shocks						
Currency crises	-3.5	-2.1	-1.7	-3.0	-1.9	-1.4
Banking crises	-0.5	-2.7	-3.8	-0.5	-2.6	-3.2
Debt crises	...	-3.6	-1.5	...	-3.2	-2.6
Sudden stops	-0.5	-2.6	-0.6	-0.5	-2.3	-1.4
Country specific external shocks						
Terms of trade	4.2	0.1	-0.4	3.9	0.0	-0.8
Disasters	-0.3	-2.2	-2.0	-0.5	-1.3	-1.8
Sociopolitical						
Wars	-1.5	1.0	-7.3	-1.1	1.0	-7.3
Political shocks	...	-2.6	-3.7	...	-1.4	-3.3
Global shocks						
Interest rate hikes	1.2	0.8	-2.0	1.6	0.6	-1.9
Oil shocks	0.5	-2.6	-1.7	1.2	-1.3	-1.4
Output events						
All	-5.0	-6.7	-5.1	-4.9	-6.4	-4.8
Ongoing	-10.0	-8.6	-3.5	-10	-7.7	-3.6
Concluded	-2.6	-7.6	-7.4	-2.3	-7.8	-5.6
No shock/event						
No shock	-0.1	-0.6	-0.6	0.0	-0.6	-0.6
No output event	-0.1	-0.6	-0.8	0.0	-0.4	-0.9
No shock or output event	0.0	-0.4	-0.6	0.1	-0.4	-0.6

Source: *World Economic Outlook*, International Monetary Fund, various issues.

C. Extension: Output Drops and Consumption Declines

Having established a number of stylized facts regarding output drops and the shocks that they are associated with, it may be interesting to explore how some of the main components of output behave during output drops. To illustrate, this section analyzes the behavior of consumption in times of output drops. In the first year of output drops, consumption declines are more than twice as large in developing and emerging countries than they are in advanced countries (Table 11, top panel).[26] Furthermore, consumption continues to decline in the second year of output drops, but only in developing and emerging countries. The relatively large declines in consumption in these countries are associated with larger initial output drops as well as larger losses over the duration of the output event. However, focusing on the income elasticity of consumption in the year of the output drop, the elasticities are substantially higher in developing and emerging countries than in advanced countries. In contrast, income elasticities in "normal" times are similar for all country groups (Table 11, bottom panel). Indeed, for developing and emerging countries, the elasticities in "normal"

[26] The results are essentially the same comparing low- and medium-income countries with high-income countries; or countries at low- or medium levels of financial development with countries at high levels of financial development.

and "output event" times are similar; in contrast, for advanced countries, the elasticities are far lower during output drops than in normal times. This is consistent with the view that consumption smoothing is relatively difficult in developing and emerging countries, though the analysis does not control for the change in expectations of future income (which may well be more severely affected in developing and emerging countries). On the whole, this first look at how one important component of output behaves during output drops seems to reinforce the view that that output drops are especially relevant episodes for the welfare of the residents of developing and emerging countries.

Table 11. Consumption and Output Drops, 1970–2001

	Developing countries	Emerging markets	Advanced economies
		(medians)	
Contingent on output event in T			
Consumption growth in T	-2.8	-4.0	-1.1
Consumption growth in T+1	-2.0	-2.2	0.5
GDP growth in T	-4.3	-3.8	-3.2
Total loss over output event	68	24	12
Country specific elasticity	0.84	1.06	0.36
No output event			
Consumption growth	1.2	2.4	2.8
GDP growth	1.6	2.7	3.1
Country specific elasticity	0.80	0.90	0.89

Source: Authors' calculation based on Penn World Table data.
Note: The country specific elasticities are the percent changes in consumption divided by the percent change in GDP.

VI. CONCLUSIONS

This is the first study to provide a systematic analysis of output drops, including their salient features and association with various financial, macroeconomic, real, and political shocks. We believe that the simple concept of "output drops" used in this paper is closely related to the general public's notion of important and undesirable economic events. Moreover, we think the analysis is relevant from the standpoint of an emerging literature that has begun to look into what factors initiate (or halt) episodes of growth, and how volatility and crises may affect economic growth over the long run.

Using data for 1900–2001 and subperiods, we have provided simple descriptive statistics on the frequency, duration, and overall cost of output drops. We have shown that although output drops occur in countries at all income levels, their frequency and (only during the post-WWII period) duration and overall cost are positively associated with initial per capita GDP.

Turning to the more detailed analysis of the association between output drops and various shock types for different groups of countries in 1970–2001, we have shown that external shocks play an important role for most countries; and that for both developing countries and emerging markets, a wide variety of financial, macroeconomic, real, and political shocks are significantly related to output drops. To summarize the relative importance of these shocks into an "expected cost" measure, we have combined, for each type of shock, the unconditional frequency of the shocks, the conditional frequency with which the shocks are associated with an output drop, and the median cost of an output drop. For the typical developing or emerging country, this summary measure suggests that some types of shock, such as sudden stops and terms of trade worsenings, carry a substantially higher expected cost than do other types of shock, such as wars and natural disasters.

Moreover, a country's level of development seems to help determine exactly which types of shock are likely to matter the most. For emerging markets, the shocks associated with the highest expected cost are financial and macroeconomic—especially sudden stops in financial flows, with an expected cost (based on the bivariate estimates for all events) of 1.5 percent of GDP annually. For the developing countries, adverse changes in the terms of trade have the highest expected cost, at 2.8 percent of GDP annually. The expected cost of individual types of shock based on multivariate probit regressions—controlling for the impact of all other shocks that may take place simultaneously—is lower than using a bivariate approach, but the broad message holds: for emerging markets, financial shocks (notably sudden stops) are at the top of the list, though real shocks (including terms of trade shocks) also play a very significant role; for developing countries, real shocks (notably terms of trade) have the largest implications, and debt crises are also significant.

Our summary measures of expected cost may thus provide a helpful gauge of the relative importance of various types of shock for different groups of countries. For some types of shock, establishing causality is an especially thorny issue. Using forecast data, we have shown that output drops are seldom expected, regardless of the shocks that appear to trigger them. While this does not conclusively establish causality, we think that it provides suggestive evidence that the shocks analyzed in this study (including financial shocks) are unlikely to be routinely caused by expected declines in output.

A potentially fruitful area for further research is the relationship between output drops and developments in other macroeconomic aggregates (including subcomponents of GDP). To illustrate this point and take an initial step in this direction, we have shown that, during output drops of a given size, consumption falls more sharply in emerging and developing countries than it does in advanced countries, even though the elasticity of consumption with respect to output is the same in all country groups in "normal times."

APPENDIX TABLES AND FIGURES

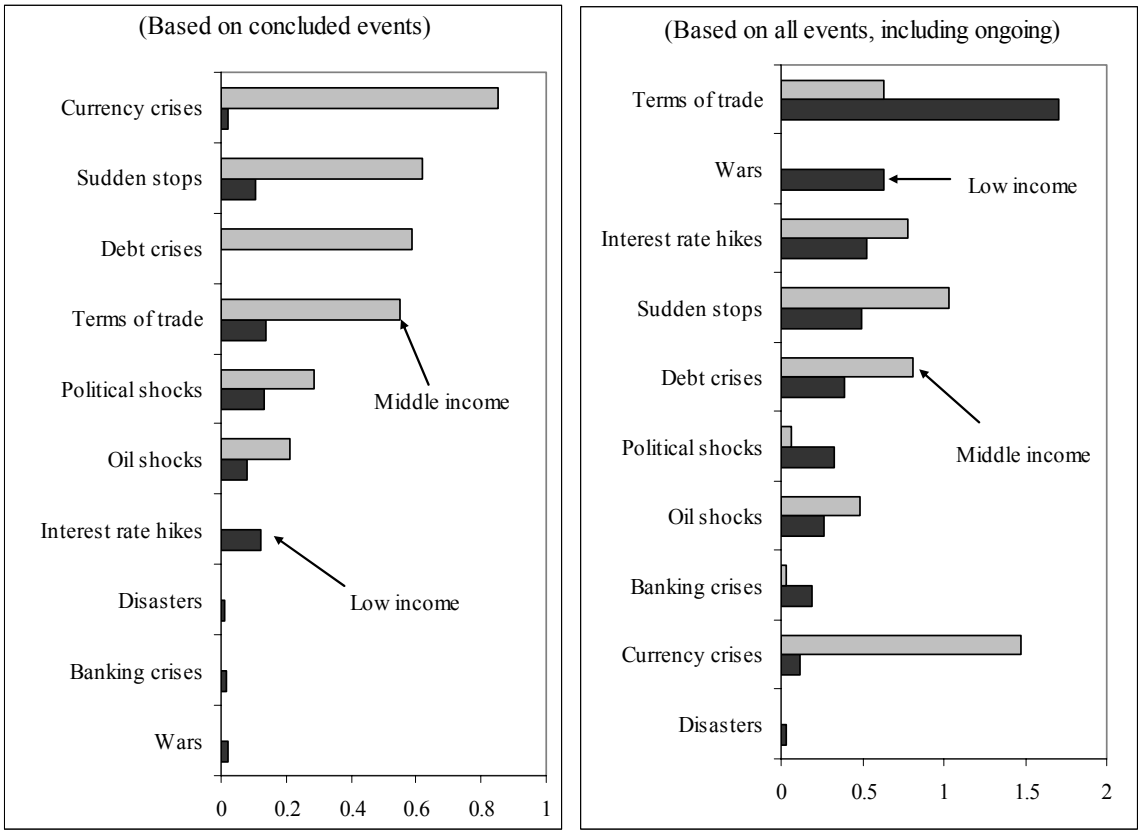
Appendix Table A1. A Century of Output Drops and Shocks

	1900-2001	1900-1949	1950-2001	1950s	1960s	1970s	1980s	1990-2001
				Unconditional Frequencies (in percent)				
Output events								
All	6.5	10.5	5.4	4.1	5.2	7.2	7.2	3.5
Ongoing	0.8	0.0	1.0	0.1	0.3	1.8	1.9	1.1
Concluded	3.8	7.6	2.8	3.2	3.9	3.7	2.7	0.9
Shocks								
Currency crisis	4.3	0.0	4.7	1.5	2.2	2.9	9.0	7.3
Banking crisis	6.5	...	6.5	...	...	2.0	8.2	8.1
Debt crisis	2.3	...	2.3	...	...	1.6	3.8	1.7
Sudden stops	11.9	...	11.9	...	...	11.1	12.3	11.8
Terms of trade shock	14.1	...	14.1	9.9	5.3	17.3	19.0	13.5
Disaster	2.3	2.4	2.2	1.2	2.2	1.9	2.6	3.0
War	4.5	6.1	2.9	2.6	2.9	3.5	2.3	3.0
Political shock	3.3	3.8	3.0	3.3	3.6	3.8	1.6	3.0
Interest rate hikes	10.9	...	10.9	25.0	0.0	20.0	10.0	8.3
Oil shock	4.0	0.0	7.7	0.0	0.0	20.0	10.0	8.3
No known shock	75.5	91.4	60.2	81.9	78.5	45.7	43.4	52.8
				Unconditional and Conditional Duration of Output Event (in years)				
Output events								
All	6.0	5.0	6.0	4.0	5.0	7.0	14.0	5.0
Ongoing	21.0	...	21.0	47.0	36.0	27.5	20.0	4.0
Concluded	5.0	6.0	4.0	4.0	4.0	4.0	7.0	5.0
All output events conditional on								
Currency crisis	3.0	...	3.0	6.0	2.0	10.5	3.0	2.5
Banking crisis	3.5	...	3.5	...	...	4.0	3.0	3.5
Debt crisis	6.5	...	6.5	...	...	16.0	16.0	2.0
Sudden stops	3.5	...	3.5	...	...	5.0	9.0	2.0
Terms of trade shock	3.0	...	3.0	1.0	2.0	2.0	7.0	3.0
Disaster	2.0	2.0	2.5	14.0	4.0	1.5	2.0	3.0
War	3.0	3.0	3.0	1.0	5.0	3.0	20.0	2.0
Political shock	4.0	7.0	3.0	3.0	2.0	4.0	12.0	6.0
Interest rate hikes	2.0	...	2.0	2.0	...	2.0	6.0	2.0
Oil shock	2.5	...	2.5	...	...	2.0	2.0	3.0
No known shock	2.0	2.0	2.0	1.0	2.0	2.0	2.0	2.0
				Unconditional and Conditional Output Loss (cumulative loss in percent of pre-event GDP per capita)				
Output events								
All	36.2	31.6	37.4	21.1	19.3	55.5	164.9	21.6
Ongoing	392.1	...	392.1	2156.5	861.3	764.9	359.1	23.0
Concluded	26.3	44.7	18.3	16.3	15.0	16.9	44.4	21.8
All output events conditional on								
Currency crisis	10.2	...	10.2	53.2	6.5	97.9	5.0	14.1
Banking crisis	10.5	...	10.5	...	...	10.9	10.2	17.8
Debt crisis	71.6	...	71.6	...	...	616.2	113.4	12.5
Sudden stops	16.5	...	16.5	...	...	40.7	75.8	7.6
Terms of trade shock	8.9	...	8.9	3.2	12.8	6.0	49.5	14.4
Disaster	9.6	9.6	9.5	144.2	16.4	8.3	3.5	14.4
War	11.6	16.7	8.6	0.6	39.6	8.0	391.2	1.9
Political shock	24.5	76.4	9.4	5.3	4.7	11.5	112.8	89.4
Interest rate hikes	6.2	...	6.2	5.7	...	6.1	38.6	6.7
Oil shock	9.4	...	9.4	...	...	10.5	11.2	8.3
No known shock	5.5	8.2	4.2	3.1	4.2	5.1	5.3	5.1

Appendix Table A2. The Costs of Multiple Shocks versus Single Shocks

Original bi-variate estimates			Only cases with a single shock			Only cases with two simultaneous shocks		
The ex-ante costs of shocks based on all events								
	Emerging	Developing		Emerging	Developing		Emerging	Developing
Currency crises	1.07	0.07	Currency crises	0.09	0.05	Bank/currency	0.13	...
Banking crises	0.28	0.28	Banking crises	0.02	0.05	Interest rate/currency	0.03	0.24
Debt crises	0.81	1.60	Debt crises	0.19	0.23	Debt/bank	0.17	...
Sudden stops	1.22	1.62	Sudden stops	0.15	0.50	Debt/currency	0.19	...
Terms of trade	0.40	2.73	Terms of trade	0.12	0.74	Oil/interest rate	0.02	0.08
Disasters	0.06	0.01	Disasters	0.03	0.00	Sudden stop/bank	0.32	...
Wars	0.06	0.77	Wars	0.03	0.58	Sudden stop/currency	0.57	...
Political shocks	0.82	0.25	Political shocks	...	0.08	Sudden stop/debt	0.58	0.96
Interest rate hikes	0.19	0.91	Interest rate hikes	...	0.28	Terms of trade/oil	0.47	0.02
Oil shocks	0.21	0.29	Oil shocks	0.06	0.05	Terms of trade/political	0.76	0.44
						Terms of trade/int. rate	0.33	1.03
						Terms of trade/war	0.14	0.55
The ex-ante costs of shocks based on concluded events								
	Emerging	Developing		Emerging	Developing		Emerging	Developing
Currency crises	0.39	0.04	Currency crises	0.03	0.04	Bank/currency	0.01	0.00
Banking crises	0.03	0.00	Banking crises	...	0.00	Interest rate/currency	0.02	...
Debt crises	0.20	0.00	Debt crises	0.09	0.00	Debt/bank	...	0.00
Sudden stops	0.81	0.02	Sudden stops	...	...	Debt/currency	0.12	...
Terms of trade	0.14	0.39	Terms of trade	0.04	0.27	Oil/interest rate	0.02	0.06
Disasters	0.04	0.01	Disasters	...	0.00	Sudden stop/bank	0.11	...
Wars	0.03	0.03	Wars	0.01	0.05	Sudden stop/currency	0.46	...
Political shocks	0.41	0.10	Political shocks	...	0.08	Sudden stop/debt	0.15	...
Interest rate hikes	0.07	0.12	Interest rate hikes	...	0.05	Terms of trade/oil	...	0.01
Oil shocks	0.15	0.10	Oil shocks	...	...	Terms of trade/political	0.28	...
						Terms of trade/int. rate	0.04	0.00
						Terms of trade/war	0.01	...
Median output loss of all output events given shock(s)								
	Emerging	Developing		Emerging	Developing		Emerging	Developing
Currency crises	68	23	Currency crises	34	40	Bank/currency	42.3	...
Banking crises	35	119	Banking crises	27	73	Interest rate/currency	11.5	285.3
Debt crises	101	1132	Debt crises	107	614	Debt/bank	82	...
Sudden stops	64	298	Sudden stops	87	446	Debt/currency	42.3	...
Terms of trade	24	152	Terms of trade	17	90	Oil/interest rate	26.6	43.8
Disasters	18	11	Disasters	17	11	Sudden stop/bank	59.1	...
Wars	10	259	Wars	10	259	Sudden stop/currency	59.9	...
Political shocks	235	75	Political shocks	...	55	Sudden stop/debt	81.4	1152.7
Interest rate hikes	36	111	Interest rate hikes	...	84	Terms of trade/oil	545	8.3
Oil shocks	27	38	Oil shocks	22	20	Terms of trade/political	431.9	422.7
						Terms of trade/int. rate	188.8	364.5
						Terms of trade/war	41.5	1152.7
Median output loss of concluded output events given shock(s)								
	Emerging	Developing		Emerging	Developing		Emerging	Developing
Currency crises	56	104	Currency crises	34	104	Bank/currency	9	...
Banking crises	10	...	Banking crises	...	...	Interest rate/currency	10.3	...
Debt crises	56	...	Debt crises	101	...	Debt/bank	...	...
Sudden stops	76	10	Sudden stops	...	...	Debt/currency	66	...
Terms of trade	14	64	Terms of trade	10	81	Oil/interest rate	26.6	40.7
Disasters	41	10	Disasters	...	11	Sudden stop/bank	42.4	...
Wars	8	24	Wars	8	72	Sudden stop/currency	77.5	...
Political shocks	235	55	Political shocks	...	55	Sudden stop/debt	63.4	...
Interest rate hikes	19	41	Interest rate hikes	...	46	Terms of trade/oil	...	6.6
Oil shocks	88	38	Oil shocks	...	...	Terms of trade/political	318.9	...
						Terms of trade/int. rate	44.4	6.7
						Terms of trade/war	7.8	...

Appendix Figure A1. Expected Cost of Shocks, Countries Grouped by Income in 1970



APPENDIX I. HODRICK-PRESCOTT-FILTER BASED DEFINITION OF EVENTS

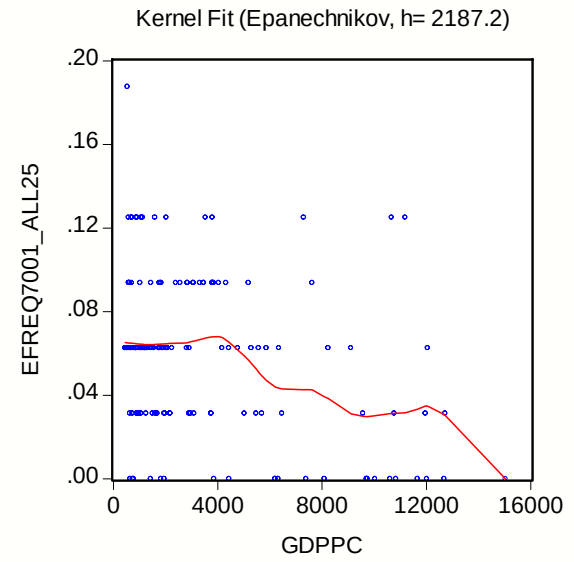
In this appendix, we show that alternative definitions of output events identify largely the same episodes, though the simple definition used in the main text seems to respond more appropriately and promptly to output changes.

Output events could be defined with respect to deviations from a (smooth) trend. This would likely help reduce the impact of measurement error or negative growth observations that simply reversed a preceding, unusually large positive growth result. To produce such a trend, in this appendix we apply a backward-looking HP filter with a relatively large lambda (1000 on annual data) to the logarithm of per capita GDP. This is in the same vein as in Gourinchas and others (2001): it penalizes changes in the trend component relatively more than in standard applications where the HP filter (with lambda around 100) is used to extract business cycles fluctuations. With a high lambda, one can smooth the series and reduce the impact of measurement error without losing information on output drops that may come from both the "trend" and "cycle" as extracted in the business cycle literature.

To illustrate with a more specific example, we define the start of an HP-event as the first observation where the actual value falls more than 1 percent below the HP-filter trend. (The series are measured in logs, so that a one percent threshold corresponds to a fall of around 7 percent of GDP below the trend at the sample median income per capita at the time of these events). Over 1970–2001, the HP-filter method identifies 215 events, whereas the output drops definition based on all events in the paper records 263 events. Of these, 51 start in the same year using both methods. More frequently, however, the start of HP-defined events tends to follow with a lag the output drops identified in the main text. There are 52, 33, and 26 HP events with a 1–, 2–, or 3–year lag respectively, for a total of 111 events to add to the 51 events that are recorded in the same year using both techniques. For lags 1-3, there is a statistically significant association between HP-filtered event starts and the start of output drops as defined in the paper. Neither longer lags, nor leads show a statistically significant positive association with start dates. In other words, in 162 of 215 cases (or 3 out of 4), HP events start in the same year or with a 1-3 year lag with respect to the output drops used in the paper. We prefer a definition of events based on straightforward negative growth, because our exercise focuses on triggers of output drops, and emphasizes the timing of shocks and events.

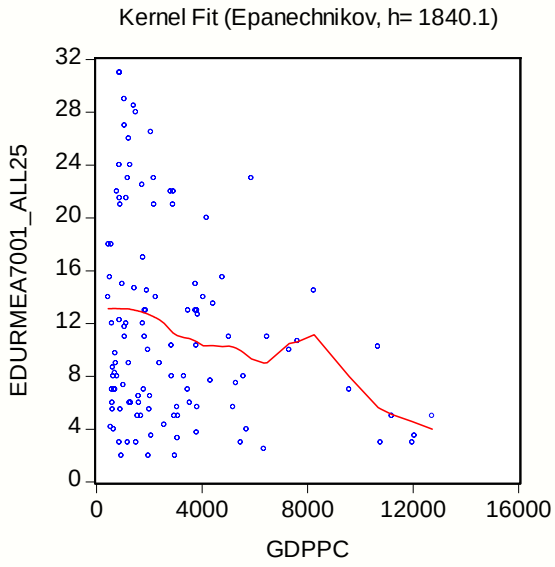
APPENDIX II. KERNEL DENSITY PLOTS: OUTPUT DROPS AND 1970 PER CAPITA GDP

Frequency of output drops against 1970 income level

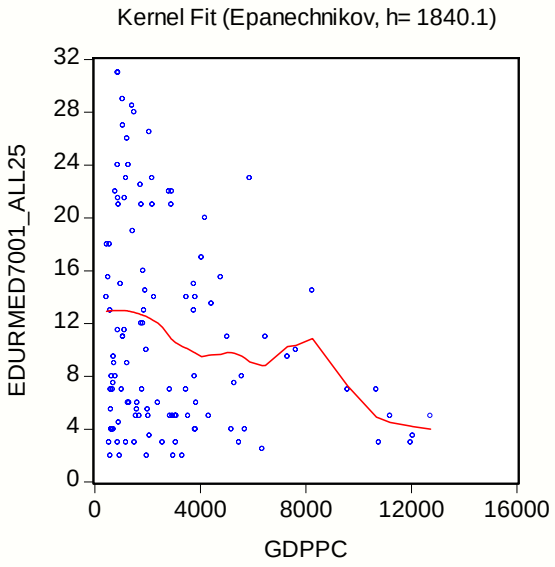


Duration of output drops against 1970 income level

Mean duration



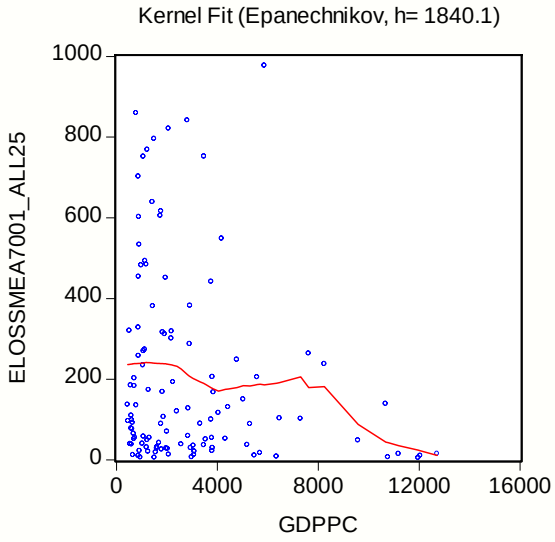
Median duration



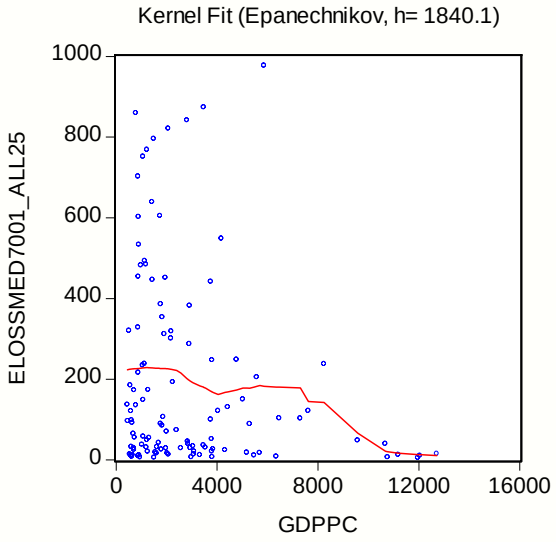
Note: The sample was restricted to countries with GDP per capita below US$16,000 in 1970 (excludes United Arab Emirates, Switzerland, Kuwait, and Qatar) and those with median output loss below 1,000 percent of GDP (excludes Comoros, Lybia, and Niger).

Loss during output drops against 1970 income level

Mean loss

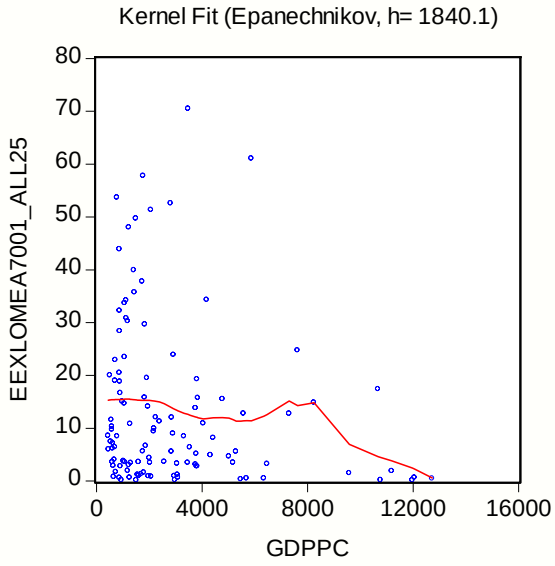


Median loss

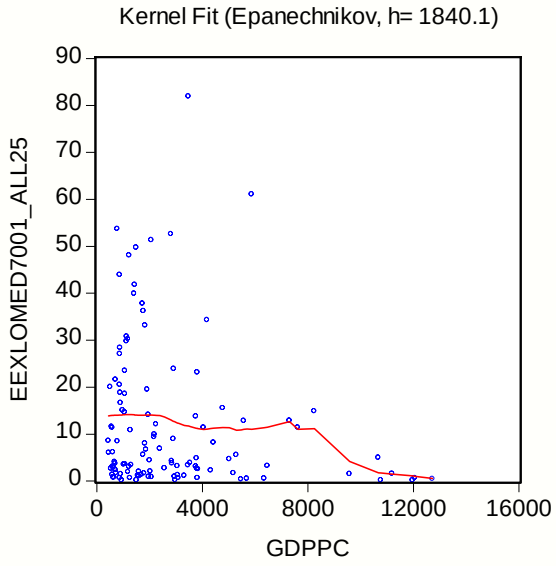


Expected loss of output drops against 1970 income level

Mean loss



Median loss



APPENDIX III. DATA SOURCES AND DEFINITIONS

Data on per capita GDP are purchasing power parity adjusted (1990 international Geary-Khamis dollars), drawn from Maddison (2003). For the purposes of the present study, the sample period is limited to 1970–2001, yielding 4,882 country-year observations. At the end of the sample period, the data cover 167 countries. The shock dates or the criteria for identifying shock dates are mainly based on existing studies. As different studies analyze different types of shock, samples vary and in general do not cover the same extensive set of country-years available for the output data.

Financial and macroeconomic shocks. The dummy for a *currency crisis* takes the value of one if the following three conditions (as in Frankel and Rose, 1996) hold at some point during the calendar year: (i) devaluation/depreciation of at least 25 percent cumulative over a 12-month period; (ii) devaluation/depreciation rate by at least 10 percentage points greater than in the preceding 12 months; (iii) a minimum of 3 years since last crisis. Given the relatively large depreciation/devaluation required, the definition of a currency crisis seems geared toward emerging and developing countries; nevertheless, to ensure consistency, the same definition was applied to all countries, using data drawn from the IMF's *International Financial Statistics*. The *banking crisis* dummy takes the value 1 if at least one of the following studies identifies the country-year as an outbreak of a banking crisis: Kaminsky and Reinhart (1999), Vila (2000), Bell and Pain (2000), Caprio and Klingebiel (2003), and Demirguc-Kunt and Detragiache (2005). The use of several studies produces a large sample, though the definition of a banking crisis is not identical across studies. Using banking crisis dates drawn from only one study does not change the main results. The *debt crisis* dummy records a 1 if at least one of the following studies identifies the country-year as the beginning of a debt crisis: Detragiache and Spilimbergo (2001), Manasse and Roubini (2005) and Reinhart, Rogoff, and Savastano (2003). The dummy for a *sudden stop* takes the value of 1 when the financial account balance worsens by more than 5 percentage points of GDP compared with the previous year, though the main results hold using alternative numerical thresholds. Other definitions of sudden stops are possible: for example, a decline in flows by more than two standard deviations, based on the individual country's distribution (Calvo, Izquierdo, and Mejia, 2004). Other things equal, however, a threshold based on percentage points of GDP will identify more episodes in countries with volatile financial flows, whereas a threshold based on standard deviations will identify a considerable number of episodes even for countries whose flows are stable by international standards. Indeed, some studies use a combination of criteria, such as the 5 percentage point of GDP cutoff together with a one standard deviation cutoff (Guidotti, Sturzenegger and Villar, 2004). An advantage of the definition used here is its simplicity. It should be noted that in a few cases, however, countries maintain a positive and substantial financial balance even after a large and rapid worsening. These "sudden slowdowns" in inflows are kept as part of the list of sudden stops because, like other sudden stops, they require a decumulation of reserves or a reduction in the current account deficit.

Country-specific external shocks. Shocks to the *terms of trade* are defined as a 10 percent worsening in the terms of trade of goods, based on data drawn from the IMF's *World Economic Outlook*. The dummy variable for *disasters* takes the value of 1 if the number of

injured times 0.3 plus the number of killed is greater than 0.01 percent of the country's total population; the data are drawn from EMDAT, published by CRED (www.em-dat.net).

Socio-political shocks. Data from the Correlates of War project was used to construct a *war* dummy, which records a 1 in the first year of a war. *Shocks to the political system* are defined as a deteriorations by 3 points or more in the Polity index published by the Polity IV project (see Marshall and Jaggers, 2002, for a definition of the variable). The data are drawn from http://www.cidcm.umd.edu/inscr/polity/ (Center for International Development and Conflict Management, University of Maryland; and Center for Global Policy, George Mason University).

Global shocks. The global *interest rate* shock takes the value 1 when the U.S. federal funds rate increases by more than 150 basis points in one year. *Oil price* shocks refer to the first year of these episodes (i.e., 1973, 1978, 1989, 1999), drawn from IMF (2004).

Boom-bust cycles. The dummy variable records a 1 in the year after the *lending boom* ends. Lending boom dates are drawn from Gourinchas, Valdés and Landerretche (2001, Table A1). A *growth boom* is defined as a three year period with an average real GDP growth rate exceeding by two standard deviations the country's average growth rate estimated over the entire sample. The dummy variable takes the value 1 in the first year after such an episode.

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