Financial Crises and Economic Activity

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Abstract

We study the output costs of 40 systemic banking crises since 1980. Most, but not all, crises in our sample coincide with a sharp contraction in output from which it took several years to recover. Our main findings are as follows. First, the current financial crisis is unlike any others in terms of a wide range of economic factors. Second, the output losses of past banking crises were higher when they were accompanied by a currency crisis or when growth was low at the onset of the crisis. When accompanied by a sovereign debt default, a systemic banking crisis was *less* costly. And, third, there is a tendency for systemic banking crises to have lasting negative output effects.

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1. Introduction

August 2009 marks the second anniversary of the start of the first global financial crisis of the 21st century. World output has experienced its sharpest drop since the Great Depression of the 1930s, with most economies contracting in late 2008 and early 2009. The severity of the crisis has surprised nearly everyone. But some of the causes of the financial implosion have been noted for some time. For example, as early as 1986, there were warnings about the tendency of new financial instruments to be underpriced.[1] And, more recently there were concerns about the dangers of asset price bubbles and credit booms.[2] Detailed investigations into exactly what went wrong will surely occupy at least one generation of researchers.

Our objective here is not to explain the causes of the current crisis. Instead we study the consequences. To do that, we examine the evolution of the real costs of financial crises to get some sense of when things are likely to improve.

Banking crises have plagued the world for centuries, leaving virtually no region or generation untouched.[3] But while they may be quite common, financial crises also tend to be quite diverse. Initial conditions are different; industrial and institutional structures are different; levels of development are different; degrees of openness are different; policy frameworks are different; and external conditions are different. The fact that crises are, in the words of Reinhart and Rogoff (2008a), "an equal opportunity menace" makes designing appropriate policy responses extraordinarily challenging.

Policymaking is about numbers – namely, about the magnitude and timing of reactions to adjustments in policy settings. A 100 basis point change in the interest rate or a fiscal stimulus amounting to 1 percentage point of GDP will influence growth and inflation, but by how *much*? And what is the *timing* of the impact? These questions, and many more like them, are central to policymaking. *And they can be answered only by looking at historical experience*. Thus, doing the statistical analysis requires data that come from an environment similar to the one we face today. Difficult in normal, tranquil times, relying on history to predict the likely evolution of the economy after a crisis is even worse.

In our view, making any progress at all requires separating the ordinary from the extraordinary. We believe that it is not possible to study crisis times by looking at models

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1 See the introduction in BIS (1986).

2 See Crockett (2000)

3 Reinhart and Rogoff (2008a) report that, over the past two centuries, the 66 countries they study have experienced 286 banking crisis, 105 of which have come since 1945. On average, countries have been in crisis for roughly one year out of every 12.

estimated during normal times. Economic behaviour is inherently nonlinear, so the linear approximation of existing empirical models is likely to be very inaccurate.[4]

Turning to the question at hand, we study crises and the related contractions in the real economy, restricting our analysis to the period identified in this way. That means several things. First, we sort the data before studying it. Second, we look at the tails of the distribution – crises are (relatively) infrequent. Third, we look for commonality among the crises we study – assuming that some exist. And finally, we conduct an entirely empirical analysis – studying data, not theoretical models. Moreover, throughout our analysis, we make no attempt to characterise the circumstances under which a crisis is likely to occur; instead, we condition our entire analysis on the fact that a crisis exists.[5]

We use information on 40 crises in 35 countries since 1980 to study the length, depth and output costs of systemic banking crises. First, we discuss the mechanisms that seem to be at work in transmitting the financial sector disturbances to the real economy. Next, we present the data and then group the crises, looking for similarities. This initial look at the data leads us to conclude that (1) most, but not all, systemic banking crises coincide with a sharp contraction in output from which it takes several years to recover, and (2) the current financial crisis is unlike any others in the dataset. That second point means that simply averaging outcomes of past crises to get a reading on the current one is likely to be misleading regardless of the sample or subsample.

With this in mind we go on to study the determinants of the output losses from past crises – initial conditions, financial structure, level of development, policy reactions, and external conditions. Our findings suggest that the costs are higher when the banking crisis is accompanied by a currency crisis or when growth is low immediately before the onset of the crisis. Furthermore, when it is accompanied by a sovereign debt default, a systemic banking crisis is *less* costly. Our multivariate estimates suggest that some of the main economies affected by the crisis will regain their pre-crisis levels of output by the second half of 2010 (but the confidence interval around this prediction is large!).

The final part of the paper takes a longer-term view and studies the impact of crises on potential output several years down the road. Cerra and Saxena (2008) show that financial crises tend to have permanent effects on output, which are not taken into account in standard estimates of the costs of crises. Our results are consistent with this, as we find that many systemic banking crises have had lasting negative effects on the level of GDP. And

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[4] Even if we were to ignore the problems caused by linearisation, we would have no way of reliably choosing among existing models. The reason is that they are all the same in one important way: they all go through the mean of the data. This means that when they are the most accurate, they are all the same. And when they are not the same, they are inaccurate and their implications are driven by their assumptions.

[5] For a discussion of vulnerabilities that help to predict the onset of a crisis, see Borio and Drehmann (2009).

even in those cases in which trend growth was higher after the crisis than it had been before, making up for the output loss resulting from the crisis itself took years.

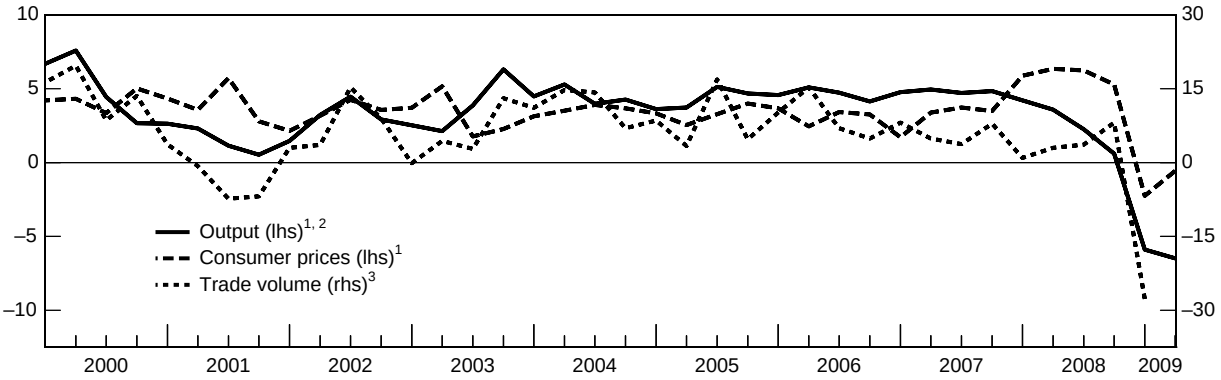
2. The channels of crisis transmission

The current financial crisis has been dramatic, reducing global real activity, trade and inflation to a degree unprecedented since World War II. Annual output growth plunged by more than 10 percentage points, annual trade volumes contracted more than 30 per cent, and consumer prices dropped (Graph 1). What is the mechanism through which the financial crisis led to such an extraordinary fall in activity?

Graph 1

Global output, trade and consumer prices

Annualised quarterly changes, in per cent



[1] Weighted average using 2005 GDP and PPP weights of: the euro area, Japan and the United States; Australia, Canada, Denmark, New Zealand, Norway, Sweden, Switzerland and the United Kingdom; China, Chinese Taipei, Hong Kong SAR, India, Indonesia, Korea, Malaysia, the Philippines, Singapore and Thailand; Argentina, Brazil, Chile, Colombia, Mexico, Peru and Venezuela; the Czech Republic, Hungary and Poland; Russia, Saudi Arabia, South Africa and Turkey. [2] First quarter of 2009 partly estimated using forecasts from JPMorgan Chase. [3] Sum of world exports and imports of goods in US dollars divided by unit values.

Sources: IMF; Bloomberg; Datastream; JPMorgan Chase; national data.

The simplest way to understand the recent crisis experience is to employ a modified version of the framework that has been developed for discussing the channels through which monetary policy affects output and prices. Changes in financial conditions – interest rates in the case of monetary policy, a much broader set of rates, spreads and asset prices in a crisis – affect real activity and inflation both directly and indirectly.

Table 1 adapts the familiar list of monetary transmission channels to the case of a financial crisis. Starting with the *cost of funding*, with the exception of the safest sovereign assets, financial system stress drives up borrowing costs. During the past two years, even though policy rates were falling, the cost of private credit (when it was available) was increasing. In the United States, for example, interest rates on both conventional 30-year mortgages and triple-A long-term bonds rose more than 100 basis points even as the federal funds rate fell 400 basis points. Declining equity prices worldwide also sharply raised the cost of obtaining funding through the stock market.

Table 1: Connecting the financial system to the real economy	
Channel	**Mechanism**
Funding costs	Higher interest rates, higher spreads and lower equity prices increase funding costs, reducing investment
Credit availability	Tighter financial conditions reduce banks' and other financial institutions' willingness to lend
Risk aversion	Higher risk aversion drives up risk premia and leads to flights to quality
Firms' net worth	Lower equity and property prices drive down firms' net worth, increasing the problems of adverse selection and moral hazard
Household net worth	Lower equity and property prices reduce individuals' net worth, worsening creditworthiness, making borrowing more difficult
Exchange rates	Flight to "safe haven" currencies, and reversals of capital flows, affect exchange rates, which have trade effects
Confidence	Consumer, business and investor confidence fall leading to a curtailing of their activities

Higher funding costs raise the threshold rate of return, driving down investment. And higher market rates, if they increase servicing costs on existing debt, could drain funds for new investment as well. This is a likely outcome in a number of countries, as a sizable proportion of corporate borrowing takes the form of revolving short-term loans or fixed-term loans with variable rates. In addition, in a number of countries increases in short-term interest rates affect households directly through adjustments in required mortgage payments. All of this suggests that tighter financial conditions are likely to reduce both corporate profits and households' disposable income.

Not only did the crisis raise the cost of borrowing, it also reduced the *availability of credit* both through the traditional lending channel and through securitisation. While the evidence concerning the existence of a bank lending channel of monetary policy transmission in normal times is mixed,[6] it is widely accepted that disruptions in the financial system curtail the supply of credit directly. During the current crisis, for example, banks (in countries for which we have surveys) have tightened lending standards sharply.[7] While the demand for credit has also declined, this has surely contributed to the reduced quantity of lending to the non-bank private sector we have observed. Beyond this, a number of non-bank lenders have

[6] Kashyap and Stein (2000) found that monetary policy has a stronger impact on small US banks, a result they interpret as evidence for a bank lending channel. In contrast, research covering the euro area in the early 2000s (summarised in Angeloni, Kashyap and Mojon (2003)) finds more mixed evidence for the existence of a bank lending channel.

[7] Exceptions include China, where anecdotal evidence suggests that banks have loosened credit standards as part of the government's stimulus packages.

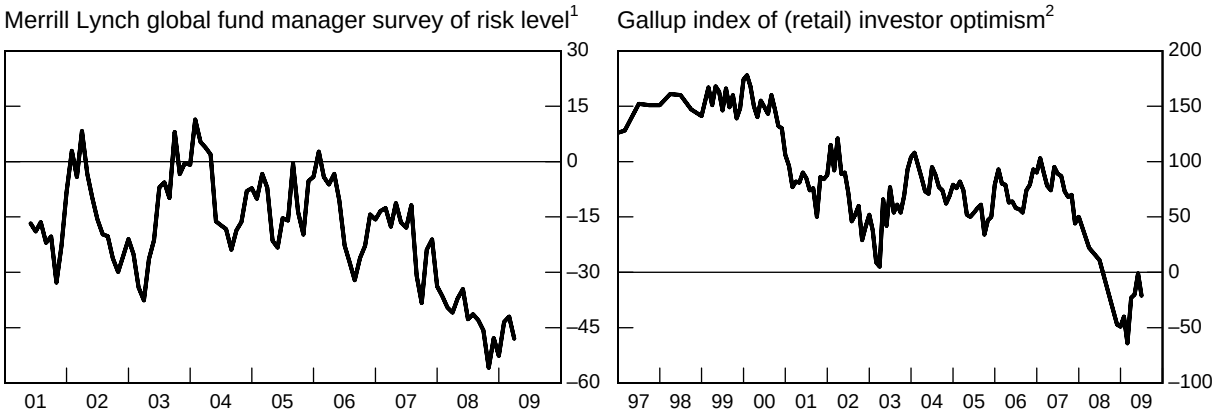
simply disappeared, victims of the crisis. And the collapse of securitisation has reduced loan supply even further.

Contributing to both the increase in funding costs and the decline in credit supply has been the sharp rise in investors' *risk aversion* through 2008 (Graph 2).[8] At the height of the crisis, institutional investors appeared reluctant to hold almost any type of risky asset, although, again, it is debatable whether prices were too high or whether there was a genuine reduction in the supply of funding.

Turning to balance sheets, declines in stock and real estate prices (but also in prices for other assets, such as used machinery) had a direct impact on *corporate net worth*, reducing the quantity of collateral firms had available to back loans

Graph 2

Indicators of investor appetite: investor surveys



[1] Net balance of respondents taking on a riskier investment strategy relative to their benchmark, in per cent. [2] Based on interviews of no fewer than 1,000 US investors with at least $10,000 of investable assets. The index had a baseline score of 124 when it was established in October 1996.

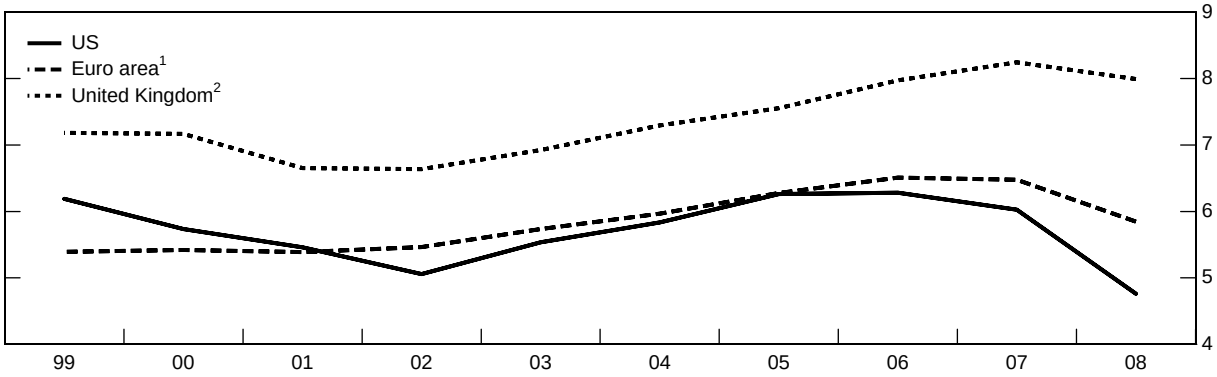
Sources: Gallup; Merrill Lynch.

The sharp drop in equity prices globally and in property prices in some countries has had a an impact through households' balance sheets on their spending and saving. Graph 3 shows the dramatic fall in *household wealth* as a fraction of disposable income. In the United States, the decline was roughly 25 per cent while in the euro area this measure of household balance sheet strength fell 10 per cent and in the United Kingdom the drop was a more modest 5 per cent.

[8] Measures of risk that are based on the volatilities that are implied by options prices show a similar pattern.

Graph 3

Household net wealth as a ratio of disposable income



[1] Estimates of 2008 net wealth based on changes in net worth (excluding revaluation of residential property). [2] Estimates of 2008 net wealth based on changes in net worth due to gross saving and capital transfers.

Sources: ECB; Federal Reserve flow of funds accounts; Datastream; UK Office for National Statistics; national data.

The details of the mechanism through which wealth affects consumption is a matter of some debate. For equities, the logic is clear: a fall in stock prices usually signals deterioration in future profitability. Slower growth means lower incomes and fewer resources to devote to current (and future) consumption. Equity markets may be fickle, often giving one day and taking back the next, but sustained movements really do signal changes in future growth. The meaningfulness of the stock signal contrasts with that from falling housing prices. People own their homes to hedge the risk arising from potential changes in the price of purchasing housing services. They want to make sure that they can continue to live in the same sized home. A fall in property prices thus means that people are consuming less housing (in nominal terms), not that they are less wealthy. Regardless of the soundness of that argument, there is at the very least a channel leading from residential property prices, through collateral value, to credit access. Declines in housing prices have a clear impact on the health of household balance sheets.

Beyond these standard wealth and collateral effects, crisis-induced declines in housing prices lead individuals to shift from less liquid assets to more liquid financial assets in response to increased financial vulnerability. And finally, there is the impact on retirement saving that arises from the decline in asset values for individuals in defined contribution pension schemes.

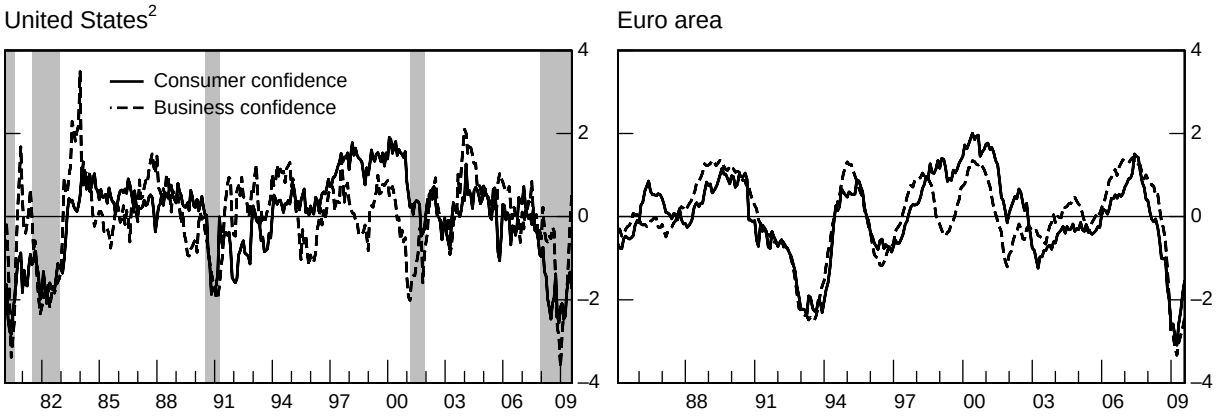
Financial crises affect economic activity through their effect on *exchange rates* as well. Individual countries' crises often suffer from capital flight, resulting in a depreciation of their currency. In the current global crisis, we have also witnessed flight into "safe haven" currencies such as the US dollar and the Swiss franc, and capital flow reversals relating to portfolio consolidations. As a result, some countries have experienced a considerable depreciation of their currency, while others – ironically some of those at the centre of the financial crisis, such as the United States and Switzerland – saw their currency appreciate.

Currency movements clearly influence trade, with depreciation tending to provide a stimulus and appreciation a break on activity. But it is important to keep in mind that otherwise beneficial declines in a country's currency can have negative effects if there are wide-spread currency mismatches in company and household balance sheets.

Finally, there is the impact on *confidence* and the effect this has on real activity. Again, the impact of the current crisis has been striking. Indicators of consumer and business confidence for both the United States and the euro area dropped to their lowest levels in more than two decades (Graph 4).

Graph 4

Confidence indicator[1]

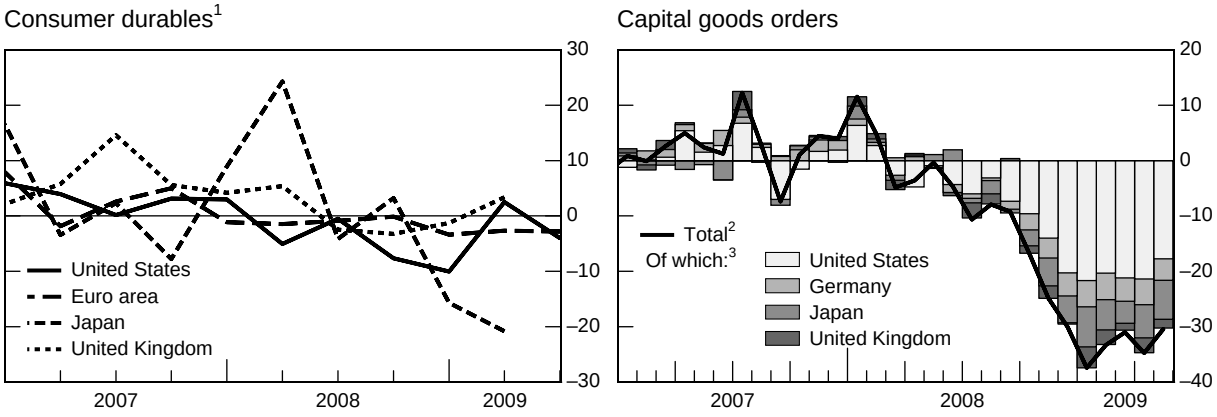


[1] Normalised data, measured as the difference between the indicator and its average (since 1980 for the United States, since 1985 for the euro area), expressed in points of standard deviation. [2] Shaded areas refer to periods of recession dated by the NBER.

Sources: Datastream; national data.

Graph 5

Change in real spending



[1] Including semi-durables; for the euro area, proxied by retail sales excluding food; quarterly changes at annual rates, in per cent. [2] Weighted average based on 2005 GDP and PPP exchange rates; changes over 12 months, in per cent. [3] Contributions, in percentage points.

Source: National data.

Disentangling the effects of the various channels is difficult if not impossible. But it is also not necessary, since all of their outcomes (except for those of the exchange rate in some countries) go in the same direction: downwards. The implication of this is clear in Graph 5: in

the United States and Japan, households cut their spending on durables by 20 per cent, and capital goods orders cumulated to a decline of 40 per cent by the last quarter of 2008. The outcome for GDP growth (Graph 1) is thus not surprising.

3. Examining crises: definitions and comparisons

Identifying a financial crisis

Before you can study financial crises, you have to define them. Unfortunately, there is no universally agreed definition. Rather than try to establish our own, we turn to Laeven and Valencia (2008, p 5), who characterise a systemic banking crisis as events in which

> a country's corporate and financial sectors experience a large number of defaults and financial institutions and corporations face great difficulties repaying contracts on time. As a result, non-performing loans increase sharply and all or most of the aggregate banking system capital is exhausted. This situation may be accompanied by depressed asset prices … sharp increases in real interest rates, and a slowdown or reversal in capital flows. In some cases, the crisis is triggered by depositor runs on banks, though in most cases it is a general realization that systematically important financial institutions are in distress.

This description is similar to that used by Bordo et al (2001), who define a banking crisis as a period of "financial stress resulting in the erosion of most or all of aggregate banking system capital", and by Reinhart and Rogoff (2008a), who define a crisis to be "one of two types of events: (i) bank runs that lead to closure, merger or takeover by the public sector of one or more financial institutions, (ii) in the absence of runs, closure, merger, takeover or large-scale government assistance of an important financial institution (or group of institutions) that marks the start of a string of similar outcomes for other financial institutions".

Our empirical work uses the crisis resolution database of Laeven and Valencia (2008). They identify 124[9] crises between 1970 and 2007 and collect information on the policies implemented during the various stages of 40 crises listed in Table 2.[10] We complement their data for these 40 crises with more detailed information on initial conditions and outcomes.

Crisis resolution tends to be undertaken by national authorities, even if the measures may be coordinated on an international level. For this reason, like many other researchers, Laeven and Valencia define crises along national boundaries. For example, for 1997 they observe separate crises in Thailand, Korea, etc, instead of a single Asian crisis. We follow this approach when defining current events. Instead of a global crisis, we focus on crises in eight

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[9] This number is far lower than the 187 identified by Reinhart and Rogoff (2008a) over this same period. The source of the difference is the definition of a crisis. We note that every crisis in Laeven and Valencia is also in Reinhart and Rogoff. We also note that there are cases in which Reinhart and Rogoff identify two crises but the Laeven and Valencia database includes only one. See Reinhart and Rogoff (2008a), p 83.

[10] The 84 crises we drop are primarily in Africa and small emerging market economies elsewhere, as well those in the United Kingdom and the United States in 2007. The remaining 40 crises all occurred between 1980 and 2007.

Table 2: Financial crises, 1980–2007

	Date	Output loss		
		Length	Depth[1, 2]	Cumulative loss relative to peak[2]
Argentina	03/1980	28	14.1	–44.5
Argentina	12/1989	9	12.1	–16.2
Argentina	01/1995	7	6.1	–5.2
Argentina	12/2001	14	15.1	–26.9
Bolivia[3]	11/1994	0	0.0	0.0
Brazil	02/1990	6	11.4	–6.0
Brazil	12/1994	7	2.5	–1.9
Bulgaria	01/1996	27	42.3	–129.3
Chile	11/1981	21	20.2	–60.1
Colombia	07/1982	0	0.0	0.0
Colombia	06/1998	14	6.8	–11.8
Côte d'Ivoire[3]	01/1988	5	0.4	–0.2
Croatia	03/1998	6	13.5	–8.3
Czech Republic	01/1996	13	2.7	–5.6
Dominica	04/2003	8	1.8	–1.8
Ecuador[3]	08/1998	11	6.3	–9.5
Estonia	11/1992	33	27.3	–116.8
Finland	09/1991	25	11.8	–40.7
Ghana[3]	01/1982	20	13.3	–31.3
Indonesia	11/1997	21	18.1	–50.7
Jamaica[3]	12/1996	25	3.3	–10.3
Japan	11/1997	15	3.4	–6.7
Korea	08/1997	7	9.2	–9.3
Latvia	04/1995	7	19.6	–14.8
Lithuania	12/1995	2	0.6	–0.2
Malaysia	07/1997	9	11.2	–13.8
Mexico	12/1994	9	10.4	–10.7
Nicaragua[3]	08/2000	0	0.0	0.0
Norway	10/1991	3	1.5	–0.6
Paraguay[3]	05/1995	0	0.0	0.0
Philippines	07/1997	6	2.7	–2.2
Russia	08/1998	8	5.3	–5.1
Sri Lanka[3]	01/1989	0	0.0	0.0
Sweden	09/1991	16	5.8	–11.0
Thailand	07/1997	23	14.9	–33.2
Turkey	11/2000	8	9.3	–9.1
Ukraine[3]	01/1998	15	4.4	–10.1
Uruguay[3]	01/2002	18	10.3	–27.0
Venezuela	01/1994	8	6.9	–6.1
Vietnam[3]	07/1997	0	0.0	0.0
Mean		11.4	8.6	–18.4
Median		8.5	6.6	–9.2
Standard deviation		8.9	8.7	28.6

[1] Peak to trough decline in GDP; peak defined using four-quarter window before and after the crisis. [2] In per cent. [3] Annual data.

countries: Germany, Ireland, Japan, the Netherlands, Spain, Switzerland, the United States and the United Kingdom. The group includes some of the economies at the heart of the crisis as well as some of those whose financial system had arguably been in relatively good shape, but which were nevertheless hit by repercussions of the crisis. Instead of assuming that all countries were affected at the same time, we allow for variation as to when the crises started. We assume that it was first felt in the United Kingdom, the United States, and Germany in August 2007 before it spread to Switzerland (in October 2007, when UBS issued its first profit warning) and, in October 2008, to the other four countries.[11]

Real losses arising from financial crises

Having settled on a list of crises, the next task is to characterise the real losses associated with each one. There are two possibilities: the *fiscal costs* of resolution or the *output costs,* relative to some benchmark. In our view, the first of these does not represent real losses, as a very activist policy with a large budget deficit could prevent a sharp general contraction, while a policy of doing nothing would result in a protracted downturn. Fiscal costs are clearly lower in the second instance, but real losses could very well be higher.[12]

For this reason, following the work of Barro (2001), Bordo et al (2001) and Hoggarth, Reis and Saporta (2001), we use output costs as the measure of the real costs of a financial crisis. Rather than constructing a counterfactual for the evolution of GDP in the absence of the crisis, we define the contraction as the period over which output is below its pre-crisis level. The length of the contraction is defined as the number of quarters it takes for output to recover to its pre-crisis level, and depth is defined as the peak to trough percentage decline in GDP.[13] In addition, we measure the cumulative loss in GDP over the length of the crisis, taken as a fraction of its peak (pre-crisis) level.

Characterising a crisis

Table 2 reports estimates of the costs of the 40 crises in our sample, together with some summary statistics. Graph 6 collates the same information in a series of histograms to give an idea of the distribution on the costs. The median length of a crisis-related contraction is 8.5 quarters, median depth nearly 6.6 per cent of the pre-crisis GDP peak and median loss (relative to peak) is 9.2 per cent of GDP.[14]

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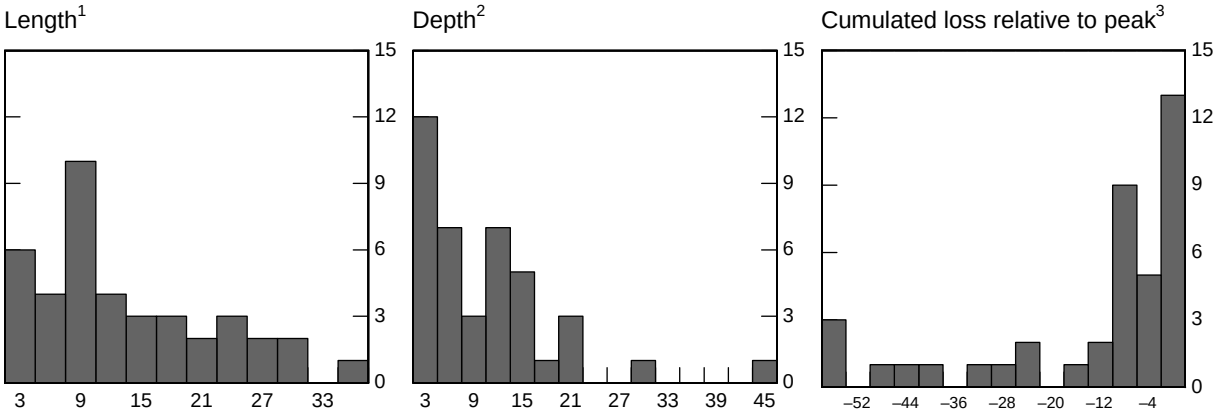
[11] To check robustness, we replicated all computations assuming the current crisis started in August 2007 in all countries. The results are very similar except where indicated in the text.

[12] This discussion does not mean that fiscal costs are not interesting in their own right, merely that they are not a good proxy for the real losses arising from a financial crisis. See eg Goodhart and Schoenmaker (2009).

[13] The pre-crisis GDP level is measured as the peak GDP level within one year either side of the crisis date. The length of the crisis-related contraction is measured starting in the quarter of the peak GDP level.

Graph 6

Measures of crisis cost



[1] In quarters; number of quarters until real GDP reverts to the peak, which is defined by using a four-quarter window before and after the crisis to screen out the maximum value in that time frame. The onset of crises is as in Laeven and Valencia (2008), see also Table 2. [2] In per cent; peak to trough decline in real GDP. [3] Summation of deviations in real GDP in each quarter (from the peak described in note 1), as a percentage of peak GDP.

Source: Own calculations.

But there is a tremendous diversity in all these measures. In fact, several of the crises were associated with no downturn whatsoever (Bolivia 1994, Colombia 1982, Nicaragua 2000, Paraguay 1995, Sri Lanka 1989 and Vietnam 1997), and several others were associated with contractions similar in magnitude to those arising from ordinary recessions. At the other extreme, a small number of crises were both extraordinarily protracted and deep. Bulgarian real GDP fell 42% in the mid-1990s and took almost seven years to recover to its pre-crisis level. Admittedly, financial disruptions were probably not the only factor explaining that dramatic drop in output, and it is hard to disentangle their impact from the concurrent political crisis and the collapse of the socialist economy. There are also issues with the measurement of GDP in transition economies. However, sharp drops in output of more than 10 percentage points, well beyond what is observed in *normal* business cycles, were also experienced in other economies in crisis, for example in Argentina (1980, 1989 and 2001), Brazil (1990), Chile (1981), Croatia (1998), Estonia (1991), Finland (1991), Ghana (1982), Indonesia (1997), Latvia (1995), Malaysia (1997), Mexico (1994), Thailand (1997) and Uruguay (2002).[15]

4. Determining the size and length of the contraction

The diversity of past crises means that averaging them to obtain an unconditional estimate of the likely impact of current events could be very misleading. But instead of seeing variation

[14] We note that the length, depth and cumulative loss have a correlation between 0.7 (length and depth) and 0.9 (depth and cumulative loss).

[15] This is consistent with the results of Claessens et al (2008) and IMF (2009), who find that recessions coinciding with financial crises tend to be deeper than those that do not.

as a curse, we can view it as an opportunity – by using the divergence across episodes to try to understand the determinants of the length and cost of the contraction following crises using conditional models. The hope is for a better understanding of the likely length and severity of the current contraction.

We attempt to exploit the variation across past crises in two ways: first, creating a comparison group of similar crises that could provide deeper information on how current events are likely to work out, and second, estimating how particular conditions affect the real impact of the crisis. These exercises require the collection of additional information on factors that could influence the real costs of a crisis.

4.1 Possible determinants

Direct testing of the transmission channels identified in section 2 would require a fully specified model of the economy and the financial system. Instead we take a reduced-form approach in which we collect data grouped into six categories:[16]

(1) country characteristics: GDP per capita and financial depth;

(2) crisis characteristics: whether the crisis was accompanied by a currency or sovereign debt crisis, GDP, credit, money growth, and the real interest rate preceding the crisis;

(3) the existence of a boom in the run-up to the crisis, as measured by GDP, credit, money, the real and nominal interest rate, equity prices and property prices;

(4) macroeconomic vulnerabilities, including the outstanding level of government debt and the fiscal balance, the current account, the net stock of foreign assets, and the deviation of the real exchange rate from its long-term average;

(5) the nature of response during the crisis, including deposit freezes and guarantees, bank mergers, nationalisations and closures;

(6) external conditions in the years after the start of the crisis, such as growth in the rest of the world, trading partner growth (this will capture changes in trade that are driven by changes in external demand), equity volatility, global risk aversion, and the presence of crises elsewhere.

In the absence of a single coherent theory that links the financial system to the real economy, we chose a set of variables that could plausibly influence the real output costs of a crisis. Many of these variables have already been used in the literature on early warning models,[17] although there are some differences: early warning models require indicators to be

[16] A list of the individual variables is given in the Appendix in Table A.1.

[17] Recent contributions are Demirgüc-Kunt, Detragiache and Gupta (2006) and Rose and Spiegel (2009).

available well before the onset of a crisis. As we do not have this requirement, not all of our variables are predetermined – for example, the policy response or external conditions clearly are not – but they are likely to have an impact on the severity of the contraction associated with a crisis.

We employ these various crisis characteristics in two ways: cluster analysis to identify historical episodes that can provide some insights into current events and regression analysis to obtain predictions for the current crisis.

4.2 Cluster analysis

Cluster analysis allows us to assign sets of observations to subsets that are similar, given a set of characteristics. Apart from the choice of the characteristics, however, the technique allows the investigator to remain agnostic. It groups observations into clusters by minimising differences within clusters and maximising differences across clusters. Cluster analysis is widely used in quantitative social research to analyse datasets with a large number of variables. For example, it allows firms to group clients that may be receptive to particular ways of marketing, and it helps authorities sort through immigration files in their hunt for terrorists.[18]

The results of the cluster analysis are represented in a dendrogramme (Graph 7).[19] To compare crises on a large number of dimensions, a reduced dataset of 28 crises was chosen in addition to the eight countries analysed for the current crisis (the names of those eight are capitalised in the graph). The graph shows the Euclidian distance (a measure of dissimilarity with respect to all variables) between the crises along the horizontal axis; the country and year of crisis is on the vertical axis. If the Euclidian distance between two observations is below a given threshold level on the horizontal axis – that is they are more similar than the level of dissimilarity we allow – they are joined in a cluster. Observations with distances above the threshold remain separate. Thus, in general, each observation would form its own cluster if the threshold distance is set at zero, and all observations would fall into one cluster if the threshold is set to be sufficiently large.

In Graph 7 we can identify several crises that are fairly similar to each other. The closest are those of Malaysia (1997) and Korea (1997). If the threshold distance is increased, these are joined by Thailand (1997) and Indonesia (1997). The cluster analysis also groups the Swedish (1991) and Finnish (1991) crises early on. By contrast, the Norwegian (1991) crisis

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[18] Applications in economics include Artis and Zhang (2001), Kok Sorensen and Puigvert Gutiérrez (2006) and Marsh and Stevens (2003). A textbook treatment can be found in Tan, Steinbach and Kumar (2006).

[19] In the version of cluster analysis we use, we compute the similarity of the crises in our dataset by computing the sum of the Euclidean distances between the possible determinants listed in Table A.1. To account for the fact that there are fewer variables in some groups than in others, we weigh each group equally. Data availability means that not all variables are included in this part of the analysis.

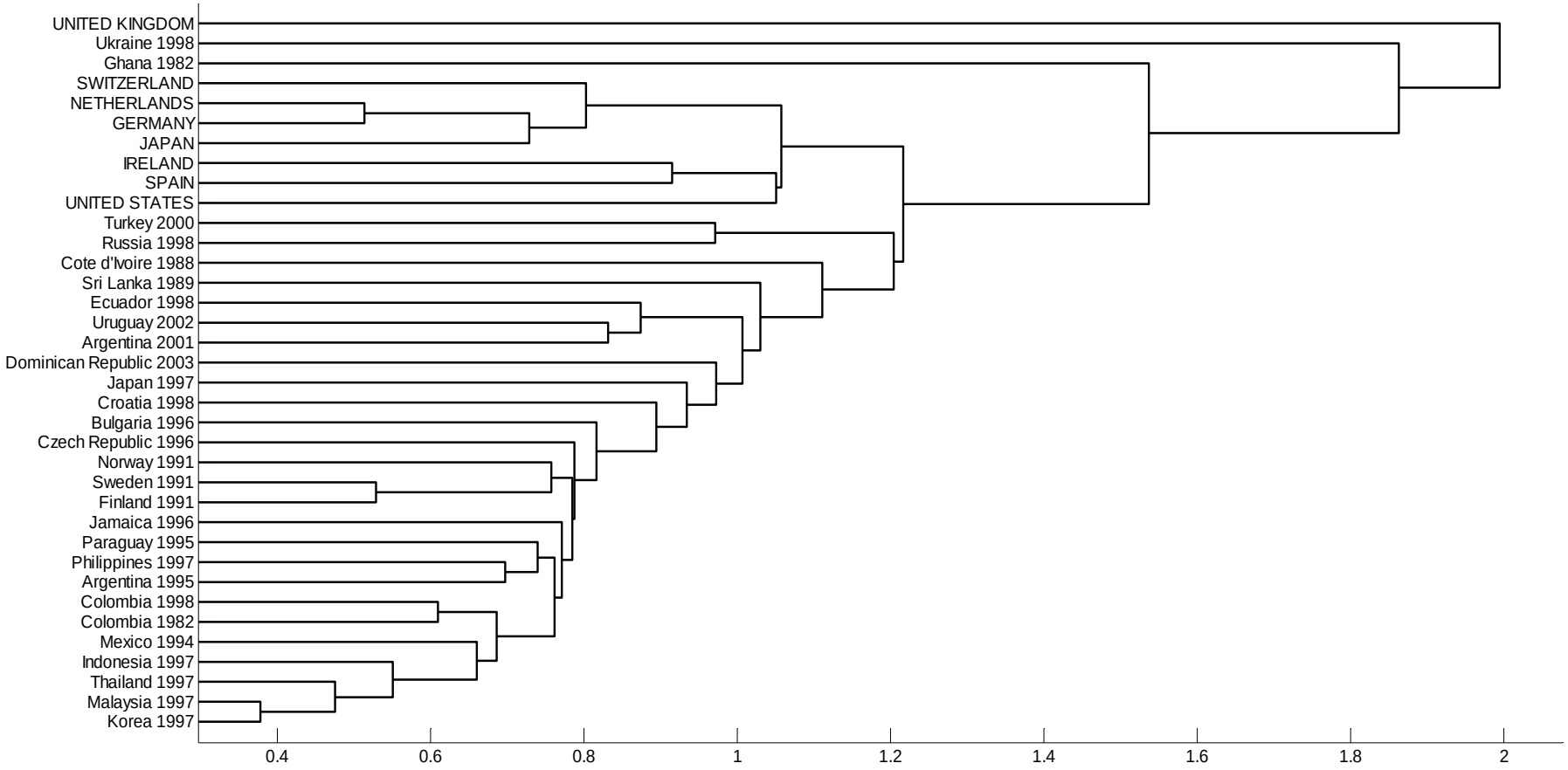
is only slightly less distant from the two contemporaneous Nordic crises than it is from the various Asian crises.

One of the most striking conclusions we draw from this way of looking at the data is that current events are unique. While some of the countries suffering from the current crisis cluster fairly close together – Germany and the Netherlands appear close – they are very dissimilar from all other episodes.[20] In fact, the cluster analysis joins the current crises only after almost all previous crises have joined. The implication is that the current crisis is less similar to all of the crises in our database than, say, the Japanese financial crisis of the 1990s is to the crisis experienced by Ecuador in 1998 or than it is to the crisis that occurred in Bulgaria during the transition!

The uniqueness of the current crisis is an important, if discouraging, result. It suggests that using simple comparisons with a selected group of previous crises, as done by Reinhart and Rogoff (2008b), for example, is unlikely to produce better results than simply averaging across all previous episodes. There simply does not appear to be a good control group with which current events can be compared.

[20] The United Kingdom has the largest distance from any other crises in the sample because of its high level of financial depth. Since the measures of Euclidean distance used in the analysis are sensitive to very large numbers, countries with high values of some variables tend to be shown as outliers. In fact, the United Kingdom clusters close to the United States if the financial depth variable is dropped.

Graph 7: Cluster analysis[1]



[1] Current crises are capitalised.

4.3 Econometric analysis

Can we predict the length and depth of the current crisis given historical experiences? The analysis in the previous sections suggests that crises are very dissimilar and that the current financial crisis is especially different from those that have come before it. As a result, it is difficult to use (unconditional) average past experience to draw conclusions about how deep and long the current contraction of the real economy is likely to be. That said, if we can identify several key drivers of the length, depth and cumulative output loss of past contractions following financial crises, then we can use this information to predict the likely real impact of the current crisis.

Our estimation strategy is as follows: we begin by analysing the bivariate relationships between the depth, length and cumulative output losses of a contraction on the one hand and a long list of candidate drivers on the other. Next we turn to some simple multivariate regressions. Finally, we use the multivariate regression estimates to construct out-of-sample predictions for the severity of the current contraction.

Table 3 shows the results of the bivariate regressions on the characteristics listed in Table A.1. Not surprisingly, given that crises are multifaceted phenomena that are not easily captured by one driver, many of the coefficients are small, or imprecisely estimated, or both. Nevertheless, a number of variables stand out.

First, the level of economic and financial development, as measured by either per capita GDP or credit to the private sector as a percentage of GDP, have little correlation with any of the measures of output loss. In other words, the length, depth and cumulative output losses of the contractions associated with financial crises appear to be unaffected by whether a country is rich or poor or whether it has a small or large financial sector.

In contrast, crisis characteristics do seem to matter. For example, a country that also faces a currency crisis has, on average, a longer and deeper contraction (by six quarters and 6 per cent of GDP at the trough, respectively).[21] Furthermore, high growth immediately prior to the onset of a crisis is associated with shorter and shallower contractions. A country that has 1 percentage point higher GDP growth in the year before the crisis has a shorter and shallower contraction (by one quarter and 0.5 per cent of GDP, respectively). This result confirms our belief that recession-induced systemic crises have higher output costs than those crises beginning when the economy is growing at a relatively high rate.[22]

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[21] This contrasts with results by Hutchison and Noy (2005), who find no evidence for an additional feedback between currency and banking crises.

[22] We get a similar, albeit less precise, result when looking at average GDP growth during the three years preceding the crisis.

The evidence on the importance of boom-bust cycles is mixed. Among the variables capturing a boom, the credit gap and the money gap stand out. While a crisis following a credit boom does appear to have larger output costs, it is not by much – our estimates suggestion that a one standard deviation (17 percentage points) higher credit or money gap increases the length of a crisis by less than 2 quarters.

Table 3: Explanatory variables' bivariate regressions

	Length		Depth		Cumulative loss relative to peak[1]	
	Coefficient	P-value	Coefficient	P-value	Coefficient	P-value
Country characteristics						
GDP p.c.	0.214	0.39	–0.030	0.87	0.224	0.64
Credit-to-GDP	0.056	0.08*	0.017	0.47	-0.097	0.21
Crisis characteristics						
Curr. Crisis	**6.44**	**0.03****	**6.27**	**0.02****	–13.57	0.14
Sov. Debt Crisis	–3.60	0.18	–3.35	0.25	11.18	0.11
ΔGDP(-1)	**–0.990**	**0.00*****	**–0.687**	**0.00*****	**2.972**	**0.00*****
ΔCredit(-1)	0.014	0.08*	–0.006	0.45	0.003	0.90
ΔM(-1)	0.047	0.32	–0.043	0.29	–0.048	0.66
r(-1)	–0.052	0.31	**–0.074**	**0.03****	0.192	0.06*
Boom						
ΔGDP(-3)	**–0.770**	**0.03****	–0.595	0.10*	2.473	0.10*
ΔCredit(-3)	–0.003	0.91	–0.038	0.29	0.103	0.40
ΔM(-3)	–0.026	0.72	–0.049	0.60	0.182	0.52
r(-3)	0.021	0.80	–0.075	0.17	0.192	0.28
i(-3)	0.043	0.60	0.139	0.33	–0.438	0.35
Creditgap(-1)	**0.088**	**0.02****	**0.078**	**0.04****	**–0.239**	**0.03****
Moneygap(-1)	**0.076**	**0.02****	**0.075**	**0.01*****	**–0.188**	**0.00*****
Stockprice(-3)[2]	–0.075	0.35	–0.004	0.95	0.017	0.94
Houseprice(-3)[2]	0.401	0.43	0.148	0.63	–0.124	0.89
Stockgap(-1)[2]	**–0.158**	**0.04****	–0.036	0.47	0.190	0.13
Housegap(-1)[2]	–0.314	0.72	–0.093	0.83	1.236	0.43
Vulnerabilites						
Gov.debt[2]	–0.025	0.56	–0.009	0.86	–0.046	0.78
Fiscal Balance	**0.618**	**0.04****	0.255	0.35	–1.438	0.18
Current Account	0.366	0.06*	0.234	0.28	–0.666	0.23
Net Foreign Assets_CB	0.086	0.28	0.100	0.16	–0.371	0.20
REER gap	**0.069**	**0.00*****	0.029	0.28	–0.096	0.22

Table 3: Explanatory variables' bivariate regressions (cont'd)

Policy response						
Deposit Freeze	0.286	0.91	2.773	0.18	1.482	0.82
Bank Holiday	1.833	0.44	2.591	0.25	–1.641	0.80
Blanket Guarantee	3.905	0.18	0.035	0.99	1.907	0.80
Liquidity Support	**5.000**	**0.07***	3.238	0.24	**–14.667**	**0.03****
Liq. Support (in %)	0.011	0.59	0.030	0.10	–0.069	0.35
Forbearance	2.524	0.36	2.399	0.34	**–13.528**	**0.05****
Government Intervention	**4.833**	**0.01*****	0.618	0.81	**–12.242**	**0.04****
Bank Closures[2]	0.092	0.42	0.257	0.12	–0.676	0.20
Bank Nationalisation	**7.054**	**0.01*****	**5.055**	**0.06***	**–16.143**	**0.05****
Bank Mergers[2]	4.583	0.11	1.162	0.72	–3.395	0.74
Sales to Foreigners[2]	3.586	0.23	1.437	0.63	–5.536	0.59
Bank Restructuring[2]	3.263	0.25	–0.046	0.98	3.512	0.64
Asset Management Company	4.333	0.12	1.140	0.67	–9.329	0.26
Recap. costs[2]	**0.306**	**0.02****	**0.288**	**0.02****	–0.672	0.16
External conditions						
ΔTrading PartnerGDP(+3)	–0.514	0.78	–1.941	0.13	4.245	0.26
ΔWorldGDP(+3)	–2.903	0.18	–1.939	0.10*	6.659	0.12
Risk Aversion Index(+3) [2]	–0.548	0.45	–0.489	0.55	1.657	0.42
VIX (+3) [2]	–0.116	0.76	–0.079	0.80	0.830	0.52
No.CrisesWorld	–0.102	0.53	–0.012	0.93	0.009	0.98
No. CrisesRegion	–0.612	0.16	–0.058	0.88	0.074	0.95

[1] Losses are defined as negative, so a positive coefficient implies lower output losses. [2] These variables were excluded from the cluster analysis and the multivariate regressions because of the low number of observations; see Appendix, Table A.2. All variables as defined in the Appendix, Table A.1

Next, we find that countries exhibiting traditional vulnerabilities such as a high level of the real exchange rate (relative to trend) have a tendency to have longer – but not necessarily deeper – contractions following financial crises.[23]

Turning to policy, the results confirm that severe crises are associated with stronger responses. For example, bank nationalisations and larger government-financed recapitalisations are accompanied by longer and more costly contractions. This surely

[23] The level of the fiscal balance relative to GDP appears also to be statistically significantly related to the length of the contraction, but the relationship has an economically counter-intuitive sign: a higher surplus position at the beginning of the crisis is related to a longer contraction. This result carries over to the multivariate regression reported below where the fiscal position is found to be significant at the 90 per cent level in explaining length, but with a positive coefficient. However, the coefficient is small, with a one per cent higher surplus implying a contraction that is longer by less than one month. We have therefore not included this variable in our preferred specification.

reflects the fact that these policy responses are both dramatic and likely to occur only when the fallout from the crisis is already severe. For the same reasons, a variety of other government interventions – liquidity support, forbearance, deposit freezes and bank holidays – are associated with more severe recessions that lead to higher output losses.

Finally, and somewhat surprisingly, external conditions do not seem to be related to economic performance following a crisis. However, this may reflect the limited cross-sectional variation in these variables as much as a lack of influence of these factors. None of the crises in our sample coincided with a worldwide slowdown in growth and trade volumes that came close to what we have witnessed in the current episode.

Bivariate correlations are clearly incapable of providing us with a full, conclusive picture of the factors that are most likely to influence real growth in the aftermath of a financial crisis. With this in mind, we construct a multivariate model for the three measures of crisis severity – length, depth and cumulative output loss – using 31 of the 44 candidate variables in Table 2 (the table notes the 13 variables excluded). The vast number of possible models, combined with a lack of theoretical guidance, means that we have inevitably exercised judgment in arriving at a parsimonious, economically meaningful model.[24]

Table 4 reports our preferred model. These are specifications that are robust across different sample sizes and specifications. Looking at the included variables and their coefficients, we see that the results are largely in line with those of the bivariate regressions. The *length* of the contraction following systemic banking crises is strongly related to the following variables:

- the growth of GDP in the year before the crisis (*higher* growth implies a shorter contraction);
- the presence of a currency crisis (*longer* by more than five quarters, on average);
- the presence of a sovereign debt crisis (*shorter* by more than seven quarters, on average);
- whether an asset management company has been set up (*longer* by more than five quarters).

The association of a sovereign debt crisis with a shorter contraction may seem surprising at first, but it is quite robust:[25] most of the crises in our sample that were associated with a

[24] We also experimented with principal components to summarise the information content of the variables belonging to a particular variable group. However, it turned out that the number of principal components required to explain a satisfactory fraction of the variation in the underlying variables was quite large and that the fit of the regressions using principal components was rather low.

[25] We note that this result is not a consequence of the interaction of currency crises with sovereign debt crises. Either coefficient remains significantly different from zero when the other variable is dropped.

sovereign debt crisis[26] were both short and shallow. The reason is that in many crises significant amounts of debt were held by foreigners, so a sovereign default freed up resources that could be used domestically rather than being transferred abroad. Given that the current crisis is centred in advanced economies, where a substantial fraction of government debt is held internally, this finding is of little practical importance today.

Turning to the *depth* of the contraction, it is strongly related to whether it was accompanied by a currency crisis (6 percentage points more GDP loss at its worst point) or a sovereign debt crisis (7 percentage points shallower) and to the GDP growth in the year preceding the crisis (lower growth implies a deeper contraction).

Finally, looking at our preferred model for the *cumulative output loss*, we note that this overall measure of cost is most closely related to whether a crisis was accompanied by a sovereign debt crisis (25 percentage points lower loss) and whether GDP growth was higher in the year preceding the crisis. Both these variables are likely to reflect their importance already seen for the length and depth of the contraction. Regulatory forbearance was also associated with higher cumulative losses.

Table 4: Multivariate models for cost of crisis (preferred models)

	Dependent variable					
Explanatory variable	Length		Depth		Cumulative output loss	
Constant	5.79	(0.00)	6.34	(0.00)	–12.82	(0.00)
Curr. Crisis	5.63	(0.00)	6.00	(0.02)		
Sov. Debt Crisis	–7.58	(0.02)	–6.93	(0.01)	24.98	(0.00)
ΔGDP(–1)	–1.00	(0.00)	–0.70	(0.00)	3.14	(0.00)
Asset Management Company	5.60	(0.00)				
Forbearance					–14.14	(0.03)
Adjusted R^2	0.67		0.31		0.41	
No. of observations	39		39		39	

Numbers in brackets are p-values, based on White heteroscedasticity-consistent standard errors and covariances. Variables as defined in the Appendix, Table A.1.

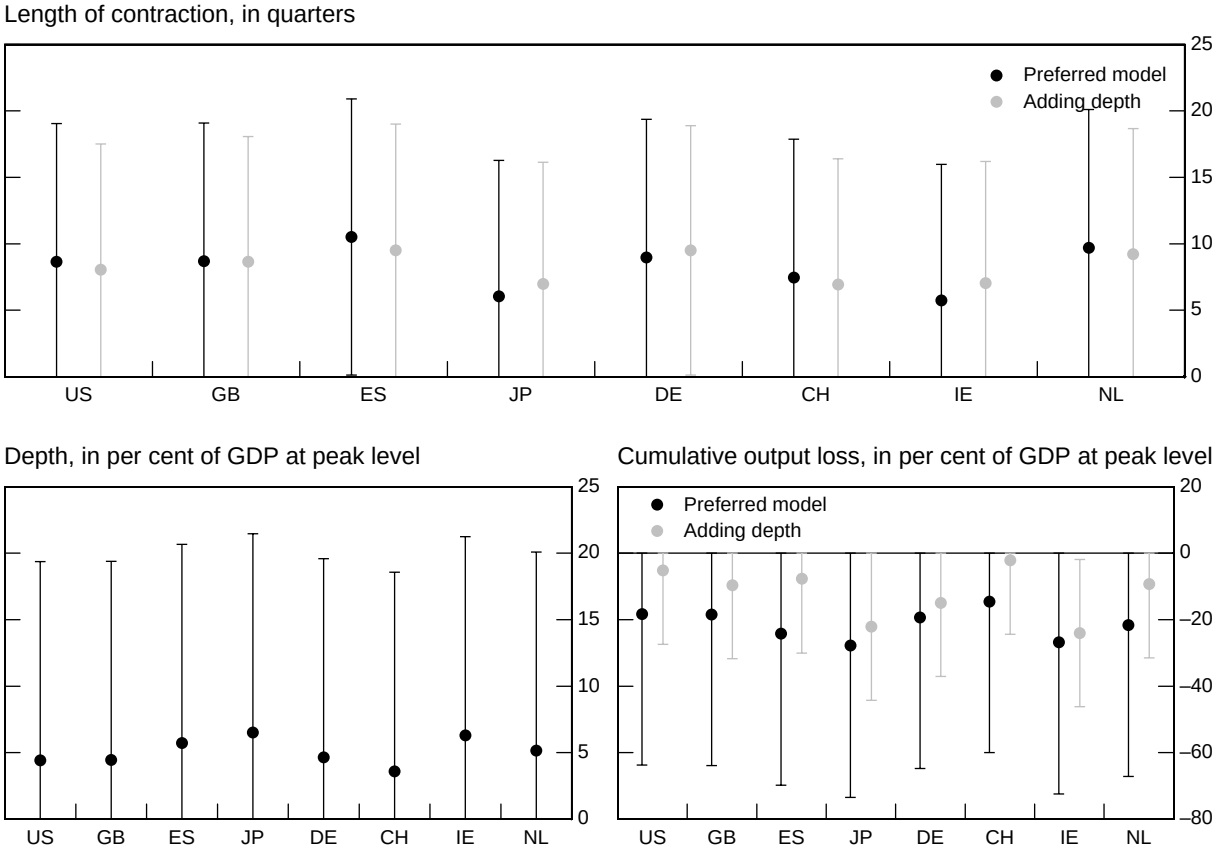
Overall, these three models fit the diverse crisis experiences reasonably well, explaining between 30 and 70 per cent of the variation in the depth and length data respectively. Given this, we use these models to produce predicted values of real output losses for a number of countries in the current crisis (see Table A3 in the Appendix for a list of these countries and

[26] Argentina (2001), Dominican Republic (2003), Ecuador (1998), Russia (1998) and Sri Lanka (1989).

the values of the explanatory variables). As a robustness check, we include a variant of the model for length and output loss that includes depth.[27] Assuming that the trough of the contraction in the current crisis has already been reached, we can now produce a set of predicted values for the length of the current crisis and output losses that will be associated with it for each of the eight countries we selected to assess the current crisis.

Graph 8

Predicted real output costs of current crisis for selected countries



CH = Switzerland; DE = Germany; ES = Spain; GB = United Kingdom; IE = Ireland; JP = Japan; NL = Netherlands; US = United States. Predictions for current crisis using preferred model and preferred model including depth; with 90% confidence intervals.

Graph 8 reports point estimates (the dots) and 90 per cent confidence bands (the lines) for our forecasts of the length, depth and cumulative cost going forward. The estimates are very imprecise. In fact, for some countries the confidence bands imply that we are unable to reject the hypothesis that the length of the downturn will be zero – even though this is clearly not how things have turned out. With this caveat in mind, we note that the mean prediction for the length of the current crisis is that it will be about 10 quarters long. Adding the assumption that the trough has already been reached does not alter this conclusion by much. For example, our point estimates suggest for the United States and the United Kingdom to regain

[27] The model estimates are in the Appendix, Table A.4; in all models, depth is significantly different from zero at the 99 per cent confidence level.

their pre-contraction level of output by the second half of 2010 (note that the length of the contraction is measured from the peak-level of GDP around the crisis, which is the second quarter of 2008 for the US and the first quarter of 2008 for the UK). Our model predicts that Spain and the Netherlands reach their pre-contraction level of output a couple of quarters later, while Japan and Ireland would rebound earlier (in the latter case, this is partly because Ireland's GDP started falling before that of the other countries). Of course, the error bands around these point estimates exceed easily one to two years.

The depth of the crisis-induced downturn will – according to the model – be around 5 per cent of peak-level GDP. But again, the 90 per cent confidence interval around this estimate ranges from zero to 20 per cent. Predicted cumulative output losses are around 20 per cent of peak-level GDP, but as before, the error bands are very wide.

For this prediction exercise, we have chosen the start of the crisis in each economy according to the criteria employed by Leuven and Valencia for the past crises in our dataset. However, our estimates of the length and severity of the current crisis are somewhat sensitive to the exact choice of the starting date. As an alternative, we have therefore analysed the case where we assume the current episode to have started in August 2007 everywhere. Making this change yields results similar to those reported above, with one caveat. In those countries where, according to Leuven and Valencia's criteria, the crisis started later this change leads to the prediction that the crisis will be shorter (this is driven by the onset of the global slowdown after August 2007). The results for Spain and Ireland are most affected, with a predicted length that is 2-3 quarters shorter, depth that is around 2 percentage points shallower, and cumulated output losses that are accordingly lower.

5. What are the long-term consequences of crises for real output?

The question that is most difficult to answer – but perhaps also one of the most interesting – is whether systemic banking crises have long-term effects on the level of real output, its trend, or both. Given the role of potential output and estimates of the output gap in modern macroeconomic policy, this is an issue of very clear importance.

A number of factors might cause financial crises to have a long-run impact on economic activity. High on the list is the rise in the cost of capital that could come from increases in longer-term risk-free real interest rates, rising actual and expected inflation and higher risk aversion. Traditional crowding out might lead to higher longer-term risk-free real interest rates following the sharp increases in government debt arising from the combination of fiscal stimulus and support for the banking system. Actual and expected inflation could rise because of the inflationary impact of central bank balance sheet expansion and the overestimation of the size of the output gap. And, more structurally, the higher equity risk

premia resulting from a re-assessment of risk and increased risk aversion could lead to lower capital accumulation in the long run. In addition, reduced leverage and slower financial innovation may prevent financing for projects that otherwise would have added to productivity growth. Finally, a possible reversal of financial globalization may reduce growth by inhibiting trade and development, although the literature (Kose et al (2009), Rodrik (2009)) has so far had difficulties finding an impact of financial integration on growth.[28]

The empirical challenge of measuring the impact of systemic banking crises on growth is at least as large as the theoretical one. Addressing the empirical question requires computing what the economic growth rate would have been in the absence of a systemic crisis. The accuracy of frequently used statistical methods – such as Hodrick-Prescott filtered trends – relies on the availability of relatively long time series. Obviously, the presence of structural breaks, such as those that might be created by systemic crises, poses significant difficulties. Temporarily lower growth immediately after a crisis as well as the higher growth rates during the recovery period will probably distort estimates for trend growth for many years after the crisis. Excluding the crisis data might appear to offer a solution, but since the length of the resulting contraction is usually not well defined, and sufficient data thereafter have to be available, it is impractical.

That said, we use a very simple approach to examine whether a longer-term change in GDP usually occurs after systemic crises and to estimate whether there is a break in the level and/or the trend of the log of GDP.[29] The equation is of the following form: [30]

$$\ln y_t = \alpha + \tilde{\alpha} D_t + \beta t + \tilde{\beta} D_t t + \varepsilon_t \qquad with \;\; D_t = 0 \; if \;\; t < crisis \;\; date \;\; and \;\; D_t = 1 \; if \;\; t \geq crisis \;\; date$$

where the crisis date is the beginning of the crisis.

We note that Quandt-Andrews (Andrews 1993) tests used to date the most likely break points find that only about half of the crisis periods are associated with breaks in GDP level

[28] The empirical literature has yielded mixed evidence as to whether financial crises affect output in the long term. Using a growth model with crisis dummies, Barro (2001) finds that crises do generally not affect output growth 5 years later. However, this also means that output lost during a crisis may never be recovered. The estimates of Furceri and Mourougane (2009) suggest that crises lower future potential output by roughly 2 percentage points on average. Ramírez (2008) shows that states more affected by the US banking crisis of 1893 grew more slowly over the following decades than other states

[29] An alternative approach is to use estimates for potential output based on production functions (see Furceri and Mourougane 2009), but this is very data intensive, making it unfeasible to study more than a small number of crises.

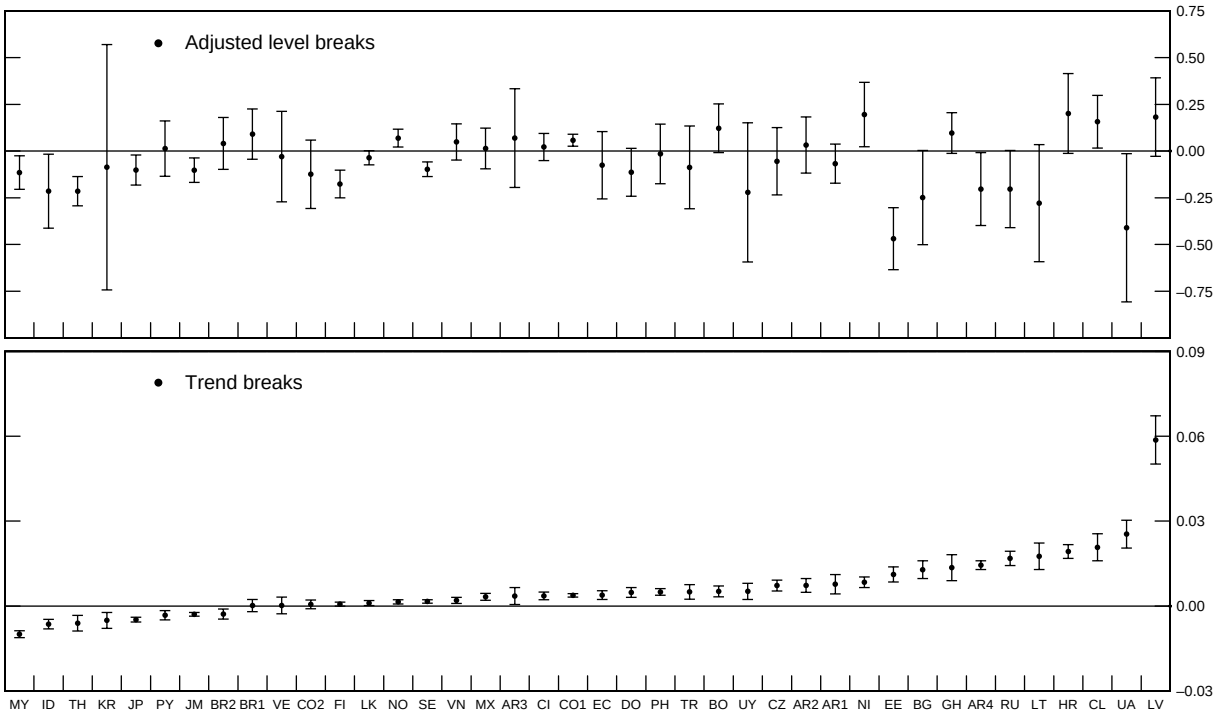
[30] ADF tests indicate that the residuals of this equation are stationary for most of the cases, even though we have relatively short sample periods for many countries. We also estimated our model in first differences; this allows us to test only for a break in the trend growth rate of GDP. The results are very similar to those in the model that allows for a break in both trend and level (see Appendix, Graph A.1).

or trend (or both).[31] The estimated break dates are usually within one to two years of the beginning of the crisis.

Graph 9

Size of the structural breaks

Break in level and trend at the beginning of the crisis[1]



AR = Argentina; BG = Bulgaria; BO = Bolivia; BR = Brazil; CI = Côte d'Ivoire; CL = Chile; CO = Colombia; CZ = Czech Republic; DO = Dominican Republic; EC = Ecuador; EE = Estonia; FI = Finland; GH = Ghana; HR = Croatia; ID = Indonesia; JM = Jamaica; JP = Japan; KR = Korea; LK = Sri Lanka; LT = Lithuania; LV = Latvia; MX = Mexico; MY = Malaysia; NI = Nicaragua; NO = Norway; PH = Philippines; PY = Paraguay; RU = Russia; SE = Sweden; TH = Thailand; TR = Turkey; UA = Ukraine; UY = Uruguay; VE = Venezuela; VN = Vietnam. Crisis dates are as in Table 2, except Q1 1985 for Argentina, Q4 1981 for Chile and Q1 1986 for Ghana, which had to be changed from the official crisis dates since time series of sufficient length to test for breaks at the official dates were not available. The coefficient estimates are marked with dots and the 90% confidence intervals with lines.

Graph 9 shows the results of the estimates $\tilde{\alpha}$ and $\tilde{\beta}$ (the estimated breaks in the level and trend) with 90 per cent confidence intervals.[32] The results show that more than half of the countries experienced a negative shift in the level of GDP, although this is only significant in one fifth of cases overall. The estimated trend growth rates tend to be higher after the crisis, but this is significant in only about half of the cases. In eight cases we find lower trend growth rates, and in most of these – including Malaysia, Indonesia, Thailand and Japan – the crisis is also associated with a decline in the level of GDP. Consistent with our earlier evidence that

[31] We applied the Quandt-Andrews test for unknown breakpoints, with a trimming of 15%. This method yielded breakpoints for almost every country included; a number of these were well outside (and therefore likely unrelated to) any crisis period. A Chow test for known break points suggests that all 40 crises coincide with a break in the level and trend of GDP, but some of these results are likely to reflect other break points of GDP that are unaccounted for in this simpler test. For details, see the Appendix, Table A.5.

[32] The estimated break in the constant is adjusted to reflect the estimated change in the level of GDP at the beginning of the crisis. The level break at the beginning of the crisis is equal to the estimated break in the constant plus γ times the estimated change in the slope, where γ is the time period when the crisis begins (t=0 at the first available observation).

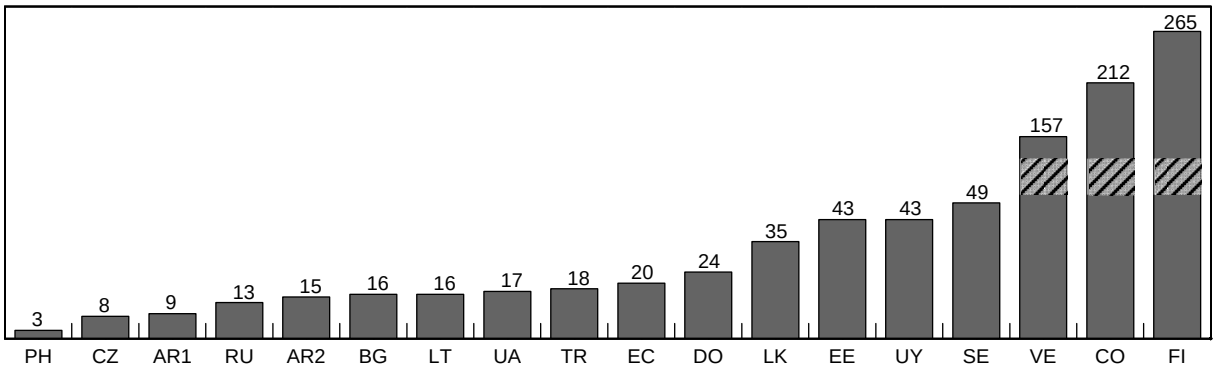
the crisis experience varies substantially across countries, a number of countries show positive, significant breaks in both the level and trend of GDP around systemic crises.

Including the contraction period in the assessment of changes in longer-run level and trend of GDP growth, as we have done so far, could bias our estimates.[33] To check whether this is a problem, we have analysed two alternatives: one in which the post-crisis period starts after the contraction (as we define it) has ended and one where the post-crisis period starts (arbitrarily) three years after the beginning of the crisis (see Appendix, Graph A.2). The results for the sign and size of the breaks in trend and level are very similar to those reported above: many countries have insignificant changes in level or trend of GDP; of those that are significant, a number show falls in the long-run level of GDP and positive significant changes in the level.

Graph 10

Time to recover from crisis-related changes in GDP

Number of quarters



AR = Argentina (AR1 for Q1 1985 and AR2 for Q4 2001); BG = Bulgaria; CO = Colombia; CZ = Czech Republic; DO = Dominican Republic; EC = Ecuador; EE = Estonia; FI = Finland; LK = Sri Lanka; LT = Lithuania; PH = Philippines; RU = Russia; SE = Sweden; TR = Turkey; UA = Ukraine; UY = Uruguay; VE = Venezuela. Crisis dates are as in Table 2, except Q1 1985 for Argentina.

Overall, these results suggest that around the time of a financial crisis, a number of countries experienced a large drop in GDP followed by a longer period of faster GDP growth. But this way of stating the case may paint an overly optimistic picture of a crisis-induced contraction and recovery, since the drops in the level of output may outweigh the faster growth that follows. To assess this issue, we have made a simple computation of the time it takes at the higher post-crisis growth rate to return to the level of GDP implied by the lower pre-crisis growth rate (in the absence of a crisis). Graph 10 shows these results. Even if we exclude the crises in Venezuela, Colombia and Finland, it takes 22 quarters on average for the higher GDP growth rate to compensate for the drop in level.[34]

[33] In most cases, the estimate of the level would be more negative and the estimate of the trend more positive.

[34] This graph includes only the 18 crises where the economy experienced both a drop in the level and a rise in the trend growth rate. In 16 cases, countries had a positive shift in the level and in 6 cases countries had a negative shift in both the level and the trend.

6. Conclusion

Financial crises are more frequent than most people think, and they lead to losses that are much larger than one would hope. On average, there have been between three and four systemic banking crises per year for the past quarter century.[35] Not all of these have had visible real costs, but most have. In the restricted sample of 40 financial crises that we study, fully one fourth resulted in cumulative output losses of more than 25 per cent of pre-crisis GDP. And one third of the crisis-related contractions lasted for three years or more.

Banking crises are also quite diverse. In fact, those that we study appear to be practically unique in their evolution. In an important sense, the average crisis does not exist. Nevertheless, by directing a battery of statistical tools at the historical data, we are able to use the variation across crises to learn a number of things that can provide insights into the likely progression of the current crisis. We find that when a banking crisis is accompanied by a currency crisis, it is more than five quarters longer, and the trough in output is (on average) 6 percentage points lower. And when it comes along with a sovereign debt default, the financial crisis is less severe – nearly two years shorter and 7 percentage points of pre-crisis GDP less deep. Furthermore, we show that if the crisis is preceded by low growth – possibly because it is induced by a recession – it tends to be more severe. For each percentage point that GDP growth is lower, the contraction is longer by one quarter and the trough in activity is 1 percentage point lower.

By altering attitudes towards risk, as well as increasing the level of government debt and the size of central banks' balance sheets, systemic crises have the potential to raise real and nominal interest rates and consequently depress investment and lower the productive capacity of the economy in the long run. We looked for evidence of these effects and found that a number of crises had lasting, negative impacts on GDP. In some countries this was a result of an immediate, crisis-induced drop in the level of real output combined with a permanent decline in trend growth. In other cases, we find that the growth trend increased following the crisis but that the immediate drop was severe enough that it took years for the economy to make up for the crisis-related output loss.

Finally, we were able to find a robust statistical model that can explain a large share of variation in contraction length across past crises. This model predicts that for the current episode, some of the main crisis-affected economies will return to their pre-crisis level of GDP by the second half of 2010.

[35] Reinhart and Rogoff (2008a, Table A3) identify 144 since 1980, while Laeven and Valencia (2008) list 124 over the same period.

Appendix

Table A.1: Variables

Variable	Definition	Source
I. Cost of crises		
Output loss	Output loss	Laeven and Valencia (2008) (hereafter, LV)
Length	Length of contraction: number of quarters until GDP reverts to pre-crisis peak	Own calculations
Depth	Depth of contraction: peak to trough decline in GDP	Own calculations
Cumulative output loss	Cumulative output loss of contraction: cumulative GDP decline during contraction	Own calculations
II. Country characteristics		
GDP p.c.	GDP per capita (PPP)	Own calculations
Credit-to-GDP	Financial depth: domestic credit to private sector as share of GDP, at four quarters before crisis	Own calculations
III. Crisis characteristics		
Curr. Crisis	Currency crisis: 1 = yes, 0 = no	LV
Sov. Debt Crisis	Sovereign debt crisis: 1 = yes, 0 = no	LV
ΔGDP(-1)	Real GDP growth in the year before crisis (t–4 to t)	Own calculations
ΔCredit(-1)	Real private domestic credit growth in the year before crisis	Own calculations
ΔM(-1)	Real broad money growth in the year before crisis	Own calculations
r(-1)	Real three-month interest rate, annualised, four-quarter average before crisis	Own calculations
IV. Boom		
ΔGDP(-3)	Real GDP growth, average annual change in the three years before crisis (t–12 to t)	Own calculations
ΔCredit(-3)	Real private domestic credit growth, average annual change in the three years before crisis	Own calculations
ΔM(-3)	Real broad money growth, average annual change in the three years before crisis	Own calculations
r(-3)	Real three-month interest rate, annualised, 12-quarter average before crisis	Own calculations
i(-3)	Nominal three-month interest rate, annualised, 12-quarter average before crisis	Own calculations
Creditgap(-1)	Real credit gap, defined as deviation from HP trend (in per cent), four-quarter average before crisis	Own calculations
Moneygap(-1)	Real money gap, defined as deviation from HP trend (in per cent), four-quarter average before crisis	Own calculations
Stockprice(-3)	Stock price increase, average annual change in the three years before crisis	Own calculations
Houseprice(-3)	House price increase, average annual change in the three years before crisis	Own calculations
Stockgap(-1)	Stock price gap, defined as deviation from HP trend (in per cent), four-quarter average before crisis	Own calculations
Housegap(-1)	House price gap, defined as deviation from HP trend (in per cent), 4-quarter-average before crisis	Own calculations

Table A.1: Variables (cont'd)

Variable	Definition	Source
V. Vulnerabilities		
Gov.debt	Government debt to GDP, one year before crisis	Own calculations or LV
Fiscal Balance	General government balance to GDP, one year before crisis	Own calculations or LV
Current Account	Current account deficit/surplus to GDP, one year before crisis	Own calculations or LV
Net Foreign Assets_CB	Net foreign assets held by central bank to M2	Own calculations or LV
REER gap	Real effective exchange rate, defined as deviation from HP trend (in per cent), one year before crisis	Own calculations
VI. Policy response		
Deposit Freeze	Deposit freeze: 1 = yes, 0 = no	LV
Bank Holiday	Bank holiday: 1 = yes, 0 = no	LV
Blanket Guarantee	Blanket guarantee: 1 = yes, 0 = no	LV
Liquidity Support	Liquidity support: 1 = yes, 0 = no	LV
Liq. Support (in %)	Liquidity support: per cent of total assets of banking system	LV
Forbearance	Forbearance: 1 = yes, 0 = no	LV
Government Intervention	Large-scale government intervention in banks: 1 = yes, 0 = no	LV
Bank Closures	Bank closures: closed banks as % of total assets	LV
Bank Nationalisation	Bank nationalisation: 1 = yes, 0 = no	LV
Bank Mergers	Bank mergers: 1 = yes, 0 = no	LV
Sales to Foreigners	Sales to foreigners: 1 = yes, 0 = no	LV
Bank Restructuring	Bank restructuring agency: 1 = yes, 0 = no	LV
Asset Management Company	Asset management company: 1 = yes, 0 = no	LV
Recap. costs	Recapitalisation cost to government (gross)	LV
VII. External conditions		
∆Trading PartnerGDP(+3)	GDP growth in top 10 trading partners, weighted average, average annual change in three years after crisis	Own calculations, consensus forecasts for current crisis
∆WorldGDP(+3)	World GDP growth, average annual change in three years after crisis	Own calculations, consensus forecasts for current crisis
Risk Aversion Index(+3)	Global risk aversion index, average during 12 quarters after crisis	Goldman Sachs
VIX (+3)	VIX (Chicago Board Options Exchange Volatility Index), average during 12 quarters after crisis	Bloomberg
No.CrisesWorld	Number of crises in the world occuring in +/- four quarters	Own calculations
No. CrisesRegion	Number of crises in same region occuring in +/- four quarters	Own calculations

Table A.2: Descriptive statistics for variables

Variable	Units	OBS	Mean	Median	Std dev
I. Cost of crises					
Length	Quarters	40	11.4	8.5	8.9
Depth	Per cent	40	8.6	6.6	8.7
Cumulative output loss	Per cent	40	–18.4	–9.2	28.6
II. Country characteristics					
GDP p.c.	US dollar ('000)	40	6.99	5.67	5.52
Credit-to-GDP	Per cent of GDP	38	47.5	29.0	39.7
III. Crisis characteristics					
Curr. crisis	1 = yes, 0 = no	40	0.6	1.0	0.5
Sov. Debt crisis	1 = yes, 0 = no	40	0.1	0.0	0.3
ΔGDP(-1)	Per cent	39	0.5	1.3	5.8
ΔCredit(-1)	Per cent	39	17.1	12.2	55.8
ΔM(-1)	Per cent	39	2.5	2.7	18.3
r(-1)	Per cent	34	6.3	5.9	17.7
IV. Boom					
ΔGDP(-3)	Per cent	38	1.6	2.7	4.5
ΔCredit(-3)	Per cent	35	14.3	11.4	33.3
ΔM(-3)	Per cent	35	7.7	5.4	14.5
r(-3)	Per cent	30	5.2	3.8	13.5
R(-3)	Per cent	30	24.7	15.8	20.1
Creditgap(-1)	Per cent	39	5.2	2.2	17.1
Moneygap(-1)	Per cent	39	3.8	1.0	17.3
Stockprice(-3)	Per cent	20	3.2	–0.3	21.7
Houseprice(-3)	Per cent	5	0.5	–1.6	6.8
Stockgap(-1)	Per cent	21	–1.7	–3.0	20.4
Housegap(-1)	Per cent	5	–3.7	0.2	6.7
V. Vulnerabilities					
Gov.debt	Per cent of GDP	32	46.3	30.0	40.0
Fiscal Balance	Per cent of GDP	40	–2.0	–2.1	4.6
Current Account	Per cent of GDP	39	–3.8	–3.0	5.0
Net Foreign Assets_CB	Per cent of M2	40	18.2	19.1	19.1
REER gap	Per cent	31	10.7	9.5	46.6

Table A.2: Descriptive statistics for variables (cont'd)

Variable	Units	OBS	Mean	Median	Std dev
VI. Policy response					
Deposit Freeze	1 = yes, 0 = no	40	0.1	0.0	0.3
Bank Holiday	1 = yes, 0 = no	40	0.1	0.0	0.3
Blanket Guarantee	1 = yes, 0 = no	40	0.3	0.0	0.5
Liquidity Support	1 = yes, 0 = no	40	0.8	1.0	0.4
Liq. Support (in %)	Per cent	40	28.3	15.1	50.1
Forbearance	1 = yes, 0 = no	40	0.7	1.0	0.5
Government Intervention	1 = yes, 0 = no	40	0.9	1.0	0.3
Bank Closures	Per cent of total assets	37	8.7	2.0	11.9
Bank Nationalisation	1 = yes, 0 = no	40	0.6	1.0	0.5
Bank Mergers	1 = yes, 0 = no	39	0.6	1.0	0.5
Sales to Foreigners	1 = yes, 0 = no	35	0.5	1.0	0.5
Bank Restructuring	1 = yes, 0 = no	38	0.5	0.5	0.5
Asset Management Company	1 = yes, 0 = no	40	0.6	1.0	0.5
Recap. costs	Per cent of GDP	31	8.0	4.3	9.7
VII. External conditions					
ΔTrading PartnerGDP(+3)	Per cent	40	2.5	2.6	0.9
ΔWorldGDP(+3)	Per cent	40	3.2	3.5	0.6
Risk Aversion Index(+3)	Index	36	4.7	4.1	1.6
VIX (+3)	Index	36	21.8	22.9	4.6
No.CrisesWorld	Number	40	18.5	18.0	8.5
No. CrisesRegion	Number	40	4.9	4.5	2.6

Table A.3: Current crisis

	Starting date	GDP p.c.	Credit-to-GDP	Curr. Crisis	SovDebt Crisis	ΔGDP (1)	ΔCredit(-1)	ΔM(-1)	r(-1)	ΔGDP(-3)	ΔCredit (-3)	ΔM(-3)	r(-3)	i(-3)	Credit gap(-1)	Moneyg ap(-1)
United States	08/2007	44119	164	0	0	2.8	7.1	9.2	2.7	2.7	6.7	5.9	1.0	4.1	1.6	2.4
United Kingdom	08/2007	33819	551	0	0	2.7	8.8	10.5	1.2	2.6	8.1	10.6	1.6	5.0	1.7	3.2
Spain	09/2008	30116	175	0	0	0.9	4.3	8.1	0.8	2.8	13.5	10.0	0.2	3.6	1.9	3.8
Japan	09/2008	33573	100	0	0	-0.3	-2.9	-1.6	0.2	1.2	-0.6	-0.8	0.3	0.5	1.2	0.8
Germany	08/2007	32454	112	0	0	2.4	-3.0	6.3	2.0	2.4	-0.8	3.9	1.1	2.8	-0.1	1.5
Switzerland	10/2007	38953	168	0	0	3.9	7.0	1.6	1.9	3.7	6.9	3.9	0.5	1.4	3.9	0.8
Ireland	09/2008	43414	193	0	0	0.1	5.8	-10.7	-0.1	3.7	13.1	8.7	-0.5	3.6	0.8	-7.8
Netherland	09/2008	38995	178	0	0	1.7	12.5	1.7	2.7	2.8	9.0	6.8	2.0	3.6	5.1	1.0

	Starting date	Gov.debt[2]	Fiscal Balance	Current Account	Deposit Freeze	Bank Holiday	Blanket Guarantee	Liquidity Support	Forbearance	Government Intervention	Bank Nationalisation	Asset Manage-ment Comp.	ΔTrading Part-ner GDP (+3)	ΔWorldGDP (+3)	No.Crises World	No. Crises Region
United States	08/2007	60.1	-2.6	-6.2	0	0	0	1	1	1	1	1	-0.2	-0.5	9	9
United Kingdom	08/2007	43.0	-2.6	-3.6	0	0	0	1	1	1	1	1	-1.5	-0.5	9	9
Spain	09/2008	36.2	2.2	-10.1	0	0	0	1	1	0	0	1	-1.0	0.6	9	9
Japan	09/2008	187.7	-2.5	4.8	0	0	0	1	1	0	0	0	1.5	0.6	9	9
Germany	08/2007	66.0	-1.5	6.1	0	0	0	1	1	1	1	1	-0.8	-0.5	9	9
Switzerland	10/2007	47.5	1.7	14.5	0	0	0	1	1	1	0	1	-1.4	-0.7	9	9
Ireland	09/2008	24.8	0.2	-5.4	0	0	1	1	1	1	1	0	-0.6	0.6	9	9
Netherland	09/2008	45.9	0.3	6.1	0	0	0	1	1	1	1	1	-1.1	0.6	9	9

Sources: IMF, authors' estimates.

Table A.4: Adding depth as explanatory variable to preferred models

	Dependent variable			
Explanatory variable	Length		Cumulative output loss	
Constant	4.12	(0.00)	6.51	(0.13)
Curr. Crisis	3.70	(0.01)		
Sov. Debt Crisis	–5.39	(0.01)	9.28	(0.10)
ΔGDP(-1)	–0.78	(0.00)	1.32	(0.02)
Asset Management Company	5.08	(0.00)		
Forbearance			–7.61	(0.08)
Depth	0.32	(0.00)	–2.47	(0.00)
Adjusted R^2	0.73		0.86	
No. of observations	39		39	

Numbers in brackets are p-values, based on White heteroscedasticity-consistent standard errors and covariances.

Table A.5: Dates of crisis and test for breaks

	Chow test for break at specified date[1]				Quandt-Andrews test for break at unknown date[1]			
	Crisis date[2]	α	β	α and β	Break date	α	β	α and β
Argentina	03/1980	✓	✓	✓	Q1 1985	✓	--	--
Argentina	12/1989	✓	--	✓				
Argentina	01/1995	✓	✓	✓	Q1 1992	--	✓	--
Argentina	12/2001	--	--	✓	Q4 2001	--	--	✓
Bolivia[3]	11/1994	✓	✓	✓	Q2 1994	--	✓	--
Brazil	02/1990	✓	✓	✓	Q1 1991	✓	✓	✓
Brazil	12/1994	✓	--	✓				
Bulgaria	01/1996	✓	--	✓	Q3 2003	--	✓	--
Chile	11/1981	--	✓	✓				
Colombia	07/1982	✓	✓	✓				
Colombia	06/1998	✓	✓	✓	Q4 1998	✓	✓[4]	--
Côte d'Ivoire[3]	01/1988	--	--	✓				
Croatia	03/1998	✓	✓	✓	Q1 2000	--	✓	--
Czech Republic	01/1996	--	✓	✓				
Dominican Republic	04/2003	✓	✓	✓	Q2 2003	✓[5]	--	✓
Ecuador[3]	08/1998	✓	--	✓				
Estonia	11/1992	✓	✓	✓	Q1 1992	✓	✓[6]	--
Finland	09/1991	✓	✓	✓	Q2 1991	✓	✓[7]	--
Ghana[3]	01/1982	✓	✓	✓	Q1 1985	✓	--	--
Indonesia	11/1997	✓	✓	✓	Q2 1998	✓	✓	--
Jamaica[3]	12/1996	✓	✓	✓	Q1 1997	--	✓	--
Japan	11/1997	✓	✓	✓	Q1 1998	--	✓	--
Korea	08/1997	✓	✓	✓	Q1 1998	✓	✓[8]	--
Latvia	04/1995	✓	✓	✓				
Lithuania	12/1995	✓	--	✓				
Malaysia	07/1997	✓	✓	✓	Q2 1998	--	✓	--
Mexico	12/1994	--	✓	✓	Q2 1997	--	✓	--
Nicaragua[3]	08/2000	✓	✓	✓				
Norway	10/1991	✓	✓	✓				
Paraguay[3]	05/1995	--	✓	✓				
Philippines	07/1997	✓	✓	✓				
Russia	08/1998	--	✓	✓				
Sri Lanka[3]	01/1989	✓	✓	✓				
Sweden	09/1991	✓	✓	✓	Q3 1991	✓	--	--
Thailand	07/1997	✓	✓	✓	Q1 1998	✓	✓[8]	--
Turkey	11/2000	✓	--	✓	Q1 2001	--	--	✓
Ukraine[3]	01/1998	--	--	✓				
Uruguay[3]	01/2002	✓	✓	✓	Q1 2002	✓[9]	--	✓
Venezuela	01/1994	--	--	--				
Vietnam[3]	07/1997	✓	✓	✓				

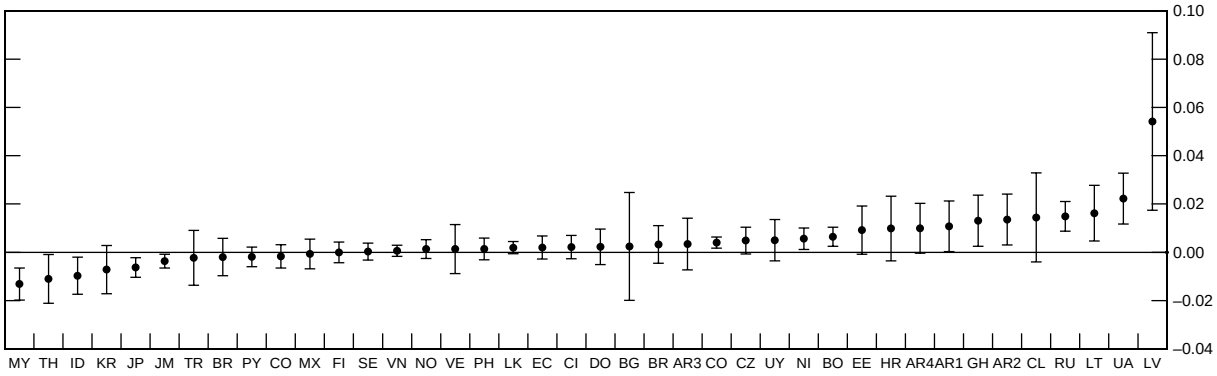
[1] A '✓' indicates that the H_0 of no break could be rejected at the 95% level; '--' indicates that the H_0 could not be rejected. No entry in the Quandt-Andrews tests indicates that no break point in the vicinity of the crisis could be found; Quandt-Andrews tests were performed with 15% trimming. [2] From Laeven and Valencia database; breakpoint tested changed to Q1 1985 in Argentina, Q4 1981 for Chile and Q1 1986 for Ghana since sufficient time series length to test for breaks prior to these were not available. [3] Annual data are used due to limited availability of quarterly data; quarterly observations were interpolated where possible. [4] Q3 1998. [5] Q1 2003. [6] Q4 2001. [7] Q1 1991. [8] Q4 1997. [9] Q3 2001.

Sources: Laeven and Valencia (2008); IMF; national data; BIS calculations.

Graph A.1

Size of the structural breaks

Break in level at the beginning of the crisis for model in first differences: $\Delta \ln GDP = \beta_1 + \beta_2 D_t + \varepsilon_t$

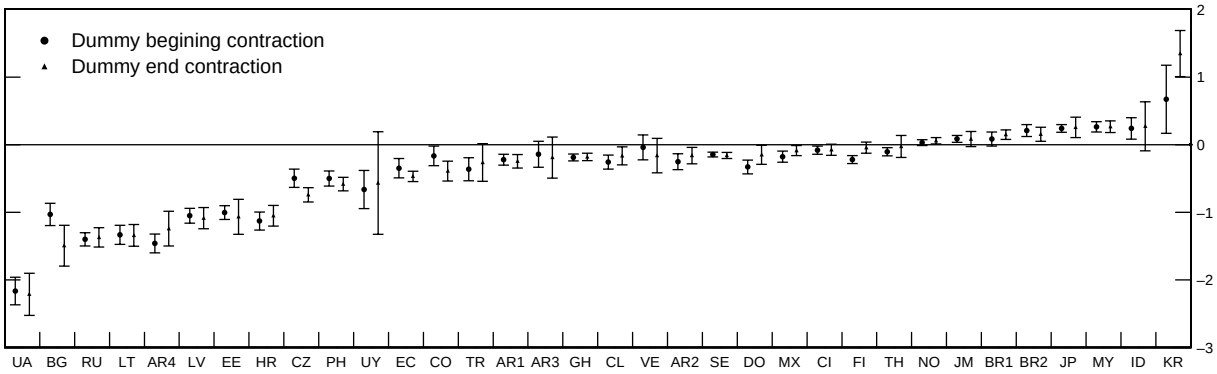


Graph A.2

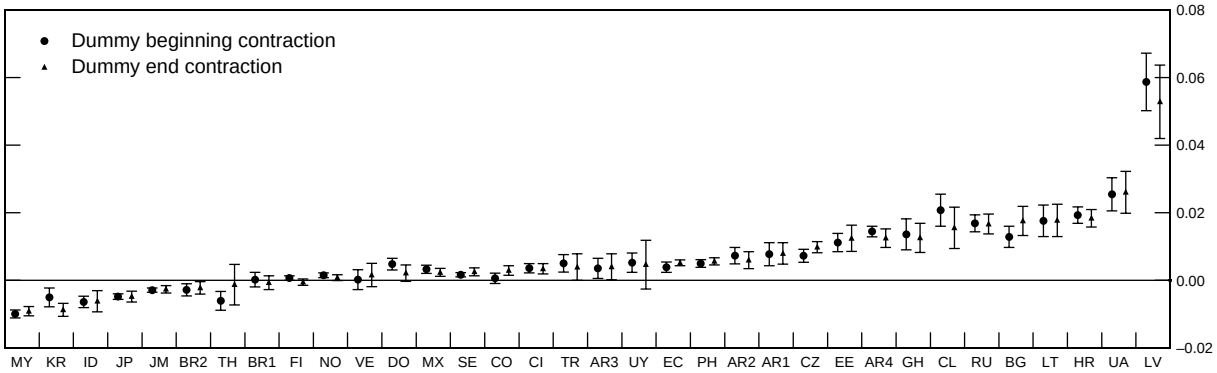
Size of the structural breaks

Break in level and trend at the beginning of the crisis (as in Graph 8) versus break excluding contraction period

Level (unadjusted)



Trend



Note: End of the contraction as defined in Table 2 “List of crisis”.

AR = Argentina; BG = Bulgaria; BO = Bolivia; BR = Brazil; CI = Côte d’Ivoire; CL = Chile; CO = Colombia; CZ = Czech Republic; DO = Dominican Republic; EC = Ecuador; EE = Estonia; FI = Finland; GH = Ghana; HR = Croatia; ID = Indonesia; JM = Jamaica; JP = Japan; KR = Korea; LK = Sri Lanka; LT = Lithuania; LV = Latvia; MX = Mexico; MY = Malaysia; NI = Nicaragua; NO = Norway; PH = Philippines; PY = Paraguay; RU = Russia; SE = Sweden; TH = Thailand; TR = Turkey; UA = Ukraine; UY = Uruguay; VE = Venezuela; VN = Vietnam. Crisis dates are as in Table 2, except Q1 1985 for Argentina, Q4 1981 for Chile and Q1 1986 for Ghana, which had to be changed from the official crisis dates since time series of sufficient length to test for breaks at the official dates were not available. The coefficient estimates are marked with dots and the 90% confidence intervals with lines.

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