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Costs of banking system instability: Some empirical evidence ☆

Glenn Hoggarth [a,*], Ricardo Reis [b], Victoria Saporta [a]

[a] *Bank of England, Threadneedle Street, London EC2R 8AH, UK*
[b] *Harvard University, UK*

Abstract

This paper assesses the cross country 'stylised facts' on empirical measures of the losses incurred during periods of banking crises. We first consider the direct resolution costs to the government and then the broader costs to the welfare of the economy – proxied by losses in GDP. We find that the cumulative output losses incurred during crisis periods are large, roughly 15–20%, on average, of annual GDP. In contrast to previous research, we also find that output losses incurred during crises in developed countries are as high, or higher, on average, than those in emerging-market economies. Moreover, output losses during crisis periods in developed countries also appear to be significantly larger – 10–15% – than in neighbouring countries that did not at the time experience severe banking problems. In emerging-market economies, by contrast, banking crises appear to be costly only when accompanied by a currency crisis. These results seem robust to allowing for macroeconomic conditions at the outset of crisis – in particular low and declining output growth – that have also contributed to future output losses during crises episodes. © 2002 Published by Elsevier Science B.V.

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* Corresponding author. Tel: +44-20-7601-3487.
E-mail address: glenn.hoggarth@bankofengland.co.uk (G. Hoggarth).

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1. Introduction

Over the past quarter of a century, unlike the preceding twenty five years, there have been many banking crises around the world. Caprio and Klingebiel (1996, 1999), for example, document 69 crises in developed and emerging-market countries since the late 1970s. In a recent historical study of 21 countries, Bordo et al. (2001) report only one banking crisis in the quarter of a century after 1945 but 19 since then.

Although there is now a substantial cross country empirical literature on the causes of banking crises, [1] there have been fewer studies measuring the potential costs of financial system instability. Yet it is a desire to avoid such costs that lies behind policies designed to prevent, or manage, crises. This paper considers the ways in which banking crises can impose costs on the broader economy and presents estimates of those costs. In particular, the paper focuses on cross-country estimates of the direct fiscal costs of crisis resolution and the broader welfare costs, approximated by output losses, associated with banking crises.

The paper is organised as follows: Section 2 considers the various potential costs of banking crises and provides a brief overview of the channels through which they are incurred. Section 3 discusses briefly the general issues involved in measuring the costs of crises. Section 4 assesses the existing evidence on the fiscal costs of crisis resolution, and Section 5 presents a number of estimates of output foregone during crisis periods. Section 6 assesses the extent to which output losses are attributable to banking crises per se rather than due to other causes. Section 7 concludes.

2. Costs of banking crises – an overview

A crisis in all or part of the banking sector may impose costs on the economy as a whole or parts within it. First, 'stakeholders' in the failed bank will be directly affected. These include shareholders, the value of whose equity holdings will decline or disappear; depositors who face the risk of losing all, or part, of their savings and the cost of portfolio reallocation; other creditors of the banks who may not get repaid; and borrowers, who may be dependent on banks for funding and could face difficulties in finding alternative sources. In addition, taxpayers may incur direct costs as a result of public sector crisis resolution – cross-country estimates of these are shown below.

Costs falling on particular sectors of the economy may just reflect a redistribution of wealth, but under certain conditions banking crises may also reduce income and wealth in the economy as a whole.

[1] For example, see the literature review on leading indicators of banking crises by Bell and Pain (2000) and the references within.

2.1. Potential channels of banking crises

A wave of bank failures – a banking crisis (BC) – can produce (as well as be caused by) a sharp and unanticipated contraction in the stock of money and result, therefore, in a recession (Friedman and Schwartz, 1963). Secondly, if some banks fail and others are capital constrained the supply of credit may contract, forcing firms and households to adjust their balance sheets and, in particular, to reduce spending. Output could fall in the short-run. This mechanism – working through the 'credit channel' – was highlighted by Bernanke (1983) who attributed the severity and length of the Great Depression in the United States to widespread bank failure. Moreover, if investment is impaired by a reduction in access to bank finance, capital accumulation will be reduced and thus the productive capacity, and so output, of the economy in the longer run will be adversely affected.

A weakened banking system can lead to a reduction in bank loans either because some banks fail or because banks under capital pressure are limited in their ability to extend new loans. Under the Basel Accord (which is applied in over 100 countries) banks can lend only if they can meet the specified capital requirements on the new loans. Banks can, of course, reduce other assets to make room for bank lending but their scope to do so may be limited. Pressure on several banks or even one bank only will lead to a persistent reduction in the overall supply of credit, however, if other banks do not step in to fill the gaps and borrowers cannot turn to other sources of funding such as the securities markets.

One school of thought suggests that bank credit cannot easily be replaced by other channels because the intermediation function of banks is necessary for some types of borrower (see Leland and Pyle, 1977; Fama, 1985). Collecting information on borrowers over a lengthy period enables banks to distinguish between the creditworthiness of 'good' and 'bad' customers. Bank failures could lead to the loss of this accumulated information and impose costs on the economy in so far as the information has to be reacquired. In addition the specificity of this information may make it difficult for some borrowers to engage with a substitute bank if theirs is unable to lend (Sharpe, 1990; Rajan, 1992). In practice, the special role played by bank credit is likely to vary from country to country, and its availability or not will be affected by the nature and extent of crisis. In most countries, too, households and small businesses at least are unlikely to be able to obtain finance from the securities markets.

There are other channels too through which difficulties in the banking system (if widespread) can affect their customers and the economy more widely. The banks' overdraft facilities and committed back-up lines for credit are one protection against liquidity pressures for customers, but Diamond and Dybvig (1983) also stress that by providing an instant-access investment (demand deposits) they provide another important mechanism. Most importantly, the payments system will not work if customers do not have confidence to leave funds on deposit at banks or, crucially, banks lose confidence in each other. A complete breakdown in the payments system would bring severe costs since trade would be impaired (see Freixas et al., 2000). In practice, the authorities are likely to take action before a complete loss of confidence occurs.

The overall impact of a BC on the economy depends amongst other things on the manner and speed of crisis resolution by the authorities. For example, a policy of forbearance by regulators could increase moral hazard and harm output over an extended period, whereas a rapid clear out of bad loans might be expected to improve the performance of the economy over the longer term. That said, such longer-run benefits need to be weighed against any potential short-run costs of strong policy action; for example, its effect on confidence in the financial sector more broadly.

2.2. Evidence of the economy wide costs of banking crises

There are only a limited number of cross-country comparisons of output losses of banking crises (see for example IMF, 1998; Bordo et al., 2001). These use similar methodologies and sample sizes of developed and emerging-market countries and find that output losses during crises are, on average, in the range of 6–8% of annual GDP for single banking crises but usually well over 10%, on average, when banking crises are accompanied by currency crises.

There is some individual country evidence, albeit mainly on the United States, on the costs of crises. [2] Bernanke (1983), Bernanke and James (1991) and Bernanke et al. (1996) provide support for the credit crunch theory of the Great Depression. Kashyap et al. (1993) provide time-series evidence for the United States, that shifts in loan supply affect investment. Hall (2000) also suggests that such an effect may have occurred in the UK in the recession of the early 1990s. Using data from a survey of loan officers in the US, Lown et al. (2000) find a strong correlation between tighter credit standards and slower loan growth and output.

In practice though, because banking sector problems are most likely to occur in recessions, it is not easy to separate out whether a reduction in bank lending reflects a reduction in the supply of or demand for funds (see Hoggarth and Thomas (1999) for the recent situation in Japan). A critical issue, covered below, is therefore whether reductions in output are caused by banking crises or vice versa.

Cross-sectional micro-data provides further support for the special role that bank credit performs in the economy. Kashyap et al. (1992) provide some evidence that non-rated firms are bank dependent. Gertler and Gilchrist (1992) have found that, following episodes of monetary contraction, small firms experience a large decrease in bank loans, which appears to be their only source of external finance. In direct contrast, large firms are able to increase their external funding by issuing commercial paper and borrowing more from banks.

3. Measuring the costs of banking crises

Since the costs of bank failure can emerge in a variety of ways, we have adopted in what follows broad measures of crisis costs.

[2] See Kashyap and Stein (1994) for a survey.

There are a number of difficulties in measuring the costs of banking crises. First, defining a crisis is not straightforward. Caprio and Klingebiel (1996) cover 69 crises which they term either 'systemic' (defined as when much or all of bank capital in the system is exhausted) or 'border line' (when there is evidence of significant bank problems such as bank runs, forced bank closures, mergers or government takeovers). These qualitative definitions have been used in most subsequent cross-country studies, including those in this paper. [3]

Even when defined, measuring the costs imposed by banking crises on the economy as a whole is also not straightforward. Most cross-country comparisons of costs focus on immediate crisis resolution. Such fiscal costs are reported in Section 4. But they may simply measure a transfer of income from taxpayers to bank 'stakeholders' rather than the overall impact on economic welfare. [4] The latter is usually proxied by the divergence of output – and in fact the focus is often output *growth* – from trend during the BC period. Estimates of these costs are also reported below in Section 5. However, these calculations estimate the output loss during the BC rather than necessarily the loss in output caused by the crisis – the costs of BC. Banking crises often occur in, and indeed may be caused by, business cycle downturns (see Gorton, 1988; Kaminsky and Reinhart, 1999; Demirguc-Kunt and Detragiache, 1998). Some of the estimated decline in output (output growth) relative to trend during the BC period would therefore have occurred in any case and cannot legitimately be ascribed to the crisis. In the final section below we attempt, using cross-section data, to separate declines in output during periods of BC attributable to the BC itself from declines due to other factors.

4. Fiscal costs

Table 1 shows recent estimates of the fiscal costs incurred in the resolution of 24 major banking crises over the past two decades, reported by Caprio and Klingebiel (1999) and Barth et al. (2000). In the table a distinction has been made between banking crises alone and those which occurred with a currency crisis ('twin' crises). [5] A currency crisis is defined, as in Frankel and Rose (1996), as a nominal depreciation in the domestic currency (against the US dollar) of 25% combined with a 10% increase in the rate of depreciation in any year of the BC period. [6]

Fiscal costs reflect the various types of expenditure involved in rehabilitating the financial system, including both bank recapitalisation and payments made to

[3] Therefore, on this definition a crisis occurs if and when banking problems are publicly revealed rather than necessarily when the underlying problems first emerge.

[4] However, fiscal costs may also include a dead weight economic cost especially if the marginal costs of social funds is high.

[5] Although the term currency 'crisis' is used here as is common in the literature, how a large exchange rate depreciation should be viewed depends on its cause.

[6] The latter condition is designed to exclude from currency crises high inflation countries with large trend rates of depreciation.

Table 1
Selected banking crises: Non-performing loans and costs of restructuring financial sectors

	Years	Duration (years)	Non-performing loans (% of total loans)[a]	Bank credit/GDP (%)[b]	Fiscal and quasi-fiscal costs/GDP[c]	GNP per head (US$000s PPP)[d]	Currency crisis as well[e] (pre-fix**)
High income countries							
Finland	1991–1993	3	9.0*	89.9 (89.9)	11.0	15.8	Yes**
Japan	1992–1998	7	13.0	119.5 (182.5)	8.0 (17)[f]	21.5	No
Korea	1997–		30–40	70.3 (82.2)	34.0	14.7	Yes**
Norway	1988–1992	5	9.0*	61.2 (79.6)	8.0	17.3	No
Spain	1977–1985	9	n/a	68.1 (75.1)	16.8	4.7	Yes
Sweden	1991	1	11.0*	50.8 (128.5)	4.0	17.2	Yes**
United States	1984–1991	8	4.0*	42.7 (45.9)	3.2[g]	15.2	No
Average		5.5	13.5	71.8 (97.7)	12.1	15.2	
Medium and low income countries							
Argentina	1980–1982	3	9.0*	29.8 (33.0)	55.3	6.4	Yes**
Argentina	1995	1	n/a	19.7 (20.0)	1.6	10.5	No
Brazil	1994–1996	3	15.0	31.7 (36.5)	5–10	6.1	No
Chile	1981–1983	3	19.0	58.8 (60.2)	41.2	2.7	Yes**
Colombia	1982–1987	6	25.0*	14.7 (14.7)	5.0	2.9	Yes**
Ghana	1982–1989	8	n/a	25.2 (25.2)	6.0	0.9	Yes**
Indonesia	1994	1	n/a	51.9 (51.9)	1.8	2.5	No
Indonesia	1997–		65–75	60.8 (60.8)	50–55	3.0	Yes**
Malaysia	1985–1988	4	33.0*	64.5 (91.8)	4.7	3.3	No
Mexico	1994–1995	2	11.0*	31.0 (36.3)	20.0	7.2	Yes**
Philippines	1981–1987	7	n/a	23.2 (31.0)	3.0	2.4	Yes
Sri Lanka	1989–1993	5	35.0	21.3 (21.3)	5.0	1.9	No
Thailand	1983–1987	5	15.0*	44.5 (48.5)	1.5	1.7	No
Thailand	1997–		46.0	118.8 (134.9)	42.3	6.2	Yes**

Table 1 (*continued*)

	Years	Duration (years)	Non-performing loans (% of total loans)[a]	Bank credit/GDP (%)[b]	Fiscal and quasi-fiscal costs/GDP[c]	GNP per head (US$000s PPP)[d]	Currency crisis as well[e] (pre-fix**)
Turkey	1994	1	n/a	14.2 (15.3)	1.1	5.4	Yes
Uruguay	1981–1984	4	n/a	33.4 (47.8)	31.2	4.6	Yes**
Venezuela	1994–1995[h]	2	n/a	8.9 (12.3)	20.0	5.6	Yes
Average		3.7	27.8	38.4 (43.6)	17.6	4.3	
Average all countries		4.2	22.4	48.1 (59.4)	16.0	7.5	
Of which: twin crises		4.1	26.1	46.5 (56.5)	22.9		
BC alone		4.3	17.7	50.8 (64.2)	4.6		

Source: Non-performing loans and fiscal costs (unless otherwise stated) Barth et al. (2000) and Caprio and Klingebiel (1999). GDP and bank credit, IMF International Financial Statistics, 1999 Yearbook (IMF, 1999). Systemic crises (according to Barth et al., 2000) in bold.

[*] *Source*: IMF, World Economic Outlook, May 1998, Chapter 4.

[a] Estimated at peak. Comparisons should be treated with caution since measures are dependent on country specific definitions of non-performing loans and often non-performing loans are under-recorded.

[b] Average during the crisis period. Credit to private sector from deposit money banks (IFS code, 22d) and the figures in brackets include also credit from other banks (IFS code, 42d).

[c] Estimates of the cumulative fiscal costs during the restructuring period expressed as a percentage of GDP.

[d] In the year the BC began.

[e] Exchange rate crisis is defined as a nominal depreciation of the domestic currency (against the US dollar) of 25% or more together with a 10% increase in the rate of depreciation from the previous year.

[f] Resolution costs in Japan were estimated at 3% of GDP by 1996. The current financial stabilisation package introduced in 1998 allows for a further 70 trillion Yen (14% of GDP) to be spent on loan losses, recapitalisation of banks and depositor protection (the figure in brackets). But by end-March 2001 only an estimated 27 trillion Yen (5% of GDP) of this had been spent.

[g] Cost of savings and loans clean up.

[h] The apparent low degree of bank intermediation in Venezuela at the time reflects the impact of high inflation on the denominator (nominal GDP).

depositors, either implicitly or explicitly through government-backed deposit insurance schemes. These estimates may not be strictly comparable across countries and should be treated with a degree of caution. Moreover, estimates for the recent crises in east Asia may be revised, as and when new losses are recorded.

That said, the data do point to some interesting stylised facts. Resolution costs appear to be particularly high when banking crises are accompanied by currency crises. The average resolution cost for a twin crisis in Table 1 is 23% of annual GDP

compared with 'only' 4.5% for a BC alone. Moreover, all countries that had fiscal costs of more than 10% of annual GDP had an accompanying currency crisis. Similarly, Kaminsky and Reinhart (1999) find that bail-out costs in countries which experienced a twin crisis were much larger (13% of GDP), on average, than those which had a BC alone (5%).

Whether the association of higher banking resolution costs with currency crises reflects a causal relationship is unclear. On the one hand, currency crises may be more likely to occur the more widespread and deeper the weakness in the domestic banking system, as savers seek out alternative investments, including overseas. On the other hand, currency crises may cause banking crises, or make them larger. A marked depreciation in the domestic exchange rate could result in losses for banks with large net foreign currency liabilities, or if banks have made loans to firms with large net foreign currency exposures, who default on their loans. Bank losses caused in this way may be particularly likely for countries that had fixed or quasi-fixed exchange rate regimes prior to the crisis; such regimes might have encouraged banks and other firms to run larger unhedged currency positions than would otherwise have been the case. Many banks made losses in this way in the recent east Asian crisis (see, for example, Drage et al., 1998). All the six countries in Table 1 that incurred fiscal costs of more than 30% of GDP previously, had a fixed or quasi-fixed exchange rate in place.

The cumulative resolution costs of banking crises appear to be larger in emerging-market economies (on average 17.5% of annual GDP) than in developed ones (12%). For example, since the recent east Asian crisis, Indonesia and Thailand have already faced very large resolution costs – 50% and 40% respectively of annual GDP – whereas, in the Nordic countries in the early 1990s, notwithstanding widespread bank failures, cumulative fiscal costs were kept down to 10% or less of annual GDP. The difference may be because developed countries face smaller shocks to their banking systems. Some data suggest that non-performing loans have been much larger in emerging-market crises (see Table 1). [7] Alternatively, both the banking system and the real economy may have been better able to withstand a given shock because of more robust banking and regulatory systems, including better provisioning policies and capital adequacy practices. The difference in these fiscal costs of crisis may also reflect the greater importance of state banks within emerging markets (their share of total banking sector assets is around three times as large, on average, as in the sample of developed countries in Table 1 [8]), since they are more likely than private banks to be bailed out by governments when they fail.

As one might expect, everything else equal, fiscal costs of banking resolution seem to be larger in countries where bank intermediation – proxied by bank credit/GDP – is higher. For example, during the savings and loans crisis in the United States in the 1980s, where intermediation by financial institutions is relatively low by the standards of developed countries, fiscal costs were estimated at 'only' 3% of annual out-

[7] Some caution is needed in comparing non-performing loans across countries because of differences in accountancy standards and provisioning policies.

[8] Data on state ownership are for 1997 from Barth et al. (2000).

Table 2
Explanation of fiscal costs (% of GDP)

	1	2
Const	−1.38	−1.23
	(−0.19)	(−0.16)
Currency dummy[a]	17.9	19.5
	(2.9)	(2.7)
Bank credit/GDP[b]	0.22	0.25
	(2.0)	(1.9)
GNPP[c]	−0.61	−0.65
	(−1.1)	(−1.1)
LOLR[d]		−3.4
		(−0.4)
Adjusted R^2	0.31	0.28
DW statistic	1.9	1.9
Number of observations	24	24

[a] Currency dummy = 1 if 25% per annum nominal depreciation of the domestic exchange rate (against the US dollar) and a 10% increase in the rate of depreciation in any year of the BC period; 0 otherwise.
[b] Bank credit/GDP = Credit to private sector from deposit money banks as a percentage of annual nominal GDP (average during the crisis period).
[c] GNPP = GNP per head (PPP-measure) in the year of the outset of the crisis (US$000s).
[d] LOLR = 1 if lender of last resort is provided, 0 otherwise (*source:* Honohan and Klingebiel, 2000).

put. However, the problems were largely confined to a segment of the banking industry. In contrast, in Japan, where bank intermediation is relatively important, the resolution costs were estimated at 8% of GDP by March 2001 and with the current stabilisation package might rise as high as 17% of GDP. [9]

The qualitative stylised facts on resolution costs discussed above are summarised in the simple regression in Table 2 equation (1), although the estimates should be interpreted with caution given the small sample size (24). The point estimates suggest that, on average, fiscal costs are 18% of annual GDP higher when associated with a currency crisis, 2.2% of GDP higher for every 10% point higher share of credit within GDP and 6% of GDP lower for every $10,000 increase in per capita GNP.

Fiscal costs incurred almost certainly depend on how crises are resolved (Dziobek and Pazarbasioglu, 1997). Poor resolution might be expected to be reflected in crises lasting longer and/or becoming increasingly severe. In the meantime some fragile banks could 'gamble for resurrection' and thus eventually require more restructuring than would otherwise have been the case. That said, there is no clear statistical relationship between fiscal costs and crisis length for the sample of crises shown in Table 1. Frydl (1999) finds a similar result. Recent work by Honohan and Klingebiel

[9] Resolution costs in Japan were already estimated at 3% of GDP by 1996. The current financial stabilisation package introduced in 1998 allows for a further 70 trillion Yen (14% of GDP) to be spent on loan losses, recapitalisation of banks and depositor protection. But by end-March 2001 only an estimated 27 trillion Yen (5% of GDP) of this had been spent. The current 70 trillion Yen facility is scheduled to be reduced to 15 trillion Yen in April 2002.

(2000), however, suggests that the approach taken to restructuring is important. This analysis of a sample of 40 developed country and emerging-market crises indicates that fiscal costs increase with liquidity support, regulatory forbearance and unlimited deposit guarantees. Although we also find in our sample (weak) positive correlation between the provision of liquidity support and fiscal costs, the LOLR dummy variable becomes statistically insignificant (and wrongly signed) when added to the regressors in Table 2 (see equation (2)).

As noted earlier, resolution costs may not always be a good measure of the costs of crises to the economy more generally but rather a transfer cost. Also, large fiscal costs may be incurred to forestall a BC or, at least, limit its effect. In this case, the overall costs to the economy at large may be small, and if the crisis were avoided would not be observed, but significant fiscal costs might have been incurred. Conversely, the government may incur only small fiscal costs, and yet the broader economic adverse effects of a BC could be severe. For example, a BC was an important feature of the Great Depression of 1929–1933 and yet fiscal costs were negligible since there was little capital support to the failing banks and no deposit insurance.

Because of these problems in measuring losses on the basis of fiscal costs, in the remainder of the paper we concentrate mainly on a broader, and at least somewhat less contentious, measure of the cost of crisis – lost output.

5. Output losses

Cross-country comparisons of the broader welfare losses to the economy associated with a BC are usually proxied by losses in GDP comparing GDP during the crisis period with some estimate of potential output. [10] Using GDP as a proxy for welfare though has its problems. First, welfare costs should ideally reflect losses to individuals' current and (discounted) future consumption over their lifetime. But, in practice, this is extremely difficult to measure. Second, changes in the level (and growth) of income may have more impact on individuals' utility at lower income levels than higher ones. This also complicates cross-country comparisons of welfare losses.

There are also a number of issues in the construction of measures of output losses.

5.1. Measurement issues

5.1.1. Defining the beginning and end of the crisis

Everything else being equal, the longer a crisis lasts, the larger the (cumulative) output losses. The size of the measured cumulative loss will therefore be sensitive

[10] An exception is a study by Boyd et al. (2000) which in a sample of mainly developed country crises includes a measure of losses based on the decline in real equity prices at the time of the crisis. The cross-country comparisons described below are dominated by emerging-market countries where stock market prices are often unavailable.

to the definition of the crisis period. Unfortunately, it is not straightforward to define either the starting or the end point of a BC.

5.1.2. Defining the beginning of crisis

Since one of the features of banks, given historic cost accounting, is that their net worth is often opaque, it is difficult to assess when and whether net worth has become negative. One possibility is to use a marked decline in bank deposits – bank 'runs' – as a measure of the starting point of a crisis. However, most post-war crises in developed countries have not resulted in bank runs, whilst many crises in emerging-market countries have followed the announcement of problems on the asset side. Bank runs, when they occur, have usually been the result rather the cause of banking crises as defined in this article. Demirguc-Kunt et al. (2000) find, for a sample of 36 developed and developing countries over the 1980–1995 period, that deposits in the banking system did not decline during banking crises. Since banking crises have sometimes followed reasonably transparent problems with the quality of banking assets, data on a marked deterioration in the quality of banking assets and/or increases in non-performing loans could, in principle, be used to pinpoint the timing of the onset of a crisis. In practice, such data are usually incomplete, unreliable or even unavailable. Another possible approach is to measure the beginning of a crisis as the point when bank share prices fall by a significant amount relative to the market. However, aside from the problem of deciding what is 'significant', bank share price indices are often unavailable for emerging-market economies – the countries where most banking crises have occurred in recent years. Instead most studies – including ours reported below – date the beginning of crisis on a softer criterion, based on the assessment of finance experts familiar with the individual episodes. [11] But these calculations too are likely to be problematic, particularly for emerging-market economies. Banking problems may only become known publicly after a lag once the situation becomes too big to hide. Moreover, even if the outbreak of the crisis can be dated, welfare losses may have been incurred beforehand because of a misallocation of resources. So output losses incurred during crises will only capture part of the welfare loss.

5.1.3. Defining the end of crisis

As to the end of a crisis, one possibility is to define it subjectively say, for example, based on the expert judgement or 'consensus' view from a range of case studies. An alternative would be to define it endogenously, for example, at the point when output growth returns to its pre-crisis trend (see, for example, IMF, 1998; Aziz et al., 2000). It could be argued that this would, if anything, measure the end of the consequences of the crisis rather than the end of the crisis itself. Both approaches are nevertheless included in our estimates reported below.

[11] Caprio and Klingebiel's (1996) extensive listing of crisis episodes seems to be the source of most subsequent studies.

Both could underestimate output losses since at the point when output growth recovers the level of output would still be lower than it would have been otherwise. If instead the end of crisis is defined as the point when the level of output returns to (the previous) trend, the length of the crisis would be longer and thus the losses during crisis higher. Finally, such estimates of output losses make no attempt to measure any possible longer-run losses or gains in output after the crisis has been resolved for example if the trend growth rate were permanently lowered – but this would be difficult.

5.1.4. Estimation of output during the crisis period in the absence of crisis

To measure the output loss during a crisis it is therefore necessary to measure actual output compared with its trend, or potential. The most straightforward way of estimating output potential is to assume that output would have grown at some constant rate based on its past performance (i.e. to estimate the shortfall relative to past trend growth). This is the approach we have used below. But this approach may overstate losses associated with crises if output growth fell to a lower trend during the BC period. For example, estimates of losses associated with the Japanese BC may be overstated if the growth in output potential in Japan has fallen since the early 1990s for reasons, such as an ageing population, unconnected to the crisis.

In producing comparable estimates of the shortfall in growth against trend in a large sample of countries a standardised approach to calculate trend growth, based on past information, is necessary. The appropriate number of years to use in estimating the past trend is not clear cut. A number of studies have found that banking sector problems often follow an economic boom (see, for example, Kindleberger, 1978; Borio et al., 1996; Logan, 2001). If output growth in the run up to the crisis was unsustainable, basing the trend growth on this period would over-estimate output losses during the crisis period. [12] On the other hand, a BC may be preceded immediately by a marked slowdown in GDP growth (see Kaminsky and Reinhart (1999) for recent crises and Gorton (1988) for a more historical perspective).

The data from our sample of 47 banking crises discussed below suggest that crises have often come after a boom in developed countries but broke at the peak of one in emerging-market economies. [13] Average GDP growth in the 3 years before crises was above its 10 year trend in two-thirds of both the emerging market and developed countries. For most emerging-market crises, output growth was higher still in the year immediately prior to crisis. In contrast, in most of the developed countries, output growth fell in the year before crisis.

We estimate the output trend, or potential, below using both a short (3 year) and long (10 year) window.

[12] In addition, it would exaggerate the length of crisis and thus estimated losses on measures that define the end of crisis when output growth returned to its past trend. For example, the rate of output growth in Mexico has yet to return to its three year average (8.5% per annum) before the 1981–1982 BC.

[13] Banking crises in transitional economies have been excluded from this sample because of their special problems of transforming from a government owned to a market-based financial system.

5.1.5. Measuring output losses: levels versus growth rates

Perhaps the most obvious way of measuring the output loss – but one that does not appear to have been used in recent research – is to sum up the differences in the level of annual GDP from trend during the crisis period. However, the IMF (1998), Aziz et al. (2000) and Bordo et al. (2001) measure output loss by summing up the differences in output growth rates between the pre-crisis trend and the actual rates during the crisis period. The output loss using the latter method approximates to the percentage deviation in the level of actual output at the point when the crisis ends from where it would have been had output grown at its trend rate. All other factors being equal, however, this method will understate losses associated with crises lasting for more than two years because it does not recognise the reduction in the output level in previous years (a more formal explanation is given in Appendix A).

Thus, other things being equal, given that crises usually last for more than two years, estimates which sum up the differences in the level of actual output from its trend during the crisis period give a higher measure of output losses. [14] Below we show estimates of losses based on accumulating losses in the level and growth in output.

5.1.6. Alternative methods used in measuring output losses

We employed three methods of estimating the output loss – the difference between actual output and output assuming an absence of crisis – during the crisis period:

(i) GAP1 uses the method of the IMF (1998) and Aziz et al. (2000) which define the output loss as the sum of the differences between the growth in potential (g^*) and actual output (g) during the crisis period. The authors define potential growth as the arithmetic average of GDP growth in the three years prior to the crisis and the end of crisis as the point where output growth returns to trend. More formally, let $N - t_0$ be the number of years for which $g_t < g^*$, i.e. output growth is lower than trend growth, and let t_0 be the 'consensus' beginning of the crisis year, then $\text{GAP1} = \sum_{t=t_0}^{N} (g^* - g_t)$.

(ii) GAP2 is defined as the cumulative difference between the level of potential output and actual output over the crisis period. The definition of crisis follows Caprio and Klingebiel (1996, 1999) based on the general opinion of country experts. These, in turn, define the outset of crisis when it first became publicly known based usually on one or more significant public events such as a forced closure, merger or government take-over. The end point attempts to capture when the banking system returns to health. Output potential is based on the trend growth over the 10-year pre-crisis period using a Hodrick–Prescott filter. [15] Then potential output growth is given by the last period of the filtered series (g^{**}). If we define d_t as the percentage deviation of the level of output (Y_t) from its trend level

[14] It will also yield a more accurate measure of output losses so long as the trend is not overstated.

[15] This is a smoothing method widely used to obtain an estimate of the long-term component of a series. Technically, the filter compares the smoothed series y_t^* of y_t by minimising the variance of y_t^* around y_t subject to a penalty that constrains the second difference in y_t^*. We set the value of the penalty to be equal to 100 which is typical for annual data (the higher this value the smoother the y_t^* series).

$(Y_{t_0-1}(1+g^{**})^{t-t_0+1})$ where t_0 is the 'consensus' beginning year and N^* the 'consensus' endpoint, then GAP2 $= \sum_{t=t_0}^{N^*} d_t$. GAP2 should be thought of as the deviation of the level of output from trend level (the cumulative output gap) incurred during the crisis period rather than necessarily the costs of BC per se.

(iii) GAP3, like GAP2, measures output losses as the cumulative difference between the counterfactual and the level of actual output during the (exogenously defined) crisis period. But unlike GAP2, the counterfactual is based on the forecast of GDP growth during the crisis period made before the outset of the crisis rather than potential, or trend, GDP. This forecast is based on the OECD projection for output growth over the forthcoming year made 1 year before the outset of crisis. Thus GAP3 estimates are made for OECD countries only.

These three methods were applied to our sample of 47 banking crises in developed and emerging-market economies over the 1977–1998 period. Our sample comprises the crises listed earlier on fiscal costs in Table 1 plus those analysed in Barth et al. (2000), where the latter are given precise dates and where, for the recent crises, timely output data are available.

5.2. Results

Table 3 shows the output losses incurred during 47 banking crises on the three different methods where data are available. Following Barth et al. (2000), the systemic cases – shown in bold in Table 3 – are defined as when all, or nearly all, of the capital in the banking system is eroded. [16]

Although the estimated cumulative output losses vary markedly from crisis to crisis, there are some broad messages from Table 3.

Taking our sample of 47 countries as a whole (1977–1998), the average (mean) estimates of GAP1 – 14.5% – are slightly higher than those from the earlier IMF study (IMF, 1998) – 11.5% – which uses the same methodology. [17] The two sample sets of crises have a large but not perfect overlap. In other respects, and not surprisingly given the methodologies are the same, our GAP1 estimates are similar to those from the IMF study. The average recovery time of output from a crisis is found to be shorter, although the cumulative losses are slightly larger, in emerging-market economies than in developed ones.

As discussed above, estimates based on summing differences in output levels from trend (GAP2) appear to be a better measure of losses than those based on summing differences in the growth of actual output from its trend (GAP1). The (mean) average losses using GAP2 (16.5% of annual GDP for all crises and 19% for systemic ones) are slightly higher than on GAP1 (14.5% and 17% respectively). In contrast to both the GAP1 estimates and the commonly held view, our GAP2 estimates suggest that

[16] On the basis of GAPs 1 and 2 the savings and loans crisis in the United States did not result in output losses since neither the growth (GAP1), or the level (GAP2), of GDP in the United States fell below its past trend during the crisis in the second half of the 1980s.

[17] The IMF study is from a slightly earlier period (1975–1997) and bigger sample (54).

Table 3
Accumulated output losses incurred during banking crises

	Date of crisis[a]	Duration[a] (years)	GAP1 (%)[b]	GAP2 (%)[c]	GAP3 (%)[c]	Currency crisis as well
High income countries						
Australia	1989–1990	2 (0)	0.0[d]	−1.4	0.0	No
Canada	1983–1985	3 (0)	0.0[d]	−10.5	0.0	No
Denmark	1987–1992	6 (7)	22.3	31.9	47.5	No
Finland	1991–1993	3 (3)	22.4	44.9	24.6	Yes
France	1994–1995	2 (0)	0.0[d]	0.7	0.0	No
Hong Kong	1982–1983	2 (4)	23.1	9.8		No
Hong Kong	1983–1986	4 (1)	1.1	4.3		No
Hong Kong	1998	1 (1)	9.6	9.0		No
Italy	1990–1995	6 (9)	18.2	24.6	36.1	Yes
Japan	1992–1998	7 (7)	24.1	71.7	30.7	No
Korea	1997–[e]		16.7	12.8	15.7	Yes
New Zealand	1987–1990	4 (6)	16.0	16.3	4.5	No
Norway	1988–1992	5 (6)	9.8	27.1	11.2	No
Spain	1977–1985	9 (9)	15.1	122.2		Yes
Sweden	1991	1 (3)	11.8	3.8	2.5	Yes
United Kingdom	1974–1976	3 (13)	34.6	26.5	31.1	No
United States	1984–1991	8 (0)	0.0[d]	−41.9	56.0	No
Average		4.1 (4.3)	13.2	20.7		
Medium and low income countries						
Argentina	1980–1982	3 (3)	20.7	25.9		Yes
Argentina	1985	1 (1)	7.9	7.1		No
Argentina	1989–1990	2 (2)	14.0	16.1		Yes
Argentina	1995	1 (2)	11.4	5.8		No
Bolivia	1986–1987	2 (1)	0.6	0.4		No
Bolivia	1994[e]	(0)	0.0[d]	−26.8		No
Brazil	1994–1996	3 (0)	0.0[d]	−12.7		No
Chile	1981–1983	3 (8)	41.4	24.3		Yes
Colombia	1982–1987	6 (4)	6.7	31.4		Yes
Egypt	1991–1995	5 (6)	10.0	22.8		No
El Salvador	1989	1 (1)	0.6	−1.3		No
Ghana	1982–1989	8 (1)	5.5	−47.4		Yes
India	1993–[e]	(0)	0.0[d]	−41.1		No
Indonesia	1994	1 (0)	0.0[d]	−2.2		No
Indonesia	1997–[e]		24.5	20.1		Yes
Madagascar	1988	1 (0)	0.0[d]	−3.1		No
Malaysia	1985–1988	4 (3)	14.5	39.2		No
Mexico	1981–1982	2 (18)	110.4	−0.2		Yes
Mexico	1994–1995	2 (1)	9.5	5.4	12.0	Yes
Nigeria	1997	1 (0)	0.0[d]	0.1		No
Peru	1983–1990	8 (1)	12.5	94.0		Yes
Philippines	1981–1987	7 (7)	35.2	111.7		Yes
Sri Lanka	1989–1993	5 (1)	0.6	−10.0		No
Thailand	1983–1987	5 (0)	0.0[d]	−2.8		No
Thailand	1997–[e]		25.9	28.1		Yes
Turkey	1994	1 (1)	10.4	9.2	10.1	Yes
Uruguay	1981–1984	4 (5)	42.0	64.1		Yes
Venezuela	1980–1983	4 (6)	27.6	52.2		No

(*continued on next page*)

Table 3 (*continued*)

	Date of crisis[a]	Duration[a] (years)	GAP1 (%)[b]	GAP2 (%)[c]	GAP3 (%)[c]	Currency crisis as well
Venezuela	1994–1995	2 (3)	14.7	10.6		Yes
Zimbabwe	1995–[e]	(1)	0.4	−3.3		Yes
Average		3.3 (2.8)	15.0	13.9		
Average all countries		3.6 (3.3)	14.4	16.4		
Of which:						
twin crises		4.2	23.1	29.9		
BC alone		3.2	7.9	6.3		

Note: Crises in bold are judged as systemic by Barth et al. (2000).

[a] Caprio and Klingebiel (1999) definition of crisis. Figures in brackets assume end of crisis is when output growth returns to trend.

[b] IMF (1998) method. The cumulative difference between trend and actual output *growth* during the crisis period. Trend is the average arithmetic growth of output in the three-year prior to the crisis. End of crisis is when output growth returns to trend.

[c] The cumulative difference between the trend and actual *levels* of output during the crisis period. Beginning and end of crisis is the Caprio and Klingebiel (1999) definition. The counterfactual path for output is based on a Hodrick–Prescott filter 10 years prior to the crisis (GAP2), and OECD forecasts of GDP growth listed in country reports one year prior to the start of the crisis (GAP3). In two cases, Japan and Mexico, the country reports give projections that covered the whole crisis period. In all other cases the reports give projections for 2 years ahead. In these cases we assumed the counterfactual growth for the later years of the crisis equal to the OECD projection for the second year of the crisis.

[d] Actual growth rate returns to trend during the first year of the crisis in Australia, Canada, France, the United States, Bolivia (1994–), Brazil, India, Indonesia (1994), Madagascar, Nigeria and Thailand (1983–1987).

[e] Where crisis has not yet ended – Korea, Indonesia and Thailand on GAP1 plus Bolivia, India and Zimbabwe on GAP2 – costs are measured up to and including 1998.

output losses incurred during crises are significantly higher, on average, in developed countries than in emerging-market ones. [18]

As for fiscal costs, output losses during crises on both measures is usually much larger – three times and five times as large for GAP1 and GAP2 respectively – in a twin crisis than in a BC alone. For emerging-market countries, in particular, output losses appear significant only when a BC is accompanied by a currency crisis. Again, however, the direction of causation is unclear. One interpretation is that exchange rate crises either lead directly to higher output losses – for example through requiring a tightening in monetary policy – or do so indirectly through increasing losses for banks with foreign currency exposures or loans to sectors which themselves have large currency exposures. [19] The latter might be expected to be a problem particularly for emerging-market banking systems for which external borrowing tends to be predominantly in foreign currency because of the cost of external borrowing

[18] Demirguc-Kunt et al. (2000) have also recently found that the slowdown in per capita GDP growth during banking crises is more persistent in developed countries than in emerging-market ones.

[19] However, the cause properly defined of the output loss here is, in fact, whatever caused the exchange rate to depreciate in the first place.

in domestic currency. But causation may be the other way round, with larger banking crises causing a general flight from domestic assets and so putting pressure on the currency, which would be exacerbated if capital inflows are concentrated in the banking sector. Another possibility is that twin crises may be more likely to occur in the face of large adverse shocks that are themselves the main cause of the reduction in output (relative to trend). The leading indicator literature suggests that twin crises tend to occur against a background of weak economic fundamentals, with banking crises more often than not preceding currency crises which, in turn, exacerbate banking crises (Kaminsky and Reinhart, 1999).

Similar to the result found by Bordo et al. (2001), we find that output losses are much larger where LOLR was provided. Unlike for fiscal costs discussed earlier, this result still holds after allowing for whether or not a BC is accompanied by a currency crisis.

5.3. Sensitivity of estimated output losses to different assumptions

The differences in estimated losses on the GAP1 and GAP2 measures could be due either to differences in the assumed end-of-crisis year, differences in trend growth profiles, and/or differences in the effect of summing up gaps in output growth from output levels. In practice, the length of crisis period is usually similar under the endogenously determined method used in GAP1 or that based on 'consensus' opinion used in GAP2 (see column 2 of Table 3). Also, in two-thirds of the sample the growth rate counterfactual is higher on GAP1 than GAP2 reflecting the stylised fact that the average growth rate in the three years prior to a BC is usually higher than its longer-term trend. In itself this would imply that the estimated losses using the GAP1 measure should be higher than GAP2. However, this impact is more than offset by the effect of summing lost output levels rather than growth rates (see Table 4). Everything else equal, as crises increase in length, (cumulative) output losses rise more on the GAP2 than the GAP1 measure. Thus GAP2 tends to be higher than GAP1 when crises last for a long period such as in Japan, Spain, Peru and the Philippines and more generally in developed countries than in emerging markets.

Average loss estimates on the GAP2 measure, unlike on GAP1, are much higher for developed countries (21% of annual GDP) than for emerging-market economies (14%). Moreover, the output loss estimates appear to be robust to the precise dating of crisis periods. The dates used in our GAP2 estimates are based on Barth et al. (2000) and Caprio and Klingebiel (1996). As mentioned earlier, the impact on the economy of weakness in the banking sector, especially in emerging-market countries, may have occurred before these dates suggest. If instead we consider the longest dating of crises periods for our sample of crises from a range of four studies (Caprio and Klingebiel, 1996; Lindgren et al., 1996; IMF, 1998 and Barth et al., 2000) the mean estimates of output losses for our whole sample rise to 22% but remain much higher in developed countries (28%) than in emerging-market ones (18%). [20] Also, if we

[20] For the minimum definition of crisis length from these studies average output losses are 15% for the sample as a whole and 20% and 12% for high and low/medium income countries respectively.

Table 4
Average estimated GAP1 and GAP2 output losses using different assumptions on the pre-crisis trend growth rates

	Growth rates (GAP1)	Levels (GAP2)
High income		
10 year (HP filter)	10.0	**20.7**
3 year	**13.2**	19.4
1 year	15.8	18.1
Low income		
10 year (HP filter)	8.3	**13.9**
3 year	**15.0**	13.9
1 year	13.7	13.9
All countries		
10 year (HP filter)	8.9	**16.4**
3 year	**14.4**	15.9
1 year	14.5	15.4

Note: Average of figures reported for individual countries in Table 3 shown in bold.

Table 5
Average estimated GAP2 output losses per year of the crisis (per cent of annual GDP)

Crisis length	All	Sample size	High income	Sample size	Low-middle income	Sample size
2 years or less	4.0	20	4.1	6	4.0	14
3–5 years	3.8	18	5.2	6	3.1	12
More than 5 years	6.1	9	5.6	5	6.8	4
All crises	4.3	47	4.9	17	4.0	30

date the outbreak of crises in emerging-market countries one and two years earlier than suggested in Table 3, output losses, in fact, fall slightly to 13.7% and 11.8% respectively. This result occurs because, as mentioned earlier, crises in our sample of emerging-market countries are usually immediately preceded by stronger than normal economic growth.

Table 5 shows output losses per year of the crisis are a little larger, on average, for developed countries than emerging markets. But more generally there is not a significant variation in losses per year either by length of crisis or by income. The table illustrates that the main reason why overall losses during crises are lower for emerging-market countries in our sample is that crises there, unlike in developed countries, tend to be short-lived. Previous studies have also found that crises last longer, on average, in developed countries than in emerging markets.

Why should banking crises last longer in developed countries? In general, financial systems in developed countries would be expected to be more robust to shocks than those in emerging-market countries. On the one hand, this might mean that it usually takes a larger shock to cause a BC in a developed economy, and that the crisis is harder to control and so longer lasting. This may be particularly likely if real wages are less flexible in developed than emerging-market countries. On the other, given the

greater strength of the financial system and real economy in developed countries, the effect of a BC on the economy may be initially less dramatic, giving the authorities freedom to take less radical action. The share of bad loans in the banking system of emerging-market economies at the time of the crisis is usually much larger than it is the case in developed countries (as shown earlier in Table 1), making the crises initially more pronounced – banks are more likely to fail. Furthermore, the banking system is usually a much larger part of the financial system in emerging-market economies than it is in developed economies, exacerbating the effect on the real economy. However, although crises in developed economies are likely to be less severe, initially, delay in resolving them is likely to increase sharply the long run loss in output. A recent example of this may be the drawn out Japanese banking problems, which have lasted since the early 1990s. In contrast, in lower income countries, speedier resolution mitigates the effects. A simple regression of the sample of countries in Table 1 shows that a higher share of bad loans within total banking system assets is associated with crises of shorter length (with statistical significance at the 95% confidence level). Moreover, according to the qualitative classification by Caprio and Klingebiel (1999), 80% of our sample of emerging-market country crises are systemic compared with 30% of our developed country ones (the countries listed in bold in Table 3).

The difference between accumulating levels rather than growth rates also explains why in the sample of OECD countries, GAP3 estimates are usually higher than those of GAP1. In contrast, there are marked variations, in both sign and magnitude, between GAP3 and GAP2 estimates. GAP3 estimates were lower than GAP2 in Finland, Japan, and Norway – countries which had just entered recession at the onset of crisis; but higher in the United States and Denmark – countries in booms as BC began. In fact, whereas GAP2 yields a negative output loss (i.e. output was above trend) during the US Savings and Loans crisis, GAP3 – by predicting that the US economy would have enjoyed continuing growth in the absence of crisis – produces large output losses during the crisis.

5.4. The relationship between the output losses and the resolution costs of crisis

As discussed earlier, the relationship between output losses incurred during crises and the fiscal costs of resolution is likely to be complicated. On the one hand, the larger the BC the larger would be expected to be both the output losses incurred and the fiscal costs needed to resolve the crisis. There would be a positive association between fiscal costs and output losses but no implied causation. On the other hand, to the extent that fiscal costs are a good proxy for effective crisis resolution, the more spent by the authorities in resolving a given BC the lower perhaps would be the output losses incurred during the crisis period (i.e. negative correlation arising from causation). [21]

[21] Of course, crisis resolution may result in longer-run costs to the economy to the extent that official intervention increases moral hazard.

Table 6
Correlation matrix between output losses and fiscal costs

	GAP1	GAP2	Fiscal costs
GAP1	1.00		
GAP2	0.62 (0.35)	1.00	
Fiscal costs	0.61	0.18	1.00

Note: Correlations between the GAP1 and GAP2 measures of output gaps over the full sample of 47 crises shown in Table 3 are given in brackets. The rest of the correlations are computed over the sample of 24 crises listed in Table 1.

Looking at the simple correlation between the fiscal costs shown earlier in Table 1 and output losses shows a positive correlation (0.6) using the GAP1 output cost measure but little association using GAP2 (0.2) (see Table 6).

Another complication between the relationship is that output losses, unlike fiscal costs, rise with the length of crisis by construction. The GAP1 and GAP2 measures of losses are accumulated for each year of the crisis period. In fact, on the GAP2 measure, so long as the growth in output during the crisis period remains below its past trend, as is usually the case, losses per year also rise with the crisis length. However, a priori, there could be economic reasons for a positive relationship also between fiscal costs and crisis length. The longer the crisis lasts the higher might be the required resolution costs if in the meantime fragile banks 'gamble for resurrection' and thus require more restructuring than would otherwise be the case. On the other hand, the more that is spent on resolution the quicker the crisis might be resolved implying also lower output costs of crisis.

Fig. 1 plots fiscal costs against the length of crisis for our sample. As shown by the line of best fit there is no clear statistical relationship between fiscal costs and crisis length. This result is similar to the findings of Frydl (1999). Although output losses

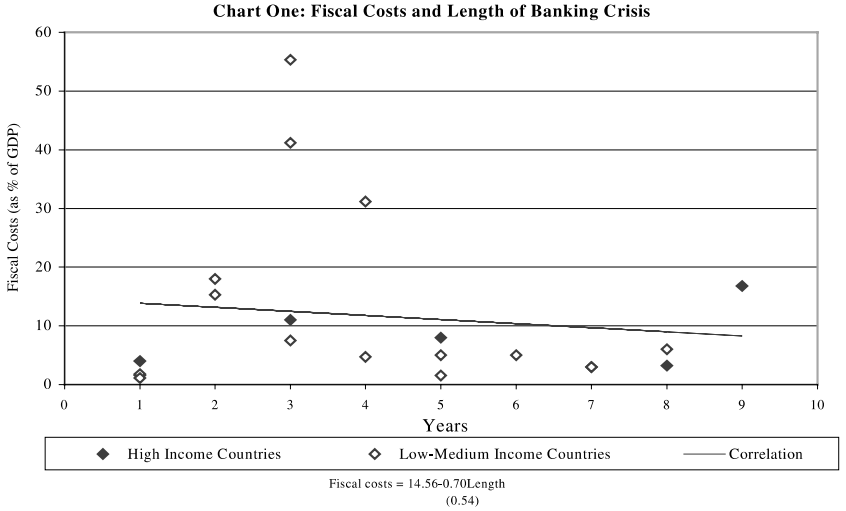

Fig. 1. Fiscal costs and length of BC.

increase with the crisis length, fiscal costs appear to be independent of the crisis length. For example, in Argentina (1980–1982) and Mexico (1994–1995), where crises were short-lived, output costs were relatively low despite being associated with high fiscal costs. In contrast, in Japan, where the crisis during the 1990s was prolonged, both output losses and fiscal costs have been high.

The precise method and speed of fiscal resolution may be more important than the costs incurred per se in determining the length and thus the output cost of crisis (as suggested by Dziobek and Pazarbasioglu (1997)). In Sweden, for example, despite relatively low fiscal costs, output costs were also low because the crisis was resolved quickly.

6. Separating out the banking crisis impact on output losses

All the estimates of output losses during crises reported above use the difference between the level (or growth) in output and its past trend. But to the extent that banking crises coincide with, or are indeed caused by, recessions these trend growth paths may overstate what output would have been during these periods in the absence of banking crises. For example, the relatively large estimated output losses during the Secondary BC (1974–1976) in the UK shown in Table 3 more likely reflect the impact of the recession at the time causing the BC rather than vice versa.

In an attempt to examine this, Bordo et al. (2001) compared, for their sample of countries, the amount of output lost during recessions that are accompanied by banking crises with those which are not. They find that, after allowing for other factors causing recessions, cumulative output losses during recessions accompanied by twin and single banking crises over the 1973–1997 period are around 15% and 5% of GDP respectively deeper than those without crises. There remains the possibility, though, that these results show partly that deeper recessions cause banking crises rather than vice versa. [22]

An alternative method of assessing whether these losses can be attributed to banking crises rather than other factors is to measure the output gaps that occurred during these same periods for similar countries that did not experience banking crises, or at least, endured less severe ones. To do this, benchmark countries are needed that, in principle at least, are similar in all respects to the crisis countries in our sample other than that they did not simultaneously face a BC. The idea here is that the movement in output relative to trend during the crisis period would have been, in the absence of a BC, the same or similar to the movement in the pairing country. In practice, of course, it is not possible to choose a perfect pair so that any comparisons should be treated with a large degree of caution. Since there is not always a clear dividing line between countries that had banking problems from those that did not, pairs have been made only for the episodes in our sample of outright systemic banking crises as defined earlier. The criteria we use to define a matching country were (i) close regional proximity implying, inter alia, the likelihood of proneness

[22] Bordo et al. (2001) attempt to address this problem through using a two-stage estimation procedure.

to similar shocks; (ii) similar level of GNP per capita; and (iii) similar structure of output (measured by the shares of manufacturing, primary production ('agriculture') and services in GDP).

The cumulative output gaps (GAP2) of the pairing countries are shown in Table 7. Since crises are often clustered in regions, choosing a geographical proximate pair country that did not also face a BC is not always straightforward. For example, banking crises in Latin America in the early 1980s, 1990s and mid-1990s affected a number of countries in the region. This was also the case for the Nordic BC in the late 1980s/early 1990s and the east Asian crisis in 1997–1998. In the Nordic countries, for example, the UK has been chosen as the non-crisis pair (although we also show estimates of Denmark where the crisis was judged to be non-systemic). In south east Asia in 1997–1998, where the crisis affected all the countries in the region, the Philippines – a crisis country – was chosen as the 'non-crisis' pair on the grounds that its bad loans/GDP were much lower than in either Thailand and Indonesia – the systemic crises in our sample. Although there are marked variations by country, these initial estimates suggest that the output gaps (i.e. GAP2s) during the crisis periods for the crises countries are usually much higher than for the chosen pairs, especially in high income countries. For example, output gaps in the UK and Denmark in the early 1990s were far smaller than in Finland and Norway, while although output fell dramatically in Korea, Thailand and Indonesia in 1997–1998 it remained close to trend over the period in both Taiwan and the Philippines – the non-crises pairs. On average, banking crises increase the cumulative output gaps by 13% of GDP.

In Table 8 we report results from regressions of output gaps, on various (0,1) dummies. The table summarises the information extracted from Table 6. As indicated by the difference in the coefficient estimates on the BC and non-BC dummies (1-BC) in equation (1) of the table, cumulated output losses are 13% (i.e. 19–6%) of GDP higher in our sample of systemic crises than in the non-crisis pairs. However, as indicated by the results of a standard Wald test of coefficient equality (see last two rows of column 2 of Table 8), this difference is not statistically significant. Within the total, output losses for crises in high and low middle income countries are, on average, 25% and 10% higher respectively than in the comparable non-crisis countries (equations (2) and (3) in columns 3 and 4). But the difference is statistically significant only for high income countries. Within low-middle income countries, the average difference in output losses between episodes of twin currency and banking crises and episodes of banking crises alone is more than 26% of GDP (equation (4)). This difference is statistically significant at the 5% level (*P*-value 3%), suggesting that for low middle income countries the incidence of currency crisis is a better explanatory variable of cross-sectional differences in output losses than the incidence of BC. Equation (5) confirms this. [23] Equation (6) suggests that this is not the case for high income countries, where the

[23] In Section 3 we discuss briefly the possibility that the effect on fiscal costs of currency crises had been larger in countries that previously had in place fixed rather than floating exchange rate regimes prior to crisis. We tested this was the case for output losses but did not find any statistical supporting evidence.

Table 7
Accumulated GAP2 output losses incurred during banking crises for systemic crisis and comparison countries

Crisis countries	GAP2 (%)	Currency crisis	Pair non-systemic BC countries	GAP2 (%)	Currency crisis
High income countries					
Finland 91–93	44.9	Yes	United Kingdom	19.6	No
			(Denmark	3.9	No)
Japan 92–98	71.7	No	Korea[a]	6.1	No
			(United States	−8.0	No)
Korea 97–	12.8	Yes	Taiwan	−1.9	No
Norway 88–92	27.1	No	United Kingdom	2.1	No
			(Denmark	20.7	No)
Sweden 91	3.8	Yes	United Kingdom	4.5	No
			(Denmark	0.5	No)
Average	32.1		Average	6.1	
Of which:			Of which:		
twin crises	20.5		currency crisis	n/a	
BC alone	49.4		Neither crisis	6.1	
Medium and low income countries					
Argentina 80–82	25.9	Yes	Brazil	15.3	Yes
Argentina 85	7.1	No	Brazil	−5.0	No
Argentina 89–90	16.1	Yes	Chile	−17.1	No
Argentina 95	5.8	No	Chile	−4.2	No
Bolivia 86–87	0.4	No	Paraguay	7.1	Yes
Bolivia 94–	−26.8	No	Peru	−149.5	No
			(Paraguay	4.7	Yes)
Brazil 94–96	−12.7	No	Chile	−8.6	No
			(Uruguay	−1.7	No)
Chile 81–83	24.3	Yes	Brazil	44.3	Yes
Colombia 82–87	31.4	Yes	Costa Rica	57.1	No
El Salvador 89	−1.3	No	Guatemala	−3.7	Yes
Ghana 82–89	−47.4	Yes	Sierra Leone	89.6	Yes
Indonesia 97–	20.1	Yes	Philippines	−1.4	Yes
Madagascar 88	−3.1	No	Malawi	−1.3	No
			(Mozambique	−4.9	No)
Mexico 81–82	−0.2	Yes	Brazil	23.3	Yes
Mexico 94–95	5.4	Yes	Chile	−3.5	No
Peru 83–90	94.0	Yes	Ecuador	95.3	Yes
Philippines 81–87	111.7	Yes	Indonesia	26.6	No
Sri Lanka 89–93	−10.0	No	India	−1.6	Yes
			(Pakistan	2.9	No)
Thailand 83–87	−2.8	No	Philippines	−86.3	Yes
			(Malaysia	25.0	No)
Thailand 97–	28.1	Yes	Philippines	−1.4	Yes
Uruguay 81–84	64.1	Yes	Brazil	64.8	Yes
Venezuela 80–83	52.2	No	Brazil	34.2	Yes
Venezuela 94–95	10.6	Yes	Chile	−3.5	No
Zimbabwe 95–	−3.3	Yes	South Africa	−23.9	Yes
			(Botswana	8.3	Yes)

(*continued on next page*)

Table 7 (*continued*)

Crisis countries	GAP2 (%)	Currency crisis	Pair non-systemic BC countries	GAP2 (%)	Currency crisis
Average	16.2		Average	6.1	
Of which:			Of which:		
twin crises	27.2		currency crisis alone	18.3	
BC alone	0.9		Neither crisis	−10.9	
Average all	19.0		Average all	6.1	
Of which:			Of which:		
twin crises	26.0		currency crisis alone	18.3	
BC alone	9.0		Neither crisis	−5.2	

Note: Alternative pairs used in the regression sensitivity analysis are shown in brackets. The summary statistics reported in the table, however, reflect averages across the pairs not shown in brackets.

[a] Since Korea – a comparison country for Japan 1992–1998 – had a crisis itself from 1997, its output loss was estimated over the 1992–1996 period and then scaled-up by multiplying by 7/5.

Table 8
Regressions of GAP2 on crisis dummies and significance tests[a]

	Equation					
	1	2	3	4	5	6
BC[b]	0.019					
1-BC	0.061					
BCH[c]		0.320				
1-BCH		0.067				
BCL[d]			0.162			
1-BCL			0.061			
BCL*CCL				0.272		
BCL*(1-CCL)				0.090		
CCL[e]					0.227	
1-CCL					−0.050	
CCH[f]						0.205
1-CCH						0.185
χ^{2}[g]	1.45	5.11**	0.64	4.58**	5.33**	0.02
P-value	0.23	0.02	0.42	0.03	0.02	0.88

** Indicates rejection of the null hypothesis at the 5% level.

[a] For the purposes of this regression GAP2 is in decimals rather than percentage points.

[b] BC = 1 if the country experienced a BC and zero otherwise.

[c] BCH = 1 if a high income country experienced a BC and zero otherwise.

[d] BCL = 1 if a low income country experienced a BC and zero otherwise.

[e] CCL = 1 if a low income country experienced a currency crisis and zero otherwise.

[f] CCH = 1 if a high income country experienced a currency crisis and zero otherwise.

[g] This is the χ^{2} statistic of a Wald test of equality between the two coefficients reported in each equation. White heteroskedasticity consistent estimators were used for all Wald tests.

incidence of banking crises (see equation (2)) and not currency crises appears to explain better cross-sectional differences in output losses.

At first glance, taken together, the information from Table 8 suggests that the incidence of currency crisis in low middle income countries (the CCL variable) and the

incidence of BC in high income countries (the BCH variable) may indeed help explain the differences in output losses for the whole sample of crisis and non-crisis countries. But such an interpretation may be misleading because it ignores the potential influence on output losses of other macroeconomic conditions prevailing prior to the year in which we start measuring output gaps which cannot be expected to be picked up by our choice of 'paired' non-BC countries. Such conditions may well explain differences in output losses independently of whether the country experienced a BC (if it was high income) or a currency crisis (if it was low income). In the extreme, it may turn out that such conditions explain differences in output losses entirely.

To control for this, we run regressions for GAP2 on a range of macroeconomic variables and on the two dummy variables: BCH and CCL (as defined in Table 8). We employed the following variables: (i) real GDP growth (measured as the first difference in log real GDP); (ii) the change in real GDP growth; (iii) consumer price inflation (measured as the first difference in log consumer prices); (iv) growth in credit relative to GDP (measured as the first difference in log credit over GDP); (v) fiscal deficit as a percentage of Gross National Income (or GDP when data on GNI were not available). As an alternative to (iv) we also considered the growth in the ratio of $M2$ to $M0$ but the results reported below are insensitive to which of the two variables we use. These variables were chosen on the basis of two criteria: (i) in the short run, at least, abnormal values of these variables can lead to output gaps, regardless of whether a BC ensues or not, and (ii) data on these variables exist for the majority of episodes in our sample. Given that our sample is dominated by emerging-market economies, we ruled out a number of variables that met the first criterion, but not the second criterion, including export volumes, the level of (ex post) real interest rates and the level of terms of trade. [24]

As mentioned above, we are interested in a measure of how different these variables are prior to the BC compared to some measure of their normal value. We measured, therefore, each variable as the difference between the average value two years before the BC starts in a country (or in its pair for non-BC countries) and the average historical values prior to this. As an alternative, we also measured each variable as the difference between the value of the variable one year (rather than averaging across two years) before a BC and the average historical value – but the results were insensitive to which measure we used. As is common in cross-sectional data, conventional diagnostic techniques reveal evidence of heteroskedasticity. To correct for this, we estimated our regressions using an ordinary least squares procedure with White heteroskedasticity-consistent standard errors and covariance matrix.

The results of three specifications are reported in Table 9. The second column (equation (1)) shows the results of regressing output losses on BCH and CCL and on all five of our macroeconomic variables. To test whether this regression is well specified, we performed a likelihood ratio redundancy test on the macroeconomic variables that are insignificant. The test fails to reject the null hypothesis of

[24] Out of our sample of 29, systemic banking crises data were missing on exports, real interest rates and terms of trade in 8, 11 and 14 cases respectively.

Table 9
Explanation of the cross-sectional variation in output losses (GAP2s) in 29 systemic crisis and pair countries[a]

Equation	1	2	3
Const	−0.030	−0.028	−0.039
	−0.343[b]	*−0.327*	*−0.566*
BCH	0.306**	0.274*	0.296**
	2.112	*1.955*	*2.266*
CCL	0.223	0.206	0.285**
	1.531	*1.536*	*2.552*
DDYP[c]	−5.689**	−6.067**	−5.143**
	−2.288	*−2.719*	*−2.400*
DYP[d]	−5.139		
	−1.615		
DCP[e]	−0.246		
	−0.561		
DCRED[f]	−0.684		
	−0.511		
FISCDEF[g]	−0.917		
	−0.344		
Adjusted R^2	0.06	0.12	0.14
Log likelihood	−21.07	−21.99	−23.94
Number of observations	46	46	58

* Indicates significance at the 10% level.

** Indicates significance at the 5% level.

[a] For the purposes of this regression GAP2 is in decimals rather than percentage points.

[b] The *t*-statistics corresponding to the coefficient estimates above them are reported in italics.

[c] DDY = change in the annual average of growth in real GDP in the two years before the crisis period.

[d] DY = annual average real GDP growth in the two years before the crisis period less its trend growth before this back to 1970.

[e] DCP = annual average consumer price inflation in the two years before the crisis period less its trend growth before this period back to 1970.

[f] DCRED = annual average growth in credit relative to GDP in the two years before the crisis less its trend growth before this period back to 1970.

[g] FISCDEF = annual average fiscal deficit relative to GDP in the two years before the crisis less its trend before this period back to 1970.

redundancy ($\chi^2 = 1.83$, P-value $= 0.23$), suggesting an alternative specification where these variables are excluded, equation (2). Given that the likelihood ratio test is valid only if both the restricted (equation (2)) and unrestricted (equation (1)) equations have the same number of observations, the results are reported for the 46 observations that are available for all variables employed in equation (1). Equation (3) reports results of estimating equation (2) using all the observations in the sample (i.e. all the 58 crises and single pair countries shown in Table 7). To check whether our results are sensitive to the choice of 'paired countries' we carried out the same procedure substituting alternative pairs for a sample of the 'comparison countries' (the paired countries shown in brackets in Table 7). Our inferences remained unaffected, so we do not report the results here for brevity. Our results also remain unaffected by dropping outlier estimates of output losses.

Overall, the results are consistent with the information extracted from Table 7. BC in high income countries and currency crises in low middle income countries can explain part of the difference in output losses in the sample. More importantly, however, we can now separate the losses in high income countries due to BC from those due to differences in pre-crisis macroeconomic conditions, notably differences in changes in growth rates. In particular, on the basis of equation (3), in high income countries, banking crises contribute, on average, around 85% to the cumulative output losses. Taking together the fact that annual output growth fell, on average, by 1.2% in the high income countries in the two years before banking crises with the coefficient (−5) on this term (DDY) in equation (3) suggests that the residual of output losses in high income countries with banking crises (around 15%) was due to a deterioration in pre-crisis macroeconomic conditions. These estimates, however, should be interpreted with caution, particularly because our sample of high income countries is small. In low middle income countries, currency crises appear to contribute 20–30% points – the coefficient on the CCL dummy variable in Table 9 – to the accumulated output losses, but these estimates are less precisely estimated, indicating the presence of near collinearity between the currency crisis variable and the other variables in the equations. [25] Standard diagnostic tests confirm this, suggesting that deteriorating macroeconomic conditions are associated with, and may in part cause, subsequent currency crises. Surprisingly perhaps, such collinearity effects, even if they do exist, do not affect significantly the precision with which the BC dummy is estimated.

7. Summary and conclusion

Theoretical studies and empirical work focussing on particular crises suggest that under certain conditions banking crises can impose large costs on an economy. Cross-country estimates of fiscal and output costs (both as a share of GDP) reported in this paper appear to bear this out.

The costs of banking crises are often measured in terms of their effect on fiscal expenditure. Cross-country estimates of fiscal resolution costs of banking crises tend to be bigger in lower income countries and those with higher degrees of banking intermediation. Countries with large fiscal costs of crisis have in the past often experienced a simultaneous currency crisis, especially those that had in place a fixed exchange rate regime.

However, resolution costs may simply reflect a transfer of income from taxpayers to bank "stakeholders" rather than necessarily the cost to the economy as a whole. A different, albeit still imperfect, proxy for the latter is the impact of crises on output. However, a crucial issue in measuring output losses is deciding whether they are caused by the banking crises, and are thus costs of banking crises, or whether recession caused the crises.

[25] Interestingly, currency crises in the sample of low middle income countries tend to be preceded by an increase in output growth in the two years before crisis.

The output losses associated with crises are usually measured as the cumulative difference in output, or output growth, during the crisis period from its pre-crisis trend. [26] Although varying markedly from crisis to crisis, our cross-country estimates of output losses during banking crises are, on average, large – around 15–20% of annual GDP. Output losses are usually much larger in the event of a twin banking/currency crisis than if there is a BC alone, particularly in emerging-market countries. Causation here is likely to run in both directions with larger banking crises causing currency runs which, in turn, may exacerbate banking problems, especially for banking systems with large net foreign currency liabilities. Crises have also typically lasted longer in developed countries than in emerging markets. Because of this, on some measures output losses during crises are larger in developed than in emerging-market countries. One possible explanation of this is that emerging-market economies must respond more quickly during banking crises because they usually incur much more widespread bad loan problems than developed countries.

Using a cross-sectional rather than time series approach, we have compared output losses in a sample of systemic banking crises with neighbouring countries that did not at the time face severe banking problems. We found that banking crises but not currency crises significantly affect output in developed countries, while the opposite was true in emerging-market countries. These results also seem to hold up after allowing for other factors that may have caused output to fall. However, there remains the possibility of reverse causation, with larger recessions causing banking (or currency) crises rather than crises causing bigger recessions.

Since there are large differences in estimated output losses from crisis to crisis, a potential fruitful avenue for future research is to explain these differences. In particular, from a public policy perspective, it would be useful to better understand what type of resolution measures are most successful in minimising the welfare costs of crises.

Summarising, it seems to be the case that regardless of whether banking crises cause or are produced by recession, they exacerbate subsequent output losses (and are often costly to resolve).

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[26] These estimates take no account of the possible output costs (or benefits) in the post-crisis period.

Appendix A. The relationship between output loss measures based on growth rates and levels

Recent research has measured output losses during crises by summing up the difference between a constant trend growth rate and actual growth rates observed during crises. This measure, denoted as $G1$, can be written as

$$G1 = \int_{t_0}^{T} (\gamma - g(t))\,\mathrm{d}t,$$

where, t_0 is the point at which the crisis started, T is the point when it ended, γ is the constant trend growth rate and $g(t) = Y'(t)/Y(t)$ is the rate of change of output $Y(t)$. [27]

A more appropriate measure of output losses during crisis periods would be to cumulate the difference between the level of actual output and its trend level as a percentage of the trend level. Using the same assumptions as above, we can write this measure, denoted by $G2$ as

$$G2 = \int_{t_0}^{T} \frac{Y(t_0)\exp(\int_{t_0}^{t}\gamma\,\mathrm{d}v) - Y(t_0)\exp(\int_{t_0}^{t} g(v)\,\mathrm{d}v)}{Y(t_0)\exp(\int_{t_0}^{t}\gamma\,\mathrm{d}v)}.$$

The above expression can be simplified to

$$G2 = \int_{t_0}^{T} (1 - \exp(x))\,\mathrm{d}t,$$

where

$$x = \int_{t_0}^{T} (g(v) - \gamma)\,\mathrm{d}v.$$

Evaluating $G2$ analytically is not straightforward, but so long as x is small and negative, i.e. actual output growth during the crisis is below its trend (in practice a valid assumption), we can use a Taylor's series expansion to approximate $\exp(x)$ by $1 + x$. This yields

$$G2 \approx \int_{t_0}^{T} \left(\int_{t_0}^{t} (\gamma - g(v))\mathrm{d}v \right) \mathrm{d}t \approx \frac{1}{2}(T - t_0) \int_{t_0}^{T} (\gamma - g(t))\mathrm{d}t = \frac{1}{2}(T - t_0)G1. \tag{1}$$

All other factors being equal, Eq. (1) shows, within approximation error, that measuring output losses by cumulating differences in growth rates rather than levels will yield: (i) lower estimates of losses for crises lasting longer than 2 year; (ii) bigger estimates of losses for crises lasting 1 year and (iii) roughly the same answer for crises

[27] Since it is usually assumed that the end of crisis (T) occurs when actual growth ($g(t)$) returns to trend (γ), $G1 \geqslant 0$.

lasting 2 year. The longer the length of the crisis the greater the gap between the two measures. Since crises usually last for longer than two years, everything else equal, cross-country estimates based on $G2$ are usually larger than those based on $G1$.

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