

# Web Appendix

**FOR:**

## **IS THE CRISIS PROBLEM GROWING MORE SEVERE?**

Michael Bordo, Barry Eichengreen, Daniela Klingebiel and Maria Soledad Martinez-Peria

**Published in:**

## **ECONOMIC POLICY, 32, SPRING 2001**

This Web Appendix describes the data and methods employed in the main body of the paper.

### **Sample**

Our 21-country sample consists of Argentina, Australia, Brazil, Canada, Chile, Denmark, Finland, Greece, Italy, Japan, Norway, Portugal, Spain, Sweden, and US (defined as ‘emerging markets’ in the pre-1914 period) as well as Belgium, France, Germany, the Netherlands, Switzerland, and Great Britain (the pre-1914 ‘industrial economies’). Classifying the US as an emerging market is controversial, but we do so because it was a steady capital importer through much of the period, like the other late developers in our sample, and because it lacked a number of the institutions of an advanced-industrial economy, notably a central bank. Starting in 1919, we re-classify Australia, Canada, Denmark, Finland, Italy, Japan, Norway, Sweden and the US as industrial.

Our 56-country sample consists of the 53 countries in IMF (1998), listed in the data table below, plus Senegal, Ghana and Côte d’Ivoire. We added these three in order to increase the overlap with the sample of countries for which we have information on crisis resolution (crisis and recession dates for these three are not included in the data table below).

### **Crisis dates**

We date currency and banking crises using both qualitative and quantitative evidence.<sup>1</sup> (The resulting series for banking and currency crises, along with our business cycle turning points, are shown in the data table below.) The use of qualitative evidence to date banking crises is standard in the literature. Because asymmetric information is intrinsic to bank intermediation, the value of non-performing loans becomes available only with a lag, and even then official estimates of loan losses understate the problem. Because of the existence of deposit insurance and lender-of-last-resort intervention, depositor runs do not necessarily accompany banking-sector problems, making the change in the

---

<sup>1</sup>For details on data and sources, see Bordo and Schwartz (1996) and Bordo and Jonung (1996, 2000).

value of deposits a poor measure of banking-sector distress. For all these reasons, any purely quantitative indicator of banking crises will be problematic.

The use of qualitative evidence to date currency crises is less standard. But because of important changes over the long historical sweep in the depth and liquidity of financial markets, as well as their regulation (the imposition and removal of capital controls, for example), the standard measure of exchange market pressure, if relied on exclusively, would suggest that crises were almost entirely concentrated in those periods when the markets were most liquid and least regulated; hence, given our historical perspective, a hybrid measure (the union of our qualitative and quantitative series) is to be preferred. In constructing the quantitative measure, we build on the exchange-market-pressure model of Girton and Roper (1977) and the methodology in Eichengreen *et al.* (1995, 1996a), as is now standard in the literature. Following the latter, the weights are calibrated to equalize the conditional volatility of the components of the index. We use Britain as the core country through 1913, the US thereafter.

Since we are concerned not just with the frequency of crises but also with the output loss, successive crises – defined as those that follow before recovery from a first crisis is complete – are scored as one event. It would create empirical problems to attempt to calculate separate recovery times or output losses associated with overlapping crises (when the first crisis was still going when the second one began). In any case, it is not clear conceptually whether two crises that occur in rapid succession are properly regarded as separate events.

Since Caprio and Klingebiel (1996, 1999) have identified banking crises in the 1970s, 1980s and 1990s using the same methods, we simply adopt their dates. We use only those banking crises that they classify as systemic. The IMF having carried out the comparable exercise for currency crises for the post-1972 period (IMF, 1998), we can again simply adopt their dates. We found a number of anomalies in this crisis chronology, which we corrected before proceeding.

While our methodology for estimating the length and depth of crises is a variant of that in IMF (1998), there are several important differences in implementation. We consider growth relative to the five-year pre-crisis trend, which differs from the three-year pre-crisis trend used by the IMF, since we found that considering only three years yields unstable and unreliable results. Recovery time is defined as the number of years until GDP growth returns to its pre-crisis trend, including the year when it returns to that trend.<sup>2</sup> By definition, then, minimum recovery time is one year. Clearly there is no single metric for crisis duration and recovery speed and in a previous paper (Bordo and Eichengreen, 1999) two of us measured recovery speed by the number of years following the crisis

---

<sup>2</sup>There is no single – or, for that matter, best – way of measuring the output loss. Mulder and Rocha (2000) argue that the approach used here will overstate the output loss because the pre-crisis growth tends to be unsustainably high, rendering it an inappropriate basis for comparison. They also observe that truncating the calculation at the point where the growth rate returns to trend will understate the loss because the level of output, as distinct from the growth rate, remains depressed for several subsequent years. Using a Hodrick-Prescott filter to estimate the trend, they obtain output losses for the 1973-98 period that are a multiple of ours. However, some of their other estimates yield smaller losses for emerging markets than those reported here. It will be obvious that these alternatives are no less problematic than our method. Adjustments to the pre-crisis growth rate are arbitrary. And truncating the calculation at, say, the point where growth returns to the level extrapolated from some pre-crisis trend rather than at the point where the growth rate recovers to its pre-crisis rate implies the equally arbitrary assumption that the level of output is invariant with respect to the crisis, even over short periods. Fortunately, there is no reason to think that these biases are more severe in one period than another. Since we are primarily concerned with intertemporal comparisons, such biases are likely to be of less moment here than in other applications.

when the growth rate turned positive, and obtained somewhat different results. Research being cumulative, we are prepared to argue that the current metric for recovery speed is more defensible.

While we include as twin crises all episodes in which currency and banking crises occurred in the same or adjoining years, the currency and banking crises in question are not also included under the 'banking crisis' and 'currency crisis' headings; again, this differs from the procedure followed by IMF (1998). Since additional crises occurring before recovery from an initial crisis was complete (including of course crises occurring in consecutive years) were counted as a single event, as noted above, the number of crises we identify for the post-1972 period is slightly fewer. Note that we dropped crises for which there was insufficient data to estimate the years required to return to the pre-crisis rate of GDP growth (because of the intervention of a war or because of data problems).

### **Crisis frequency**

We divide the number of crises by the number of country-year observations in each sub-period (omitting all but the first year of each crisis episode). The fact that we have a growing number of emerging markets in the sample after 1971 may bias the results toward finding more crises in recent years than in 1880–1913 and 1945–71. We cannot do the same calculation for previous periods for the same 56-country sample, since in earlier years many of the countries in question did not exist. What we can do is to replicate the calculations for 1973–98 using the 21-country sample employed for earlier periods. When we do, crisis frequency falls, not unexpectedly, to 8.8%, mainly due to a lesser frequency of currency crises. This number, while not matching the disastrous levels of the interwar years, is still noticeably higher than in 1880–1913 and 1945–71.

It might be thought that our procedure of counting subsequent crises that break out before recovery from a first crisis is complete as one event, and of excluding from the denominator used in this calculation the years following the onset of the crisis when that recovery is underway biases the results toward finding more crises in the recent decades. There is some basis for this second objection, since it turns out that recovery takes somewhat longer before 1913 than after 1973 (resulting in the exclusion of more observations from the denominator in the earlier period). When we count successive events as separate crises (except those occurring in the same or immediately adjoining years, which we continue to categorize as twin crises), and normalize by all country-year observations (in contrast to the calculations underlying Figure 1, adding back in the years in the exclusion window), the frequencies are 6.4 in 1880–1913, 13.4 in 1919–39, 7.9 in 1945–71, and 10.7 in 1973–97. The contrast between our age and earlier periods is still there, but it is less pronounced.

### **Business cycles**

While for the US we have NBER dates, similar dates are not available for all 21 countries we consider before 1971 or for the even larger country sample we consider subsequently.<sup>3</sup> We

---

<sup>3</sup>We have NBER historical business cycle chronologies for the UK, France, Germany, Sweden and Canada, and ECRI dates for eight additional countries from 1948 to the present. In principle this should make it possible to compare output losses in recessions using these

therefore follow Stock and Watson (1999) in applying a band-pass filter to identify when the de-trended output series turns down. For the US, there is reasonable conformance between the NBER dates and those obtained using the band-pass filter (as Stock and Watson have noted previously). Our application of the band-pass filter (Stock and Watson 1999) to identify business cycle peaks and troughs is based on a three-year centred moving average, with the weights chosen to minimize the squared difference between the optimal and approximately optimal filters, subject to the constraint that the filter has zero gain at frequency zero. The filter places zero weight on all frequencies between 2 and 8 years. Peaks and troughs are then identified in three stages. First, we locate all local maxima and minima. Second, we eliminate all local maxima that occurred such that the log deviation from trend was negative. (In effect, this amounts to removing all peaks with a negative growth rate.) At this stage we also eliminate all local minima around which the log deviation from trend was positive (in effect eliminating all local minima for which the growth rate was positive). Finally, we remove adjacent peaks and adjacent troughs. When there are two consecutive peaks or troughs, the larger of the two is selected. Note that the band-pass filter tends to pick out a number of growth recessions (since it is removing from the data a positive growth trend and leaving decelerations in the rate of growth, which the methodology picks up as recessions). Thus, in text, we refer to recessions in which no output loss occurs. These are the growth recessions in question.

---

chronologies with the band-pass filter dates, but only for a relatively limited sub-sample of countries and years.

**Data for Figure 1. Crises frequency 1880–1997, by crisis type**

Period	Banking crises (%)	Currency crises (%)	Twin crises(%)	All crises (%)
<i>Industrial nations</i>				
1880–1913	2.0	1.0	0.5	3.5
1919–1939	3.7	4.3	4.0	12.0
1945–1971	0.0	5.4	0.0	5.4
1973–1997	2.5	8.1	1.7	12.2
<i>Emerging nations</i>				
1880–1913	2.6	1.4	1.9	6.0
1919–1939	5.8	2.5	2.5	10.8
1945–1971	0.0	10.3	0.6	10.9
1973–1997	2.4	9.8	14.6	26.8

*Source:* Authors' calculations based on data tables below.

**Table 1 (expanded). Duration and depth of crises**

Duration (average number of years)	1880–1913	1919–1939	1945–1971	1973–1997 21 nations	1973–1997 56 nations
<i>Currency crisis</i>					
All countries	2.6	1.9	1.8	1.9	2.1
Industrial nations	3.0	1.9	1.7	1.8	2.0
Emerging nations	2.5	2.0	2.1	2.0	2.1
<i>Banking crises</i>					
All countries	2.3	2.4	<sup>a</sup>	3.1	2.6
Industrial nations	3.0	2.5	<sup>a</sup>	3.4	3.1
Emerging nations	2.0	2.1	<sup>a</sup>	1.0	2.4
<i>Twin crises</i>					
All countries	2.2	2.7	1.0	3.7	3.8
Industrial nations	1.0	2.3	<sup>a</sup>	5.4	5.0
Emerging nations	2.4	4.3	1.0	2.3	3.4
<i>All crises</i>					
All countries	2.4	2.4	1.8	2.6	2.5
Industrial nations	2.7	2.3	1.6	2.8	2.7
Emerging nations	2.3	2.6	2.0	2.1	2.4

Depth (% GDP loss)	1880–1913	1919–1939	1945–1971	1973–1997 21 nations	1973–1997 56 nations
<i>Currency crisis</i>					
All countries	8.3	14.2	5.2	4.0	5.5
Industrial nations	3.7	11.4	2.4	3.0	3.8
Emerging nations	9.8	26.5	9.0	8.5	6.4
<i>Banking crises</i>					
All countries	8.3	10.5	<sup>a</sup>	7.0	6.2
Industrial nations	11.6	11.5	<sup>a</sup>	7.9	7.0
Emerging nations	7.2	8.9	<sup>a</sup>	0.0	5.8
<i>Twin crises</i>					
All countries	14.5	15.8	1.7	15.7	18.6
Industrial nations	0.0	13.8	<sup>a</sup>	17.5	15.6
Emerging nations	16.3	24.0	1.7	14.1	19.5
<i>All crises</i>					
All countries	9.8	13.4	5.2	7.8	8.3
Industrial nations	7.7	12.3	2.4	6.7	6.3
Emerging nations	10.4	16.5	8.6	10.8	9.2

Notes: This is an expanded version of Table 1 in the body of the article.

<sup>a</sup> indicates no crises

Source: Authors' calculations based on data tables below.

**Data Table: Crises dates and business cycle turning points.**

**A.1883–1913**

(BC =banking crises, CC =currency crises, P =business cycle peaks, T = business cycle troughs.)

Date	Argentina	Australia	Belgium	Brazil	Canada	Chile	Denmark	Finland	France	Germany	Greece	Italy	Japan	Netherlands	Norway	Portugal	Spain
1883																	
1884				T				P						T			
1885	CC	T					BC	T		P	CC						
1886												P			T		P
1887	T				T	CC	T		T	T				P		P	
1888				P		T			CC	P		T					
1889	P	P		BC,CC				P	P,BC				T				T
1890	BC,CC			BC	P		P							T	P		
1891	BC				CC	P						BC		P		BC,CC	
1892	T									T		P	P	T		T	
1893		T,BC			CC		T	T	T	CC		BC					P
1894	P									P		CC			T		T
1895										T				P			P
1896						T		P					T	T		P	
1897				BC	T									P,BC			
1898	T			T,CC		BC,CC			P	P		T		T			
1899		P					P									T	T
1900	P			BC		P		BC					P,CC				
1901				BC	P				T	T,BC		P	BC		P	P	
1902	T			P			T						T				P
1903		T						T						P			
1904					T				P			T	P,CC				
1905						T		P		P				T	T	T	
1906					P		P		T								T
1907						BC	BC		BC	CC		P,BC	T,BC				P
1908	CC			T	CC		BC		P			CC	CC		P	P	
1909					T				T				P	P			
1910							T	T		T		T			T		T
1911		P			P				P				T	T			
1912	P			P		P	P			P							
1913									T							T	

**B. 1913–1939**

Date	Argentina	Australia	Belgium	Brazil	Canada	Chile	Denmark	Finland	France	Germany	Greece	Italy	Japan	Netherlands	Norway	Portugal	Spain
1913									T							T	
1914							T						P				
1915					T	T		P						P	P	P	P
1916	T			T								P					
1917													T		T		
1918					P	P		T						T			
1919		T		P								T					T
1920	P				T											T,BC	BC
1921	T			T	CC	T	T,BC,CC	P,BC,CC				BC	P,CC	P,BC,CC	P,BC		
1922			T				CC		T						T,BC		P
1923				BC	BC		P	T	CC					CC	BC	BC	
1924	P		P,CC	P	P	P		P	P			P			P	P	BC
1925			BC		T	BC		T						T		T	T,BC
1926	T		BC	T		T	T		CC	T		T					
1927		P	T										T,BC		T		
1928				P				P				P					P
1929	P,CC				P,CC	P				P				P	P		
1930	CC		P	CC			P		BC			BC	P			P	
1931	BC,CC	T	BC	CC	CC	CC	BC,CC	T,BC,CC	BC	BC,CC	T,BC,CC	BC	CC		BC,CC	BC,CC	BC,CC
1932	T,CC	CC		T		T	CC		BC	T	CC	T	CC			BC	T
1933		CC			T		T						T		T		
1934	BC		T,BC	CC						CC				T			P
1935	P		CC			P	P			P		BC,CC		CC			
1936		P		P	P		T		T,CC	T		CC				T	
1937			P	CC				P	CC		P				P		T
1938	T		CC				P										
1939		T	BC		T			BC				P	BC	T			

Note: Missing entries for business cycle turning points during World War I reflect the absence of GDP data.

(BC =banking crises, CC =currency crises, P =business cycle peaks, T = business cycle troughs.)

**C. 1940–1971**

Date	Argentina	Australia	Belgium	Brazil	Canada	Chile	Denmark	Finland	France	Germany	Greece	Italy	Japan	Netherlands	Norway	Portugal	Spain
1940	P		T														P
1941								T					T	P		P	
1942		P					T					P					
1943				T	P	T							P				T
1944	T					P		P					T	T			P
1945		T										T				T	
1946			T												T		
1947				P	T		P				T						
1948	P							T	CC			P		P			
1949		P,CC	T,CC	T		T	P	CC	P	CC	P			CC	CC	P	T
1950	CC			P	CC						CC	T					
1951			P		P					P			T		T		
1952	T			T													P
1953		T		P		P,CC				T	T	P		T		T	T
1954		P	T		T				T								P
1955				T		T				P	P				P	P	T
1956	P		P	P				P	P					P			P
1957					P	P	T		CC				P			T	
1958								T		T		T					CC
1959	CC		T	CC							T		T		T		
1960						T			T		P						T
1961		T			T			P		P							
1962	CC			T,CC	CC	P,CC					T	P		T			P
1963	T			BC, CC						T			P			P	T
1964		P				T			P	P		CC			T		
1965			P	P,CC			P				P			P		T	P
1966	P						P									P	T
1967	CC	T	T		P	P	T	T	T	T		T		T	P		P,CC
1968	T					CC	P		CC		T		T				
1969						T	P										
1970	CC				T		T									T	
1971		T,CC	CC	T			P,CC	CC			CC		P	CC	CC	CC	T,CC

(BC =banking crises, CC =currency crises, P =business cycle peaks, T = business cycle troughs.)

## D. 1972–1998

Date	Argentina	Australia	Austria	Bangladesh	Belgium	Brazil	Canada	Chile	China	Colombia	Costa Rica	Denmark	Ecuador	Egypt	Finland	France	Germany
1972	P				P			P								P	P
1973							P					T					
1974		P										P			P		
1975	CC			P,CC		P		CC						CC			
1976		T,CC					T	T,BC		T	T	T,CC				T	T
1977	T		T	T		T		CC	T					P	T		BC
1978			P									P				P	
1979	P			P			P		P		P			CC			P
1980	BC	P		CC		P		P	CC	P							
1981				T,CC			CC	BC			CC		BC	T,BC	P		
1982	CC				CC			CC	T	BC		T	CC				
1983	T	T,CC				T	T				T		T				
1984	CC							T,CC		T			P,CC				
1985	BC	CC		P	T						P		T,CC				
1986							CC		CC			P	P		T,CC	T	
1987	P,CC		T	BC		P,CC			P		T,BC	BC					
1988								P		P	P		T,CC				T
1989	BC,CC	P,BC		T			P		CC			T		P,CC	P		
1990	T		P		P	BC,CC		T			T	P	P	BC		P	
1991	CC			P				P	T				T,CC		BC,CC		P
1992		T				T	T	T	CC	T		CC				CC	
1993	P			T				P				T,CC	P		T,CC		
1994						BC					P			T		T,BC	
1995	BC,CC	P			T	P		T	P	P							T
1996												P					
1997	T	T	T					P			T						
1998	P			P		CC				T							

(BC =banking crises, CC =currency crises, P =business cycle peaks, T = business cycle troughs.)



**D. 1972–1998 (continued)**

Date	Japan	Korea	Malaysia	Mexico	Netherlands	New Zealand	Nigeria	Norway	Pakistan	Paraguay	Peru	Philippines	Portugal	Singapore	South Africa	Spain	Sri Lanka
1972					P									P			
1973																	
1974																P	
1975			CC			P,CC	P	T	P	T	P,CC	P			P,CC		
1976	T		T	CC	T							T	T,CC	T		CC	T
1977									T		CC				BC	BC	CC
1978		P		T		CC					T		CC		T,CC		
1979	CC				P	T	T		CC								
1980	P	CC				CC		P		P							
1981		T		P,BC			P,CC		P		P	BC	P		P,CC		
1982				CC								P,CC		BC	CC	CC	
1983			P	CC	T			T			BC,CC	CC	CC	P			
1984						CC				CC	T				CC		
1985	T		BC	CC	P		T		T	T			T		BC	T	
1986						P	CC	P,CC		CC		T,CC			CC		P
1987			T		T	BC		BC			P			T	T		
1988				T		CC	CC		CC		CC				CC		
1989		P								P,CC		P		P	P		T,BC
1990	P		P	CC	P		P	T	CC		CC	CC				P	
1991							BC,CC				T		P				
1992	BC			P	CC	T					CC			T	CC	CC	
1993		T	T				CC		P,CC			T			T		
1994				BC,CC	T		CC									T	P
1995				CC		P			CC	BC	P		T	P	CC	CC	
1996		P	P	T			T					P			P		
1997		BC,CC	CC						CC	T		CC					T
1998		BC,CC	BC,CC	P	P	T		P	T		T	BC		CC			

(BC =banking crises, CC =currency crises, P =business cycle peaks, T = business cycle troughs.)

