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Rocha, Bruno; Solomou, Solomos

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The Effects of Systemic Banking Crises in the Inter-War Period

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Bruno Rocha
Solomos Solomou

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The Effects of Systemic Banking Crises in the Inter-War Period

Abstract

This paper examines the time-profile of the impact of systemic banking crises on GDP and industrial production using a panel of 24 countries over the inter-war period and compares this to the post-war experience of these countries. We show that banking crises have effects that induce medium-term adjustments on economies. Focusing on an eight-year horizon, it is clear that the negative effects of systemic banking crises last over the entirety of this time-horizon. The effect has been identified for GDP and industrial production. The adverse effect on the industrial sector stands out as being substantially larger in magnitude relative to the macroeconomic effect. Comparing the results across long-run historical periods for the same selection of countries and variables identifies some differences that stand out: the short term macroeconomic impact effects are much larger in the post-war period, suggesting that the propagation channels of shocks operate at a faster pace in the more recent period. Moreover, the time-profile of effects differs, suggesting that modern policies may be modulating the temporal shape of the response to banking crises shocks. However, the broad magnitude of the adverse effect of banking crises remains comparable across these time periods.

JEL-Code: E600, N000, N200, G010.

Keywords: local projections, banking crises, financial crises, economic history, inter-war.

Bruno Rocha
University of Cambridge
Cambridge / United Kingdom
bit41@cam.ac.uk

*Solomos Solomou**
Faculty of Economics
University of Cambridge
Sidgwick Avenue
United Kingdom - CB3 9DD Cambridge
ss19@cam.ac.uk

*corresponding author

1 Introduction

This paper examines the time-profile of the impact of systemic banking crises on GDP and industrial production using a panel of 24 countries over the inter-war period and compares this to the post-war experience of these countries. The main aim of the paper is to clarify our understanding of the impact of banking crises during the inter-war period. The choice of countries is partly determined by historical data availability but we are able to study a diverse set of economies with differences in production structures, per capita income, and financial depth. Although there is significant general interest on the inter-war period in the literature on financial crises, partly because banking crises were widespread during this period, there exist only a few econometric studies of the period. Often, the inter-war data forms part of the sample in a longer period study of financial crises. For example, Bordo *et al*. (2001), Dwyer *et al*. (2013) and Jordà *et al*. (2013) include data from the inter-war era in their estimations but do not provide separate econometric analysis for this specific period. Occasionally the 1930s are excluded as a robustness check on observed results (Schularick and Taylor, 2012; Jordà *et al*., 2013) as a way of testing the assumption of the exceptionalism of the Great Depression. The assumption that inter-war banking crises were more severe in their effects lingers in the literature; for example, in a study of the OECD economies during the period 1967-2007 Romer and Romer (2015) assert that banking crises before World War II distort our understanding of the impact of banking crises in more recent years by leading us to believe that the effect is large and persistent – they find that banking crises had mild short-term effects. This paper contributes to the literature by explicitly comparing results for the inter-war and post-war periods for the same set of 24 countries.

Bernanke and James (1991) provide one of the few econometric studies focusing on the inter-war period; they analyse a monthly panel data set of industrial production for the

period from 1930 to 1936 and find an important role for banking crises in explaining the link between falling prices and falling output. They find that banking crisis have a significant and large negative impact effect on industrial production growth rates, implying that severe banking panics reduce output growth independently of gold-standard effects. A number of other studies use descriptive analysis to document the effect of major financial crises. Reinhart and Rogoff (2009b) argue that major financial crises raise unemployment and reduce growth in the decade following a major banking crisis. Reinhart and Reinhart (2010) plot the probability density functions of several key macroeconomic indicators for the ten years before and after major financial crises, and use the non-parametric Kolmogorov-Smirnov test to examine whether these indicators are drawn from the same distribution. They find that real GDP per capita growth rates are significantly lower in the decade following severe financial crises, such as the 1930s. Reinhart and Rogoff (2014) examine the effect of 100 systemic banking crises since the mid-19th Century (approximately one third of their events take place within the inter-war period) and find that such events have long lasting effects; it takes a mean of eight years to reach pre-crises levels of per capita income. Grossman (1994, 2010) describes the cyclical time-profiles of GDP during the Great Depression of the 1930s in countries experiencing banking crises and non-crisis countries and finds evidence of high amplitude depressions and persistent differences in the recovery profiles of banking crises countries, compared to non-crisis countries.

This paper contributes to our understanding of the impact of banking crises in the inter-war period from three separate angles. First, we have refined the existing data sets on banking crises to construct a new banking crises data set for 24 countries that allows us to document an important distinction between systemic and non-systemic banking crises and refine the dating of the starting year of banking crisis events. As part of this exercise, we reviewed existing data sets and identified inconsistencies across classifications. We then used

country-specific studies to determine the severity of specific events. All classifications of inter-war banking crises, including our own, involve an element of qualitative judgment and we outline the details of each event in Appendix I to account for our classifications. Given the qualitative nature of classifications, and the existence of some unavoidable classification uncertainty, a further innovation in our approach is to retain information about less severe events in a broader selection (B) which we include in our estimations for sensitivity analysis. In doing so, we have attempted to emphasise the difference between banking crises that are clearly systemic and events that may only share some elements of systemic features. Thus, although ideally banking crises would likely be best described by a spectrum of severity (data permitting), we attempt to use available information to document two points on this spectrum. For completeness, we also consider the even broader classification of Reinhart and Rogoff (2009), which contains a number of what they consider to be "Type II banking crises" i.e. events that entail limited financial distress.

Second, we consider the effects of banking crises on GDP and industrial production. The differences of results pertaining to industrial production and GDP have not been considered with regard to inter-war banking crises. This is an interesting aspect since much of interwar literature relies on Bernanke and James who focus only on industrial production. Bernanke and James's (1991) work on inter-war banking crises used the League of Nations industrial production data as a proxy for macroeconomic performance. Here we utilise recent revisions to historical data for GDP and industrial production to identify, separately, the effect of banking crises on these two variables. The motivation for this is the observation of Reinhart and Reinhart (2009) who find that the analysis of policy effects in the 1930s differs if we use GDP or industrial production data. We replicate the importance of this distinction for studies of inter-war banking crises; the differences between the growth rates of GDP and of industrial production suggest that the latter is not a good proxy for the former. Moreover,

identifying the distinction between macroeconomic and industrial sector effects adds new insights on the effect of inter-war banking crises.

Thirdly we apply modern econometric methodology to analyse the effect of banking crises on the real economy, building on the descriptive results reported above. In this paper we use the local projections method developed by Jordà (2005) to model the effect of banking crises within a panel econometric setting, as done, among others, in Furceri and Zdzienicka (2012), Jordà *et al*. (2013), and Teulings and Zubanov (2014). The defining characteristic of the local projections method is that it is based on estimating separate regressions that are local to each forecast horizon. In doing so we build the time-profile of the impulse response function (IRF) for banking crises as a shock variable. Although the local projections method has been applied to long-run data sets this is the first application that is specific to the inter-war period. Moreover, the construction of comparable data sets for the post-war and inter-war periods allows us to directly compare the effects of banking crises across different historical periods.

The paper is structured as follows: Section 2 describes the econometric methodology used to estimate impulse response functions; Section 3 describes the data used in this study, including banking crisis dating, GDP and industrial production indices, and a set of control variables for other shocks; Section 4 presents our results on the inter-war period and evaluates the robustness of the results to different banking crisis classifications and to the inclusion of control variables; Section 5 provides a comparison with the post-war period for the same selection of countries, in an attempt to clarify and evaluate the idea of inter-war exceptionalism; Section 6 concludes.

2 Empirical methodology

To estimate the impulse-response profile of banking crises we employ the local projections approach of Jordà (2005). As noted above, this method has been used recently to study the impact of banking crises in a panel econometric context. The method is based on estimating separate regressions that are local to each forecast horizon. As noted in the literature (Jordà, 2005, 2009; Jordà *et al*., 2013; Teulings and Zubanov, 2014), the method has advantages vis-à-vis the estimation of ARDL equations. It is of practical application, as it only requires traditional least-squares methods. More importantly, it appears to be particularly robust to misspecification of the data generating process, as it does not require the specification and estimation of the unknown true multivariate dynamic system itself.

More formally, we estimate the effect of a banking crisis event that occurs in country *i* and year *t* on output in year *t* + *h* (*h* = 0, 1, …, 7) through the estimation of the following sequential equations:

$$\frac{y_{i,t+h}}{y_{i,t-1}} - 1 = \delta^h D_{i,t} + \boldsymbol{X}_{i,t}\boldsymbol{\theta}^h + \alpha_i^h + \eta_t^h + u_{i,t+h}. \qquad [1]$$

The dependent variable is the cumulative growth of *y*. As noted above, we consider GDP and industrial production (when *h* = 0, we have annual growth observed in *t*). Dummy variable *D* equals 1 if there is a banking crisis that starts in year *t* and zero otherwise, so our main coefficients of interest are the δ^h. These shape the impulse response function (IRF) and hence allow us to trace the time-profile of the effect of crises over time (when *h* = 0 the respective coefficient represents the contemporaneous impact of the crisis). Vector $\boldsymbol{X}$ contains

control variables, which in our case will include concurrent economic and political shocks (currency crises, sovereign debt crises, inflation crises, and changes in the political regime; these will be detailed in the next section). We control for country and year fixed effects – α and η respectively – in all regressions. Given the short time dimension of the inter-war data, in order to estimate the average effect of a banking crisis with a reasonable number of events we limit our forecast horizon to a maximum h of 7 (more on this in Section 4).

3 Data

3.1 Systemic banking crises

It is clear that the precise terms of the concept of a systemic banking crisis are not easy to define. Moreover, there is no simple quantitative rule to help resolve classification problems. An example is given by Bernanke and James (1991) who discuss how sharp drops in the deposit-currency ratio in the inter-war period could help to identify banking panics. However, they stress that there are crises that are not associated to drops in the deposit-currency ratio and that, conversely, there were significant drops in that ratio which are not associated with banking panics (these can reflect exchange rate difficulties, for instance).

We have built a new data set of banking crises for 24 countries in the inter-war period. As in other studies, our classification is based on qualitative informed judgement, documenting the *extent* of financial distress in the banking system of a country. We have used information from all previous classifications – Bernanke and James (1991), Bordo *et al.* (2001), Reinhart and Rogoff (2009, 2014), Grossman (2010), Schularick and Taylor (2012) – and, in addition, we have used a variety of country-specific studies to help resolve classification differences. Table 1 contains our proposed list of crises; Appendix I provides

details on each classification.[1] The table contains two categories of events: a smaller group A and an extended group B. The former contains the banking crises we consider to be systemic crises. The B category includes extra events that appear to be less severe and therefore it is doubtful that they display the features of a full-fledged systemic crisis. In general this has led us to exclude from group A events that affected only one bank or a small number of banks. An example is Canada in 1923 when the Home Bank of Canada failed. Although Bordo *et al*. (2001) and Reinhart and Rogoff (2009, 2014) list this as a systemic banking crisis, Grossman (2010) argues that this does not constitute a systemic crisis, noting this as an example of an isolated failure of a bank that was relatively local. Other factors of exclusion included evidence pointing to the existence of policy responses that avoided more serious potential harm (e.g. Spain in 1931) or an explicit comparison found in the literature with more severe events (Portugal and Sweden), as detailed in Appendix I. Inevitably, such classification uncertainty will be difficult to resolve. In light of this problem we have chosen to retain the information on such milder crises to evaluate the sensitivity of econometric results to classification uncertainty.

[1] For completeness, Appendix I also comprises information on some minor bank-related events that are neither in the A nor in B set.

TABLE 1. List of banking crises: start dates

Countries	A	B
Argentina	1931, 1934	-
Australia	-	-
Austria	1929	1923
Belgium	1931, 1934	1925
Brazil	1923	-
Canada	-	1923
Chile	-	1925
Denmark	1921	-
France	1930	-
Germany	1931	-
India	-	-
Italy	1921, 1930	1935
Japan	1927	1920, 1922
Mexico	-	1921, 1931
Netherlands	1920	-
New Zealand	-	-
Norway	1921	1931
Portugal	1920, 1923, 1925	1931
Spain	1920, 1924	1931
Sweden	1922	1932
Switzerland	1931	-
United Kingdom	-	-
United States	1930	-
Uruguay	-	-

3.2 GDP and industrial production

The GDP series we use for 23 of our 24 countries are from the most updated version of the well-known Barro-Ursua Macroeconomic Dataset (Barro and Ursua, 2010) for the period 1920-1938. In addition, we use a recent revision for Italy (Baffigi, 2011). Barro-Ursua raised a number of valid criticisms of Maddison's data sets,[2] including the existence of revisions that have not been incorporated in Maddison's data and the fact that Maddison made many arbitrary interpolation assumptions when constructing missing data series. These criticisms are particularly relevant to this paper as many previous studies have used the Maddison GDP series in their analysis, including Reinhart and Rogoff (2009), Schularick and Taylor (2012), and Dwyer *et al*. (2013).

Our data set for industrial production contains indices for 23 countries,[3] again for the period 1920-1938. These series are often part of revisions to the national accounts from the output side. The data set we assembled represents an improvement on existing alternatives both in terms of temporal coverage and data reliability. The sources of the data series are presented in Appendix II.

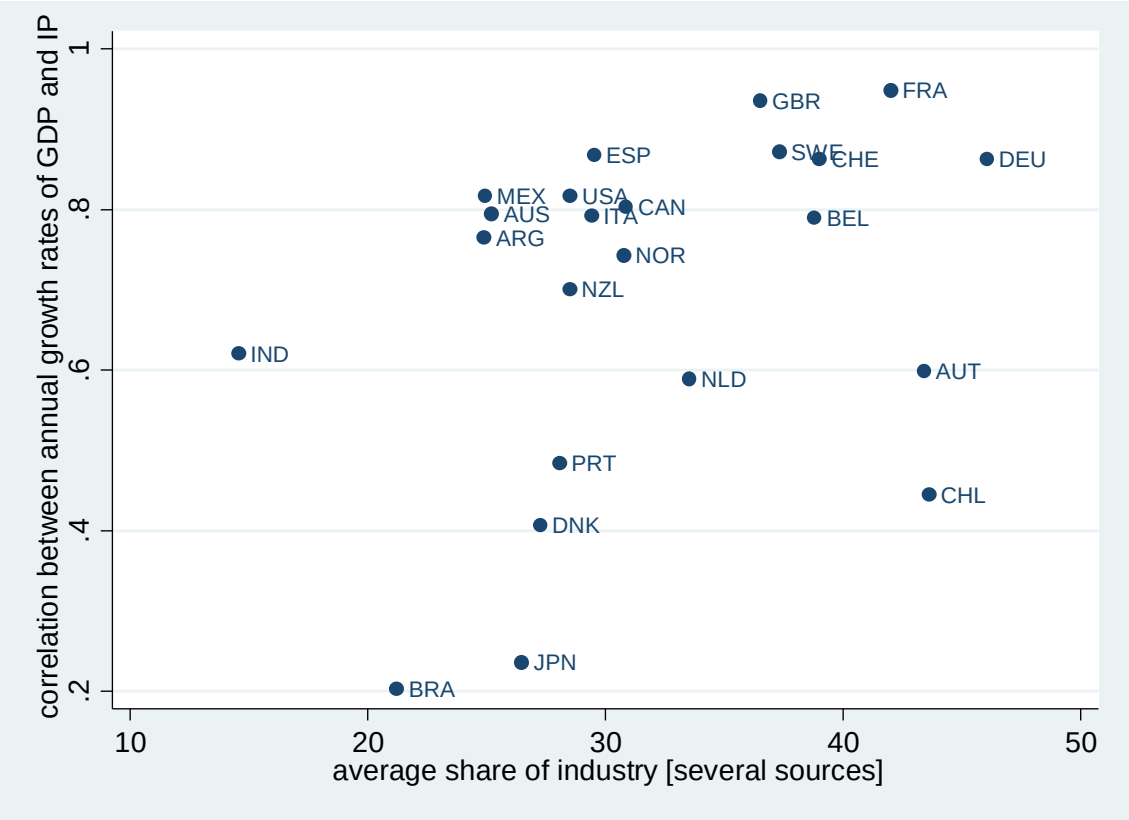
By considering the evidence for industrial production and GDP (both at annual frequency) we are able to offer a more comprehensive picture of the inter-war evidence than has been possible to date. Note that there is large variation in the production structures of the 24 economies in our selection, as shown in Figure 1 (x-axis). The mean share of industry in GDP is 31.4 percent, but this varies between a minimum of 14.6 (India) and a maximum of 46.1 (Germany). In addition, averaging over the countries the correlation of annual growth

[2] Maddison's data has been provided in a number of vintages. The last version was his 2008 data set found at http://www.ggdc.net/maddison/oriindex.htm.

[3] Industrial production data are not available for Uruguay.

rates of GDP and industrial production in the inter-war period results in a figure of 0.693 but the variation is substantial (see the range of the y-axis in Figure 1).

FIGURE 1. Share of industry in GDP and correlation between annual growth rates of GDP and industrial production



Note. The share of industry was calculated by averaging for each country the available data points between 1919 and 1938. See further details in Appendix II.

3.3 Control variables

Given the widespread presence of other economic shocks in the inter-war period it is important to control for such shocks when analysing the effect of banking crises. In this study we consider a wide set of controls, including currency crises, sovereign debt crises, and inflation crises. All data series come from Reinhart and Rogoff (2009) and are based on quantitative criteria.[4] A currency crisis is defined as an annual depreciation versus the US dollar, or the relevant anchor currency, of 15 percent or more. An inflation crisis is a year with an inflation rate of 20 percent or more. Although these decision rules are somewhat arbitrary, they should capture a wide range of macroeconomic problems that were common in the inter-war period and, in principle, could explain part of the association of banking crises to variations in GDP and industrial production.

Political changes were also a very marked feature of the inter-war period. Recall, for instance, the ascension of Nazism in Germany and Fascism in Italy, the establishment of right-wing dictatorships in Portugal and Spain, and the 1930 Argentine coup d'état establishing a military junta government. In contrast, for some other countries we had change towards wider democracy. We have tried to identify political shocks by considering the first difference of the Polity2 democracy indicator (the indicator varies between a maximum of 10 for democracy and a minimum of -10 for non-democracy) of the widely used Polity IV data set (Marshall *et al.*, 2013). This allows us to capture *changes* in the political regime. For example, in Germany in 1933 such first difference is equal to -15, reflecting a change from 6 to -9.

[4] Reinhart and Rogoff (2009) distinguish external from domestic debt crises. In order to make the specification more compact i.e. reduce the number of control variables, we have merged the information in a single variable and consider the starting year of a debt crises, regardless of the jurisdiction – international/foreign or national – under which the defaulted debt was issued.

4 Empirical results

In this section we present local projection results based on the specification described in equation [1]. The baseline IRFs in Tables 2 and 3 correspond to the sequences of more parsimonious regressions, not including control variables. In Table 2 the dependent variable is cumulative growth in GDP;[5] the number of observations available for estimation at $h = 0$ is 432, and this decreases gradually until it reaches 264 in year $h = 7$.

In the first IRF (Table 2, row 1) we consider our group A of systemic crises. We truncate the IRF at $h = 7$ as a way of maintaining a large sample of observations and at the same time capturing a reasonable number of banking crisis events for the estimation of the impulse response function. The number of banking crisis events is equal to 19 at the initial year of the forecast horizon and 17 at the final year (at $h = 8$ and $h = 9$ the number of A events falls to only 13 and 10 respectively). It is clear from the time-profile of effects that systemic banking crises have a severe and long-lasting effect on GDP. In the first three years, the effect is around a 2.5 percent decrease of GDP. This negative effect doubles in the later years. For example at $h = 5$ (i.e. half-decade after the crisis) the loss inflicted to the cumulative growth rate is 5.32 percentage points.[6]

[5] We also estimated the effect on GDP per capita. The results are very similar in magnitude, significance and time-profile to those reported for GDP.

[6] As a robustness check we have evaluated the sensitivity of the results to any one country by removing any single country from the sample and estimating the respective IRF. The qualitative message conveyed by row 1 of Table 2 is robust to the removal of any individual country. These 24 IRFs are in the Appendix III.

TABLE 2. Impulse Response Function of GDP

Banking crises	*h* = 0	*h* = 1	*h* = 2	*h* = 3	*h* = 4	*h* = 5	*h* = 6	*h* = 7
1. GROUP A (restrict)	-0.0219**	-0.0282**	-0.0264(a)	-0.0598***	-0.0511**	-0.0532*	-0.0549*	-0.0578(a)
	(0.00977)	(0.0128)	(0.0171)	(0.0210)	(0.0183)	(0.0283)	(0.0320)	(0.0406)
Number of events included	19	19	19	19	19	17	17	17
2. GROUP B (broad)	-0.0127	-0.0204*	-0.0143	-0.0310(a)	-0.0232	-0.0362(a)	-0.0485**	-0.0618**
	(0.0108)	(0.0116)	(0.0185)	(0.0194)	(0.0199)	(0.0240)	(0.0218)	(0.0292)
Number of events included	31	31	31	31	30	28	28	27
3. Group R&R	0.00127	-0.00182	0.00973	-0.00492	-0.0108	-0.0237	-0.0401(a)	-0.0334(a)
	(0.0106)	(0.0105)	(0.0153)	(0.0191)	(0.0202)	(0.0247)	(0.0234)	(0.0251)
Number of events included	39	39	39	39	38	36	36	36
Observations	432	408	384	360	336	312	288	264

Notes. The estimations are based on Equation [1] (the dependent variable is cumulative growth of GDP, calculated using GDP indices for 1920-1938). The number of countries included in the estimations is 24. Robust-clustered standard errors are in parenthesis; (a), *, **, and *** denote significance levels of 20, 10, 5, and 1 percent respectively.

The second set of results (Table 2, row 2) report the IRF for the broader B group of banking crises, which now contains 31 crises for the initial year of the forecast horizon – an increase of 12 events vis-à-vis the A group. Although all the point estimates are negative and, in general, a negative effect appears to be building up, a significant time-profile of effects fails to be identified.[7] The average effects are now visibly smaller than for the systemic crises (except for h = 7, which is difficult to interpret) and the overall IRF is estimated in a less smooth and less precise way. This suggests that some of the additional events may not have a significant impact on GDP, contributing to produce an average effect that is closer to zero and introducing noise in the estimation.

For comparison purposes, the final set of results in Table 2 uses the even broader crisis dating from Reinhart and Rogoff (2009) which includes systemic and a set of less severe or minor events. It is opportune to note here that the well-known Reinhart and Rogoff (2009) data set represents a colossal collection effort covering 70 countries over more than two centuries (1800-2010) and that, in their more recent research on post-crisis recoveries, the authors themselves move in the direction of identifying a smaller set of systemic banking crises (Reinhart and Rogoff, 2014).[8] As expected, given the earlier results, as we widen the

[7] The standard errors reported in the tables can be used to directly construct confidence bands. There is no standard accepted confidence level, and choices in the applied literature based on panel local projections have ranged between 68 and 95 percent. An interesting point, however, is that confidence bands constructed in this way may represent a conservative assessment of the uncertainty associated to the estimated impulse response function. This is noted in Jordà (2009), who points out that in general impulse response coefficients are serially correlated. This reflects the intuition that a sequence of previous negative coefficients represents, in reality, a greater probability that there is a significant negative effect at a given h^{th} impulse, although some of the hth individual coefficients can be statistically insignificant when t-statistics are calculated in the traditional way i.e. disregarding the past path.

[8] Reinhart and Rogoff (2009: p.10) define a banking crisis by two types of events: "(1) bank runs that lead to the closure, merging, or takeover by the public sector of one or more financial institutions; (2) if there are no runs,

set of banking crises, the IRF fails to identify a significant time-profile of negative effects. These results reinforce the idea that minor events do not appear to have effects on GDP. Taken together with the results for A-crises the broad set of results suggests that only systemic crises have clearly identifiable and significant macroeconomic effects.

In Table 3 we report a similar analysis for the cumulative growth of industrial production. From the time-profile of the first IRF (group A) we can see that the magnitude of the effect is clearly larger than the comparable IRF for GDP.[9] For example, at $h = 5$ this is 10.4 percent for industrial production, roughly double the effect on GDP. Moreover the negative effect builds up with time. A plausible conjecture for the large effect on industry is that, for many countries, the industrial sector in the inter-war period was the sector in the economy with the largest dependence on bank financing, frequently involving large-scale, long-term investments. In many countries of our sample, including France, Germany, and Italy, industrial firms and universal banks were often part of the same conglomerates, with the financial part of a group providing credit and liquidity to the industrial part. Hence, the transmission of shocks between financial sector and industry was inevitable, with serious consequences for this sector.[10]

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the closure, merging, takeover, or large-scale government assistance of an important financial institution (or group of institutions) that marks the start of a string of similar outcomes for other financial institutions". This approach gives rise to a very wide set of events, only some of which will be systemic banking crises. Reinhart and Rogoff (2009: p.11) noted the difference between Type I systemic (severe) banking crises and Type II banking crises, entailing less severe financial distress. Reinhart and Rogoff (2014) have separated out a list of 100 systemic crises since 1857.

[9] In terms of the *contemporaneous* effect of banking crises on industrial production, our estimate of a negative impact effect on the annual growth rate of approximately 3 percentage points is well below that reported in Bernanke and James (1991: p.61), who estimate the effect to be around 16 percentage points.

[10] As a robustness test we repeated the exercise described in Footnote 6 for industrial production; the results remain unchanged in qualitative terms. See Appendix III.

TABLE 3. Impulse Response Function of industrial production

Banking crises	*h* = 0	*h* = 1	*h* = 2	*h* = 3	*h* = 4	*h* = 5	*h* = 6	*h* = 7
1. GROUP A (restrict)	-0.0294	-0.0585*	-0.0668**	-0.0632*	-0.0822*	-0.104*	-0.0855(a)	-0.0766
	(0.0229)	(0.0287)	(0.0318)	(0.0313)	(0.0432)	(0.0556)	(0.0552)	(0.0628)
Number of events included	19	19	19	19	19	17	17	17
2. GROUP B (broad)	-0.0209	-0.0565**	-0.0610**	-0.0735**	-0.0773**	-0.103**	-0.0997**	-0.102**
	(0.0181)	(0.0229)	(0.0282)	(0.0313)	(0.0308)	(0.0373)	(0.0364)	(0.0387)
Number of events included	29	29	29	29	28	26	26	25
3. Group R&R	-0.0106	-0.0285	-0.0418(a)	-0.0283	-0.0274	-0.0634*	-0.0425	-0.0332
	(0.0207)	(0.0239)	(0.0249)	(0.0215)	(0.0243)	(0.0347)	(0.0346)	(0.0418)
Number of events included	38	38	38	38	37	35	35	35
Observations	406	383	360	337	314	291	268	245

Notes. The estimations are based on Equation [1] (the dependent variable is cumulative growth of Industrial Production, calculated using IP indices for 1920-1938). The number of countries included in the estimations is 23 (Uruguay is not included due to the lack of IP data). Robust-clustered standard errors are in parenthesis; (a), *, **, and *** denote significance levels of 20, 10, 5, and 1 percent respectively.

The second row of results in Table 3 relates to the analysis of the effects of a wider B-crises classification. In contrast to what we have observed for GDP, the inclusion of a wider set of events does *not* attenuate the average negative effect of a banking crisis. This suggests that even milder events influence industrial production, which adds a supplementary perspective to the notion that banking crises are particularly detrimental for the industrial sector during this period. A way of making sense of the overall results is that milder events affect industry but the macroeconomy is able to absorb those shocks, perhaps through reallocating resources from industry to other activities. When crises are more clearly systemic the reallocation capabilities of the economy are more affected and there is a visible effect on GDP. While we are fully aware that this remains no more than a speculative thought experiment, what is clear is that a word of caution is in order concerning the use of industrial production as a proxy for the evolution of GDP. As seen here, the two variables behave in different ways.

The final IRF in Table 3 is estimated with the very broad Reinhart and Rogoff (2009) banking crises classification. Although the estimated effects are negative, the time-profile of effects is not well identified, with most of the estimates being statistically insignificant. The inference to draw is that although our classification of A and B crises matters to the industrial sector, the very wide classification of Reinhart and Rogoff appears to be adding noise to the estimation of the IRF. Hence, as we move along the spectrum of severity of banking crises by including more mild events we fail to identify significant average effects.

The robustness of these results is confirmed in the estimations reported in Tables 4 to 7, where we control for other economic and political shocks. In order to ensure that the IRFs we have reported above are not capturing the effects of other shocks, we enrich our

specification with a vector $\boldsymbol{X}$ (see equation [1] above) of four control variables capturing shocks that occurred at the same time as a banking crisis. The tables also report the number of instances in which a banking crisis co-exists with at least one of these control events. For comparison purposes we also report the IRFs of the control events, although it must be noted that a detailed analysis of the effect of these shocks is beyond the scope of the current paper.

In Table 4 we report the effect of the A crises on GDP. The time-profile and magnitude of the IRF is very similar to the one in Table 2. Currency and inflation crises do not appear to have a negative effect. Sovereign debt crises have only a short-term effect, which vanishes quickly; at $h = 3$ and afterwards there is even a positive effect. This result is consistent with empirical discussions of the effect of debt default in the 1930s (Eichengreen, 1991). Changes in the democracy indicator are, if anything, associated to a negative effect in the later segment of the IRF.

In Table 5 we look at the robustness of the effect of banking crises on the time-profile of industrial production. In broad terms the same pattern emerges from the data – the IRF is indeed quite similar in time-profile and magnitude to the one reported in Table 3, although coefficients are estimated with slightly less precision (not unsurprisingly, given the large number of total events included in the estimation). Currency crises have, if anything, a positive effect on industrial production – perhaps related with an increase in exports associated with a devalued currency as argued in Eichengreen and Sachs (1985). A curious result is the effect of political shocks whereby shifts to less democratic regimes are associated with a better industrial production path after two/three years of a shock. This suggests a possible nexus with recovery-based policies implemented by dictatorial regimes and relates to the literature showing that policy regime changes, even if dictatorial, had a positive effect on recovery profiles, as found by Temin (1989) in the discussion of Germany in the 1930s. For completeness, Tables 6 and 7 repeat the analysis for the B crises (to save space we do not

show the IRFs of the control shocks, as they are almost the same as the ones reported in Tables 4 and 5), which confirm that the IRFs of interest are robust when we control for concurrent shocks.

TABLE 4. Impulse Response Function of GDP controlling for other shocks

Event	*h* = 0	*h* = 1	*h* = 2	*h* = 3	*h* = 4	*h* = 5	*h* = 6	*h* = 7
Banking crisis (GROUP A)	-0.0219**	-0.0263**	-0.0239(a)	-0.0571**	-0.0467**	-0.0467(a)	-0.0529(a)	-0.0546
	(0.00933)	(0.0119)	(0.0165)	(0.0218)	(0.0211)	(0.0311)	(0.0347)	(0.0414)
Number of events included	19	19	19	19	19	17	17	17
Overlap with other shocks	6	6	6	6	6	6	6	6
Currency crisis	-0.00481	-0.00744	-0.0106	0.00393	0.0185	0.0237	0.00773	-0.0254
	(0.00772)	(0.0116)	(0.0194)	(0.0296)	(0.0348)	(0.0369)	(0.0397)	(0.0463)
Number of events included	62	58	56	50	48	47	42	38
Sovereign debt crisis	-0.0495*	-0.0687(a)	-0.0300	0.0565(a)	0.0722	0.107*	0.171**	0.102***
	(0.0269)	(0.0404)	(0.0476)	(0.0365)	(0.0561)	(0.0549)	(0.0729)	(0.0360)
Number of events included	14	13	12	11	10	10	9	3
Inflation crisis	-0.00623	-0.0177	-0.0207	0.000165	0.0222	0.0321	0.0506	0.0154
	(0.0222)	(0.0368)	(0.0483)	(0.0583)	(0.0634)	(0.0696)	(0.0654)	(0.0784)
Number of events included	15	15	14	13	13	13	13	12
Political shock (ΔPolity2)	0.00263(a)	0.000752	-0.000450	-0.00373	-0.0116(a)	-0.0175*	-0.0127*	-0.0117(a)
	(0.00195)	(0.00234)	(0.00422)	(0.00597)	(0.00683)	(0.00934)	(0.00732)	(0.00720)
Number of events included	36	35	34	34	33	30	28	27
Observations	414	391	368	345	322	299	276	253

Notes. The estimations are based on Equation [1] (the dependent variable is cumulative growth of GDP, calculated using GDP indices for 1920-1938). The number of countries included in the estimations is 23 (pre-independence India is not covered by Polity2). Robust-clustered standard errors are in parenthesis; (a), *, **, and *** denote significance levels of 20, 10, 5, and 1 percent respectively.

TABLE 5. Impulse Response Function of industrial production controlling for other shocks

Event	*h* = 0	*h* = 1	*h* = 2	*h* = 3	*h* = 4	*h* = 5	*h* = 6	*h* = 7
Banking crisis (GROUP A)	-0.0277	-0.0534*	-0.0580*	-0.0535(a)	-0.0698(a)	-0.0938(a)	-0.0804(a)	-0.0704
	(0.0227)	(0.0287)	(0.0327)	(0.0338)	(0.0446)	(0.0578)	(0.0585)	(0.0660)
Number of events included	19	19	19	19	19	17	17	17
Overlap with other shocks	6	6	6	6	6	6	6	6
Currency crisis	0.0160	0.0245	0.0278	0.0740(a)	0.0870(a)	0.0626	0.0647	0.0135
	(0.0162)	(0.0223)	(0.0301)	(0.0470)	(0.0537)	(0.0563)	(0.0644)	(0.0717)
Number of events included	56	53	51	45	43	42	37	33
Sovereign debt crisis	-0.0337	-0.0240	0.0526	0.150**	0.205**	0.205**	0.206**	-0.0530
	(0.0388)	(0.0587)	(0.0655)	(0.0612)	(0.0952)	(0.0798)	(0.0940)	(0.0519)
Number of events included	13	12	11	10	9	9	8	3
Inflation crisis	-0.00324	-0.0310	-0.0622	-0.0236	0.0154	0.0440	0.0139	0.00574
	(0.0419)	(0.0776)	(0.0912)	(0.0970)	(0.0836)	(0.0704)	(0.0568)	(0.0621)
Number of events included	13	13	12	11	11	11	11	10
Political shock (ΔPolity2)	0.00146	-0.000943	-0.00555	-0.0147**	-0.0242***	-0.0298***	-0.0233*	-0.0235*
	(0.00134)	(0.00321)	(0.00518)	(0.00543)	(0.00691)	(0.00862)	(0.0113)	(0.0125)
Number of events included	34	33	32	32	31	29	27	26
Observations	389	367	345	323	301	279	257	235

Notes. The estimations are based on Equation [1] (the dependent variable is cumulative growth of Industrial Production, calculated using IP indices for 1920-1938). The number of countries included in the estimations is 22 (Uruguay is not included due to the lack of IP data; pre-independence India is not covered by Polity2). Robust-clustered standard errors are in parenthesis; (a), *, **, and *** denote significance levels of 20, 10, 5, and 1 percent respectively.

TABLE 6. Impulse Response Function of GDP controlling for other shock

Event	*h* = 0	*h* = 1	*h* = 2	*h* = 3	*h* = 4	*h* = 5	*h* = 6	*h* = 7
Banking crisis (GROUP B)	-0.0145(a)	-0.0210*	-0.0136	-0.0271(a)	-0.0156	-0.0247	-0.0386(a)	-0.0546*
	(0.0105)	(0.0103)	(0.0184)	(0.0199)	(0.0221)	(0.0260)	(0.0234)	(0.0310)
Number of events included	31	31	31	31	30	28	28	27
Overlap with other shocks	10	10	10	10	10	10	10	10
Observations	414	391	368	345	322	299	276	253

Notes. The estimations are based on Equation [1] (the dependent variable is cumulative growth of GDP, calculated using GDP indices for 1920-1938). The number of countries included in the estimations is 23 (pre-independence India is not covered by Polity2). Robust-clustered standard errors are in parenthesis; (a), *, **, and *** denote significance levels of 20, 10, 5, and 1 percent respectively. To save space the coefficients of the control events IRFs are not reported.

TABLE 7. Impulse Response Function of industrial production controlling for other shocks

Event	*h* = 0	*h* = 1	*h* = 2	*h* = 3	*h* = 4	*h* = 5	*h* = 6	*h* = 7
Banking crisis (GROUP B)	-0.0197	-0.0525**	-0.0528*	-0.0614*	-0.0600*	-0.0860**	-0.0869**	-0.0940**
	(0.0178)	(0.0229)	(0.0291)	(0.0346)	(0.0338)	(0.0384)	(0.0387)	(0.0428)
Number of events included	29	29	29	29	28	26	26	15
Overlap with other shocks	9	9	9	9	9	9	9	9
Observations	389	367	345	323	301	279	257	235

Notes. The estimations are based on Equation [1] (the dependent variable is cumulative growth of Industrial Production, calculated using IP indices for 1920-1938). The number of countries included in the estimations is 22 (Uruguay is not included due to the lack of IP data; pre-independence India is not covered by Polity2). Robust-clustered standard errors are in parenthesis; (a), *, **, and *** denote significance levels of 20, 10, 5, and 1 percent respectively. To save space the coefficients of the control events IRFs are not reported.

5 Post-war and inter-war comparisons

Evaluating the extent and causes of time-period heterogeneity is an important issue for economic historians, economists and policymakers. One of the motivations of this historical analysis of banking crises is to analyse the similarities and differences in the effect of such shocks across different time-periods. The focus on the inter-war period and comparisons with the post-war era allow us to explicitly evaluate the extent of inter-war exceptionalism. In order to see how our specific results for the inter-war period relate to the more recent period we have constructed a directly comparable data set for the same 24 countries in our inter-war study.[11] This allows us to evaluate the response profile of shocks in a different economic environment.

Are the effects of banking crises fundamentally different between the inter-war and post-war eras? Much of the literature has implicitly assumed that the effects of banking crises were more severe in the Great Depression era. To address this, Jordà *et al*. (2013) showed that the overall long-run results for the period since the 1870s are not being driven by the exceptionalism of the Great Depression by excluding the 1930s data from their estimation. Here we focus on providing more detail on the similarities and differences across the inter-war and post-war periods that complements the findings of Jordà *et al*. (2013). Figure 2 depicts the time-profile of banking crises effects on GDP. The most visible difference is that the adverse effect builds more quickly in the post-war period, suggesting that modern

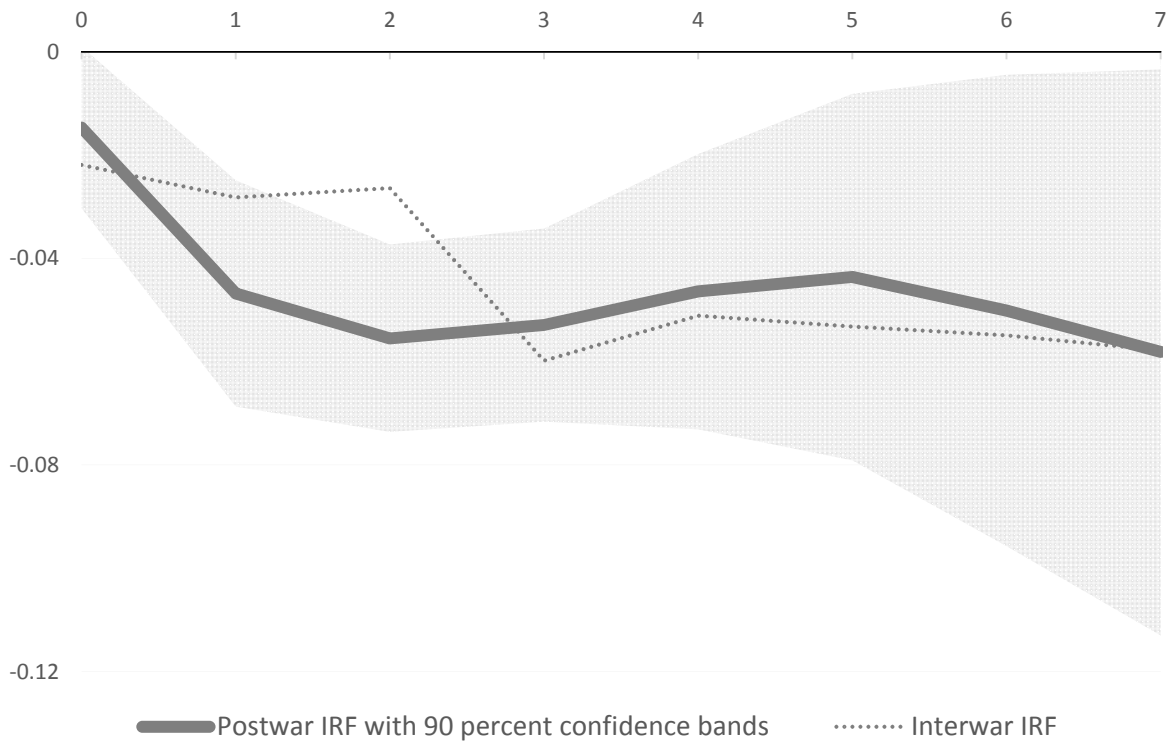
[11] We use the banking crises data set of Laeven and Valencia (2013), which we regard as an analogous counterpart to our A-type crises. Their list starts in 1970 but we know that between 1950 and 1969 there was only one banking crisis in the countries of our sample: Brazil in 1963 (Reinhart and Rogoff, 2009). Given that there is some uncertainty as to whether 1963 captures a systemic banking crisis we have also undertaken the estimation without this event. The time-profile of the IRF is qualitatively unchanged. The data set for GDP and industrial production is described in Appendix II.

economies seem to react faster to problems in the banking sector. At this stage in our research programme we cannot identify the causes of these differences but clearly a number of hypotheses need to be investigated, including the possibility of greater international contagion and stronger inter-bank linkages. Already at $h = 1$ (i.e. the year after the crisis) the effect is around 4.7 percent of GDP, while in the inter-war the effect at the same forecast horizon is only of 2.8 percent. The fact that financial activities developed and acquired generalised reach in modern post-war economies, linked to the more extensive financing of consumption and housing may also explain the faster transmission of banking problems in the wider macroeconomy.

At $h \geq 3$ the estimated effects have similar magnitudes. At first glance the evidence of comparable effects across the inter-war and post-war periods is perhaps surprising, given the fact that financial depth is greater in the post-war era, as seen in the strong growth of credit to GDP ratios in the Schularick and Taylor (2012) data set. This apparent "containment" may reflect the policy responses of modern central banks. However, there is a hint of evidence of further negative effects in the last two IRF years. This time-profile is consistent with the Reinhart and Rogoff (2014) perspective that systemic banking crises are often double-dip in their effects.

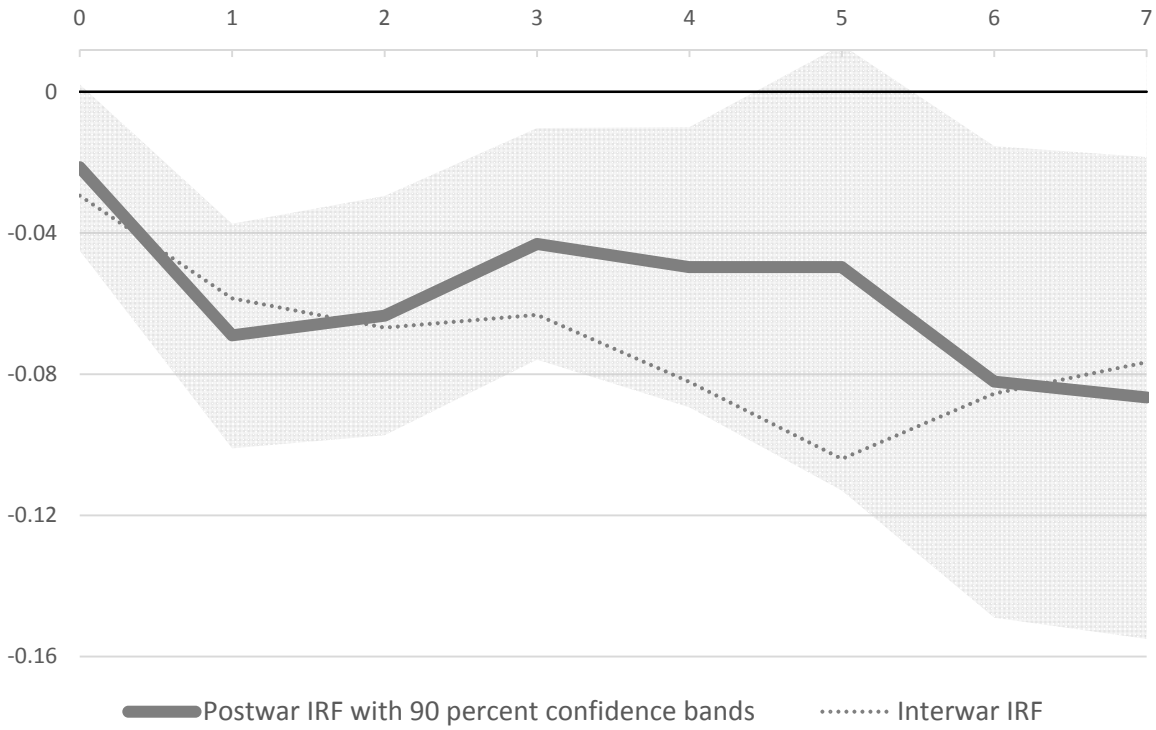
The comparison for industrial production is presented in Figure 3. The time-profiles of the inter-war and post-war IRFs are similar for the first three years of the shock. Substantial differences become evident at $h = 4$ and $h = 5$, with the post-war data showing a (transitory) containment of the effects of the shock. However, the feature of a double-dip effect also emerges for industrial production – and in a more marked way than for GDP.

FIGURE 2. Impulse Response Function of GDP



Notes. The number of crisis events included in the post-war estimates are as follows: 32 for $0 \leq h \leq 3$, 21 for $h = 4$, and 19 for $5 \leq h \leq 7$. The confidence bands are based on robust-clustered standard errors. The inter-war IRF is the one reported in row 1 of Table 2.

FIGURE 3. Impulse Response Function of industrial production



Notes. The number of crisis events included in the post-war estimates are as follows: 30 for $0 \leq h \leq 4$, 19 for $h = 5$, and 17 for $h = 6$ and $h = 6$. The confidence bands are based on robust-clustered standard errors. The inter-war IRF is the one reported in row 1 of Table 3.

6 Conclusions

The following conclusions stand out from our analysis. First, we find that systemic banking crises have a macroeconomic effect, as captured by effects on GDP (and GDP per capita). This effect can be identified up to an eight year horizon. It must be stressed that the limits of the time-dimension of the inter-war data set prevents us from discussing longer-term effects using data for this period. The time-profile of the negative effect that we are able to identify using the local projections methodology is comparable in duration to the profile of effects discussed in Reinhart and Rogoff (2014). Although our results complement the findings of others it needs to be stressed that we focus on a specific historical period and that we follow a recent econometric methodology. For example, we obtain a similar result to the Reinhart and Rogoff result that systemic banking crises have severe effects that last for approximately a decade but we do so using econometric methods, whilst they rely on descriptive statistics. This is an important distinction. Romer and Romer (2015) argue that the use of descriptive methods has resulted in results that are not robust when evaluated with econometric estimation. We show the very opposite in this instance. The Romer-Romer results appear to stand out as an outlier in the research on the effects of banking crises that need further evaluation. In light of our results, we suggest three areas of further investigation. First, there may be problems in the way they construct their measure of financial distress using information from the OECD that was not focusing directly on financial aspects. Second, their treatment of non-linearity may not capture possible non-linear effects – our interwar analysis has highlighted that minor crises have no clear effect but systemic events have severe economic effects. Finally, within their selection of OECD economies the number of severe banking crisis events is small making their results highly sensitive to individual country experiences.

Although systemic banking crises have effects that last into an 8-year horizon it is important that the reader does not assume that the observation of negative effects of banking crises lasting into an eight year horizon can be interpreted as a permanent effect – to address this theme we would need to consider evidence over a longer period. We also conclude that, although systemic banking crises have a clear effect on GDP, a broader set of banking crisis events fails to identify such effects in a clear way. This result bears some connection with the findings of Dwyer *et al*. (2013) that show that 25 percent of banking crises are not associated with a decrease in GDP per capita in the year of the crisis or the following two years.[12] Our findings offer a plausible explanation why this might be the case – only systemic crises have macroeconomic effects. Such a result implies that care needs to be exercised when drawing inferences about the effects of banking crises. Indeed the inter-war evidence suggests that the severity of a banking crisis determines the effect in a non-linear relationship – systemic crises represent a destructive shock as they have significant and long lasting effects; mild banking events, on the other hand, may not have any clearly identifiable effects. Merging the two types of shocks may generate artefact insignificant average effects.

Second, we find important differences between the profile of effects on GDP and industrial production. Systemic banking crises have much larger effects on the industrial sector than for GDP, suggesting that the bank-industry links were central to adding shocks to the economy. Moreover, systemic and a set of less severe banking crises have a significant effect on the industrial sector. This analysis suggests that research on the inter-war period should heed the observations of Reinhart and Reinhart (2010) that emphasise the distinction between GDP and industry effects during the inter-war period when analysing policy effects. The same general point holds for an analysis of banking crises effects.

[12] For the pre-WWII period Dwyer *et al*. (2013) use the Bordo *et al*. (2001) classification of banking crises.

Third, the time-profile of the effect of systemic banking crises on GDP and industrial production during the inter-war period suggests that the adverse effect builds up over time. The negative effect only shows signs of containment after about half a decade. This suggests, perhaps, that during the inter-war period the policy reactions to systemic banking crises often were limited, too late and ineffective in modulating the negative effect.

Fourth, a comparison with the post-war period reveals that the adverse effect of systemic banking crises builds more quickly in the post-war period, suggesting that modern economies have faster transmission mechanism to the problems in the banking sector. However, the total effect after the initial impact is comparable across the two periods, confirming the conclusions of Jordà *et al*. (2013) that the 1930s are not driving the empirical results on the effects of banking crises.

An obvious caveat is the usual distinction between statistical association and *causality*. To be sure, we cannot rule out the possibility of a third variable that explains part of the association between banking crisis events and post-crisis trajectories. We made an effort to address this through an intuitive approach – we considered a set of economic and political control events. The magnitude and time-profile of the results in our conclusions are robust to the inclusion of these control variables for other shocks.

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APPENDIX I

INTER-WAR BANKING CRISES START DATES

In the list below we identify groups A and B of banking crises – the former refers to events that could be identified as being systemic banking crises with effects at the national level. The B category includes extra events that appear to be less severe and therefore it is doubtful that they display the features of a full-fledged systemic crisis. As documented below, in general, we exclude from group A events that affected only one bank or a small number of banks, and events where the evidence points to the existence of a localised crisis or where policy responses avoided more serious banking panics.

Argentina

1931 (A) Bernanke and James (1991), Bordo and Eichengreen (1999), Bordo *et al.* (2001), Reinhart and Rogoff (2009, 2014), and Conde (2010) all agree that this was a banking crisis. Argentina left the gold standard in 1929 but the debt overhang from the 1920s resulted in a build-up of insolvent bank loans. The collapse of commodity prices forced a generalised default of many farmers. Conde (2010) also notes that a collapse of trade resulted in falling revenue for the government, resulting in a failure to pay for its debt and putting pressure on banks.

1934 (A) Bernanke and James (1991), Bordo *et al.* (2001), and Reinhart and Rogoff (2009) list this as a separate crisis from the 1931 event. Bernanke and James (1991) note that banking problems resulted in a government-sponsored merger of four banks (Banco Espanol del Rio de la Plata, Banco el Hogar Argentina, Banco Argentina-Uruguayo, Ernesto Tomquist & Co.). Della Paolera and Taylor (2002) estimate that the bailout by the Instituto Movilizador de Inversiones Bancarias (a specific-purpose institution created in 1935) included about 32 percent of the loans of the private banking system, suggesting that this was a systemic crisis.

Australia

1931 Although this is listed as a crisis in Reinhart and Rogoff (2009), Reinhart and Rogoff (2014) do not classify this as a systemic crisis. According to Fisher and Kent (1999: p.44), "… the financial problems of the 1930s were relatively mild: only three financial institutions suspended payments; the fall in the level of deposits was more moderate [compared with the 1890s]; and there was only a relatively small decline in bank credit". This event is not included in our list of systemic banking crisis.

Austria

1923 (B) Reinhart and Rogoff (2009) list the crisis year as being 1924. Following Bernanke and James (1991) who note that Allgemeine Depositenbank ran into difficulties and was liquidated in July 1923 we date the crisis year as starting in 1923. As the problems were focused on one bank we do not consider this as a systemic crisis; however, since the Allgemeine was a major bank we include this event as part of sensitivity analysis.

1929 (A) Bernanke and James (1991), Reinhart and Rogoff (2009, 2014), and Grossman (2010) consider this to be a banking crisis. In 1929, the Boden Credit Anstalt failed and merged with Credit Anstalt. Banking problems continued into 1931 when the Credit Anstalt and the Vienna Mercur-Bank both failed. A run of foreign depositors in the summer of 1931 affected banks. We consider 1929 as the year in which the banking crisis starts.

Belgium

1925 (B) Bordo *et al.* (2001) and Reinhart and Rogoff (2009) list this as a banking crisis. Reinhart and Rogoff (2014) and Bernanke and James (1991) do not list this as a major/systemic banking crisis. Grossman (2010: p.300) dates the banking crisis year as being in 1926 and notes that "[f]ears over currency depreciation led to panic deposit withdraws". We treat this as part of a broader definition of banking crises, including the event in our B list for sensitivity analysis.

1931 (A) Bernanke and James (1991), Bordo *et al.* (2001), Maes and Buyst (2009), Reinhart and Rogoff (2009, 2014), and Grossman (2010) classify this as a severe banking crisis. Bernanke and James (1991: p.52) summarise the extent of the crisis: "[r]umors about imminent failure of the Banque de Bruxelles, the country's second largest bank, induce

withdrawals from all banks. Later in the year, expectations of devaluation lead to withdrawals of foreign deposits".

1934 (A) Bernanke and James (1991), Bordo *et al.* (2001), Maes and Buyst (2009), Reinhart and Rogoff (2009), and Grossman (2010) list this as a separate crisis to the 1931 crisis. Reinhart and Rogoff (2014) treat 1931/4 as one systemic crisis. Bernanke and James (1991) note that the failure of the Banque Belge de Travail developed into a general banking/exchange rate crisis, which resulted in a rush to withdraw deposits en masse.

Brazil

1923 (A) Bordo and Eichengreen (1999), Triner (2000), Bordo *et al.* (2001), and Reinhart and Rogoff (2009, 2014) classify this as a severe banking crisis. Reinhart and Rogoff (2009: p.353) note "[t]he treasury supported large budget deficits by issuing notes for discount at the Banco do Brasil. High inflation and public dissatisfaction led to the re-establishment of the gold standard and a new government reorganised the Banco do Brasil, making it the central bank. However, it failed to operate independently of political control. The banking sector contracted by 20 percent in the next three years due to diminished money supply".

1926 Only listed in Reinhart and Rogoff (2009). Not included as a systemic crisis in our dating.

1929 Only listed in Reinhart and Rogoff (2009). Not included as a systemic crisis in our dating.

Canada

1923 (B) Williamson (1989), Bordo *et al.* (2001), and Reinhart and Rogoff (2009, 2014) list this as a banking crisis. The Home Bank of Canada, with over 70 branches, failed. However, Grossman (2010: p.301) argues that this does not constitute a systemic crisis, noting that "[t]he Home Bank was a large (but relatively local) bank, accounting for 1.5 percent of paid-up banking capital. Its failure, due to fraud was notable but isolated". We include this event in our broader B category for sensitivity analysis.

Chile

1925 (B) Bordo and Eichengreen (1999) and Bordo *et al.* (2001) refer to this as a banking crisis. Reinhart and Rogoff (2009 and 2014) date the crisis as occurring in 1926. Carrasco (2009) notes that in December 1925 the Banco Español, the second most important Chilean bank, was liquidated by the Superintendencia de Bancos, which protected the interests of the bank's creditors. Since this was a large bank we include the 1925 event as part of our broad B list of banking crises used for sensitivity analysis.

Denmark

1921 (A) Bernanke and James (1991), Bordo *et al.* (2001), Hansen (1991, 1995), Jonung and Hagberg (2005), Reinhart and Rogoff (2009, 2014), and Grossman (2010) treat this as a severe crisis. Hansen (1995: p.34) notes: "[i]t is most likely that the Danish banking system would have collapsed in 1922 if the National Bank, and, in the case of the Landmandsbanken, the state, had not acted as 'lender of last resort' to the commercial banks in that crisis year".

1931 Bordo *et al.* (2001) and Reinhart and Rogoff (2009, 2014) treat this as a banking crisis. However, Grossman (2010: p.315) notes: "… commercial bank deposits fell only slightly in 1931. There were no general runs on the banks and no suspension of payments by any commercial bank." Similarly Hansen (1991, 1995) notes that although Handelsbanken faced problems the offer of unconditional liquidity from the Central Bank prevented a banking crisis. Banking problems were limited to a few small and local banks. Hence, we do not consider 1931 to be a systemic banking crisis.

France

1930 (A) Bernanke and James (1991), Plessis (1994), Bordo *et al.* (2001), Reinhart and Rogoff (2009, 2014), and Grossman (2010) list this as a banking crisis. In 1930 many banks failed including large banks such as Banque Adam, Boulogne-Sur-Mer, and Oustric Group. There were also runs on provincial banks. In 1931 the major deposit bank Banque Nationale de Crédit collapsed (and was restructured as Banque Nationale pour le Commerce et l'Industrie). There were further bank failures and runs in 1931. In 1932 losses of a large investment bank, Banque de l'Union Parisienne, forced a merger with Credit Mobilier Français.

Germany

1925 Only listed in Reinhart and Rogoff (2009). Not included as a systemic crisis.

1931 (A) Bernanke and James (1991), Bordo *et al.* (2001), Pontzen (2009), Reinhart and Rogoff (2009, 2014) and Grossman (2010) all agree that this was a banking crisis. Bernanke and James (1991: p.52) note "[b]ank runs, extending difficulties plaguing the banking system since the summer of 1930. After large loss of deposits in June and increasing strain on foreign exchanges, many banks were unable to make payments and Darmstadter Bank closes". The Berlin Grossbank also failed.

India

1921 This is listed in Reinhart and Rogoff (2009) as a banking crisis. Chandavarkar (1983) uses the *Banking and Monetary Statistics of India* from the Reserve Bank of India which shows that some bank failures were common in every year of the interwar period in India. In terms of number of banks failing (and the magnitude of paid up capital) 1921 does not stand out as a systemic banking crisis year.

1929 This is listed in Reinhart and Rogoff (2014) as a systemic crisis. However, Chandavarkar (1983) shows that although 11 banks failed (with a low magnitude for paid up capital) this is well below the mean number of banks failing in the 1920s. In light of this data it would be difficult to argue that there is evidence of a systemic banking crisis in India in 1929.

Italy

1921 (A) Bordo *et al.* (2001), Gigliobianco *et al.* (2009), Reinhart and Rogoff (2009, 2014), and Gigliobianco and Giordano (2010) view this as a banking crisis. The Banca Italiana di Sconto, which extended loans heavily to war industries, failed in 1921. The third and fourth largest banks became insolvent.

1930 (A) Bernanke and James (1991), Bordo *et al.* (2001), Gigliobianco *et al.* (2009), Reinhart and Rogoff (2009, 2014), and Gigliobianco and Giordano (2010) list this as a banking crisis year. Following from this the Banca Agricola Italiana was broken up on 1931 and a number of other banks were subject to panic and government reorganisation.

1935 (B) Reinhart and Rogoff (2009: p.369) note that "[t]here were agricultural bank closures and savings and commercial bank mergers to such an extent that the Italian banking system appeared completely reorganised". Bernanke and James (1991: p.53) note that in October "deposits fall after Italian invasion of Abyssinia". We treat this as part of a broader definition of banking crises, including the event for sensitivity analysis.

Japan

1920 (B) Tamaki (1995), Shizume (2009), and Grossman (2010) list this as a banking crisis. In March 1920 there was a stock market crash, triggering bank runs in several Japanese regions. Operations were suspended at 21 banks and the Bank of Japan had to extend various "special loans" to deal with the crisis.

1922 (B) Shizume (2009) notes this as a banking crisis. The bankruptcy of a lumber company in February 1922 led to bank runs in two regions of Japan. Later in the year, bank runs spread across the country. Operations were suspended at 15 banks and the Bank of Japan extended "special loans" to 20 banks.

1923 Bernanke and James (1991), Reinhart and Rogoff (2009, 2014), and Shizume (2009) list this as a banking crisis. Following the Great Kanto earthquake there were fears of depositor losses and delays in loan repayments. However, the government intervened, allowing postponement of payments; "[a] temporary moratorium on bills payable in stricken areas had been extended until 1927" (Grossman, 2010: p.308). Government measures prevented the outbreak of a banking crisis. Bernanke and James (1991) note that in the wake of the earthquake bad debts threatened the Bank of Taiwan and Bank of Chosen, which were restructured with government help. The policy response to the problems of 1923 prevented a systemic banking crisis or at least postponed the crisis until 1927.

1927 (A) Bernanke and James (1991), Tamaki (1995), Bordo *et al.* (2001), Reinhart and Rogoff (2009, 2014), Shizume (2009), and Grossman (2010) list this as a severe banking crisis. According to Reinhart and Rogoff (2009: p.370), this was "[a] nationwide financial panic. The failure of Tokyo Watanabe bank led to runs and wave of failures; fifteen banks were unable to make their payments. The government's unwillingness to bail out banks led to more uncertainty and other runs".

Mexico

1921 (B) Reinhart and Rogoff (2009) and Maurer (2002) observe a banking crisis in 1920. According to Gómez-Galvarriato (2014), the general context was that the banking system had a weak institutional basis during the Revolutionary period. In the last three days of 1920 two and a half million pesos were withdrawn from the Compañía Bancaria de París y México. On January 1921 this bank suspended payments and closed its doors. The same happened to Banque Française du Mexique. The Mercantile Banking Co. went bankrupt. Turrent (2007) notes that only six banks were forced to close due to insolvency. In November 1922 another panic broke out with the collapse of Banque Française du Mexique. Many banks and banking houses suspended payments.

1931 (B) Reinhart and Rogoff (2014) list a systemic crisis as starting in 1929. However their source is Bernanke and James (1991: p.52) who report banking problems in 1931: "[s]uspension of payments after run on Credito Espanol de Mexico. Run on Banco Nacional de México". Despite the potential problems the Banco de México stepped in printing pesos to provide liquidity. Given the moderate extent of banking problems in 1931, we treat this as part of a broader definition of banking crises, including the event in our B list for sensitivity analysis.

Netherlands

1920 (A) Bernanke and James (1991),'t Hart et. al. (1997: p.125), Bordo and Eichengreen (1999), Bordo *et al.* (2001), Reinhart and Rogoff (2009), and Colvin *et al.* (2013) see this as a severe banking crisis. The latter establishes that the start of the crisis is in 1920. A large number of banks failed and many others experienced serious problems.

New Zealand

No events. Bordo *et al.* (2011) do not observe any banking crises for the interwar period. Hunt (2009: p.37) notes "[b]ank balance sheets were therefore sufficiently robust to manage the decline in asset quality over the entire interwar slump, including the sharp deterioration in economic activity in the early 1930s".

Norway

1921 (A) Bordo *et al.* (2001), Gerdrup (2003), and Reinhart and Rogoff (2009, 2014) treat 1921 as the start of a severe banking crisis. Bernanke and James (1991) note the failure of Centralbanken for Norge in April 1923 but this can be seen as an unfolding of banking problems that started in 1921. The crisis was related to the rapid growth of lending during the war and postwar price declines in major Norwegian industries during 1920-21 (particularly in agriculture, wood production, mining, and shipping).

1931 (B) Bordo *et al.* (2001), Reinhart and Rogoff (2009), and Grossman (2010) identify some banking problems in 1931 mainly focused on the suspension of two of the largest banks, Bergen Privatbank and Den norske Creditbank. Reinhart and Rogoff (2009) note that the support given by Norges Bank to smaller banks prevented a systemic crisis. Grytten and Hunnes (2014: p.42) observe that "the banking system in Norway survived the crises better than in almost every other capitalist country". Nordvik (1992) and Gerdrup (2003) also support the idea of a non-systemic event in 1931. Clearly the banking problems in 1931 did not amount to a systemic crisis, but given the problems in a number of large banks we retain this crisis in our broad B list for sensitivity analysis.

Portugal

1920 (A) Bordo and Eichengreen (1999), Bordo *et al.* (2001), Reinhart and Rogoff (2009), and Reis (1995) document a banking crisis in 1920. According to the latter, there were banking crises in 1920, 1923, and 1925. All of them were characterized by runs by the public to liquidate financial assets, sharp increases in the currency/deposit ratio, and defensive positions assumed by banks (e.g. cuts in credit and reinforcement of cash reserves).

1923 (A) See observations from Reis (1995) reported above.

1925 (A) According to Reis (1995: p.483), the Bank of Portugal "suffered what was probably the greatest fraud ever perpetrated in Portuguese banking history and one which proved to be a veritable earthquake for the Portuguese political and financial world. The discredit this brought upon the Bank and upon banking in general … was doubtless one of the reasons for the severity of the bank crisis, since it came at a time when intervention by the reserve bank was needed more than anything else".

1931 (B) Bordo and Eichengreen (1999), Bordo *et al.* (2001), and Reinhart and Rogoff (2009) observe a banking crisis in 1931. However Reis (1995: p.486) refers to the 1925 event as "a severe banking crisis though one which turned out to be the last of the entire inter-war period". Total commercial bank assets never fell below their 1930 level. On the other hand, the same author also mentions drops in discounts and credits, closure of five banks, huge losses at Banco Nacional Ultramarino (equal to 10 percent of total commercial banks assets), failures among banking houses, difficulties with liquidity and loss of confidence arising from bank runs. We treat this as part of a broader definition of banking crises, including the event in our wider B list for sensitivity analysis.

Spain

1920 (A) Bordo *et al.* (2001), Betrán *et al.* (2009), Reinhart and Rogoff (2009), and Betrán and Pons (2013) observe a banking crisis in 1920 and/or 1921 – we date the *start* of the crisis as being in 1920. Reinhart and Rogoff (2009: pp.382-3) note: "a number of Catalonian universal banks became insolvent, which eventually led to the failure of the most prominent and oldest credit institutions (Banco de Barcelona), with the severest impact on Barcelona".

1924 (A) Bordo *et al.* (2001), Betrán *et al.* (2009), Reinhart and Rogoff (2009), and Betrán and Pons (2013) note this as a severe banking crisis. The crisis appeared as a continuous run on bank deposits. Six banks failed and were forced to liquidate, including two major banks, Banco de la Union Mineira and Banco Vasca. Bernanke and James (1991) list 1925, referring to the failure of these two banks; however, this is clearly part of a process that started in 1924.

1931 (B) Bordo *et al.* (2001), Betrán *et al.* (2009), and Reinhart and Rogoff (2009, 2014) classify this as a banking crisis. Three banks failed in 1931 and from 1st April to 30th June, 1931, 10 percent of total deposits were withdrawn from banks (Gamir, 2011). However, Grossman (2010) argues that this was not a systemic crisis, noting that although Spain experienced bank runs, the Bank of Spain could lend freely as lender of last resort and banks were able to monetize their holdings of government paper, preventing a serious crisis. Betrán and Pons (2013) also note that banks were able to obtain all the cash they needed from the Bank of Spain. We treat this as part of a broader definition of banking crises, including the event for sensitivity analysis.

Sweden

1922 (A) This is noted by Bernanke and James (1991), Jonung and Hagberg (2005), Reinhart and Rogoff (2009, 2014), Grossman (2010), and Lonnborg *et al.* (2011) as a severe banking crisis. Reinhart and Rogoff (2009: p.384) refer to this as "one of the severest banking crises in Swedish banking history." A large number of banks had to be closed or restructured and in 1922 the Government established the Credit Bank to support banks.

1932 (B) This is noted by Bordo *et al.* (2001), Jonung and Hagberg (2005), and Reinhart and Rogoff, 2009, 2014) as a banking crisis, resulting from the collapse of the Kreuger industrial and financial activities. Bernanke and James (1991: p.53) note the problems of the Skandinaviska Kreditaktiebolaget in March 1932. However, the evidence does not suggest a systemic crisis; Grossman (2010) notes that deposits dropped only slightly since government intervention secured stability with deposit guarantees. The League of Nations (1934: p.193) reported: "although the events of 1931 had no serious visible repercussions on the commercial banks, the latter were increasingly affected by the deterioration of economic conditions, and to alleviate their position, without precipitating any sudden credit contraction, they had recourse to the central bank for rediscounts on a considerable scale". Hence, in this light, state interventions seem to have prevented a more severe banking crisis. Lonnborg *et al.* (2011) note that the crisis of 1931 was far less severe than the crisis of 1922. We treat this as part of a broader definition of banking crises in our B selection, including the event for sensitivity analysis.

Switzerland

1921 Only listed in Reinhart and Rogoff (2009). Not included as a systemic crisis.

1931 (A) Bernanke and James (1991), Cassis (1994), Bordo and Eichengreen (1999), Bordo *et al.* (2001), Vogler (2001), Reinhart and Rogoff (2009), and Grossman (2010) list this as a severe banking crisis. Reinhart and Rogoff (2014) consider 1931-3 as a period of systemic crisis. Swiss banks were badly affected by the German banking crisis. Total assets shrank and many banks were restructured. The Union Financière was rescued and The Banque de Geneve failed. There was a three-week run on the banks. The crisis continued into 1934, with the failure of Banque d'Escompte Suisse. We consider 1931 as the year in which a systemic crisis starts.

United Kingdom

1931 Reinhart and Rogoff (2014) list this as a systemic crisis. However, as noted by Grossman (2010: p.316), "despite a sterling crisis in 1931, not one bank failed during the period". Although there were rumours of a threat to London merchant banks from European involvements the crisis did not progress. Similarly, Billings and Capie (2011) and Capie (2012) observe a currency crisis but not a banking crisis. Since our focus is on banking crises we do not include the 1931 event in our study.

United States

1930 (A) The US crisis unfolded in waves of bank failures in 1930, 1931, and 1933. Bordo *et al.* (2001), Reinhart and Rogoff (2009, 2014), White (2009), Grossman (2010), and Tallman and Wicker (2010) treat this as one linked event. Bernanke and James (1991) list the dates of the specific bank failures mainly because they are using high frequency data in their analysis. We date the start date of the crisis by its first year (1930), as is conventional in the literature on the USA.

Uruguay

No events. Reinhart and Rogoff (2009) do not observe any banking crises in the inter-war period.

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APPENDIX II

DATA SOURCES

1) 24-COUNTRY SELECTION

Argentina
Australia
Austria
Belgium
Brazil
Canada
Chile
Denmark
France
Germany
India
Italy
Japan
Mexico
Netherlands
New Zealand
Norway
Portugal
Spain
Sweden
Switzerland
United Kingdom
United States
Uruguay

2) INTER-WAR DATA SOURCES

GDP

We use the GDP per capita series from Barro and Ursua (2010) for 23 countries and Baffigi (2011) for Italy. The data for population comes from Maddison's Statistics of world Population Data: http://www.ggdc.net/maddison/oriindex.htm.

Industrial Production

Argentina, Brazil, Chile, Mexico: MOxLAD.

Australia: Haig (2001).

Austria, Germany, Norway: Mitchell (2003c).

Belgium, India, Netherlands, Spain, Sweden: Smits *et al.* (2009).

Canada: Mitchell (2003a).

Denmark: calculated as the annual series from the monthly series in Klovland (1998).

France: calculated as the annual series from the monthly series in CEPII.

Italy: Baffigi (2011).

Japan: revisions to the *Estimates of Long-Term Economic Statistics of Japan* (*LTES*) as reported in Ohkawa and Shinohara (eds.; with Meissner) (1979).

New Zealand: Greasley and Oxley (2010).

Portugal: Batista *et al*. (1997).

Switzerland: Ritzmann-Blickenstorfer (ed.) (1996).

United Kingdom: Feinstein (1972).

United States: Kendrick (1961) Table D-II.

Control Variables

The information used to identify the three economic shocks – currency crises, sovereign debt crises, and inflation crises – comes from Reinhart and Rogoff (2009). The variable that captures political shocks is the first difference of the Polity2 indicator, which is sourced from the Polity IV dataset (Marshall *et al*., 2013).

Share of industry in GDP

For each country we averaged the available data points between 1919 and 1938. The sources are as following: Ritzmann-Blickenstorfer (ed.) (1996) for **Switzerland**; Batista *et al*. (1997) for **Portugal**; Easton (1998) for **New Zealand**; Braun-Llona *et al*. (2000) for **Chile**; Carreras *et al*. (2005) for **Spain**; Smits *et al*. (2009) for **Belgium**, **France**, **India**, and the **Netherlands**; and Mitchell (2003a, 2003b, 2003c) for the remaining 15 countries. Gas, water, and electricity supply is not included for Brazil, Canada, Chile, Mexico, and United States. The share of construction for Mexico and Brazil refers to the period 1940-44. The shares of construction and gas, water, and electricity supply for Chile refer respectively to 1940 and 1960.

3) POST-WAR DATA SOURCES

Banking crises

The identification of crisis events is from Laeven and Valencia (2013).

GDP

Penn World Tables, version 8.0 (Feenstra *et al*., 2013).

Industrial Production

Argentina, Brazil, Chile, Mexico: MOxLAD.

Australia: Mitchell (2003b) for 1957-1974 and OECD for 1975-2013.

Austria, Belgium, France, Germany, Italy, Japan, Netherlands, Norway, Sweden, United Kingdom, United States: IMF (2014).

Canada: Leacy *et al*. (eds.) (1983) for 1955-60 and OECD for 1961-2013.

Denmark: Mitchell (2003c) for 1950-1973 and OECD for 1974-2013.

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APPENDIX III

SUPPLEMENTARY RESULTS

TABLE III.1. Impulse Response Functions of GDP excluding any single country

h = 0	*h* = 1	*h* = 2	*h* = 3	*h* = 4	*h* = 5	*h* = 6	*h* = 7	country excluded
-0.0241**	-0.0296**	-0.0244(a)	-0.0634***	-0.0514**	-0.0512(a)	-0.0540(a)	-0.0550	ARG
-0.0226**	-0.0282**	-0.0253(a)	-0.0582**	-0.0490**	-0.0510*	-0.0527(a)	-0.0549(a)	AUS
-0.0217**	-0.0286**	-0.0267(a)	-0.0583**	-0.0451**	-0.0458(a)	-0.0473(a)	-0.0493	AUT
-0.0207*	-0.0269*	-0.0226	-0.0564**	-0.0455**	-0.0512(a)	-0.0529(a)	-0.0522	BEL
-0.0248**	-0.0281*	-0.0212	-0.0565**	-0.0509**	-0.0568*	-0.0526(a)	-0.0522	BRA
-0.0234**	-0.0303**	-0.0294*	-0.0626***	-0.0526**	-0.0540*	-0.0547(a)	-0.0566(a)	CAN
-0.0250**	-0.0313**	-0.0306*	-0.0632***	-0.0514**	-0.0489(a)	-0.0494(a)	-0.0502	CHE
-0.0237**	-0.0324**	-0.0300*	-0.0617***	-0.0525***	-0.0552*	-0.0552(a)	-0.0563(a)	CHL
-0.0191*	-0.0235*	-0.0245(a)	-0.0607**	-0.0548***	-0.0656**	-0.0723**	-0.0824**	DEU
-0.0196*	-0.0271*	-0.0291(a)	-0.0617**	-0.0486**	-0.0516*	-0.0507(a)	-0.0514	DNK
-0.0229**	-0.0317**	-0.0296(a)	-0.0700***	-0.0582***	-0.0656**	-0.0690**	-0.0779*	ESP
-0.0230**	-0.0301**	-0.0247(a)	-0.0604**	-0.0484**	-0.0455(a)	-0.0465(a)	-0.0479	FRA
-0.0221**	-0.0284**	-0.0263(a)	-0.0599***	-0.0511**	-0.0535*	-0.0553(a)	-0.0584(a)	GBR
-0.0210**	-0.0264*	-0.0246(a)	-0.0587**	-0.0509**	-0.0527*	-0.0558*	-0.0597(a)	IND
-0.0205*	-0.0299**	-0.0351**	-0.0690***	-0.0600***	-0.0638**	-0.0540(a)	-0.0614(a)	ITA
-0.0211*	-0.0297**	-0.0257(a)	-0.0570**	-0.0521**	-0.0624**	-0.0697**	-0.0675(a)	JPN
-0.0216**	-0.0286**	-0.0265(a)	-0.0597***	-0.0499**	-0.0516*	-0.0524(a)	-0.0555(a)	MEX
-0.0211**	-0.0270**	-0.0251(a)	-0.0588**	-0.0508**	-0.0518*	-0.0537(a)	-0.0574(a)	NLD
-0.0165*	-0.0236*	-0.0194	-0.0510**	-0.0431**	-0.0407(a)	-0.0399(a)	-0.0405	NOR
-0.0234**	-0.0302**	-0.0274(a)	-0.0613***	-0.0519***	-0.0539*	-0.0545(a)	-0.0560(a)	NZL
-0.0224*	-0.0201(a)	-0.0285(a)	-0.0511**	-0.0555**	-0.0445(a)	-0.0579(a)	-0.0657(a)	PRT
-0.0259**	-0.0307**	-0.0293(a)	-0.0621**	-0.0555***	-0.0556*	-0.0542(a)	-0.0602(a)	SWE
-0.0214**	-0.0285**	-0.0290(a)	-0.0618***	-0.0528***	-0.0539*	-0.0554*	-0.0571(a)	URY
-0.0190*	-0.0260*	-0.0179	-0.0511**	-0.0446**	-0.0493(a)	-0.0576(a)	-0.0626(a)	USA

Notes. The estimations are based on Equation [1] (the dependent variable is cumulative growth of GDP, calculated using GDP indices for 1920-1938). The number of countries included in the estimations is 23. Robust-clustered standard errors are in parenthesis; (a), *, **, and *** denote significance levels of 20, 10, 5, and 1 percent respectively.

TABLE III.2. Impulse Response Functions of industrial production excluding any single country

h = 0	*h* = 1	*h* = 2	*h* = 3	*h* = 4	*h* = 5	*h* = 6	*h* = 7	country excluded
-0.0326	-0.0605*	-0.0693*	-0.0662*	-0.0863*	-0.106*	-0.0848(a)	-0.0775	ARG
-0.0313(a)	-0.0607**	-0.0682**	-0.0639*	-0.0819*	-0.104*	-0.0847(a)	-0.0728	AUS
-0.0286	-0.0518(a)	-0.0589*	-0.0524(a)	-0.0688(a)	-0.0954(a)	-0.0781(a)	-0.0690	AUT
-0.0275	-0.0531*	-0.0611*	-0.0557(a)	-0.0675(a)	-0.0947(a)	-0.0759(a)	-0.0593	BEL
-0.0397*	-0.0737***	-0.0682*	-0.0590*	-0.0796*	-0.0951(a)	-0.0867(a)	-0.0832	BRA
-0.0299	-0.0601**	-0.0693**	-0.0652*	-0.0840*	-0.106*	-0.0850(a)	-0.0763	CAN
-0.0363(a)	-0.0635*	-0.0720**	-0.0635*	-0.0757(a)	-0.0937(a)	-0.0829(a)	-0.0614	CHE
-0.0289	-0.0582*	-0.0652*	-0.0616*	-0.0823*	-0.104*	-0.0861(a)	-0.0786	CHL
-0.0246	-0.0511*	-0.0640*	-0.0624*	-0.0823*	-0.113*	-0.0944(a)	-0.0935(a)	DEU
-0.0208	-0.0453(a)	-0.0544*	-0.0509*	-0.0694(a)	-0.0820(a)	-0.0581	-0.0468	DNK
-0.0296	-0.0621*	-0.0762**	-0.0777**	-0.100**	-0.121*	-0.110*	-0.101(a)	ESP
-0.0347(a)	-0.0599*	-0.0621*	-0.0583*	-0.0733(a)	-0.0837(a)	-0.0667	-0.0531	FRA
-0.0300	-0.0586*	-0.0664*	-0.0631*	-0.0819*	-0.104*	-0.0853(a)	-0.0772	GBR
-0.0270	-0.0551*	-0.0636*	-0.0612*	-0.0799*	-0.104*	-0.0885(a)	-0.0781	IND
-0.0305	-0.0642**	-0.0797**	-0.0769**	-0.103**	-0.129**	-0.0940(a)	-0.0898	ITA
-0.0292	-0.0625**	-0.0764**	-0.0750**	-0.105**	-0.132**	-0.113**	-0.0995(a)	JPN
-0.0293	-0.0614**	-0.0693**	-0.0666**	-0.0828*	-0.104*	-0.0830(a)	-0.0750	MEX
-0.0282	-0.0590**	-0.0706**	-0.0674**	-0.0859*	-0.108*	-0.0885(a)	-0.0795	NLD
-0.0164	-0.0478(a)	-0.0598*	-0.0574*	-0.0759(a)	-0.0892(a)	-0.0656	-0.0556	NOR
-0.0305	-0.0593*	-0.0663*	-0.0624*	-0.0815*	-0.103*	-0.0842(a)	-0.0744	NZL
-0.0263	-0.0536(a)	-0.0585(a)	-0.0594(a)	-0.0772(a)	-0.0994(a)	-0.0824	-0.0840	PRT
-0.0390(a)	-0.0697**	-0.0816**	-0.0721**	-0.0909*	-0.122**	-0.102*	-0.0930(a)	SWE
-0.0254	-0.0548*	-0.0556*	-0.0560(a)	-0.0757(a)	-0.100(a)	-0.0872(a)	-0.0851	USA

Notes. The estimations are based on Equation [1] (the dependent variable is cumulative growth of Industrial Production, calculated using IP indices for 1920-1938). The number of countries included in the estimations is 22. Robust-clustered standard errors are in parenthesis; (a), *, **, and *** denote significance levels of 20, 10, 5, and 1 percent respectively.