Bank Equity and Banking Crises[*]

Matthew Baron, Emil Verner, and Wei Xiong[**]

September 2018

Abstract

Despite the prominence of bank equity in theories of banking crises, there is little systematic analysis of the empirical performance of bank equity returns in identifying banking crises and predicting subsequent economic outcomes. To address this gap, we construct a new historical dataset on bank equity returns for 46 countries over the period 1870-2016. We find that bank equity declines provide an informative measure of the occurrence and severity of historical banking crises identified by existing narrative-based approaches. More generally, bank equity declines predict persistent credit contractions and output gaps, after controlling for non-financial equities, even *unconditional* on banking crises. Consistent with models of constrained intermediaries: 1) the relation between bank equity and future bank credit is asymmetric, with only large negative shocks predicting credit contraction, and 2) bank equity prices tend to fall earlier than non-financial equities at the start of banking crises, especially in the post-war period and advanced economies. Finally, large bank equity declines allow us to refine the existing chronologies of banking crises, in which we uncover a number of forgotten banking crises and remove spurious crises.

[*] The authors would like to thank William Shao and Bryan Tam for their extraordinary research assistance. Isha Agarwal, Isaac Green, Md Azharul Islam, Jamil Rahman, Sylvia Lu, Felipe Silva, and the librarians at the Harvard Business School Historical Collections also provided valuable assistance. The authors would also like to thank Mikael Juselius, Moritz Schularick, and seminar participants at Cornell University, Erasmus University Rotterdam, University of Bonn, University of Rochester, the Federal Reserve Board, the OCC, and the 2018 AEA meetings for their comments and feedback. We thank Mika Vaihekoski and Frans Buelens for sharing data.

[**] Contact information: Matthew Baron, Johnson Graduate School of Management, Cornell University, baron@cornell.edu; Emil Verner, MIT Sloan, everner@mit.edu; Wei Xiong, Princeton University and NBER, wxiong@princeton.edu.

I. Introduction

The commonly observed association between banking crises and macroeconomic catastrophes, e.g., Reinhart and Rogoff (2009), has motivated a quickly growing literature of the economic impact of banking crises. In theories of banking crises, e.g., Holmstrom and Tirole (1997) and Gertler and Kiyotaki (2011), bank equity is a key state variable that determines banks' ability to intermediate funds from savers to firms and households. The market value of bank equity provides the best real-time proxy for the shadow value of bank equity in these theories. Despite its strong conceptual appeal, the empirical performance of bank equity returns in identifying banking crises and predicting subsequent economic outcomes is largely unknown. As a reflection of the lack of attention to bank equity returns, the existing literature has primarily used narrative, qualitative, and backward-looking approaches to classify historical banking crises and analyze their causes and consequences. Bordo et al. (2001), Caprio and Klingebiel (2003), Demirgüç-Kunt and Detragiache (2005), Reinhart and Rogoff (2009), Schularick and Taylor (2012), and Laeven and Valencia (2013) identify banking crises based on narrative information about events such as bank runs and large-scale government interventions. To overcome potential biases from these backward-looking accounts, Romer and Romer (2017) construct a real-time measure of financial distress from real-time country economic reports of the OECD for 25 advanced economies starting in 1967, even though the OECD accounts may still be subjective.

Relative to these narrative-based approaches to identifying banking crises, bank equity returns offer several advantages, being objective, real-time, and quantitative. However, as many other factors beyond banking crises may also cause large fluctuations in bank equity prices, their empirical performance in predicting crises and subsequent economic outcomes cannot be taken for granted. So far, the lack of a complete database of historical equity prices for a large set of countries going back to the pre-war period has prevented systematic studies of this important issue. This paper aims to address this gap.

We construct a new historical dataset on bank equity prices and dividends for 46 advanced and emerging economies going back to 1870. We supplement existing bank stock indexes with indexes constructed from new, hand-collected stock price and dividend data from historical newspapers to provide coverage that is as comprehensive as possible. Moreover, to be able to control for broader stock market conditions, we also construct new indexes for non-

financial stocks over the same sample. Our dataset thus provides nearly 4000 country-years of information on bank equities, non-financial equities, and macroeconomic variables. In addition, we also systematically collect new narrative information on other characteristics of banking crises, such as deposit runs, bank failures, and government intervention, backed by over 400 pages of narrative documentation.

We begin by asking whether large negative bank equity returns provide a useful signal of a banking crisis in real-time. To examine this, we pool together narrative banking crises from six influential studies into a Joint Crisis List of roughly 300 banking crises. Using receiver operating characteristic (ROC) analysis, a standard tool for assessing diagnostic performance, we find that bank equity returns provide the best real-time signal of narrative banking crisis identified by existing historians relative to a host of other variables, including non-financial equity returns, credit spreads, and macroeconomic conditions. However, the diagnostic accuracy is far from perfect, as in some cases large declines in bank equity occur during years that historians do not classify as crisis.

Declines in bank equity thus provide a signal of the incidence of crises identified by historians. An advantage of banking equity relative to narrative accounts is that it potentially provides an objective, quantitative measure of the severity of crises. We confirm this by showing that, conditional on banking crises on the Joint Crisis List, a larger decline in the bank equity return predicts an increased likelihood and severity of deposit runs, non-performing loans, and bank failures and an increase in the likelihood of government interventions in various forms to support the banking sector. Furthermore, larger declines in bank equity are associated with more severe recessions, conditional on a crisis defined by existing classifications. The informativeness of bank equity is not solely driven by the general decline in equity markets during a banking crisis. In fact, these results also hold, albeit not as strongly, when using bank returns in excess of nonfinancial equity returns. These facts confirm that bank equity returns capture the salient features of banking crises.

Next, we turn to the main part of our analysis, which tests whether bank equity declines have predictive content for future macroeconomic dynamics, beyond the information contained in non-financial equities. Theories of constrained financial intermediaries predict that declines in bank net worth hamper banks' ability to intermediate funds, leading to a contraction in credit

supply and therefore to lower output. We find that bank equity declines predict persistently lower subsequent output. For example, a decline in bank equity of at least 30% predicts 2.5% lower output after three years. At the same time, bank equity declines predict sharp and persistent contractions in bank credit to the private sector. Three years after a bank equity decline, bank credit-to-GDP declines by 5.4%, relative to periods without a decline. These estimates control for non-financial equities, which capture investor expectations about broader macroeconomic developments. Consistent with a large literature, e.g. Stock and Watson (2003), non-financial equity declines also separately predict lower GDP, but, interestingly, non-financial equity declines have no relation to subsequent bank credit growth. Large bank equity declines thus likely pick up episodes when output contracts in part due to a bank lending channel.

A sharp prediction of models of constrained intermediaries is that the relation between bank equity and the macroeconomy is non-linear. Large declines in bank equity are more likely to force banks against financing constraints and therefore cut lending sharply. We find modest evidence of nonlinearity between bank equity returns and future output growth, but strong evidence for credit growth. Only bank equity declines, and especially larger declines, predict subsequent credit-to-GDP contractions. Increases in bank equity, on the other hand, do not systematically predict a future credit-to-GDP expansion.

The predictability of bank equity declines for macroeconomic downturns after controlling for non-financial equity may reflect that bank equity is more sensitive to unobserved macroeconomic shocks, rather than the bank credit channel. To address this argument, we examine the timing of declines in bank and non-financial equities and spikes in bank credit spread and non-financial corporate credit spread around narrative banking crises. Interestingly, bank equity declines tend to precede non-financial equity declines at the start of banking crises.

These findings are consistent with the view that, at least for most postwar banking crises in advanced economies, banking crises tend to originate with losses to the banking sector (due to specific, concentrated exposure to real estate, for example) that are then transmitted to the broader economy through a bank lending channel. If, instead, most banking crises were caused by an initial broader weakness in the nonfinancial economy that only later led to banking sector losses, we would expect non-financial equities to decline before or at the same time as bank equity—which is, in fact, what we find for many early banking crises and those in emerging

economies. Thus, by looking at the relative timing of bank versus nonfinancial equity declines allows us to document the changing nature of banking crises over time.

In the final part of the paper, , we build on our earlier finding that bank equity robustly captures the occurrence and severity of banking crises identified by existing research to refine the chronology of banking crises using information from bank equity returns. Our goal is to combine the wealth of information in the list of narrative crises with "hard" information from bank equity returns. One strategy would be to rely only on bank equity declines, as is sometimes done in the currency crisis literature (Frankel and Rose, 1996). In practice, this approach produces a number of "false positives" (i.e. episodes that have none of the characteristics of banking crises, such as runs, bank failures, or government intervention) Therefore, we refine the existing lists as follows. First, we uncover new banking crises that are not in existing databases through a two-step procedure: (i) we first screen for *potential* banking crises by identifying declines in the bank equity index of at least 30% (which potentially indicates a large disruption to the banking sector), and (ii) we then zoom in to these potential episodes and ask if there is an abundance of narrative evidence consistent with a banking crisis (historical evidence of widespread bank failures or bank runs, which we document in great detail). Using this method, we uncover a number of "forgotten" banking crises that are strongly backed by the historical narrative. Second, after combining the Joint Crisis List with these new crises, we remove spurious crises with the following two step procedure: (i) we screen Joint Crisis List episodes to identify episodes where bank stock prices do not display a crash of at least 30% (which potentially indicates little disruption to the banking sector), and (ii) we zoom into the narrative accounts and document affirmative evidence that the usual characteristics of banking crises were non-existent or minimal (e.g. confined to a few small provincial banks). Many of these deleted episodes are typos or historical errors from previous approaches, while others are monetary or currency issues that had only minor effects on the banking sector. By adding new crises and removing spurious crises, we create a revised chronology of banking crises.

We then showcase some features of our revised chronology of banking crises. We first highlight several interesting historical examples of added and deleted crises. We then compare our revised chronology to previous ones, and find that the aftermath of banking crises tends to be

more severe, especially when restricting our chronology to crises featuring large bank equity declines. The slight increase in severity is due in large part to the deletion of spurious crises.

In addition to contributing to the large literature using various approaches to identify and study banking crises, our paper is also related to empirical studies of the bank lending channel. Bernanke (1983) argues that disruptions in the banking sector during the Great Depression increased the cost of credit intermediation and further depressed economic activity. Several studies exploit cross-sectional variation across banks to study the effects of bank lending contraction (e.g. Peak and Rosengren 2000, Khwaja and Mian 2008, Ivashina and Sharfstein 2010, Chodorow-Reich 2014). Complementing these studies, we provide evidence consistent with the importance of a bank lending channel in understanding the macroeconomic effects of banking crises across a broad sample of countries over the past 150 years. Our results also suggest that the bank lending channel may be important in understanding macroeconomic outcomes even outside of formally-defined banking crises.

Our paper is organized as follows. Section II discusses the new historical data. Section III presents the results on the informativeness of bank equity returns. Section IV analyzes the performance of bank equity in predicting macroeconomic outcomes. Section IV compares the timing of bank equity and non-financial equity declines in advance of banking crises. Section V presents our revised chronology of banking crises, and Section VI concludes the paper.

II. Data

As this paper relies on new historical data, we start by describing how we gather and construct the historical database used in our analysis. We discuss, in turn, the following types of variables: narrative banking crisis dates, bank and nonfinancial equity total returns and credit spread, macroeconomic variables, and variables of characteristics or "symptoms" of banking crises. All variables are annual (except those noted as monthly variables) and form an unbalanced country panel across 46 countries over the period 1870-2016. See the Appendix for further details on data sources and data construction beyond what is presented here.

Potential banking crisis dates. We collect the starting years of banking crises from six prominent papers: Bordo (2001), Caprio and Klingebiel (2003) Demirguc-Kunt and Detragiache

(2005), Laeven and Valencia (2013), Reinhart and Rogoff (2009, and online spreadsheets updated 2014)[1], and Schularick and Taylor (2012, online update 2017). We use the most recent update of each paper.

These lists of crises and their starting dates are presented together in Appendix Table 2. We take the union of all these crisis dates as the Joint Crisis List that we will use throughout this paper.[2] We will later refine the Joint Crisis List into a new list of banking crises, called the Revised Crisis List, presented in Section IV, but initially we want to cast a net as wide as possible to include any event that has ever been labeled a crisis. (As we will see in Section IV, even this Joint Crisis List omits several banking crises that we newly identify.) We occasionally merge two successive banking crisis dates into one event, if other papers consider these events to be a single event (see Appendix Table 4). For the starting dates of crises on the Joint Crisis List, we take the earliest date among the six papers.

Annual bank and nonfinancial stock returns. We construct a new historical dataset on bank equity prices and dividends for 46 advanced and emerging economies going back to 1870. As documented in Appendix Table 1, the data starts around 1870 for Australia, Austria, Belgium, Canada, France, Germany, Ireland, Italy, New Zealand, Sweden, Switzerland, the U.K. and the U.S. and even around 1870 for emerging market economies such as Argentina, Brazil, Egypt, Greece, Hong Kong, India, Mexico, Russia, and Ottoman Turkey.

For each country in the sample, we construct annual (as of December 31 of each year) price return and dividend return indexes for both bank and nonfinancial stocks. The price and dividend indexes in a given country may not necessarily correspond to the exact same underlying banks due to data availability, but they are both generally market-cap-weighted or price-weighted indexes of the broad domestic banking and nonfinancial sectors within each country. Each of

[1] Reinhart and Rogoff (2009) present three slightly different banking crisis lists: in Appendix A3, in Appendix A4, and in online spreadsheets (we use the latest 2014 update). We generally take the union of these lists; however, when there is a small disagreement regarding the starting date of a banking crisis, we use the most recent online update.

[2] Romer and Romer (2017) construct a continuous, narrative measure of "financial distress" for OECD countries rather than present a list of banking crises. We do not include the Romer and Romer (2017) dates in the Joint Crisis List because it is unclear which threshold of "financial distress" should be used to define a banking crisis.

these series is pieced together from a variety of sources, discussed below (with additional documentation and source tables in the Appendix).[3,4]

We start by collecting premade bank equity indexes from Global Financial Data (mainly price indexes only), Datastream (price and dividend indexes), and Baron and Xiong (2017, which contains newly constructed bank dividend indexes). In addition to using premade indexes, we form price-weighted bank equity price and dividend indexes from individual bank and nonfinancial companies' stock prices and dividends. Our most prominent source of new data on individual bank stock comes from individual newspapers. We hand-collect price and dividend information on an annual basis (the closing price closest to December 31) for commercial banks and nonfinancial firms listed in the following newspapers: *Journal de Bruxelles* for Belgium (1868-1935); *Dagens Nyheder* for Denmark (1868-1909); *De Telegraaf* and *De Standaard* for the Netherlands (1875-1933); *Le Temps* for France (1873-1939); *Berliner Borsen-Zeitung* and *Berliner Morgenpost* for Germany (1871-1933); *La Stampa* for Italy (1865-1934); *Japan Times* for Japan (1897-1915); *Diario de Lisboa* for Portugal (1921-1990); the *Straits Times* for Singapore (1965-1980); *ABC* for Spain (1909-1965); and *Gazette de Lausanne*, *Journal de Genève*, *Le Temps*, and *Neue Zürcher Zeitung* for Switzerland (1852-1936). Examples of historical newspapers can be seen in Figure 1.

[INSERT FIGURE 1 HERE]

Additional dividend data for individual bank stocks is hand-collected from Moody's Banking Manuals (1928-2000) and from individual financial statements of banks accessed at the Harvard Business School library's Historical Collections. Other data on individual stocks prices and dividends of banks and nonfinancial firms come from several databases from Yale's International Center for Finance (gathered and made publicly available by William Goetzmann

[3] The bank equity index generally contains a broad representation of the largest domestically-chartered commercial banks mainly located in the country's financial center. The exact range of included banks varies across countries and historical periods, due to historical data limitations, and is documented and analyzed in the Appendix. It is important to note that the focus on large banks in the country's financial center may lead the bank equity measures to under-represent banking crises centered on smaller or provincial banks.

[4] The non-financial equity index is constructed to represent a diverse set of important and large industrial and retail companies, mainly covering the following industries: iron steel, goods manufacturing, electrical equipment, textiles, chemicals, paper and pulp products, food suppliers and breweries, and retail. We generally avoid transportation stocks (railroads and shipping), commodity-related stocks (including mining), utilities, real estate companies, and foreign and colonial enterprises, due to their exposure to international factors or their concentrated exposure to real estate specifically.

and K. Geert Rouwenhorst) including *Investor's Monthly Manual* data (1869-1934), New York Stock Exchange data (1800-1871), and St. Petersburg Stock Exchange data (1865-1917). Finally, we collect stock returns data from a variety of additional sources including: Argentinian stock returns data (1900-1935) from Nakamura and Zarazaga (2001); Belgian stock returns data from the SCOB database (University of Antwerp, Belgium); Danish stock returns data (1911-1956) from *Denmark Statistical Yearbooks*; Finnish stock returns data (1911-1974) from Nyberg and Vaihekoski (2010, the authors generously shared their underlying data); French stock returns data (1860-1871) from Sumner (1896); and Swedish stock returns data (1870-1901) from Waldenstrom (2014).

We add the bank equity price returns and dividend returns to get bank equity total returns and then adjust by the CPI for each country to get bank equity real total returns.

Monthly stock returns and credit spreads for banks and nonfinancials. For studying whether bank equity declines pick up crises before or after other crisis indicators, we turn to monthly stock price and credit spread data. In particular, we construct monthly series for each country for bank equity index returns and nonfinancial equity index returns, and, when available, a bank credit spread index and a nonfinancial corporate credit spread index.

Due to data availability issues, the monthly data is a subset of the larger annual data set on bank stock returns.[5] Sources include Datastream, which covers the period 1980-2016 over a wide range of countries, *Investor's Monthly Manual*, and Global Financial Data. In addition, going back further historically to 1870, the monthly data covers fifteen countries (Argentina, Australia, Belgium, Denmark, France, Germany, Italy, Japan, Netherlands, Norway, Spain, Sweden, Switzerland, U.K., and U.S.), where monthly bank and nonfinancial stock prices were transcribed from the historical newspapers listed in the previous section or obtained from other new historical sources. The smaller sample of countries going back to 1870 and the focus on just around banking crises are due to the difficulty of hand-collecting over a hundred years of monthly data from historical records.

Macroeconomic variables. From Global Financial Data, we obtain annual data for each country on nominal GDP and the CPI for each country, which we use to calculate real GDP. We

[5] For bank equity returns, the monthly and annual data come from the same source, so that, for consistency, the monthly data aggregates to the annual data.

fill in the gaps for real GDP with additional data from Maddison, the Jorda-Schularick-Taylor Macrohistory Database, and the OECD, IMF, and World Bank datasets. The same CPI is used to deflate returns to obtain real returns. We also obtain unemployment data from these same sources.

Data on bank credit-to-GDP comes mainly from Jorda-Schularick-Taylor (which goes back to 1870 but for 17 countries only) and from the BIS long credit series for other countries. The BIS data is supplemented with newly transcribed data from IMF statistical manuals from the 1940s and 50s and from "League of Nations: Money and Banking Statistics" volumes from 1925 to 1939, which allows us to form aggregate bank credit-to-GDP series going back to at least 1918 for almost all the countries in our sample.

The Jorda-Schularick-Taylor dataset is also used to collect additional macroeconomic variables, though data is available only for a subsample of 17 countries. Variables include: real consumption per capita, investment to GDP, the broad money supply, government debt to GDP, total mortgages, and a house prices index.

"Symptoms" and policy responses of banking crises. Our main measure of a banking crisis is the decline in the bank equity index, which roughly capture to the degree of undercapitalization of the aggregate banking sector during a banking crisis. However, banking crises are multi-dimensional and may exhibit other "symptoms" and policy responses such as bank runs, bank failures, government equity injections or nationalization of banks, and central bank liquidity support.

We construct a database of banking crisis symptoms. Following Laeven and Valencia (2013), who build a similar database for the period 1970-2012, we define the following variables for each potential crisis in our sample:

- Deposit runs (1 if a number of significant banks experience widespread and sustained runs on deposit or short-term liabilities, 0 otherwise);
- Decline in deposits (the peak-to-trough % decline in aggregate deposits of the banking sector, only calculated for pre-1945 banking crises, since postwar crises are generally not associated with a loss in aggregate deposits);

- Significant bank closures (1 if a number of significant banks fail or are closed or absorbed by other institutions or the government because they are about to fail, 0 otherwise);
- Failed banks (% of total bank assets or deposits);
- Largest banks failing (1 if any of the failed banks are among the very largest banks in the country, 0 otherwise);
- NPL at peak (the peak level of non-performing loans of the banking sector or of the largest banks);
- Significant liability guarantees (1 if the central bank or government provides extraordinary guarantees of bank deposits and other short-term liabilities, 0 otherwise);
- Significant liquidity support (1 if the central bank or government provides extraordinary liquidity support to the banking sector, 0 otherwise);
- Banks nationalized (1 if the government nationalizes any major banks, 0 otherwise);
- Government equity injections (1 if the government purchases newly issued equity of major banks in an effort to recapitalize the banking sector, 0 otherwise).

The above variables are gathered for each of the crises on the Joint Crisis List, which involved a major data collection effort using an extensive number of primary and secondary sources. First, we started with the dataset of Laeven and Valencia (2013), which collected all the above variables for their set of crises over the period 1970 – 2012. To extend our dataset back further, we examined the descriptions of crises in the following secondary sources and gathered information on the above variables, whenever it was present; sources include Reinhart and Rogoff (2009, Appendix A3), Bordo (2001), Caprio and Klingebiel (2003), Kindleberger (1993), Mehrez and Kaufmann (2000), Rocha and Solomou (2015), Conant (1915), Sumner (1896), and Grossman (2010).

We then supplemented this list with over 150 other papers and books on individual bank crises, detailed in the Appendix. Many were secondary sources written about specific crisis episodes. We also used primary sources, including the “League of Nations: Money and Banking Statistics”, volumes from 1925 to 1939, which was useful for gathering data on bank failures and deposit declines in a wide range of countries during the interwar period, and various individual primary sources covering individual countries and banking crisis episodes. All sources are

carefully documented in the Appendix, and we plan to provide this new database to other researchers studying historical banking crises.

III. Bank equity returns as an informative signal of banking crisis

A. Bank equity provides the best real-time signal of banking crisis

We begin by showing that bank equity returns provide the best real-time signal of banking crises compared with a host of other financial and macroeconomic variables. To test the performance of bank equity returns in detecting crises, Figure 2 presents receiver operating characteristic (ROC) curve for classifying banking crises. The ROC curve is a simple tool that allows us to assess the performance of bank equity in identifying narrative crises in real-time. We can then compare the bank equity ROC curve with the curve for other macro and financial variables. To be clear, we are not predicting banking crises but simply asking which variable best coincides with banking crises identified from existing classifications.

For a given classifying variable, the ROC curve plots the "true positive" rate against the "false positive" rate (Type I error) when varying the classification threshold. A higher value of the ROC curve, therefore, indicates a better classifying variable, as it implies a higher "true positive rate" for a given "false positive" rate. The area under the ROC curve (AUC) provides a summary measure of the performance of the classifying variable. The 45-degree line represents the benchmark uninformative classifier for a variable having no information content, which has an AUC of 0.50.

It is, of course, unclear what a "true" banking crisis should be—hence, this paper. However, for this preliminary ROC analysis, we use as our set of "true" banking crises the narrative-based banking crises on the Joint Crisis List, because the revised list of banking crises presented in Section VI incorporates information from bank equity, which would give bank equity returns an unfair advantage in picking up these crises. The Joint Crisis List is simply a natural starting point to test whether bank equity returns provide an informative signal of those banking crises put forward by other researchers.

Panel A in Figure 2 presents the ROC curves for bank equity returns and other financial market variables. These variables include non-financial returns, market returns, corporate credit spreads, and bank credit spreads. We compute the ROC curves for the sample for which bank equity returns, non-financial equity returns, and market returns are non-missing.

Panel A shows that for most false positive rates, the bank equity return ROC curve is the highest curve. Consistent with this, the bank equity return has the highest AUC of all these financial variables (0.73). In particular, the bank equity return ROC curve lies above the non-financial return and market return, so bank equity is more successful at classifying JCL crises than the broader stock market. Nevertheless, non-financial equities do provide incremental value in classifying crises. For example, the bank abnormal return, which subtract non-financial returns from bank equity returns, performs substantially worse than both bank equity returns and non-financial returns, with an AUC of (0.57).

Bank equity also provides a better signal of a crisis compared to credit market variables. Panel A compares bank equity returns to bank and corporate credit spreads. Bank credit spreads provide the best signal of a JCL crisis after bank equity, with an AUC of 0.70. Corporate credit spreads also signal a JCL crisis, but its AUC is lower than all stock market measures (0.61).[6] We should note that we only have credit spreads for about one-third of our overall sample. However, repeating the analysis on the same sample actually strengthens the results in favor of bank equity, whose AUC rises from 0.73 to 0.80.

Panel B repeats the ROC analysis for several macroeconomic variables. To facilitate comparison, we perform compute the ROC curves on the same sample for all four variables. The ROC curves show that bank equity returns provide a better real-time signal of a JCL crisis than the increase in the unemployment rate, the decline in GDP growth. Many negative macroeconomic shocks are not as powerful a classifying variable of banking crises, presumably because they frequently also occur outside of banking crises, thus generating a lot of "false positives". Credit contraction is another possible signal of a banking crisis. Panel B also reports the ROC for credit contraction from year t to t+5 and shows that this variable also lines up with crises, but is not as powerful a classifying variable as is bank equity.

[6] The ROC curve for corporate credit spreads in Figure 3 uses the *level* of corporate credit spreads. The results are similar, albeit slightly weaker, using the change in the corporate spread or the corporate spread relative to its five-year moving average.

B. Bank equity declines are correlated with common symptoms of banking crises

We next validate the usefulness of bank equity declines by showing that they are highly correlated with other common symptoms of banking crises and policy responses like bank failures and government intervention when the crisis occurs. Recall the variables described in Section II, which relate to symptoms and policy responses of crises.

We estimate the following regression, with each of the observations being a single banking crisis from the Joint Crisis List:

$$y_{i,t} = \alpha_i + \beta r_{i,t} + \gamma 1_t^{postwar} + \varepsilon_{i,t} \quad (1)$$

where $y_{i,t}$ represents a host of common symptoms of banking crises and policy responses like bank failures and government intervention; α_i is a country fixed effect, $1_t^{postwar}$ is a dummy variable that takes on the value of 1 if the year of the crisis is greater than 1945; and $r_{i,t}$ is the peak-to-trough change in the real bank equity index during the crisis. The postwar dummy is important, since prewar data is generally more volatile (though part of this may be an artifact of the data, e.g., Romer, 1999). The sample size of different regressions with different dependent variables differs due to differences in data availability. Again, we take the Joint Crisis List as a starting point, from which to evaluate the informativeness of bank equity.

[INSERT TABLE 2 HERE]

Table 2 Panel A shows that bank equity peak-to-trough declines during banking crises are correlated with other symptoms of banking crises. Banking crises with larger bank equity declines are associated with increased likelihood of depositor runs and larger declines in bank deposits. A larger bank equity decline also correlates with an increased incidence of failure of the largest banks and higher non-performing loans. Moreover, bank equity declines predict an increased probability of various forms of government intervention including significant liability guarantees, liquidity support, bank nationalization, or government equity injections. Thus, although crises are multidimensional and evolve in different ways, greater bank equity declines are associated with increased likelihood and severity of symptoms and policy responses.

C. Bank equity declines are informative about the severity of crises

Next, we show the informativeness of bank equity declines in the sense that they are associated with the severity of banking crises in terms of various macroeconomic outcomes. This section also tests a key hypothesis that the undercapitalization of the banking sector is a key driver of the macroeconomic severity of banking crises.

We re-estimate Equation (1), with each of the observations being a single banking crisis from the Joint Crisis List, as before. The dependent variable $y_{i,t}$ now represents a host of macroeconomic variables (e.g., real GDP), all expressed as the peak-to-trough change during the banking crisis; the other variables remain the same as before.

Panel B of Table 2 shows that greater declines in bank equity prices are associated with larger output declines. The output decline is measured in three ways. In column 1, the dependent variable is the peak-to-trough decline in real GDP. However, one problem with this measure is that real GDP growth does not turn negative in many crises if the country's underlying growth rate is high, even if there a substantial slowdown in growth. Therefore, the dependent variable used in column 2 is the percentage point decline in real GDP growth (measured peak-to-trough), and the dependent variable in column 3 is the maximum deviation of real GDP growth from its past 10-year average. The estimates from all three columns show that a 100% peak-to-trough decline in bank equity returns is associated with a 13.1% peak-to-trough decline in real GDP, an 11.5 percentage point decline in the real GDP growth rate (peak-to-trough), and an 8.2 percentage point decline in the real GDP growth rate from its past 10-year average.

Panel C reports similar results, also estimated from Equation (1), for a host of macroeconomic variables. Note that the sample size of different columns varies due to data availability of the dependent variable. A 100% peak-to-trough decline in bank equity returns is associated with a 10.0% percentage point decline in real consumption per capita, a 4.7% decline in investment to GDP, a 30.3% decline in the broad money supply, and a 21.7% percentage point increase in government debt to GDP. A 100% peak-to-trough decline in bank stock returns also predicts a 21.3% decline in total bank loans, a 28.2% decline in mortgage loans, and a 11.2% decline in house prices. With the exception of the estimates for house prices, all estimates in panel C are statistically significant. The adjusted R^2 ranges in 3-21%, demonstrating a reasonably high correlation between bank equity declines and macroeconomic outcomes.

Thus, we conclude that bank equity declines during banking crises are correlated with the severity of the crisis, thus showing the informativeness of bank equity declines as a way to capture banking crisis severity.

D. Alternative measures of bank equity declines

We next show the above results are robust to alternative measures of bank equity declines. One may be concerned, for example, that the bank equity decline simply reflects a general decline in equity markets, rather than something specific about bank equity. Therefore, in Appendix Table 3 Panel A, we show that our results are robust to replacing bank equity returns with *bank abnormal returns* (defined as bank equity total returns minus nonfinancial equity total returns).

The specialness of bank equity returns, relative to non-financials, is explained by the fact that, as we show in more detail below, the dynamics of bank equity declines are different from nonfinancial equity declines during crises. For example, the bank equity decline tends to precede the nonfinancial equity decline, is more severe in magnitude (even though, unconditional on a crisis, the bank equity index has a lower market beta, about 0.8), and, unlike the nonfinancial index, does not generally recover post-crisis.

In terms of the magnitude of the estimates and the adjusted R^2, however, the bank equity return is a substantially better predictor of crisis severity than bank abnormal return. For example, the adjusted R^2 for real GDP peak-to-trough decline on the bank equity decline is 14.1%, compared to 6.1% for the bank abnormal returns. Thus, both as a signal of a narrative crisis on the Joint Crisis List and as a measure of crisis severity, bank equity returns dominate bank abnormal returns. Non-financial equities fall substantially during severe bank crisis, in part because of banking sector distress, and this overall level effect provides valuable information beyond the differential information contained in bank abnormal returns.

Panel B re-estimates Equation (1) with *bank market capitalization returns* as the independent variable. Recall that this variable seeks to capture the change in the market value of equity within the banking sector. Specifically, it is bank equity price returns plus new issuance of bank equity. We use price returns rather than total returns, because dividends are paid out from

the bank and hence deplete bank equity. Equity issuance is new capital raised by the bank, which may be important as banks seek to recapitalize. Given that theory (e.g. Bernanke, Gertler, and Gilchrist, 1999; Brunnermeier and Sannikov, 2014) links the net equity of the banking sector to macroeconomic outcomes, we should expect *bank market capitalization returns* to have the strongest predictability for output. Indeed, this is the case, as Panel B shows adjusted R^2 values in the range of 18% to 24%, substantially higher than the 10% to 14% in Table 3.

It is important to note that *bank abnormal returns* and *bank market capitalization returns* can only be constructed on a subsample of the data, due to historical data limitations on the availability of nonfinancial equity indices and new bank equity issuance. As a result, we use these variables only for robustness analysis.

Panel C of Appendix Table 3 is similar to Table 2B but has an additional independent variable, the *bank equity recovery* (the positive returns in the bank equity total returns index subsequent to the trough within three years after a banking crisis). Rebounds in bank equity returns may be due to unexpected policy interventions or to the fact that the crisis may not have been as severe as initially perceived by equity investors. However, surprisingly, Panel C shows that the *bank equity recovery* has no predictability for economic output, a result which is robust to various other measures of bank equity recoveries.

IV. Bank equity declines and future macroeconomic dynamics

The previous section established that bank equity returns provide an informative real-time signal of the occurrence, severity, and timing of banking crises. In this section we explore the macroeconomic implications of bank equity declines without conditioning on narrative crises.

A. Bank equity declines and future GDP growth

We begin by examining the consequences of bank equity declines for subsequent GDP growth in our full annual panel dataset. In Table 3A column 1 we use bank and non-financial equity declines to predict next year's GDP growth rate using the following specification, estimated on the full panel:

$$\Delta y_{i,t+1} = \alpha_i + \beta BE\ Decline_{i,t} + \delta NFE\ Decline_{i,t} + X_{i,t}\Gamma + \varepsilon_{i,t} \qquad (2)$$

The variables $BE\ Decline_{i,t}$ and $NFE\ Decline_{i,t}$ equal 1 when the bank and non-financial return indexes are below -30%, and zero otherwise. Standard errors are dually clustered on country and year to account for within country residual correlation, as well as residual correlation across countries induced by common shocks.

Column 1 shows that bank equity declines predict 2.2% lower growth in the following year, controlling for non-financial equity declines. Non-financial equity declines also contain information about growth in the subsequent year, predicting 1.7% lower growth. Column 2 shows that these results are robust to controlling for lagged bank and non-financial equity crash variables, along with contemporaneous (t-1 to t) and lagged GDP growth and bank credit-to-GDP change. We include three lags for all variables, but the results are not sensitive to the lag length. Column 3 replaces the dependent variable with GDP growth from t to t+3 and finds that the bank equity declines predict persistently lower output.

[INSERT TABLE 3 HERE]

Figure 3 explores the relation between bank equity returns and subsequent growth in more detail. To flexibly estimate the impact of bank equity return shocks, we estimate the following Jordà (2005) local projection specification for horizons h=1,…,10.

$$\Delta_{\mathrm{h}} y_{i,t+h} = \alpha_i^h + \gamma_t^h + \sum_j \beta_j^h\ BE\ Bin_{i,t}^j + \sum_j \delta_j^h\ NFE\ Bin_{i,t}^j + X_{i,t}\Gamma^{\mathrm{h}} + \varepsilon_{i,t}^h, \qquad (3)$$

where α_i is a country fixed effect, γ_t is a year fixed effect, and $BE\ Bin^j$ ($NFE\ Bin^j$) is an indicator variable for whether the bank (non-financial) equity return in within bin j. The controls in $X_{i,t}$ are three lags of the BE and NFE bins, contemporaneous and three lags in GDP growth, and contemporaneous and three lags in the change in credit-to-GDP.

[INSERT FIGURE 3 HERE]

To examine the impact of bank equity shocks across the full distribution of returns, we expand on the bank equity crash measure by including six bins for returns: less than -50%, -50% to -25%, -25% to 0%, 0% to 25%, 25% to 50%, and greater than 50%. The omitted bin is the 0% to 25% range. The ability to estimate the impulse response flexibility and allow for nonlinearities is an advantage of the local projection framework.

The key parameters of interest are the sequence of local projection impulse responses $\{\beta_j^h\}$. Our specification only allows a bank equity return shock to affect GDP with a lag, and it controls for GDP growth and the change in credit-to-GDP from t-1 to t. This avoids bias from reverse causality in which real economic distress negatively impacts bank equity. However, equities are forward looking, so bank equity prices may crash in anticipation of lower future growth. Controlling for non-financial equities partially addresses this concern, as non-financial equity returns summarize growth expectations for a broader range of sectors in the economy. As such, we view the estimates of $\{\beta_j^h\}$ as, at least partly, capturing the causal impact of shocks to bank net worth on the real economy.

The left panel in Figure 3A shows the response of real GDP to the bank equity return bins. Relative to "normal times" (0% to 25% returns), declines in bank equity of greater than 50% predict 5% lower output three year after the shock. This negative effect is highly persistent, translating into a permanent loss in output after 10 years of about 5%. More moderate, but still substantial shocks of-25% to -50% are followed by 3% lower output after 4 years, followed by a partial recovery. In contrast, smaller negative shocks of -25% to 0% and positive shocks lead to weaker effects on future GDP. These estimates therefore provide evidence consistent with the idea that shocks to bank equity have non-linear effects on the real economy, consistent with models of constrained intermediaries such as Krishnamurthy and Muir (2016). This evidence of non-linearity contrasts with the results in Romer and Romer (2017), who find no evidence of non-linearity between a narrative continuous measure of financial distress and subsequent output.

The right panel in Figure 3A shows the GDP responses to non-financial equity shock. Not surprisingly, larger declines in non-financial equity predict lower subsequent output. In contrast with the bank equity shocks, there is limited evidence of non-linearity for non-financial equity returns. The ability of non-financial equities to predict future GDP growth is consistent with Stock and Watson (2003).

B. Bank equity declines and future bank credit growth

Why do bank equity declines predict lower future growth, even conditional on non-financial equities? This may seem surprising. Banks represent a small portion of value added and

controlling for non-financial equities captures the stock market's expectation about future growth. In this section we argue that bank credit to the private sector, i.e., the bank lending channel, plays a key role.

Table 3 panel B we estimate equation (2), replacing GDP growth with the change in bank credit-to-GDP as the dependent variable. Column 1 shows that bank equity declines of 30% or more predict a 1.7% decline in credit-to-GDP in the following year. The estimate is robust to including controls (column 2) and rises to 5.7% after 3 years (column 3). A crash in the non-financial equities has a smaller and often insignificant relation with future credit-to-GDP.

Figure 3 panel B plots the responses from estimating (3) with bank credit-to-GDP as the dependent variable. The left panel depicts the responses across bank equity bins. After 5 years, a bank equity crash of over 50% predicts a 12% decline in credit-to-GDP. Declines of between -25% and -50% also predict sizeable credit contractions, amounting to credit-to-GDP decline of -7% after 5 years.

Figure 3B also shows that the response of credit-to-GDP to bank equity return shocks is nonlinear. While large declines in bank equity are followed by sharp credit contraction, increases in bank equity have much more muted effects on future credit creation. While the evidence for nonlinearity between bank equity and future output was modest, nonlinearity for bank credit is strong in the data. Non-linearity in credit growth is consistent with models in which banks are financial constrained. Larger shocks to bank net wealth are more likely to force banks against their capital constraint and therefore to contract the asset side of their balance sheet.

The right panel in Figure 3B shows the credit-to-GDP response to non-financial equity shocks. There is a striking asymmetry between the bank equity and non-financial equity shocks. Non-financial equity shocks have essentially no effect on future credit-to-GDP. Even large declines or increases in non-financial equity returns have limited impact on subsequent credit-to-GDP. This asymmetry between bank and non-financial equity shocks provides an explanation for why bank equity shocks matter for future growth, even when we control for non-financials. Bank equity declines capture shocks to bank net wealth, which translate into a credit supply contraction that depresses household consumption and corporate investment and production.

C. Robustness

Figure 3 displayed responses to 6 bins of bank equity returns to depict the full dynamic response to bank equity shocks in a non-parametric way. A concern with this approach is that the results are sensitive to the cut-off choices. Appendix Figure 2 Panel A varies the cutoff by showing the responses to bank and non-financial equity declines of at least 30%. The responses to 30% declines are consistent with our preceding results. Both bank and non-financial equity declines predict lower future growth, and the estimates are significant. On the other hand, only bank equity declines predict subsequent credit-to-GDP contraction.

Appendix Figure 2 Panel B presents robustness by using shocks to bank and non-financial equity *returns*. This assumes a linear relation between return shocks and subsequent outcomes. The left panel shows that shocks to both bank equity and non-financial equity predict higher subsequent growth. Interestingly, the magnitudes of the responses are similar. The right panel shows that only bank equity return shocks affect future credit-to-GDP. Non-financial equity return shocks have zero impact on subsequent credit-to-GDP.

D. Bank equity declines vs. narrative crises

Thus far our approach has been to trace the effect of bank equity declines, conditional of non-financial equities, on the macroeconomy. This can be thought of as estimating the impact of a real time objective signal of the shock to bank capital perceived by the market. A natural question is how the impact of bank equity declines relates to the impact of narrative crises. We know that bank equity declines correlate strongly with crises, but the overlap is far from perfect. Do bank equity declines subsume effect of narrative crises? Or do narrative crises contain additional information?

Figure 4 explores these questions by jointly estimating the impact of 30% bank equity declines and narrative crises using the following local projection specification:

$$\Delta_{\mathrm{h}} y_{i,t+h} = \alpha_i^h + \gamma_t^h + \beta^h BE\ Crash_{i,t}^j + \phi^h Narrative\ Crisis_{i,t}^j + \Gamma^{\mathrm{h}} X_{i,t} + \varepsilon_{i,t}^h. \quad (4)$$

In this specification, $X_{i,t}$ controls for lags in bank equity crash and narrative crisis indicators, as well as contemporaneous and lagged non-financial equity crash indicators, real GDP growth, and

credit-to-GDP change. For this exercise we use our revised narrative crisis list to capture the most correct narrative chronology available.

The solid lines in Figure 4 Panel A presents the sequence of estimates of $\{\beta^h\}$ and $\{\phi^h\}$ for GDP growth, and Table 4A columns 1 and 2 report the regression versions at the three-year horizon. Both bank equity crash and narrative crisis shocks are associated with lower subsequent growth, and the magnitudes are similar. Panel B shows the response of credit-to-GDP. Again, both bank equity declines and narrative crises predict a credit-to-GDP contraction of similar magnitude.[7]

[INSERT FIGURE 4 HERE]

An implication of Figure 4 is that bank equity declines do not drive out the narrative crisis indicator. Instead, both estimates are negative and significant. There are two potential reasons for this. First, the narrative crisis indicator may capture additional information not incorporated by bank equity, such as non-bank financial distress, distress among private banks, or government intervention. Second, another reason may be that narrative crises select crises with more severe macroeconomic outcomes, leading to biased estimates of the effect of banking sector distress on the real economy.

The dashed lines in Figure 4 provide some support for the hypothesis that narrative crises capture additional information about the shock to the banking sector. Specifically, we re-estimate (4), controlling for key symptoms of crises (significant liquidity support, government equity injections, and bank nationalization) which may not be entirely captured by bank equity declines. For example, crises with significant government liquidity support may force banks to suppress lending, but the intervention may cushion equity markets. The estimated effect of a narrative crisis is attenuated by one-third to one-half when these symptoms of crises are included as controls. However, this means that a substantial fraction of the narrative effect cannot be accounted for by bank equity measures or crisis symptoms. Therefore, the narrative chronology likely captures some hindsight bias in identifying crises.

[7] Interestingly, bank equity declines predict future growth slowdown and credit contraction even outside of banking crises (Appendix Figure 3).

V. Bank equity prices pick up the crises before non-financials and credit spreads

A. Comparing the timing of bank and non-financial equity declines around banking crises

The fact that bank equity declines predict output and credit contractions, conditional on non-financials, is consistent with a credit channel interpretation. However, an alternative interpretation is that bank equity returns is simply more sensitive to macroeconomic shocks that translate into lower future growth, instead of capturing a causal mechanism from banking sector distress to the real economy.

While it is nearly impossible to fully address this concern, analyzing the timing and dynamics of bank equity declines during banking crises can shed some light on this issue. In this section, we therefore use monthly data to zoom in on the relative timing of bank equity returns, non-financial equity returns, and credit spreads. A key result is that bank equity prices pick up crises before these other financial market measures.

This key result can be seen in the case of the U.S. 2007-8 banking crisis, so we start with this case. Figure 5 shows the dynamics of bank equity, non-financial equity, corporate credit spreads, and bank credit spreads up to and during the 2007-08 crisis in the U.S. The figure clearly shows that bank equity prices pick up the impending crisis first – before nonfinancial equity measures and before credit spread measures. Bank equity declined ten months before the nonfinancial index peaked (January 2007 for bank equity, compared to October 2007 for nonfinancial equity). Additionally, corporate spreads (the AAA-Govt and BAA-AAA spreads; dashed and solid black lines, respectively) did not reach historically-unusual levels until September 2008, a full 21 months later. However, in this specific case, interbank lending spreads (the LIBOR-OIS spread, green line) did reach historically-unusual levels early on, in August 2007, though this is not generally the case in most historical banking crises. This makes sense, as bank shareholders take first losses, they should be most sensitive to potential loan losses – while creditors respond only later when banks approach default.

[INSERT FIGURE 5 HERE]

We next analyze the dynamics of bank equity declines relative to nonfinancial equity prices and credit spreads more systematically across all crises. To do this, we turn to our monthly dataset, which contains four series for each country: bank equity index returns, nonfinancial

equity index returns, a bank credit spread index, and a nonfinancial corporate credit spread index.

In order to pick up in "real time" whether a bank equity decline is happening, we record a bank equity decline (or, similarly, a nonfinancial equity decline) in the first month in which the equity index falls a cumulative -30% in real total returns from its peak.[8] To see when credit spreads pick up financial distress, we record a credit spread "spike" as the first month in which credit spreads increase at least 1 or 2 percentage points above their pre-crisis average levels. (We use both 1 and 2 percentage points for robustness; a level too low can potentially pick up too many false positives, while a level too high might never be reached.)

[INSERT TABLE 5 HERE]

Table 5 analyzes when crises are first detected, comparing the timing of bank equity declines to the onset of crises according to other financial indicators (nonfinancial equity index declines, bank credit spread spikes, and non-financial corporate credit spread spikes). We analyze the timing of events in 3-year pre and post windows around Revised Crisis List banking crisis. For each crisis, we record the average time difference in months between picking up a bank equity decline relative to various other events listed in each column (the time difference is positive if the bank equity decline is recorded before the other event and negative if after the event). A t-statistic is calculated under the null hypothesis that the average time difference is zero. As an alternative nonparametric test, we also count in how many of the banking crisis the bank equity decline is recorded first ("pos"), the other event is recorded first ("neg"), or both events are recorded in the same month ("zero"); we then calculate the fraction of times that the bank equity decline happens first ("pos / (pos + neg)") and calculate a p-value under the null hypothesis that the bank equity decline happening first is Bernoulli-distributed with parameter 0.50.

As Table 5 Panels A and B show, the detection of bank equity declines precedes the detection of nonfinancial equity declines, bank credit spread spikes, and nonfinancial corporate

[8] To further show that bank equity tends to falls *first* and not just *more* than nonfinancial equities, we also compare the timing of peaks. Table 5, Panel B, shows that bank equity reaches its peak, on average, a statistically-significant 1.37 months before nonfinancial equity. Bank equity peaked first in 41% of cases, at the same time in 44% of cases, and after in 14% of cases.

credit spread spikes around financial crises. Thus, from a statistical perspective, bank equity has an advantage in picking up the crisis first.

Figure 6 shows the average dynamics of monthly bank and non-financial equities around financial crisis. Time 0 in event time is defined as January of the narrative crisis year, based on the revised crisis list constructed below. Panel A shows that bank equity peaks before non-financials and starts declining earlier, consistent with the results in Table 5.

[INSERT FIGURE 6 HERE]

These findings are consistent with the view that banking crises originate with shocks to the banking sector that are then transmitted to the broader economy through a bank lending channel. If most banking crises were caused by macro shocks to the real economy that then led to banking sector losses, we would expect non-financial equities to decline before or at the same time as bank equity. These results are therefore consistent with our interpretation that the predictability of bank equity declines for future GDP growth, conditional on non-financials, is driven by a bank credit channel.

This finding has two additional important implications. First, it suggests that regulators may want to use bank equity returns as indicators of the severity of the crisis. Although the theoretical advantages of using bank equity returns rather than credit spreads follow from the Merton (1974) model that bank shareholders take first losses while creditors respond only later when banks approach default, regulators tend to focus almost completely on credit spreads as indicators of banking distress. Second, the timing of bank equity declines helps resolve debate on the start of various historical banking crises. On the basis of bank equity declines, we revised the start dates of 18 crisis episodes, where the bank equity decline was in conflict with start date from other papers (see Appendix Table 3).

On average, bank equity declines before non-financial equities. However, bank equity does not always lead non-financial equities a banking crisis. We therefore investigate in which circumstances bank equity declines before non-financial equities and in which circumstances the non-financial equity decline comes first. Table 6 shows that bank equity tends to lead the crisis in the post-war era and in advanced economy crises. Figure 6 Panels B and C visually show that in post-war crises, bank equity falls before non-financials. In contrast, in pre-war crisis banks and

non-financials fall at the same time. One interpretation of this is that the initial causes of crises have changed over time, with more recent crises starting with distress in the banking sector exposed to narrow segment of the economy, as opposed to broader macroeconomic shocks.

[INSERT TABLE 6 HERE]

B. The dynamics of bank equity during banking crises: additional findings

Several other facts stand about the dynamics of bank equity around banking crises. First, bank equity returns decline substantially more than nonfinancial equity returns, even though, unconditional on a crisis, bank equity has a beta of 0.8, so is actually less volatile than the market most of the time. In the U.S. case in Figure 5, the bank equity index falls over 80% peak-to-trough (red line), compared to about 60% for non-financials (blue line). Across all banking crises, the average peak-to-trough decline in bank equity is -34.4% across all episodes on the Revised Crisis List, compared to -13.6% for nonfinancial equity. Among all banking crises on the Revised Crisis List, the average peak-to-trough abnormal return (bank minus nonfinancial return) is -35.2%; among crises where bank equity falls in excess of 30%, the average abnormal return is -44.3% and is negative in 98% of cases.

Second, bank equity declines are "permanent," in the sense that they do not recover post-crisis, presumably reflecting permanent credit losses (a cash flow effect). In contrast, nonfinancial equities recover after the crisis, suggesting nonfinancial equity declines are mainly driven by a discount rate effect. This can be clearly seen in the U.S. case in Figure 5 and in the general case across all crises in Figure 6, Panel A.

Finally, bank equity declines tend to unfold gradually over one to three years. In other words, in equity prices, there is generally not a "Minsky moment" where equity declines suddenly; there is a surprisingly slow and gradual process from peak to trough. In the U.S. case in Figure 5, the bank equity decline begins in August 2007 and reaches its trough in February 2009. There is not a sudden free-fall moment; in fact, bank equity had already declined over 45% before March 2008 when Bear Stearns collapsed and 65% before September 2008 when Lehman Brothers collapsed. Across all crises, the average duration of the bank equity decline was 29.11 months, according to Table 5, Panel A. In 83.8% of cases, the decline took greater than 12

months, and only in two of those cases did the majority of the decline happen within a single month.

This slow decline could potentially reflect a behavioral bias of overoptimistic investors initially underestimating the true depth of the crises. Alternatively, in a rational framework, investors may face informational frictions, making it difficult to piece together the extent of bank losses when bad lending practices start to become apparent. Nevertheless, bank equity declines are slow and gradual, and there does not seem to be evidence of a single "Minsky moment" in bank equity prices.

VI. A revised chronology of banking crises

In this section, we use bank equity index returns, along with other narrative information on crises, to refine the existing chronology of banking crises.

A. Constructing a revised chronology of banking crises

We use the following algorithm to construct a refined chronology of banking crises. The intuition behind the strategy is as follows: we first cast as wide a net as possible to capture all potential banking crises (which adds new banking crises not previously on the Joint Crisis List), then narrow down this list (eliminating spurious crises or events that do not rise to the level of a true banking crisis) primarily using bank equity returns data but also additional narrative information on banking crises collected from a wealth of primary and secondary sources on each of the potential crises.

Specifically, we start with the Joint Crisis List and add events that meet both of the following two criteria: i) the peak-to-trough bank equity decline is greater than 30%, and ii) there is overwhelming evidence from the new narrative evidence of either widespread panics or significant bank failures (or both).[9] Then, to narrow down this list, we eliminate events which meet *both* of the following criteria: i) the bank equity decline is less than 30%, and ii) there is

[9] Based on narrative evidence of widespread banking panics, we also added one episode (Hong Kong 1965), in which the bank equity decline was less than 30%. There are also a few added episodes for which bank stock data is unavailable but where the narrative evidence is persuasive. Similarly, there were a few deleted episodes where we did not have bank stock data but where the narrative evidence strongly suggested these were erroneously labeled as banking crises.

overwhelming narrative evidence of a lack of both widespread bank failures or bank runs.[10] The philosophy behind this algorithm is to be conservative when adding episodes and deleting episodes, hence only making changes where there is both overwhelming bank stock *and* narrative evidence supporting these change.

The narrative information comes from wealth of primary and secondary sources, which we use to create over 400 pages of documentation regarding the specific timelines of each of these potential crises. For each crisis episode, we reconstruct a history of which specific banks saw deposit runs, failed, and/or were rescued; the specific action taken by central bankers and government officials (liquidity support, liability guarantees, bank holidays, asset purchases, recapitalization efforts); other symptoms, background causes, and consequences of each crisis. We sought to be painstakingly careful in documenting each event.

[INSERT TABLE 7 HERE]

To highlight some of the refinements we make to the Joint Crisis List, we first present newly identified banking crises in Table 7, Panel A, which we add to our revised chronology of banking crises. We also present a list of spurious banking crises in Table 7, Panel B, which we argue should not be considered banking crises and are removed from our revised chronology of banking crises. Many of these deleted events in Panel B are typos or historical errors, while others are monetary or currency issues that had only minor effects on the banking sector. Finally, we present in Panel C our new revised chronology of banking crises. We also list the bank equity return (i.e. the peak-to-trough log real total return) as a measure of the severity of each banking crisis.[11]

B. Newly-uncovered crises and spurious crises

[10] As noted in the previous section, we base the 30% threshold on an analysis of "true" crises: among all episodes on the Joint Crisis List in which there is unanimous agreement among at least three papers, only three crises do not fall below the -30% threshold. (These three episodes are Argentina 1995, Chile 1976, and the U.S. 1984.) Thus, -30% seems a natural threshold under which almost all "true" banking crises fall.

[11] We occasionally combined several pairs of episodes (see Appendix Table 4, Panel A) occurring close together in time, when it seemed more appropriate to consider them as a single crisis (i.e. when bank equity prices did not show two separate declines and when the narrative evidence on bank failures and panics conveyed a continuous sequence of banking distress across time, not clustered into two phases). We also revised the starting years of several bank crises (see Appendix Table 3, Panel B) by looking at the timing of bank stocks declines.

We highlight several examples of newly-uncovered crises (episodes added to our revised chronology) and spurious crises (episodes deleted from our chronology) to showcase some of the improvements of our chronology. Three interesting newly-uncovered crises, taken from Table 7, Panel A, are:

Belgium in 1876. As reported by Grossman (2010): "the boom in Belgium after Franco-Prussian war led to the establishment of new banks. Several of these failed when the international crisis of 1873 arrived in Belgium. A few smaller banks went into receivership, and the larger Banque de Belgique, Banque de Bruxelles, and Banque Central Anversoise had to be re-organized. Durviaux (1947) calls this a serious crisis, while Chelpner (1943) suggests it may have been less serious."

Japan in 1922. This episode is distinct from the Japanese banking crises of 1920 and 1923, the latter of which was triggered by the Great Kanto earthquake of 1923. Regarding 1922, Shizume (2012) writes: "Ishii Corporation, a lumber company engaged in speculative activities, went bankrupt at the end of February 1922, triggering bank runs in Kochi Prefecture (in south-western part of Japan) and Kansai region (Osaka, Kyoto and their environs). Then, from October through December 1922, bank runs spread far across the country, from Kyushu (the westernmost part of Japan) through Kanto (Tokyo and its environs in eastern Japan). In 1922, operations were suspended at 15 banks, either permanently or temporarily. The BOJ extended "special loans" to 20 banks from December 1922 to April 1923."

Portugal in 1876. As reported by the Banker's Magazine (October 1876) in an article titled "The Banking Crisis in Portugal": "The first announcement of this trouble was made in London, 19th August, when the telegraph announced that a general run on the banks had begun on the previous day, and that the banks had suspended payments. The explanation was given that the trouble arose from the failure of some financing banks in Oporto, last May, when several of the weak institutions were assisted by the Bank of

> Portugal… It thus became apparent that the banks of Lisbon, by aiding the suspended banks of Oporto, had so weakened themselves that suspension was inevitable. Under these circumstances, two expedients were adopted by the Portuguese Government. The first was to issue a decree suspending for sixty days the payment of debts… The second expedient was to use the credit of the Government in London, and to obtain from several financial houses there advances of about $5,000,000. An export of gold to Lisbon was thus begun, and for the present the financial excitement seems almost to have ceased."

Other less surprising additions to our revised chronology of banking crises include the 2010-12 Eurozone banking crises in Austria, Belgium, Denmark, France, Germany, Greece, Ireland, Italy, Luxembourg, the Netherlands, Portugal, and Spain.

We next highlight three episodes, taken from Table 7 Panel B, as examples of spurious banking crises that we delete from our revised chronology of banking crises.[12] Removing spurious crises reflects the concerns of Schwartz (1987) on distinguishing real crises from pseudo-crises.[13] These examples are, as follows. In subsection IV.D, we further showcase several added and deleted episodes from the Great Depression.

> Argentina 1985. This episode seems to be the result of a typographical error in Reinhart and Rogoff. Their original source for this crisis was Kaminsky and Reinhart (1999), but after looking at the description of the 1985 crisis in that paper, this episode seems to actually be the Argentina 1989 crisis.

[12] We also wish to mention one other important example of a spurious crisis, even though it's out of our sample period, since it incorrectly shows up in many banking crisis chronologies: the U.S. in 1825. Although there was a major banking crisis in the U.K. in 1825, there were no notable bank panics in the U.S. (see Jalil, 2015).

[13] Schwartz (1987) argues that the U.S. and U.K. have not experienced "real" banking crises over the period 1933-1987 and 1866-1987, respectively. She defines "pseudo-crises" as episodes only featuring: a "decline in asset prices of equity stocks, real estate, commodities; depreciation of the exchange value of a national currency; financial distress of a large non-financial firm, a large municipality, a financial industry, or sovereign debtors." She defines a "real crisis" as an event leading to a "scramble for high-powered money" that "squeezes the reserves of the banking system," in other words, a panic. In contrast, in our paper, we use a broader characterization of banking crisis to include episodes featuring widespread bank failures and solvency concerns (the latter as measured by large bank equity declines), even when there is no traditional panic. Our chronology of banking crises also includes minor or non-systemic banking crises but in which the capitalization of the banking sector was nonetheless largely affected.

Germany 1977. Reinhart and Rogoff (2009) simply report that "Giro institutions faced problems" (though we have not been able to independently confirm this fact), and, from reading (English-language) newspaper clippings, there seemed to be no unusual problems affecting the banking sector at the time. The peak-to-trough bank equity decline was small (-11.7%).

Netherlands 1893 and 1897. According to Sumner (1896), 1893 was a monetary crisis but did not feature depositor panics or bank failures. There was a large outflow of gold, which necessitated the Netherlands Bank and foreign banks to raise their discount rates to stem the outflow. The discount rate was lowered to normal levels after three months when the gold outflows had subsided. There was no decline in annual bank equity prices. As for 1897, we could not find any reference to a banking crisis[14], and there was no decline in annual bank equity prices.

We summarize the properties of all the added and deleted episodes in Table 8, Panel A, which is further supporting evidence that the added banking crises are real and the deleted banking crises are spurious. Column 1 shows that the added crises have an average peak-to-trough bank equity decline of -57.2% an average peak-to-trough real GDP decline of -7.4%, a high likelihood of deposit runs, liability guarantees, and liquidity support, and high non-performing loans and deposit outflows. These numbers are comparable to, or in most case greater than, the average for episodes from the Revised Chronology (column 3), suggesting that these added episodes are truly crises.

[INSERT TABLE 8 HERE]

Column 2 has statistics for deleted crises: an average peak-to-trough bank equity decline of -10.1, an average peak-to-trough real GDP decline of -2.4%, a low likelihood of deposit runs, liability guarantees, and liquidity support, and low non-performing loans and deposit outflows.

[14] Reinhart and Rogoff (2009) justify this banking crisis by citing Bordo et al. (2001) and Homer and Sylla (1991). However, Bordo et al. (2001) gives no explanation regarding this crisis, and Homer and Sylla (1991) only show in a graph that short-term interest rates were high; Homer and Sylla (1991) never actually refers to 1897 as a crisis year.

These numbers are considerably less than the average for episodes from the Revised Chronology (column 3), suggesting that these deleted episodes are not actually banking crises.

C. Comparisons to other chronologies of banking crises

How does our revised chronology of banking crises compare to other chronologies? Table 8, Panels B and C, compares the average severity of crises by looking at declines in real GDP and also selected symptoms of crises.

In our revised chronology, the average crisis has a -5.3% peak-to-trough decline in real GDP, as discussed above. In comparison, Reinhart and Rogoff's (2014) headline number is an average peak-to-trough decline in real GDP per capita of -9.6%. However, Reinhart and Rogoff's headline statistic overstates the severity of banking crises, since it is calculated over a subsample of 100 severe banking crises (it is unclear what criteria is used to select this sample, other than ex-post severity). Instead, estimating the consequences of banking crises on Reinhart and Rogoff's entire list of banking crises, we find the consequences are much less severe — the average fall in real GDP that we calculate for Reinhart and Rogoff in Table 8, Panel B, is -4.5% — in fact less severe than using our revised chronology (a difference of 0.8% with a t-statistic of 2.40). Looking at the likelihood and magnitude of other symptoms of crises and policy interventions – including liability guarantees, liquidity support, deposit runs, non-performing loans, and declines in deposits – our revised list is also more severe.

The fact that our revised chronology is on average more severe is, in large part, due to the fact that we eliminate many spurious crises from their list.[15] And if one restricts our list to episodes featuring a large negative shock to bank equity (defined as a greater than 30% decline), our list makes banking crises look even more severe than using the full Reinhart-Rogoff chronology, as shown in column 3 of Panel B.

Similarly, our revised chronology crises are more severe than Schularick and Taylor's (when compared on their sample of 14 countries) and Bordo's, but slightly less severe than Laeven and Valencia's (when compared on their time sample 1970-2012), perhaps because

[15] In our revised chronology, we delete 51 events from Reinhart and Rogoff's list, having an average GDP decline of -2.6%. This small number brings the average severity down for Reinhart and Rogoff's crises.

Laeven and Valencia only identify crises that are serious enough to warrant several forms of major government intervention. We therefore conclude that, comparing our revised chronology to previous chronologies, the aftermath of banking crises tends to be more severe, especially when restricting our chronology to crises featuring large bank equity declines. However, it's important to note that the evidence is nuanced and also that the comparisons are sensitive to the sample studied.

References

Baron, Matthew D. "Countercyclical bank equity issuance." (2017).

Baron, Matthew, and Wei Xiong. "Credit expansion and neglected crash risk." *Quarterly Journal of Economics* 132.2 (2017): 713-764.

Bemanke, Ben, and Harold James. "The gold standard, deflation, and financial crisis in the Great Depression: An international comparison." In *Financial markets and financial crises*. (1991): 33-68.

Bernanke, Ben S., Mark Gertler, and Simon Gilchrist. "The financial accelerator in a quantitative business cycle framework." In *Handbook of Macroeconomics* vol. 1 (1999): 1341-1393.

Bordo, Michael, Barry Eichengreen, Daniela Klingebiel, and Maria Soledad Martinez-Peria. "Is the crisis problem growing more severe?" *Economic policy* 16, no. 32 (2001): 52-82.

Brunnermeier, Markus K., and Yuliy Sannikov. "A macroeconomic model with a financial sector." *American Economic Review* 104.2 (2014): 379-421.

Caprio, Gerard, and Daniela Klingebiel. "Episodes of systemic and borderline banking crises." In *Managing the real and fiscal effects of banking crises*, World Bank publication (2003): 31-49.

Chelpner, B.S. *Belgian Banking and Banking Theory*. Washington: Brookings Institution. (1943)

Conant, C. A. *A History of Modern Banks of Issue*. GP Putnam's Sons. (1915)

Demirgüç-Kunt, Asli, and Enrica Detragiache. "Cross-country empirical studies of systemic bank distress: a survey." *National Institute Economic Review* 192.1 (2005): 68-83.

Durviaux, R., *La banque mixte: origine et soutien de l'expansion économique de la Belgique*. (1947).

Eichengreen, Barry, and Jeffrey Sachs. "Exchange rates and economic recovery in the 1930s." *Journal of Economic History* 45.4 (1985): 925-946.

Frankel, Jeffrey, and Andrew Rose, “Currency Crashes in Emerging Markets: An Empirical Treatment,” *Journal of International Economics*, 41 (1996), 351-366.

Friedman, Milton, and Anna Schwartz. *A Monetary History of the United States*. Princeton University Press (1963).

Gertler M, Kiyotaki N. “Financial intermediation and credit policy in business cycle analysis.” In *Handbook of monetary economics*, vol. 3, Elsevier. (2010): 547-599

Gorton, Gary, and George Pennacchi. "Financial intermediaries and liquidity creation." *Journal of Finance* 45, no. 1 (1990): 49-71.

Grossman, Richard S. *Unsettled Account: The Evolution of Banking in the Industrialized World since 1800*. Princeton University Press (2010).

Holmstrom, Bengt, and Jean Tirole. “Financial intermediation, loanable funds, and the real sector.” *Quarterly Journal of Economics* 112, no. 3 (1997): 663-691.

Homer, Sidney and Richard Sylla. *A History of Interest Rates*. Rutgers University Press (1991).

Jalil, Andrew. “A new history of banking panics in the United States, 1825-1929: construction and implications." *American Economic Journal: Macroeconomics* 7.3 (2015): 295-330.

Jordà, Òscar. “Estimation and inference of impulse responses by local projections.” *American Economic Review* 95.1 (2005): 161-182.

Kaminsky, Graciela, and Carmen Reinhart. “The twin crises: the causes of banking and balance-of-payments problems.” *American Economic Review* 89.3 (1999): 473-500.

Kindleberger, Charles. *A Financial History of Western Europe*. Oxford University Press, (1993).

Kryzanowski, Lawrence, and Gordon Roberts. “Canadian banking solvency, 1922-1940.” *Journal of Money, Credit and Banking* 25.3 (1993): 361-376.

Laeven, Luc, and Fabian Valencia. “Systemic banking crises database.” *IMF Economic Review* 61, no. 2 (2013): 225-270.

Madsen, Jakob “Trade barriers and the collapse of world trade during the Great Depression.” *Southern Economic Journal* (2001): 848-868.

Mehrez, Gil, and Daniel Kaufmann. “Transparency, liberalization, and financial crisis.” World Bank publication, (2000).

Merton, Robert C. “On the pricing of corporate debt: The risk structure of interest rates.” *Journal of Finance* 29, no. 2 (1974): 449-470.

Nakamura, Leonard, and Carlos Zarazaga. “Banking and Finance in Argentina in the Period 1900-35.” Working paper, (2001).

Nyberg, Peter, and Mika Vaihekoski. “A new value-weighted total return index for the Finnish stock market.” In *Research in international business and finance* 24.3 (2010): 267-283.

Reinhart, Carmen and Kenneth Rogoff, *This Time Is Different: Eight Centuries of Financial Folly*, Princeton University Press, (2009).

Reinhart, Carmen, and Kenneth Rogoff. “Recovery from financial crises: Evidence from 100 episodes.” *American Economic Review* 104.5 (2014): 50-55.

Da Rocha, Bruno T., and Solomos Solomou. “The effects of systemic banking crises in the inter-war period.” *Journal of International Money and Finance* 54 (2015): 35-49.

Romer, Christina “Changes in business cycles: evidence and explanations.” *Journal of Economic Perspectives* 13.2 (1999): 23-44.

Romer, Christina, and David Romer, “New evidence on the impact of financial crises in advanced countries,” *American Economic Review* 107 (2017), 3072-3118.

Schularick, Moritz and Alan Taylor, “Credit Booms Gone Bust: Monetary Policy, Leverage Cycles and Financial Crises, 1870–2008,” *American Economic Review*, 102 (2012), 1029-1061.

Schwartz, Anna. “Real and pseudo-financial crises.” In *Money in historical perspective*. University of Chicago Press, (1987): 271-288.

Shizume, Masato. "The Japanese economy during the interwar period: instability in the financial system and the impact of the world depression." In *The Gold Standard Peripheries*. Palgrave Macmillan, (2012): 211-228.

Sumner, William G. *A History of Banking in All the Leading Nations*. Vol. 1-4. (1896).

Waldenström, Daniel. “Swedish stock and bond returns, 1856–2012.” Working paper, (2014).

Figure 1: Sample historical data

This figure shows scans of three historical newspapers containing bank stock price data. Panel A shows Italian bank stock prices at the end of 1904 from the newspaper *La Stampa*. Panel B shows Dutch bank stock prices at the end of 1908 from the newspaper *De Telegraaf*. Panel C shows German bank stock prices at the end of 1873 from the newspaper *Berliner Boersen-Zeitung*. The full list of historical primary sources for bank stock prices and dividends can be found in Appendix Section I.

Panel A: Italian bank stock prices, 1904



BORSE ITALIANE.

Corsi di chiusura del 23 dicembre 1904.

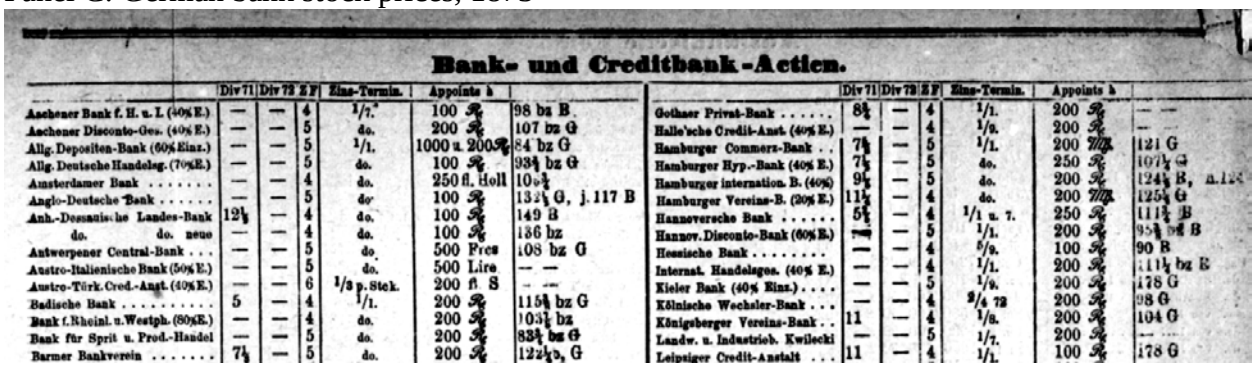
Valori	Roma	Milano	Genova	Firenze
Rend. It. 5 0/0 perc.	105 35	105 25	105 32 1/2	105 37
» f.m.	105 50	105 38	105 37 1/2	105 52 1/2
3 1/2 0/0 p.c.	103 42 1/2	— —	— —	103 35
» f.m.	103 35	103 32 1/2	103 37 1/2	103 30
Az. Banca d'It.	1132 —	1134 50	1135 50	— —
» Banca Comm.	628 —	628 50	628 —	— —
» Credito Ital.	611 —	611 —	612 —	— —
» Meridionali	736 —	736 —	738 —	738 —
» Mediterranee	— —	459 —	460 —	466 50
» Rubattino	— —	468 50	470 —	— —
» Terni	— —	1946 —	1949 —	— —
» Elba	— —	— —	— —	— —
» Savona	— —	— —	— —	— —
» Molini Alta It.	— —	— —	— —	— —
» Fridania	— —	— —	— —	— —
» Carburo Rom.	— —	— —	— —	— —

Panel B: Dutch bank stock prices, 1908



	V.K.	L.K.	H.K.
Amst. Liq.-Kas. dito...	115	—	—
Buit. Bankver. A-U. dito	64	—	—
Cent. Bankv. L. & N. dito	—	—	—
Cen. Cred.-Bank S.....4½	99¾	—	—
Cent. Werkg. Ris.-B. O.4½	100¾	100¾	—
Crediet-Vereen. A.....	101½	—	—
Disc. en Eff.b. 1&2ser.do.	112	—	—
Disc.-Mij te Rotterd. do.	—	—	—
Fin. Mij v. Zuid-Afr. do.	25	—	—
Geld. Credietvereenig.	165	—	—
Gemeente-Cred. Obl. 4	101½	—	—
dito dito dito 3½	96½	96⅛	—
dito dito dito 3	85¼	85⅜	—
dito dito dito 2½	—	—	—
Holl. Belegg. Cie. dito 4	98	—	—
Holl. Voorsch. Bk. S. b..	100	—	—
Incasso Bank Aand...	116½	—	—
Ind. Bnk. te Haarl. dito	—	—	—
Kas Vereeniging Aand.	142	142½	—

Panel C: German bank stock prices, 1873



Bank- und Creditbank-Actien.

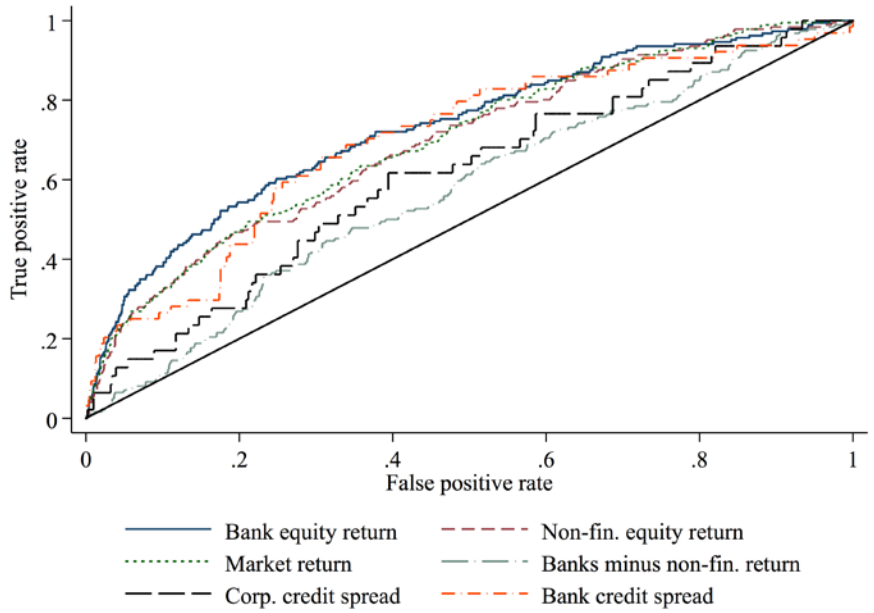
	Div 71	Div 72	E F	Einz.-Termin.	Appoints à	
Aachener Bank f. H. u. L. (40% E.)	—	—	4	1/7.	100 ℛ	98 bz B
Aachener Disconto-Ges. (40% E.)	—	—	5	do.	200 ℛ	107 bz G
Allg. Depositen-Bank (60% Einz.)	—	—	5	1/1.	1000 u. 200 ℛ	84 bz G
Allg. Deutsche Handelsg. (70% E.)	—	—	5	do.	100 ℛ	93¾ bz G
Amsterdamer Bank	—	—	4	do.	250 fl. Holl	10⅝
Anglo-Deutsche Bank	—	—	5	do	100 ℛ	132½ G, j. 117 B
Anh.-Dessauische Landes-Bank	12½	—	4	do.	100 ℛ	149 B
do. do. neue	—	—	4	do.	100 ℛ	136 bz
Antwerpener Central-Bank ...	—	—	5	do.	500 Frcs	108 bz G
Austro-Italienische Bank (50% E.)	—	—	5	do.	500 Lire	— —
Austro-Türk. Cred.-Anst. (40% E.)	—	—	6	1/2 p. Stck.	200 fl S	— —
Badische Bank	5	—	4	1/1.	200 ℛ	115¾ bz G
Bank f. Rheinl. u. Westph. (80% E.)	—	—	4	do.	200 ℛ	103½ bz
Bank für Sprit u. Prod.-Handel	—	—	5	do.	200 ℛ	83¾ bz G
Barmer Bankverein	7½	—	5	do.	200 ℛ	122½ G

	Div 71	Div 72	E F	Einz.-Termin.	Appoints à	
Gothaer Privat-Bank	8¾	—	4	1/1.	200 ℛ	— —
Halle'sche Credit-Anst. (40% E.)	—	—	4	1/9.	200 ℛ	—
Hamburger Commerz-Bank ..	7⅛	—	5	1/1.	200 ℛ	121 G
Hamburger Hyp.-Bank (40% E.)	7⅛	—	5	do.	250 ℛ	107½ G
Hamburger internation. B. (40%)	9⅛	—	5	do.	200 ℛ	124⅛ B, a. 124
Hamburger Vereins-B. (20% E.)	11½	—	4	do.	200 ℛ	125⅛ G
Hannoversche Bank	5⅛	—	4	1/1 u. 7.	250 ℛ	111½ B
Hannov. Disconto-Bank (60% E.)	7⅛	—	5	1/1.	200 ℛ	95⅛ bz B
Hessische Bank	—	—	4	5/9.	100 ℛ	90 B
Internat. Handelsges. (40% E.)	—	—	4	1/1.	200 ℛ	111½ bz B
Kieler Bank (40% Einz.)	—	—	5	1/9.	200 ℛ	178 G
Kölnische Wechsler-Bank ...	—	—	4	2/4 72	200 ℛ	98 G
Königsberger Vereins-Bank ..	11	—	4	1/9.	200 ℛ	104 G
Landw. u. Industrieb. Kwilecki	—	—	5	1/7.	200 ℛ	— —
Leipziger Credit-Anstalt ...	11	—	4	1/1.	100 ℛ	178 G

Figure 2: Bank equity returns provide the best real-time signal of narrative banking crises: ROC analysis

This figure presents receiver operator curves (ROC) to understand which variables best coincide with banking crises from the *Joint Crisis List*. The higher the ROC curve, the better the variable coincides with *Joint Crisis List* episodes. Panel A compared the ROC curve constructed from bank equity returns with the ROC curves constructed using other financial variables, while Panel B performs the comparison relative to macroeconomic variables. Panel A uses the sample for which bank equity returns, non-financial equity returns, and market returns are non-missing. Panel B uses the sample for which bank equity returns, unemployment rate change, GDP growth, and credit contraction are non-missing.

Panel A: Bank equity compared with other financial variables



Panel B: Bank equity compared with macroeconomic variables

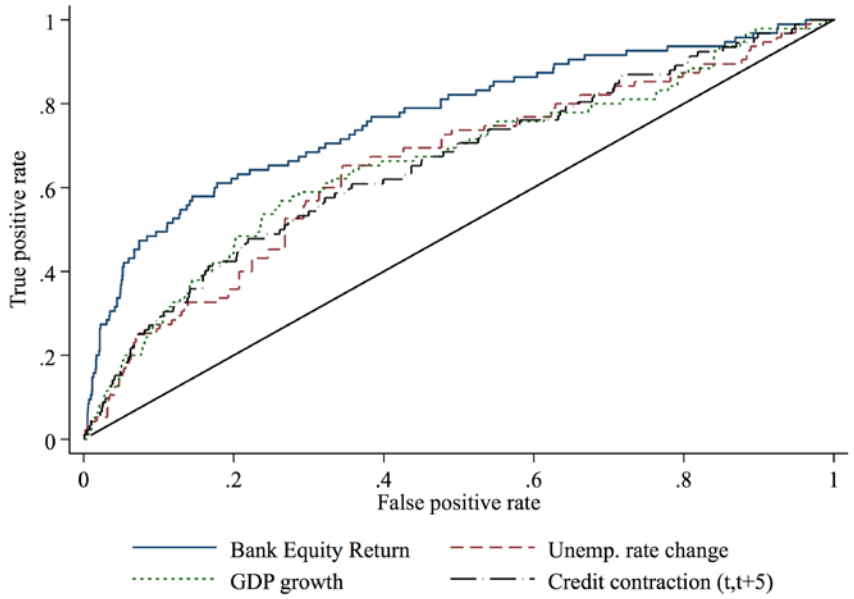
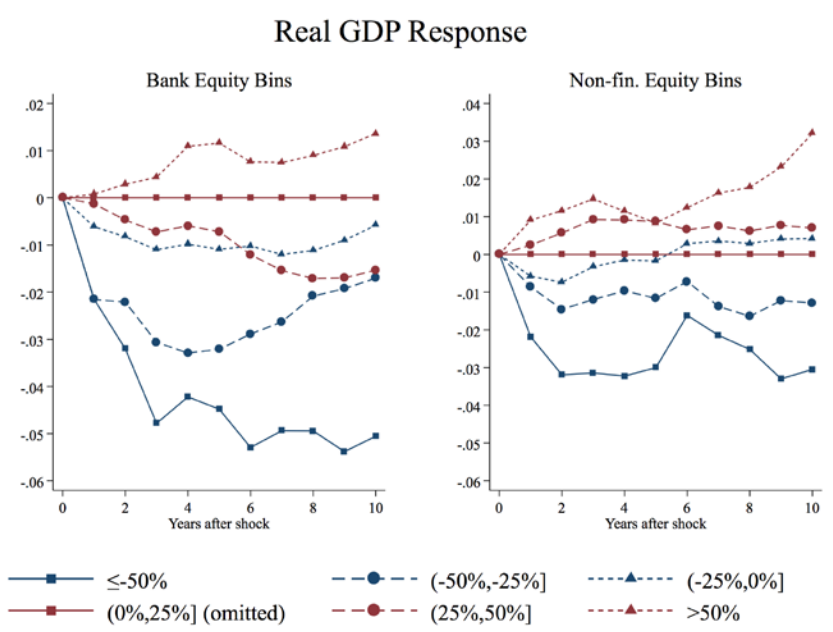


Figure 3: Bank equity declines and macroeconomic outcomes

This figure plots the impact of bank equity and non-financial equity returns on real GDP (Panel A) and bank credit-to-GDP (Panel B). The responses are estimated using Equation 2, with controls for year fixed effects and lags in GDP growth and the change in credit-to-GDP. The x-axis is time in years, and the y-axis is Real GDP or Bank Credit-to-GDP relative to the omitted category of returns between 0% and 25%. The dashed lines represent 95% confidence intervals based on standard errors dually clustered on country and year.

Panel A: Real GDP



Panel B: Credit-to-GDP

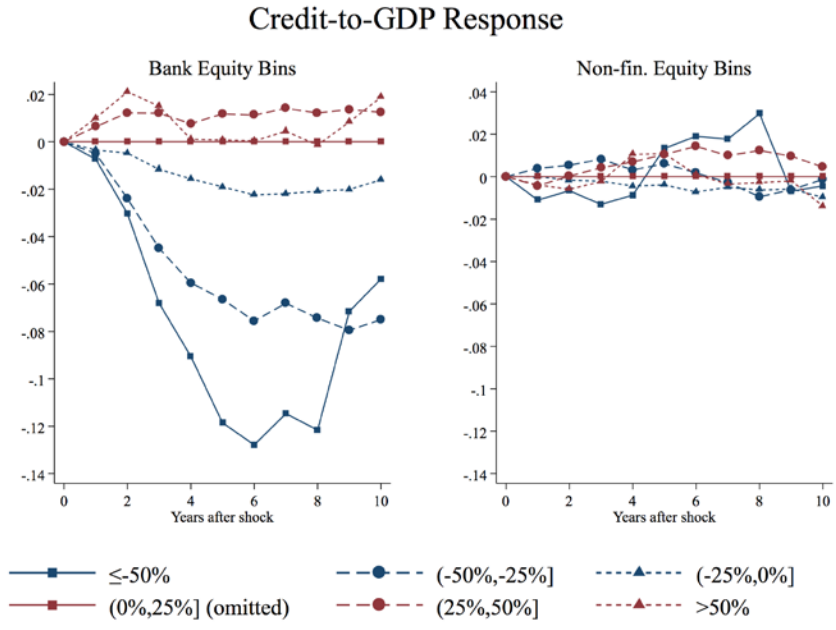
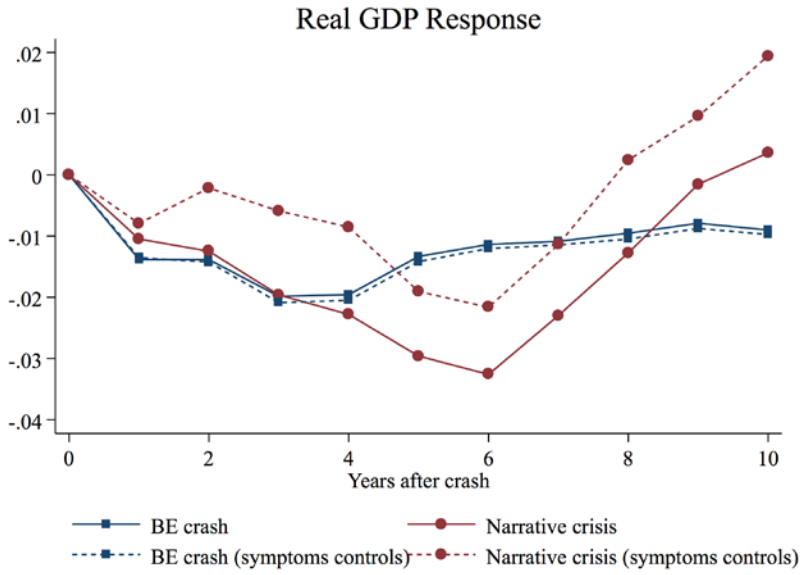


Figure 4: The information content of bank equity versus narrative approaches

This figure presents responses of real GDP (panel A) and credit-to-GDP (panel B) to bank equity declines and "narrative crisis" episodes. *Bank equity decline* is an indicator that equals one if country-year experiences a 30% drop in the bank equity total returns index. *Narrative crisis* is an indicator that equals one if a country-year is classified as a crisis based on our *Revised Crisis List*. The responses in the solid lines are estimated controlling for country and year fixed effects; contemporaneous credit-to-GDP change, real GDP growth, and a non-financial decline; and three lags in all variables. The dashed lines represent a separate specification that also controls for symptoms of financial crises (bank nationalization, significant liquidity support, and government equity injection).

Panel A: Impact of bank equity declines and narrative crises on real GDP



Panel B: Impact of bank equity declines and narrative crises on credit-to-GDP

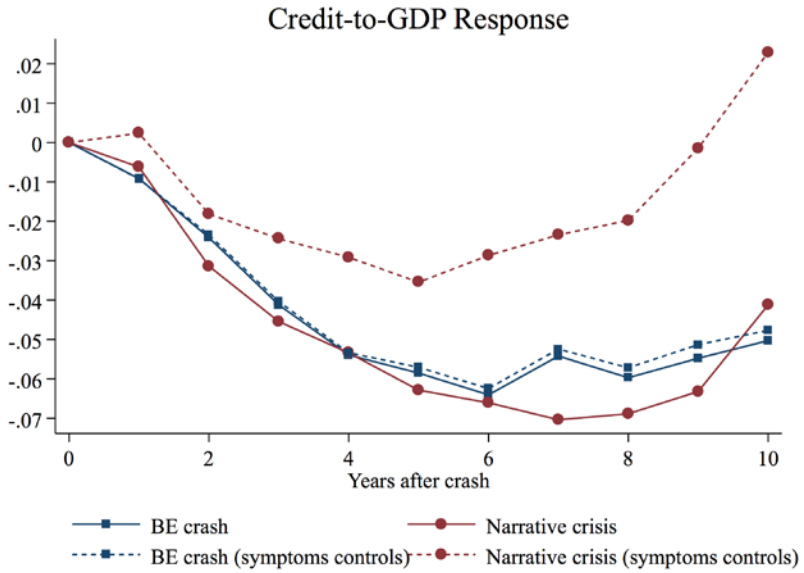


Figure 5: Equity returns and credit spreads around the U.S. 2007-8 banking crisis

This figure plots equity total return indexes and credit spreads around the U.S. 2007-8 banking crisis. The bank equity index is in blue, the nonfinancial equity index is in red, corporate credit spreads are in black (dashed is the AAA 10-year Corporate minus 10-year Treasury yield, solid is the BAA minus AAA 10-year Corporate spread), and the 3-month LIBOR minus OIS spread is in green. The scale on the left corresponds to equity returns, and the scale on the right corresponds to bond yield spreads.

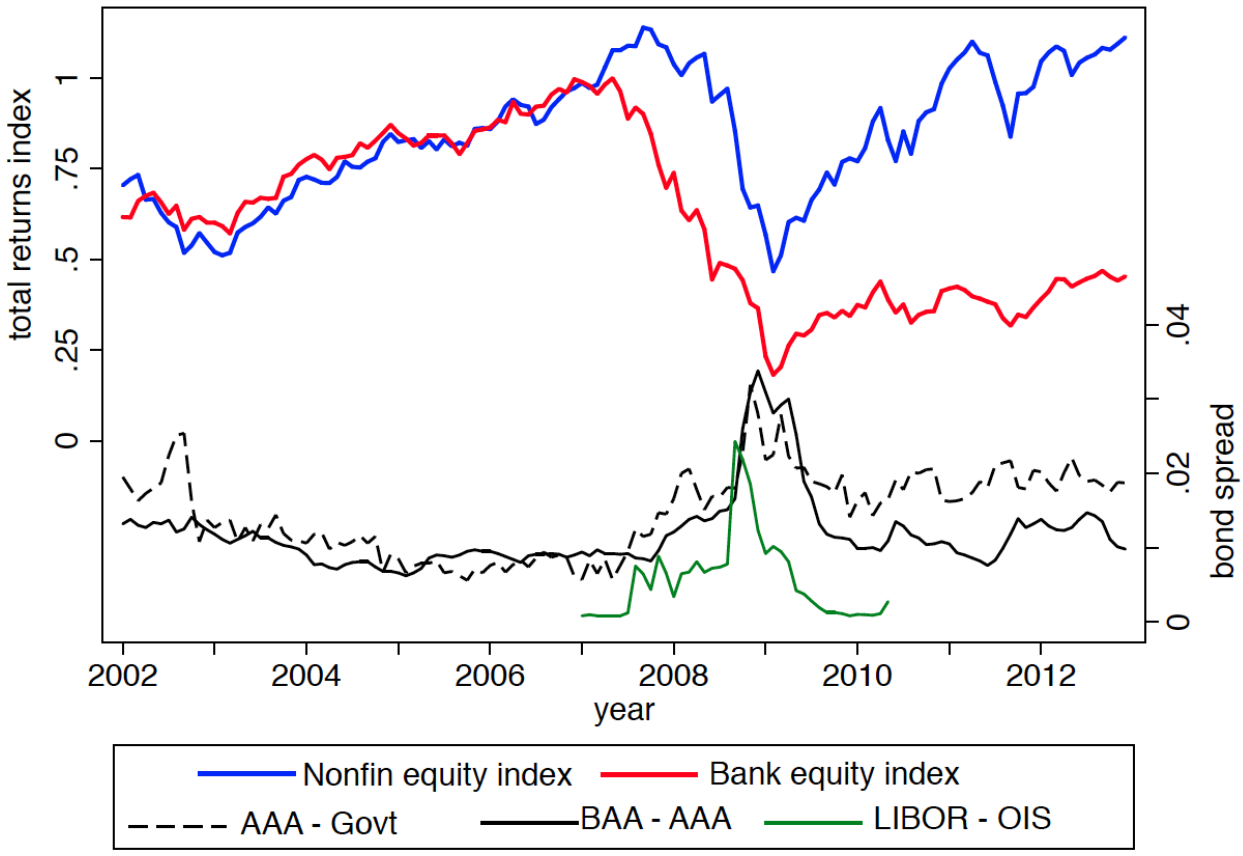
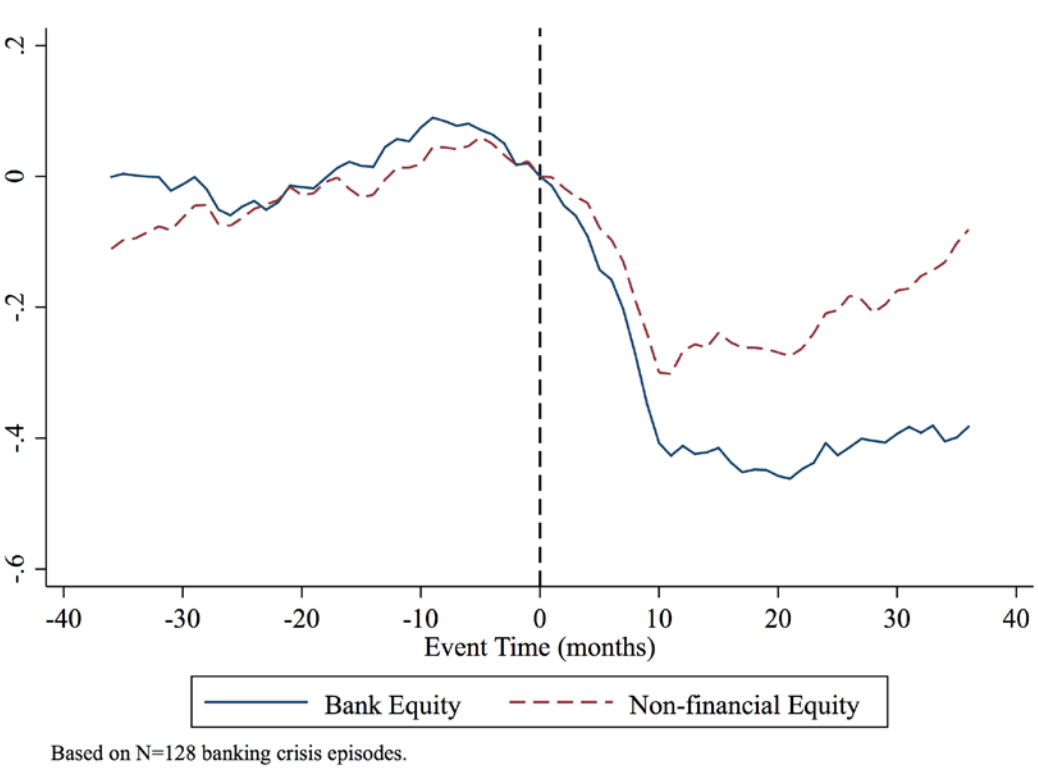


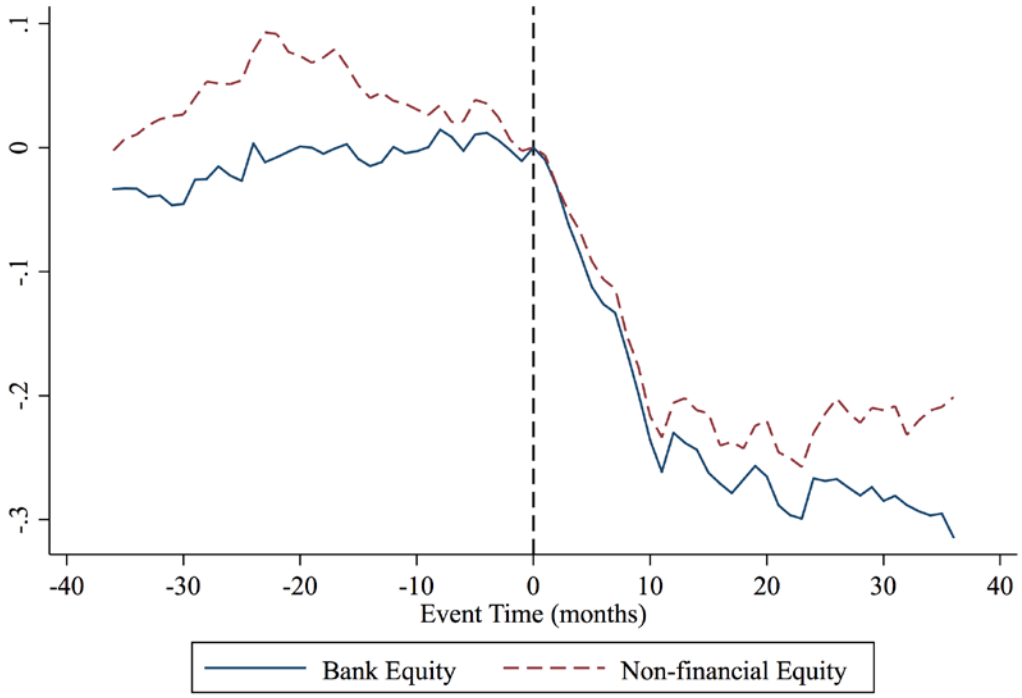
Figure 6: Timing of bank versus nonfinancial equity declines

This figure compares the timing of bank stocks (in blue) and nonfinancial stocks (in red) for banking crises on the *Revised Crisis List*. Event time is defined such as January of the crisis year for each crisis episode. The stock indexes are computed by averaging the cumulative log returns (relative to t = 0) across all banking crisis episodes. Panel A is for the full sample (1870 – 2016), Panel B is for the prewar sample (1870-1945), and Panel C is for the postwar sample (1946-2016).

Panel A: Full sample

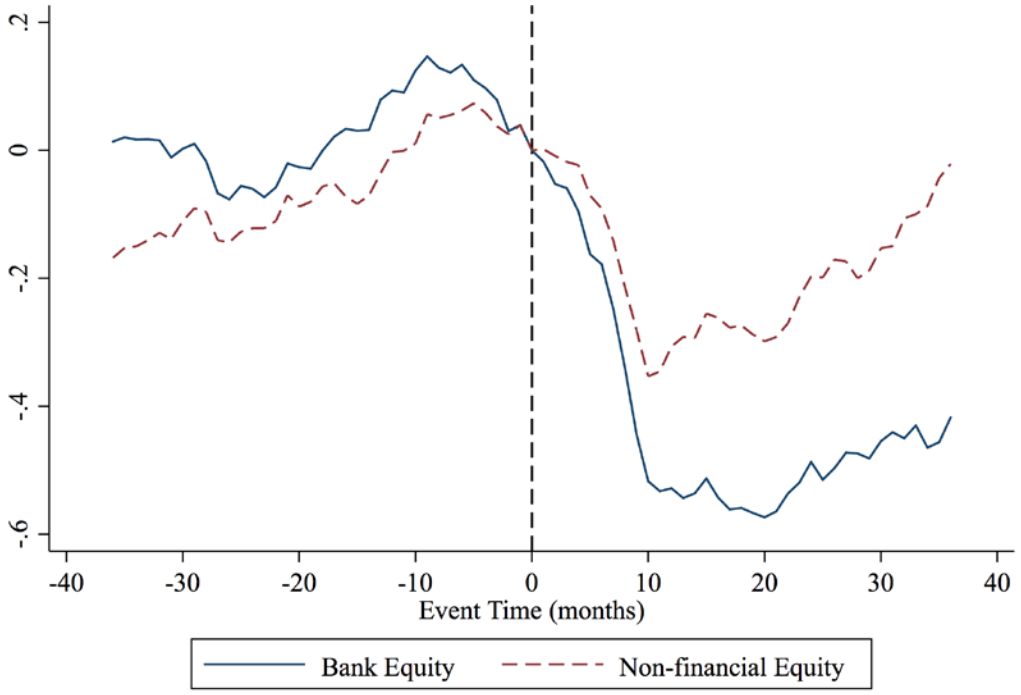


Panel B: Pre-war



Based on N=50 banking crisis episodes.

Panel C: Post-war



Based on N=78 banking crisis episodes.

Table 1: Banking crises in Germany

This table illustrates disagreement in the literature regarding the occurrence of banking crises, looking at the case of Germany (similar results hold for other countries, see Appendix Table 2). The following table lists the occurrence of banking crises according to six prominent papers. Years listed correspond to the starting year (and quarter, if available) of the banking crisis, according to each paper. A "0" means that the source reports no banking crisis in a given year, while a blank cell means that the crisis is not covered in the sample period (i.e. no information provided either way as to whether a banking crisis occurred).

Legend:
YYYY = starting year of banking crisis
0 = "no crisis"
[blank] = outside of sample

Reinhart Rogoff	Schularick Taylor	Laeven Valencia	Bordo	Caprio Klingebiel	Demirguc-Kunt & Detragiache
0	1873				
1880	0				
1891	1891		0		
1901	1901		1901		
0	1907		0		
1925	0		0		
1929	1931		1931		
1977	0	0	0	late 1970s	
2008	2008	2008		0	

Table 2: Symptoms and severity of banking crises

This table shows that bank equity peak-to-trough declines during banking crises are correlated with the "symptoms" and severity of banking crises. The table reports estimates from Equation 1, which regresses various dependent variables (in the various columns) on bank equity peak-to-trough returns. Each observation is a banking crisis from the *Joint Crisis List*, which covers 46 countries over the period 1870-2016; the sample size of different columns varies due to data available of the dependent variable. Data sources for the dependent variables are described in Section II of the text.

Panel A: Symptoms of banking crises

	Deposit runs	Decline in deposits (pre-war only)	Significant bank closures	Failed banks (% of total bank assets)	Largest banks failing	NPL at peak	Significant liability guarantees	Significant liquidity support	Banks nationalized	Govt equity injections
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)
Bank equity decline	-0.623***	0.287***	-0.176	-0.411**	-0.431*	-0.152*	-0.369	-0.817***	-0.597**	-1.298***
	[-3.531]	[2.678]	[-1.234]	[-2.289]	[-1.735]	[-1.744]	[-1.498]	[-3.699]	[-2.367]	[-4.574]
Post-1945 dummy	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
Adj. R^2 (within)	0.109	0.119	0.085	0.205	0.041	0.049	0.125	0.165	0.293	0.377
N	105	55	149	62	123	62	126	135	101	85

Panel B: Severity of banking crises

	Real GDP (peak-to-trough decline)	Real GDP growth (%.-pt. decline, peak-to-trough)	Real GDP growth (max deviation from trend)
	(1)	(2)	(3)
Bank equity decline	0.131***	0.115***	0.082***
	[5.698]	[5.772]	[4.834]
Post-1945 dummy	✓	✓	✓
Adj. R^2 (within)	0.141	0.138	0.098
N	198	198	198

Panel C: Other macroeconomic measures

	Real consumption per capita	Investm. to GDP	Broad money	(minus) Govt debt to GDP	Total loans	Total mortgages	House prices
	(1)	(2)	(3)	(4)	(5)	(6)	(7)
Bank equity decline	0.100**	0.047*	0.303***	0.217**	0.213***	0.282***	0.122
	[2.260]	[1.955]	[3.755]	[2.305]	[3.301]	[3.880]	[1.364]
Post-1945 dummy	✓	✓	✓	✓	✓	✓	✓
Adj. R^2 (within)	0.206	0.030	0.150	0.053	0.140	0.125	0.016
N	115	110	111	142	105	107	91

Table 3: Bank equity declines and subsequent GDP and credit growth

This table shows that bank equity declines are highly correlated with our narrative crisis chronology and predict lower subsequent GDP and credit growth. Controls refers to contemporaneous real GDP growth and credit-to-GDP change, as well as three lags in bank equity decline, non-financial equity decline, credit-to-GDP change, and real GDP growth. Standard errors are dually clustered on country and year.

Panel A: Real GDP growth				
	Real GDP growth$_{t+1}$	Real GDP growth$_{t+1}$	Real GDP growth$_{t,t+3}$	Real GDP growth$_{t,t+3}$
	(1)	(2)	(3)	(4)
Bank equity decline	-0.022***	-0.023***	-0.032***	-0.025***
	[-3.52]	[-5.40]	[-3.69]	[-3.64]
Non-financial equity decline	-0.017***	-0.019***	-0.021**	-0.019**
	[-3.16]	[-3.82]	[-2.02]	[-2.06]
Country fixed effects	✓	✓	✓	✓
Controls		✓	✓	✓
Year fixed effects				✓
Adj. R^2	0.014	0.1	0.043	0.26
Observations	3797	3046	2960	2960

Panel B: Credit-to-GDP change				
	(Credit / GDP) change$_{t+1}$	(Credit / GDP) change$_{t+1}$	(Credit / GDP) change$_{t,t+3}$	(Credit / GDP) change$_{t,t+3}$
	(1)	(2)	(3)	(4)
Bank equity decline	-0.017***	-0.011**	-0.057***	-0.054***
	[-2.71]	[-2.31]	[-4.92]	[-4.93]
Non-financial equity decline	0.0086*	0.0099**	0.014	0.0055
	[1.86]	[2.51]	[1.40]	[0.52]
Country fixed effects	✓	✓	✓	✓
Controls		✓	✓	✓
Year fixed effects				✓
Adj. R^2	-0.0084	0.18	0.1	0.17
Observations	3296	3026	2924	2924

Table 4: The information content of bank equity versus narrative approaches

This table compares the predictive effect of bank equity declines and narrative crises for GDP growth (Panel A) and the change in credit-to-GDP (Panel B). Narrative crisis is an indicator that equals one if a country-year is a narrative crisis based on the revised crisis list. All columns control for country fixed effects, and three lags of bank equity decline, non-financial equity decline, narrative crisis, GDP growth, and credit-to-GDP change. Columns 2 and 4 include year fixed effects. Columns 3 and 4 control for specific symptoms of banking crises.

Panel A: Real GDP growth

	Real GDP $growth_{t,t+3}$ (1)	Real GDP $growth_{t,t+3}$ (2)	Real GDP $growth_{t,t+3}$ (3)	Real GDP $growth_{t,t+3}$ (4)
Bank equity decline	-0.024***	-0.020***	-0.024***	-0.021***
	[-3.20]	[-2.95]	[-3.30]	[-3.10]
Non-financial equity decline	-0.020**	-0.019**	-0.019*	-0.018**
	[-1.97]	[-2.01]	[-1.92]	[-2.03]
Narrative crisis	-0.031**	-0.020*	-0.015	-0.0059
	[-2.08]	[-1.78]	[-0.77]	[-0.40]
Control for symptoms of crises			✓	✓
Country fixed effects	✓	✓	✓	✓
Controls	✓	✓	✓	✓
Year fixed effects		✓		✓
Adj. R^2	0.047	0.26	0.049	0.27
Observations	2960	2960	2960	2960

Panel B: Credit to GDP

	(Credit / GDP) $change_{t,t+3}$ (1)	(Credit / GDP) $change_{t,t+3}$ (2)	(Credit / GDP) $change_{t,t+3}$ (3)	(Credit / GDP) $change_{t,t+3}$ (4)
Bank equity decline	-0.042***	-0.041***	-0.042***	-0.040***
	[-4.29]	[-4.78]	[-4.46]	[-4.78]
Non-financial equity decline	0.014	0.0061	0.016*	0.0079
	[1.61]	[0.63]	[1.95]	[0.86]
Narrative crisis	-0.052***	-0.045**	-0.025	-0.024
	[-2.65]	[-2.41]	[-1.15]	[-1.16]
Control for symptoms of crises			✓	✓
Country fixed effects	✓	✓	✓	✓
Controls	✓	✓	✓	✓
Year fixed effects		✓		✓
Adj. R^2	0.12	0.18	0.12	0.19
Observations	2924	2924	2924	2924

Table 5: Timing of bank equity declines

This table analyzes when crises are first detected, comparing bank equity declines to nonfinancial equity declines. A bank or non-financial equity decline is recorded as the first month in which the equity index falls a cumulative 30% in log real total returns from its peak. We analyze the timing of events in 3-year pre and post window around *Revised Crisis List* episodes. In Panel A, we record for each banking crisis the average time difference in months between picking up a bank equity decline relative to a nonfinancial equity decline (Column 1); in addition, we also record the average time difference in months between a bank equity peak and a nonfinancial equity peak (Column 2), and the average duration of a bank equity decline from peak to trough (Column 3). Panel B performs a similar analysis but compares the timing of the bank equity decline with credit spread indicators (bank credit spread spikes and non-financial corporate credit spread spikes, where a credit spread spike is recorded as the first month in which credit spreads increase at least 1 or 2 percentage points above their pre-crisis average levels). In all these analyses, the time difference is positive if the bank equity decline is recorded before the other event and negative if after the event. For each column, a t-statistic is calculated under the null hypothesis that the average time different is zero. As an alternative non-parametric test, we also count in how many of the banking crisis the bank equity decline is recorded first ("pos"), the other event is recorded first ("neg"), or both events are recorded in the same month ("zero"); we then calculate the fraction of times that the bank equity decline happens first ("pos / (pos + neg)") and calculate a p-value under the null hypothesis that the bank equity decline happening first is Bernoulli-distributed with parameter 0.50.

Panel A: Timing of bank vs. nonfinancial equity declines

	Before non-fin. eq. decline	Bank equity peak before nonfin equity peak	Duration of bank equity decline
Avg. (in months, signed)	1.84**	1.71**	29.11***
t-stat	2.24	2.25	15.50
N	127	132	117
Pos	64	58	Duration ≥ 12 mo. = 107 episodes
Zero	17	36	
Neg	46	38	Duration < 12 mo. = 10 episodes
Pos / (Pos + Neg)	58.2%**	60.4%**	% Duration ≥ 12 mo. = 91.5%***
p-value	0.035	0.016	0.000

Panel B: Timing relative to credit spread spikes

	Before 2% spike in bank credit spread	Before 1% spike in bank credit spread	Before 2% spike in corp credit spread	Before 1% spike in corp credit spread
Avg. (in months, signed)	6.37***	2.91**	10.30***	5.00**
t-stat	5.31	2.42	5.22	2.37
N	54	56	23	23
Pos	40	22	2	5
Zero	7	5	0	3
Neg	7	29	21	15
Pos / (Pos + Neg)	85.1%***	56.9%	91.3%***	75.0%**
p-value	0.000	0.201	0.000	0.021

Table 6: Timing of bank equity declines and its shift over time

This table shows that bank equity is more likely to pick up the crisis before non-financial equity in post-war crises and in advanced economy crises. *Post-war* is an indicator that takes the value of one when the year is after 1945. *Emerging market* is an indicator that takes the value of one for emerging market countries. In columns 1 through 3, the dependent variable is equal to one when the bank equity index declines (defined as a cumulative drop of 30% or more) declines before the non-financials index, zero when the peak is simultaneous, and minus one when the non-financials index declines first. In column 4, the dependent variable is equal to one when the bank equity index peaks first, zero when the peak is simultaneous, and minus one when the non-financials index peaks first. The regression is estimated over the set of *Revised Crisis List* episodes for which monthly bank and nonfinancial stock return data is available.

	Dependent variable: Bank equity declines first			Dependent variable: Bank equity peaks first
	(1)	(2)	(3)	(4)
Post-war	0.273***	0.345***	0.252*	0.264**
	[2.97]	[3.59]	[1.84]	[2.53]
Emerging market		-0.227**	-0.131	-0.258**
		[-2.17]	[-0.93]	[-2.28]
Adj. R^2	0.061	0.098	0.042	0.068
N	110	110	82	96

Table 7: Newly identified and spurious banking crises

This table lists examples of several newly identified banking crises in Panel A and spurious banking crises in Panel B. These lists are based on the criteria for banking crises in Section IV.A, which uses both bank equity returns and narrative evidence on the "symptoms" of crises. The starting year of the crisis is taken from the *Joint Crisis List*, and the bank equity return is the peak-to-trough log real total return.

Panel A: Newly-identified banking crises

Country	Starting year of crisis	Bank equity return
Austria	2011	-0.509
Belgium	1876	-0.565
	2011	-0.755
Chile	1878	
	1931	-0.356
Colombia	1931	-0.675
Czech	1923	
Denmark	2011	-0.444
Egypt	1914	-0.407
France	2011	-0.512
Germany	1914	
	2011	-0.419
Greece	2010	-0.961
Hong Kong	1891	-0.565
	1965	-0.197
Hungary	1873	-0.518
Iceland	1920	-0.875
	1930	
Ireland	2011	-0.908
Italy	2011	-0.601
Japan	1922	-0.404
Luxembourg	2012	-0.914
Netherlands	1931	-0.418
	2011	-0.523
Peru	1914	-0.612
	1931	-0.373
Portugal	1876	
	2011	-0.725
Spain	2010	-0.411
Switzerland	1914	
Turkey	1914	-0.654
Average		**-0.572**

Panel B: Spurious banking crises

Country	Starting year of crisis	Bank equity return
Argentina	1885	0
	1985	
Australia	1931	-0.230
Belgium	1870	-0.031
	1925	-0.193
Brazil	1897	0
	1926	0
	1963	
	1985	
Canada	1873	0
	1906	0
	1912	-0.002
Chile	1890	-0.254
Czech	1931	-0.099
Denmark	1902	0
	1914	-0.296
	1931	-0.102
Finland	1939	-0.111
France	1871	-0.364
	1904	0
	1907	-0.049
	1939	-0.121
Germany	1880	0
	1907	-0.051
	1977	-0.117
India	1908	0
	1929	
India (cont.)	1947	
Israel	1977	0
Italy	1935	
Japan	1871	
	1914	-0.232
	1917	-0.239
Korea	1986	0
Mexico	1992	0
Netherlands	1893	0
	1897	0
Norway	1914	
	1927	0
	1936	-0.209
Portugal	1986	
Singapore	1982	-0.275
South Africa	1877	-0.004
	1977	-0.153
	1989	0
Sweden	1897	-0.183
Switzerland	1910	0
Turkey	1991	-0.634
U.K.	1908	-0.011
	1984	0
	1991	-0.147
	1995	-0.159
U.S.	1914	-0.158
Average		**-0.101**

Panel C: A revised chronology of banking crises in 46 countries, 1870-2016

Country	Starting year of crisis	Bank equity return
Argentina	1890	-0.307
	1914	-0.473
	1931	-0.819
	1934	-0.563
	1980	
	1989	
	1995	-0.305
	2001	-0.656
Australia	1893	-0.469
	1989	-0.281
Austria	1873	-0.715
	1924	-0.240
	1929	-0.566
	2008	-0.673
	2011	-0.509
Belgium	1876	-0.565
	1885	0
	1914	
	1929	-0.831
	1939	-0.511
	2008	-0.842
	2011	-0.755
Brazil	1890	-0.275
	1900	0
	1914	-0.374
	1923	-0.131
	1929	-0.038
	1990	
	1994	
Canada	1907	-0.081
	1923	-0.426
	1983	-0.164
Chile	1878	
	1898	-0.003
	1907	
	1914	
	1925	
	1931	-0.356
	1976	0.000
Chile (cont.)	1981	-0.837
Colombia	1931	-0.675
	1982	-0.831
	1998	-0.813
Czech	1923	
	1991	
Denmark	1877	-0.207
	1885	-0.043
	1907	-0.269
	1921	-0.347
	1987	-0.425
	2008	-0.739
	2011	-0.444
Egypt	1907	-0.132
	1914	-0.407
	1931	-0.608
	1980	
	1990	
Finland	1877	
	1900	
	1921	-0.569
	1931	-0.252
	1991	-0.814
France	1882	-0.456
	1889	-0.106
	1914	-0.475
	1930	-0.571
	1994	-0.246
	2008	-0.640
	2011	-0.512
Germany	1873	-0.371
	1891	-0.230
	1901	-0.050
	1914	
	1925	-0.420
	1929	-0.489
	2008	-0.728
	2011	-0.419

Country	Starting year of crisis	Bank equity return
Greece	1931	-0.727
	1991	-0.391
	2008	-0.671
	2010	-0.961
Hong Kong	1891	-0.565
	1965	-0.197
	1982	-0.445
	1998	-0.464
Hungary	1873	-0.518
	1931	
	1991	-0.398
	2008	-0.671
Iceland	1920	-0.875
	1930	
	1985	
	1993	
	2008	-0.963
India	1913	-0.249
	1921	-0.495
	1993	-0.561
Indonesia	1992	-0.659
	1997	-0.880
Ireland	2007	-0.918
	2011	-0.908
Israel	1983	-0.499
Italy	1873	-0.237
	1887	-0.348
	1891	-0.453
	1907	-0.240
	1914	-0.333
	1921	-0.550
	1930	-0.073
	1990	-0.397
	2008	-0.575
	2011	-0.601
Japan	1882	
	1890	
Japan (cont.)	1901	-0.221
	1907	-0.377
	1920	-0.405
	1922	-0.405
	1923	-0.157
	1927	-0.168
	1990	-0.546
	1997	-0.605
Korea	1983	-0.326
	1997	-0.726
Luxembourg	2008	-0.474
	2012	-0.914
Malaysia	1985	-0.368
	1997	-0.686
Mexico	1883	
	1893	-0.325
	1908	-0.029
	1913	-0.596
	1921	
	1929	-0.839
	1981	
	1994	-0.602
Netherlands	1907	-0.083
	1914	-0.093
	1921	-0.251
	1931	-0.418
	1939	-0.366
	2008	-0.562
	2011	-0.523
New Zealand	1887	-0.549
	1894	-0.337
	1987	-0.892
Norway	1898	
	1921	-0.710
	1931	0
	1987	-0.464
Peru	1872	
	1914	-0.612

Country	Starting year of crisis	Bank equity return
Peru (cont.)	1931	-0.373
	1983	-0.980
	1999	-0.396
Philippines	1981	-0.719
	1997	-0.687
Portugal	1876	
	1890	
	1920	-0.643
	1923	-0.684
	1931	-0.597
	2008	-0.613
	2011	-0.725
Russia	1875	-0.188
	1896	-0.401
	1995	
	1998	-0.751
	2008	-0.723
Singapore	(no crises)	
South Africa	1881	-0.270
	1890	-0.062
	1984	-0.492
Spain	1882	-0.349
	1890	-0.124
	1913	
	1920	-0.140
	1924	-0.222
	1931	-0.336
	1977	-0.814
	2008	-0.466
	2010	-0.411
Sweden	1878	
	1907	-0.135
	1922	-0.395
	1931	-0.431
	1991	-0.787
	2008	-0.519
Switzerland	1870	-0.418
	1914	
	1921	-0.432
	1931	-0.559
	1991	-0.326
	2008	-0.676
Taiwan	1923	
	1927	
	1983	
	1995	-0.307
	1997	-0.557
Thailand	1979	-0.461
	1983	0
	1997	-0.734
Turkey	1914	-0.654
	1931	-0.719
	1982	-0.409
	1994	-0.203
	2000	-0.622
U.K.	1878	-0.132
	1890	-0.128
	1914	
	1974	-0.737
	2007	-0.707
U.S.	1873	-0.172
	1884	0
	1890	0
	1893	-0.290
	1907	-0.334
	1929	-0.654
	1984	-0.263
	1990	-0.332
	2007	-0.676
Venezuela	1978	-0.340
	1993	-0.839
	2009	-0.614

Table 8: Comparison of banking crisis chronologies

This table compares quantities across the various banking crisis chronologies. Panel A compares averages of Added episodes (newly-uncovered banking crises), Deleted episodes (spurious banking crises), Revised Chronology episodes, and Revised Chronology episodes having a bank equity decline of less than -30%. Panel B and C compare episodes from Reinhart-Rogoff's and Laeven-Valencia's chronologies to episodes on the *Revised Chronology List* and to the episodes on the *Revised Chronology List* having a bank equity decline of less than -30%. Differences in averages are computed, along with t-statistic in brackets (which is computed using a pooled standard deviation across the differenced groups). The Laeven-Valencia comparison is relative to the *Revised Chronology List* taken over a comparable sample period (1970-2012).

Panel A: Summary statistics of added, deleted, and Revised Chronology episodes

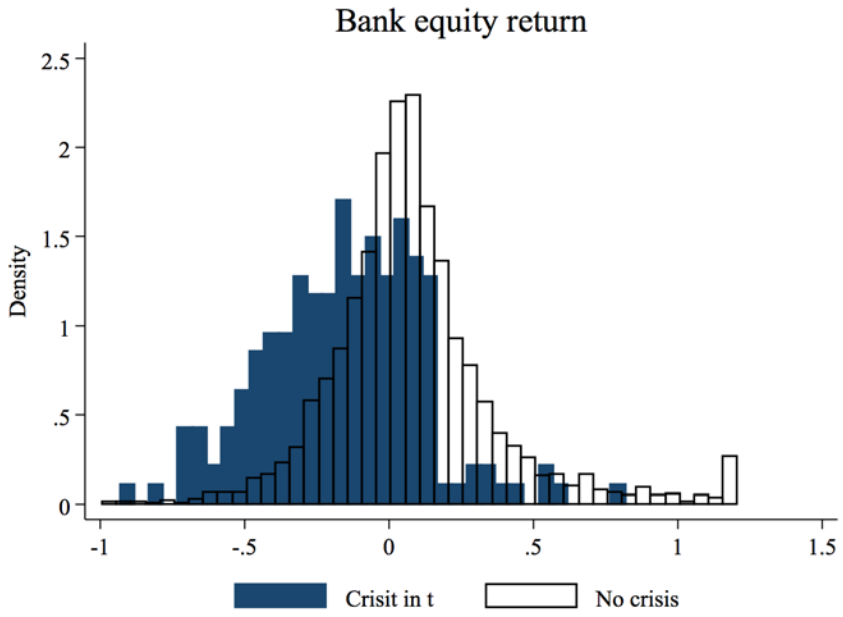
	Added	Deleted	Revised Chronology	Revised Chronology (Bank equity decline < -30%)
Bank equity decline	-0.572	-0.101	-0.344	-0.446
Abnormal bank equity decline	-0.407	-0.159	-0.352	-0.443
Bank market cap decline	-0.530	-0.077	-0.424	-0.528
Real GDP decline (pk to tr)	-0.074	-0.024	-0.052	-0.060
Real GDP growth decline (pk to tr)	-0.083	-0.055	-0.084	-0.089
Real GDP growth (max dev from trend)	-0.071	-0.037	-0.059	-0.063
Failed banks (% of total bank assets)	0.322	0.025	0.292	0.301
NPL at peak	0.113	0.046	0.152	0.149
Decline in deposits (pre-war only)	-0.143	-0.056	-0.191	-0.199
Significant liability guarantees	1.000	0.346	0.547	0.631
Significant liquidity support	0.750	0.273	0.750	0.817

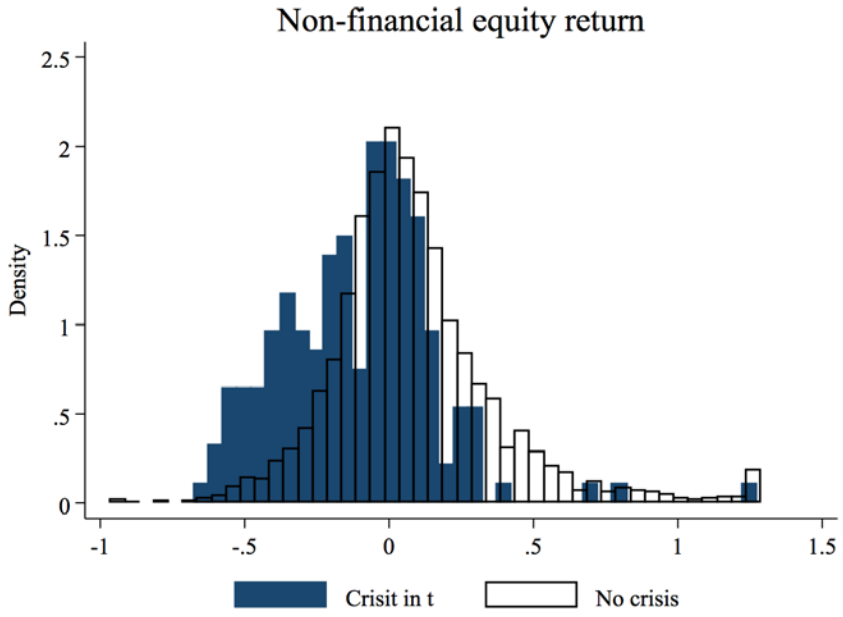
Panel B: Comparison of Reinhart and Rogoff episodes with Revised Chronology episodes

	Reinhart Rogoff	Difference with Revised Chronology		Difference with Revised Chronology (Bank equity decline < -30%	
Bank equity decline	-0.288	0.056	[6.17]	0.158	[17.80]
Abnormal bank equity decline	-0.310	0.043	[3.01]	0.134	[8.57]
Bank market cap decline	-0.326	0.098	[5.07]	0.201	[10.37]
Real GDP decline (pk to tr)	-0.045	0.008	[2.40]	0.015	[4.27]
Real GDP growth decline (pk to tr)	-0.080	0.005	[1.82]	0.009	[3.23]
Real GDP growth (max dev from trend)	-0.055	0.005	[2.19]	0.009	[3.53]
Failed banks (% of total bank assets)	0.252	-0.041	[-1.89]	-0.049	[-2.05]
NPL at peak	0.144	-0.008	[-0.84]	-0.006	[-0.54]
Decline in deposits (pre-war only)	-0.164	0.028	[2.01]	0.035	[2.35]
Significant liability guarantees	0.504	-0.043	[-1.39]	-0.127	[-3.66]
Significant liquidity support	0.681	-0.069	[-2.55]	-0.136	[-4.51]

Appendix Figure 1: Distribution of bank and non-financial equity returns

This figure presents histograms of bank equity and non-financial equity returns during years identified by the *Joint Crisis List* as crisis years and other years. Bank and non-financial equity returns are annual total returns. The figure shows that the bank equity return distribution for *Joint Crisis List* years relative to non-crisis years is shifted further left and more skewed left. These patterns are qualitatively similar but quantitatively weaker for the non-financial equity return distribution.

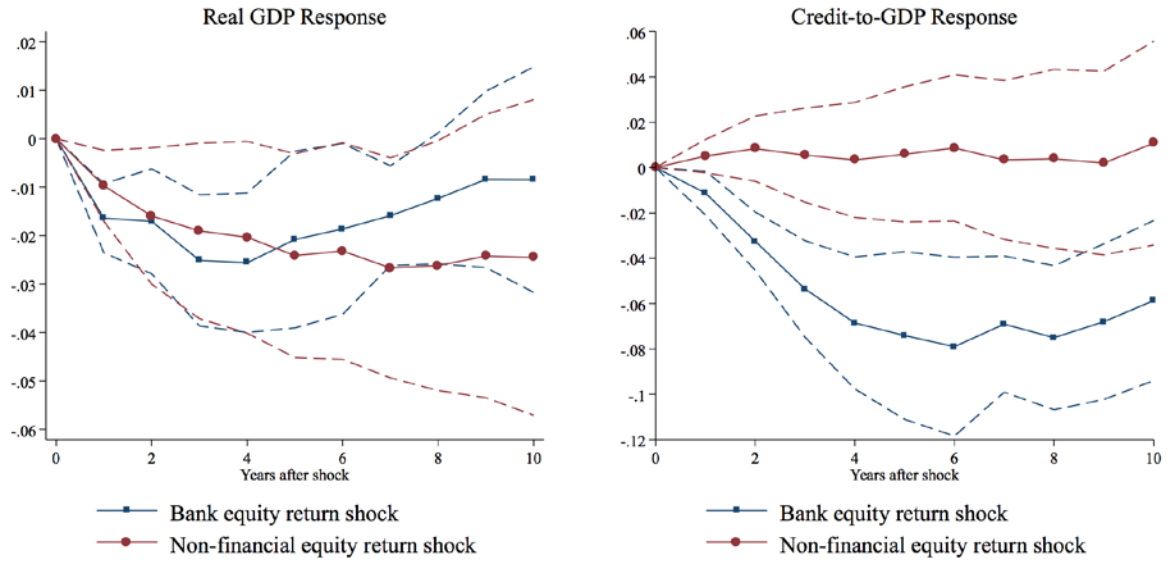




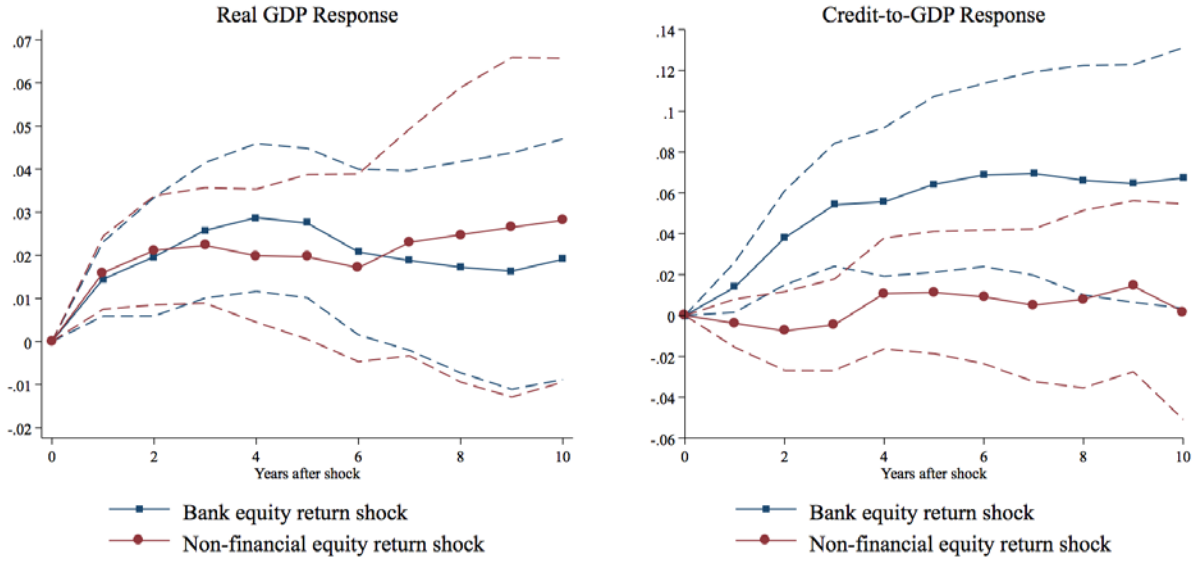
Appendix Figure 2: Bank equity declines and macroeconomic outcomes: robustness

Panel A plots the responses of real GDP and credit-to-GDP to 30% declines in bank and non-financial equity. Specifications controls for three lags in bank and non-financial equity returns, country and year fixed effects, as well as contemporaneous and three lags of real GDP growth and credit-to-GDP change. Panel B replaces the bank and non-financial equity declines indicators with bank and non-financial returns as continuous variables.

Panel A: Bank and non-financial equity 30% declines



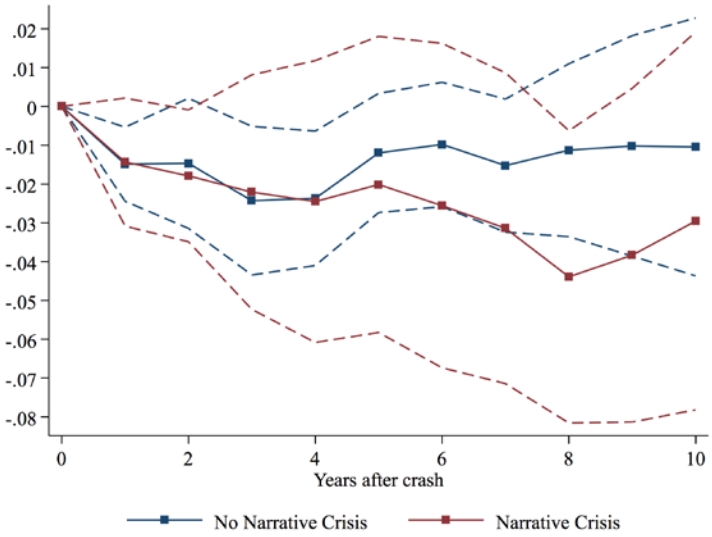
Panel B: Response to bank and non-financial equity returns (continuous variable)



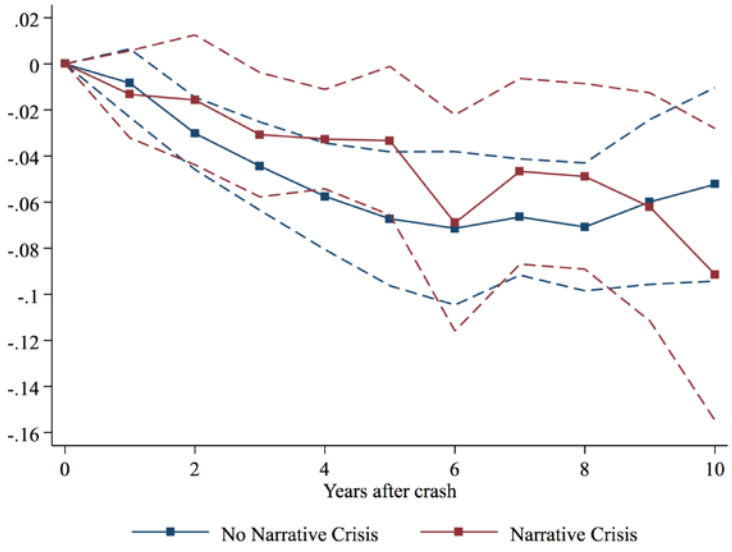
Appendix Figure 3: Responses to bank equity outside of narrative crises

This figure plots the response of real GDP (Panels A and C) and credit-to-GDP (Panels B and D) conditional on being in a Joint Crisis List episode and conditional on *not* being in a Joint Crisis List episode. The figure shows that the macroeconomic response is similar across crisis and non-crisis states. The response is to 30% equity declines in Panels A and B and continuous returns in Panels C and D.

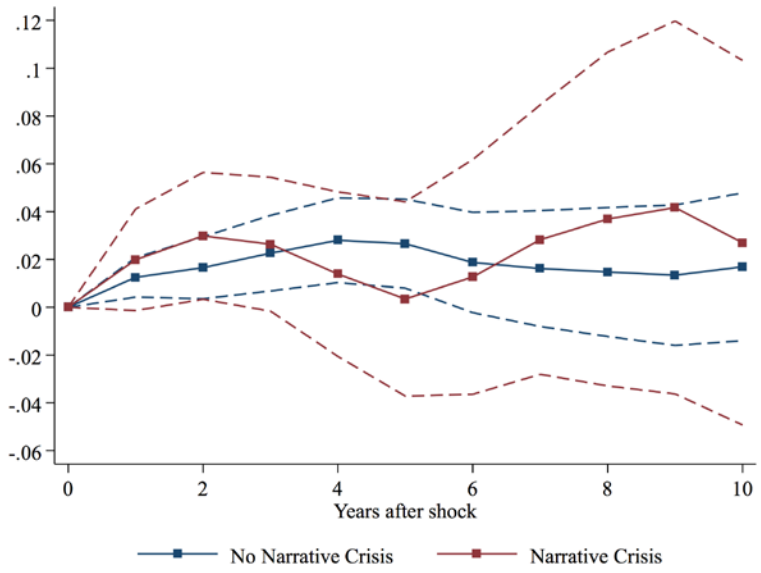
Panel A: Real GDP response to bank and non-financial equity 30% declines



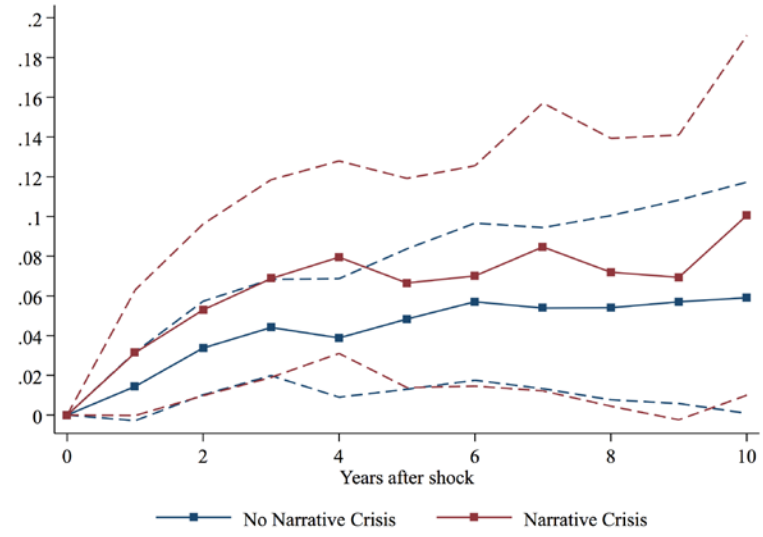
Panel B: Credit-to-GDP response to bank and non-financial equity 30% declines



Panel C: Real GDP response to bank and non-financial equity returns (continuous variable)

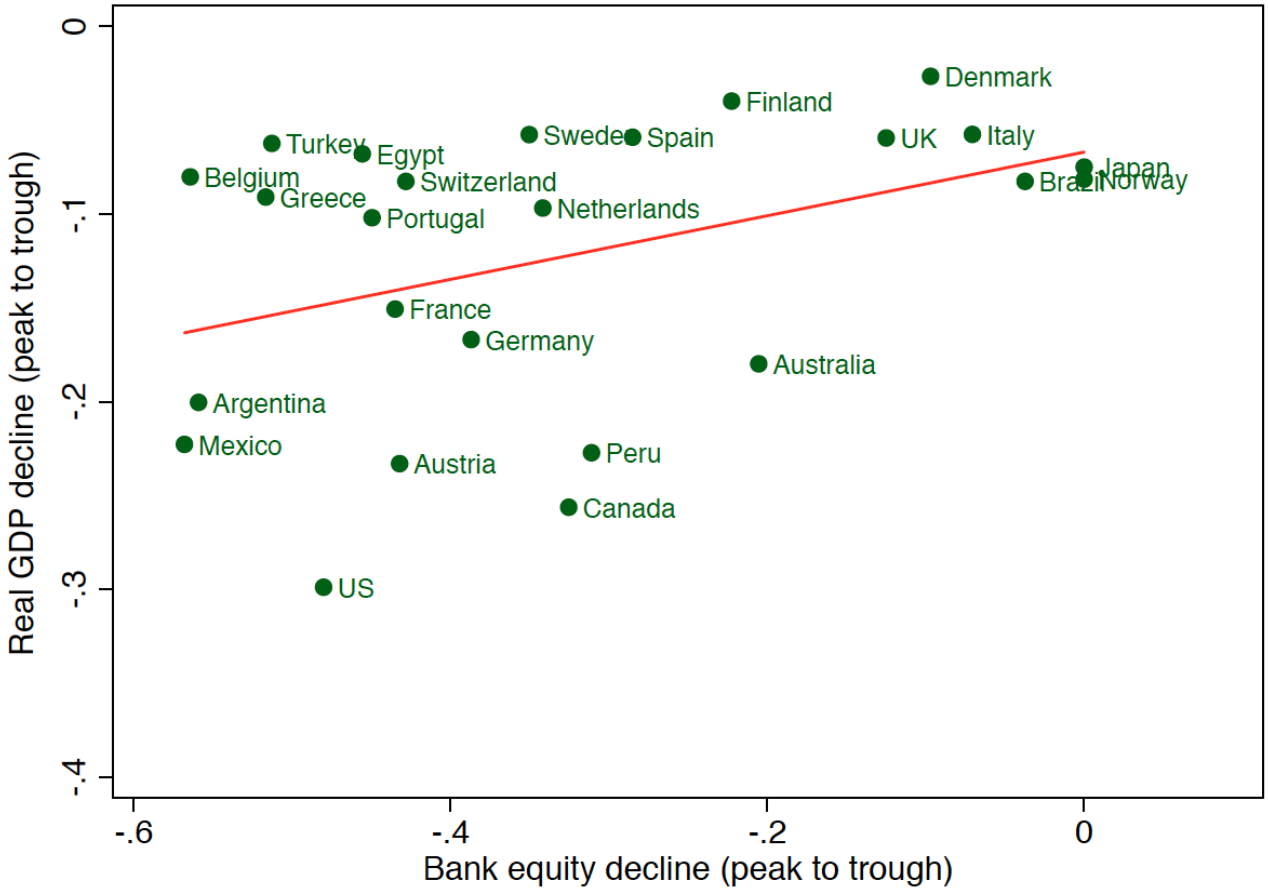


Panel D: Credit-to-GDP response to bank and non-financial equity returns (continuous variable)



Appendix Figure 4: Bank equity declines and the Great Depression

This figure plots the peak-to-trough decline in real GDP against the peak-to-trough bank equity decline over the period 1929-1933. Note that this figure plots *all* countries in the sample for which data is available, not just those that experienced banking crises. Note that, in the *Revised Crisis List*, Australia, Canada, Denmark, Japan, Norway, and the U.K. are considered not to have had banking crises during this period.



Appendix Table 1: Sample period by country

The table lists the starting year of the bank equity real total returns index for each country in the sample. The ending year is 2016 for all countries, though there are gaps in the data corresponding to wars, stock market closures, and other reasons.

Country	First year	Country	First year
Argentina	1870	Japan	1898
Australia	1870	Korea	1975
Austria	1870	Luxembourg	1872
Belgium	1870	Malaysia	1970
Brazil	1870	Mexico	1886
Canada	1870	Netherlands	1873
Chile	1891	New Zealand	1870
Colombia	1927	Norway	1915
Czech	1919	Peru	1870
Denmark	1870	Philippines	1952
Egypt	1870	Portugal	1921
Finland	1913	Russia	1872
France	1870	Singapore	1967
Germany	1872	South Africa	1870
Greece	1870	Spain	1870
Hong Kong	1870	Sweden	1891
Hungary	1870	Switzerland	1870
Iceland	2000	Taiwan	1987
India	1870	Thailand	1975
Indonesia	1990	Turkey	1870
Ireland	1870	UK	1870
Israel	1967	US	1870
Italy	1870	Venezuela	1949

Appendix Table 2: The *Joint Crisis List* and associated peak-to-trough bank index returns

The following table reports the *Joint Crisis List*, defined as the union of all banking crises from seven prominent papers. Years listed correspond to the starting year (and quarter, if available) of the banking crisis, according to each paper. The starting year of the *Joint Crisis List* is the earliest year across all seven papers. A "0" means that the source reports no banking crisis in a given year, while a blank cell means that the crisis is not covered in the sample period (i.e. no information provided either way as to whether a banking crisis occurred). The bank total return is the peak-to-trough return of the log real total return bank equity index.

Legend:
YYYY = starting year of banking crisis
0 = "no crisis"
[blank] = outside of sample

	Reinhart Rogoff	Schularick Taylor	Laeven Valencia	Bordo	Caprio Klingebiel	Demirguc-Kunt Detrag.	Joint Crisis List	Bank Total Return
Argentina	1885						1885	no decline
Argentina	1890			1890			1890	-0.307
Argentina	1914			1914			1914	-0.473
Argentina	1931			1931			1931	-0.916
Argentina	1934			1934			1934	-0.921
Argentina	1980		1980	1980	1980	1980	1980	
Argentina	1985		0	0	0	0	1985	
Argentina	1989		1989	1989	1989	1989	1989	
Argentina	1995		1995	1995	1995	1995	1995	-0.305
Argentina	2001		2001		2001	2001	2001	-0.673
Australia	1893	1893		1893			1893	-0.469
Australia	1931	0		0			1931	-0.230
Australia	1989	1989	0	1989	1989	0	1989	-0.281
Austria	1873						1873	-0.593
Austria	1924						1924	-0.973
Austria	1929						1929	-0.640
Austria	1931						1931	-0.566
Austria	2008		2008				2008	-0.673
Belgium	1870	1870					1870	-0.307
Belgium	0	1885					1885	
Belgium	1914	0		1914			1914	-0.150
Belgium	1925	1925		1925			1925	-0.250
Belgium	1931	1931		1931			1931	-0.816
Belgium	1934	1934		1934			1934	-0.831
Belgium	1939	1939		1939			1939	-0.737
Belgium	2008	2008	2008				2008	-0.842
Brazil	1890			1890			1890	-0.021
Brazil	1897			1897			1897	-0.011
Brazil	1900			1900			1900	-0.099
Brazil	1914			1914			1914	-0.374
Brazil	1923			1923			1923	-0.514
Brazil	1926			0			1926	-0.250
Brazil	1929			0			1929	-0.182
Brazil	1963			1963			1963	-0.841

Brazil	1985		0	0	0	0	1985	
Brazil	1990		1990	1990	1990	1990	1990	
Brazil	1994		1994	1994	1994	1994	1994	no decline
Canada	1873	0					1873	no decline
Canada	1906	0					1906	-0.081
Canada	1908	1907					1907	-0.081
Canada	1912	0					1912	-0.081
Canada	1923	0		1923			1923	-0.426
Canada	1983	0	0	1983	1982	0	1983	-0.164
Chile	1890			1889			1890	-0.075
Chile	1898			1898			1898	-0.254
Chile	1907			1907			1907	
Chile	1914			1914			1914	
Chile	1926			1925			1925	no decline
Chile	1976		1976	1976	1976		1976	-0.724
Chile	1980		1981	1981	1981	1981	1980	-0.526
Colombia	1982		1982	1982	1982	1982	1982	-0.737
Colombia	1998		1998	0	0	1999	1998	-0.813
Czech	1931						1931	-0.099
Czech	1991		1996		1991		1991	
Denmark	1877	1877					1877	-0.207
Denmark	1885	1885		1885			1885	-0.043
Denmark	1902	0		0			1902	-0.022
Denmark	1907	1908		1907			1907	-0.269
Denmark	1914	0		1914			1914	-0.329
Denmark	1921	1921		1921			1921	-0.406
Denmark	1931	1931		1931			1931	-0.143
Denmark	1987	1987	0	1987	1987	0	1987	-0.193
Denmark	2008	2008	2008				2008	-0.739
Egypt	1907						1907	-0.132
Egypt	1931						1931	-0.608
Egypt	1980		1980	1981	1980s	0	1980	
Egypt	1990		0	1991	1991	0	1990	
Finland	0	1877					1877	
Finland	1900	1900		1900			1900	
Finland	1921	1921		1921			1921	-0.900
Finland	1931	1931		1931			1931	-0.252
Finland	1939	0		1939			1939	-0.329
Finland	1991	1991	1991	1991	1991	1991	1991	-0.814
France	1871						1871	-0.364
France	1882	1882		1882			1882	-0.456
France	1889	1889		1889			1889	-0.475
France	1904	0		0			1904	-0.008
France	1907	0		1907			1907	-0.049
France	1914	0		0			1914	-0.475
France	1930	1930		1930			1930	-0.571
France	1939	0		0			1939	-0.498
France	1994	0	0	1994	1994	0	1994	-0.412
France	2008	2008	2008				2007	-0.640
Germany	0	1873					1873	-0.286
Germany	1880	0					1880	-0.371
Germany	1891	1891		0			1891	-0.230
Germany	1901	1901		1901			1901	-0.050
Germany	0	1907		0			1907	-0.051
Germany	1925	0		0			1925	-0.487
Germany	1929	1931		1931			1929	-0.531

Germany	1977	0	0	0	late 1970s		1977	-0.334
Germany	2008	2008	2008		0		2007	-0.728
Greece	1931			1931			1931	-0.727
Greece	1991		0	1991	1991	0	1991	-0.391
Greece	2008		2008				2008	-0.798
Hong Kong	1982		0	1982	1982		1982	-0.310
Hong Kong	1983		0	1983	1983		1983	-0.445
Hong Kong	1998		0		1998		1998	-0.464
Hungary	1931						1931	
Hungary	1991		1991		1991	0	1991	
Hungary	2008		2008				2008	-0.671
Iceland	1985		0	1985	1985	0	1985	
Iceland	1993		0	1993	1993	0	1993	
Iceland	2007		2008				2006	-0.935
India	1908						1908	-0.162
India	1913						1913	-0.531
India	1921						1921	-0.073
India	1929						1929	
India	1947						1947	
India	1993		1993	1993	1993	1991	1991	-0.355
Indonesia	1992		0	0	0	1992	1992	-0.659
Indonesia	1994		0	1994	1994	0	1994	-0.659
Indonesia	1997		1997	1997	1997	1997	1997	-0.880
Ireland	2007		2008				2007	-0.918
Israel	1977		1977	1977	1977	0	1977	-0.479
Israel	1983		0	counted above	counted above	1983	1983	-0.499
Italy	0	1873					1873	-0.305
Italy	1887	1887					1887	-0.348
Italy	1891	0		1891			1891	-0.532
Italy	1893	1893		1893			1893	-0.644
Italy	1907	1907		1907			1907	-0.240
Italy	1914	0		1914			1914	-0.404
Italy	1921	1921		1921			1921	-0.711
Italy	1930	1930		1930			1930	-0.328
Italy	1935	1935		1935			1935	
Italy	1990	1990	0	1990	1990	1990	1990	-0.298
Italy	2008	2008	2008				2007	-0.575
Japan	1872	1871					1871	
Japan	1882	0					1882	
Japan	0	1890		0			1890	
Japan	1901	0		1901			1901	-0.221
Japan	1907	1907		1907			1907	-0.377
Japan	1914	0		0			1914	-0.377
Japan	1917	0		1917			1917	-0.383
Japan	0	1920		0			1920	-0.568
Japan	1923	0		0			1923	-0.547
Japan	1927	1927		1927			1927	-0.300
Japan	1992 counted above	1997	1997	1992 counted above	1991 counted above	1992 counted above	1991 1997	-0.546 -0.726
Korea	1983		0	0	0	0	1983	-0.326
Korea	1986		0	0	0	0	1986	-0.326
Korea	1997		1997	1997	1997	1997	1997	-0.814
Luxembourg			2008				2008	-0.474
Malaysia	1985		0	1985	1985	1985	1985	-0.368

Malaysia	1997		1997	1997	1997	1997	1997	-0.686
Mexico	1883						1883	
Mexico	1893						1893	-0.325
Mexico	1908						1908	-0.029
Mexico	1913						1913	-0.596
Mexico	1920						1920	-0.562
Mexico	1929						1929	-0.878
Mexico	1981		1981 counted above	1981	1981 counted above	0	1981	
Mexico	1982			0		1982	1982	
Mexico	1992		0	0	0	0	1992	no decline
Mexico	1994		1994	1995	1994	1994	1994	-0.602
Netherlands	0	1893		0			1893	no decline
Netherlands	1897	0		1897			1897	no decline
Netherlands	0	1907		0			1907	-0.083
Netherlands	1914	0		1914			1914	-0.093
Netherlands	1921	1921		1921			1921	-0.262
Netherlands	1939	1939		1939			1939	-0.366
Netherlands	2008	2008	2008				2008	-0.562
New Zealand	1890						1890	-0.549
New Zealand	1893						1893	-0.565
New Zealand	1987		0	1987	1987	0	1987	-0.901
Norway	1898	1899		0			1898	
Norway	1914	0		0			1914	-0.176
Norway	1921	1922		1921			1921	-0.791
Norway	1927	0		0			1927	-0.084
Norway	1931	1931		1931			1931	-0.084
Norway	1936	0		0			1936	-0.079
Norway	1987	1988	1991	1987	1987	1987	1987	-0.464
Peru	1872						1872	no decline
Peru	1983		1983	1983	1983	1983	1983	-0.980
Peru	1999		0		0	0	1999	-0.396
Philippines	1981		1983	1983	1981	1981	1981	-0.719
Philippines	1997		1997		1998	1998	1997	-0.524
Portugal	1890	1890		1891			1890	
Portugal	1920	1920		1920			1920	-0.643
Portugal	1923	1923		1923			1923	-0.907
Portugal	1931	1931		1931			1931	-0.603
Portugal	0	0	0	0	0	1986	1986	-0.119
Portugal	2008	2008	2008				2008	-0.668
Russia	1875						1875	-0.188
Russia	1896						1896	-0.162
Russia	1995		0		1995	0	1995	
Russia	1998		1998		1998	0	1998	-0.751
Russia	2008		2008				2008	-0.723
Singapore	1982		0	1982	1982		1982	-0.236
South Africa	1877						1877	
South Africa	1881						1881	
South Africa	1890						1890	
South Africa	1977		0	1977	1977		1977	-0.527
South Africa	0		0	0	0	1985	1985	-0.472
South Africa	1989		0	0	1989	0	1989	-0.492
Spain	0	1883					1883	-0.400
Spain	0	1890		0			1890	-0.124
Spain	0	1913		0			1913	-0.038
Spain	1920	1920		1920			1920	-0.320

Spain	1924	1924		1924			1924	-0.293
Spain	1931	1931		1931			1931	-0.336
Spain	1977	1977	1977	1977	1977		1977	-0.840
Spain	2008	2008	2008				2008	-0.466
Sweden	1876	1878					1876	
Sweden	1897	0		1897			1897	-0.183
Sweden	1907	1907		1907			1907	-0.192
Sweden	1922	1922		0			1922	-0.669
Sweden	1931	1931		1931			1931	-0.431
Sweden	1991	1991	1991	1991	1991	1990	1991	-0.787
Sweden	2008	2008	2008				2008	-0.519
Switzerland	1870	1870					1870	-0.418
Switzerland	1910	1910		0			1910	-0.097
Switzerland	1921	0		0			1921	-0.534
Switzerland	1931	1931		1931			1931	-0.559
Switzerland	1933	0		1933			1933	-0.559
Switzerland	0	1991	0	0	0	0	1991	-0.502
Switzerland	2008	2008	2008				2007	-0.676
Taiwan	1923						1923	
Taiwan	1927						1927	
Taiwan	1983			1983	1983	0	1983	
Taiwan	1995			1995	1995	0	1995	-0.748
Taiwan	1997			1997	1997	1997	1997	-0.748
Thailand	1979		0	0	0		1979	-0.461
Thailand	1983		1983	1983	1983	1983	1983	-0.461
Thailand	1996		1997	1997	1997	1997	1996	-0.734
Turkey	1931						1931	-0.719
Turkey	1982		1982	1982	1982	1982	1982	-0.409
Turkey	1991		0	0	0	1991	1991	-0.758
Turkey	1994		0	1994	1994	1994	1994	-0.758
Turkey	2000		2000		2000	2000	2000	-0.716
U.K.	1878	0					1878	-0.132
U.K.	1890	1890		1890			1890	-0.055
U.K.	1908	0		0			1908	-0.011
U.K.	1914	0		0			1914	-0.219
U.K.	1974	1974	0	1974	1974		1974	-0.737
U.K.	1984	0	0	0	1980s-90s	0	1984	-0.215
U.K.	1991	1991	0	0	0	0	1991	-0.147
U.K.	1995	0	0	0	0	0	1995	-0.159
U.K.	2007	2007	2007				2007	-0.638
U.S.	1873	1873					1873	-0.172
U.S.	1884	0		1884			1884	-0.029
U.S.	1890	0		0			1890	-0.016
U.S.	1893	1893		1893			1893	-0.290
U.S.	1907	1907		1907			1907	-0.495
U.S.	1914	0		1914			1914	-0.334
U.S.	1929	1929		1930			1929	-0.653
U.S.	1984	1984	1988	1984	1984	1980	1984	-0.261
U.S.	counted above	counted above	counted above	0	counted above	counted above	1990	-0.332
U.S.	2007	2007	2007				2007	-0.676
Venezuela	1978		0	1978	late 1970s		1978	-0.294
Venezuela	1993		1994	1994	1994	1993	1993	-0.839
Venezuela	2009		0				2009	-0.614

Appendix Table 3: Alternative measures of bank equity declines

This table is similar to Table 3 but uses alternate measures of bank equity declines as the independent variable in Equation. In Panel A, the independent variable is *abnormal bank equity decline*, which is defined as the peak-to-trough decline of the bank equity total return minus nonfinancial equity total return. In Panel B, the independent variable is *bank market capitalization decline*, defined as the peak-to-trough decline in an index defined by annual returns of (1+bank equity price returns) * (1+bank equity new issuance). Panel C has two independent variables: *bank equity decline* and *bank equity recovery* (positive returns in the bank equity total returns index subsequent to the trough within three years after a banking crisis).

Panel A: Abnormal bank equity decline (i.e. bank equity minus nonfinancial equity returns)

	Real GDP (peak-to-trough decline)	Real GDP growth (pctage.-pt. decline, peak-to-trough)	Real GDP growth (max deviation from trend)
	(1)	(2)	(3)
Abnormal bank decline	0.054***	0.045***	0.037***
	[3.449]	[3.207]	[3.190]
Post-1945 dummy	✓	✓	✓
Adj. R^2 (within)	0.061	0.043	0.043
N	191	191	191

Panel B: Bank market capitalization decline

	Real GDP (peak-to-trough decline)	Real GDP growth (pctage.-pt. decline, peak-to-trough)	Real GDP growth (max deviation from trend)
	(1)	(2)	(3)
Bank market cap decline	0.102***	0.073***	0.070***
	[4.676]	[3.855]	[4.307]
Post-1945 dummy	✓	✓	✓
Adj. R^2 (within)	0.222	0.197	0.169
N	86	86	86

Panel C: Bank equity recoveries

	Real GDP (peak-to-trough decline)	Real GDP growth (pctage.-pt. decline, peak-to-trough)	Real GDP growth (max deviation from trend)
	(1)	(2)	(3)
Bank equity decline	0.130***	0.105***	0.073***
	[5.183]	[4.901]	[3.996]
Bank equity recovery	-0.003	-0.024	-0.023
	[-0.120]	[-1.132]	[-1.245]
Post-1945 dummy	✓	✓	✓
Adj. R^2 (within)	0.136	0.140	0.101
N	198	198	198

Appendix Table 4: Changes to start years of banking crises

This table lists other modifications made in constructing our revised chronology of banking crises. Panel A lists episodes from the *Joint Crisis List* which were deemed to be part of the same episode. Panel B lists changes in start dates of banking crises that were made by examining the year in which bank equity returns index declined -30% or more.

Panel A: Combined episodes for the revised chronology of banking crises

Country	Combined Events
Austria	1924 and 1926
Austria	1929 and 1931
Belgium	1931 and 1934
Hong Kong	1982 and 1983
Indonesia	1992 and 1994
Italy	1891 and 1893
Mexico	1981 and 1982
Mexico	1992 and 1994
Switzerland	1931 and 1933

Panel B: Changes in starting dates of banking crises

Country	Changes in starting date
Belgium	1931 -> 1929
Chile	1980 -> 1981
France	2007 -> 2008
Germany	2007 -> 2008
Iceland	2006 -> 2008
India	1991 -> 1993
Italy	2007 -> 2008
Japan	1991 -> 1990
Mexico	1920 -> 1921
New Zealand	1890 -> 1887
New Zealand	1893 -> 1894
South Africa	1985 -> 1984
Spain	1883 -> 1882
Sweden	1876 -> 1878
Switzerland	2007 -> 2008
Thailand	1996 -> 1997

Appendix Table 5: Selected episodes of minor bank distress

This table lists selected episodes of minor bank distress that were not classified as banking crises in our revised chronology. These episodes are generally instances of a single idiosyncratic bank failure or failures of many small banks that collectively do not rise to the level of a "widespread" crisis. The list contains only selected episodes and is far from complete. This table is presented simply as a guide for the interested reader; these episodes are not analyzed in this paper.

Country	Starting year of bank distress
Argentina	1985
Australia	1931, 1974, 1977, 2008
Belgium	1900, 1920, 1925
Brazil	1985
Canada	1873, 1887, 1891, 1901, 1905, 1912, 2008
Czech	1931
Denmark	1914, 1931, 1984
Finland	2008
France	1991
Germany	1907, 1974, 2003
India	1938
Ireland	1885
Israel	2002
Italy	1926, 1982, 1997
Japan	2001, 2008
Netherlands	1981
New Zealand	2008
Norway	1886, 1914, 1926, 2008
South Africa	1977, 1991
Spain	1990
Switzerland	1910
Turkey	2008
U.K.	1984, 1991, 1995
U.S.	1998