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Macroeconomic effects of corporate default crisis: A long-term perspective ☆

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ABSTRACT

Using an extensive data set on corporate bond defaults in the US from 1866 to 2010, we study the macroeconomic effects of bond market crises and contrast them with those resulting from banking crises. During the past 150 years, the US has experienced many severe corporate default crises in which 20–50% of all corporate bonds defaulted. Although the total par amount of corporate bonds has at times rivaled the amount of bank loans outstanding, we find that corporate default crises have far fewer real effects than do banking crises. These results provide empirical support for current theories that emphasize the unique role that banks and the credit and collateral channels play in amplifying macroeconomic shocks.

1. Introduction

In this paper, we use an extensive data set compiled by Giesecke, Longstaff, Schaefer, and Strebulaev (2011) on corporate bond defaults to study the macroeconomic effects of major crises in the corporate bond market. To provide additional perspective, we contrast these effects with those resulting from banking crises.

Our motivation for doing this is threefold. First, while banking crises in the US have been the focus of many studies [important examples include Reinhart and Rogoff, 2009; Schularick and Taylor, 2012], relatively little attention has been given to corporate bond market default crises (corporate default crises, for short) in the literature. The corporate bond market, however, has been a major source of credit in the US during the past 150 years, and the amount of outstanding corporate bonds has occasionally rivaled, or even exceeded, the amount of bank loans outstanding. We focus on the US because, until the latter part of the 20th century, it has been the only country where privately owned corporations issued public debt on a large scale. By studying this important but

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underresearched market, we hope to broaden understanding of the role that credit plays in the macroeconomy.

Second, the corporate debt markets have experienced many major shocks during the past 150 years. A number of these shocks were much more severe than even those during the Great Depression. For example, more than 50% of all outstanding bonds in the US defaulted during the 1871–1879 period as many railroads found themselves overextended in the wake of their rapid expansion during the post-Civil War technology boom.[1] Thus, corporate bond markets have suffered crises that could be as severe as any experienced by the banking sector. Furthermore, Friedman and Schwartz (1963) argue that large declines in the market value of banks' portfolios of corporate bonds were a major contributing factor to the widespread bank failures of the Great Depression.[2] Because of this, the historical experience of the corporate bond market in the US could provide a new perspective on financial crises.

Third, by contrasting the effects of corporate default and banking crises on the economy, we hope to be able to shed new light on the mechanisms by which financial crises propagate economic fluctuations. This is because the two primary channels by which current theory suggests that banking crises accelerate economic downturns are largely absent in corporate bond market crises. Thus, studying the macroeconomic effects of corporate default crises essentially provides an additional test of the role of these two channels.

More specifically, current theoretical models of banking crises emphasize the central role of the credit and collateral channels. For example, Bernanke (1983) argues that a major reason for the persistence of the Great Depression was the collapse of the credit channel after a large fraction of US banks failed. This collapse hit small and medium-size firms particularly hard because they did not have the same access to alternative forms of credit that a larger firm might [see the discussion by Reinhart and Rogoff, 2009 in their comprehensive review of banking crises]. This theme also appears in Bernanke, Gertler, and Gilchrist (1996), who explicitly incorporate heterogeneity in firms' abilities to borrow in the capital markets into their model of the financial accelerator.[3] Another important literature focuses on the role of the collateral channel in triggering economic downturns. For example, Kiyotaki and Moore (1997) show how an initial decline in asset values can reduce the ability of firms to borrow because their collateral is impaired, which, in turn, can lead to further rounds of declines in asset values. Similarly, Bernanke and Gertler (1995) study a model in which shocks affect the value of firms' collateral, forcing them to turn to more expensive external credit channels.

In contrast, neither the credit nor collateral channels are likely to play much of a role in a corporate bond market crisis. In particular, only larger firms would be initially affected by a corporate default crisis because they are the only firms that participate in this capital market. Among the many reasons that this is the case are the fixed costs of issuance as well as the disclosure costs that make only issues of large size economically viable. These larger firms, however, might be able to find alternative sources of credit in a crisis, thereby cushioning the output effects of the initial shock. Furthermore, the vast majority of corporate bonds issued in the US are in the form of unsecured debentures instead of mortgage or equipment-secured bonds.[4] Thus, large firms that issue bonds in the capital markets are able to borrow against their future income streams, instead of being limited to their current collateral. Because collateral plays a much smaller role in the corporate bond market, the ability of the collateral channel to function as an accelerator in a corporate default crisis is limited, thereby dampening the potential effects on the macroeconomy.

For these reasons, an examination of the macroeconomic effects of a corporate default crisis could provide useful insights into the importance of the credit and collateral channels. For example, finding that the real effects of a corporate default crisis were just as severe as those of a banking crisis would argue against these two channels playing a central role in accelerating economic downturns. However, finding that corporate default crises have only relatively minor macroeconomic effects would be consistent with the credit and collateral channels being prime suspects for explaining why banking crises are particularly damaging.

We begin by showing that corporate default and banking crises are separate and distinct phenomena. In particular, very little correlation exists between the timing of corporate default and banking crises.

Next, we confirm that significant differences are evident in the roles that the credit and collateral channels play in the two types of crises. Not surprisingly, we find that bank lending growth declines after a banking crises. Interestingly, however, we find that bank lending increases significantly shortly after a corporate default crisis. In contrast, the opposite is not true after a banking crisis. Thus, these results strongly suggest that large corporate bond issuers are able to substitute sources of credit after a corporate default crisis, thereby mitigating the impact of the credit channel mechanism. This finding is consistent with Ivashina and Scharfstein (2010) who find that large corporate borrowers increased their bank borrowing significantly in the wake of the 2008 Lehman Brothers crisis in the capital markets by drawing on their existing banking lines of credit. These results are also consistent with Gertler and Gilchrist (1994), Chari, Christiano, and Kehoe (2007), and many others who argue that large firms have greater access to capital during a crisis than do small firms. In an important and closely related paper, Schularick and Taylor (2012) demonstrate that bank loan growth has

[1] In contrast, the highest corporate default rate during the Great Depression was 6.73% in 1933. The highest business failure and mortgage foreclosure rates during the Great Depression were 1.53% in 1932, and 2.39% in 1933, respectively [rates based on series V27 and N301 of US Department of Commerce, Bureau of the Census, 1975].

[2] For a discussion of the evidence on this issue, see Calomiris and Mason (2003b).

[3] Also see Calomiris (1993), who discusses the evidence showing that larger manufacturing firms had greater access to credit during the Great Depression than smaller firms.

[4] This is also true during the earlier part of the study period. For example, Hickman (1953) estimates that the fraction of corporate bonds issued in the US between 1990 and 1945 that were secured by claims against assets such as equipment was on the order of 2–3%.

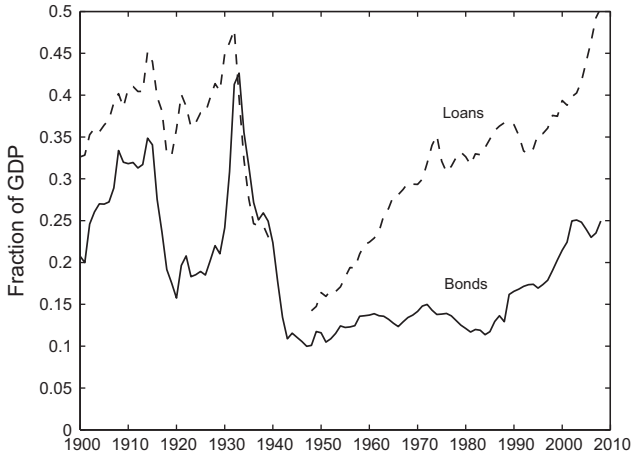

Fig. 1. Outstanding bank loans and corporate bonds as a fraction of gross domestic product (GDP). This graph plots the ratio of total outstanding bank loans to GDP and the ratio of total outstanding corporate bonds to GDP from 1900 to 2008.

predictive power in explaining future banking crises. Our results complement theirs by showing that a corporate default crisis can lead to an increase in bank lending.

Focusing next on the collateral channel, we explore the implications of Kiyotaki and Moore (1997) by examining whether negative shocks in the values of major classes of collateral map into subsequent contractions in lending. We find that declines in housing and stock market values both result in significant declines in subsequent bank lending. In contrast, declines in housing or stock market values have either much smaller or insignificant effects on the subsequent amount of corporate bond issuance. Since bank lending is typically collateralized while corporate bond issuance is not, these results support the Kiyotaki and Moore argument that the link between collateral values and credit availability is central to understanding the macroeconomic impact of banking crises.

Finally, we compare the real and financial effects of banking and corporate default crises on gross domestic product (GDP) growth, industrial production, and inflation. We find that corporate default crises do not have a significant effect on output, measured either by GDP or by industrial production. In contrast, banking crises have longlasting effects on both GDP growth and industrial production. Friedman and Schwartz (1963), Reinhart and Rogoff (2009), and others show that banking crises tend to be followed by periods of lower inflation or even deflation. We extend this literature by showing that the same is also true following corporate default crises. These results are important since they highlight the unique role played by banks. In particular, banking crises are followed by both real and monetary effects while other types of financial crises are followed only by monetary effects.

Taken together, these results provide strong support for the implications of current theoretical models about the macroeconomic effects of banking crises. In particular, these models imply that corporate default crises should have less severe macroeconomic consequences because the credit and collateral mechanisms are largely absent in default crises. As support for this latter point, we show that corporate borrowers are more able to substitute sources of credit after a crisis, and that negative shocks to asset or collateral values have little or no effect on the amount of corporate bond indebtedness. Consistent with theory, we confirm that banking crises have more severe effects on the macroeconomy than do default crises.

2. The data

Although banking crises in the US have been the focus of many studies, relatively little attention has been given to corporate default crises in the literature. The primary reason for this may simply be that historical data on corporate default crises have not been as readily available to researchers.

Corporate bond markets, however, have historically played almost as important a role in providing capital in the US as the banking sector. To illustrate this, we obtain data on the total amount of corporate bonds outstanding in the US during the 1900–2010 period as well as the total amount of bank loans outstanding in the US during the 1900–1940, 1948–2008 period. The data for the total amount of corporate bond outstanding are obtained from the data set compiled by Giesecke, Longstaff, Schaefer, and Strebulaev (2011) (see the Appendix for a description of this data). The data for the total amount of bank loans outstanding are obtained from the Online Appendix of Schularick and Taylor (2012). In turn, Schularick and Taylor obtain the loan data from two sources: total loans and leases of commercial banks from the Board of Governors of the Federal Reserve, US All Bank Statistics, 1886–1955, and total loans and leases and security investment of commercial banks from the Board of Governors of the Federal Reserve H.8 release, 1947–2008 (see Schularick and Taylor, Appendix B).

Fig. 1 plots the total amount of corporate bonds outstanding during the 1900–2008 period alongside the total amount of bank loans in the US, where both series are normalized by GDP. As shown, the size of the corporate bond market has rivaled the total amount of bank loans throughout much of the sample period. The ratio of bank loans to GDP averages 33.2% during the study period,

Table 1
Corporate bond issuers.

This table lists the total number of US nonfinancial corporate bond issuers in the historical records by industry category for the dates shown. The source data are obtained from *The Commercial and Financial Chronicle*, Hickman (1953, 1958, 1960), Atkinson (1967), and Moody's Investors Service, and are described in the Appendix. Because the data are obtained from different historical sources, the definitions of the respective categories might not be fully comparable over time.

Year	Railroad	Canal	Real estate	Industrial	Utility	Transport	Total
1870	147	14		5	1		167
1880	339	12		11	1		363
1890	369	4		26	3		402
1900	344			193	276		813
1910	331			134	552		1017
1920	306			206	659		1171
1930	574		111	491	930		2106
1940	519		231	680	976		2406
1950	335		137	219	366		1057
1960	121			169	73		363
1970				297	229	89	615
1980				592	285	108	985
1990				1596	337	142	2075
2000				2059	528	126	2713
2010				2520	603	104	3227

while the same measure is 19.2% for corporate bonds. During the 1933–1940 period, corporate bonds actually represented a larger fraction of GDP than did bank loans. After World War II, however, bank lending grew more rapidly than corporate bonds, and is currently about twice as large as a fraction of GDP. The total amount of bank loans includes not only direct lending to firms, but also to households. For example, the Federal Reserve Board's H.8 release shows that commercial and industrial loans represent less than 30% of all bank loans throughout the 1973–2008 period. Thus, the comparison of the size of the corporate bond market to total bank loans clearly understates the relative importance of the corporate bond market in providing debt capital to firms.

The role of the corporate bond market in raising capital has evolved significantly during the past 150 years. To illustrate this, Table 1 provides some summary information about the number of bond issuers listed in the historical record by industry or sector. Because the definitions of the categories shown in Table 1 have changed over time in the historical sources, care should be taken in interpreting the growth rates of individual categories.

During the 1866–1890 period, corporate bonds were issued primarily to finance the rapid growth of the capital-intensive railroad and canal industries. Even during this early period, however, the bond markets were used to provide funding for new technology. For example, Western Union Telegraph bonds appear as early as 1867, and American Bell Telephone bonds appear in 1890. Beginning in the 1890s, electric, gas, street railways, and water utilities began to raise significant amounts of capital through the corporate bond market.

By the early 1900s, it became increasingly common for broader classes of industrial firms such as oil, coal, steel, natural resource, and manufacturing firms to issue public debt as well. Familiar names that appear in the historical record include Proctor and Gamble in 1891, General Electric in 1894, American Telephone and Telegraph in 1901, and US Steel in 1902.

During the Great Depression, the corporate bond market became a major source of capital for financing large real estate projects such as hotels and office buildings as bank financing became less available. For example, bond issues for the Chrysler Building, the Waldorf Astoria, and the Schubert Theater in New York appear in the 1933 *Commercial and Financial Chronicle*. Interestingly, it was not until the 1970s that banks and other financial firms began to raise significant amount of funds in the corporate bond markets.[5]

In this paper, we make use of an extensive data set recently compiled and described in Giesecke, Longstaff, Schaefer, and Strebulaev (2011). Specifically, the data set includes the annual percentage default rates for all US nonfinancial corporate bonds during the 1866–2010 period along with estimates of the annual growth rates in the corporate bond market for much of this period. The data set is composed of both hand-collected data extracted from historical financial records such as the *Commercial and Financial Chronicle* and tabulated data from a variety of sources including Hickman (1953, 1958, 1960), Friedman and Schwartz (1963), Atkinson (1967), Homer and Sylla (1991), and Moody's Investors Service (2011). While industry sources provide data on corporate default rates dating back to 1970 (and some limited data back to 1920), this data set extends the historical record on corporate defaults by nearly a century. Furthermore, the default rates in this data set are value-weighted because they are based on the outstanding par amount of corporate bonds that default each year. Thus, the value-weighted average default rates differ from the default rates provided by industry sources that are typically issuer weighted. This distinction is important because smaller firms are more likely to default, potentially inflating issuer-weighted default rates.[6] The advantage of value-weighted default rates is that it reflects the loss rates of a representative bond investor.[7]

A number of firms have defaulted more than once during the sample period. For example, the worst repeat offender in the sample is the Seaboard Air Line Railway, which either defaulted or underwent a corporate reorganization six times during the study period, in 1905, 1908, 1921, 1928, 1939, and 1944. Another example is the Chicago, Peoria, and St. Louis Railway that defaulted a total of five times, in 1893, 1898, 1906, 1914, and 1919. These examples suggest that, as is often the case in sovereign debt markets, corporate debt issuers can return quickly to the capital markets after a default or reorganization.

To contrast the effects of corporate default crises with those of banking crises, we use the coding of banking crisis

[5] See Giesecke, Longstaff, Schaefer, and Strebulaev (2011) for a discussion of the history of the US corporate bond market.

[6] That smaller firms are more likely to default follows from the evidence that issuer-weighted default rates tend to be much higher than value-weighted default rates. See the discussion in Giesecke, Longstaff, Schaefer, and Strebulaev (2011).

[7] A caveat is that recovery rates are not available for most of the study period.

Table 2
Summary statistics for corporate default crises.

This table lists the dates for the corporate bond market default crises during the 1866–2010 sample period, where a crisis is identified as a contiguous period during which annual default rates generally exceed 2.5%. The table also reports the average default rate and the total default rate during each corporate default crisis. Also reported are the rankings of the corporate default crises in terms of their severity based on the average default rate and on the total default rate. Default rates are expressed as percentages.

Date of crisis	Average default rate		Total default rate	
	Value	Ranking	Value	Ranking
1866–1866	2.54	13	2.54	13
1869–1869	7.13	1	7.13	7
1871–1879	6.49	2	58.43	1
1883–1885	5.36	3	16.06	4
1887–1889	2.57	12	7.71	6
1891–1896	4.93	4	29.95	2
1898–1898	3.73	7	3.73	9
1904–1904	2.97	9	2.97	11
1914–1915	4.19	5	8.39	5
1932–1935	4.03	6	16.13	3
1938–1939	2.67	10	5.34	8
2002–2002	3.07	8	3.07	10
2009–2009	2.60	11	2.60	12
Average	4.68	–	12.59	–

years during the 1870–2008 period provided by Schularick and Taylor (2012), which in turn is based on Bordo, Eichengreen, Klingebiel, and Martinez-Peria (2001), Reinhart and Rogoff (2009), Laeven and Valencia (2008), Cecchetti, Kohler, and Upper (2009), and others. Because a key objective of these papers is to study the output effects of banking crises, they take care not to use ex post information in defining a banking crisis. For example, Schularick and Taylor (p. 1038) state "In line with the previous studies we define financial crises as events during which a country's banking sector experiences bank runs, sharp increases in default rates accompanied by large losses of capital that result in public intervention, bankruptcy, or forced merger of financial institutions." These criteria are all based on current information, not ex post information. Similarly, Laeven and Valencia (2008) explain that their definition of a systemic banking crisis is based on contemporaneously observable variables such as increases in nonperforming loans, depletion of aggregate bank capital, and depositor runs on banks. These sources identify the following years as US banking crises: 1873, 1884, 1893, 1907, 1930–1933, 1984–1991, and 2007–2008. Following Schularick and Taylor, we construct an indicator variable that takes value one for banking crisis years and zero otherwise. Finally, the other macroeconomic and financial variables used in the study are described in the Appendix.

3. Corporate default crises

As a working definition of a corporate bond market crisis, we characterize a crisis as any year or set of consecutive years during which the default rate is in excess of 2.50%, which is roughly five times the median default rate. While many other possible ways exist of defining corporate default crises, this approach at least has the virtue of simplicity. This threshold implies that the US was in a corporate default crisis about 24% of the time during the 1866–2010 period. This parallels Reinhart and Rogoff (2009), who argue that the US has spent roughly 18% of the time during the 1800–2008 period in a banking crisis. Giesecke, Longstaff, Schaefer, and Strebulaev (2011) use a lower threshold of 1.50% to define what they term default cycles, which they then contrast with business cycles. We use the higher threshold of 2.50% because our focus is on identifying not simply cycles, but events extreme enough to qualify as crises, and then contrasting their macroeconomic effects with those of banking crises.[8] The results are also similar when we simply use the annual default rate in the analysis instead of an indicator variable to identify specific crisis periods.

Table 2 provides summary statistics for the 13 corporate default crises identified during the study period. As shown, there have been extended crises in which corporate capital markets were battered by severe levels of default. For example, more than 50% of all outstanding bonds in the US defaulted during the 1871–1879 period as many railroads found themselves overextended in the wake of their rapid expansion during the post-Civil War era. The second most-severe crisis during the 1891–1896 period resulted in nearly 30% of all bonds defaulting. Surprisingly, the corporate default crisis during the Great Depression was only the third most-severe crisis in terms of total defaults and only the sixth most-severe crisis in terms of average default rate.

The average length of a corporate default crisis is 2.69 years, and the median length is 2.00 years. This contrasts starkly with the average length of 1.48 years for the 31 National Bureau of Economic Analysis (NBER)-defined business downturns during the 1865–2010 period. Thus, while default crises are less frequent than business downturns, they are almost twice as persistent.

To provide some sense for the relation between the different types of crisis periods, we compute the correlation of indicator variables that take value one during a corporate default crisis and one during a banking crisis, and zero otherwise. The correlation between the corporate default indicator and the banking indicator is only 0.04. This low correlation suggests that a corporate default crisis is a distinct phenomenon from a banking crisis. As one has to be cautious about interpreting simple correlations, we proceed with a more in-depth analysis of the data in subsequent sections.

4. Credit substitution

One possible explanation for why banking crises might lead to more severe consequences for the macroeconomy than corporate default crises could be the credit channel mechanism. In particular, shocks to the banking sector could accelerate economic downturns as small and mid-size bank borrowers face restricted access to credit.

[8] However, our results are robust to the threshold used to define a corporate default crisis.

Table 3
Credit crisis vector autoregression (VAR) results.

Panel A reports summary statistics from the estimation of a four-equation three-lag VAR specification for bank loan growth rates, corporate bond market growth rates, banking crisis indicators, and corporate default crisis indicators. *Loan* denotes the annual percentage change in the outstanding amount of bank loans. *Par* denotes the annual percentage change in the par amount of corporate bonds outstanding. *Bank* is an indicator variable that takes value one during a banking crisis and zero otherwise. *Bond* is an indicator variable that takes value one during a corporate default crisis and zero otherwise. Coefficient denotes the coefficient for the indicated lagged explanatory variable. ***, **, and * denote significance at the 1%, 5%, and 10% level, respectively. Panel B reports the *p*-values for the test of Granger causality from the indicated lagged explanatory variables to the indicated dependent variable. The sample period is 1900–1940, 1948–2008 (102 observations).

Panel A: VAR summary statistics

Variable, lag	*Loan* equation		*Par* equation		*Bank* equation		*Bond* equation	
	Coefficient	*t*-Statistic	Coefficient	*t*-Statistic	Coefficient	*t*-Statistic	Coefficient	*t*-Statistic
Intercept	0.0066	0.37	0.0243	1.85*	0.0244	0.30	0.2992	3.82***
Loan								
1	0.4305	3.75***	0.0197	0.23	0.3196	0.60	−1.2346	−2.41**
2	−0.0180	−0.15	0.1298	1.47	0.4047	0.74	−0.4884	−0.93
3	0.2126	1.92*	0.0947	1.14	0.0439	0.09	−0.9058	−1.83*
Par								
1	0.1329	0.93	0.1024	0.95	0.2597	0.39	−0.5159	−0.80
2	0.0331	0.26	0.0286	0.30	0.4965	0.83	1.1431	2.00**
3	0.1518	1.22	0.2189	2.35**	−1.2892	−2.23**	−0.9190	−1.66
Bank								
1	−0.0770	−3.37***	0.0132	0.77	0.7432	6.98***	0.0291	0.29
2	−0.0058	−0.19	0.0083	0.37	0.1138	0.81	0.2107	1.55
3	0.0267	1.00	0.0029	0.15	−0.0542	−0.43	−0.2730	−2.29**
Bond								
1	−0.0098	−0.40	−0.0247	−1.34	0.0467	0.41	0.3188	2.89***
2	0.0580	2.26**	0.0043	0.22	−0.1716	−1.44	−0.2964	−2.59**
3	−0.0100	−0.39	−0.0157	−0.82	0.1847	1.56	0.1262	1.11
Adj. R^2		0.411		0.291		0.512		0.368

Panel B: p-values for Granger causality tests

Lagged explanatory variable	Dependent variable in VAR equation			
	Loan	*Par*	*Bank*	*Bond*
Loan	0.0000	0.1075	0.6424	0.0009
Par	0.2883	0.0220	0.1023	0.0658
Bank	0.0002	0.4347	0.0000	0.0782
Bond	0.1006	0.4223	0.2265	0.0025

However, large corporate bond issuers might be able to find alternative sources of credit after a shock to the capital markets. Thus, differences in the macroeconomic effects of the two types of crises might be attributable to heterogeneity in the ability of firms to substitute sources of credit.

To explore this issue, we use a simple vector autoregression (VAR) framework to look for evidence of credit substitution after corporate default and banking crises. Specifically, we estimate a four-equation VAR specification for the annual percentage change in the outstanding amount of bank loans, the annual percentage change in the par amount of corporate bonds outstanding, an indicator variable for bank crisis periods, and an indicator variable for corporate default crisis periods. The lag length for the VAR is chosen to be three, based on both the Akaike information criterion and the Schwartz criterion. The sample period for the VAR is 1900–1940, 1948–2008 (102 observations). Panel A of Table 3 reports the coefficient estimates and the *t*-statistics for the lagged variables for each of the four equations in the VAR along with the corresponding adjusted R^2s. Panel B of Table 3 reports the *p*-values for the test of Granger causality from the indicated lagged explanatory variable to the dependent variable in each equation.[9] Fig. 2 plots selected impulse response functions for the explanatory variables in the VAR model (the complete set of impulse response functions for this and the other VARs estimated in the paper are shown in the Online Appendix). All of the impulse response functions in this paper are based on the generalized approach of Koop, Pesaran, and Potter (1996) and Pesaran and Shin (1998), which does not require orthogonalization of shocks and is invariant to

[9] The test for Granger causality is based on Eq. (11.2.10) of Hamilton (1994). Hamilton (p. 305) suggests that this test could be the best test for Granger causality based on evidence provided by Geweke, Meese, and Dent (1983).

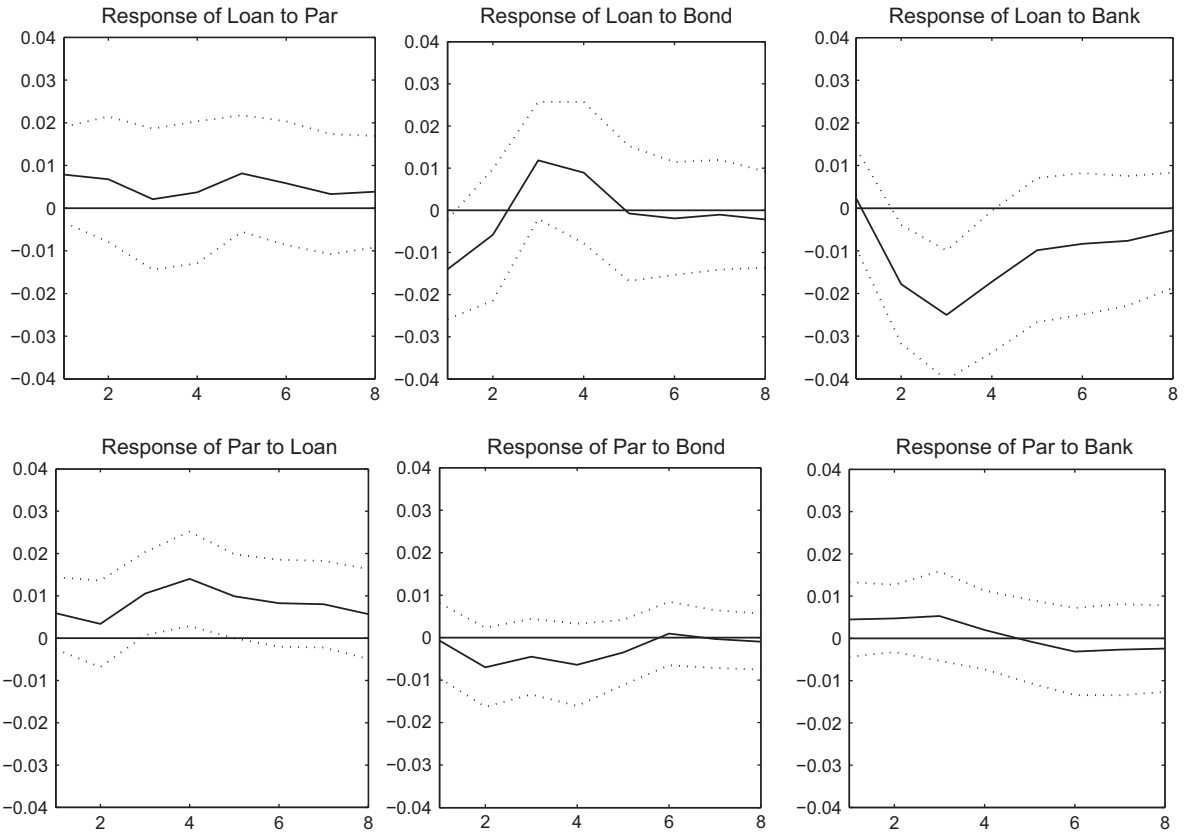

Fig. 2. Impulse response functions from the credit crisis vector autoregression (VAR). The solid lines plot the impulse responses to a generalized one standard deviation innovation from the credit crisis VAR specification reported in Table 3. The dotted lines show the two standard deviation confidence bands for the impulse response functions.

the ordering of the variables in the VAR.[10] Finally, it is important to note that the VAR specification we estimate is a simple reduced-form VAR. Thus, our approach is equivalent to simply regressing each dependent variable on three lags of itself and the other explanatory variables. In particular, we do not attempt the much more difficult task of estimating a structural VAR, which would require a significant number of additional assumptions to identify exogenous relations between the variables.

We focus first on the equations for bank loan growth and corporate bond market growth. The results indicate that both bank loan growth and corporate bond market growth tend to be serially correlated over time. In particular, an increase in current bank loan growth forecasts future bank loan growth, and similarly for corporate bond market growth. Not surprisingly, the results for the loan equation show that when a banking crisis occurs, the growth rate of bank loans declines significantly the next year. Thus, banking crises are typically associated with a contraction of banking credit, consistent with Schularick and Taylor (2012) and many others. In contrast, no evidence exists of a decline in corporate bond market growth when a corporate credit crisis occurs. This result reinforces the view in the literature that the banking sector plays a unique but more fragile role in providing credit to borrowers than does the capital market.

We also examine whether increases in bank lending lead to an increase in the size of the corporate bond market, or vice versa. As shown in Table 3, none of the lagged values of corporate bond market growth is individually significant in explaining bank credit growth. The results in Panel B show that corporate bond market growth does not Granger cause bank loan growth, which is also evident from the impulse response function. In contrast, the *p*-value for the test of Granger causality from bank loan growth to corporate bond market growth is 0.1075, which just misses being significant at the 10% level, and the impulse response function shows that there is a significant effect after four or five periods. Thus, mild evidence exists that bank loan growth tends to be followed by corporate bond market growth.

Turning to the central issue of credit substitution, the results illustrate that there is an important asymmetry between the two types of crises. In particular, a corporate default crisis results in a significant increase in the growth rate of bank loans in the second subsequent year (*t*-statistic is 2.26). Furthermore, the test for Granger

[10] However, this approach computes the impulse response for each variable by essentially assuming that the variable is first in the Cholesky decomposition. Thus, the invariance to the ordering is based on this assumption. As a robustness check, we compute the impulse response functions using the standard Cholesky decomposition approach and find that they are similar to those we report.

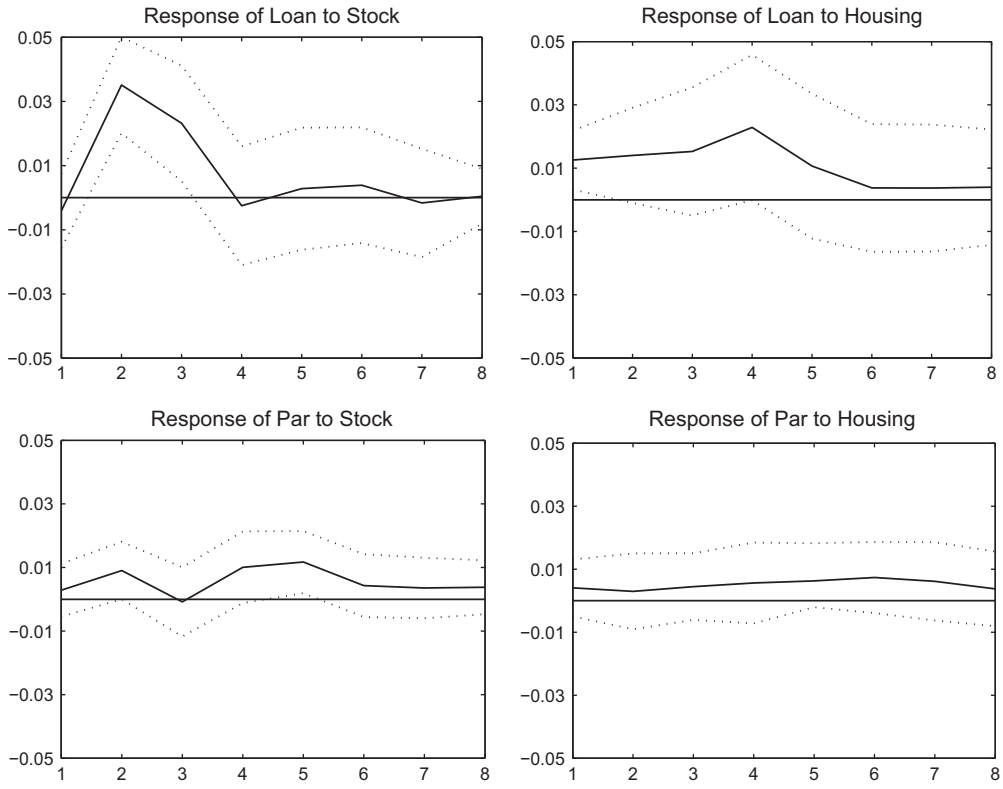

Fig. 3. Impulse response functions from the collateral vector autoregression (VAR). The solid lines plot the impulse responses to a generalized one standard deviation innovation from the collateral VAR specification reported in Table 4. The dotted lines show the two standard deviation confidence bands for the impulse response functions.

causality from the lagged bond crisis variables to bank loan growth is significant (at the 10% level). This can also be seen from the impulse response functions plotted in Fig. 1. In contrast, no significant relation exists between lagged bank crisis indicators and subsequent corporate bond market growth based on the *t*-statistics for the individual coefficients, the Granger causality test, or the impulse response function. These results are consistent with a scenario in which large firms are able to turn to bank lending as an alternative source of credit after a crisis in the corporate bond market. This result also parallels Ivashina and Scharfstein (2010), who show that while most types of bank lending declined during the recent financial crisis, a significant increase is evident in the amount of commercial and industrial loans provided to large corporate borrowers in the wake of the Lehman default crisis. They show that this increase in commercial and industrial lending was due mainly to large corporations drawing on their existing banking lines of credit as the capital markets seized up after the defaults or reorganizations of Lehman, AIG, Federal National Mortgage Association, Federal Home Loan Mortgage Corporation, etc. In contrast, there is no evidence of credit substitution effects after a banking crisis. In summary, the results support the view that the credit channel mechanism described by Bernanke (1983) could be present in banking crises, but not in default crises.

Turning now to the equations for the bank crisis and corporate default crisis indicators, Table 3 shows no clear evidence that an increase in bank loans outstanding is related to subsequent bank crises. While this result could seem somewhat inconsistent with Schularick and Taylor (2012), we observe that their conclusions are based on a cross section of countries while ours are limited to the US. The results show that an increase in bank loans reduces the prospect of a corporate default crisis (based both on *t*-statistics and the test for Granger causality). Thus, these results suggest that increases in the amount of bank credit in the markets have beneficial effects on default risk in the corporate bond markets. The same results do not hold for increases in the amount of corporate bonds outstanding. In particular, while an increase in the size of the corporate bond market is associated with a decline in subsequent banking crises, it is also associated with an increase in subsequent corporate debt crises.

Taken together, these results again underscore that bank credit plays a unique role in the macroeconomy that is not easily replicated by other types of credit. Finally, the VAR results indicate that both bank crises and corporate default crises tend to be persistent.

5. The role of collateral

Collateral could play a much smaller role in the corporate bond market than it does in the banking sector. To explore this possibility, we again use a VAR framework to examine the effects on lending activity of shocks in two

important asset classes: housing and the stock market. Several reasons can be cited for focusing on these two asset classes. For example, real estate and securities have often been used as collateral in secured lending transactions. In addition, historical data are available for stock returns and housing values for most of our study period. While other types of assets could be used as collateral in bank lending, these two asset classes together represent a major portion of the total amount of assets in the economy.[11] The stock returns are based on the historical time series provided by Schwert (1990) as well as the Center for Research in Security Prices (CRSP) value-weighted index, and the housing returns are based on the nominal housing index reported in Shiller (2005).

Specifically, we estimate a five-equation reduced-form VAR specification for bank loan growth, corporate bond market growth, stock returns, housing returns, and inflation. We include inflation in the VAR specification given that Bernanke (1983) and others have emphasized the effect of declines in the price level (debt-deflation) on the value of collateral as an important propagator of the Great Depression. By including the inflation rate in the VAR specification, we can control for debt-deflation effects in examining the relation between changes in collateral values and the provision of credit by banks and the corporate capital markets. As before, we use three lags in the VAR specification based on the Akaike information and Schwartz criteria. The sample period for the VAR is 1900–1940, 1948–2008 (102 observations). Panel A of Table 4 reports the coefficient estimates and the *t*-statistics for the lagged variables for each of the VAR equations along with the corresponding adjusted R^2s. Panel B of Table 4 reports the *p*-values for the test of Granger causality from the indicated lagged explanatory variable to the dependent variable in each equation. Fig. 3 plots selected impulse response functions for the VAR model.

As shown, a highly significant relation exists between the return on the stock market and the growth rate of banking lending during the subsequent year. The *t*-statistic for the lagged stock market return is nearly seven, and the Granger causality test and impulse response function provide similar strong support for the relation. The positive sign of the coefficient implies that a negative stock return tends to be followed by lower bank loan growth. Similarly, there is a significant (at the 10% level) relation between changes in housing values and the growth rate of bank lending the next year. Although the Granger causality test for this relation is not significant, the impulse response function is significant at four lags. Again, the positive sign of the coefficient implies that declines in housing values map into lower subsequent availability in bank credit or a reduction in demand. These relations between stock and housing returns and subsequent bank lending growth are significant even after controlling for the inflation or deflation rate, indicating that these collateral effects are not simply proxying for debt-deflation effects of the type described by Bernanke (1983). Furthermore, both of these stock and housing return results are consistent with standard collateral-based macroeconomic models such as Kiyotaki and Moore (1997), which imply that bank lending could decrease precipitously in the wake of a major decline in collateral values.[12]

In contrast, Table 4 shows that the relation between stock market and housing returns and the subsequent growth rate in corporate bonds outstanding is much weaker. In particular, the *t*-statistic for the first lagged stock return in the corporate bond market growth equation is only 1.83, and none of the lagged values of the housing returns is significant. The Granger causality tests and impulse response functions are consistent with these patterns. These results are probably not all that surprising given that the vast majority of corporate bonds are issued on an uncollateralized basis. Nevertheless, confirming that there is little link between corporate debt issuance and the values of major asset classes is important because it allows us to attribute differences in the macroeconomic effects of banking and default crises more directly to the role of the collateral channel. In summary, the results lend support to the view that the collateral channel could play a much larger and direct role in banking crises.[13]

The results for the stock and housing return equations off the VAR show that stock returns are difficult to forecast on the basis of the variables used in the VAR. In contrast, housing returns tend to be forecastable based on their own lagged values and on lagged stock returns. Similarly, the inflation rate is forecastable on the basis of its lagged values and also on lagged housing returns. Neither stock returns, housing returns, nor inflation rates are forecastable using loan and bond market growth rates.

Finally, while corporate bonds might not be explicitly collateralized, one could view them as being collateralized in a broad sense by the corporation's business value because the bondholders take over the firm in the event of a default. Recovery rates on unsecured corporate bonds, however, have tended to be much lower historically than recovery rates on secured borrowing such as bank debt. For example, Moody's Investors Service (2011) estimates that the recovery rate on senior secured bank loans was 65.8% during the 1982–2010 period, and the recovery rate on senior unsecured bonds was only 36.7% during the same period. Similar results are reported by Altman, Brady, Resti, and Sironi (2005), Acharya, Bharath, and Srinivasan (2007), and Jankowitsch, Nagler, and Subrahmanyam (2013), and others. These considerations

[11] To illustrate the importance of these two asset classes, we observe that the value of household real estate represented 21.66%, 26.76%, and 22.74% of total household wealth in the years 1950, 1980, and 2010, respectively [based on Federal Reserve Board Flow of Funds Data (Release Z.1)]. Similarly, the value of corporate equity and mutual fund holdings represented 11.85%, 8.71%, and 18.21% of total household wealth in the same three years, respectively.

[12] Kiyotaki and Moore (1997) illustrate the collateral channel mechanism using the example of real estate values.

[13] As a robustness check, we also estimate a version of the VAR in which we include contemporaneous changes in GDP and industrial production. The reason for this is to ensure that the significance of lagged stock returns is not simply due to the stock market anticipating subsequent macroeconomic conditions. The results from this specification about the significance of stock returns and housing returns are similar to those reported in Table 4.

Table 4
Collateral vector autoregression (VAR) results.

Panel A reports summary statistics from the estimation of a five-equation three-lag VAR specification for bank loan growth rates, corporate bond market growth rates, stock returns, housing returns, and inflation rates. *Loan* denotes the annual percentage change in the outstanding amount of bank loans. *Par* denotes the annual percentage change in the par amount of corporate bonds outstanding. *Stock* denotes the annual stock market return. *Housing* denotes the annual return on the nominal housing index. *Inflation* is the annual percentage change in the consumer price index. Coefficient denotes the coefficient for the indicated lagged explanatory variable. ***, **, and * denote significance at the 1%, 5%, and 10% levels, respectively. Panel B reports the *p*-values for the test of Granger causality from the indicated lagged explanatory variables to the indicated dependent variable. The sample period is 1900–1940, 1948–2008 (102 observations).

Panel A: VAR summary statistics

Variable, lag	*Loan* equation		*Par* equation		*Stock* equation		*Housing* equation		*Inflation* equation	
	Coefficient	*t*-Statistic	Coefficient	*t*-Statistic	Coefficient	*t*-Statistic	Coefficient	*t*-Statistic	Coefficient	*t*-Statistic
Intercept	−0.0025	−0.21	0.0091	0.87	0.1405	2.63***	−0.0019	−0.14	0.0051	0.55
Loan										
1	0.5982	4.95***	0.0136	0.13	−0.1654	−0.30	−0.0450	−0.32	0.0882	0.93
2	−0.0246	−0.20	0.0758	0.70	−0.2348	−0.43	0.1034	0.72	−0.0023	−0.02
3	0.1224	1.18	0.1917	2.11**	−0.1791	−0.39	−0.1311	−1.09	0.0776	0.95
Par										
1	−0.1175	−0.95	0.1662	1.54	−0.0854	−0.15	0.0672	0.47	−0.1140	−1.18
2	0.1111	1.00	0.0624	0.64	0.3837	0.77	0.1558	1.21	0.0157	0.18
3	0.0020	0.02	0.2006	2.10**	−0.1929	−0.40	0.0353	0.28	−0.0008	−0.01
Stock										
1	0.1802	6.99***	0.0414	1.83*	0.0001	0.00	0.0614	2.05**	0.0303	1.49
2	0.0066	0.21	−0.0162	−0.58	−0.2368	−1.65*	0.0238	0.64	0.0036	0.14
3	−0.0389	−1.24	0.0407	1.47	0.0373	0.26	−0.0713	−1.95*	−0.0332	−1.34
Housing										
1	0.1831	1.76*	0.0396	0.43	0.3907	0.84	0.3981	3.29***	0.1967	2.41**
2	0.0017	0.02	0.0200	0.21	0.6896	1.45	0.0095	0.08	−0.1735	−2.08**
3	−0.0025	−0.02	0.0043	0.05	−0.4180	−0.92	−0.1175	−0.99	0.2302	2.88***
Inflation										
1	−0.1072	−0.73	0.0529	0.41	0.0683	0.10	0.2974	1.75*	0.6337	5.53***
2	0.1188	0.76	−0.1618	−1.18	−0.0937	−0.13	−0.2219	−1.22	−0.2409	−1.96**
3	−0.0481	−0.37	0.0219	0.19	0.0493	0.08	0.2367	1.57	−0.0405	−0.40
Adj. R^2		0.567		0.278		−0.026		0.205		0.456

Panel B: p-values for Granger causality tests

Lagged explanatory variable	Dependent variable in VAR equation				
	Loan	*Par*	*Stock*	*Housing*	*Inflation*
Loan	0.0000	0.0000	0.7109	0.6489	0.3136
Par	0.5847	0.0028	0.8527	0.3299	0.6166
Stock	0.0000	0.0997	0.3209	0.0059	0.1106
Housing	0.2629	0.9509	0.2002	0.0025	0.0000
Inflation	0.8105	0.5970	0.9988	0.1076	0.0000

could help explain the results in Table 4, which show that stock returns have some forecast power for subsequent corporate bond market growth, but that the effect is much weaker than is the case for bank loan growth.

6. Macroeconomic effects

Is there a difference in the nature of the macroeconomic effects resulting from banking and corporate default crises? To study the macroeconomic effects resulting from a crisis, we focus on three variables for which data are available from 1870: the annual growth rate in per capita real GDP, the annual growth rate in industrial production, and the annual inflation rate. Similar to the analysis in previous sections, we use a five-equation VAR specification that includes these three variables along with an indicator variable for bank crisis periods and an indicator variable for corporate default crisis periods. By including the corporate default crisis indicator, we can examine the macroeconomic effects of a major disruption in the corporate debt markets. By including the banking crisis indicator, we can also contrast the effects of the two types of crises. The sample period for the VAR is 1870–2008 (139 observations). Panel A of Table 5 reports the coefficient estimates and the *t*-statistics for the lagged variables for each of the VAR equations along with the corresponding adjusted R^2s. Panel B of Table 5 reports the *p*-values for the test of Granger causality from the indicated lagged

Table 5
Macroeconomic effects vector autoregression (VAR) results.

Panel A report summary statistics from the estimation of a five-equation three-lag VAR specification for gross domestic product (GDP), industrial production, inflation, banking crisis indicators, and corporate default crisis indicators. *GDP* denotes the annual percentage change in GDP. *IP* denotes the annual percentage change in industrial production. *Inflation* denotes the annual percentage change in the consumer price index. *Bank* is an indicator variable that takes value one during a banking crisis and zero otherwise. *Bond* is an indicator variable that takes value one during a corporate default crisis and zero otherwise. Coefficient denotes the coefficient for the indicated lagged explanatory variable. ***, **, and * denote significance at the 1%, 5%, and 10% level, respectively. Panel B reports the *p*-values for the test of Granger causality from the indicated lagged explanatory variables to the indicated dependent variable. The sample period is 1870–2008 (139 observations).

Panel A: *VAR summary statistics*

Variable, lag	*GDP* equation		*IP* equation		*Inflation* equation		*Bank* equation		*Bond* equation	
	Coefficient	*t*-Statistic	Coefficient	*t*-Statistic	Coefficient	*t*-Statistic	Coefficient	*t*-Statistic	Coefficient	*t*-Statistic
Intercept	−0.0090	−1.14	0.0424	2.49**	0.0196	1.92*	0.1557	3.29***	0.1288	2.22**
GDP										
1	−0.0987	−0.91	−0.0712	0.30	0.1340	0.96	1.7344	2.67***	−0.7839	−0.98
2	0.0310	0.30	−0.0949	−0.42	−0.0167	−0.12	0.2914	0.46	−1.7935	−2.33**
3	−0.1217	−1.45	−0.1387	−0.76	0.0096	0.09	−0.7230	−1.43	0.7599	1.23
IP										
1	0.3515	7.08***	0.0077	0.07	0.1223	1.91*	−0.5751	−1.93*	−0.5521	−1.51
2	0.0789	1.31	−0.1037	−0.80	−0.0435	−0.56	−0.5428	−1.50	0.2489	0.56
3	0.1054	1.91*	0.1240	1.04	0.0046	0.07	−0.2410	−0.73	0.6227	1.53
Inflation										
1	0.0236	0.32	−0.1474	0.93	0.2352	2.47**	−0.7136	−1.61	−0.1940	−0.36
2	0.0558	0.74	0.0070	0.04	0.0387	0.40	0.3991	0.88	−1.1057	−1.99**
3	0.1146	1.57	0.0139	0.09	0.0366	0.39	−0.8515	−1.95*	−0.2393	−0.45
Bank										
1	−0.0438	−3.07***	−0.1023	−3.32***	−0.0371	−2.01**	0.5457	6.37***	0.1058	1.01
2	0.0607	3.60***	0.0478	1.31	0.0192	0.88	0.1114	1.10	−0.0971	−0.78
3	−0.0148	−0.93	0.0374	1.09	0.0107	0.52	−0.0402	−0.42	0.0725	0.62
Bond										
1	0.0180	1.43	0.0239	0.88	−0.0312	−1.92*	−0.0109	−0.14	0.3812	4.11***
2	−0.0043	−0.32	−0.0198	−0.68	−0.0095	−0.54	−0.1590	−1.96**	0.0462	0.47
3	0.0092	0.74	0.0374	1.40	0.0012	0.08	−0.0393	−0.53	0.1578	1.73*
Adj. R^2		0.363		0.088		0.185		0.391		0.401

Panel B: *p-values for Granger causality tests*

Lagged explanatory variable	Dependent variable in VAR equation				
	GDP	*IP*	*Inflation*	*Bank*	*Bond*
GDP	0.4289	0.6359	0.8459	0.0774	0.1226
IP	0.0000	0.3994	0.2461	0.2833	0.1717
Inflation	0.3643	0.0643	0.1087	0.1572	0.2194
Bank	0.0039	0.0151	0.3313	0.0000	0.7194
Bond	0.3941	0.2955	0.1442	0.0719	0.0000

explanatory variable to the dependent variable in each equation. Fig. 4 plots selected impulse response functions for the VAR model.

The results show that banking crises have significant predictive power for both subsequent GDP and industrial production growth rates. In particular, the coefficient for the first lagged banking crisis indicator is significant in both the GDP and industrial production regressions. Furthermore, these significant coefficients are both negative in sign, indicating that banking crises are followed by declines in real output. The tests for Granger causality also show a strong significant relation between bank crises and subsequent output. This can also be seen clearly from the impulse response functions shown in Fig. 4. These results are consistent with the extensive literature showing that banking crises have large negative effects on the macroeconomy.

In sharp contrast, the results in Table 5 indicate that corporate default crises do not have any significant effects on output. In particular, the lagged values of the corporate default crisis indicator do not forecast subsequent changes in GDP or industrial production. Similarly, there is no evidence of Granger causality from the lagged corporate default crisis indicators to either changes in GDP or industrial production, based on the Granger causality tests in Panel B or on the impulse response functions. These results are consistent with the implications of the banking crisis literature discussed earlier in the paper.

The results for the inflation equation show that the first lagged value of both the bank crisis and corporate default

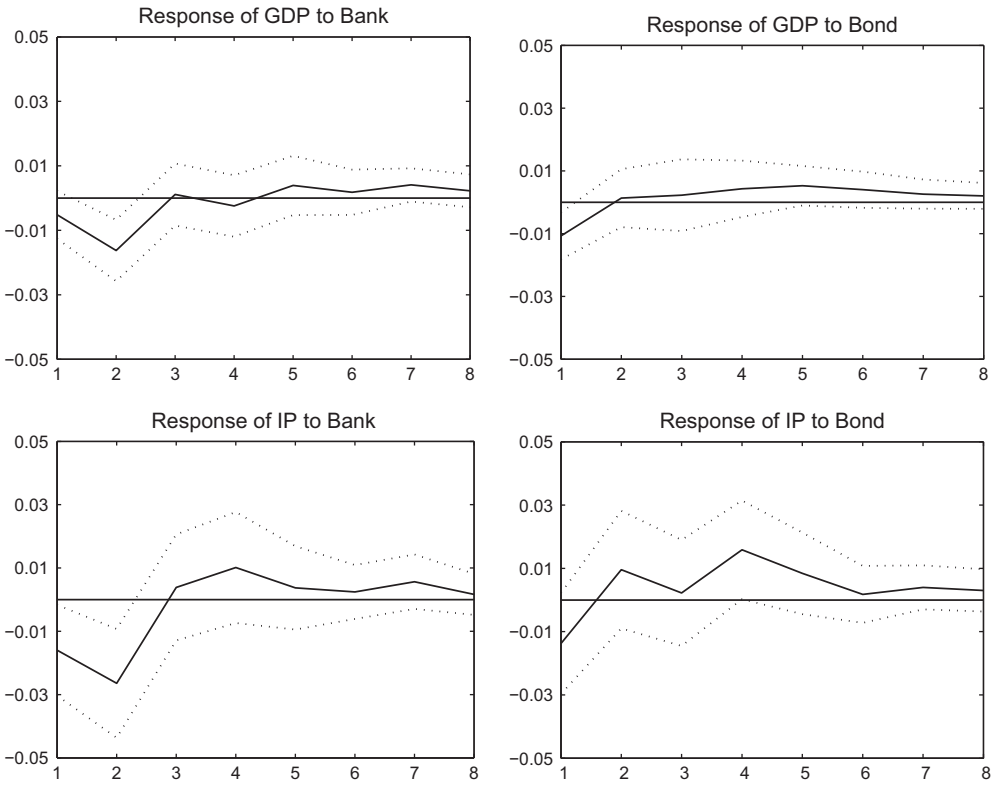

Fig. 4. Impulse response functions from the macroeconomic effects vector autoregression (VAR). The solid lines plot the impulse responses to a generalized one standard deviation innovation from the macroeconomic effects VAR specification reported in Table 5. The dotted lines show the two standard deviation confidence bands for the impulse response functions.

crisis indicators are significant in forecasting inflation. In addition, both of these significant coefficients are negative in sign, indicating that the two types of crises tend to be followed by a decline in the inflation rate. These results complement previous research on the monetary effects of banking crises such as Garcia-Herrero (1997), Calomiris and Mason (2003a), Kaehler (2010), Qian, Reinhart, and Rogoff (2011), and others. While the first lagged values of the bank crisis and corporate default crisis indicators are significant, we cannot reject the hypothesis that no Granger causality exists between these indicators and subsequent inflation based on the Granger causality tests in Panel B of Table 5.

Finally, the bank crisis and corporate default crisis equations in the VAR show that lagged changes in GDP have some forecast power for subsequent crises. For example, the first lagged change in GDP is significant in forecasting bank crises, and the second lagged change in GDP is significant in forecasting corporate default crises. However, only the relation between GDP changes and bank crises is significant (at the 10% level) based on the Granger causality tests. One additional interesting result is that either the second or third lagged inflation rate is significantly negative in both the bank crisis and corporate default crisis equations. This is consistent with the debt-deflation interpretation in which deflation or lower inflation rates increase the risk of financial distress because of the change in the real value of indebtedness.

7. Discussion

Bank debt is a major constituent of private debt contracts, and corporate bonds are major examples of public debt contracts. As such, they differ along a number of important dimensions that can help articulate the economic mechanisms that determine why these types of debt and their associated crises have different macroeconomic real effects.

First, bank debt has covenants that are both more numerous and tighter than corporate bonds.[14] Long-term corporate bonds have mainly negative covenants (i.e., covenants preventing firms from engaging in certain types of activities), and short-term corporate debt (such as commercial paper) has very few covenants at all. At the same time, bank (and nonbank private) debt typically also has affirmative covenants (requiring firms to maintain certain financial metrics such as new worth or interest coverage ratio covenants) in addition to negative covenants. The macroeconomic implication is that a relatively small decrease in asset and collateral values is sufficient for firms to violate bank covenants and enter default or renegotiate their obligations, and a large decline in asset values is needed for firms to default on corporate bonds.

[14] For example, see Kahan and Tuckman (1996), who compare covenants of privately placed debt and public bonds.

Second, bank debt is typically of short-term maturity, and corporate bonds typically are of long-term maturity. For example, James (1987) reports that the average maturity of US nonfinancial bank debt is 5.6 years, and the average maturity of publicly listed debt (mostly corporate bonds) is 18 years at issuance. Moreover, a large fraction of bank debt is in the form of short-term (less than one year) credit lines. In the earlier part of our sample, the maturity of corporate bonds is likely even larger as they were issued mostly to finance long-duration enterprises such as railroads. In terms of macroeconomic implications, at the time of the crises when a large fraction of bank debt is needed to be refinanced, liquidity becomes an all-important issue. This might lead to snowball effects. As public debt has longer maturity, liquidity issues are much less important.

Third, bank debt is typically collateralized, and public debt is not. Furthermore, bank debt is typically senior to public debt if firms have both bank debt and public debt outstanding. Clearly, this means that a decline in collateral values has a larger impact on firms that have bank debt outstanding than those with public debt.

These three features need to be considered together. Small firms, which predominantly have access to bank debt, face shorter maturities, have tighter covenants, and pledge higher collateral than their large counterparts. Thus, they are more likely to be affected by the collateral and related channels; large firms, less effected. This could have important implications for macro policy, although it is important to take into account the advantages of bank debt for small firms in terms of long-term relations and monitoring.

8. Conclusion

Even though the size of the corporate bond market over the past 150 years is on the same order of magnitude as the bank lending market, we find that banking crises have much graver implications for the macroeconomy than do corporate default crises. Banking crises are followed by decreased output and lower inflation rates. Corporate bond market crises appear to have little or no effect on GDP and industrial output.

These results provide a new perspective on the importance of the banking credit channel in the propagation of economic downturns. Current theory suggests that the reason that banking crises have such large real effects is that small and medium borrowers become credit constrained during a crisis. The flip side of this argument is that a crisis in a credit market that is accessed only by large borrowers should have much smaller effects. Not only do we find that the macroeconomic effects of a corporate default crisis are much less severe, but we also find evidence consistent with a scenario in which large borrowers are able to tap the bank lending market when the corporate capital market is experiencing severe distress. Clearly, however, it would be desirable to have additional direct evidence that the differences in results are due to the relative sizes of borrowers in the banking and corporate bond markets.

Similarly, these results also provide support for the importance of the collateral channel in banking crisis. This is because collateral plays a much smaller role in corporate bond markets than in the banking sector. Thus, another reason that banking crises have much larger effects on the macroeconomy than default crises could simply be that the shocks to the value of collateral could restrict the access of bank borrowers to obtain credit, but not the ability of large firms to issue corporate bonds.

Appendix A

This appendix briefly describes the variables used in the paper along with the source of the data.

Corporate bond default rates: The value-weighted US nonfinancial corporate bond default rates from 1866 to 2010 are in an Online Appendix. The data sources, default definitions, and empirical approach used to construct the time series of corporate bond default rates are shown in detail in the Appendix of Giesecke, Longstaff, Schaefer, and Strebulaev (2011).

Corporate bond market crisis dates: These dates are given in Table 2.

Bank crisis dates: The dates of banking crises are taken from Schularick and Taylor (2012) and are listed in Section 2.

Corporate bond market growth rates: Annual growth rates in the notional size of the US corporate bond market are based on three sources. The size of the corporate bond market from 1900–1944 is given in Table A6 of Hickman (1953) (straight bonds, large issues only). The size of the corporate bond market from 1945 to 1965 is given in Table 21 of Atkinson (1967). The size of the corporate bond market from 1970 to 2008 is based on the total amount of nonfinancial corporate bonds reported as line 2 of Table L.212 of the Flow of Funds Accounts of the United States reported by the Board of Governors of the Federal Reserve System (release Z.1). Values for missing dates are linearly interpolated from available data for the closest matching dates.

Bank loan growth rates: Annual bank loan growth rates are based on the bank loan data provided in the online data Appendix to Schularick and Taylor (2012).

Stock market returns: The annual stock market return time series is given by first using the monthly stock return data for 1802–1929 provided by Schwert (1990) to compute annual returns for this period, and then using the CRSP annual value-weighted stock market return index for the subsequent period.

Housing values: Percentage changes in housing values for 1890–2008 are based on the nominal home price index data given in Fig. 2.1 of Shiller (2005) (updated data available on Robert Shiller's website: http://www.econ.yale.edu/ shiller/data.htm).

GDP growth rate: Annual GDP growth rates are based on the real GDP estimates for the US for 1870–2008 provided in the Online data Appendix of Schularick and Taylor (2012).

Industrial production growth rate: Annual industrial production growth rates are based on data from three sources. Industrial production data for the 1865–1915 period are given in Davis (2004). For the 1916–1920 period, we use the total physical production data provided by the NBER as macroeconomic series a01008a. Data for

the 1921–2008 period are obtained from the Federal Reserve Board, series G17.

Inflation: Annual inflation rates for 1871–2008 are based on the consumer price index data given in Chapter 26 of Shiller (2005) (updated data available on Robert Shiller's website: http://www.econ.yale.edu/ shiller/data.htm).

Appendix B. Supplementary data

Supplementary data associated with this article can be found in the online version at http://dx.doi.org/10.1016/j.jfineco.2013.10.014.

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