Bank Lending Standards, Loan Demand, and the Macroeconomy: Evidence from the Korean Bank Loan Officer Survey*

Sangyup Choi
Yonsei University

A typical sign-restriction approach imposes restrictions on the bank lending rate (price) and the volume of loans (quantity) to identify a loan supply shock under the implicit assumption that the observed interest rate equates supply and demand for loans. Using the bank loan officer surveys from 12 countries, we document a novel cyclical pattern found in bank lending standards and loan demand, which differs between market-based and bank-based economies. In particular, the lending rate does not necessarily reflect the credit market conditions in bank-based economies, suggesting the presence of excess demand for credit. Using the Korean economy as an example, we demonstrate the failure of identification of loan supply shocks when relying on the lending rate and propose novel

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identifying schemes by exploiting the information from the bank loan officer survey. Our findings suggest that disentangling the supply and demand factors of credit shocks is crucial in understanding their macroeconomic effects.

E32, E44, E51.

1. Introduction

Are credit shocks an important driver of the macroeconomy? Various theoretical models have been proposed to understand the mechanism through which an exogenous shock to credit markets drives fluctuations in output (Holmstrom and Tirole 1997; Kiyotaki and Moore 1997). Indeed, the recent episodes of widespread credit crunches and recessions following the collapse of Lehman Brothers have spurred renewed interest in understanding the link between credit markets and the macroeconomy using a quantitative framework (Gertler and Karadi 2011; Gilchrist and Zakrajšek 2012; Perri and Quadrini 2018).

As earlier studies emphasized, however, identifying a causal link from credit market disturbances to the macroeconomy is challenging because of apparent reverse causality. While declines in credit growth often coincide with recessions, one cannot rule out potential credit demand effects in addition to credit supply effects (Bernanke and Lown 1991; Bernanke and Gertler 1995; Peek, Rosengren, and Tootell 2003; Jiménez et al. 2014; Amiti and Weinstein 2018).[1] Although the sign-restriction approach of Faust (1998), Canova and De Nicolo (2002), and Uhlig (2005) has been widely used to identify credit supply shocks, most applications of this approach impose restrictions on the price of credit—the interest

[1] Another stream of the literature has focused on how exogenous events affect bank credit supply to establish causality between credit markets and economic activity. For example, see Peek and Rosengren (2000) on the Japanese banking crisis in the early 1990s, Leary (2009) on the introduction of certificates of deposits in the early 1960s, and Chava and Purnanandam (2011) on the Russian crisis in 1998. However, these exogenous events provide only limited implications on the effect of credit supply shocks over business cycles because of their one-off nature.

rates on bank loans or corporate bonds—under the implicit assumption that the observed price reflects the underlying credit market conditions.

Whether this assumption holds in the data depends on the degree of credit market imperfection in the economy. If nonprice lending terms are widely used to alleviate information asymmetry or moral hazard, especially during economic downturns (Weinstein and Yafeh 1998; Bae, Kang, and Lim 2002), the observed interest rate may fail to equate supply and demand factors for bank loans. In extreme circumstances, this may result in credit rationing in which the allocation of credit to borrowers is independent of the interest rate (Laffont and Garcia 1977; Stiglitz and Weiss 1981). This issue is more likely to be problematic in bank-based economies, where firms' access to corporate bond markets is rather limited, than in market-based economies (Gyntelberg, Ma, and Remolona 2006; Khwaja and Mian 2008; Gambacorta, Yang, and Tsatsaronis 2014).

We address the identification issue by controlling for loan demand over business cycles using novel bank loan officer survey data. Among the various types of credit, we exclusively focus on bank lending to the business sector because household credit often behaves differently from firm credit (Den Haan and Sterk 2011; Bahadir and Gumus 2016). We aim to disentangle the demand and supply factors in bank lending and evaluate their macroeconomic effects using a Bayesian sign-restriction vector autoregression (VAR) model à la Uhlig (2005). To the best of our knowledge, this is the first attempt to apply a sign-restriction approach to the information from bank loan officer surveys. We are motivated to use this identification strategy by the novel stylized facts about cyclicality in bank lending standards and loan demand across both advanced and emerging market economies (EMEs).

Bank loan officer surveys provide important information about bank lending standards and demand for business loans that is not necessarily captured by the bank lending rate. The U.S. Federal Reserve Board's Senior Loan Officer Opinion Survey on Bank Lending Practices (SLOOS) and the euro-area Bank Lending Survey (BLS) are the best-known bank loan officer surveys. They have been used to identify credit supply shocks in the United States (Lown and Morgan 2006; Bassett et al. 2014; Becker and Ivashina 2014) and more recently in the euro area (Del Giovane, Eramo, and Nobili

2011; Ciccarelli, Maddaloni, and Peydro 2015; van der Veer and Hoeberichts 2016) because tightened lending standards are associated with an adverse shock to credit supply.[2]

However, we cannot identify changes in bank loan supply just using changes in lending standards because of the obvious demand-side interpretation. Tighter standards could signal another negative disturbance to economic activity that reduces demand for loans simultaneously. To overcome this problem, Bassett et al. (2014) adjusted lending standards for macroeconomic and bank-specific factors affecting loan demand using bank-level data and obtained a cleaner measure of loan supply factors. Similarly, Becker and Ivashina (2014) used firm-level information on substitution from bank loans to corporate bonds and commercial papers to control for bank loan demand. Alternatively, Del Giovane, Eramo, and Nobili (2011), Ciccarelli, Maddaloni, and Peydro (2015), and van der Veer and Hoeberichts (2016) exploited bank-level information on the factors behind tightened standards and reduced loan demand from the BLS data to identify a credit supply shock.[3]

Unfortunately, such micro-level information is not readily available in the bank loan officer survey from the rest of the world. Instead, we use a sign-restriction approach to separate the loan supply from the loan demand factors reflected in the aggregate data.[4] We impose sign restrictions on lending standards, loan demand, and the volume of bank loans to jointly identify bank loan demand and supply shocks and estimate their macroeconomic effects. Imposing restrictions on the demand and supply factors proxied by the survey data directly, we obtain a cleaner measure of a loan supply shock that is less subject to the criticism raised by Musso, Neri, and Stracca

[2]For example, Gilchrist and Zakrajšek (2012) found a high correlation between changes in bank lending standards and the excess bond premium—their measure of credit market conditions. See, among others, Dell'Ariccia and Marquez (2006) and Ravn (2016) for the structural interpretation of changes in bank lending standards as an outcome of the information asymmetry between lenders and borrowers.

[3]In the BLS, banks also respond to more detailed questions about the factors affecting their decisions on credit standards, the specific terms and conditions for approving loans, and their assessment of the determinants of loan demand.

[4]Using micro-level data is not a panacea when identifying loan supply shocks, as they typically do not allow us to estimate macroeconomic effects (with the notable exception of Amiti and Weinstein 2018), which is our ultimate interest.

(2011), who noted that "while there is consensus on how to identify monetary policy and housing demand shocks, it is somewhat harder to come up with restrictions for identifying credit supply shocks." Although the sign-restriction approach has been widely used to identify credit supply shocks in advanced economies (Busch, Scharnagh, and Scheithauer 2010; De Nicolò and Lucchetta 2011; Helbling et al. 2011; Hristov, Hülsewig, and Wollmershäuser 2012; Meeks 2012; Finlay and Jääskelä 2014; Halvorsen and Jacobsen 2014; Gambetti and Musso 2017), applications to other countries, especially EMEs, are limited.[5]

This paper has two parts. In the first part, we establish novel stylized facts about bank lending that have not been exploited in the existing literature using the bank loan officer surveys from 12 countries. Although both lending standards and loan demand are strongly procyclical in the SLOOS and BLS data,[6] when extending to the similarly constructed bank loan officer surveys from the 10 additional countries where survey data are available (Chile, Estonia, Hungary, Japan, Korea, Poland, the Philippines, Russia, Thailand, and Turkey), loan demand is acyclical or even countercyclical in many of these countries, which suggests increased bank loan demand during turbulent times.

We further discover that the cyclicality of loan demand is strongly associated with the banking-sector dependence of each economy. In a country where firms rely more on indirect financing via banks, demand for bank loans appears less procyclical. Moreover, using a panel estimation with fixed effects, we find that the bank loan rate does not reflect the demand conditions in bank-based economies only. These stylized facts illustrate why conventional identifying assumptions using the bank lending rate are unsuitable in a bank-based economy where direct financing does not readily substitute bank loans.

[5] To the best of our knowledge, Tamási and Világi (2011) (Hungary) and Houssa, Mohimont, and Otrok (2013) (South Africa) are the only existing studies of EMEs using the sign-restriction approach. However, these studies impose a restriction on output, which prevents them from studying the short-term impact of a loan supply shock on output, or use corporate bond spreads to identify a bank loan supply shock, probably because of limited data availability.

[6] In other words, bank lending standards tighten (loosen) and loan demand decreases (increases) during recessions (expansions).

In the second part, using the Korean economy as a benchmark unit of the Bayesian VAR analysis, we demonstrate the failure of the conventional assumptions used to identify a bank loan supply shock (i.e., standard sign restrictions relying on the price-quantity framework) and provide alternative identification schemes using the bank loan officer survey. Once correctly identified, we find that an adverse loan supply shock has a substantial negative effect on output, while a negative loan demand shock does not have any recessionary effect. Depending on the VAR model specifications, loan supply shocks account for 10–15 percent of output fluctuations in the Korean economy, which is in line with previous studies of other countries using a sign-restriction approach (e.g., Meeks 2012 in the United States; Hristov, Hülsewig, and Wollmershäuser 2012 and Bijsterbosch and Falagiarda 2015 in the euro area; Halvorsen and Jacobsen 2014 in the United Kingdom and Norway; and Helbling et al. 2011 in G-7 countries). During the peak of the global financial crisis, this shock contributes to more than 40 percent of the output decline, suggesting its particular importance under extreme financial conditions.

We then discuss the interpretation of our findings. Using data from the Korean corporate bond market, we explain the contrasting effects on output between a loan supply shock and a loan demand shock. We find that the identified negative loan supply shock acts as a tightening in economy-wide credit supply, reflected in a sharp increase in credit spreads. The identified negative loan demand shock, however, is associated with an improvement in corporate bond market conditions. The substitution of bank loans by corporate bonds that is driven by improved bond market conditions appears the reason why a negative loan demand shock is not recessionary in the Korean economy. Extending the baseline model to jointly identify other structural shocks (monetary policy, aggregate supply, and aggregate demand shocks) embedded in a standard small-scale New Keynesian framework, we confirm the main results of the baseline model. If anything, loan demand and supply shocks have qualitatively different effects on the macroeconomic variables, further suggesting the importance of disentangling supply and demand factors. The additional exercise using Japanese data to validate our findings arrives at similar results.

The rest of this paper is organized as follows. Section 2 documents novel stylized facts about the cyclicality in lending standards and loan demand across 12 countries and provides the panel estimation results for the determinants of the bank lending rate. Section 3 illustrates the issues with the conventional identification of a loan supply shock using a sign-restriction approach and proposes an alternative approach using the survey data. Section 4 presents the key findings by estimating a baseline model with the Korean data and discusses the mechanism at work. Section 5 provides a battery of robustness checks, including an extension to the small-scale New Keynesian model and using Japanese data. Section 6 concludes the paper.

2. Stylized Facts from the Bank Loan Officer Surveys

This section provides a set of new empirical stylized facts by exploiting the bank loan officer surveys from 12 countries, including four advanced economies (the United States, the euro area, Korea, and Japan) and eight EMEs (Chile, Estonia, Hungary, the Philippines, Poland, Russia, Thailand, and Turkey), in which the relevant data are available for more than 30 quarters. Although such data have been available in the current format for the United States since 1991:Q4, they are available for much shorter periods in most countries. As a result, bank loan officer surveys have been largely unexploited, especially in the EME context. We bridge this gap in the literature by providing a novel systematic analysis that uncovers interesting heterogeneity in the determinants of the interest rate as well as its link to the corporate financing structure.

2.1 Cyclicality of Bank Lending Standards and Loan Demand

We first document the cyclical pattern of bank lending standards and loan demand in the United States and the euro area as benchmarks. U.S. data are taken from the SLOOS, and euro-area data are from the BLS. See online appendix C (at http://www.ijcb.org) for further details on the U.S. and euro-area survey data. Figure A.1 in online appendix A shows lending standards and demand for business loans in the United States from 1991:Q4 to 2019:Q2 (left) and the euro area from 2003:Q1 to 2019:Q1 (right), together with the recession dates defined by the OECD. An increase in the index of lending standards denotes relaxed lending standards for new loans.[7] Over business cycles, lending standards move closely with loan demand in both economies and both fall sharply during recessions, indicating that both lending standards and loan demand are procyclical in these economies.

We further document the cyclical pattern of lending standards and loan demand in the eight EMEs as well as Korea and Japan to assess whether the pattern found in the United States and euro area can be generalized to the rest of the world. We check the main questionnaires across countries, carefully using their central bank websites. We focus only on questions on lending to the business sector, not the household sector, to ensure consistency with the U.S. and euro-area data. Compared with figure A.1 in online appendix A, the EME data in figure 1 show an interesting cyclical pattern. In general, there is much weaker co-movement between lending standards and loan demand over business cycles.[8]

We argue that such a difference is not simply driven by the difference in income level or the (potentially) poor quality of the bank loan officer surveys in EMEs, as a similar pattern from the two additional advanced economies (Korea and Japan) is found (figure 2). Among the countries in which relevant survey data are available, Korea and Japan are characterized by firms' heavy reliance on bank financing via lending relationships over direct financing (Weinstein and Yafeh 1998; Bae, Kang, and Lim 2002).[9] Indeed, loan demand does not appear to be procyclical in these two countries, and it increased shortly after the collapse of Lehman Brothers, while banks tightened their lending standards.[10]

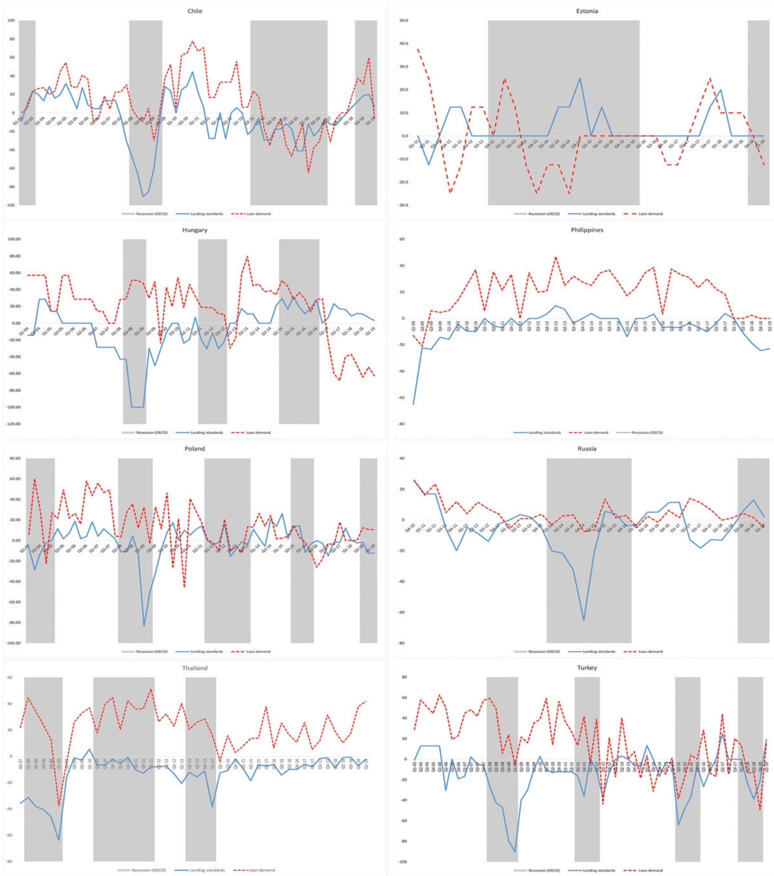
[7]For consistency across countries, we reverse the sign of the lending standards in the original data if an increase denotes tightening.

[8]Discrepancies in the questionnaires do not explain this difference, because the EME bank loan officer survey takes the SLOOS as a benchmark and essentially asks the same questions (see online appendix C for the sources and coverage of surveys as well as examples of the main questionnaires). Thus, the compatibility of the survey is not the primary concern here.

[9]As shown in figure A.2 in online appendix A, banks are still the primary source of corporate financing in the two countries.

[10]The sharp increase in the loan demand of Japanese firms during the global financial crisis is particularly helpful for understanding the factors underlying the cyclical behavior of bank loan demand. The Financial Systems and Bank Examination Department of the Bank of Japan provides detailed information about the

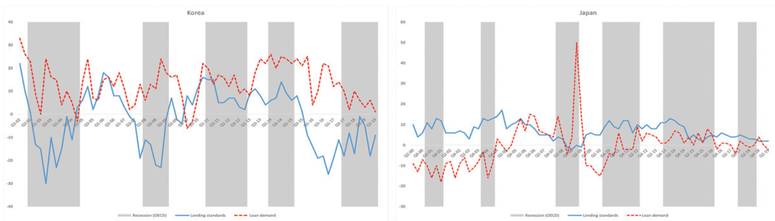
Figure 1. Lending Standards and Loan Demand: Emerging Market Economies



Notes: This figure shows changes in lending standards towards new business loans (solid) and demand for business loans (dashed) in EMEs. Shaded areas denote the recession dates defined by the OECD. Recession dates for the Philippines are not available. The signs of the lending standards in the original data are reversed so that a decrease denotes tightening. See online appendix C for further details on the construction of indexes.

survey results. In 2008:Q4, 22 percent and 44 percent of banks report substantially and modestly stronger loan demand from firms, respectively, whereas only 2 percent report weaker loan demand. Among banks experiencing stronger loan demand, the most important factor attributable to this increase is "customers'

Figure 2. Lending Standards and Loan Demand: Korea (left) and Japan (right)



Notes: This figure shows changes in lending standards towards new business loans (solid) and demand for business loans (dashed) in Korea (left) and Japan (right). Shaded areas denote the recession dates defined by the OECD. The signs of the lending standards in the original data are reversed so that a decrease indicates tightening. See online appendix C for further details on the construction of indexes.

Table 1 summarizes the cyclical pattern shown in the previous graphs as well as the country-level bank dependency ratio to provide a greater structural interpretation. The cyclicality of bank lending standards and loan demand is computed as their correlation with (quarter-over-quarter) real GDP growth. The bank dependency ratio is the ratio of bank credit to the private sector expressed as a percentage of the sum of bank credit plus bond and equity market capitalization averaged from 2001 to 2011. A higher value of the indicator suggests a more bank-oriented financial structure (Gambacorta, Yang, and Tsatsaronis 2014). These data, which provide the relative importance of the banking sector in corporate financing, contain information beyond the absolute importance of the banking sector—often measured by the ratio of bank credit to GDP.[11]

On average, both bank lending standards and loan demand are procyclical, consistent with the well-known "simultaneity problem" when identifying a bank loan supply shock (Jiménez et al. 2014;

borrowing shifted from other sources to your bank," followed by "customers' internally generated funds decreased" and "customers' funding from other sources became difficult to obtain." Hence, an increase in bank loan demand is clearly a consequence of credit market imperfections rather than an increase in investment opportunities.

[11]No aggregate data on the euro area exist.

Table 1. Banking-Sector Dependency and the Cyclicality of Lending Standards and Loan Demand

Country	**Period**	**Bank Dependence**	$Corr(\Delta y, \Delta s_t)$	$Corr(\Delta y, \Delta d_t)$
		Advanced Economies		
United States	1991:Q1–2019:Q2	0.19	0.48*	0.30*
Euro Area	2003:Q1–2019:Q2	N/A	0.69*	0.55*
Japan	2000:Q2–2019:Q2	0.42	0.13	−0.05
Korea	2002:Q1–2019:Q1	0.41	0.24*	0.03
		Emerging Market Economies		
Chile	2003:Q1–2019:Q1	0.33	0.48*	0.46*
Estonia	2011:Q1–2019:Q1	0.61	0.01	0.18
Hungary	2002:Q3–2019:Q1	0.63	0.63*	−0.18
Philippines	2009:Q1–2019:Q1	0.37	0.61*	0.27
Poland	2004:Q1–2019:Q1	0.56	0.03	0.10
Russia	2010:Q4–2019:Q1	0.33	0.49*	0.46*
Thailand	2007:Q4–2019:Q1	0.52	0.16	0.25
Turkey	2005:Q1–2019:Q1	0.46	0.38*	0.16
Average		0.43	0.37	0.21

Notes: Bank dependence is measured by the ratio of bank credit to the private sector to the sum of bank credit plus bond and equity market capitalization. A higher value of the indicator suggests a financial structure that is more bank oriented (Gambacorta, Yang, and Tsatsaronis 2014). $Corr(\Delta y, \Delta s_t)$ denotes the correlation between real GDP growth rate and changes in lending standards, whereas $Corr(\Delta y, \Delta d_t)$ denotes the correlation between real GDP growth rate and changes in loan demand. Countries with bank loan officer surveys that are available for more than 30 quarters are included. The bank loan officer survey for Hungary is at a semi-annual frequency before 2009:Q1. * denotes that the correlation is statistically significant at the 5 percent level.

Amiti and Weinstein 2018). However, the substantial heterogeneity across countries masks the average cyclicality, especially in loan demand. In many economies, bank loan demand is acyclical or even countercyclical, which is in sharp contrast to the United States and euro area. The imperfect substitutability between direct and indirect financing and higher dependence on the banking sector as a source of corporate borrowing could explain the distinct pattern.

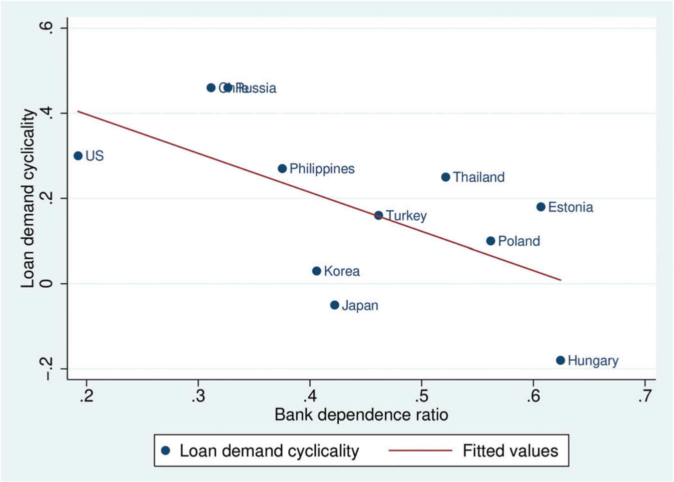
First, bank loan demand may increase during turbulent times if firms have limited access to market finance, as they look to finance countercyclical liquidity needs to manage inventories and trade payables and working capital (e.g., Gertler and Gilchrist 1993). The detailed information from the Japanese bank loan survey about the factors driving the increase in bank loan demand during the global financial crisis is fully consistent with this case. Second, banks also treat firms differently in times of financial distress because they are long-term players in the debt market, whereas bondholders or equity holders are not. Acquiring information about firms, banks attract firms that are likely to face temporary financial distress (e.g., Chemmanur and Fulghieri 1994 and De Fiore and Uhlig 2011). A firm's preference for bank debt over public debt during turbulent times due to credit market imperfections is, therefore, compatible with higher bank dependence in the steady state.

We provide suggestive evidence for this hypothesis by plotting the cyclicality of bank loan demand against the bank dependency ratio. As shown in figure 3, there is a robust negative relationship between the two factors: loan demand is less procyclical in a country with higher banking-sector dependence.[12] Interestingly, Chile and Russia, which have the largest procyclicality of loan demand comparable to the United States, also have the lowest banking-sector dependence. Figure A.3 in online appendix A confirms that this pattern hardly changes when we include offshore bank lending.

Taken together, this empirical regularity implies that economic development does not necessarily translate into the development of public debt markets, and thus banks could still play a unique role

[12]Despite the small sample, the relationship between the two is strong: while the correlation is −0.62 and the associated p-value is 0.04, Spearman's rank correlation coefficient is −0.71, and the associated p-value is 0.02.

Figure 3. Correlation between the Banking-Sector Dependency and the Cyclicality of Loan Demand



Notes: Bank dependence ratio is the ratio of bank credit to the private sector that is expressed as a percentage of the sum of bank credit plus bond and equity market capitalization. A higher value of the indicator suggests a financial structure that is more bank oriented (Gambacorta, Yang, and Tsatsaronis 2014). Bank loan officer surveys of emerging economies available for more than 30 quarters are included. The bank loan officer survey for Hungary is at a semi-annual frequency before 2009:Q1. The cyclicality of loan demand is taken from table 1.

in providing credit even in advanced economies.[13] Although a small sample prevents us drawing a clear-cut conclusion, the decline in the volume of bank lending during recessions in countries with higher bank dependency is likely to be driven by a supply-side disruption in contrast to the United States and euro area, where both supply and demand factors contribute to the reduction in the volume of bank lending. Thus, ignoring confounding factors is likely to underestimate the adverse effect of a loan supply shock in bank-based economies.

[13]For example, Demirguc-Kunt and Levine (2001) found that legal origin is an important determinant of the bank- and market-based financial structure across a large group of countries.

2.2 Determinants of the Bank Lending Rate

Motivated by the distinct pattern in the cyclicality of loan demand in bank-based economies, we ask whether the bank lending rate in these countries truly reflects credit market conditions. If not, the observed bank lending rate could fail to equate supply and demand for bank loans, which implies the possibility of a credit market disequilibrium; therefore, the failure of the conventional sign restriction applied to the price (lending rate) and quantity (volume) of bank loans to identify a loan supply shock in the literature.

To test this possibility, we estimate the following panel regression with country and time fixed effects:

$$\begin{aligned}\Delta i^L_{i,t} = \alpha_i + \alpha_t &+ (\beta_0 + \beta_1 \times high_i)\Delta S_{i,t} \\ &+ (\gamma_0 + \gamma_1 \times high_i)\Delta D_{i,t} + X_{i,t} + u_{i,t}, \\ &u_{i,t} \sim N(0, \Sigma),\end{aligned} \tag{1}$$

where $i^L_{i,t}$ is the bank loan rate in country i at time t, $S_{i,t}$ is a supply factor proxied by bank lending standards (an increase indicates easing), and $D_{i,t}$ is a demand factor proxied by bank loan demand. α_i and α_t capture the country and time fixed effects, respectively. $high_i$ denotes a dummy variable indicating that country i has a high (i.e., above median) bank dependency ratio, and $X_{i,t}$ includes additional time-varying country-level variables.

Because we cannot reject the null hypothesis that the bank lending rate is nonstationary, we take the first difference and use it as a dependent variable.[14] The country fixed effects capture any time-invariant factors specific to each country, and the time fixed effects control for any movements at the global level that affect the bank lending rate in every country, such as global financial cycles and U.S. monetary policy. If the bank loan officer survey captures both the supply and the demand factors of bank lending correctly, the bank loan rate must be negatively (positively) associated with an increase in lending standards (loan demand), other things being constant.

[14]The Dickey–Fuller unit-root test for individual countries cannot reject the I(1) process of the bank lending rate except for Turkey, Chile, and Poland. After taking the first difference, the null of the existence of a unit root is rejected in every country.

Any deviation from this theoretical relationship suggests that the observed volume of bank loans does not necessarily equate demand and supply, which casts doubt on the ability of conventional sign restrictions to identify a loan supply shock using the bank loan rate.

Table 2 shows the estimation results, which highlight the problem of using the bank lending rate for the identification. Column 1 shows the baseline result. The estimated coefficients on lending standards and loan demand are statistically significant, and their signs are consistent with the textbook theory of interest rates. However, the interaction term of loan demand and the dummy variable is negative and statistically significant, indicating that the theoretical relationship between loan demand and the interest rate does not hold in a bank-based economy. The interaction term of lending standards and the dummy variable is close to zero and statistically insignificant, suggesting no difference between the two groups in this case.

Columns 2–7 confirm the robustness of our findings. In column 2, we control for changes in CPI inflation (quarter-over-quarter) since lending standards and loan demand are real factors, whereas the dependent variable is nominal. Although changes in the inflation rate enter the expected sign with statistical significance, controlling for the inflation rate does not affect the main results. We further control for real GDP growth, which is associated with both lending standards and loan demand. While we must take caution in interpreting the results because of multicollinearity, controlling for real GDP growth hardly changes the main result (column 3). We also take the lagged values of the independent variables in robustness checks (column 4). Although the statistical significance of the interaction term of loan demand and the dummy variable weakens, the results are qualitatively similar to the baseline results. Column 5 shows the results from limiting the sample from 2010:Q1 to rule out the possibility that the main finding is driven by the global financial crisis.

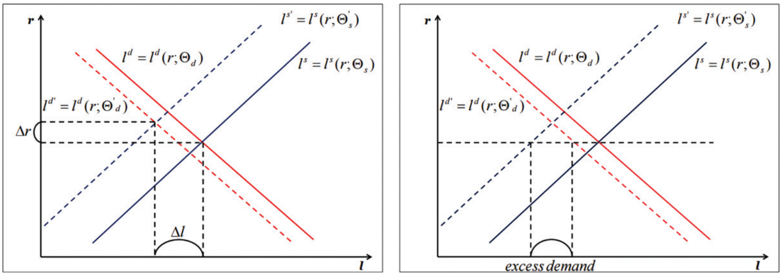
Instead of the estimation using the interaction terms, columns 6 and 7 show the results from the subsample estimation of countries with high and low bank dependency, respectively. Despite the weak power of the test due to the reduced sample size, our main finding is preserved. An increase in loan demand, if anything, is followed by a decline in the bank loan rate in bank-based economies. Taken

Table 2. Determinants of the Bank Loan Rate

	(1)	(2)	(3)	(4)	(5)	(6)	(7)
Lending Standards	−0.015**	−0.012**	−0.012**	−0.006	−0.017*	−0.005	−0.017**
	(0.006)	(0.004)	(0.004)	(0.007)	(0.009)	(0.003)	(0.005)
Loan Demand	0.010*	0.010*	0.011**	0.007*	0.008*	−0.005	0.012**
	(0.005)	(0.005)	(0.005)	(0.003)	(0.004)	(0.005)	(0.005)
High × Lending Standards	0.000	0.002	0.005	−0.001	−0.003		
	(0.008)	(0.007)	(0.006)	(0.007)	(0.015)		
High × Loan Demand	−0.016**	−0.016**	−0.017**	−0.005	−0.014***		
	(0.006)	(0.006)	(0.006)	(0.003)	(0.004)		
Changes in Inflation		0.099***	0.098***			0.088**	0.117**
		(0.018)	(0.017)			(0.032)	(0.036)
Real GDP Growth			−0.012			−0.031***	0.001
			(0.009)			(0.007)	(0.006)
Country Fixed Effect	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Time Fixed Effect	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Obs.	625	625	616	615	410	330	284
R-squared	0.252	0.356	0.375	0.210	0.266	0.412	0.480

Notes: Heteroskedasticity-robust standard errors are in parentheses. Standard errors are clustered at the country level. ***, **, and * denote significance at the 1 percent, 5 percent, and 10 percent levels, respectively. Standard errors are in parentheses.

Figure 4. Identifying a Loan Supply Shock under Credit Market Equilibrium (left) and Disequilibrium (right)



Notes: The left panel illustrates a negative loan supply shock when the bank lending rate equates the supply and demand for bank loans, whereas the right panel illustrates the case when the bank lending rate does not equate the two.

together, we find robust evidence that the bank loan rate fails to reflect a loan demand factor in a country in which firms heavily rely on the banking sector. This finding motivates the use of bank loan officer surveys to identify structural shocks.

3. Empirical Framework

3.1 Illustration of the Credit Market Disequilibrium

The left panel in figure 4 highlights the empirical difficulty of identifying a loan supply shock from demand-side factors when using aggregate data. Both the supply of (l^s) and demand for (l^d) bank loans depend on the bank lending rate (r) and other factors (Θ_s and Θ_d), which shift the supply and demand curves. For the supply curve, such factors include the bank deposit rate, the cost of evaluating the creditworthiness of borrowers, and the minimum reserve ratio. The need for working capital, cost of direct financing, and availability of trade credit are examples of factors that shift bank loan demand.

In addition, factors simultaneously shift the supply and demand curves in the same direction (i.e., $\Theta_s \cap \Theta_d \neq \emptyset$), as illustrated in figure 4. Such factors include the expectation about the prospects of the economy and uncertainty surrounding the course of monetary policy. Therefore, the aggregate data are likely to show a combination of loan supply and demand shocks, which corresponds to the "simultaneity problem" when identifying a bank loan supply shock (Jiménez et al. 2014; Amiti and Weinstein 2018). To resolve this issue using aggregate data, the sign-restriction approach of Uhlig (2005) has been applied to the credit market (Busch, Scharnagl, and Scheithauer 2010; De Nicolò and Lucchetta 2011; Helbling et al. 2011; Hristov, Hülsewig, and Wollmershäuser 2012; Meeks 2012; Finlay and Jääskelä 2014; Halvorsen and Jacobsen 2014; Gambetti and Musso 2017). The intuition is simple; a loan supply shock must move the interest rate and volume of loans in opposite directions.

However, this identification approach is only valid when the bank lending rate reflects credit market conditions. If r observed from the data cannot equate the demand for—and the supply of—bank loans, the equilibrium condition ($l^* = l^s = l^d$) may not hold, and either excess supply or excess demand can exist ($l^* = \min\{l^s, l^d\}$), as illustrated by Laffont and Garcia (1977). If this were true, the real effect of loan supply shocks could be considerably larger than any model using the lending rate would predict. The right panel in figure 4 demonstrates the case of credit rationing as a result of excess loan demand.[15]

In this regard, the bank loan officer surveys can improve the identification of structural shocks by providing information beyond the bank lending rate. For example, Lown and Morgan (2006) and Ravn (2016) showed theoretically and empirically that bank lending standards obtained from the bank loan officer surveys adequately summarize various nonprice lending terms in typical bank business loans, thereby capturing the supply factors of bank credit. Imposing a non-negative sign restriction on the loan demand proxy directly, we can further eliminate the contribution of a simultaneous drop in loan demand to a negative loan supply shock, which is not feasible in the identification scheme using the interest rate.

3.2 Sign-Restriction Approach

We briefly summarize the sign-restriction approach here (refer to Uhlig 2005 for more details). Instead of relying on restrictions based

[15]Without loss of generality, we focus on excess demand for bank loans in the example.

on the timing of shocks, this identification approach can produce impulse responses consistent with the theoretical predictions. Consider a reduced-form VAR model:

$$Y_t = \sum_{p=1}^{P} B_p Y_{t-p} + u_t, \tag{2}$$
$$u_t \sim N(0, \Sigma),$$

where Y_t is an $n \times 1$ vector of the observed economic variables, B_p are $n \times n$ matrices of autoregressive coefficients, and u_t are an $n \times 1$ vector of reduced-form residuals with a variance-covariance matrix Σ. We estimate the VAR using Bayesian techniques, with the prior and posterior distributions of the reduced-form VAR following an n-dimensional normal-Wishart distribution.

Because the reduced-form residuals u_t bear no structural interpretation, we incorporate additional restrictions to identify the structural shocks. As in Faust (1998), Canova and De Nicolo (2002), and Uhlig (2005), we identify shocks by imposing sign restrictions. Consider an $n \times n$ matrix A, which relates reduced-form residuals u_t to structural shocks ϵ_t:

$$u_t = A\epsilon_t, \tag{3}$$
$$\Sigma = E[u_t u_t'] = AE[\epsilon_t \epsilon_t']A' = AA'.$$

For any orthogonal matrix Q such that $QQ' = I_n$ and $\Sigma = AQQ'A$, there is also an admissible decomposition for which $u_t = AQ\tilde{\epsilon_t}$ and $\tilde{\epsilon_t}\tilde{\epsilon_t}' = I_n$, where $\tilde{\epsilon_t}$ denotes the (many) different structural shocks implied by the alternative identification. Although different orthogonal matrices Q produce different signs and magnitudes of the impulse responses, discriminating among them from the data is not possible, as they imply identical VAR representations. Therefore, for any decomposition $\Sigma = AA'$, there exist infinitely many identification schemes $AQ^{(k)}$ for $k = 1, 2, \ldots, \infty$, such that $\Sigma = AQ^{(k)}Q^{(k)'}A'$. Following Rubio-Ramirez, Waggoner, and Zha (2010), an orthogonal matrix $QQ' = I$ is generated from a QR decomposition of some random matrix W, which is drawn from an $N(0, I_n)$ distribution.

Unlike Uhlig (2005), who identified only one (monetary policy) shock, we attempt to identify multiple structural shocks simultaneously:

(i) Draw $d = 1, \ldots, m$ models from the posterior distribution of the VAR (model d consists of VAR parameters $B_j^{(d)}$ and a covariance matrix $\Sigma^{(d)}$).

(ii) For $j = 1, 2, \ldots,$ draw randomly from the m models.

(iii) Choose $A = \tilde{A}^{(j)}$, where $\tilde{A}^{(j)}$ is any Cholesky decomposition of $\Sigma^{(j)}$, such that $\Sigma^{(j)} = \tilde{A}^{(j)}\tilde{A}^{(j)\prime}$.

(iv) For each j, draw random matrices $Q^{(k(j))}$, $k(j) = 1, \ldots, K$ until the impulse response functions implied by B_p^j and identification schemes $\tilde{A}^{(j)}Q^{(k(j))}$ satisfy the sign restrictions. If all the sign restrictions are satisfied, we define the combination of model j and identification scheme $\tilde{A}^{(j)}Q^{(k(j))}$ as an accepted model.

(v) Iterate over (ii)–(iv) until 200 models are accepted. We assign an equal positive weight to the accepted draws and a zero weight to those that violate the restrictions.

3.3 Identification Strategy

We do not attempt to identify every structural shock in the system because imposing further sign restrictions is not necessarily desirable for our purpose (Uhlig 2005). The approach taken in this study identifies loan supply and demand shocks by imposing sign restrictions on three variables—namely, d_t, s_t, and l_t—and remains agnostic about the response of r_t and y_t. This identifying scheme is in sharp contrast to those in the empirical literature imposing restrictions on the interest rate to identify a loan supply shock. We show that this scheme achieves a cleaner identification of the shock when credit market imperfections prevent the equilibrating role of the interest rate.

Our identification strategy is also a departure from earlier analyses that impose a sign restriction on output to identify a credit supply shock (e.g., Busch, Scharnagl, and Scheithauer 2010; Tamási and Világi 2011; Hristov, Hülsewig, and Wollmershäuser 2012).[16]

[16]For example, Busch, Scharnagl, and Scheithauer (2010) and Tamási and Világi (2011) imposed a restriction on output for two quarters without

In practice, a contraction in bank lending does not necessarily lead firms to change their current production immediately. Instead, the lower availability of funding restricts production in later periods. Moreover, remaining agnostic about the response of output helps us distinguish a credit-specific demand shock from an aggregate demand shock.

While a decline in the volume of bank loans must follow both adverse loan supply and demand shocks by design, a negative loan supply shock should not decrease loan demand, and a negative loan demand shock should not reduce loan supply in the joint identification of both shocks. These restrictions are intuitive and similar to the assumption in the bank lending model of Hülsewig, Mayer, and Wollmershäuser (2006). Joint restrictions on lending standards and loan demand allow for a clean identification of a loan supply shock from a loan demand shock when the bank lending rate fails to respond to excess loan demand. Our identification strategy shares the same spirit as Helbling et al. (2011), who controlled for an endogenous credit response to expected fluctuations in future activity using sign-restriction VARs.[17]

We simultaneously identify multiple structural shocks.[18] Identifying each structural shock individually does not guarantee the orthogonality of the multiple shocks, thus casting doubt on whether the identified shocks are truly structural. As in Helbling et al. (2011), we limit the baseline model to the identification of two shocks (loan supply and loan demand) because the more orthogonal conditions are imposed, the harder it is to obtain impulse vectors satisfying the sign restrictions. Table 3 summarizes the sign restrictions used in the baseline VAR model. The symbol "?" indicates that the signs of the responses are indeterminate a priori.

simultaneously identifying aggregate demand or aggregate supply shocks, which may contaminate their "identified" credit supply shock. Hristov, Hülsewig, and Wollmershäuser (2012) imposed a restriction on output for a year, which prevents the author from identifying the real effect of credit supply shocks in the short run.

[17]To purge the potential demand channel, Helbling et al. (2011) required that the decline in credit not be followed by a decrease in productivity or an increase in default rates. They did not impose any restriction on the response of output.

[18]Because the number of structural shocks is still less than the number of variables, this model is partially identified.

Table 3. Sign Restrictions on a Contractionary Shock: Baseline Model

Structural Shock	d_t	s_t	l_t	r_t	y_t
Loan Supply Shock	≥ 0	≤ 0	≤ 0	?	?
Loan Demand Shock	≤ 0	≥ 0	≤ 0	?	?

Notes: Restrictions are imposed for two quarters. ? denotes indeterminate responses a priori.

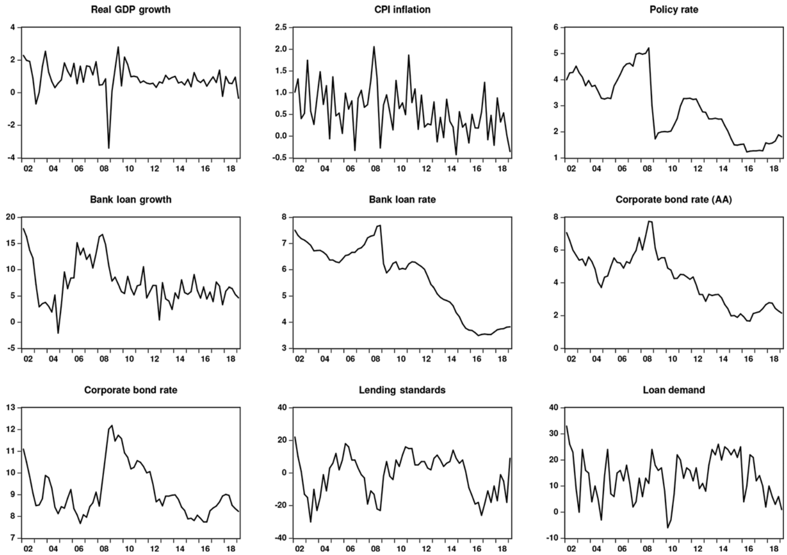
We estimate the VAR model in levels because a large body of the literature on this issue suggests that this is still desirable even if the variables have unit roots (e.g., Sims, Stock, and Watson 1990). Although the Bayesian information criterion suggests two lags, we use four lags ($p = 4$) in the baseline model, considering the quarterly frequency of the data. Following Uhlig (2005), all restrictions are imposed for two quarters ($k = 2$) following the initial shock. We evaluate the sensitivity of the results to these specifications in section 5.

3.4 Korean Macroeconomic Data

We use the Korean economy as a benchmark for the following Bayesian VAR analysis to illustrate the failure to identify a loan supply shock when relying on the interest rate. We then demonstrate how the alternative identification scheme resolves this issue. We choose Korea because it has one of the most extended bank loan officer surveys available and ample data availability compared with EMEs, especially detailed data on bank loans to the nonfinancial business sector and corporate bond markets.[19] These data are

[19]We consulted with the Banking System Analysis team at the Bank of Korea and learned about the high quality of the Korean bank loan officer survey. After the Asian financial crisis in 1998, the Bank of Korea learned the importance of the timely monitoring of the banking sector and has since invested resources in constructing and conducting the survey. For the survey of commercial banks we use in the present study, two members of the Banking System Analysis team visit the headquarters of each bank on a quarterly basis, and their counterparty from the bank in charge is typically a high-level manager with sufficient knowledge about the banking system. Given the long-term relationship between the Bank of Korea and surveyed commercial banks, these managers take the survey seriously.

Figure 5. Korean Economic Data: 2002:Q1–2019:Q1



Notes: Bank loan growth, real GDP growth, and the inflation rate are the quarter-on-quarter growth of CPI deflated total bank loans to the business sector, real GDP, and the level of CPI, respectively. The policy rate is measured by the overnight call rate. All data are taken from the Bank of Korea.

crucial for understanding the transmission mechanism of a bank loan supply shock.

Figure 5 shows the evolution of the key macrovariables as well as bank lending standards and loan demand at a quarterly frequency. The inflation rate, policy rate, and corporate bond yields are also displayed because they are used in the extended model presented in section 5.3 to investigate the comprehensive effect of loan supply and loan demand shocks as well as their transmission channel.[20] To ease

Even if measurement errors exist due to careless responses, they will go against finding any sensible results from the VAR analysis using the survey as the main input.

[20] Although we use the weighted composite indicator for bank lending standards and loan demand throughout the paper, the results are robust to the use of an indicator specific to small and medium-sized enterprises. The correlation between this indicator and the composite indicator is 0.88 for lending standards and 0.83 for loan demand.

the comparison, these variables are shown in the first (log) difference (quarter-over-quarter growth) except for the interest rate.

Although Korea is a small open economy, using a closed-economy framework hardly affects the extent to which bank lending to non-financial firms is dominated by national banks, as documented by Banker, Chang, and Lee (2010). Korea adopted a flexible exchange rate regime throughout the sample period, which mitigated the direct impact of foreign shocks on domestic bank lending. Moreover, most existing studies using a sign-restriction approach to identify credit supply shocks in the small open-economy context do not include the exchange rate in their VAR system (Busch, Scharnagl, and Scheithauer 2010; Helbling et al. 2011; Hristov, Hülsewig, and Wollmershäuser 2012; Gambetti and Musso 2017). Indeed, if some studies do, they do not impose any restrictions on the exchange rate to identify credit supply shocks (Tamási and Világi 2011; Finlay and Jääskelä 2014). Thus, for the parsimony of the model, we abstract from any foreign variables and the exchange rate.

At the beginning of the sample, business-sector bank lending plummeted with the economic downturn in 2003, driven by the bursting of the credit card lending boom. Bank lending picked up quickly and expanded rapidly until the sharp recession in 2008–09, which is consistent with the ample evidence on excessive domestic credit expansion as a robust indicator of financial crisis globally (Gourinchas and Obstfeld 2012). Then, bank lending growth has moderated over the past decade. The problem of using an identification scheme based on the bank lending rate readily stands out at first glance. For example, a sharp drop in the bank lending rate—supported by an expansionary monetary policy—in the early stage of the global financial crisis (2008:Q4–2009:Q1) masks deteriorating conditions in the bank loan market (reflected by the increase in loan demand accompanied by the tightening of lending standards and a decline in the volume of bank loans). The deterioration in credit market conditions is also reflected in the sharp increase in corporate bond yields, especially for risky borrowers.

If we conduct the standard sign-restriction approach using quantity (i.e., the volume of loans) and price (i.e., bank lending rate) information alone, the decline in the observed volume of bank loans is likely to be attributed to a decrease in loan demand, implying that this is an optimal response of firms facing a reduction in loan demand for their products. However, if the decline in bank lending is driven by a supply-side disruption despite the increase in demand, this implies a more binding borrowing constraint, and therefore the adverse effect on the macroeconomy could be more significant. Moreover, if the interest rate fails to restore the loan market equilibrium, the economic consequences and optimal policy responses might be different than the demand-driven decline in credit. We delve into a more formal analysis to demonstrate the identification problem and provide a solution.[21]

4. Baseline Results

4.1 Results from Using Conventional Sign Restrictions

Before we present the main results using our preferred identification scheme, we show how standard sign restrictions relying on the price-quantity framework fail to identify a loan supply shock. This example illustrates the importance of the nonprice information from the bank loan officer survey when identifying bank loan supply shocks, which is particularly true for bank-based economies in which the unique role of banks in alleviating information asymmetry during turbulent times results in countercyclical loan demand.[22]

Following much of the literature on identifying a credit supply shock using the sign-restriction approach, we impose restrictions on price (i.e., bank lending rate (r_t)) and quantity (i.e., the volume of

[21] A standard VAR approach using short-run restrictions (i.e., Cholesky ordering) may still achieve a clean identification of loan supply and demand shocks as long as the information from the bank loan officer survey is used. If lending standards and loan demand can capture bank loan dynamics as predicted by the supply and demand interpretation, additional identifying assumptions (i.e., sign restrictions) would be unnecessary, and inferences of the structural shocks would be straightforward. In online appendix B, we demonstrate that this is not necessarily the case and that the sign-restriction approach is more desirable.

[22] For example, the government ownership of banks is common in bank-based economies, and the lending decisions of these banks are influenced by factors other than the interest rate (Dinç 2005) in contrast to private banks (Brei and Schclarek 2013). In addition, nonprice lending terms based on the soft information produced from a long-term relationship between banks and firms can be more important than the interest rate when banks make their lending decisions (Uchida, Udell, and Yamori 2012). Thus, considering a factor other than the bank lending rate is particularly crucial in bank-based economies.

Table 4. Conventional Identifying Assumptions on a Contractionary Shock

Structural Shock	l_t	r_t	y_t
Loan Supply Shock	≤ 0	≥ 0	?
Loan Demand Shock	≤ 0	≤ 0	?

Notes: Restrictions are imposed for two quarters. ? denotes indeterminate responses a priori.

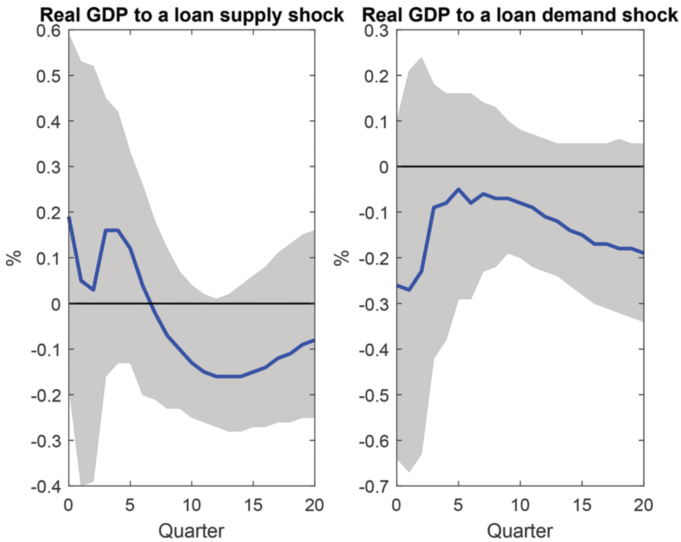
bank loans (l_t)). This identifying assumption corresponds to table 4, and the rest of the identification procedure is the same as in the baseline model discussed in sections 3.2 and 3.3. Here, we illustrate the most parsimonious model; however, the results remain similar when we include other macroeconomic variables such as prices and the policy rate and impose a set of sign restrictions on these variables following the literature (Busch, Scharnagl, and Scheithauer 2010; Helbling et al. 2011; Hristov, Hûlsewig, and Wollmershäuser 2012; Gambetti and Musso 2017).

Figure 6 shows the effects of negative loan supply and loan demand shocks on output. Following Uhlig (2005), the solid lines plot the median impulse responses, and the shaded areas note their 16th and 84th percentile bands from 200 accepted draws. Under the conventional identification scheme using the bank lending rate, a negative loan supply shock does not have any recessionary effect on output.[23] This finding is clearly at odds with the theoretical predictions and existing empirical evidence, indicating the poor identification of a loan supply shock. Using the spread between the bank lending rate and policy rate instead delivers similar results (see figure A.4 in online appendix A). These results also corroborate the suggestive evidence from the panel estimation in which the bank lending rate does not reflect credit market conditions in bank-based economies.

Against this background, we analyze the effects of bank loan supply and demand shocks on the Korean economy using our preferred

[23]Increasing the length of restriction horizons only exacerbates the failure in the identification. The results are available upon request.

Figure 6. The Response of Output: Conventional Identifying Assumptions Using the Lending Rate



Notes: A negative loan supply shock (left) and a loan demand shock (right) are identified by restrictions on the bank lending rate and the volume of bank loans. Solid lines plot the median impulse responses, and the shaded areas note their 16th and 84th percentile bands from 200 accepted draws.

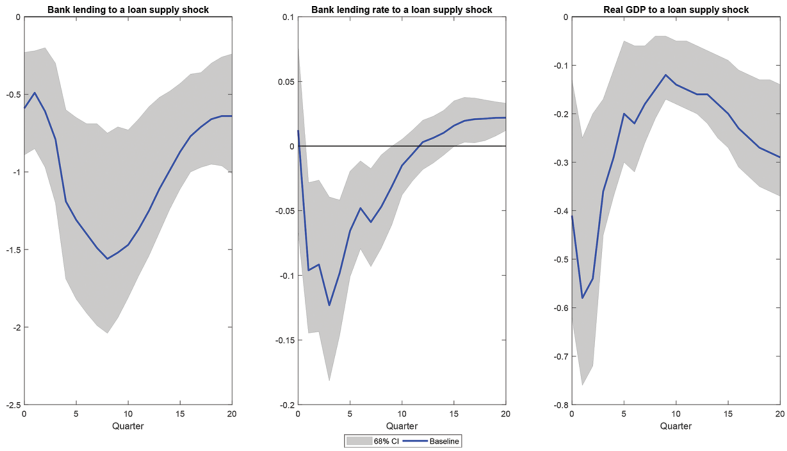
identification strategy in three steps. First, we derive the impulse responses of the variables in the VARs to the identified shocks. Second, we compute the variances of the macrovariables attributed to these shocks. Third, we decompose historical output fluctuations into the parts explained by each of the structural shocks to evaluate their role over business cycles.

4.2 Impulse Responses

Figure 7 shows the responses of the macrovariables to adverse bank loan supply shocks.[24] A decline in bank loans follows an adverse loan supply shock by design. However, the response is persistent

[24]The median and confidence intervals are computed from all the impulse responses that satisfy the sign restrictions. Using the terminology of Paustian (2007) and Fry and Pagan (2011), the confidence intervals reflect both the

Figure 7. The Responses to a Negative Loan Supply Shock



Notes: Solid lines plot the median impulse responses, and the shaded areas note their 16th and 84th percentile bands from 200 accepted draws.

despite the two-quarter restriction. We impose no restrictions on the response of the bank loan rate and output, leaving it open agnostically. The bank loan rate decreases sharply in response to a negative loan supply shock. This finding is no longer surprising because we have already demonstrated that the bank loan rate fails to capture adverse credit market conditions. In contrast to the conventional identifying assumption, we find a strong negative effect on real GDP. The quantitative effect of the identified loan supply shocks is significant (a 0.6 percent drop in real GDP after two quarters) and persistent, in line with Meeks (2012)'s findings for the United States (a 1 percent drop in industrial production) and those of Hristov, Hülsewig, and Wollmershäuser (2012) for the euro area (a 0.6 percent drop in real GDP) using a similar sign-restriction approach.

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sampling uncertainty and the modeling uncertainty stemming from the non-uniqueness of the identified shocks. In section 5.2, we check the sensitivity of the results using the median target method proposed by Fry and Pagan (2011).

A vast body of the empirical literature, including Lown and Morgan (2006), Helbling et al. (2011), Hristov, Hülsewig, and Wollmershaüser (2012), Meeks (2012), and Bassett et al. (2014), has focused only on credit supply shocks rather than credit demand shocks because it is difficult to distinguish the latter from aggregate demand shocks.[25] Unlike these earlier studies, we explicitly disentangle loan demand shocks from loan supply shocks using the information from the bank loan officer survey.

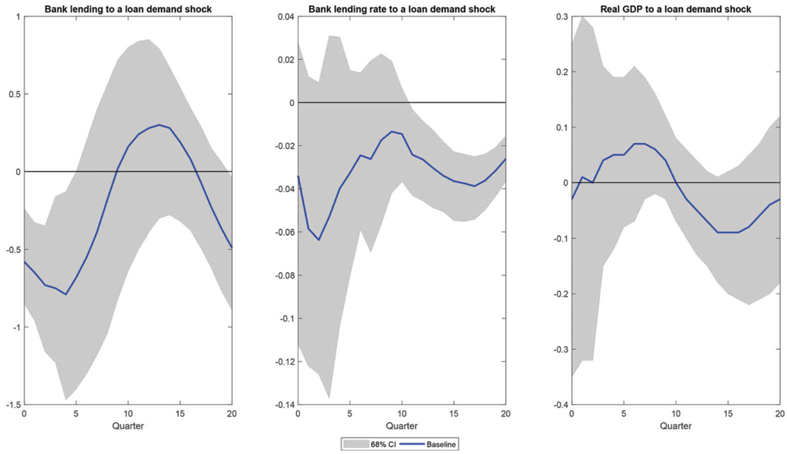
Figure 8 shows that the decline in bank loans due to the reduction in loan demand does not have any adverse effect on output. If anything, subsequent analyses point to the positive effect on output, which seems puzzling if a decrease in loan demand is an optimal response by firms facing a reduction of demand for their products.[26] However, considering the implication of credit market imperfections on a firm's choice of external debt (Diamond 1991; Chemmanur and Fulghieri 1994; Hale 2007; De Fiore and Uhlig 2011), a decline in loan demand signals easier access to public debt markets for financing.[27] In a related study using a sign-restriction VAR approach, Peersman (2011) found that loan supply and demand shocks have contrasting effects on euro-area output. He interpreted this puzzling effect by noting that exogenous loan demand shocks capture the consequences of changes in access to alternative forms of finance or shifts in borrowers' preferred volume of lending. In section 4.5, we test this mechanism using data on corporate bond spreads.

[25] Finlay and Jääskelä (2014) is an exception, as they identified both credit supply and demand shocks by imposing sign restrictions on the volume of credit and credit spreads for three small open economies (Australia, Canada, and the United Kingdom). However, using corporate bond spreads as a price indicator of bank credit is questionable, as bank financing and bond financing are not perfect substitutes. Moreover, corporate bond spreads are known to be an independent business cycle indicator via a risk channel (e.g., Gilchrist and Zakrajšek 2012 and Faust et al. 2013).

[26] Because the impact of both identified shocks on the volume of bank loans is the same, the difference in the size of the effect cannot explain the qualitative difference in the effects on output.

[27] This is also consistent with Friedman and Kuttner (1993) and Bernanke and Gertler (1995)'s arguments that after a negative shock, bank loan demand may increase to finance working capital and inventories due to limited access to market finance.

Figure 8. The Responses to a Negative Loan Demand Shock



Notes: Solid lines plot the median impulse responses, and the shaded areas note their 16th and 84th percentile bands from 200 accepted draws.

4.3 Variance Decomposition

We evaluate the quantitative importance of these two structural shocks for explaining the variation in bank loans, the bank loan rate, and real GDP. Table 5 shows that a loan supply shock explains a substantial share of the variation in bank loans (20 percent) and real GDP (28 percent) after one quarter. The significant role of the shock in the short run is by construction (i.e., the sign restrictions applied to the first two quarters). After five years, this shock explains about 10 percent of the variation in each variable, within a range of 10 percent and 20 percent for output demonstrated in earlier studies using the sign-restriction approach (Helbling et al. 2011; Hristov, Hülsewig, and Wollmershäuser 2012; Meeks 2012; Finlay and Jääskelä 2014; Halvorsen and Jacobsen 2014).

While a bank loan demand shock explains 26 percent of the variation in bank loans after one quarter, the importance of the shock quickly diminishes over the estimation horizon. After five years, a loan demand shock explains only 6 percent of the variation in real GDP, which is consistent with its insignificant effect on the output

Table 5. Forecast Error Variance Decomposition: Baseline Model

Structural Shock	Horizon (Quarters)	Bank Loans	Bank Loan Rate	Real GDP
Loan Supply Shock	1	20.32	8.07	27.91
	4	10.65	9.88	10.35
	20	10.23	10.29	10.02
Loan Demand Shock	1	26.31	10.31	6.26
	4	6.03	6.40	7.02
	20	6.43	6.60	6.64

Notes: The share of forecast error variance decomposition (percent) explained by (orthogonal) loan supply and loan demand shocks. The reported variance decomposition does not necessarily add up to 100 percent because other unidentified shocks make up the balance.

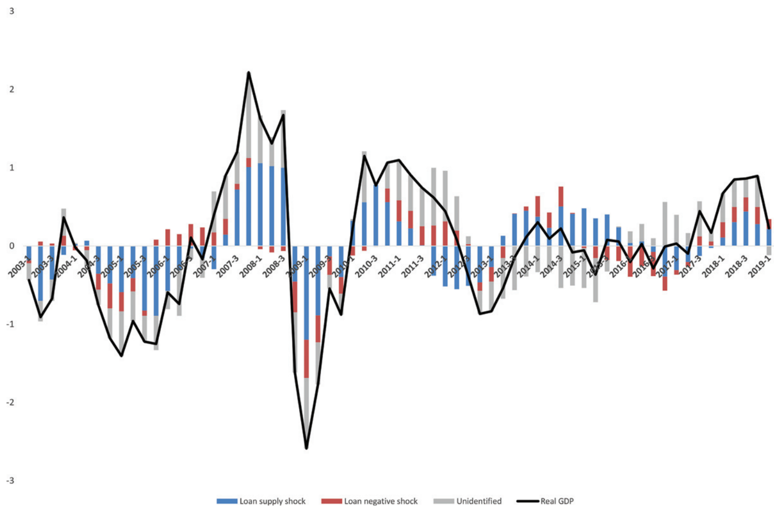
shown in the impulse response function analysis. Taken together, loan supply and demand shocks are not dominant drivers of output fluctuations in Korea on average, but rather play a non-negligible role.[28]

4.4 Historical Decomposition of Output Fluctuations

While the previous exercise illustrated the overall importance of the identified structural shocks for explaining the macrovariables, it is interesting to learn how their contribution changes over business cycles, especially during the global financial crisis period. Using a dynamic stochastic general equilibrium (DSGE) model augmented with financial frictions, Perri and Quadrini (2018) claimed that credit shocks are more relevant than productivity shocks for explaining the global financial crisis. Faust et al. (2013) found that the ability of credit market variables to forecast economic activity is more potent during recessions than expansions. Bank loan supply

[28]The variance decomposition exercise here should be taken with caution because we identified only a subset of structural shocks. The reported variance decomposition does not necessarily add up to 100 percent because other unidentified shocks make up the balance. See Fry and Pagan (2011) for further details.

Figure 9. Historical Decomposition of Output Fluctuations



Notes: The solid black line denotes the structural residuals of real GDP during the sample period. The blue and red bars denote the contribution of loan supply and loan demand shocks in the residuals, respectively (see online version at http://www.ijcb.org for figures in color). Other unidentified shocks make up the balance.

shocks may also have asymmetric importance between expansions and recessions despite their moderate importance in variance decomposition (table 5).

Figure 9 shows the historical decomposition of real GDP during the sample period.[29] Loan supply shocks accounted for 40 percent of the Korean output decline during the global financial crisis, consistent with earlier findings for other regions that demonstrate the moderate role of loan supply shocks for the full sample but a substantially more significant role during crisis periods (Meeks 2012; Gambetti and Musso 2017). Loan supply shocks also played a dominant role during the earlier expansion period before the recession, consistent with a credit-driven boom followed by a bust. The contribution of loan supply shocks has been moderated since then.

[29] Because we use four lags in the baseline model, the historical decomposition starts from 2003:Q1.

While loan demand shocks contribute a non-negligible share of the output decline, their contribution over business cycles is somewhat limited.

4.5 Discussion of the Results

Using the preferred identifying assumption based on the Korean bank loan officer survey, we find robust evidence of the recessionary effect of a negative bank loan supply shock. On the contrary, we do not see any adverse effect on the output of a negative bank loan demand shock, which seems puzzling from the prediction of a standard frictionless model in which a firm's demand for credit is determined by the expectation of demand for its products. However, our finding is consistent with the prediction of theories on the choice between bank loans and publicly traded debt (Diamond 1991; Chemmanur and Fulghieri 1994; Hale 2007; De Fiore and Uhlig 2011). According to the theoretical prediction under credit market imperfections, the preference for public debt over bank debt is more likely for high-quality projects (e.g., less uncertainty about future cash flows, higher collateralized value), and thus we would expect higher relative demand for bank debt in recessions, especially in bank-based economies.

In this case, a reduction in demand for bank loans may signal an improvement in access to other sources of financing and alleviated borrowing constraints, meaning that the non-recessionary effect we find is unsurprising. To test this hypothesis, we include the credit spread, measured by the difference between risky and safe corporate bond yields, in the baseline VAR model. The credit spread captures distress in corporate bond markets, thereby measuring whether an alternative financing condition is alleviated after a loan supply or demand shock. We use the same set of sign restrictions as in table 3 and do not impose any sign restrictions on the response of the credit spread to let the data speak for themselves.

Figures A.5 and A.6 in online appendix A compare the responses of the macrovariables to loan supply and demand shocks when the credit spread is included in the baseline VAR model. The contrasting responses of the credit spread to these shocks shed light on the mechanism through which each shock affects the real economy. Despite the decline in the bank lending rate following the negative loan supply shock, the credit spread increases sharply, suggesting that firms' access to the public debt market becomes limited. Thus, the identified negative loan supply shock corresponds to an economy-wide contraction in credit supply, which serves as a driver of output fluctuations. On the contrary, the credit spread falls significantly after the negative loan demand shock, implying that firms benefit from the alleviated financing conditions in the public debt market and, therefore, the relaxed borrowing constraints. With the inclusion of a credit spread variable, we now find an expansionary effect of the negative loan demand shock. Taken together, the extended model highlights the imperfect substitutability between bank loans and corporate bonds and its consequence on the macroeconomy.[30]

5. Robustness Checks

5.1 Alternative VAR Specification

Following Uhlig (2005), we impose sign restrictions for the two quarters after the structural shock. However, setting the length of the restrictions is still an open choice. We test the sensitivity of the baseline results by varying the restriction horizons ($k = 1$ and 3). We also check the robustness by changing the lag orders of the VAR system ($p = 2$ and 6). Figure A.7 in online appendix A shows that none of these changes affects the qualitative effects of the identified shocks on output.

5.2 Median Model

We plot the pointwise posterior medians of the impulse response functions from the 200 accepted draws to summarize the dynamic response of each variable to a loan supply/demand shock. However, Fry and Pagan (2011) and Inoue and Kilian (2013) criticized the use of the medians of different impulse response functions because the

[30]The substitutional role between bank and bond financing in driving the macroeconomy is also consistent with the finding of Choi (2020), who showed that the effect of bank lending shocks on output in the U.S. economy has substantially declined with the development of its public debt markets over time.

medians at each horizon are likely to be obtained from different models, which makes economic interpretation difficult. Following Fry and Pagan (2011), we compute the responses of the median model determined by minimizing the distance between the impulse responses of each of the accepted models and median impulse responses over a fixed horizon (20 quarters). We measure the distance by the sum of the squared difference between the impulse responses of the accepted models and median impulse responses. Consistent with findings of Busch, Scharnagl, and Scheithauer (2010), we find a negligible difference (see figure A.8 in online appendix A).

5.3 Extended Model

So far, we have imposed minimal sign restrictions to identify only two structural shocks in a small VAR system and mainly studied their effects on output, ignoring variables related to prices and monetary policy stance. Through the lens of a small-scale New Keynesian framework, we extend the baseline VAR model to include these additional variables. However, the theoretical effects of a loan supply shock on the price level and policy rate are indeterminate. For example, a negative loan supply shock may decrease prices because of the contraction in aggregate demand induced by the decrease in credit volume (Curdia and Woodford 2010; Gertler and Karadi 2011). By contrast, the same shock may increase prices by raising the cost of credit or real wages (Gerali et al. 2010). Depending on the response of prices, the optimal monetary policy response would differ as well. Thus, we do not impose any restrictions on the additional variables when identifying loan supply and loan demand shocks and let the data speak for themselves, similar to Busch, Scharnagl, and Scheithauer (2010), Hristov, Hülsewig, and Wollmershaüser (2012), and Gambetti and Musso (2017).

From an econometric point of view, such a model may require a larger number of sign restrictions to ensure the identification of the structural shocks (Faust 1998; Paustian 2007). In this case, increasing the number of identified innovations can help uncover the correct sign of the impulse response functions of interest at the expense of higher computational burden. We choose the restrictions deliberately to rule out the potentially confounding influences of other structural shocks such as monetary policy, aggregate supply, and

Table 6. Sign Restrictions on a Contractionary Shock: Extended Model

Structural Shock	d_t	s_t	l_t	r_t	y_t	p_t	i_t
Loan Supply Shock	≥ 0	≤ 0	≤ 0	?	?	?	?
Loan Demand Shock	≤ 0	≥ 0	≤ 0	?	?	?	?
Monetary Policy Shock	?	?	?	?	≤ 0	≤ 0	≥ 0
Aggregate Supply Shock	?	?	?	?	≤ 0	≥ 0	?
Aggregate Demand Shock	?	?	?	?	≤ 0	≤ 0	≤ 0

Notes: Restrictions are imposed for two quarters. ? denotes indeterminate responses a priori.

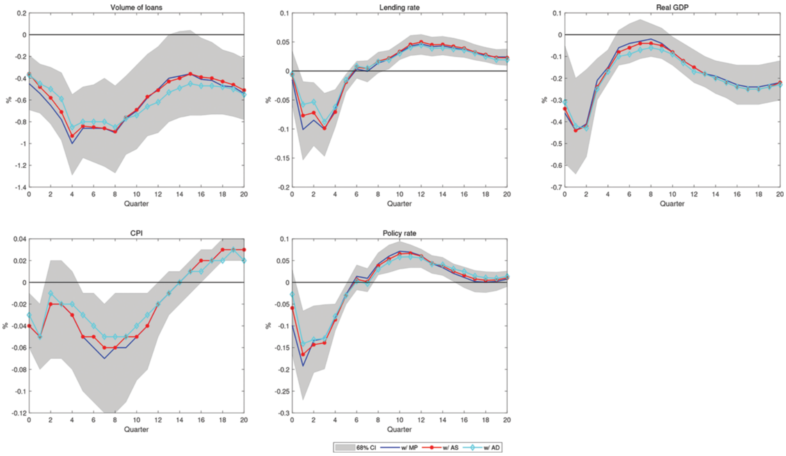
aggregate demand shocks on our results. For example, a monetary policy shock moves policy rates in the opposite direction to output and inflation. An aggregate supply shock such as technology, oil price, and labor supply shocks moves prices and output in the opposite directions, whereas an aggregate demand shock such as consumption, preference, and investment demand shock moves prices, policy rates, and output in the same direction. Hence, we do not impose any restrictions on the four variables related to bank loans to identify any of these structural shocks because of their ambiguous theoretical effects on these variables.

However, the joint identification of all the structural shocks heightens the computational burden because more matrices $Q^{(k(j))}$ need to be discarded to obtain impulse responses that satisfy the restrictions. As a compromise, instead of identifying five orthogonal structural shocks simultaneously,[31] we identify each of the three new structural shocks jointly with the existing loan supply and demand shocks in turn and then check whether the newly added structural shock influences the main findings. Table 6 summarizes the identification restrictions for all the structural shocks in the extended model (the sign of the shocks is normalized to indicate a contractionary shock).

We start by estimating the extended model by identifying contractionary monetary policy shocks jointly with negative loan supply

[31] When identifying the five structural shocks simultaneously, we did not obtain a sufficient number of correct draws of the impulse vectors from 10^7 draws.

Figure 10. The Responses to a Negative Loan Supply Shock: Extended Model

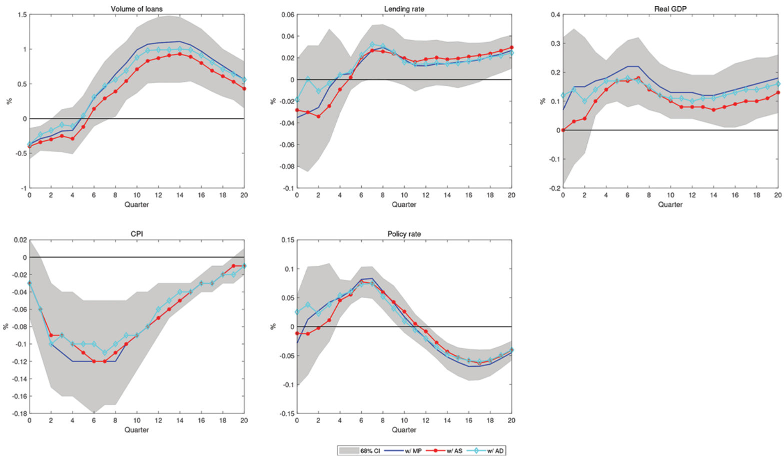


Notes: Solid blue lines plot the median impulse responses, and the shaded areas note their 16th and 84th percentile bands from 200 accepted draws of the extended model in which loan supply and loan demand shocks are identified with monetary policy shocks. The red circled and the blue diamond lines plot the median impulse responses of the extended model in which loan supply and loan demand shocks are identified with aggregate supply and aggregate demand shocks, respectively. (See online version at http://www.ijcb.org for figures in color.)

and demand shocks. The simultaneous identification of monetary policy shocks is useful, as it tests whether shifts in banks' loan supply directly influence economic activity independent of the existence of a bank lending channel of monetary policy (Kashyap, Stein, and Wilcox 1993). The key factor in identifying a negative loan supply shock from a bank lending channel of monetary policy is the sign of the policy rate response: if negative loan supply shocks induce monetary policy loosening, the negative effect on output is independent of the bank lending channel of monetary tightening. We further estimate the extended model in the presence of the identified aggregate supply shock and aggregate demand shock, in turn, to check the robustness of our findings.

Figures 10 and 11 show the responses of the five variables (bank loans, lending rate, real GDP, CPI, and the policy rate) to both loan

Figure 11. The Responses to a Negative Loan Demand Shock: Extended Model



Notes: Solid blue lines plot the median impulse responses, and the shaded areas note their 16th and 84th percentile bands from 200 accepted draws of the extended model in which loan supply and loan demand shocks are identified with monetary policy shocks. The red circled and the blue diamond lines plot the median impulse responses of the extended model in which loan supply and loan demand shocks are identified with aggregate supply and aggregate demand shocks, respectively. (See online version at http://www.ijcb.org for figures in color.)

supply and demand shocks.[32] When jointly identified with a monetary policy shock, their effects on the volume of bank loans, the lending rate, and output are similar to those in the baseline model (see figures 7 and 8). Moreover, negative loan supply shocks are now followed by a decline in prices and accommodative monetary policy, which favors the theoretical predictions presented by Curdia and Woodford (2010) and Gertler and Karadi (2011).

Importantly, a decrease in bank loans now has an expansionary effect on output if driven by a decline in loan demand. Unlike the case of a loan supply shock, the central bank responds to the expansion by tightening its monetary policy. Taken together, the sharp

[32]Figures A.9–A.11 in online appendix A summarize the responses of these variables to the monetary policy shock as well as aggregate supply and demand shocks.

difference in the response of output and the policy rate between figure 10 and figure 11 emphasizes the importance of identifying the factors behind the decrease in bank loans to obtain the optimal policy mix. When jointly identified with aggregate supply and aggregate demand shocks, the effects of loan supply and demand shocks hardly change from the case of monetary policy shocks, confirming the robustness of our findings.

5.4 Extension to the Japanese Economy

As a final robustness check, we investigate whether the identification issue we found from the Korean data exists in a country with a similar financial structure. This is an important test to provide external validity to our main findings. We choose the Japanese economy for this exercise, given its heavy reliance on bank financing discussed in the previous section. Figure A.12 in online appendix A shows the evolution of the relevant variables during the sample period (2000:Q1–2019:Q2). As the Japanese economy has been subject to the zero lower bound (ZLB) constraint, only minimal movement in interest rates is observed. After applying the same treatment of the data and identification assumption, we cannot identify a loan supply shock when using the bank lending rate. Figure A.13 in online appendix A shows that a negative loan supply shock does not have any adverse effect on output, which cannot be squared with any theoretical prediction. Perhaps this finding is not surprising given the ZLB constraint throughout the sample period.

Once we apply our preferred identifying assumptions based on the bank loan officer survey, we find results consistent with the Korean case. Figure A.14 in online appendix A shows that the response of the bank lending rate to the negative loan supply shock is minimal and not statistically different than zero, indicating the failure of the bank lending rate to reflect credit market conditions. The negative loan supply shock has a significantly negative effect on output, which is in sharp contrast to the evidence from the identification using the bank lending rate. Figure A.15 in online appendix A shows that the response of output to the negative loan demand shock is non-negative, as in the Korean case. Again, this finding demonstrates that the decline in bank lending due to a reduction in loan demand is not recessionary.

However, the estimation results of the Japanese economy should be interpreted with caution because the reason why the bank lending rate fails to capture the credit market conditions in Japan (i.e., the binding ZLB constraint) is different than in Korea. Nevertheless, the exercise using the Japanese data again illustrates how the information from the bank loan officer surveys can improve the identification of structural shocks when conventional sign restrictions using the price-quantity framework cannot be applied because of the ZLB constraint.

6. Conclusion

We establish novel stylized facts about bank lending using bank loan officer surveys. The stylized facts illustrate why conventional identifying assumptions using the bank lending rate are unsuitable when bank loans and corporate bonds are not readily substitutable from a borrower's perspective. As a result, a standard identifying assumption using the bank lending rate and volume of loans alone may result in a failed identification of loan supply and demand shocks.

Motivated by these findings, we provide a perspective on the link between credit and the macroeconomy by applying the sign-restriction VAR approach to Korean and Japanese data. We find that the decline in bank loans is associated with the different economic outcomes depending on the supply and demand factors behind the decline. The macroeconomic effects of loan supply and demand shocks in the Korean economy are consistent with the theoretical prediction under credit market imperfections in which bank loans and direct financing are not perfect substitutes, thereby highlighting the unique role of bank financing during turbulent times. As illustrated by the Japanese example, the information from bank loan officer surveys can be particularly helpful when the ZLB constraint prevents us from applying sign restrictions on the interest rate.

References

Amiti, M., and D. E. Weinstein. 2018. "How Much Do Idiosyncratic Bank Shocks Affect Investment? Evidence from Matched Bank-Firm Loan Data." *Journal of Political Economy* 126 (2): 525–87.

Bae, K.-H., J.-K. Kang, and C.-W. Lim. 2002. "The Value of Durable Bank Relationships: Evidence from Korean Banking Shocks." *Journal of Financial Economics* 64 (2): 181–214.

Bahadir, B., and I. Gumus. 2016. "Credit Decomposition and Business Cycles in Emerging Market Economies." *Journal of International Economics* 103 (November): 250–62.

Banker, R. D., H. Chang, and S.-Y. Lee. 2010. "Differential Impact of Korean Banking System Reforms on Bank Productivity." *Journal of Banking and Finance* 34 (7): 1450–60.

Bassett, W. F., M. B. Chosak, J. C. Driscoll, and E. Zakrajšek. 2014. "Changes in Bank Lending Standards and the Macroeconomy." *Journal of Monetary Economics* 62: 23–40.

Becker, B., and V. Ivashina. 2014. "Cyclicality of Credit Supply: Firm Level Evidence." *Journal of Monetary Economics* 62: 76–93.

Bernanke, B. S., and M. Gertler. 1995. "Inside the Black Box: The Credit Channel of Monetary Policy." *Journal of Economic Perspectives* 9 (4): 27–48.

Bernanke, B. S., and C. S. Lown. 1991. "The Credit Crunch." *Brookings Papers on Economic Activity* 22 (2): 205–48.

Bijsterbosch, M., and M. Falagiarda. 2015. "The Macroeconomic Impact of Financial Fragmentation in the Euro Area: Which Role for Credit Supply?" *Journal of International Money and Finance* 54: 93–115.

Brei, M., and A. Schclarek. 2013. "Public Bank Lending in Times of Crisis." *Journal of Financial Stability* 9 (4): 820–30.

Busch, U., M. Scharnagl, and J. Scheithauer. 2010. "Loan Supply in Germany during the Financial Crisis." Manuscript.

Canova, F., and G. De Nicolo. 2002. "Monetary Disturbances Matter for Business Fluctuations in the G-7." *Journal of Monetary Economics* 49 (6): 1131–59.

Chava, S., and A. Purnanandam. 2011. "The Effect of Banking Crisis on Bank Dependent Borrowers." *Journal of Financial Economics* 99 (1): 116–35.

Chemmanur, T. J., and P. Fulghieri. 1994. "Reputation, Renegotiation, and the Choice between Bank Loans and Publicly Traded Debt." *Review of Financial Studies* 7 (3): 475–506.

Choi, S. 2020. "Changes in the Effects of Bank Lending Shocks and Development of Public Debt Markets." *Finance Research Letters* 33 (March): Article 101225.

Ciccarelli, M., A. Maddaloni, and J.-L. Peydro. 2015. "Trusting the Bankers: A New Look at the Credit Channel of Monetary Policy." *Review of Economic Dynamics* 18 (4): 979–1002.

Curdia, V., and M. Woodford. 2010. "Credit Spreads and Monetary Policy." *Journal of Money, Credit and Banking* 42 (s1): 3–35.

De Fiore, F., and H. Uhlig. 2011. "Bank Finance versus Bond Finance." *Journal of Money, Credit and Banking* 43 (7): 1399–1421.

De Nicolò, G., and M. Lucchetta. 2011. "Systemic Risks and the Macroeconomy." NBER Working Paper No. 16998.

Del Giovane, P., G. Eramo, and A. Nobili. 2011. "Disentangling Demand and Supply in Credit Developments: A Survey-based Analysis for Italy." *Journal of Banking and Finance* 35 (10): 2719–32.

Dell'Ariccia, G., and R. Marquez. 2006. "Lending Booms and Lending Standards." *Journal of Finance* 61 (5): 2511–46.

Demirguc-Kunt, A., and R. Levine. 2001. "Financial Structure and Economic Growth." In *Financial Structure and Economic Growth: A Cross-Country Comparison of Banks, Markets, and Development*. Cambridge, MA and London: MIT Press.

Den Haan, W. J., and V. Sterk. 2011. "The Myth of Financial Innovation and the Great Moderation." *Economic Journal* 121 (553): 707–39.

Diamond, D. W. 1991. "Monitoring and Reputation: The Choice between Bank Loans and Directly Placed Debt." *Journal of Political Economy* 99 (4): 689–721.

Dinc, I. S. 2005. "Politicians and Banks: Political Influences on Government-owned Banks in Emerging Markets." *Journal of Financial Economics* 77 (2): 453–79.

Faust, J. 1998. "The Robustness of Identified VAR Conclusions about Money." *Carnegie-Rochester Conference Series on Public Policy* 49 (December): 207–44.

Faust, J., S. Gilchrist, J. H. Wright, and E. Zakrajšek. 2013. "Credit Spreads as Predictors of Real-time Economic Activity: A Bayesian Model-Averaging Approach." *Review of Economics and Statistics* 95 (5): 1501–19.

Finlay, R., and J. P. Jääskelä. 2014. "Credit Supply Shocks and the Global Financial Crisis in Three Small Open Economies." *Journal of Macroeconomics* 40 (June): 270–276.

Friedman, B. M., and K. N. Kuttner. 1993. "Economic Activity and the Short-term Credit Markets: An Analysis of Prices and Quantities." *Brookings Papers on Economic Activity* 24 (2): 193–284.

Fry, R., and A. Pagan. 2011. "Sign Restrictions in Structural Vector Autoregressions: A Critical Review." *Journal of Economic Literature* 49 (4): 938–60.

Gambacorta, L., J. Yang, and K. Tsatsaronis. 2014. "Financial Structure and Growth." *BIS Quarterly Review* (March): 21–35.

Gambetti, L., and A. Musso. 2017. "Loan Supply Shocks and the Business Cycle." *Journal of Applied Econometrics* 32 (4): 764–82.

Gerali, A., S. Neri, L. Sessa, and F. M Signoretti. 2010. "Credit and Banking in a DSGE Model of the Euro Area." *Journal of Money, Credit and Banking* 42 (s1): 107–41.

Gertler, M., and S. Gilchrist. 1993. "The Role of Credit Market Imperfections in the Monetary Transmission Mechanism: Arguments and Evidence." *Scandinavian Journal of Economics* 95: 43–64.

Gertler, M., and P. Karadi. 2011. "A Model of Unconventional Monetary Policy." *Journal of Monetary Economics* 58 (1): 17–34.

Gilchrist, S., and E. Zakrajšek. 2012. "Credit Spreads and Business Cycle Fluctuations." *American Economic Review* 102 (4): 1692–1720.

Gourinchas, P.-O., and M. Obstfeld. 2012. "Stories of the Twentieth Century for the Twenty-first." *American Economic Journal: Macroeconomics* 4 (1): 226-65.

Gyntelberg, J., G. Ma, and E. Remolona. 2006. "Developing Corporate Bond Markets in Asia." *BIS Papers* 26 (February): 13–21.

Hale, G. 2007. "Bonds or Loans? The Effect of Macroeconomic Fundamentals." *Economic Journal* 117 (516): 196–215.

Halvorsen, J. I., and D. H. Jacobsen. 2014. "How Important Can Bank Lending Shocks Be for Economic Fluctuations?" *North American Journal of Economics and Finance* 29 (July): 104–23.

Helbling, T., R. Huidrom, M. A. Kose, and C. Otrok. 2011. "Do Credit Shocks Matter? A Global Perspective." *European Economic Review* 55 (3): 340–53.

Holmstrom, B., and J. Tirole. 1997. "Financial Intermediation, Loanable Funds, and the Real Sector." *Quarterly Journal of Economics* 112 (3): 663–91.

Houssa, R., J. Mohimont, and C. Otrok. 2013. "Credit Shocks and Macroeconomic Fluctuations in Emerging Markets." Manuscript.

Hristov, N., O. Hülsewig, and T. Wollmershäuser. 2012. "Loan Supply Shocks during the Financial Crisis: Evidence for the Euro Area." *Journal of International Money and Finance* 31 (3): 569–92.

Hülsewig, O., E. Mayer, and T. Wollmershäuser. 2006. "Bank Loan Supply and Monetary Policy Transmission in Germany: An Assessment Based on Matching Impulse Responses." *Journal of Banking and Finance* 30 (10): 2893–2910.

Inoue, A., and L. Kilian. 2013. "Inference on Impulse Response Functions in Structural VAR Models." *Journal of Econometrics* 177 (1): 1–13.

Jiménez, G., S. Ongena, J.-L. Peydró, and J. Saurina. 2014. "Hazardous Times for Monetary Policy: What Do Twenty-three Million Bank Loans Say about the Effects of Monetary Policy on Credit Risk-taking?" *Econometrica* 82 (2): 463–505.

Kashyap, A. K., J. C. Stein, and D. W. Wilcox. 1993. "Monetary Policy and Credit Conditions: Evidence from the Composition of External Finance." *American Economic Review* 83 (1): 78–98.

Khwaja, A. I., and A. Mian. 2008. "Tracing the Impact of Bank Liquidity Shocks: Evidence from an Emerging Market." *American Economic Review* 98 (4): 1413–42.

Kiyotaki, N., and J. Moore. 1997. "Credit Cycles." *Journal of Political Economy* 105 (2): 211–48.

Laffont, J.-J., and R. Garcia. 1977. "Disequilibrium Econometrics for Business Loans." *Econometrica* 45 (5): 1187–1204.

Leary, M. T. 2009. "Bank Loan Supply, Lender Choice, and Corporate Capital Structure." *Journal of Finance* 64 (3): 1143–85.

Lown, C., and D. P. Morgan. 2006. "The Credit Cycle and the Business Cycle: New Findings Using the Loan Officer Opinion Survey." *Journal of Money, Credit and Banking* 38 (6): 1575–97.

Meeks, R. 2012. "Do Credit Market Shocks Drive Output Fluctuations? Evidence from Corporate Spreads and Defaults." *Journal of Economic Dynamics and Control* 36 (4): 568–84.

Musso, A., S. Neri, and L. Stracca. 2011. "Housing, Consumption and Monetary Policy: How Different Are the US and the Euro Area?" *Journal of Banking and Finance* 35 (11): 3019–41.

Paustian, M. 2007. “Assessing Sign Restrictions.” *BE Journal of Macroeconomics* 7 (1).

Peek, J., and E. S. Rosengren. 2000. “Collateral Damage: Effects of the Japanese Bank Crisis on Real Activity in the United States.” *American Economic Review* 90 (1): 30–45.

Peek, J., E. S. Rosengren, and G. M. B. Tootell. 2003. “Identifying the Macroeconomic Effect of Loan Supply Shocks.” *Journal of Money, Credit and Banking* 35 (6): 931–47.

Peersman, G. 2011. “Bank Lending Shocks and the Euro Area Business Cycle.” Working Paper No. 11/766, Faculty of Economics and Business Administration, Ghent University.

Perri, F., and V. Quadrini. 2018. “International Recessions.” *American Economic Review* 108 (4–5): 935–84.

Ravn, S. H. 2016. “Endogenous Credit Standards and Aggregate Fluctuations.” *Journal of Economic Dynamics and Control* 69 (August): 89–111.

Rubio-Ramirez, J. F., D. F. Waggoner, and T. Zha. 2010. “Structural Vector Autoregressions: Theory of Identification and Algorithms for Inference.” *Review of Economic Studies* 77 (2): 665–96.

Sims, C. A., J. H. Stock, and M. W. Watson. 1990. “Inference in Linear Time Series Models with Some Unit Roots.” *Econometrica* 58 (1): 113–44.

Stiglitz, J. E., and A. Weiss. 1981. “Credit Rationing in Markets with Imperfect Information.” *American Economic Review* 71 (3): 393–410.

Tamási, B., and B. Világi. 2011. “Identification of Credit Supply Shocks in a Bayesian SVAR Model of the Hungary Economy.” Manuscript.

Uchida, H., G. F. Udell, and N. Yamori. 2012. “Loan Officers and Relationship Lending to SMEs.” *Journal of Financial Intermediation* 21 (1): 97–122.

Uhlig, H. 2005. “What Are the Effects of Monetary Policy on Output? Results from an Agnostic Identification Procedure.” *Journal of Monetary Economics* 52 (2): 381–419.

van der Veer, K. J. M., and M. M. Hoeberichts. 2016. “The Level Effect of Bank Lending Standards on Business Lending.” *Journal of Banking and Finance* 66 (May): 79–88.

Weinstein, D. E., and Y. Yafeh. 1998. “On the Costs of a Bank-centered Financial System: Evidence from the Changing Main Bank Relations in Japan.” *Journal of Finance* 53 (2): 635–72.