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Lending Standards and the Business Cycle: Evidence from Loan Survey Releases*

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Abstract

The Fed's Senior Loan Officer Opinion Survey (SLOOS) is widely considered a good indicator of banks' lending conditions. We use the change in corporate bond spreads on SLOOS release days to instrument changes in lending standards. A series of estimated IV local projections shows that lending standards have highly significant effects on macroeconomic and financial variables. A relaxation of standards expands economic activity and eases financial conditions. We then use the change in spreads and the change in the VIX index on release days to identify a pure credit supply shock and a risk-taking shock using sign restrictions in a Bayesian VAR model. We find that an easing in lending has different consequences for both types of shocks. While the VIX, the excess bond premium and stock prices decrease after a pure credit supply shock, they increase after a risk-taking shock.

Keywords: loan survey, credit supply, risk-taking, instrumental variable local projections, shock identification

JEL classification: E32, E44, G14

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1 Introduction

Banks play a major role in firms' financing decisions. This is true even in countries such as the US, where market finance dominates bank finance. As a consequence, changes in banks' credit conditions drive economic activity and financial markets. One key element of credit conditions are the standards banks apply when extending or curtailing credit to firms. A large literature to be surveyed below estimates the economic and financial effects of exogenous changes to banks' lending standards using the lending standards banks self-report in surveys such as the Fed's Senior Loan Officer Opinion Survey (SLOOS).

The challenge for empirical work is how to identify exogenous changes to lending standards. As a matter of fact, standards are endogenous and reflect aggregate economic conditions, competition in the banking sector and bank-specific characteristics. Many researchers estimate vector autoregression (VAR) models comprising lending standards and standard business cycle variables and impose restrictions on the contemporaneous interaction of the variables (e.g. Basset et al., 2014). The drawback of this approach is that the restrictions are relatively ad hoc and they already predetermine some of the model´s results.

In this paper, we revisit the estimation of the effect of changes in lending standards and make two contributions. First, we introduce a novel identification strategy. The release of the results of the SLOOS prompts a market response. Corporate bond yields change when the lending standards reported in the survey are surprisingly lax or tight, respectively. We use the change in the spread between interest rates on low-quality and AAA-rated corporate bonds on SLOOS release days as an exogenous instrument. The assumption is that the change in the corporate bond spread is not systematically affected by other news on SLOOS release days.

The economic rationale for using changes in corporate spreads is as follows. Suppose banks tighten standards. If the demand for credit is unchanged, firms substitute bank lending with bond financing and turn to the corporate bond market (see Becker and Ivashina, 2014, and Kashyap et al., 1993). The yields on corporate bonds increase. This bank-bond substitution is more difficult for firms in weak financial conditions, for which access to the bond market is strenuous and external financing is particularly expensive (see Bell and Young, 2010). This is why yields on low-rated bonds should rise more than yields on AAA-rated bonds. As a result, the corporate credit spread widens.

We estimate a series of local projections (Jordà, 2005) for financial and business cycle variables and use the response of spreads in order to instrument changes in lending standards. Thus, we estimate instrumental variables (IV) local projections as in

Stock and Watson (2018). The advantage of this approach is that the identification is relatively light on assumptions. In particular, we do not need to impose an ordering onto the variables or any restrictions on the signs and the magnitudes of the responses such as in VAR models.

Second, we acknowledge that changes in lending standards as reported in the survey can be decomposed into two alternative structural shocks. The spread instrument introduced before elicits the responses to changes in standards as such but is unable to help us differentiate between these two underlying driving forces. Suppose banks report an increase in standards. One way to interpret the higher standards is as an adverse credit supply shock: banks curtail the amount of lending for a given willingness to accept a certain exposure to risk. An alternative interpretation is a drop in the bank's willingness to accept risk for a given loan volume. Our second contribution is a decomposition of lending standards into these two alternative shocks. We draw on the work of Jarocinski and Karadi (2020) and use a second instrument, the change in the VIX index on SLOOS release days, besides the change in spreads on release days. We estimate a Bayesian VAR model, in which imposing sign restrictions on the instruments allows us to disentangle both shocks.

We argue that a risk-taking shock narrows the spread on release days and increases the VIX as banks are willing to increase their risk exposure when making their lending decision. A pure credit supply shock, in contrast, also leads to a narrowing of the corporate bond spread on release days but reduces the VIX. As financial conditions ease, the fear of financial stress abates. Hence, a pure credit supply shock describes an expansion of credit for unchanged risk preferences, while the risk-taking shock is a credit expansion that goes hand in hand with more risk-taking. While the macroeconomic effects of both shocks might be similar, the consequences for financial stability are not. In particular, the risk-taking shock contributes to a build-up of financial risk and instability.

We find that a relaxation of lending standards has strong and highly significant effects on macroeconomic and financial variables. A drop of one percentage point in the net percentage share of banks tightening their standards increases industrial production and consumer prices by 0.1%. The excess bond premium of Gilchrist and Zakrajsek (2012) falls by five basis points and the S&P 500 stock market index increases by 0.4%. These are economically sizable effects. The demand for credit, which is also elicited in the loan survey, remains unaffected. This supports the notion that the estimated effects are driven by the supply rather than the demand for credit.

The pure credit supply shock and the risk-taking shock, which we obtain from the estimated Bayesian VAR model with the two external instruments, both cause an easing of financial conditions. Credit conditions as reflected in the Chicago Fed Financial Conditions index improve, lending standards fall and spreads narrow. The stock market indices (the VIX index) decrease (increases) after a risk-taking shock and improve (declines) after an expansionary credit supply shock. The Fed tightens monetary conditions after an expansionary pure credit supply shock, but not after a risk-taking shock.

This paper combines lending standards with news announcements and, hence, relates to both strands of the literature. Let us briefly highlight the relationship to either branch. Lown and Morgan (2006) investigate the nexus between macroeconomic variables and changes in lending standards according to the SLOOS. They observe that tighter lending standards negatively correlate with commercial loan growth and real activity. To account for the possible endogeneity of these variables, they estimate a six variables VAR model identified via a Cholesky decomposition. They find that shocks to lending standards affect lending and output and that a positive aggregate loan shock leads to tighter standards. The role of credit supply and lending standards gained momentum after the global financial crisis. Building on granular bank-level information from the SLOOS, Basset et al. (2014) develop a credit supply indicator that is free of macroeconomic factors and bank-specific characteristics. They estimate a standard VAR model where the credit supply indicator, real GDP, core lending capacities of banks[1], inflation and the credit spread are endogenous variables. They identify the VAR via a recursive ordering and find that credit supply shocks significantly impact all variables.

Following Basset et al. (2014), Altavilla et al. (2015) also construct a credit tightening indicator that is not contaminated by the prevailing credit demand conditions from the Bank Lending Survey for the euro area. Rather than estimating a VAR with the indicator as an endogenous variable, they use it as an external instrument in a VAR a la Stock and Watson (2012) and Mertens and Ravn (2013). Their analysis indicates that real activity and credit volumes drop and bank lending spreads widen after a credit tightening shock. Lucidi and Semmler (2020) rely on an instrument to disentangle the endogenous relationship between credit standards and the real economy. Specifically, the use rotations of external auditors within banks in the euro area an an exogenous source of variation and find a significant impact of credit standards on real and financial variables.

A separate branch of the literature studies the role of banks' lending standards

[1]The lending capacity of banks is defined as the sum of outstanding core loans and the corresponding unused commitments.

for the credit channel and the risk-taking channel of the transmission of monetary policy. Ciccarelli et al. (2014) use data from the SLOOS and the BLS to analyze the credit channel of monetary policy. They show that credit demand and supply amplify monetary policy shocks in the US and the euro area. Darracq-Paries and De Santis (2015) show that the ECB's long-term refinancing operations in 2011 and 2012 led to relaxed lending conditions. Similarly, Kurtzman et al. (2018) come to the conclusion that the first and third round of quantitative easing in the US significantly lowered lending standards. Buch et al. (2014) use the Federal Reserve's Survey of Terms of Business Lending to show that expansionary monetary policy increases the degree of bank risk-taking. Likewise, Paligorova and Santos (2017) employ bank-level information from the SLOOS and show that banks grant riskier loans when the Fed eases monetary policy.

The paper is also related to the vast literature on the responses of financial markets to news releases. Fleming and Remolona (1999), Gürkaynak et al. (2005a) and Altavilla et al. (2017) show that macroeconomic surprises can affect the entire term structure. Kuttner (2001) and Gürkaynak et al. (2005b) exploit changes on federal funds futures around FOMC announcements to unveil monetary policy shocks. In a similar vein, Känzig (2021) relies on oil futures prices around OPEC production announcements to identify oil supply news. A contractionary oil supply shock increases oil prices and inflation expectations but decreases oil and industrial production. Focusing on news related to lending, Mokas and Giuliodori (2021) analyze how announcements of loan-to-value restrictions impact EU economies. They find that announcements of tighter restrictions lead to a decrease in household credit and house prices. Patrella and Resti (2013), Flannery et al. (2017) and Fernandes et al. (2020) show that stress test releases affect returns for the stress-tested banks. Consequently, trading volumes increase on the disclosure dates. Building on that, Guerrieri and Modugno (2021) analyze whether this reaction stems from the immediate impact on capital distribution plans to investors, whose approval by the Fed is linked to the stress test results, or whether it is driven by the fact that stress test results unveil information about the ability of banks to withstand harsh economic conditions. They find that both transmission mechanisms are relevant.

As we identify lending standards shocks via changes in yields for corporate bonds across the rating spectrum, our paper is also related to the literature on credit spreads. Meeks (2012) provides evidence that changes in the lending spreads drive the macroeconomy. Gilchrist et al. (2014) analyze the relationship between uncertainty, investments and credit spreads on corporate bonds within a structural VAR model and find that uncertainty shocks are to a large extend transmitted through credit spreads. Focusing on uncertainty of financial regulation policy, Nodari (2014) finds that for the US credit spreads widen in response to an increase in uncertainty. The remainder of this paper is structured as follows. In section two, we review the SLOOS and derive the instrument from release days. Section three introduces the local projection model and discusses the results. The decomposition in credit supply and risk-taking shocks is presented in section four, while section five draws conclusions.

2 Releases of the Fed's loan officer survey

In the Fed's Senior Loan Officer Opinion Survey on Bank Lending Practices (SLOOS), loan officers are asked about their assessment of lending conditions and credit demand for various loan categories. Specifically, they indicate whether they have eased or tightened standards in comparison to the previous quarter or whether they remain unchanged. Accordingly, for loan demand, they report whether loan demand was stronger, weaker or unchanged.[2]

The survey is conducted on a quarterly frequency since 1990. In total, the survey covers up to eighty large domestic banks and twenty-four US branches and agencies of foreign banks.[3] Banks can answer the survey in a time window of ten days. The window closes about four weeks prior to the release. The July 2019 survey, for example, was conducted between June 24 and July 5, 2019. The results were released on August 9, 2019. Members of the Federal Open Market Committee (FOMC) had the results available for their July 30/31 meeting.

The survey responses from the individual banks are not reported. Instead, the Fed provides market participants with aggregate estimates of lending conditions and demand across all banks. The release contains the so-called net percentage change. It is given by the share of banks that report a tightening of lending standards ("tightened considerably" or "tightened somewhat") minus the share of banks reporting an easing ("eased considerably" or "eased somewhat"). For credit demand, it is the share of banks observing a stronger demand minus the share reporting a weaker

[2] The specific question is

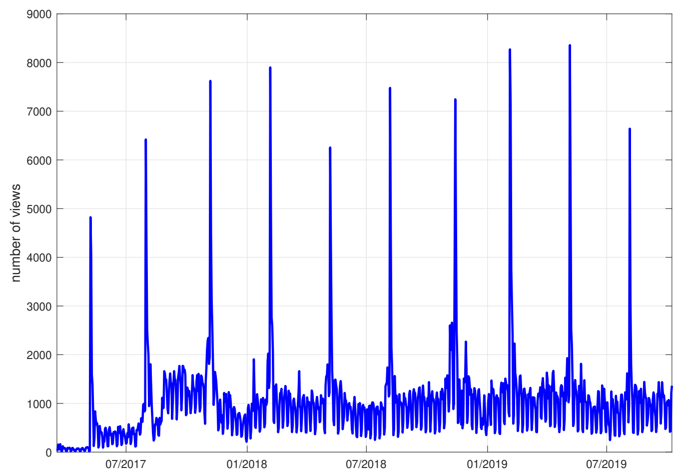
> "Over the past three months, how have your bank's credit standards for approving applications for C&I loans or credit lines—other than those to be used to finance mergers and acquisitions—to large and middle-market firms and to small firms changed?"

Respondents can choose among the following answers: tightened considerably, tightened somewhat, remained basically unchanged, eased somewhat and eased considerably.

[3] See the Fed website for details: https://www.federalreserve.gov/econres/notes/feds-notes/an-aggregate-view-of-bank-lending-standards-and-demand-20200504.htm.

demand.[4]

Figure 1: Views of "Data" section of Fed website



Notes: Daily number of views of the "Data" section of the Website of the Federal Reserve. The outliers correspond to release dates of the loan survey. Sample: March 18, 2017 to October 8, 2019

Starting with Lown and Morgan (2006), academics use the SLOOS results to understand the tightness of credit markets. Moreover, the release of the results from the loan survey receives a lot of attention from market participants and the media. To illustrate the public's interest in the survey results, Figure (1) shows the daily number of views of the "Data" section of the Fed's website between 2017 and October 2019.[5] This section contains the detailed set of survey results. Importantly, the SLOOS release days are clearly visible as extreme outliers in the series. On release days, the "Data section" receives between 5,000 and 8,000 views, while the number of views fluctuates between 1,000 and 2,000 on normal days. The huge interest the loan survey receives motivates us to exploit the market response on the release days. Changes in loan conditions, with the evolution of banks' lending standards being center stage, should contain information on the future path of the macroeconomy and financial markets. Consequently, market participants update their assessment of the credit market when the SLOOS is released.

For a given loan demand, a change in lending standards shifts loan supply. Suppose banks tighten credit standards. As demand for credit is unchanged, firms substitute bank lending with bond financing and turn to the corporate bond market (see Becker

[4] In the aggregation process, the individual bank responses are typically unweighted. However, net percentage changes that are weighted by banks' holdings of the relevant loan category are also available.

[5] See Tillmann (2021) for details on this data set.

and Ivashina, 2014 and Kashyap et al., 1993). Hence, the supply of bonds increases and their prices fall. The yield on corporate bonds increases. This substitution is more expansive for firms in weak financial conditions, for which access to the bond market is strenuous (see Bell and Young, 2010). This is why yields on BAA-rated bonds should rise more than yields on AAA-rated bonds. As a result, the credit spread widens.

To the extent the changes in lending conditions come as a surprise, they should prompt an adjustment of credit spreads on the release day. Therefore, we draw information contained in the response of spreads on release days in order to construct an instrument for changes in credit standards.

2.1 Constructing our instrument for lending standard changes

We collect the release days from the individual survey releases (before 2010) and from ALFRED (since 2010). Table (7) lists the release dates considered. For each release day, we construct the change in the spread between BAA- and AAA-rated corporate bonds relative to the day before the release. Hence, our daily series of surprise changes is

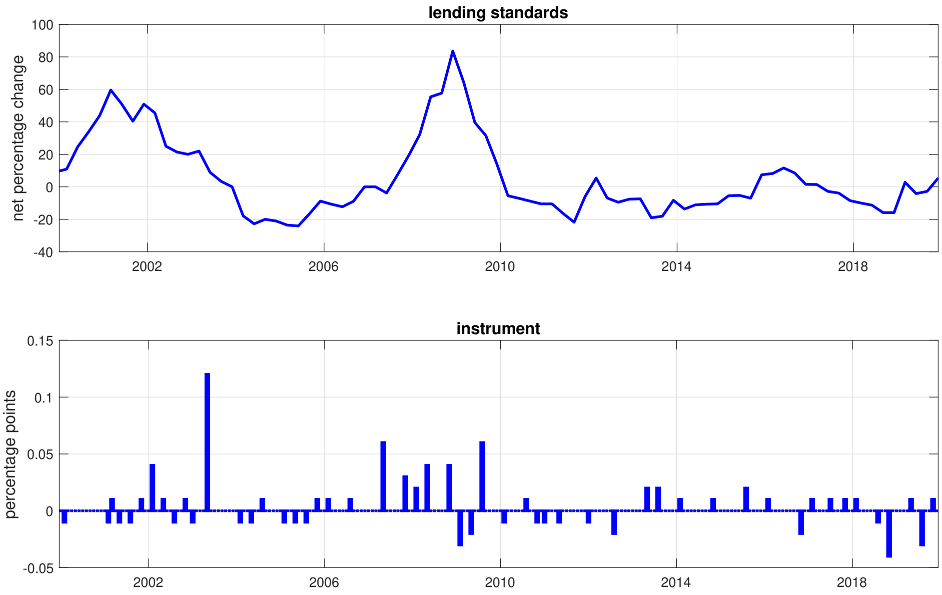
$$z_{t,d}^{spread} = \left(R_{t,d}^{BAA} - R_{t,d}^{AAA}\right) - \left(R_{t,d-1}^{BAA} - R_{t,d-1}^{AAA}\right), \tag{1}$$

where t and d indicate the month and the day of the release. Here, $R_{t,d}^{BAA}$ and $R_{t,d}^{AAA}$ are the yields on BAA- and AAA-rated corporate bonds on the release day, respectively. For non-release days, the surprise is zero. Finally, we transform the daily surprise series into a monthly instrument, which we use for the empirical analysis below. We obtain a monthly instrument series by assigning every release date to the corresponding month. For months without any release, the instrument series receives a zero. Accordingly, the instrument series is given by

$$z_t^{spread} = \begin{cases} z_{t,d}^{spread} & \text{if release in } t \\ 0 & \text{if no release in } t \end{cases}$$

Under the standard identifying assumption in the news announcement literature that other factors are white noise and, hence, do not affect the corporate bond spread on SLOOS release dates on average, the daily changes in the spread between low rated corporate bonds and their higher rated peers on these days is an indicator of unanticipated changes in the credit standards.

Figure 2: Lending standards and surprise on loan survey release days



Notes: The upper panel shows the net percentage of domestic banks tightening lending standards. The lower panel shows the Change in the spread between BAA- and AAA-rated corporate bonds on SLOOS release days (in percentage points). See Appendix A for data sources.

Figure (2) shows the net percentage change of banks tightening lending standards (upper panel) and the instrument series, z_t^{spread} (lower panel). The most pronounced surprises were on 9 May 2003, followed by 17 May 2007 and 17 August 2009. As expected, the volatility increases during the 2008/09 financial crisis and the subsequent recession.

2.2 Properties of our instrument

In this subsection, we evaluate the characteristics of the instrument series constructed in the previous subsection. We begin by studying the information content of the instrument. Table (2) sheds light on the information content of the change in the spread on release days. The upper panel compares the mean and the standard deviation on the release dates with the mean and the standard deviations on 5, 15 and 30 trading days prior and after the release dates, respectively. In all six cases, the standard deviation of changes of the spread on the release date is larger. In three cases, the difference is statistically significant on a 5% level. Thus, the change in spreads on release days contains significantly more information compared to alternative days.

The information content of the change in spreads on SLOOS release days could be impaired when other macroeconomic news are released on the same days. Scotti (2016) constructs an indicator of US macroeconomic surprises. The index summarizes the weighted surprise components of the most important data releases such as nonfarm employment, GDP, retail sales and others. We study the correlation between the change in spreads on release days against the level and the percentage change of the Scotti (2016) macroeconomic surprise index. The correlation of our instrument with the level (change) of the surprise index is 0.07 (-0.03), respectively. We now turn to our monthly shock series, which we compare to two alternative series of monetary policy shocks, that is, the shocks derived by Swanson (2021) and Bu et al. (2021). Both monetary policy shocks are only weakly correlated with our shock series with both correlation coefficients equal to -0.15. Hence, the shock we identify is not systematically related to news about monetary policy.

We now compare the instrument with the net percentage change of lending standards itself. We identify changes in the lending standards indirectly via the market response because the change in standards itself might be predictable using information available before the release. It is imperative that the variable is a true shock, i.e. that it is not predictable. In fact, a simple forecast exercise reveals that while the net percentage change is to some extent predictable, the change in the spread can be seen as a surprise. This forecast exercise is based on a least-squares estimation of the following regression

$$y_t = c + \beta(x_{t-1} - x_{t-2}) + \varepsilon_t, \tag{2}$$

where y_t is either the net percentage change or the instrument in t. On the right hand-side of the equation, c is a constant, $x_{t-1} - x_{t-2}$ is the change in the exogenous variable from $t-2$ to $t-1$ and ε_t describes the error term.

Since the time span during which banks respond to the survey usually includes the end of the first and the beginning of the second month in each quarter, it is not always possible to assign the net percentage change to a specific month. Hence, we estimate the equation with quarterly data. The equation allows us to quantify whether changes in economic or financial variables help to predict the net percentage change of lending standards in the upcoming period. The list of exogenous variables covers the (log) Dow Jones, the (log) S&P500, (log) real GDP, (log) loans, the GZ spread, the excess bond premium, the (shadow) short rate and the BAA-AAA corporate bond spread. We run a separate regression for each variable and report Newey-West standard errors.

Table (3) shows the results. For the net percentage change, all eight variables have the expected sign. Four of them are significant on a 95% confidence level. Hence, current quarter-on-quarter (qoq) growth rates of the Dow Jones Index, the S&P500 and GDP as well as qoq changes in the shadow rate contain valuable information about the net percentage change of lending standards in the next quarter. In contrast to that, the instrument series is not predictable based on any of the eight variables. Finally, we also assess the autocorrelation of the two series. This allows us to take a stand on whether the variables can be predicted by their own lags. Table (4) reports the autocorrelation and partial autocorrelation as well as the Ljung-Box Q-statistic. According to the latter, the net percentage change (change of spreads) exhibits (no sign of) serial correlation.

Below, we rely on a second instrument that allows us to distinguish banks' risk-taking behavior from changes to their credit supply. For that purpose, we build on the daily growth rate of the CBOE Volatility Index (VIX), which we also receive from FRED. On release days, the standard deviation of the growth rate is again larger than 5, 15 and 30 trading days before or after the announcement, see the lower panel of Table (2). This finding is significant in five cases.

3 Evidence from local projections

Our aim is to estimate the impact of surprise changes to lending standards on macroeconomic and financial conditions. For that purpose, we estimate a series of local projections (Jordà, 2005) and instrument lending standards with the response of spreads on SLOOS release days. Hence, we estimate instrumental variable local projections (IV-LP) following Stock and Watson (2018).

3.1 Model

We regress the dependent variable y_t at time $t+h$ on a constant, α_h, the net percentage change of lending standards, $stand_t$, and a vector of control variables, $\mathbf{x}_t$, which also includes lags of the dependent variable using 2SLS,

$$y_{t+h} = \alpha_h + \beta_h \widehat{stand}_t + \gamma_h \mathbf{x}_t + u_{t+h}, \tag{3}$$

where we use z_t^{spread} as an instrument for $stand_t$. Hence, $\widehat{stand}_t$ are the fitted values of lending standards obtain from the first-stage regression of lending standards on the instrument and the control variables.

The estimate of β_h is the coefficient of interest. Plotting β_h as a function of $h = 0, ..., 30$ provides us with an impulse response function. We follow Jordà (2005) and apply a Newey-West correction to our standard errors, which we use below to construct confidence bands around the impulse responses. The maximum lag for the Newey-West correction is set to $h + 1$.

The list of independent variables includes industrial production (in logs), consumer prices (in logs), the short-term interest rates, the VIX volatility index, the excess bond premium of Gilchrist and Zakrajsek (2012), the GZ spread of Gilchrist and Zakrajsek (2012), the spread between high-yield bonds and AAA-rated bonds, the loan volume (in log), the Credit Subindex of the Financial Conditions Index of the Federal Reserve Bank of Chicago, nonfarm payroll employment (in log), the overall volume of commercial and industrial loans (in logs), the Dow Jones and S&P 500 equity price indices (in logs) and the index of house prices (in logs). The net percentage change of lending standards is taken from the SLOOS.

The data frequency is monthly and the estimation sample is 2000:1 to 2019:12. Table (5) provides details on the definition of the macroeconomic and financial variables and the data sources. Table (6) lists the variables from the loan survey, such as the net percentage changes, which are linearly interpolated from quarterly to monthly frequency.

The vector of controls includes the log of industrial production, the log of the PCE price level, the excess bond premium and the Wu-Xia shadow federal funds rate. For these variables, we include the realization in t and two lags. The vector also includes two lags of the dependent variable. If one of the control variables is used as the dependent variable, the vector $\mathbf{x}_t$ is adjusted accordingly. Overall, the results appear very insensitive to the choice of control variables and their lag structure.

To be a valid instrument, z_t^{spread} has (i) to meet the relevance condition, i.e. it must be correlated with the variable to be instrumented, (ii) to be contemporaneously exogenous with respect to u_t and (iii) must be uncorrelated with all leads and lags of u_t. The first property is evaluated using the $F-$statistic in the first-stage regression. The second property is met by construction: the change in the BAA-AAA spread on release days should be exogenous with respect to the other variables in the equation. To meet the lead-lag exogeneity assumption, we follow Stock and Watson (2018) and include two lags of the instrument as well as lags of the endogenous variable and the control variables from equation (3) in the first-stage regression. The number of lags of z_t^{spread} is chosen by minimizing the Akaike Information Criterion. This procedure recommends two lags in the first-stage regression throughout all specifications.

As the set of right-hand side variables differs across the estimated models due to lags of the dependent variables, we obtain an $F-$statistic for each model. For the baseline model with GDP as the dependent variable, the heteroscedasticity-robust $F-$statistic is $F^{HAC} = 12.36$, and the conventional standard $F-$statistic is

$F^{Hom} = 12.96$. The $F-$statistic lies above the critical value of 10, which is typically used in the applied literature, for all endogenous variables other than the variables taken from the SLOOS itself. When estimating the response of banks' perceived demand for credit, which is elicited in the survey, the $F-$statistic drops to 3.8. This is not surprising: in this case, the first-stage regression includes lending standards and credit demand, both taken from the survey. Since both are strongly negatively correlated, the instrument losses its explanatory power. Hence, we need to remain cautious when interpreting the response of credit demand to the identified shock.

3.2 Results

Figures (3) to (6) report the estimated impulse responses. The confidence bands cover 65% and 90% of the potential estimates, respectively. All figures show the response to a fall of one percentage point in the net percentage of banks tightening lending standards. Hence, the shock is expansionary in nature.

Figure (3) shows the shock impact on the business cycle. An easing of credit standards leads to a significant improvement of economic activity as reflected in GDP and industrial production, respectively. Moreover, consumer prices increase. As a result of the increase in both activity and prices, short-term interest rates rise. Hence, the Fed tightens monetary policy conditions.

The credit market eases after a surprise fall in credit standards. Figure (4) shows that spreads, both the high-yield/AAA spread and the GZ spread, narrow significantly following the shock. Furthermore, the excess bond premium falls and peaks ten months after the shock. The overall loan volume remains stable in the first year after the shock before it eventually increases. Credit conditions as reflected in the Credit Subindex of the Chicago Fed's Financial Conditions Index ease significantly after the relaxation of lending standards.

Figure (5) reports the sensitivity of various asset prices to credit standards. The level of stock prices increases significantly. While the peak response of the overall Dow Jones and S&P 500 indices is about 0.4%, the subindex of the Dow Jones covering the banking industry increases more than twice as much. Looser standards also reduce equity price volatility as reflected by the VIX index. The responses of employment, house prices and credit demand are shown in Figure (6). Employment increases strongly after the shock, with the peak occurring two years after the shock. This is consistent with the response of GDP discussed before and the nature of employment as a lagging indicator of the business cycles. Throughout the 30 months shown in the Figure, house prices remain insensitive to shocks to lending standards.

The responses of credit demand reported in the SLOOS are shown in the bottom half of Figure (6). The loan demand of medium and large firms appears insensitive to lending standards shocks, while the demand from small firms tends to fall. When interpreting these responses, though, we have to remember the low $F-$statistic from the first-stage regression for credit demand. The instrument loses its information content in this case, thus pointing to a weak instrument problem.

To summarize, a surprise easing of credit standards causes a significant expansion of financial conditions and economic activity. In the next section, we decompose these responses into two alternative channels.

4 Credit supply vs. risk-taking shocks

Our analysis in the previous section highlights that an unanticipated easing in lending standards, identified by a decrease in spreads on SLOOS release dates, has macroeconomic consequences for real and financial market variables. An easing of lending standards by banks can result from two alternative motives: First, banks extend the supply of credit for a given degree of risk-taking. Thus, they give more loans to firms of equal quality. Second, banks increase the amount of risk they are willing to accept when giving loans and provide loans to creditors of lower quality. The aggregate business cycle implications of both types of shocks might be similar, but the implications for financial stability are not.

We now disentangle these two channels with a BVAR model following Jarocinski and Karadi (2020), in which we differentiate between two instruments. Besides the change in the spread on release days introduced before, we also use information from daily changes of the VIX on SLOOS release days. Specifically, we identify an increase in credit supply (risk-taking) via a decrease in the spread accompanied by a decrease (increase) in the VIX. We outline the methodology and the shock identification in Section (4.1) in more detail and present the corresponding results in Section (4.2).

4.1 Model

Following Jarocinski and Karadi (2020), the BVAR model includes macroeconomic and financial variables on a monthly frequency as well as higher frequency changes of instruments around pre-specified events. In our case, the pre-specified events are SLOOS release dates. We consider daily changes in the spread and the VIX from the eve on the day before until the end of the day of the release to discern between credit supply shocks and risk-taking shocks. As before, we receive a monthly time series for each instrument by assigning each release date to the corresponding month. If there is no release date in a month, both instruments receive zeros. In the baseline scenario, the list of monthly variables includes the (shadow) short rate, (log) employment, (log) prices, (log) VIX, the EBP and bank lending standards from the SLOOS. Hence, we estimate a VAR model with six monthly variables and two instruments. Let z_t^{spread} and z_t^{VIX} be the monthly instrument series for the spread and the VIX, respectively, such that $z_t = [z_t^{spread} \; z_t^{VIX}]'$ holds. In a more general case, N reflects the number of instruments. The $M \times 1$ vector of the monthly series is given by y_t.

The model's special feature are the instruments. As it is standard in VAR models, they are allowed to affect the monthly variables on impact and with some delay. In contrast to that, we assume that the lags of all eight variables have no impact on the instruments. The rationale behind that assumption is that agents have all relevant information on the eve before the release dates including information on the lags of the other variables. Hence, they cannot affect the instrument.[6]

Moreover, we do not include a constant for the instruments as they are surprises that should have a mean of zero. The model can be described as follows

$$\begin{pmatrix} z_t \\ y_t \end{pmatrix} = \sum_{p=1}^{P} \begin{pmatrix} 0 & 0 \\ B_p^{yz} & B_p^{yy} \end{pmatrix} \begin{pmatrix} z_{t-p} \\ y_{t-p} \end{pmatrix} + \begin{pmatrix} 0 \\ c^y \end{pmatrix} + \begin{pmatrix} u_t^z \\ u_t^y \end{pmatrix}, \tag{4}$$

where P denotes the lag length, $\mathbf{B_p^{yz}}$ and $\mathbf{B_p^{yy}}$ are a $N \times (N+M)$ and an $M \times (N+M)$ matrices of coefficients capturing lagged influences of the instrument and the monthly data, respectively. While c^y is a vector of constants for the monthly series, u_t^z and u_t^y capture the normally distributed error terms with a mean of zero and a variance-covariance matrix $\mathbf{\Sigma}$.

BVAR models require the elicitation of prior distributions for all estimated coefficients and the variance-covariance matrix. Following Jarocinski and Karadi (2020), we rely on Minnesota priors, where the variance-covariance matrix is assumed to follow an Inverted Wishard distribution. We employ a Gibbs sampler to generate draws from the posterior.[7]

The shock identification deserves special attention. As before, we assume that relaxed credit standards narrow the credit spread. Consequently, changes in the spread on the release day signal agents' perception of the information on the SLOOS. More precisely, a decrease in the spread signals looser standards than expected before the release. However, an unexpected loosening in credit standards can either be asso-

[6] As shown 2.2 a simple forecast exercise reveals that the the daily changes of the high yield AAA spread on the SLOOS release days are indeed not linked to macroeconomic developments or its own lagged values.

[7] More details on the applied priors can be found in Jarocinski and Karadi (2020).

ciated with lower or higher overall market risk. Specifically, market risk increases indicate that agents question whether the looser lending conditions are well anchored in the macroeconomic environment. If standards are too lax, they create stability concerns that are reflected by higher market uncertainty. Put differently, banks increase their risk-taking behavior as their standards decrease and risk increases simultaneously. In contrast to that, market participants appreciate a decrease in lending standards when it is accompanied by a decrease in market risk. In this case, agents believe that the relaxed credit conditions boost lending and thereby economic activity, which ultimately decreases market risk. As we assume that the VIX adequately captures the market risk, its changes on the release day serve as the second instrument series. For convenience, we label the former shock a "risk-taking shock" and the latter a "pure credit supply shock".

Overall, the two surprises have a non-significant positive correlation of 0.044. In 31 (25) of 80 cases, both surprises show the same (opposing) signs. In 24 cases, we observe no change in one of the two variables. In line with the theory, we observe that while the majority of risk-taking shocks occurred prior to the Lehman Brothers collapse, the majority of credit supply shocks unveiled thereafter. Put differently, releases in lending standards were mainly caused by banks' risk appetite prior to the recession.

Table (1) displays the identifying restrictions for the two shocks formally. Despite the sign restrictions mentioned on the surprises, we leave all other variables unrestricted. Additionally, we rely on the uncontroversial assumption that other shocks have no effect on the surprises.

Table 1: Identifying restrictions

		shock	
variable	risk-taking	pure credit supply	other
z_t^{spread}	-	-	0
z_t^{VIX}	-	+	0
y_t	unrestricted	unrestricted	unrestricted

Notes: The identifying assumptions are imposed on impact, where "+" corresponds to an increase and "-" to a decrease in the underlying variable. "0" marks zero restrictions, i.e. the underlying variable is not allowed to respond on impact.

Following Jarocinski and Karadi (2020), we set the lag length to 12. However, the results are largely unaffected by other lag length choices. For reasons of comparability, we standardize both shocks so that they are associated with a one basis point drop in the spread on the release date.

Figure (7) shows the time series of the pure credit supply and the risk-taking shock, respectively. Note that the series is defined such that a positive realization of either shock is an easing of credit conditions. The cumulative series reported in the bottom panel of the figure reveals interesting differences across the two shocks. A sequence of shocks in one direction implies that the cumulative series persistently deviate from zero. In 2005, i.e. before the financial crisis, the risk-taking shock was particularly expansionary. Put differently, there was a sequence of expansionary risk-taking shocks, which is consistent with the view that increased risk-taking contributed to the build-up of financial imbalances. After 2008, the cumulative risk-taking shock indicates a particularly restrictive contribution of the shock as banks curtailed their exposure to risky borrowers.

4.2 Results

Figures (8) and (9) display the impulse-response functions for our baseline model. The consequences of an expansionary pure credit supply shock are shown in Figure (8), while the impact of the risk-taking shock is reported in Figure (9).

All variables behave as expected and in line with our findings in Section (3). Both shocks lead to a drop in the lending standards. According to the peak responses, the credit supply shock is more substantial and its effect lasts longer. The fact that the VIX decreases (increases) after a pure credit supply (risk-taking) shock shows that our identification strategy is successfully disentangling the two shocks. The results of the EBP are similar to those of the VIX. We find an increase after an risk-taking shock and the tendency of a decrease after a pure credit-supply shock. Interestingly, the short rate's reaction is more pronounced in the aftermath of a pure credit-supply shock. One possible interpretation is that pure credit-supply shocks are a bigger threat to price stability in the eyes of policymakers. Another explanation could be that the Fed wants to position itself as an institution that is not leaning against the wind so that they do not respond to financial imbalances associated with the risk-taking behavior. Although both expansionary shocks positively affect the median response of employment, the 16th percentile response is at no point in time positive. In a similar vein, prices tend to increase after both shocks. However, this time, the increases after the risk-taking shock are, in particular in the first periods, stronger. This can be the result of the weaker policy response to the risk-taking shock.

We now estimate a number of seven variable BVAR model where the additional variables stem from the following list: the lending standards of small firms, the credit demand from large and medium size firms as well as from small firms, the corresponding lending spreads, (log) S&P 500, the (log) overall and bank-specific Dow Jones Index, the spread between high yields and AAA-rated corporate bonds, the GZ spread, the Credit Subindex of the Chicago Fed's Financial Conditions Index, (log) loans, (log) real GDP, (log) industrial production and (log) house prices. As in Section 3, this allows us to gain more granular information on the behavior of macroeconomic and financial variables. Moreover, we can assess the accuracy of our previous findings. Figures (10) and (11) show the impulse responses for the additional SLOOS variables. In line with the standards for large and medium enterprises, the standards for small firms also decrease after both shocks. The fact that we observe no clear drop in credit demand in three of the four cases indicates that our shock strategy is not accidentally identifying a credit demand shock. The lending spread tends to decrease after a pure credit-supply shock. In contrast to that, the risk-taking shock has no substantial impact.

Figures (12) and (13) display the response of the financial variables to the pure credit-supply and the risk-taking shock, respectively. Interestingly, while all three stock indices (S&P 500, Dow Jones and Dow Jones Banks) tend to increase after a credit supply shock, they decrease after a risk-taking shock. The response to the credit supply shock is in line with the theory, as bank lending can spur economic growth. For the risk-taking shock, an additional opposing channel exists. Specifically, the higher risk lead to drops in share prices. Moreover, the bank index shows a stronger reaction than the other two indices after a credit supply shock. The high Yield AAA spread decreases after a credit supply shock but shows no clear pattern after a risk-taking shock. In contrast to that, the GZ spread tends to drop after both types of shocks. Credit conditions, as reflected in Credit Subindex of the Chicago Fed's Financial Conditions Index, ease after both shocks. The easing is slightly more pronounced after the risk-taking shock.

Finally, Figures (14) and (15) outline how macroeconomic variables react to both shocks. Interestingly, loans and industrial production only increase after the pure credit supply shock. GDP and house prices tend to increase after both analyzed shocks in the medium term.

5 Conclusions

This paper analyzes the impact of banks‘ credit conditions on macroeconomic and financial variables. Specifically, we focus on the lending standards that banks report in the Fed´s Senior Loan Officer Opinion Survey (SLOOS). The difficulty in assessing these effects arise from the endogenous nature of the variables. Put differently, banks change their credit conditions for a reason, e.g. they ease lending standards when the economic outlook improves. Vice versa, credit conditions affect loans and hence the real economy. The bulk of the empirical literature assesses the nexus between lending standards and economic and financial variables via VAR models.

In contrast to that, our first contribution is that our method relies on information on SLOOS release days. We use the change of the spread between BAA and AAA-rated corporate bonds as an instrument for unexpected changes in lending standards. The reason for this choice is that bank credit and corporate bonds are alternative funding sources for firms and hence (imperfect) substitutes. However, firms with weaker balance sheets find it more difficult and more expansive to substitute so that the spread widens when lending standards tighten more than expected.

With this instrument at hand, we then estimate instrumental variables local projections following Stock and Watson (2018). Specifically, we regress a number of macroeconomic and financial variables on the net percentage change where the series of daily changes of the BAA-AAA corporate bond spread is the instrument via local projections. We find that tighter standards reduce economic activity and weaken financial conditions significantly.

Building on that, we acknowledge that unexpected changes in lending standards could be associated with changes in the credit supply or the risk-taking behavior of banks. We show that a second instrument, the change of the VIX on release dates, allows us to differentiate between them. We receive impulse responses for pure credit supply and risk-taking shocks from a VAR with sign restrictions on the instrument a la Jarocinski and Karadi (2020). Our results show that while both shocks have similar effects on real economic variables, including consumer prices, they impact financial variables and risk measures differently.

Our paper has several implications for policymakers. First, changes in lending standards impact the economy even when one controls for anticipation effects. Second, the release of the survey creates a market reaction. Hence, policymakers that know the outcome of the survey before all other agents might have the opportunity to use the first-mover advantage to create a room where the impact of the shocks can be damped, e.g. via forward guidance. Third, changes in lending standards can be the result of a pure credit supply or a risk-taking shock. As variables such as the

VIX reacts differently to both kinds of shocks, policymakers should monitor these developments so that they can identify the shocks in real time.

Several extensions of the paper are feasible, but beyond the scope of this research. First, we refrain from a structural model that decomposes the a risk-taking shock from a credit supply. Second, we do not consider non-linear or time-varying effects in our empirical estimation approach. Third, the empirical model could also be applied to other economies such as the euro area.

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A Tables and figures

Table 2: The information content of the instruments

	change in BAA-AAA spread						
	release day	release day $+k$					
		$k = -5$	$k = 5$	$k = -15$	$k = 15$	$k = -30$	$k = 30$
mean ($\times 10$)	0.092	0.030	0.066	0.018	0.265	-0.011	-0.128
std. dev.	0.115	0.080***	0.073***	0.082***	0.111	0.077***	0.065***

	change in VIX						
	release day	release day $+k$					
		$k = -5$	$k = 5$	$k = -15$	$k = 15$	$k = -30$	$k = 30$
mean ($\times 10$)	0.040	-0.022**	-0.006	0.004	-0.047**	-0.001	-0.011
std. dev.	0.210	0.015***	0.019	0.016***	0.020	0.151	0.020***

Notes: The upper (lower) panel shows the mean and standard deviation of the change in the BAA-AAA corporate bond spread (the change in the VIX) on the SLOOS release dates and compares them with the first and second moment 5, 10 and 15 trading days before and after the release. The corresponding significance level of 1%, 5% and 10% is marked by ***, **, *, respectively.

Table 3: Forecast of dependent variable

x_t	net percentage change in standards: constant	net percentage change in standards: $x_{t-1} - x_{t-2}$	net percentage change in standards: R^2	change of spreads: constant	change of spreads: $x_{t-1} - x_{t-2}$	change of spreads: R^2
Dow-Jones (log)	6.643 (0.181)	-1.140 (0.015)	0.124	0.004 (0.100)	0.000 (0.982)	0.000
S&P 500 (log)	6.720 (0.135)	-1.390 (0.002)	0.196	0.004 (0.118)	0.000 (0.795)	0.002
GDP (log)	12.00 (0.027)	-13.91 (0.001)	0.184	0.007 (0.058)	-0.005 (0.158)	0.032
loans (log)	6.633 (0.202)	-1.475 (0.292)	0.025	0.005 (0.075)	0.000 (0.664)	0.003
GZ spread	5.090 (0.305)	9.917 (0.142)	0.062	0.004 (0.084)	-0.004 (0.398)	0.011
EBP	5.061 (0.324)	7.515 (0.418)	0.019	0.004 (0.088)	-0.010 (0.178)	0.042
rate	3.743 (0.340)	-23.79 (0.000)	0.285	0.004 (0.078)	-0.005 (0.246)	0.015
spread	4.946 (0.318)	19.86 (0.105)	0.057	0.004 (0.081)	-0.011 (0.177)	0.023

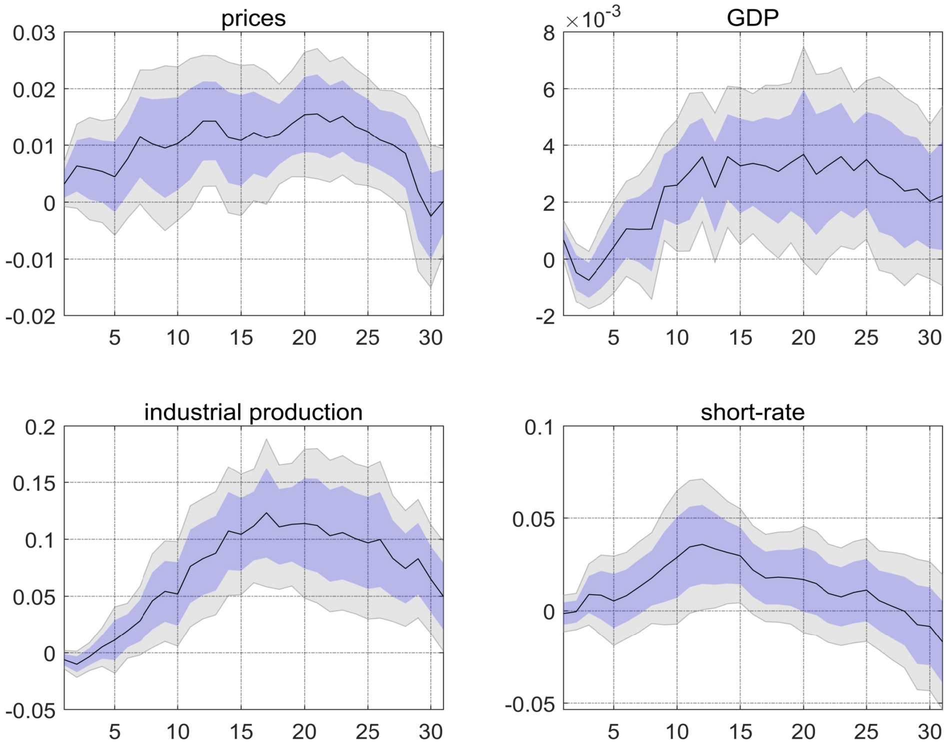
Notes: The dependent variable are the net percentage change in lending standards (left panel) and our instrument from Equation (2) (right panel). Log in the exogenous variables refer to log differences and can hence be interpreted as growth rates. The presented p-values are constructed via Newey-West standard errors and displayed in brackets.

Table 4: Autocorrelation of change in lending standards and spreads

lag	net percentage change in standards: AC	PAC	Q-statistic	change of spreads: AC	PAC	Q-statistic
1	0.919	0.919	70.169 (0.000)	-0.053	-0.053	0.2366 (0.627)
2	0.797	-0.310	123.58 (0.000)	0.019	0.016	0.2663 (0.875)
3	0.664	-0.075	161.16 (0.000)	0.008	0.010	0.2721 (0.965)
4	0.489	-0.368	181.80 (0.000)	0.016	0.017	0.2948 (0.990)
5	0.309	-0.033	190.13 (0.000)	0.138	0.140	1.9593 (0.855)
6	0.151	0.005	192.14 (0.000)	0.076	0.093	2.4731 (0.871)
7	0.024	0.126	192.19 (0.000)	-0.120	-0.118	3.7608 (0.807)
8	-0.080	-0.058	c192.78 (0.000)	-0.157	-0.186	6.0157 (0.645)
9	-0.178	-0.190	195.70 (0.000)	0.020	-0.005	6.0512 (0.735)
10	-0.251	-0.055	201.60 (0.000)	-0.049	-0.060	6.2761 (0.792)

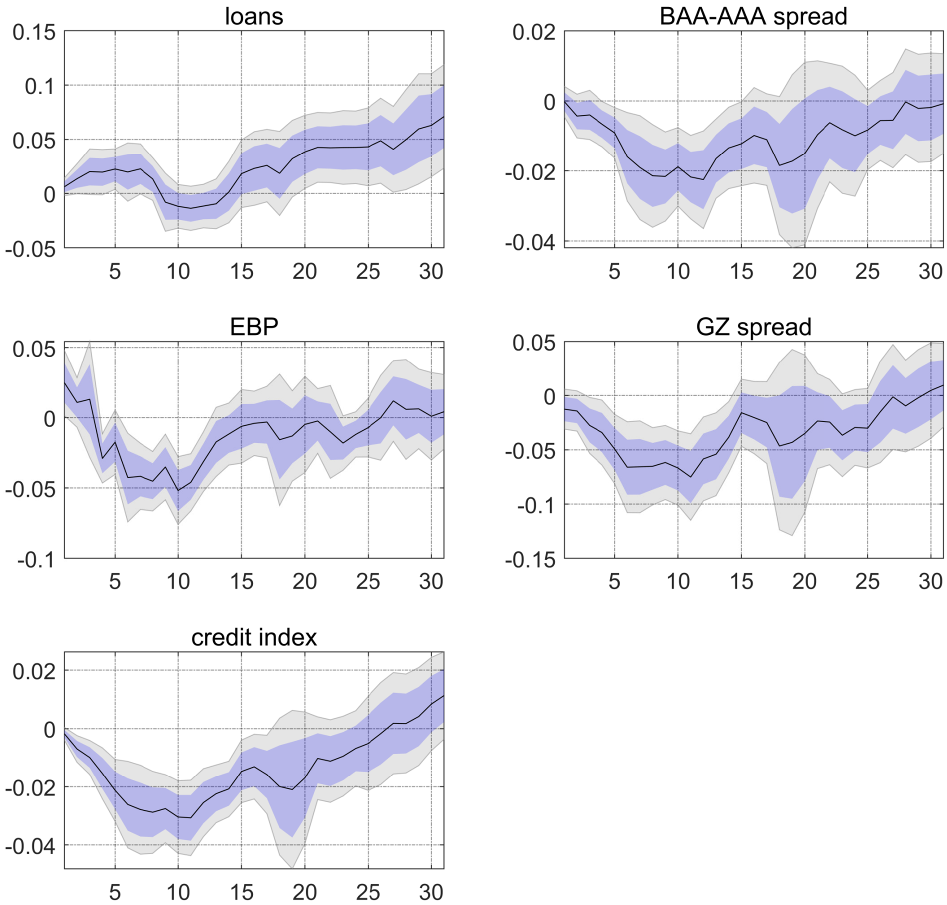
Notes: The left panel shows the autocorrelation (AC), the partial correlation (PAC) and the Ljung-Box Q-statistics from the net percentage change in lending standards. The p-values for the Ljung-Box Q-statistics are displayed in brackets. The underlying null hypothesis assumes no autocorrelation of order k. The right panel reports the corresponding results for our instrument from Equation (2).

Figure 3: Response to credit standards shock I



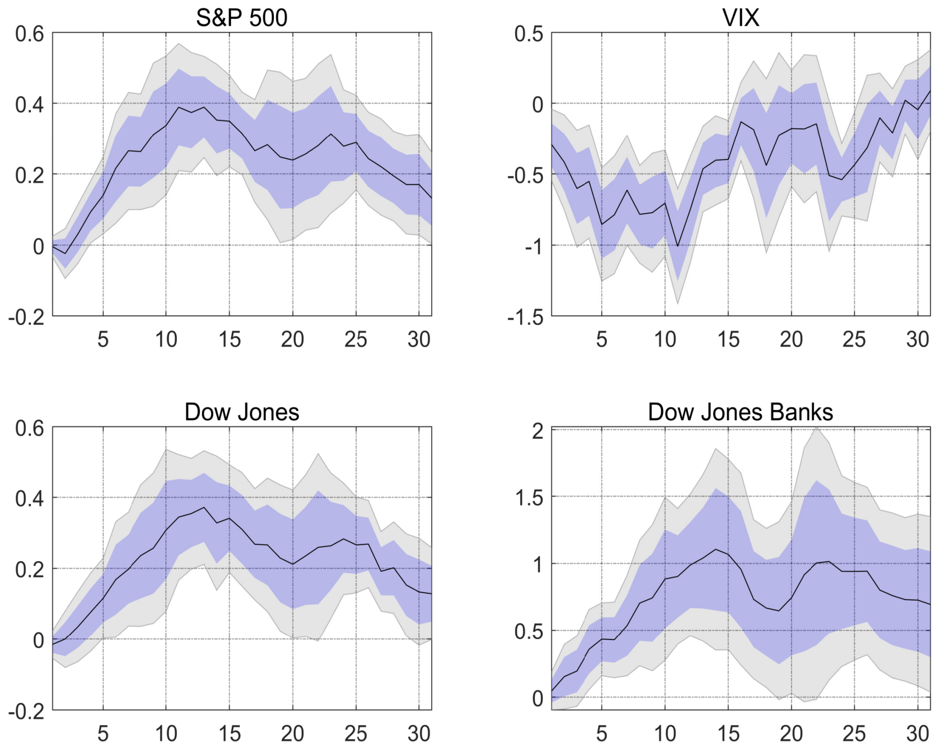
Notes: The figure shows the estimated β_h coefficient (solid line), i.e. the response to a change in the BAA-AAA spread of one basis point on SLOOS release days. The blue and grey shaded areas display the 68% and 90% confidence bands, respectively. They are constructed using Newey-West standard errors.

Figure 4: Response to credit standards shock II



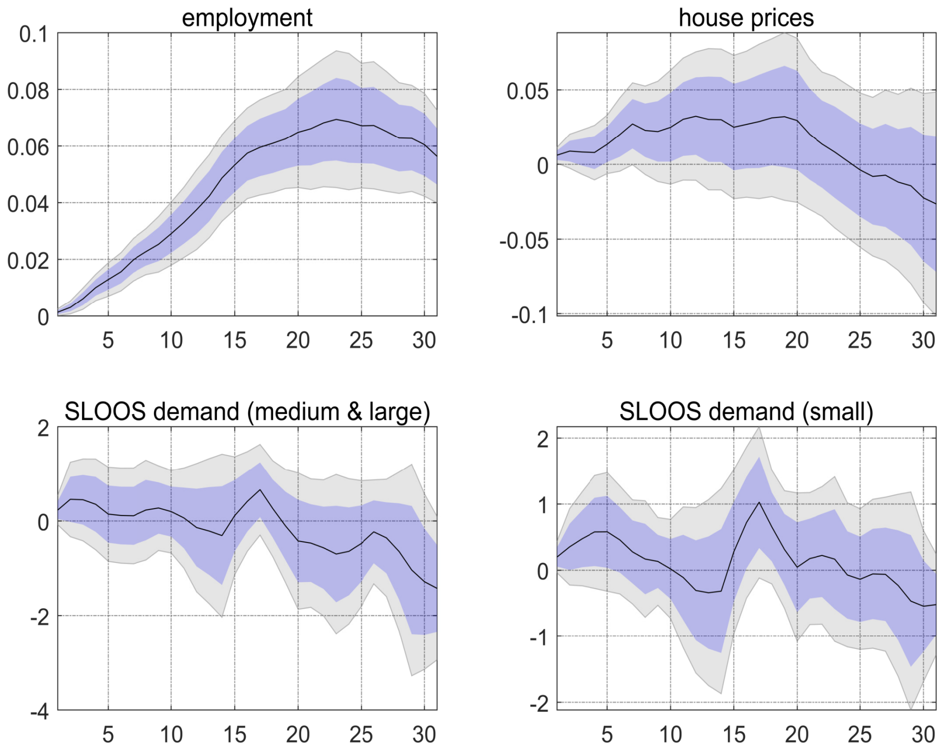
Notes: The figure shows the estimated β_h coefficient (solid line), i.e. the response to a change in the BAA-AAA spread of one basis point on SLOOS release days. The blue and grey shaded areas display the 68% and 90% confidence bands, respectively. They are constructed using Newey-West standard errors.

Figure 5: Response to credit standards shock III



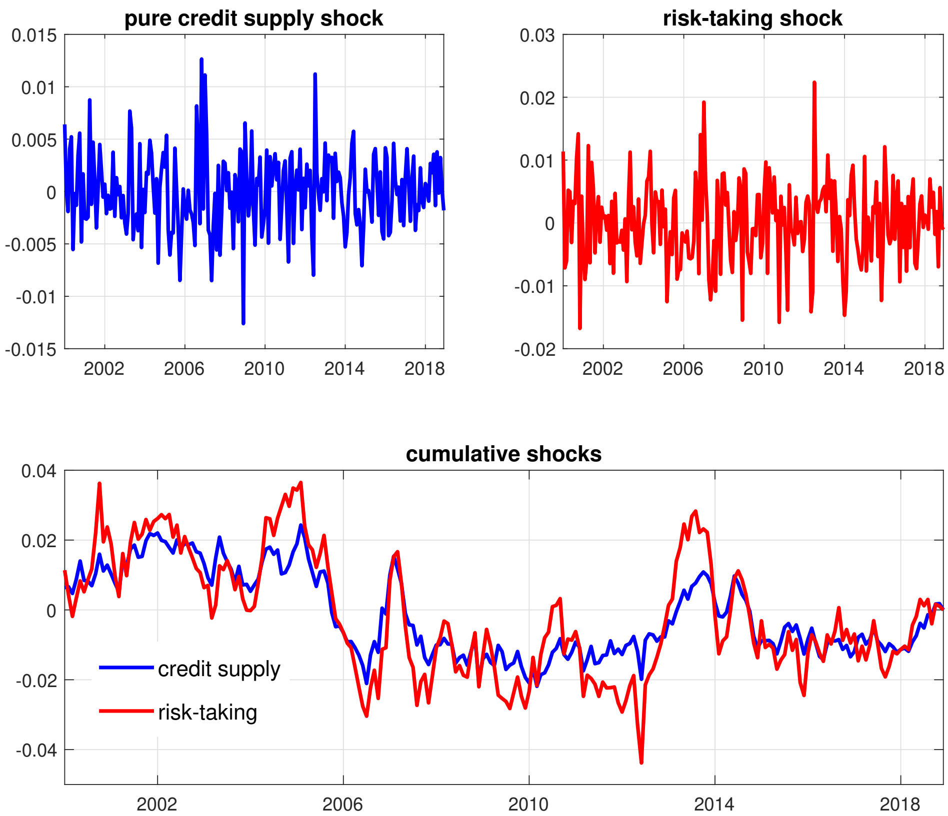
Notes: The figure shows the estimated β_h coefficient (solid line), i.e. the response to a change in the BAA-AAA spread of one basis point on SLOOS release days. The blue and grey shaded areas display the 68% and 90% confidence bands, respectively. They are constructed using Newey-West standard errors.

Figure 6: Response to credit standards shock IV



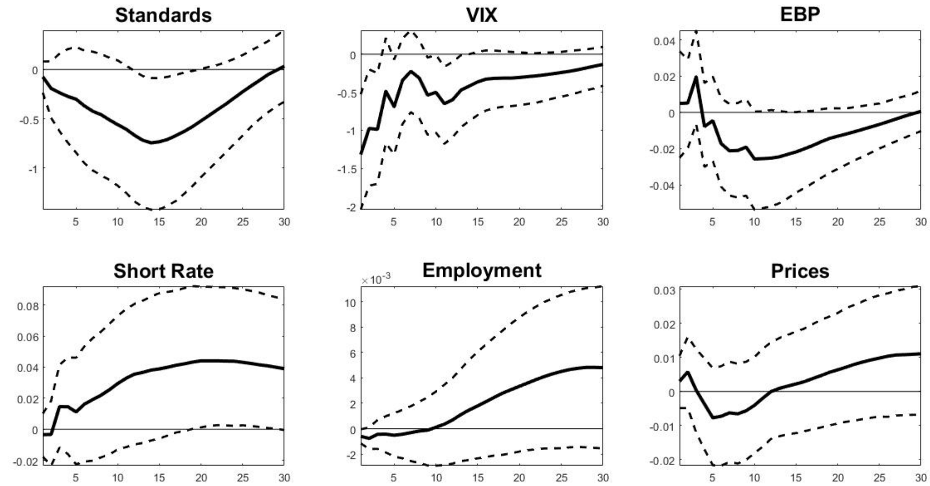
Notes: The figure shows the estimated β_h coefficient (solid line), i.e. the response to a change in the BAA-AAA spread of one basis point on SLOOS release days. The blue and grey shaded areas display the 68& and 90% confidence bands, respectively. They are constructed using Newey-West standard errors.

Figure 7: Decomposed shock series



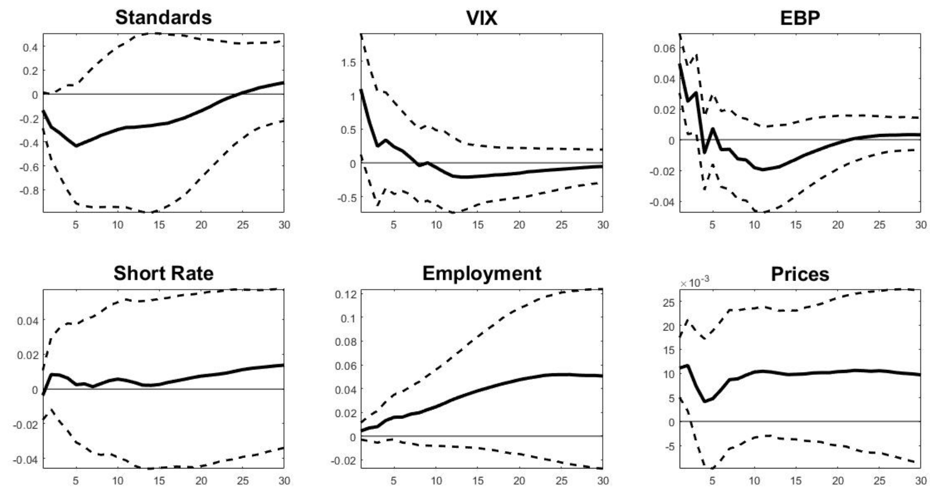
Notes: The figure shows the estimated β_h coefficient (solid line), i.e. the response to a change in the BAA-AAA spread of one basis point on SLOOS release days. The blue and grey shaded areas display the 68& and 90% confidence bands, respectively. They are constructed using Newey-West standard errors.

Figure 8: Baseline VAR model (pure credit supply shock)



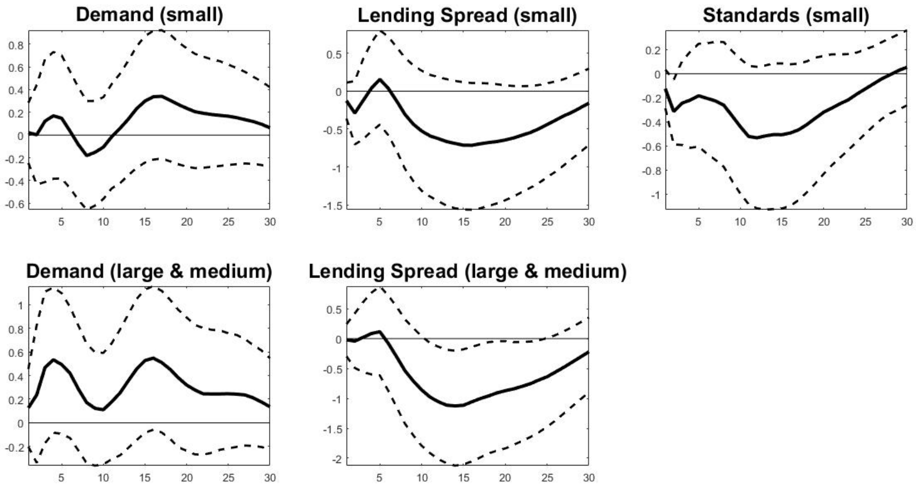
Notes: The sold line depicts the median response. The dotted lines are the 16th and 84th percentiles.

Figure 9: Baseline VAR model (risk-taking shock)



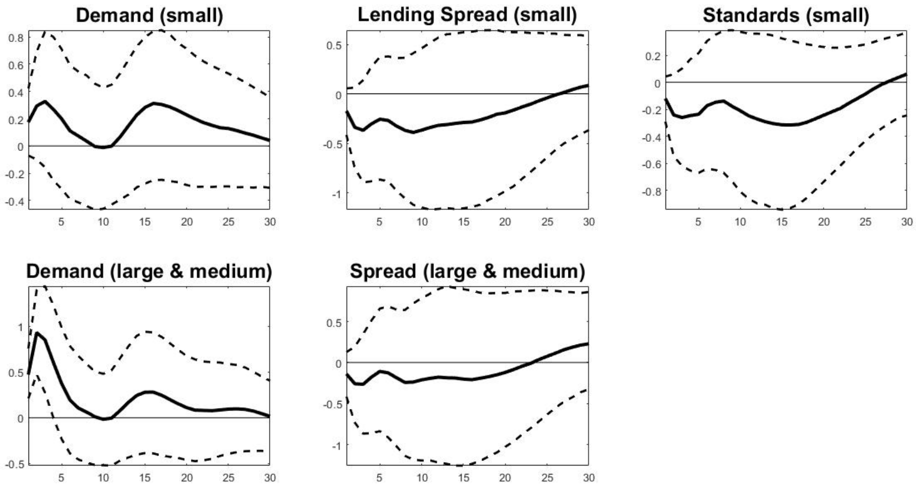
Notes: The sold line depicts the median response. The dotted lines are the 16th and 84th percentiles.

Figure 10: SLOOS variables (pure credit supply shock)



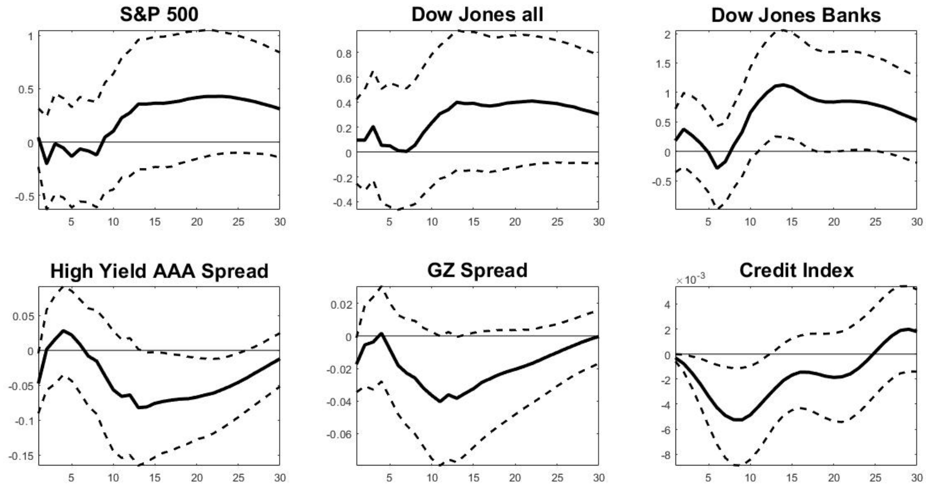
Notes: The sold line depicts the median response. The dotted lines are the 16th and 84th percentiles.

Figure 11: SLOOS variables (risk-taking shock)



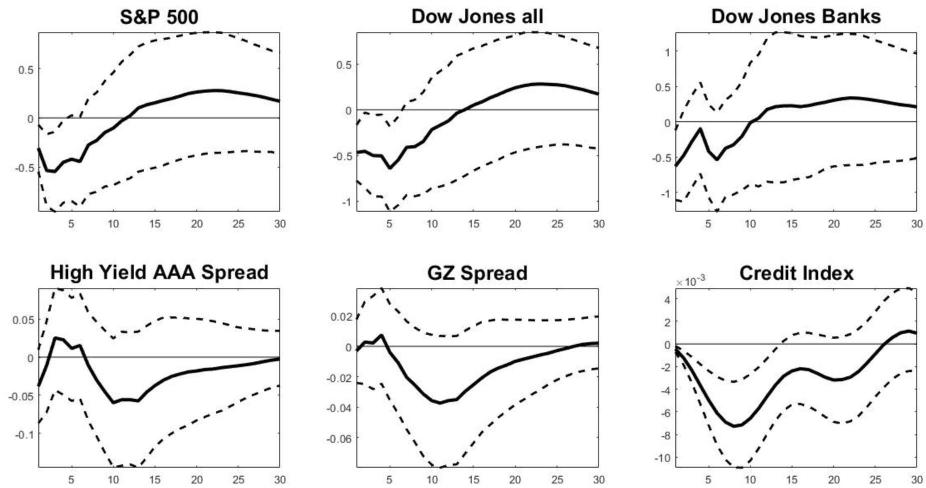
Notes: The sold line depicts the median response. The dotted lines are the 16th and 84th percentiles.

Figure 12: Financial variables (pure credit supply shock)



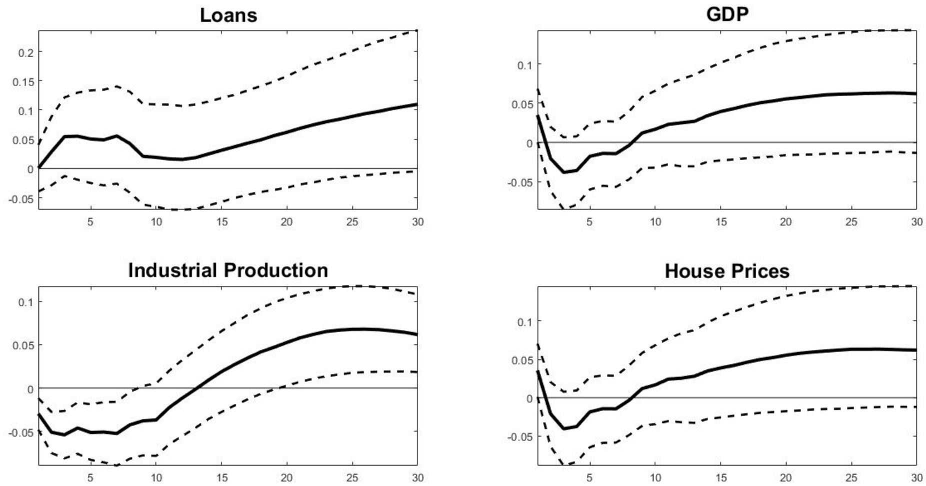
Notes: The sold line depicts the median response. The dotted lines are the 16th and 84th percentiles.

Figure 13: Financial variables (risk-taking shock)



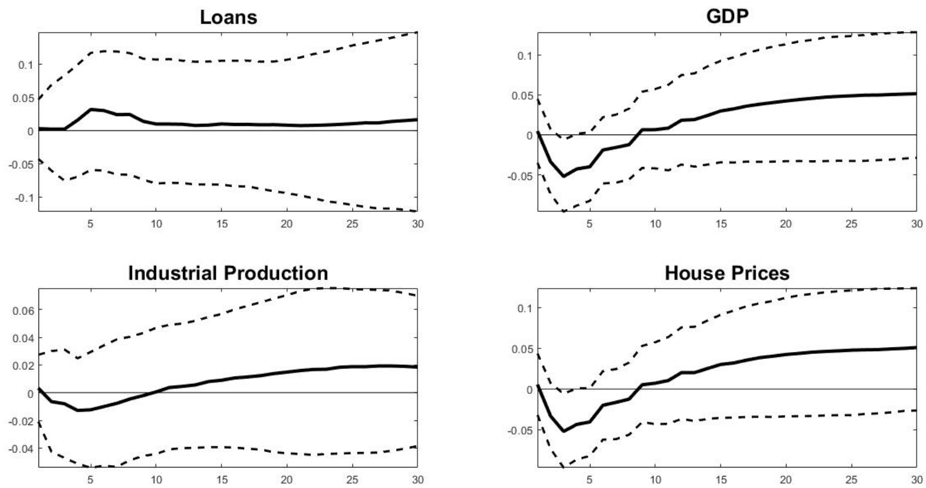
Notes: The sold line depicts the median response. The dotted lines are the 16th and 84th percentiles.

Figure 14: Macroeconomic variables (pure credit supply shock)



Notes: The sold line depicts the median response. The dotted lines are the 16th and 84th percentiles.

Figure 15: Macroeconomic variables (risk-taking shock)



Notes: The sold line depicts the median response. The dotted lines are the 16th and 84th percentiles.

B Data sources and definitions

This appendix contains details about the data series used in this paper.

Table 5: Data series I

series	definition	units	frequency	source
industrial production	Industrial Production: Total Index s.a.	2012=100 log	monthly	FRED
prices	Personal Consumption Expenditures: Chain-type Price Index s.a.	2012=100 log	monthly	FRED
short rate	2-Year Treasury Constant Maturity Rate	percent	monthly	FRED
VIX	CBOE Volatility Index: VIX	index log	daily/monthly	FRED
EBP	excess bond premium of Gilchrist and Zakrajšek (2012)	percent	monthly	FED
GZ spread	credit spread of Gilchrist and Zakrajšek (2012)	percent	monthly	FED
AAA yield	Moody's Seasoned Aaa Corporate Bond Yield	percent	daily/monthly	FRED
BAA yield	Moody's Seasoned Baa Corporate Bond Yield	percent	daily/monthly	FRED
high yield	ICE BofA US High Yield Index Effective Yield	percent	daily/monthly	FRED
employment	total nonfarm employees	log	monthly	FRED
S&P 500	stock price index	log	monthly	Thomson Reuters
Dow Jones	stock price index	log	monthly	Thomson Reuters
loans	Bank Credit, All Commercial Banks, s.a.	log	monthly	FRED
house prices	Purchase Only House Price Index, s.a.	log	monthly	FRED
credit conditions	FRBCHI Financial Conditions Credit Subindex	deviation from mean	monthly	FRED

Table 6: Data series II

series	definition	units	frequency	source
credit standards	Net Percentage of Domestic Banks Tightening Standards for Commercial and Industrial Loans	net percentage	interpolated from quarterly to monthly	FRED
credit demand	Net Percentage of Domestic Banks Reporting Stronger Demand for Commercial and Industrial Loans	net percentage	interpolated from quarterly to monthly	FRED
spread	Spreads of loan rates over bank's cost of funds	net percentage	interpolated from quarterly	FRED

C Release dates

This appendix contains the SLOOS release days used in this paper. The dates are listed in Table (7).

Table 7: Release dates

08.02.2000	07.02.2005	03.05.2010	03.08.2015
19.05.2000	09.05.2005	16.08.2010	02.11.2015
25.08.2000	15.08.2005	08.11.2010	01.02.2016
17.11.2000	07.11.2005	31.01.2011	02.05.2016
05.02.2001	08.02.2006	02.05.2011	01.08.2016
26.03.2001	15.05.2006	15.08.2011	07.11.2016
17.05.2001	14.08.2006	07.11.2011	06.02.2017
24.08.2001	30.10.2006	30.01.2012	08.05.2017
13.11.2001	05.02.2007	30.04.2012	31.07.2017
04.02.2002	17.05.2007	06.08.2012	06.11.2017
10.05.2002	13.08.2007	31.10.2012	05.02.2018
19.08.2002	05.11.2007	04.02.2013	04.05.2018
12.11.2002	04.02.2008	06.05.2013	06.08.2018
31.01.2003	05.05.2008	05.08.2013	13.11.2018
09.05.2003	11.08.2008	04.11.2013	04.02.2019
15.08.2003	03.11.2008	03.02.2014	06.05.2019
03.11.2003	02.02.2009	05.05.2014	05.08.2019
03.02.2004	04.05.2009	04.08.2014	04.11.2019
07.05.2004	17.08.2009	03.11.2014	
16.08.2004	09.11.2009	02.02.2015	
15.11.2004	01.02.2010	04.05.2015	

Notes: The dates are taken from the individual survey releases (before 2010) and from ALFRED (after 2010).