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Bank Lending, Monetary Policy Transmission, and Interest on Excess Reserves: A FAVAR Analysis

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Abstract

Has paying interest on excess reserves (IOER) impacted monetary policy transmission? We employ a factor-augmented VAR (i.e. FAVAR) to analyze a traditional bank lending channel (BLC) as well as a potential reserves channel. Our main results are: (i) the bank-lending response to an exogenous monetary policy innovation in the Federal Funds rate (i.e. the BLC) remains active but smaller than pre-2008 measures; (ii) the bank-lending response to any IOER-based liquidity innovations (i.e. the reserves channel) either mimics the BLC or is largely insignificant. These results provide little evidence that IOER has significantly impacted bank lending or monetary transmission.

Keywords: Bank Lending Channel; FAVAR; IOER; Monetary Policy

JEL: E51, E52, C32

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1. Introduction

The 2008 Global Financial Crisis has left the Federal Reserve (henceforth, Fed) with a new and unique monetary policy tool: the authority to pay interest on commercial banks' excess reserve holdings.[1] Unlike the Federal Funds Rate (henceforth, FFR), which is a market rate set and actively maintained via open market operations, the interest rate on excess reserves (henceforth, IOER) is an administered rate set via movements in the Fed's balance sheet and passively maintained. Goodfriend (2002) modeled how a central bank could use open market operations to pursue interest rate policy while independently using interest on reserves to target bank reserves.[2] In other words, the Fed can use the IOER to control the amount of liquidity in the banking system without directly impacting market interest rates and the amount of liquidity outside the banking system. This framework establishes the IOER as an interest rate floor, with arbitrage inhibiting market interest rates from venturing below. However, entities unable to earn IOER (i.e. government-sponsored enterprises or GSEs) routinely lend liquidity to commercial banks at the FFR who in turn earn the IOER on the reserve amount, therefore driving the FFR consistently below the IOER. Goodfriend (2015) cites this failure of the floor rate as a failure to separate interest rate and bank reserve channels of monetary policy transmission, suggesting a partial divorce of money from monetary policy. In addition, large-scale asset purchases have resulted in commercial banks holding an unprecedented amount of liquidity.[3] In this paper we attempt to analyze the current state of monetary transmission in light of these recent observations.

Our tool of choice for analyzing elements of monetary transmission is a factor-augmented vector autoregression (henceforth, FAVAR). A FAVAR combines elements of a VAR and a factor (i.e. principal components) model to capture two elements crucial to our analysis.

[1] The Financial Services Regulatory Relief Act of 2006 granted the authority to pay interest on reserves beginning on October 1, 2011, but the Emergency Economic Stabilization Act of 2008 accelerated the start date to October 1, 2008.

[2] Keister et al. (2008) expand upon this notion and show how monetary policy can be effectively *divorced* from money.

[3] The quantity of US bank reserves in 2008 Q2 was around $29 billion, and increased to more than $1.5 trillion by 2015 Q1.

First, a FAVAR conditions general economic concepts (e.g. economic activity) on a large list of observable time series rather than just a single arbitrary data series as in traditional VARs.[4] Second, a FAVAR can identify both latent and observed factors, as well as their exogenous innovations. When identifying monetary policy with either a market-determined interest rate or a spread between administered and market-based interest rates, one should be confident that exogenous innovations are interpretable as monetary policy actions. A FAVAR can map out the endogenous reactions observed in many variables to provide the best identification of exogenous monetary policy innovations.

We use our FAVAR to examine two channels of monetary policy transmission in the post-2008 US episode: the bank lending channel and the reserves channel. The bank lending channel (henceforth, BLC) stems from Bernanke and Blinder's (1992) observation that movements in aggregate bank lending volume follow changes in the stance of monetary policy. The BLC assumes that reservable deposits are not perfectly substitutable with other forms of external loan finance, so a monetary contraction resulting in fewer reservable deposits should result in a decrease in the supply of loans (all else equal). This channel has been studied by Kashyap and Stein (1995, 2000), Kishan and Opiela (2000), Den Haan et al. (2007), Dave et al. (2013), and others to identify the types of banks and loans most sensitive to monetary policy shocks.[5] In particular, Dave et al. (2013) estimate a FAVAR in the episode prior to the Global Financial Crisis (1976:Q1 to 2005:Q3) to show that a monetary policy contraction results in significant declines in loan growth for all types of lending (C&I, real estate, and individual) and for all banks grouped by asset size. However, ample reserves like those currently observed in the banking system would relax a liquidity constraint central to

[4] Bernanke et al. (2005) argue that central banks examine hundreds of data series when deciding on policy, so a measurement of policy innovations limited to a small number of comprehensive macro-economic variables is likely to be contaminated.

[5] Kashyap and Stein (1995, 2000) find that increases in the FFR are followed by significant declines in lending volume for only the smallest (in terms of assets) and least liquid banks. Kishan and Opiela (2000) find that banks with the weakest capital positions are the most responsive to monetary policy. Den Haan et al. (2007) consider aggregate loan components of domestically chartered banks and find that real estate and consumer loans decline sharply in response to a monetary contraction while commercial and industrial (C&I) loans increase.

the BLC. In addition, Hendrickson (2017) finds that IOER may curtail the effectiveness of monetary policy by increasing the payment processing efficiency of commercial banks. Our FAVAR analysis for the post-Global Financial Crisis episode (2008:Q4 to 2019:Q3) shows that the BLC is currently alive and well, but smaller and less persistent than it was prior to 2008.

The reserves channel discussed by Goodfriend (2002, 2015) can only exist in the presence of IOER. Ennis and Wolman (2015) view this channel through the lens of the BLC, and we further this view by examining the response in bank lending volume to an exogenous increase in the IOER as well as the spread between the IOER and a market-determined risk-free rate (e.g. either the overnight LIBOR rate or 90-day Treasury yield). If the IOER is significantly driving banks' lending decisions like the FFR did in the pre-2008 episode, then an exogenous increase in the relative return to reserves should result in a decline in loan volume.

Our FAVAR results suggest that exogenous innovations in the IOER do not significantly impact either the growth in bank lending or the composition of bank assets, at least in the short run. In particular, an exogenous increase in the IOER results in significant declines in loan growth for some bank asset groups and for some loan classifications, but the impact in smaller and less significant that an exogenous increase in the FFR under a BLC scenario. Since the BLC existed prior to 2008 and the FFR and the IOER are highly correlated, we interpret this reserves channel as capturing a muted BLC rather than an independent transmission mechanism. In addition, an exogenous increase in the spread between the IOER and the overnight LIBOR rate (or 90-day Treasury yield) results in small but insignificant *increases* in loan growth for all types of lending and for all bank-asset groups for up to one year after the shock. This implies that an increase in the IOER relative to a risk-free return does not appear to reduce loan growth. We also consider the response of the loan-asset ratios to changes in the IOER to determine if there are any changes in banks' balance-sheet composition. Our FAVAR results suggest that an increase in the IOER results in an *increase* in total loans relative to total assets due to increases in real estate and C&I lending, with only a significant decline in individual loans for some bank groups. An increase in the IOER relative to a risk-free return also fails to bear out a significant reserves channel with either largely insignificant responses or offsetting components of lending.[6]

Our inability to find a significant reserves channel follows the conclusions of Ennis and Wolman (2015) who find that changes in rates of return on lending were small and not tightly linked to changes in the reserve allocation across large banks, and Martin et al. (2016) who show that banks' lending decisions are made based on marginal expected returns and independent of the IOER. These conclusions are in line Bernanke and Kohn (2016) who suggest that paying interest on reserves does not prevent banks from lending. However, Beckworth (2018) and Hogan (2018) both find empirical evidence that the bank loans relative to assets significantly decline in response to a contemporaneous increase in the IOER relative to a market-based risk-free rate.[7] One reason our results might differ from those of Beckworth (2018) and Hogan (2018) is that their models are confounding exogenous monetary policy innovations. An increase in the IOER relative to a market-based risk-free rate can occur when the administered IOER goes up or the market-based risk-free rate goes down (all else equal). The former would be considered an exogenous monetary policy innovation while the latter may be an endogenous innovation. While single equation systems like those considered by Beckworth (2018) and Hogan (2018) would treat both of these innovations equally, a FAVAR uses a great deal of information to separate the exogenous and endogenous innovations.

The remainder of the paper is organized as follows. Section 1 outlines the FAVAR. Section 2 discusses the data. Section 3 presents our empirical results. Section 4 concludes.

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[6] We also find that none of our choices for identifying monetary policy have a significant impact on the total asset volume of commercial banks, suggesting that insignificance in the loan-asset ratio is not attributable to similar movements in both the numerator and denominator.

[7] Beckworth (2018) considers aggregate commercial bank observations while Hogan (2018) consider bank observations at the holding-company level. They both conclude that that the IOER depresses lending activity.

2. The FAVAR

Our presentation of the FAVAR follows Bernanke et al. (2005). Suppose the dynamics of an economy are driven by a vector C_t of common components. We consider the stance of monetary policy to be a common component which can be measured by movements in an observable policy instrument R_t.[8] The remaining elements of C_t are captured by a $K \times 1$ vector of unobserved factors F_t. These factors capture fluctuations in general economic concepts (e.g. *economic activity*, *aggregate prices*, *credit conditions*, etc.) that cannot be easily represented by a few time series but rather are reflected in a wide range of economic variables.

We assume that the joint dynamics of $C_t' = [F_t' \; R_t]$ are given by

$$C_t = \Phi(L) C_{t-1} + \upsilon_t \tag{1}$$

where $\Phi(L)$ is a conformable lag polynomial of finite order which can contain a priori restrictions. The error term υ_t is i.i.d. with zero mean and covariance matrix Q. While equation (1) is a VAR in C_t, it cannot be directly estimated because the factors in F_t are unobserved.

Since the factors in C_t are interpreted as forces affecting many economic variables, one can use a large set of observed *informational* series to infer something about them. Let X_t denote the $N \times 1$ vector of variables, where N is large relative to K. It is assumed that X_t is related to all common components according to an observation equation

$$X_t = \Lambda C_t + e_t \tag{2}$$

where Λ is an $N \times (K+1)$ matrix of factor loadings. The $N \times 1$ vector e_t contains the zero-mean, series-specific error components that are uncorrelated with C_t, but allowed to

[8] The FFR is a common choice for R_t when performing a traditional BLC analysis, but R_t could also be measured by the IOER or the difference between the IOER and a market-determined risk-free rate when performing a reserves channel analysis.

be serially correlated and weakly correlated across indicators. Equation (2) reflects the fact that C_t represents pervasive forces which drive the *common* dynamics of X_t. Conditional on R_t, the variables in X_t are thus noisy measures of the underlying unobserved factors F_t.[9]

Estimation of the above model involves a two-step principal components approach. In the first step, principal components are extracted from X_t to obtain consistent estimates of the common factors. In the second step, the policy instrument is added to the estimated common factors and the data are used to estimate equation (1). In particular, our estimation follows Boivin et al. (2009) and differs from Bernanke et al. (2005) insofar that we assume R_t is a factor in the first-step. This guarantees that the latent factors recover dynamics not captured by the observable policy instrument.[10]

3. Data and Estimation

Our data is quarterly from 2008:Q4 to 2019:Q3. Let the vector of informational variables X_t in equation (2) be decomposed as $[X_{1t} \quad X_{2t}]$. The vector X_{1t} contains 105 macroeconomic indicators such as measures of industrial production, price indices, employment and other key macroeconomic and financial variables which contain useful information in identifying the state of the economy. These variables are the same as those considered by Bernanke et al. (2005) and Boivin et al. (2009) with three exceptions. First, we dropped three variables on loans and credit outstanding from the variable list originally considered because they were closely correlated with a large number of our lending variables.[11] Second, four variables were lost when the Producer Price Index (PPI) transitioned from the Stage of

[9] Bernanke et al. (2005) note that the implication of X_t depending only on current factors is not restrictive in practice, as F_t can be interpreted as including arbitrary lags of the fundamental factors.

[10] In particular, we follow Boivin et al. (2009) in the several ways. In the first step, start with an initial estimate of F_t, denoted by $F_t^{(0)}$, which is obtained as the first K principal compenents of X_t. We then iterate through the following steps: (i) regress X_t on $F_t^{(0)}$ and R_t to obtain the coefficient on R_t, denoted $\hat{\lambda}_R^{(0)}$; (ii) compute $\tilde{X}_t^{(0)} = X_t - \hat{\lambda}_R^{(0)} R_t$; (iii) estimate $F_t^{(1)}$ as the first K principal components of $\tilde{X}_t^{(0)}$; and (iv) repeat steps (i)-(iii) multiple times.

[11] Specifically, the three variables were: (i) the net change in C&I loans reported from large commercial banks; (ii) nonrevolving consumer credit outstanding; and (iii) the real C&I loans outstanding.

Processing (SOP) aggregation system to the Final Demand-Intermediate Demand (FD-ID) aggregation system.[12] Third, the variables were transformed from monthly to quarterly series by selecting the months corresponding to our lending data. These quarterly time series were then detrended and made stationary using the same methods as Bernanke et al. (2005).

The vector X_{2t} contains our coarsely disaggregated lending series. The lending data is taken from the Consolidated Report of Condition and Income (Call Reports) that all insured banks submit to the Federal Reserve. Data on total loans, C&I, real estate, and individual loans were collected for each individual bank following Den Haan et al. (2007) who in turn follow the detailed instructions on forming consistent time series provided by Kashyap and Stein (2000). The main difference in the lending data between Kashyap and Stein (2000) and Den Haan et al. (2007) is that the former considers loans reported on a consolidated basis (i.e. both domestic and foreign branches), while the latter considers loans issued by domestic branches only.[13] Total assets from each bank were used to assign it to one of three size categories for every quarter following Kashyap and Stein (2000): total assets below the 95^{th} percentile (*small*), total assets between the 95^{th} and 99^{th} percentile (*medium*), and total assets above the 99^{th} percentile (*large*). We then used these category assignments to construct a coarse disaggregation of the commercial banking data. We consider two variations for how we define the lending variables in X_{2t}. First, we construct loan growths for all loan components aggregated up to the entire sector as well as within each size category. This follows the BLC literature by delivering lending variables for each loan type which can be directly compared to Bernanke and Blinder (1988) who consider aggregate loan growth of the entire commercial banking sector, and Kashyap and Stein who consider lending growth aggregated up to bank asset sizes. Second, we aggregate the total assets for the entire

[12] Effective with the January 2016 Producer Price Index (PPI) data release, PPI ceased the calculation and publication of the Stage of Processing (SOP) versions of indexes for finished goods (PWFSA), finished consumer goods (PWFCSA), intermed mat supplies & components (PWIMSA), and crude materials (PW-CMSA). We replaced the above 4 PPI variables by Producer Price Index by Commodity for Final Demand (PPIFIS).

[13] Den Haan et al. (2007) argue that it makes more sense to focus on loans issued by domestic branches (rcon data) when one wants to examine the effect of monetary policy shocks on regional and aggregate real activity.

banking sector as well as for each size category and construct loan-asset ratios. This follows Beckworth (2018) and Hogan (2018) and allows us to capture potential changes in the asset composition of banks' balance sheets that might be overlooked when examining pure changes in lending volume.

In addition to the two definitions of X_{2t} above, we consider four alternatives for identifying monetary policy in R_t. The first is the FFR which again follows the BLC literature. As a direct comparison between the BLC and reserves channel, we consider the IOER as a substitute for the FFR. Since the IOER might not provide a clear measure of the opportunity cost of lending, we also consider two variations of a *liquidity gap* measure by considering the contemporaneous difference between the IOER and either the overnight LIBOR rate or the 90-day Treasury yield. These two liquidity gaps were considered by Beckworth (2018) and Hogan (2018) in their examinations of the reserves channel.

The four variables used to construct our identifications of monetary policy are illustrated in Figure 1. These data are recorded at the end of each quarter to conform with the Call Report observations. As can be gathered from the figure, these variables closely track each other. The contemporaneous correlations between FFR and the other three interest rates range from 0.9940 (LIBOR) to 0.9981 (IOER) throughout the entire sample. Restricting attention to the episode where the IOER was fixed at 0.25 percent (2009:Q1 to 2015:Q3) clearly reduces the correlation between FFR and IOER, but the remaining interest rates are still correlated with FFR around 0.86. While these correlations suggest that our various identifications of monetary policy might be redundant, we nonetheless consider them all to provide a complete view of the potential of monetary transmission throughout the episode.

[Insert Figure 1 about here]

We estimate equations (1) and (2) for the eight FAVARs differing in either the definition of bank lending or identification of monetary policy. For each FAVAR, we chose the number of factors F_t after some experimentation to ensure that our conclusions are not affected by additional latent factors.[14] All models use 4 quarterly lags in estimating equation (1). The information summarizing each of our FAVARs is presented in Table 1.

[Insert Table 1 about here]

Following Bernanke et al. (2005), we assume that the FFR may respond to contemporaneous fluctuations in estimated factors, but that none of the latent common components can contemporaneously respond to monetary policy shocks. This is the FAVAR extension of the standard recursive identification of monetary policy shocks in conventional VARs used by Den Haan et al. (2007) and others. Note that in contrast to VARs, the macroeconomic indicators (X_t) are allowed to contemporaneously respond to monetary shocks. This is another valuable feature of a FAVAR, for it side-steps potentially difficult endogeneity problems.

4. Results

The easiest way for us to present the findings from our eight FAVAR estimations is to group our results according to the definitions of the lending variables considered. We first present our results for the FAVARs estimated with loan growth included in X_t as in traditional BLC analyses, and then our results for loan-asset ratios. All of our results are presented as responses of our lending variables to an unexpected (25 basis point) increase in the interest rate (or interest rate gap) used to identify monetary policy. Each panel of the figures illustrates the response of a particular lending variable aggregated across all banks as well as the three asset sizes. A circle on the response paths indicate that the impulse response at that particular time horizon is significant at the 95 percent confidence level or better.[15]

[14] In addition, we followed Bernanke et al. (2005) and chose the number of factors to ensure that our results did not predict an increase in aggregate prices (i.e. the infamous ‘price puzzle’).

[15] Confidence intervals were constructed via bootstrapping and follows Den Haan et al. (2007).

4.1. Loan Growth

Figure 2 follows a traditional BLC scenario by illustrating the response of loan growth to a monetary policy shock identified as an exogenous innovation to the FFR. The upper-left panel of the figure indicates significant and persistent declines in total loan growth for all bank groups as well as the entire sector. The remaining panels illustrates the various loan types, and suggest that total lending follows that of real estate and C&I loans, while the response of individual consumer loans are larger but less significant than the others.

The results from Figure 2 share much in common with those from Dave et al. (2013) (Figure 1, page 1713). Even in the current ample-reserves regime, there is evidence of a BLC under a FAVAR identification of monetary policy shocks. However, the quantitative results illustrated in the post-2008 episode are smaller in magnitude and less persistent than what was previously captured. For example, the largest impact for total loans across the three bank groups obtained in the post-2008 episode were about half the size of those obtained in the pre-2008 episode, and about half as persistent. These results suggest that while the BLC is alive and well in the post-2008 episode, it has weakened in both size and persistence as can be expected by a banking sector flush with liquidity.

Figure 3 illustrates the responses of the same components of loan growth as above to a monetary policy shock identified as an exogenous innovation to the IOER. These responses in loan growth qualitatively mimic those in Figure 2, but are quantitatively smaller and less significant on the whole. When comparing the results from these two figures, and considering both the existence of the BLC in the pre-2008 episode and the strong post-2008 correlation between the FFR and the IOER, it becomes apparent that the reserves channel illustrated here is simply a weaker identification of the BLC. In other words, we do not find these results in particular to provide compelling evidence of an independent reserves channel in the post-2008 episode.

We look further into the existense of a reserves channel by identifing a monetary policy shock as an exogenous increase in the gap between the IOER and either the overnight LIBOR rate (Figure 4) or the 90-day Treasury yield (Figure 5). While the illustrated responses on the whole are entirely insignificant, they nonetheless suggest that loan growth increases in response to an exogenous 25 basis point increase in the gap between the IOER and a risk-free market rate in the short run. In short, banks do not decrease their lending volume in response to an increase in the returns to reserves. As stated in the introduction, these results follow those of Martin et al. (2016) and show that bank lending decisions are made independently of the IOER.

[Insert Figures 2 through 5 about here]

4.2. Lending Share of Total Assets

While examining the response in bank lending volume has been the traditional measure for identifying the BLC, it is unable to capture any impact to the composition of assets on a bank's balance sheet. For example, a reserves channel of monetary policy transmission might not deliver a significant decline in loan growth across certain types of lending or bank groups, but it might lead banks to change the amount of loans relative to total assets. Since this lending share measure was previously found to significantly decline in response to either an increase in the IOER or the gap between the IOER and a risk-free market rate by Beckworth (2018) and Hogan (2018), we reestimate our FAVAR using this measure.

Figure 6 follows the same decomposition of the lending data into different components and bank groups as before, but illustrates the response of loans-to-total asset ratios to a monetary policy shock identified as an exogenous innovation to the FFR. The figure indicates that all but the largest banks experience an immediate and significant decline in their loan-asset ratio immediately after a surprise increase in the FFR. However, this decline is immediately reversed in the following period. These results in total lending seem to be due to shifts in the types of lending done by the various bank groups. For example, C&I and individual lending declines for all but the smallest bank group while real estate lending generally increases.

Figure 7 illustrates the responses to the loan-asset ratios to a monetary policy shock identified as an exogenous innovation to the IOER. Similar to the comparison of the loan growth responses to an innovation in the FFR or IOER, the responses to the IOER are less significant than the responses to the FFR. However, there are some interesting qualitative changes. First, the total loan-to-asset ratios do not immediately decline in response to an innovation in the IOER but significantly increase. After that immediate increase, implying that banks shift their assets to more lending in response to an increase in the IOER, the remainder of the response path is not statistically significant. The response of real estate lending again appears to mimic the response in total lending, while the offsetting C&I and individual loan-asset responses suggest a compositional shift among types of lending. While these results are interesting, they do not provide evidence for a significant reserves channel.

Figures 8 and 9 consider the response of loan-asset ratios to an exogenous innovation in the gap between the IOER and the overnight LIBOR rate and 90-day Treasury yield, respectively. When considering an innovation in the IOER-LIBOR gap, only medium banks possess an immediate and significant decline in total loans relative to assets. All other response paths illustrate insignificant declines or increases which are counter to the existence of a reserves channel. When considering an innovation in the IOER-Treasury yield gap, a sizeable and significant decline in real estate lending is almost completely offset by a significant increase in individual lending. On the whole, there again appears to be no systematic responses across banks groups or loan types for these identifications of monetary policy.

To conclude this section, we estimated one additional FAVAR where the total asset growth of banks groups are considered instead of any lending variables. Since the loan and asset levels can both respond to monetary policy, it would be useful to see if the results using loan-asset ratios were attributable to movements in either the numerator or denominator. The response in asset growth for the entire banking sector as well as each bank-asset group to each of the four alternative identifications of a monetary policy shock are compared in Figure 10. While the response paths for an innovation to either the FFR or IOER look identical, and the response paths for an innovation in either liquidity gap look identical for the first six months, none of the responses are significant. This suggests that the results presented in this section considering loan-asset ratios are not significantly clouded by movements in total assets, but simply indicate an insignificant reserves channel.

[Insert Figures 6 through 10 about here]

5. Conclusion

Given the current levels of ample-reserves in the banking sector as well as the unprecedented actions of the Federal Reserve paying interest on commercial banks, we set out to examine the current state of monetary policy transmission. Using a FAVAR which has previously uncovered a significant bank lending channel of monetary policy (i.e. a significant decline in loan growth in response to a positive innovation in the Federal Funds rate) in the pre-2008 episode, we examine the current state of the bank lending channel as well as any evidence in support of a new reserves channel which may have come into existence due to the establishment of an IOER. Our FAVAR results using several coarsely disaggregated lending series and identifications of monetary policy delivered several key results. First, the BLC is significantly present in the post-2008 episode, but it appears smaller and less persistent than what was observed prior to 2008. In other words, loan growth still significantly declines in response to a monetary policy innovation identified by an exogenous increase in the FFR, but the declines are smaller due to either excess liquidity in the banking sector or some other factor. Second, using the IOER to identify monetary policy innovations as opposed to the FFR delivers qualitatively similar, but smaller and less significant responses. Since the IOER and FFR are highly correlated in the post-2008 episode and the BLC existed prior to 2008, we view these results as being an alternative identification of the BLC and not a new reserves channel. This conclusion is supported by additional results indicating no evidence for significant responses of bank loans or loans relative to assets for a variety of monetary policy identification schemes previously used in the literature to capture a reserves channel.

While our results go against some previous results that do not incorporate the use of a FAVAR and support those who suggest that an IOER should not impact bank lending, we believe that they should not be taken definitively. While we found no significant reserves channel, we were constrained to use a relatively short time horizon (where an IOER was in effect), and this episode was clearly unusual due to the Global Financial Crisis. Given that an extension of our data set would immediately include the economic crisis brought on by the COVID-19 pandemic, an appropriate episode where one can cleanly analyze the existence (if any) of an active reserves channel appears far off. Nonetheless, our results indicate little to no existence of a reserves channel thus far, and suggest that monetary policy might be having a lengthy divorce from money.

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6. Tables and Figures

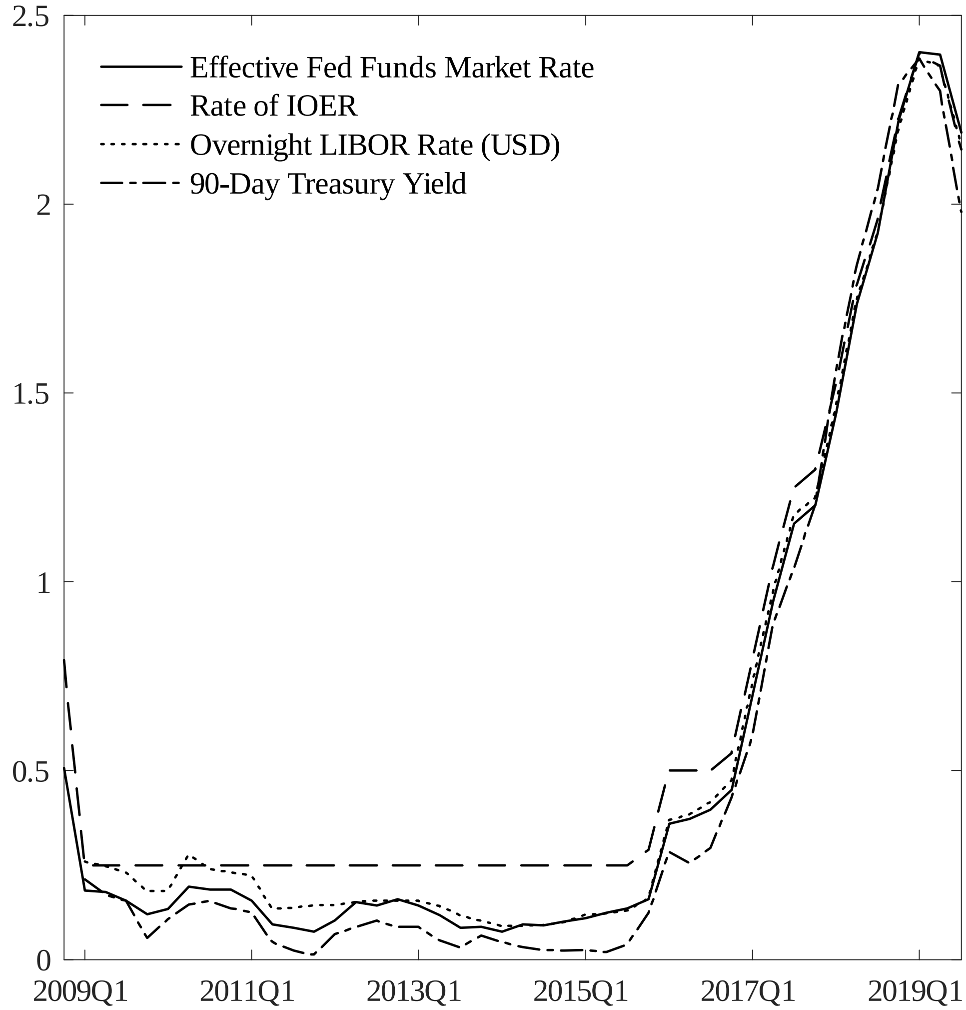

Figure 1: Interest Rate Series used to Identify Monetary Policy

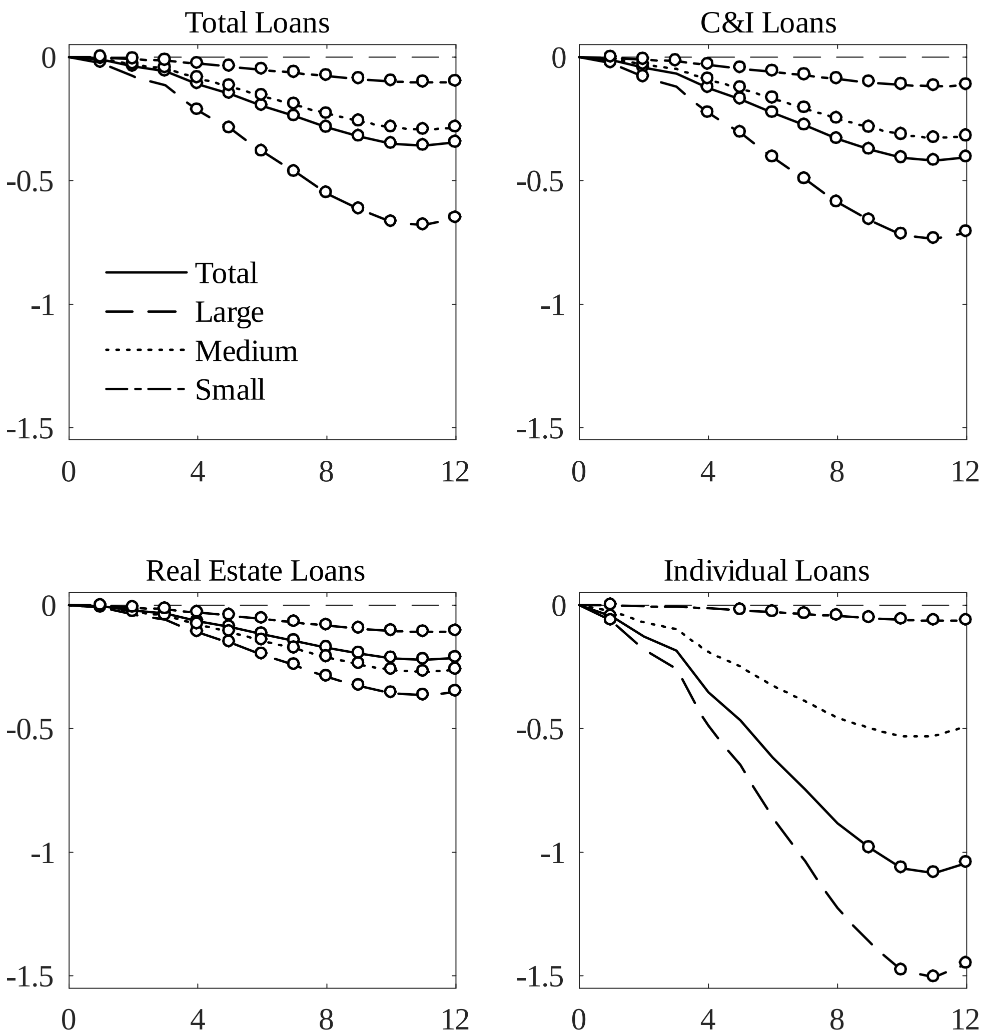

Figure 2: Impulse Response of Lending Volume (in Percentage Change) to a Monetary Policy Shock Identified via the Federal Funds Rate.

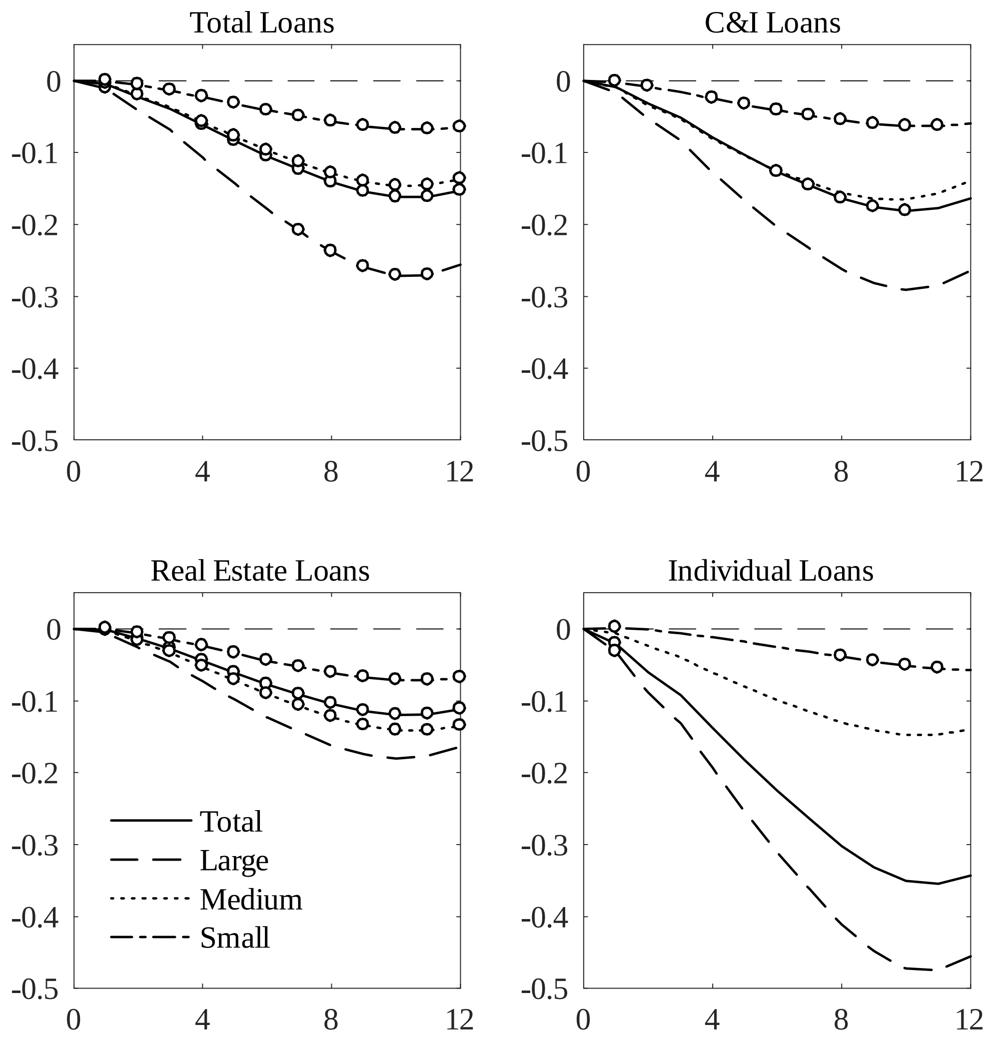

Figure 3: Impulse Response of Lending Volume (in Percentage Change) to a Monetary Policy Shock Identified via the IOER Rate.

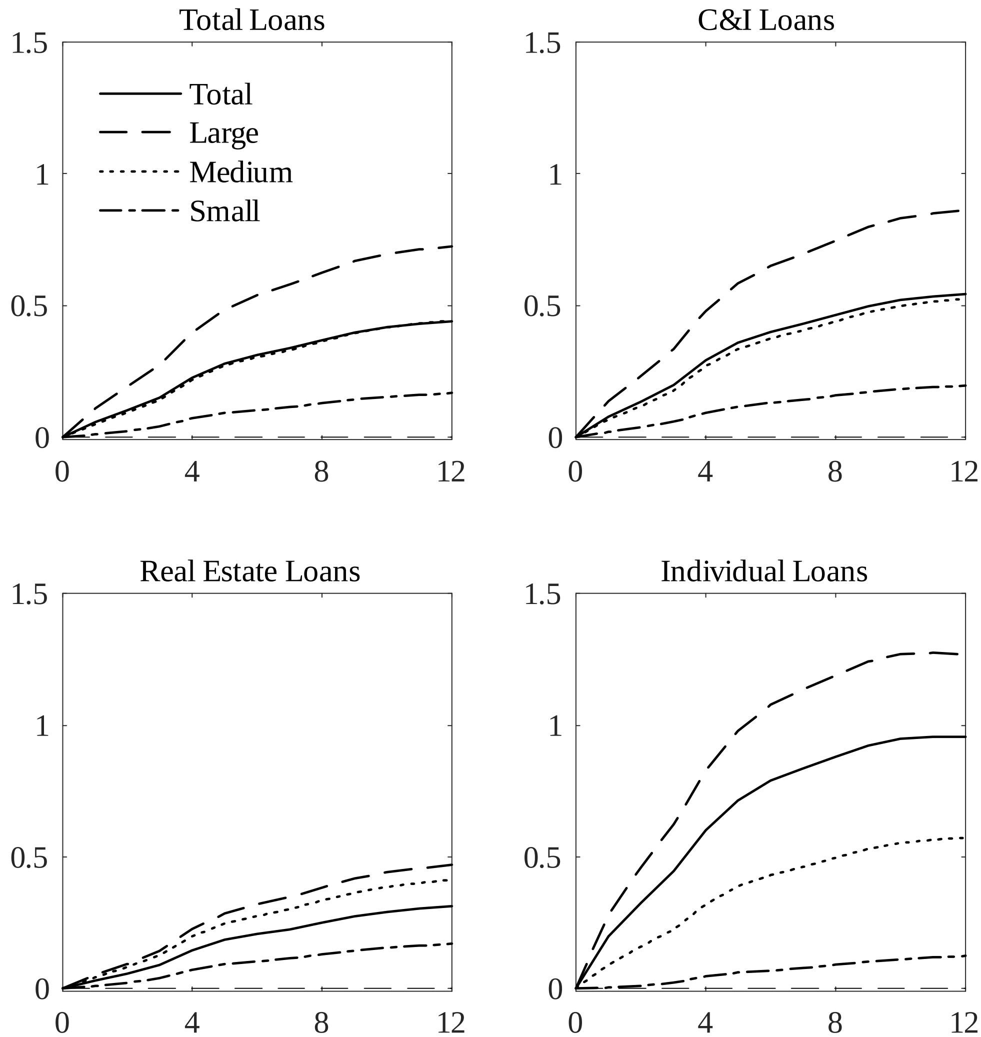

Figure 4: Impulse Response of Lending Volume (in Percentage Change) to a Monetary Policy Shock Identified via the difference between the IOER and the overnight LIBOR rate.

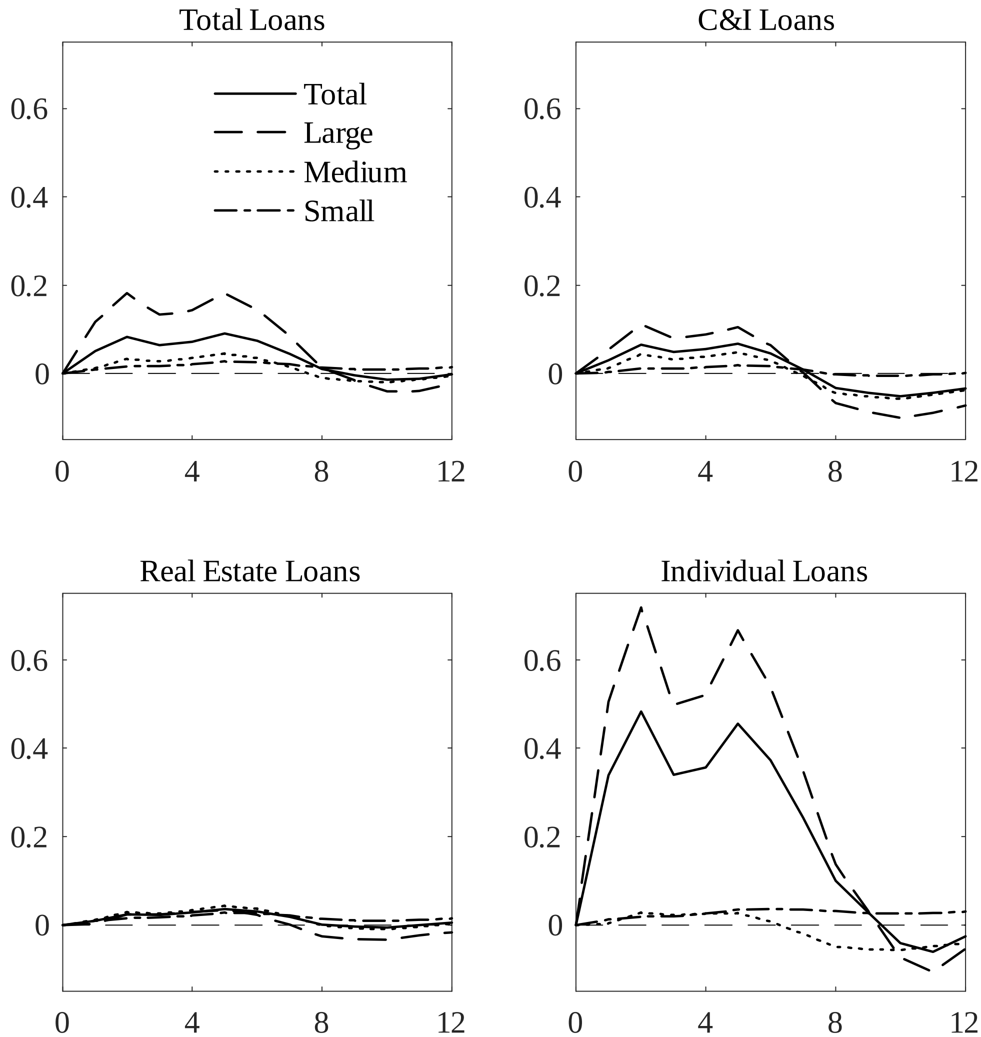

Figure 5: Impulse Response of Lending Volume (in Percentage Change) to a Monetary Policy Shock Identified via the difference between the IOER and the 90-day Treasury yield.

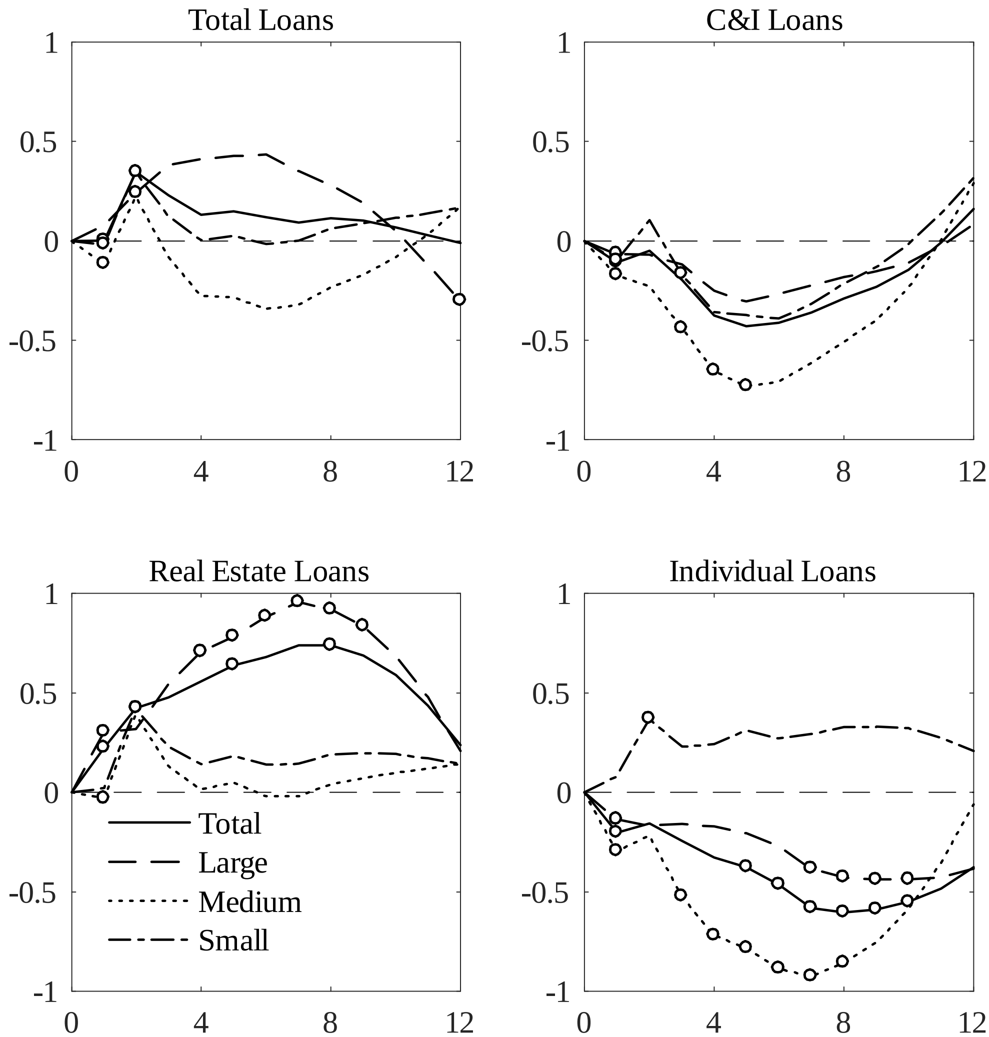

Figure 6: Impulse Response of the Lending-Asset Ratio (in Percentage Change) to a Monetary Policy Shock Identified via the Federal Funds Rate.

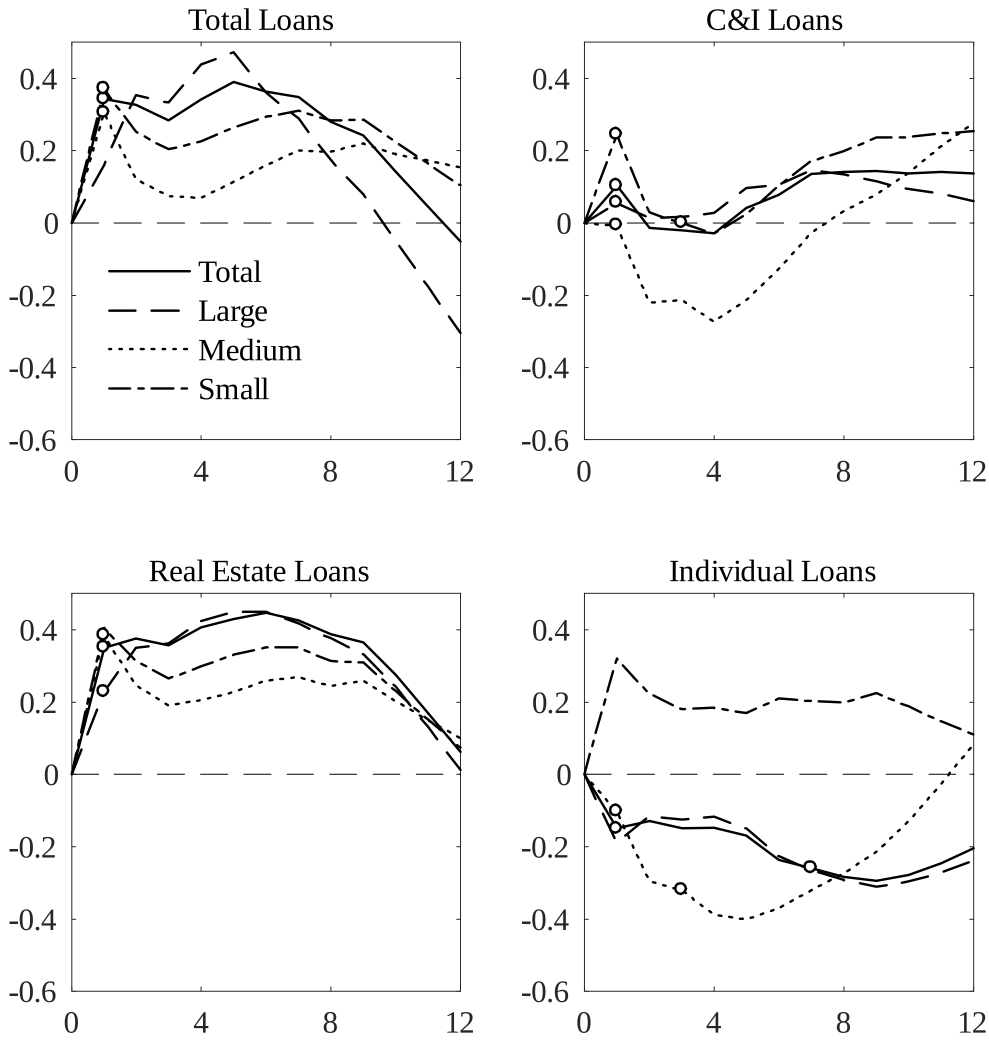

Figure 7: Impulse Response of the Lending-Asset Ratio (in Percentage Change) to a Monetary Policy Shock Identified via the IOER Rate.

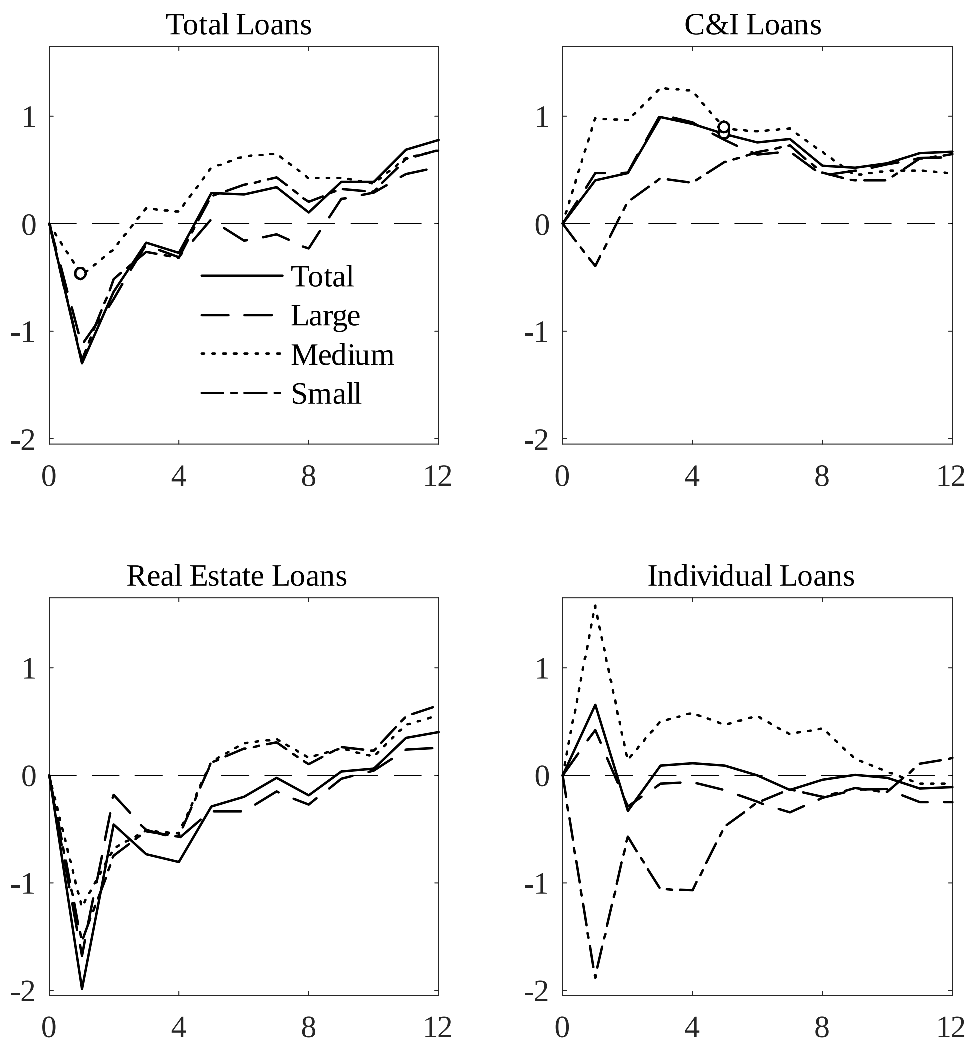

Figure 8: Impulse Response of the Lending-Asset Ratio (in Percentage Change) to a Monetary Policy Shock Identified via the difference between the IOER and the overnight LIBOR rate.

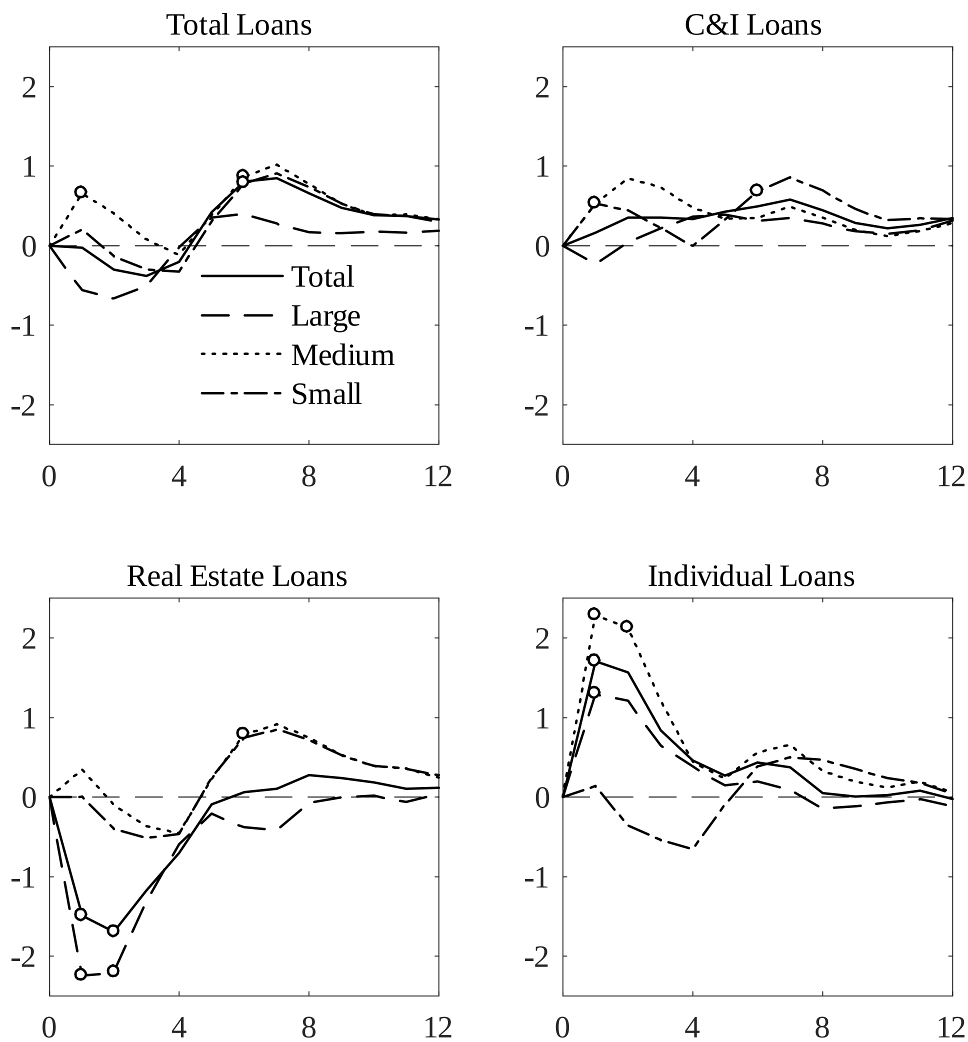

Figure 9: Impulse Response of the Lending-Asset Ratio (in Percentage Change) to a Monetary Policy Shock Identified via the difference between the IOER and the 90-day Treasury yield.

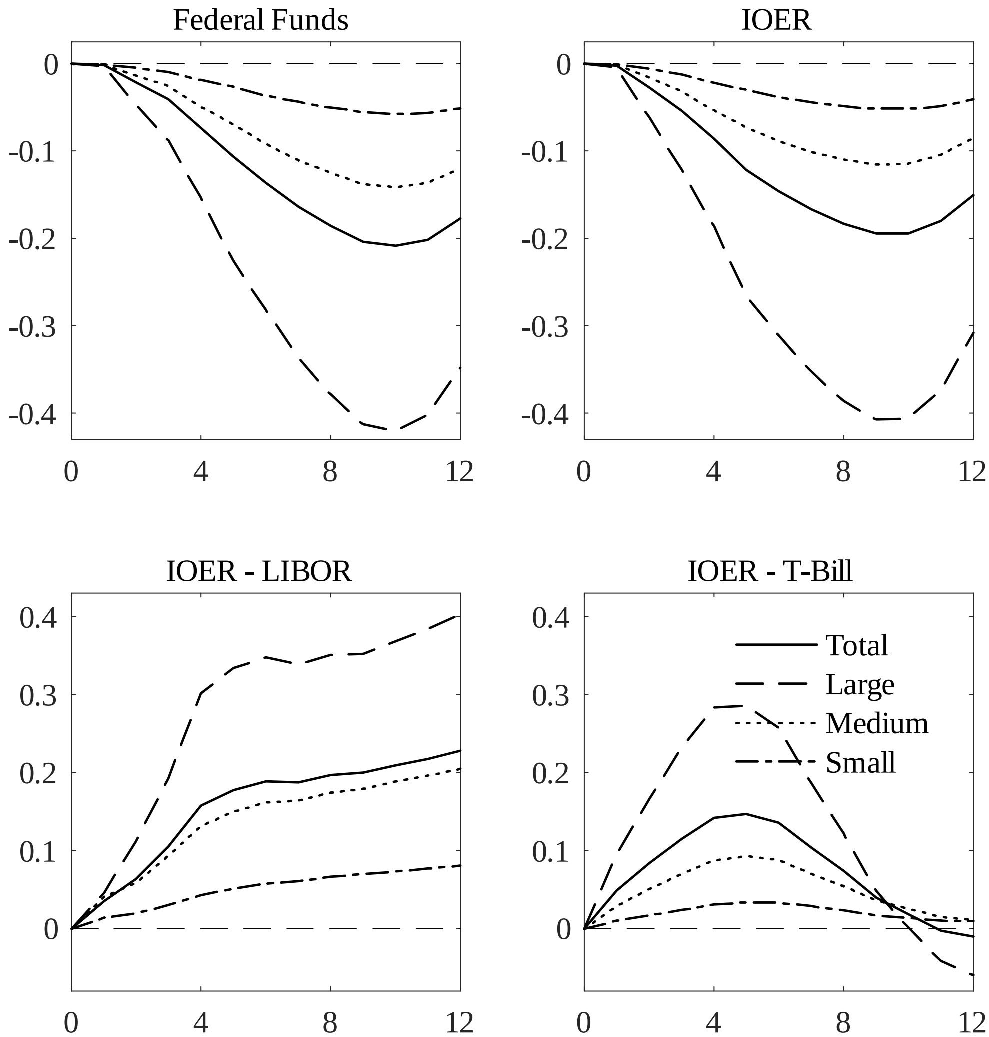

Figure 10: Impulse Response of Asset Growth (in Percentage Change) to a Monetary Policy Shock Identified via Each of the Four Methods

Table 1: Summary of Data Sets and FAVARs

Title	Variables in X_t	Definition of R_t	Factors
Lending Volume / FFR	X_{1t}; Total, C&I, RE, and Ind. loans, of all banks; Total, C&I, RE, Ind. loans of all bank groups	FFR	3
Lending Volume / IOER	Same as above	IOER	3
Lending Volume / LIBOR	Same as above	IOER-LIBOR	3
Lending Volume / T-Bill	Same as above	IOER-3MTB	4
Lending Share / FFR	X_{1t}; Total Loan-Asset Ratio of all banks; Loan-Asset Ratio of Total, C&I, RE, Ind loans of all bank groups	FFR	3
Lending Share / IOER	Same as above	IOER	3
Lending Share / LIBOR	Same as above	IOER-LIBOR	4
Lending Share / T-Bill	Same as above	IOER-3MTB	4

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