The macroeconomic effects of bank regulation: New evidence from a high-frequency approach*

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Abstract

Bank regulation supports financial stability, but might constrain economic activity. This paper estimates the macroeconomic consequences of bank regulation using a high-frequency identification approach. We measure market surprises in a bank stock price index during a narrow time window around Federal Reserve speeches that discuss the US banking system and its regulation. We then use two alternative procedures, based on sign restrictions and a narrative strategy, to elicit the variation in these market surprises that can plausibly be interpreted as *news about bank regulation*. News about bank regulation mitigates risk in the banking sector, but reduces economic activity by increasing banks' funding costs and reducing loan supply. A 10 basis point regulation-induced reduction in bank risk premiums is accompanied by a 27.5 basis point peak increase in the unemployment rate, suggesting a high macroeconomic cost of bank regulation relative to previous studies.

Keywords: Federal Reserve; Bank regulation; Macroprudential policy; Financial stability; High-frequency identification.

JEL Classification: E44, E51, E52, E58, G28.

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"Now—a decade from the onset of the crisis and nearly seven years since the passage of the Dodd-Frank Act and international agreement on the key banking reforms—a new question is being asked: Have reforms gone too far, resulting in a financial system that is too burdened to support prudent risk-taking and economic growth?"

Janet Yellen at the Jackson Hole Economic Symposium 2017

1 Introduction

Bank regulation supports financial stability, but might constrain economic activity, at least in the short run. For example, while stronger bank capital buffers protect banks from losses on their balance sheet, mandating capital ratios might suppress bank lending to firms and households. Understanding and quantifying such trade-offs is critical for policy makers to build a regulatory environment that balances risk mitigation with economic dynamism.

Empirically studying how changes in bank regulation affect risk and economic activity is a challenge. Financial regulation does not occur randomly, but typically changes in response to shifts in the macroeconomic environment or the occurrence of financial crises. For example, the financial deregulation of the 1980s was implemented against the backdrop of a stagflationary environment, while the Dodd-Frank Act of 2010 was a response to the Global Financial Crisis (GFC). The simultaneity between bank regulation and economic outcomes makes it impossible to determine causal relationships without a suitable identification strategy.

This is the first paper to employ a high-frequency identification approach to study the macroeconomic consequences of bank regulation. Previous studies of bank regulation have used quantitative models (Corbae and D'Erasmo, 2021), micro data in quasi-experimental designs (Jiménez et al., 2017), or cross-country data (Jordà et al., 2021). Our distinct approach enables us to estimate the impact of bank regulation news at the macroeconomic level, accounting for the combined impact of different regulatory instruments and their general equilibrium effects.

The idea behind our high-frequency approach is that in a narrow time window around public announcements about bank regulation, the reaction of financial markets is informative about the economic effects of the news about regulation. In the same narrow time window, the information about other aspects of the economy arguably does not change. A financial crisis may be the reason for changes in bank regulation, but expectations about the economic effects of the crisis itself should already be priced in before the announcement of new regulation. High-frequency approaches have been applied to assess the effects of changes in monetary policy (Gürkaynak, Sack, and Swanson, 2005; Gertler and Karadi, 2015; Nakamura and Steinsson, 2018), oil supply (Känzig, 2021), or fiscal policy (Hazell and Hobler, 2024).

Our empirical strategy consists of estimating surprises in a bank stock price index in a narrow window around Federal Reserve speeches that primarily discuss the US banking system and its regulation. While the US Congress passes legislation that underlies bank regulation, the Fed, as one of the major US supervisory authorities, implements bank regulation. When the Fed tells the public about the details of its implementation or when it comments on ongoing or future regulation by Congress, financial market participants carefully listen to any new information. Focusing our analysis on the US context has the advantage that the Fed has been a bank supervisor over a long time span. This is more complicated in other countries, where the supervisory responsibilities have moved between institutions.

Our methodology follows two steps. In the first step, we measure changes in a US bank stock price index in a narrow time window around speeches by Fed officials that primarily discuss bank-related topics. Jayawickrema and Swanson (2023) exploit Fed speeches to extract market surprises about monetary policy. They point out that many Fed speeches are not about monetary policy and discard them. Instead, we focus only on speeches that discuss the US banking system and its regulation. To select relevant speeches, we use natural language processing techniques. Among 8,231 Fed speeches that we retrieve from the St. Louis Fed's FRASER data base, we identify 3,310 speeches that are primarily about banking. We focus on two sample periods. In the 1971–2023 period, we construct market surprises at daily frequency and in the 2005–2023 period at intraday frequency.

We refer to the bank stock price changes around those speeches as "raw" market surprises. Without additional refinements, it is not clear if these exclusively capture news about bank regulation. For example, they could also contain news about the Fed's assessment of the banking sector's health rather than about regulatory policy. There is an analogy in the literature on monetary policy surprises, where an interest rate surprise could also contain news about the economy's overall health, known as "information effects" (Romer and Romer, 2000; Nakamura and Steinsson, 2018).

We perform some preliminary tests to understand how the raw surprises shift macroeconomic and financial variables, bearing in mind that such shifts occur through multiple channels. Following a raw negative surprise, bank lending decreases. The raw negative surprise also contracts real economic activity, reducing GDP, and increasing unemployment. Credit spreads for nonfinancial firms widen.

In "Placebo" tests, we construct market surprises in the bank stock price index in randomly selected time windows, rather than around Fed speeches. These surprises are not associated with statistically significant changes in macroeconomic and financial variables. This finding confirms that there is relevant economic information contained in the raw surprises.

In the second step of our methodology, we refine the estimated raw surprises. The goal of this step is to elicit only that portion of the variation in the raw surprises that can plausibly be interpreted as *news about bank regulation*. We do so using two alternative refinement procedures. One is based on sign restrictions and the other is based on a narrative identification strategy.

The sign restriction procedure exploits changes in bank credit default swap (CDS) premiums around Fed speeches. We posit that news about tightening bank regulation lowers expectations about bank profitability, thereby reducing bank stock prices, while simultaneously reducing expectations about future default probabilities, thus decreasing bank CDS premiums. In contrast, news about worse bank health also reduces bank stock prices, but increases rather than decreases bank CDS premiums due to higher likelihood of default. Put simply, tighter regulation news lowers returns and lowers risk, while poor health news lowers returns and increases risk. Based on this logic, we select only the subset of raw surprises that leads to a positive comovement of the bank stock price index and average bank CDS premiums. The procedure is inspired by Jarocinski and Karadi (2020), who apply sign restrictions to distinguish monetary policy shocks from information shocks.

The narrative strategy uses only a subset of Fed speeches, which we select based on additional historical and institutional information. Specifically, we use only 8 individual speeches, all of which contain the first mention of major legislative action in US financial regulation. For example, we select the first speech that ever anticipates the regulation that would eventually be passed through the Dodd-Frank Act. The idea of this approach is that in those selected instances, the regulatory information contained in the speech was the overwhelming news content.

Having constructed bank regulation news "shocks" with our two refinement procedures, we estimate impulse response functions of macroeconomic and financial variables using local projections. Our results suggest that news about bank regulation mitigates risk in the banking sector but lowers economic activity.

We find that after news of bank regulation arrives, bank lending decreases. The reduction in lending activity is associated with a decrease in GDP and a rise in unemployment. These effects on lending and economic activity are quite persistent, with the peak increase in unemployment occurring after 2 years. Bank regulation news shocks trigger an increase in credit spreads for nonfinancial firms, suggesting a higher perceived risk of corporate default due to the decline in lending and the economic slowdown. The shocks are also mildly deflationary, with a short-lived decrease in the PCE index. The fall in both GDP and prices indicates a slowdown in aggregate demand following bank regulation news. Consistent with this interpretation, the Fed lowers the federal funds rate following the bank regulation news shock. We obtain these results both for the sign restriction and for the narrative approach to constructing bank regulation news shocks.

We investigate the economic mechanisms underlying our results. In response to bank regulation news shocks, a credit tightness indicator increases and the loan interest margin charged by banks rises. These responses support the interpretation that banks actively reduce loan supply in response to the news shock. Furthermore, we find that an important channel through which news about bank regulation has an effect today is through the immediate reaction of investors in banks and the associated changes in banks' funding costs. Banks' equity funding costs rise strongly after the shock, whereas their weighted average cost of capital increases by less. This finding is consistent with equity and debt investors reacting to lower profitability and lower risk, respectively. Bank regulation news also leads to a decrease in firm entry and an increase in firm exit, a potential root cause for the strong unemployment we find. Lending by nonbanks to firms and households falls after bank regulation news, a result that suggests that nonbank lenders cannot make up for the reduction in credit by banks.

Quantitatively, a 10 basis point (bp) reduction in bank CDS premiums is accompanied by a 27.5 bp peak increase in the unemployment rate and a 0.24% peak reduction in real GDP. A 10 basis point reduction is equivalent to a 18.75 bp lower annual probability of default of the average US bank. Since the average annual probability of default priced in the CDS market in our sample is 1.5%, with a standard deviation of 1.2%, 18.75 bp is a meaningful fraction of the annual probability of default of major US banks. However, a 27.5 bp increase in the unemployment rate is also a significant reduction in macroeconomic activity and thus constitutes a meaningful cost of tighter regulation.

Although comparisons are difficult, our estimate of the economic costs of bank regulation is sizable relative to existing studies, which we review systematically. However, several qualifications are in order. First, our estimated increase in unemployment is temporary and reverts after several years. Second, a lower probability of default of banks could reduce the tail risk of a severe crisis, which itself would likely lead to large increases in unemployment. In the quantification of our results, we provide some calculations on how large such a reduction in tail risk might be. Finally, an argument for tighter regulation is that a stable economic environment supports growth in the long run, even though they might harm activity at shorter horizons. Although such longer-term benefits are difficult to estimate with our methodology, we do find tentative evidence that activity turns positive again at an 8 to 10 year horizon.

Literature. On the one hand, the consequences of bank regulation are widely studied using structural models. Examples include Begenau (2020), Begenau and Landvoigt (2021), Corbae and D'Erasmo (2021), Elenev et al. (2021). On the other hand, empirical estimates are typically at the microeconomic level, often based on quasi-experimental designs. For example, Jiménez et al. (2017) study the impact of macroprudential policy in Spain and find that regulation supports firms in bad times. Gropp et al. (2019) use the European Banking Authority's 2011 capital exercise as a quasi-natural experiment and find that banks reduce lending, which lowers firm investment. Huber (2021) studies the effects of bigger banks on economic outcomes using a quasi-experimental design in Germany and discusses implications for (de)regulation.[1] In contrast to both of these literatures, we assess the effects of bank regulation using macroeconomic data and an identification approach that is inspired by the empirical literature in monetary economics. Our macroeconomic estimates can capture the combined impact of different regulatory instruments and account for their general equilibrium effects. We discuss specific

[1]Other examples of quasi-experimental studies include Jayaratne and Strahan (1996) and Behn et al. (2016). Fraisse et al. (2020) and Irani et al. (2020) exploit institutional features of the implementation of Basel bank regulation that differentially affected banks in the cross section. Bouwman et al. (2018) exploit size thresholds of the Dodd-Frank Act.

general equilibrium mechanisms that micro-level estimates might miss.[2]

Empirical studies of the macro-level impact of financial regulation include Jordà et al. (2021), who examine the relationship between capital ratios and the probability of financial crises using country-level panel data, and Richter et al. (2019), who investigate the effects of raising loan-to-value ratios on output and inflation. Sufi and Taylor (2022) combine data from Kaminsky and Schmukler (2008) and Jordà et al. (2017) to show that financial liberalizations lead to credit expansion. While all of these studies use cross-country variation, we provide new macro-level evidence on the economic effects of bank regulation in the United States over time.

Methodologically, our paper contributes to the literature that develops high-frequency identification approaches. In many cases, this approach uses federal funds rate futures data to identify monetary policy shocks around Fed announcements (e.g. Gürkaynak, Sack, and Swanson (2005), Gertler and Karadi (2015), Nakamura and Steinsson (2018), Swanson (2021) and Bauer and Swanson (2023)). Känzig (2021) studies oil supply news shocks. Relative to this literature, our approach identifies a new type of shock, news about bank regulation.[3]

Our refinement step that uses a narrative approach takes inspiration from narrative identification in macro, e.g. Romer and Romer (1989). Fieldhouse, Mertens, and Ravn (2018) also apply such an approach to regulatory events, but study housing rather than bank regulation. Hazell and Hobler (2024) also combine a narrative and a high-frequency approach, to study the impact of deficits on inflation.

Two studies are particularly related to ours. First, Jayawickrema and Swanson (2023) also study the high-frequency impact of Fed speeches, but for the purpose of eliciting changes in monetary policy. They exclude speeches that discuss the US banking system and its regulation, while we put them at the center of our analysis. Similarly to Jayawickrema and Swanson (2023), we can use a large number of speeches which enhances the statistical power of our estimated shock. Second, Ottonello and Song (2022), also study high-frequency surprises in bank stock price data. While we focus on Fed speeches and the economy-wide bank regulation

[2]Huber (2023) formalizes the difficulties in drawing conclusions from quasi-experimental designs about the general equilibrium effects of macroeconomic shocks.

[3]Aikman et al. (2024) use a high-frequency approach to study credit controls in Britain after World War 2. They argue that these can be viewed as similar to present-day macroprudential policies. Other studies identify broader types of "financial shocks" with methods other than high-frequency ones, e.g. in VARs with sign restrictions (Furlanetto et al., 2017). We aim to identify a financial shock that has a specific interpretation as being caused by changes in bank regulation.

news they contain, they identify news about bank-level net worth revealed through the release of financial statements. Thus, the interpretation of our regulation news shocks is different from the shocks estimated by Ottonello and Song (2022), which are closer to what we call bank health news shocks in our discussions.

2 Data set construction

2.1 Federal Reserve speeches

We collect speeches by Fed policy makers. We employ an NLP approach to select speeches that primarily discuss the US banking system and its regulation.

2.1.1 Institutional background: relation between Fed speeches and regulation

The laws underlying US bank regulation are passed by Congress. The Federal Reserve, as one of the major US supervisory authorities, interprets and implements these laws. There are two ways in which speeches by the Fed can reveal news about future regulation to financial markets.

The first way is that Fed speeches communicate to the public about the implementation of regulation that has already been passed by Congress, but the regulation leaves open important details to be decided by the Fed. Fed Chair Ben Bernanke explains in a February 2011 speech that "*The (Dodd Frank) act gives the Federal Reserve important responsibilities both to make rules to implement the law and to apply the new rules. In particular, the act requires the Federal Reserve to complete more than 50 rule makings and sets of formal guidelines.*" Bouwman et al. (2018) provide specific examples from the regulatory process surrounding the Dodd-Frank Act. For example, banks with assets above 50bn USD "*must limit their aggregate credit exposure to an unaffiliated company to no more than 25% of its capital stock and surplus, or lower if decided by the Federal Reserve.*" A more recent example is a December 2019 speech by Randal Quarles, which explains how provisions in the Economic Growth, Regulatory Relief, and Consumer Protection Act of 2018 were going to be implemented by the Fed.

The second way is that the legislative process in Congress is ongoing, but Fed speeches reveal recommendations to Congress about how legislation should be designed. For example, in an October 2009 speech, Bernanke emphasizes "*(...)*

we are working with our fellow regulatory agencies toward the development of capital standards and other supervisory tools (...). Options under consideration in this area include requiring systemically important institutions to hold aggregate levels of capital above current regulatory norms or to maintain a greater share of capital in the form of common equity or instruments with similar loss-absorbing attributes (...)." These ideas were later implemented in the Dodd-Frank Act. In an April 2017 speech, Dan Tarullo states the need for legal reform: "*I believe we should be moving toward a much simpler capital regime for community banks. (...) it may be helpful to amend the law so as to make clear that the agencies would have the flexibility to create a simple capital regime applicable only to community banks.*" In a June 2017 speech, Jerome Powell makes similar arguments and mentions the Fed was developing an explicit proposal for regulatory change.

As a final remark on the institutional context, we emphasize that our focus on the US has the advantage that the Federal Reserve has been a bank supervisor over a long time span. The supervisory responsibilities are often more complex in other countries, where they have moved between institutions over time. For example, in several countries the central bank only became a bank supervisor after the GFC.

2.1.2 Source and samples

We retrieve all Fed speeches available through FRASER, a digital library maintained by the Federal Reserve Bank of St. Louis. This includes speeches by Fed Chairs, members of the Board of Governors, and Presidents of regional Federal Reserve Banks. The speeches consist of, for example, presentations at banking associations or universities. It also includes testimonies before Congress. For each speech, we obtain the full text content with web scraping techniques, along with relevant metadata such as the date of the speech, the speaker name, and title.

We start with speeches given in 1971, the year in which the daily bank stock price data becomes available. We end with speeches given in 2023. For the 1971–2023 period, we retrieve a total of 8,231 speeches. For speeches delivered after November 2005, when tick data for the bank stock price index become available, we also collect the precise time stamp of the speech.[4]

[4] In most cases, the release date and time are indicated on the first page of the speech transcript. When the release time is not available, we discard the speech unless it is a speech by the Fed Chair. In that case, we manually construct the time stamp using additional data sources such as web archives of news outlets or congressional websites. This ensures that we include as many Chair speeches as possible, as these are particularly closely watched by markets (Jayawickrema and Swanson, 2023).

2.1.3 Speech classification with natural language processing

To select the subset of Fed speeches that focus primarily on the banking system, we follow the topic modeling approach of Hansen, McMahon, and Prat (2018). These authors develop a Latent Dirichlet Allocation (LDA) algorithm to uncover latent topics in FOMC transcripts. LDA assumes that a document is composed of a mixture of several topics and that each topic generates a specific probability distribution over words. Observing the frequency of words in the document, it is possible to estimate the proportion of latent topics.

Training an LDA algorithm requires setting the number of latent topics K. Typically, a smaller K enhances interpretability, while a larger K improves the statistical fit. Since our interpretation of which topics relate to banking is based on judgment, we prioritize the interpretability of the algorithm output and set a relatively small number of topics, $K = 5$.[5]

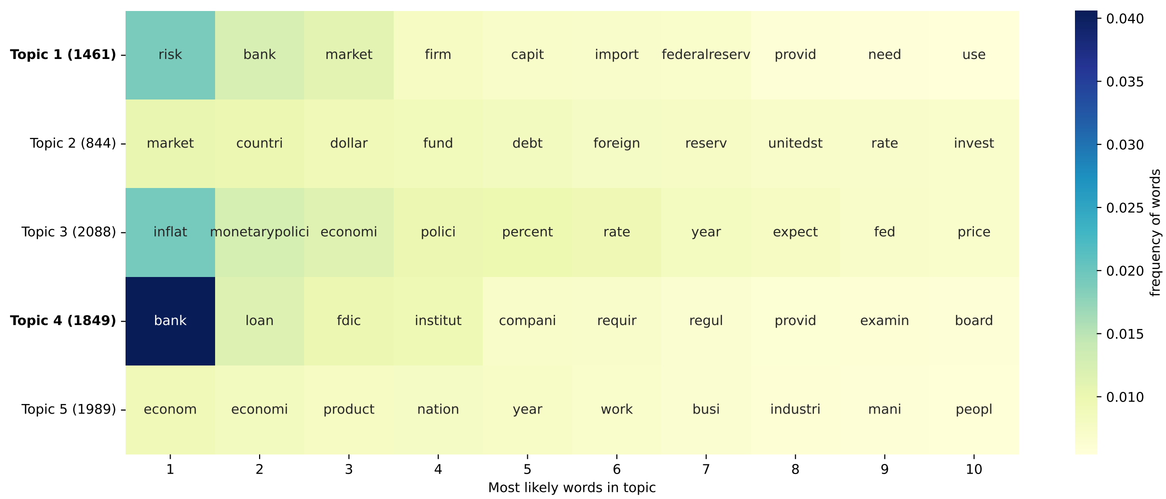
Figure 1 presents the estimation results of the LDA algorithm. Each row represents one of the five latent topics. The cells in a given row represent, from left to right, the words (word stems) with the top 10 highest probabilities of belonging to that topic. Darker shadings represent higher probabilities. The LDA generates distinct clusters of speeches. Topic 3 is characterized by words such as “inflation” and “monetary policy” and “rate”, indicating a clear focus on monetary policy. 2,088 speeches are mainly associated with that topic. Topic 2 appears to be related to international economic developments, while Topic 5 captures discussions of real economic activity and production.

Most importantly, we consider topics 1 and 4, with 1,461 and 1,849 speeches, to be primarily related to banking. They are characterized by words such as “bank”, “loan”, “fdic” and “regul”. This body of 3,310 Fed speeches is then further processed to be matched with financial market data for our high-frequency analysis.

Figure 1 makes clear that the speeches belonging to the two topics we select are mainly bank-related and that the speeches on the topics that we exclude are not mainly bank-related. However, it is not clear at this stage whether the speeches we

[5]As long as we estimate high-frequency surprises based on lower numbers of topics, they are strongly correlated with each other for different choices of K. This indicates that as long as K remains small, the results do not depend on the specific value of K. On the other hand, when setting larger values, topics become difficult to interpret, and there is greater room for arbitrariness when judging which topics are related to bank regulation. The Online Appendix shows results for $K = 10$ and $K = 20$ to illustrate this point.

Figure 1: Topics and associated words in Fed speeches between 1971 and 2023



Notes: We estimate the probability that a Fed speech belongs to one of five topics, and select the topic with the highest classification probability as the main topic of a given speech. The figure shows these five topics in separate rows, with the cells in a row representing, from left to right, the words (word stems) with the top 10 highest probabilities of belonging to that topic. Darker shadings represent higher probabilities. The number in parentheses for each topic indicates the number of speeches classified into that topic. Based on interpreting the most likely words, we consider topics 1 and 4, with 1,461 and 1,849 speeches, to be primarily related to banking.

select necessarily contain news about bank *regulation*. Furthermore, even speeches that do discuss regulation might also convey other information about the banking system. We address these issues in the methodology section.

2.1.4 Further restrictions to match speeches with financial market data

Table 1 provides an overview of our speech classification with additional breakdowns and further refinements of the speech sample. The column labeled *Full sample* shows the 2,088 monetary policy-related and 3,310 bank-related speeches that have been found among the total of 8,231 speeches we downloaded from FRASER, matching the speech counts appearing in Figure 1. In the panels below, the table indicates how many of those speeches have been given by the Fed Chair, the Vice Chair and other speaker, such as Reserve Bank Presidents. This breakdown shows, for example, that the Fed Chair gives about an equal amount of speeches about monetary policy and banks, while other speakers tend to talk more about the banking system than about monetary policy.

The columns labeled *Tick data sample* show the number of speeches in the sample

Table 1: Number of speeches, broken down by different categories and samples

Speaker	Topic	Full sample (1971–2023)	Tick data sample (Nov 2005–Dec 2023)					Matched to:	
			All	Time stamp		Trading hour		Daily	Intraday
				Yes	No	Yes	No	Prices	Prices
All speakers	all topics	8231	3136	1134	2002	744	390	–	–
	mon. policy	2088	1137	430	707	280	150	–	–
	bank	3310	1281	510	771	345	165	**3310**	**345**
Chair	all topics	1221	378	375	3	248	127	–	–
	mon. policy	366	150	149	1	103	46	–	–
	bank	370	119	119	0	79	40	370	79
Vice Chair	all topics	603	285	248	37	153	95	–	–
	mon. policy	185	125	120	5	69	51	–	–
	bank	310	148	117	31	78	39	310	78
Other speakers	all topics	6407	2473	511	1962	343	168	–	–
	mon. policy	1537	862	161	701	108	53	–	–
	bank	2630	1014	274	740	188	86	2630	188

starting in November 2005, for which we have tick data available for the bank stock price index. We further break this down by speeches that have a time stamp, and, among speeches with a time stamp, those within and outside trading hours. We exclude speeches outside trading hours, as explained in more detail in the methodology section. Both the availability of a time stamp and the release inside trading hours thus restrict the number of speeches that can be used for our analysis based on intraday market prices.

In the last two columns, headlined with *Matched to*, we summarize the number of speeches that can be matched to our two main analysis samples. For the 1971–2023 sample, for which we use daily financial market data, we use 3,310 speeches. For the period after November 2005, where we have intraday price data, 345 speeches are suitable for analysis (these are the ones related to banking, excluding those without time stamps and those outside of trading hours). These can be considered large numbers of observations in the context of the high-frequency monetary policy literature. Jayawickrema and Swanson (2023) discuss the statistical power gained by using Fed speeches in addition to FOMC announcements in more detail.

2.1.5 Sanity check for our speech classification

It is useful to compare our speech counts with those of Jayawickrema and Swanson (2023). These authors remove speeches that are not about monetary policy, using information from market commentary in major newspapers. This is a different approach from our LDA algorithm, so it is helpful to check whether similar speech samples are obtained. The sample period considered by Jayawickrema and Swanson (2023) is 1988–2019. Their data set contains 847 speeches by the Chair and 310 speeches by the Vice Chair. For the same period, our data set contains 815 speeches by the Chair and 357 by the Vice Chair. Their selection procedure picks 466 speeches related to monetary policy (which they keep). Our LDA algorithm selects 391 speeches related to monetary policy (which we remove). Thus, although the aim of our algorithm is not to identify speeches on monetary policy specifically, our selection procedure appears to yield outcomes comparable to theirs.

2.2 High-frequency financial market data

In constructing our market price data set, we proceed similarly to the high-frequency literature in monetary economics (Gürkaynak et al., 2005; Gertler and Karadi, 2015; Nakamura and Steinsson, 2018). However, we consider US bank stock price indeces, instead of federal funds rate futures.

2.2.1 Bank stock price index data

We employ two types of financial market data: daily prices over a longer period and tick price (or intraday) data, which are available for a shorter sample.

Daily frequency. We obtain prices for the NASDAQ Bank Index (symbol 'INDEXNASDAQ: BANK') from Bloomberg. This widely known bank stock price index is a composite of the stock prices of companies listed on the NASDAQ exchange that are classified as banks according to the Industry Classification Benchmark. Daily prices are available for the period from February 1971 to December 2023. The advantage of this long sample is that it contains many regulatory changes, both in the direction of looser and tighter regulation on banks. The disadvantage is that only daily and not intraday frequency data are available.

Intraday frequency. We use tick price data for the SPDR S&P Bank ETF (symbol 'NYSEARCA: KBE'). This ETF tracks the S&P Banks Select Industry Index. This index represents the banking segment of the S&P Total Market Index, which is designed to track the broad US equity market. This data is available starting from November 2005. This is the longest available tick data for a US bank stock index that we were able to find. We purchased the data from Tick Data LLC, the same provider used in monetary economics literature; see, e.g. Jayawickrema and Swanson (2023). We retrieve raw tick data for 15-minute ticks; we specify the size of the intraday windows in the methodology section below.

2.2.2 Bank CDS data

For one of the refinements procedures of our identification approach, we use bank CDS spread data as a measure of bank risk. Following the literature that analyzes bank CDS spreads (Eichengreen et al., 2012; Yang and Zhou, 2013), we obtain data for 5-year CDS, which is the most liquid in the market. Our data source is Bloomberg's generic prices (CBGN), from which we obtain daily data for the six largest US banks (JP Morgan Chase, Bank of America, Citigroup, Wells Fargo, Goldman Sachs, and Morgan Stanley). We aggregate the CDS data of individual banks by calculating the simple average of these banks' CDS spreads. The data period for this aggregated bank CDS premium begins in November 2002.

3 Methodology

We proceed in two steps. First, we measure high-frequency bank stock price surprises around Fed speeches about bank regulation. Second, we use sign restrictions and a narrative approach to refine the "raw" surprises. These refinements elicit variation that plausibly reflects news about bank regulation. We discuss interpretations of our bank regulation news shocks as well as advantages and disadvantageous of our approach.

3.1 Step 1: construct "raw" surprises

We measure changes in a bank stock price index in narrow windows around Federal Reserve speeches that we classified as primarily discussing the banking system. We use two windows, a daily window for the 1971–2023 sample and an intraday window for the 2005–2023 sample for which tick data are available.

3.1.1 Daily frequency (1971–2023 sample)

Let $\{\tau_1, ..., \tau_N\}$ denote days during which bank-related Fed speeches are given. We define the raw daily surprise caused by speech i as

$$s_i = \log p_{\tau_i} - \log p_{\tau_i - 1} \tag{1}$$

where p_τ denotes the close price of the bank stock index on day τ and $p_{\tau-1}$ the close price of the previous day.[6]

3.1.2 Intraday frequency (2005–2023 sample)

Let $\{(\tau_1, h_1), ..., (\tau_N, h_N)\}$ denote combinations of the day τ_i and the release time h_i of bank-related Fed speech i. We retrieve our tick price data in 15-minute intervals, so, to be precise, h_i represents the closest 15-minute time interval that occurs *before* the timestamp of the speech. We define the raw intraday surprise caused by speech i as

$$s_i = \log p_{\tau_i, h_i + \Delta_i} - \log p_{\tau_i, h_i} \tag{2}$$

where $p_{\tau,h}$ denotes the tick price of the bank stock index at date τ and time h. Δ_i is the time window. Following Jayawickrema and Swanson (2023), we use a 2-hour window for speeches and a 3-hour window for congressional testimony.[7]

3.1.3 Returns vs. excess returns

An alternative way to construct the surprises would be to calculate the change in the bank stock price index and subtract the change in a general stock price index. This would amount to constructing a surprise in the excess return, rather than the

[6] If day τ_i is a non-trading day, we treat the close price on the next trading day after the speech date as p_{τ_i}. Similarly, if $\tau_i - 1$ is a non-trading day, we treat the close price on the last trading day before $\tau_i - 1$ as $p_{\tau_i - 1}$. Only about 4% speeches happen on non-trading days.

[7] For the intraday version, we exclude speeches outside trading hours, to avoid that factors other than speeches, such as the release of macroeconomic data, influence stock prices. Jayawickrema and Swanson (2023) include speeches outside of trading hours because the federal funds futures market opens at 8:20 AM, prior to the release of any macroeconomic data. However, the trading of bank stocks begins at 9:30 AM, making this reasoning inapplicable to our analysis.

return, on bank stocks. Whether this excess-return version is preferable depends on the desired interpretation of the surprises. The excess return version essentially controls for the movement in the prices of stocks of nonfinancial firms. However, it may not be desirable to do so because the change in these stock prices might reflect the equilibrium transmission channel of bank regulation news. For example, investors might sell stocks of a manufacturing firm exactly because they know that more tightly regulated banks would harm the credit supply to that firm. This effect is part of the mechanism that we are interested in. Therefore, we opt for the return version as our baseline, and consider the excess-return version as an alternative.

3.2 Step 2: elicit news about bank regulation

It is not clear whether the raw surprises around the bank-related speeches contain only news about bank *regulation*. These speeches are likely to also reveal other types of information. When Fed policy makers talk about bank regulation or banks in general, they typically also discuss the health of the banking system. News about bank regulation and news about the health of banks could trigger different macroeconomic responses. A similar issue arises in the literature on monetary policy surprises, where monetary policy announcements by the Fed might also convey information about the Fed's assessment of the economy (Romer and Romer, 2000; Nakamura and Steinsson, 2018). See also Bauer and Swanson (2023) and Acosta (2023) for further discussion.

To address this identification challenge, we use two alternative refinement procedures. Both procedures are designed to elicit only that portion of the variation in the raw surprises that can plausibly be interpreted as news about bank regulation. The first is based on sign restrictions and the second on a narrative identification strategy. Based on these refinements, we interpret news about bank regulation in a more structural way than our raw surprises, and we will label it as a "shock."

3.2.1 Sign restrictions

Our first refinement procedure takes advantage of additional information on the response of bank CDS premiums to regulation. To distinguish bank regulation news shocks from bank health news shocks, we posit the following logic. The news of tightening bank regulation lowers expectations about bank profitability, thereby reducing bank stock prices. Tighter bank regulation should also reduce future default probabilities, so it should decrease bank CDS premiums.[8] News about worse bank health, on the other hand, also reduces bank stock prices, but increases rather than decreases bank CDS premiums. This is because when the Fed speaks of poor bank health, the market should interpret this as a higher likelihood of bank default.

Table 2: Sign restrictions to separate different types of news shocks

	Bank stock price index	Bank CDS premium
Bank regulation news shocks	−	−
Bank health news shocks	−	+

Table 2 summarizes the sign restrictions implied by this logic. Of course, bank regulation news shocks and bank health news shocks can be positive or negative, implying tighter vs. looser regulation and sound vs. poor bank health. What the restrictions imply is that bank regulation news shocks move stock prices and CDS premiums in the same direction, while bank health news shocks imply a negative comovement between stock prices and CDS premiums.

There are different ways to apply the restrictions to our raw surprises. The first is what Jarocinski and Karadi (2020) refer to as "poorman's sign restrictions." We simply handpick only those raw surprises that satisfy the sign restriction for the bank regulation news shock. The second is based on formally imposing the sign restrictions on a BVAR, which contains the raw surprises and the bank CDS premium as variables. This idea also follows Jarocinski and Karadi (2020).

3.2.2 Narrative approach

The second refinement procedure uses a narrative approach. The idea is to select only a subset of speeches based on a more restrictive criterion for their content. Specifically, we focus only on those speeches that are the first to discuss major changes in bank regulation. A related approach has been taken by Fieldhouse, Mertens, and Ravn (2018) who focus on regulatory events in the US housing market.

In a first step, we create a list of major legislative changes in financial regulation that occurred during our 1971–2023 sample. To create this list, we draw on reports provided by the Fed and the FDIC.[9] The list is shown in the first column of Table 3.

[8] The negative relationship between regulation and CDS premiums is consistent with empirical evidence provided in Handorf (2017). This author finds that regulation-favored balance sheet ratios imply lower CDS premiums across banks. More broadly, the goal of bank regulation is to avoid bank

Table 3: Financial regulatory changes and first discussion in Fed speeches

Legislative Act	Passed	Speech with 1st mention
The Depository Institutions Deregulation and Monetary Control Act of 1980 (DIDMCA)	3/31/1980	7/26/1978
The Garn–St Germain Depository Institutions Act of 1982	10/15/1982	11/14/1980
The Financial Institutions Reform, Recovery, and Enforcement Act of 1989 (FIRREA)	8/9/1989	11/19/1987
The Federal Deposit Insurance Corporation Improvement Act of 1991 (FDICIA)	12/19/1991	7/12/1990
The Riegle-Neal Interstate Banking and Branching Efficiency Act of 1994	9/13/1994	9/15/1992
The Gramm-Leach-Bliley Act of 1999	11/12/1999	4/19/1998
The Dodd-Frank Wall Street Reform and Consumer Protection Act in 2010	7/21/2010	7/24/2008
The Economic Growth, Regulatory Relief, and Consumer Protection Act (EGRRCPA)	5/24/2018	9/28/2016

Notes: 'Date' refers to the date each law was enacted. 'Speech Date' is the date each law was first mentioned in a Fed speech, identified using the method described in the main text. The terms characterizing each law are determined judgmentally and are specifically as follows: DIDMCA: {'ceiling', 'Regulation Q', 'interest rates'}, Garn–St Germain: {'real estate', 'garn'}, FIRREA: {'deposit insurance', 'thrift', 'resolution'}, FDICIA: {'prompt corrective', 'taxpayers'}, Riegle-Neal: {'branch', 'interstate'}, Gramm-Leach-Bliley: {'financial holding'}, Dodd-Frank: {'reform'}, EGRRCPA: {'Dodd-Frank', 'Volcker', 'consumer protection'}.

In a second step, we identify that speech that first mentions a given piece of legislation. As we explain in Section 2.1.1, these discussions start occurring prior to the passing of laws in Congress, with Fed speeches calling for legislative action and the markets understanding that regulation becomes more likely. The second step to classify such speeches is not straightforward. For example, during the financial deregulation period of the 1970's and 1980's, various issues related

failures. For example, this is explicitly stated in the Basel Framework for bank regulation.

[9]See these reports by the Fed and FDIC. Relative to the legislation highlighted in these reports, (i) we exclude "The Competitive Equality Banking Act of 1987", as its main purpose was to inject public funds into deteriorating S&Ls for recapitalization. This is arguably not a regulation, but a bailout; (ii) we include the "The Economic Growth, Regulatory Relief, and Consumer Protection Act (EGRRCPA) of 2018", which is not contained in the reports due to its recency.

to financial regulation are continuously debated. To minimize arbitrariness, we adopt a predefined selection procedure. We consider speeches made in the two years preceding the enactment of a given piece of regulation and search for several keywords that characterize that financial regulation. Among the speeches that contain these key words, the earliest one is identified as the first speech to mention the financial regulation, even if the regulation might not be mentioned by name. We then verify whether the speech is indeed related to the financial regulation by manually reading the text.

Table 3 shows the implementation date for each legislation, as well as the date of the speech we selected as the first to discuss the legislation. The notes of the table also contain the key words we used for each piece of legislation.

A case in point is the Dodd-Frank Act, which passed on July 21, 2010, but was first anticipated in a speech in July 2008. Although Lehman Brothers would only file for bankruptcy in September 2008, it was understood that a crisis had begun, and regulatory discussions were underway. Bear Stearns had collapsed in March 2008. In August 2007, BNP Paribas froze redemptions from its funds, and in July 2008, US GSEs were in distress. The July 2008 speech was delivered by Timothy Geithner, then President of the New York Fed. The speech recognizes that significant macroprudential policy changes were needed in response to the financial crisis. Geithner strongly pivots to reforms that would anticipate the content of the Dodd-Frank Act, for example, regulations on over-the-counter derivatives.[10]

3.3 Interpretation of bank regulation news shocks

Both refinement procedures select a subset of our raw bank stock price surprises. The sign restriction approach orthogonalizes the surprises with respect to bank health news shocks, which are an important source of convolution. The narrative approach restricts our analysis to speeches that mainly discuss new legislation related to bank regulation. We give the resulting time series measures a cleaner interpretation, as *bank regulation news shocks*.

Our bank regulation news shocks have certain features that make their use different from existing approaches to studying the effects of bank regulation.

[10] As the notes of Table 3 indicate, we use the search "reform" in the two-year window prior to the Dodd-Frank Act. Since there were no financial regulatory reforms between 1999 and Dodd-Frank, our logic in this case is that the term "reform" catches the anticipation of the Dodd-Frank Act. We apply a similar approach to other regulatory changes, as shown in the table.

First, our macroeconomic estimates should capture the full general equilibrium effects of regulation. While estimates at the micro-level can be more informative about the effects of specific regulatory tools, they might miss some indirect macroeconomic consequences. For example, if capital requirements are raised for a specific subset of banks, it is useful to study their effect at the bank level. However, these estimates could be very different from an increase in capital requirements for *all* banks in the economy. If all banks in the economy need to raise more capital, this could, for example, significantly change the cost of capital in funding markets. Such an effect might not be accurately captured by the micro-level estimates. Similar reasoning can be applied to other regulatory tools, which might alter market prices or the behavior of other agents in the economy, once they are widely applied to the banking system and not only to individual banks or subsets of banks. Huber (2023) formally discusses the difficulties in drawing conclusions from quasi-experimental designs about the general equilibrium effects of macro shocks.

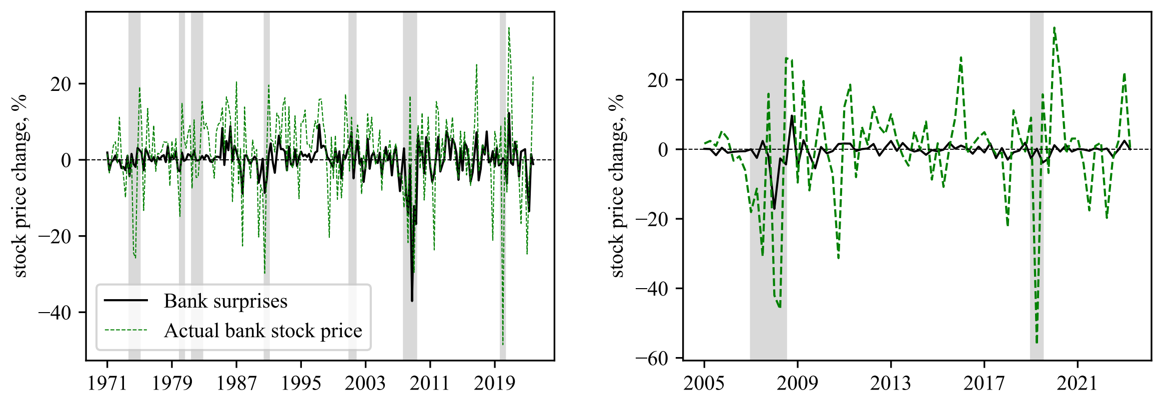
Second, our news shocks capture changes in multiple types of regulatory instruments. When the market learns about how the Fed will enforce new regulatory legislation passed by Congress or when the Fed guides future congressional action, this can encompass, for example, details about new capital requirements, changes in reporting requirements, or changes in the frequency of supervisory audits. The market reaction to a Fed speech in which these details are explained then captures the combined effect of all of them. In other words, we cannot pin down the effects of specific instruments, such as a change in capital requirements, which might be in and of themselves interesting to policy makers.

4 Preliminary analysis: raw surprises

We perform a preliminary analysis of the raw surprises that result from only Step 1 of our methodology. Figure 2 presents the daily version in the longer sample in Panel (a) and the intraday version for the shorter sample in Panel (b). In both cases, we aggregate the surprise time series to quarterly frequency and plot it together with the actual change in the stock price index over the same period. As expected, only a subset of the variation in the bank stock price index can be attributed to surprise changes triggered by Fed speeches. The correlation coefficient between the daily surprise and the intraday surprise in the overlapping sample period is 0.6.

Figure 2: Raw bank stock price index surprises around Fed speeches

(a) Daily surprises (1971–2023) **(b)** Intraday surprises (2005–2023)



Next, we assess whether raw surprises induce shifts in macroeconomic and financial data, bearing in mind that they do not cleanly capture structural shocks absent our refinement procedures. We estimate the following local projection:

$$y_{t+h} = \alpha^h + \beta^h s_t + \gamma^h y_{t-1} + \epsilon_{t+h} \tag{3}$$

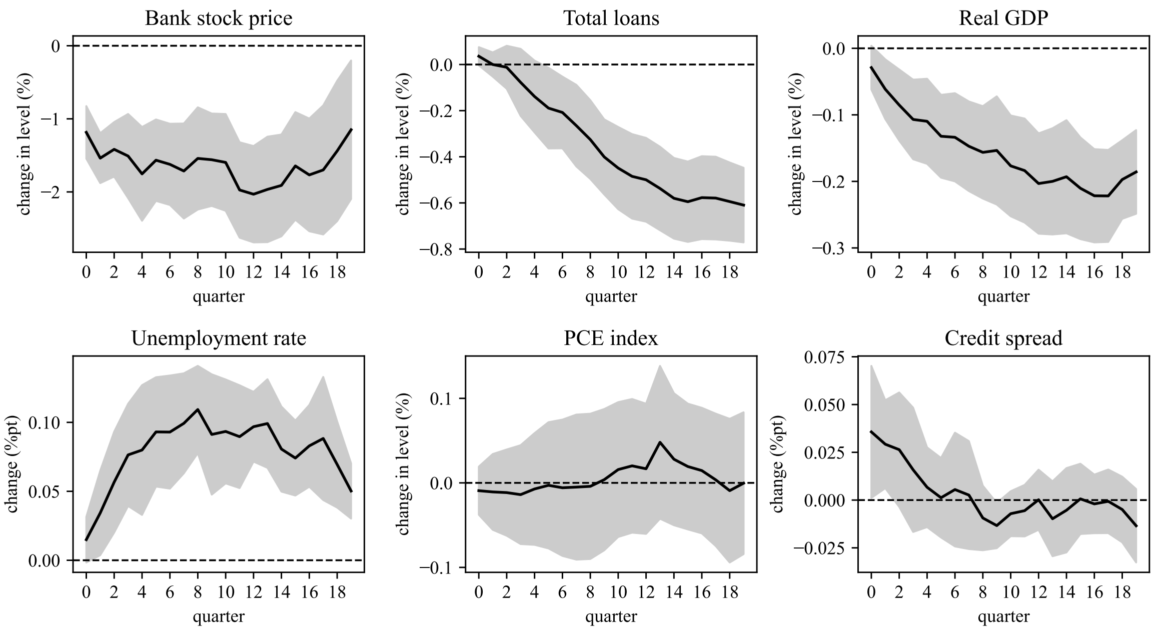
where y_t denotes the outcome variables and s_t denotes the raw high-frequency surprises. We apply a logarithmic transformation to all output variables, except those originally expressed as percentages (such as the unemployment rate). t denotes quarters. The estimate of β^h represents the horizon-h IRF of variable y_t. We convert the surprises to quarterly frequency by summing them within a quarter, but we also consider outcomes at daily and monthly frequency.

Figure 3, Panel (a) focuses on the daily version and shows impulse response functions (IRFs) to a negative raw surprise that reduces the bank stock price index by 1%.[11] The shaded areas represent 90% confidence bands based on heteroskedasticity and autocorrelation consistent (HAC) standard errors. A negative raw surprise is associated with a decline in bank lending and a contraction in real activity. These effects are quite persistent. Credit spreads for nonfinancial firms widen. There is no significant change in inflation after a raw surprise. The same IRFs are shown for the intraday version of the raw surprises in Panel (b). The results are mostly similar, even in terms of magnitudes, as in Panel (a). An exception

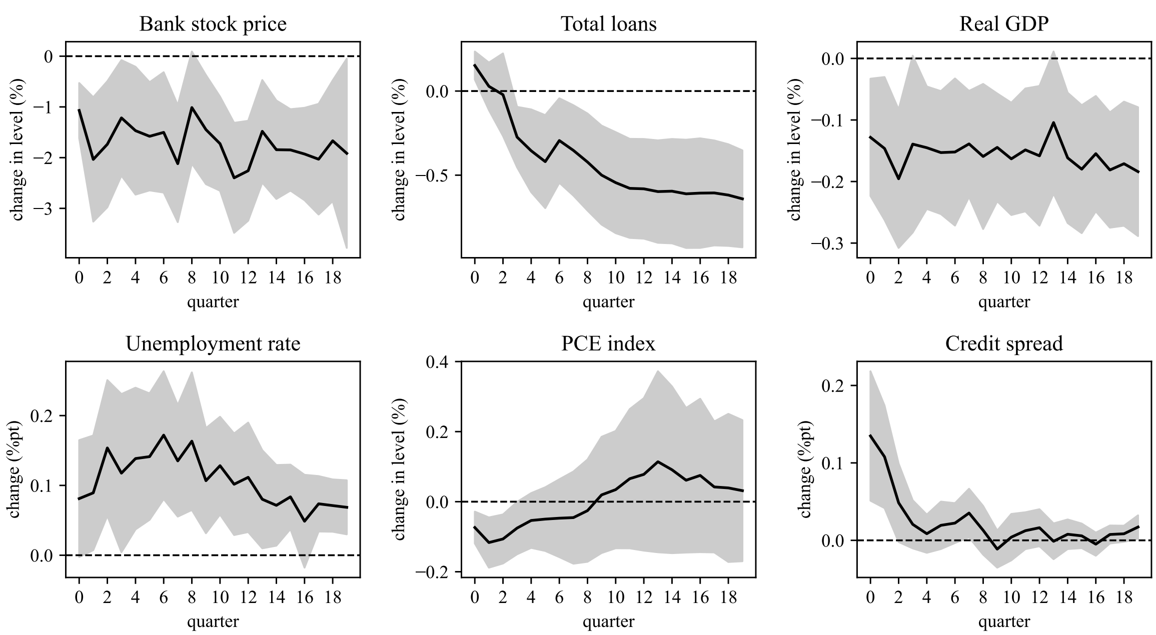
[11] The normalization is such that the bank stock price index declines by 1% at high frequency. The implied impact on the bank stock price IRFs, estimated at quarterly frequency, can differ from 1%.

Figure 3: Impulse response functions associated with raw surprises

(a) Daily frequency surprises



(b) Intraday frequency surprises (2005–2023 sample)



Notes: The IRFs are estimated with the local projection (3). The shocks are normalized as -1% decline in the bank stock price index at high frequency (which can differ from the quarterly impact). Error bands represent 90% confidence interval, based on HAC standard errors. The credit spread measure for nonfinancial firms is the one by Gilchrist and Zakrajšek (2012).

is the inflation response, which is negative on impact for the intraday version.

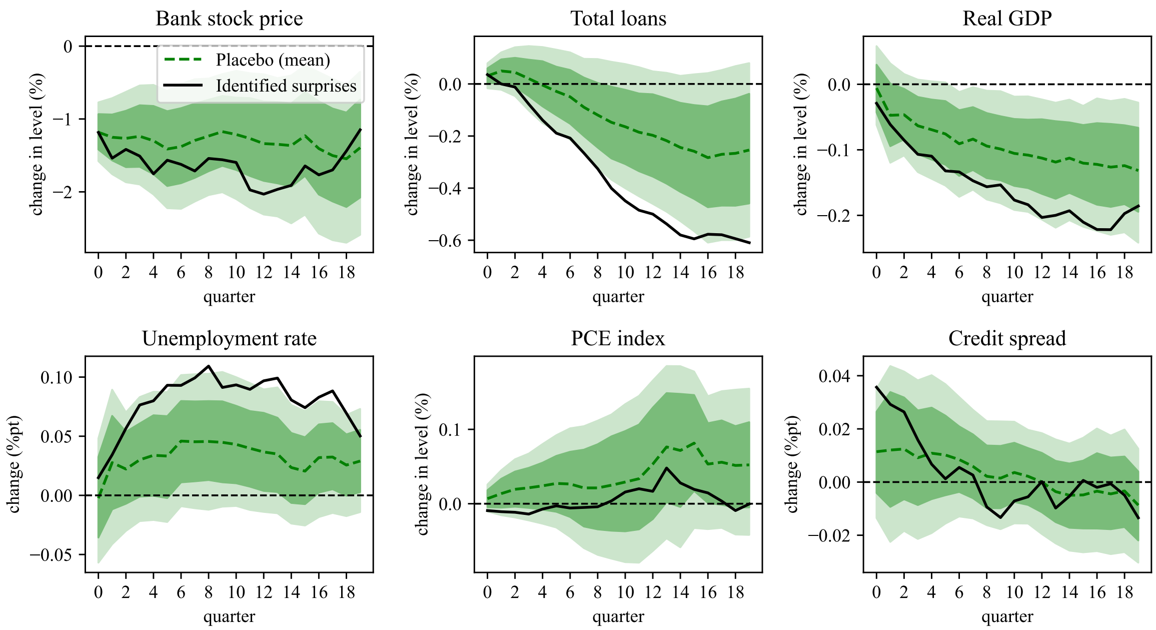
Placebo tests. Do the raw surprises really capture important information conveyed by Fed speeches or do they merely constitute "random" fluctuations in bank stock prices? In the latter case, Figure 3 might simply reflect the IRFs to an average innovation in the bank stock price index. To test whether the speeches capture meaningful information, we randomly draw the same number of points in time that we use to measure the raw surprises around speeches, and then construct the surprises and associated IRFs for those random points in time. This process is repeated 1,000 times to obtain a set of 1,000 Placebo IRFs.

Figure 4 shows the result of this simulation study for the daily version of the raw surprises. The green shaded areas show percentiles of the Placebo IRF distribution, while the solid black line repeats the mean IRF from Figure 3, Panel (a). Several of the responses fall outside the percentiles of the Placebo distribution. For example, the contraction in bank loans after Fed speeches that induce bank stock price declines is more severe than 90% of the contractions that follow a decline in bank stock prices unrelated to Fed speeches. The unemployment response is also much stronger. These results support the conclusion that our method for constructing surprises captures meaningful information conveyed by Fed speeches and not random variation in bank stock prices.

Excess return surprises. In the Online Appendix, we inspect the alternative version of the daily surprises based on subtracting the overall NASDAQ price change from the NASDAQ Bank price change. One difference is that raw surprises based on subtracting general stock prices are not associated with an increase in credit spreads of nonfinancial firms. This is consistent with the interpretation that the subtraction eliminates part of the general equilibrium effect.

Take-aways from raw surprise analysis. We do not interpret the IRFs associated with the raw surprises as structural estimates. However, they do give a first indication that our surprises are associated with meaningful macroeconomic consequences. The fact that the IRFs are quite precisely estimated echoes the arguments of Jayawickrema and Swanson (2023) that the high frequency of Fed speeches enhances the statistical power of the shocks (instruments) that can be constructed from them.

Figure 4: Result for Placebo test using random bank stock price changes



Notes: We randomly select daily intervals in the 1971–2023 sample, then construct bank stock prices index surprises over these intervals and estimate associated IRFs. We repeat this process 1,000 times and show percentiles over the 1,000 draws in each panel as green shaded areas (dark area corresponds 68% bands, light area 90% bands). The result are compared to the point estimate of Figure 3, Panel (a), shown as the black solid line.

5 The macro effects of bank regulation news shocks

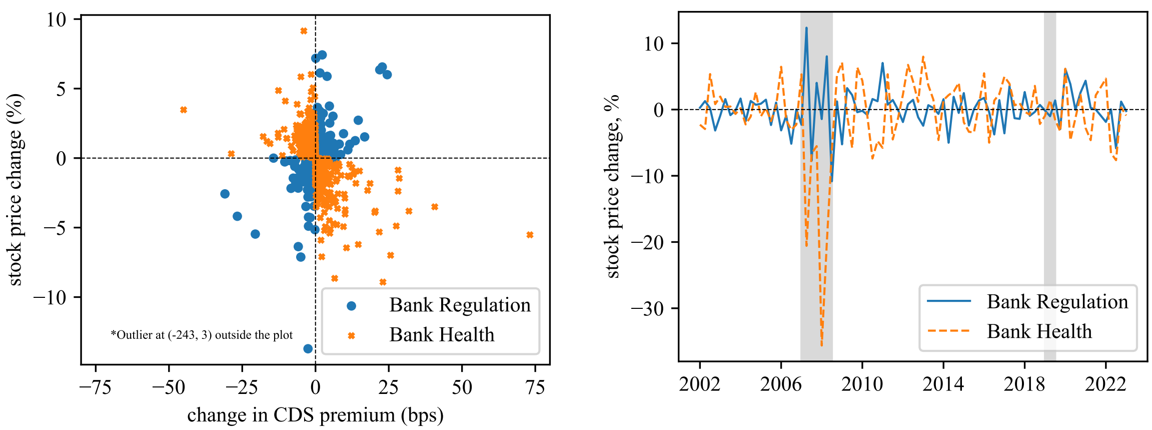
This section presents our main results on the macroeconomic effect of bank regulation news shocks. Based on both steps of our methodology, including the refinement of the raw surprises, we now construct IRFs of macroeconomic responses to our new shock measure. We discuss the results separately for the two alternative refinement procedures based on sign restrictions and on the narrative strategy. Given the nature of our bank regulation shock, our results can be interpreted as the combined macroeconomic impact of regulatory instruments that the Fed speeches discuss and should be understood to capture general equilibrium effects.

5.1 Results based on sign restrictions

Using the sign restrictions in Table 2, we decompose the raw surprises into bank regulation news shocks and bank health news shocks. Since the CDS data required

Figure 5: Shocks identified by sign restrictions, using intraday data

(a) Bank stock prices and CDS premiums **(b)** Shock series



to impose the sign restrictions are only available since the early 2000's, we use the intraday surprises. We employ the "poorman's" version of sign restrictions (Jarocinski and Karadi, 2020), by selecting those bank stock price surprises that induce a positive comovement with bank CDS premiums and discarding those that imply a negative comovement. The distinction is shown in Figure 5, Panel (a), which presents a scatter plot, where each dot represents a Fed speech. The plot distinguishes bank regulation shocks (positive comovement) and bank health shocks (negative comovement). Panel (b) shows the two shock time series in the time dimension. Interestingly, the large negative raw surprises during the Great Recession are mainly attributed to negative bank health shocks.[12]

To construct IRFs of macroeconomic variables, we estimate equation (3), where s_t now represents the bank regulation news shock instead of the raw surprises. Figure 6 presents the IRFs for quarterly variables. In the Online Appendix we also study outcomes at daily and monthly frequency. The shock normalized to reduce the bank stock price index by one percent and the shaded areas represent 90% confidence intervals based on HAC standard errors. The dashed black lines

[12]To validate that our bank regulation news shocks have the statistical properties of structural shocks, we assess their autocorrelation, their predictability with macroeconomic data, and their correlation with estimates of other types of macroeconomic shocks from the literature. The results are presented in the Online Appendix. We find slight autocorrelation in the shocks, and some limited predictability with macro data. When we exclude the GFC from the sample, the shocks are cleanly iid across time and entirely unpredictable. This motivates us to also study the effects of the shocks without the GFC. Even including the GFC, our shocks are uncorrelated with measures of monetary policy, fiscal policy, oil supply news and uncertainty shocks.

superimpose, for comparison, the responses associated with a raw surprise (see Figure 3).[13] The negative stock price response to bank regulation news shocks is persistent, remaining negative for the following 5 years. By design, the response of bank CDS premiums is negative on impact. Afterwards, the response is relatively short-lived and becomes indistinguishable from zero after around one year.

The bank regulation news shock causes a persistent reduction in bank lending. This result holds for different types of bank lending. The figure separately shows the response of just business lending, but we obtain similar results for real estate lending (omitted in the figure). Real GDP falls and the unemployment rate increases in response to the shock. Credit spreads for nonfinancial firms widen, indicating the negative consequences of tighter regulation on the financing situation of firms.

There is a significant reduction in inflation in response to the shock. The response is quite quick, different, for example, from the slow and gradual price response to monetary policy shocks (see Aruoba and Drechsel (2024) for a discussion). The negative sign of PCE response indicates that bank regulation news shocks act through an aggregate demand reduction, lowering quantities and prices. It is interesting in light of the question whether financial disruptions (more broadly) act as aggregate supply or aggregate demand shocks (Benguria and Taylor, 2020; Drechsler et al., 2022). In line with the aggregate demand slowdown, the Fed loosens monetary policy, as indicated by the reduction in the federal funds rate following the shock.

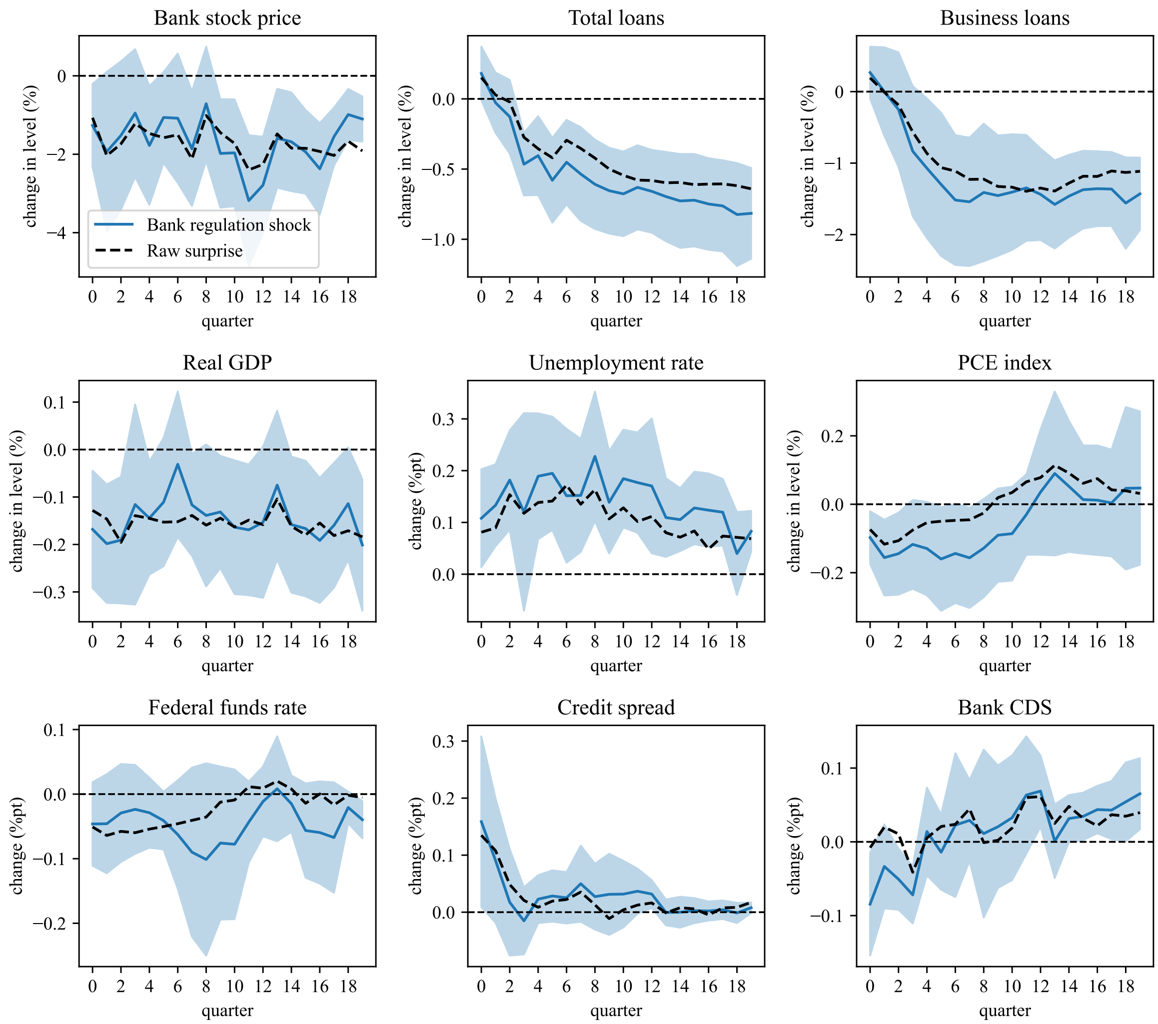
In comparison to the macroeconomic dynamics associated with raw surprises, most of these responses are larger in magnitude. For example, the peak increase in the unemployment rate is above 20 basis points for the refined shock measure. We discuss the magnitudes of these effects further below, where we draw conclusions about the quantitative trade-offs surrounding bank regulation.

5.2 Results based on narrative approach

Our alternative way to select bank regulation news shocks is to handpick only a subset of the raw surprises, as described by Table 3. Since the regulatory events we exploit in this narrative approach go as far back as 1980, we now use the daily

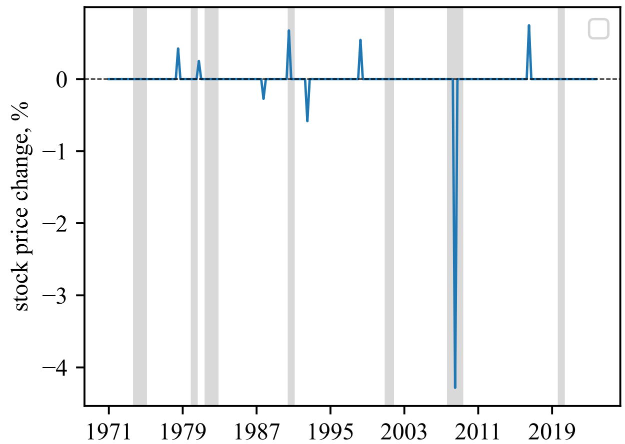
[13] In the Online Appendix, we present the IRFs following a bank health news shock for comparison, that is, the shock implied by the other negative comovement between the bank stock price index and bank CDS premiums.

Figure 6: IRFs to bank regulation news shock identified with sign restrictions



Notes: IRFs estimated with the local projection (3). The solid lines correspond to the bank regulation news shock identified by the sign restrictions in Table 2. The shocks are normalized as 1% decline in bank stock prices at high frequency (which can differ from the quarterly impact). Error bands represent 90% confidence interval, based on HAC standard errors. The dashed black lines superimpose, for comparison, the responses associated with a raw surprise (see Figure 3). Sample period: 2005Q4–2023Q4.

Figure 7: Shocks identified by narrative restrictions, using daily data



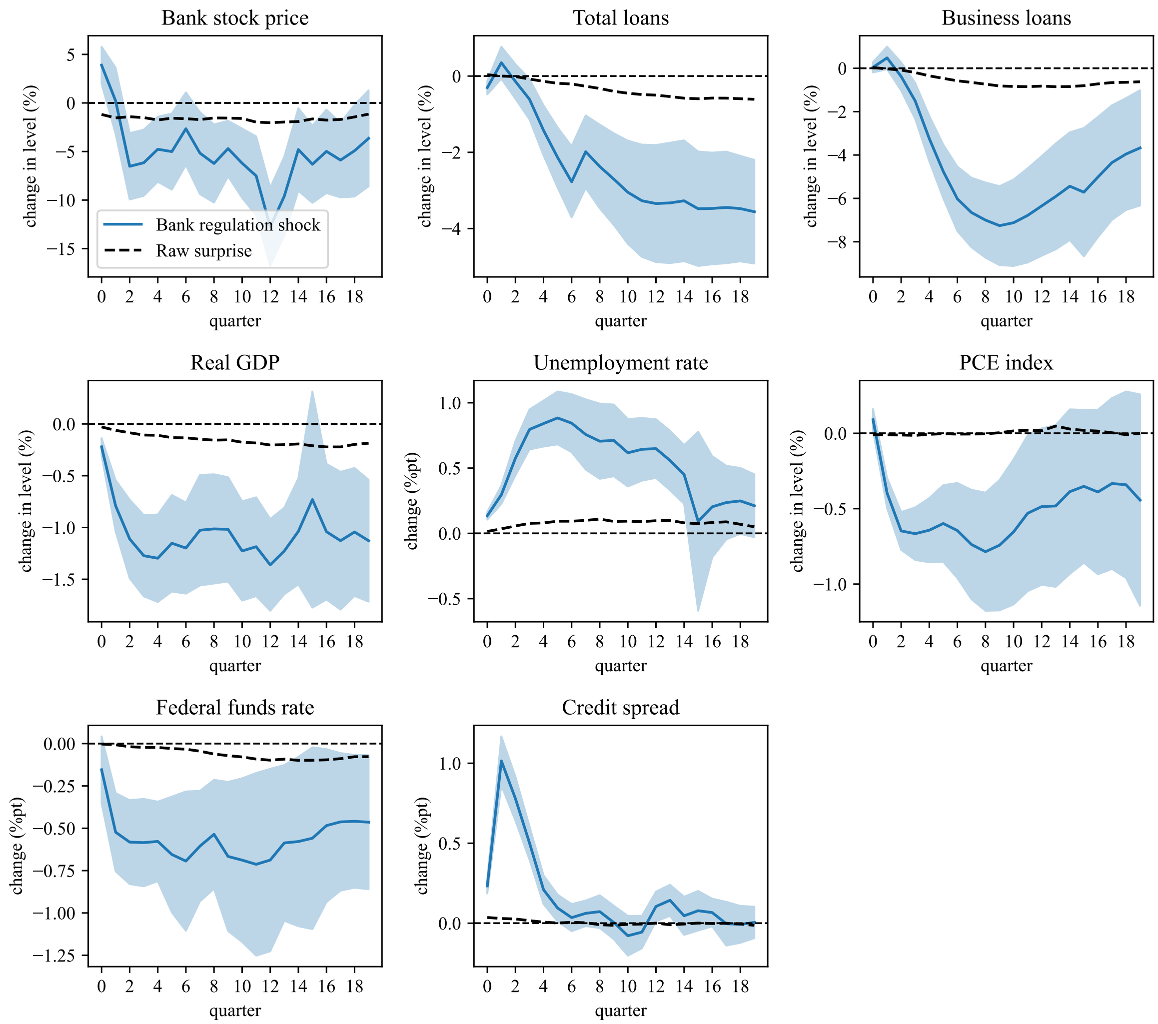
surprises. Figure 7 shows a plot of the resulting shock time series. Unlike the shocks based on sign restrictions, this is now a coarse series with only a few observations different from zero. These observations include both positive and negative shocks and are spread over the 1971–2023 sample. Note that, incidentally, the shocks shown in Figure 7 that fall into the sample for which we have CDS data satisfy the sign restrictions that Table 2 would require. In other words, the observations belong to the top-right and bottom-left quadrants of Figure 5.

Figure 8 presents the corresponding IRFs of macro variables, again based on the estimation of equation (3) with 90% HAC error bans. It is reassuring that the broad contours of these results are similar to the sign restriction version of the shock. Regardless of the refinement procedure, shocks that strengthen financial regulation strain lending activity and slow down economic activity. We again see a reduction in inflation and an increase in credit spreads on nonfinancial firms. Again, the federal funds rate falls, indicating a monetary easing in the face of reduced aggregate demand. However, the responses are generally stronger in magnitude than with the sign restrictions approach. This becomes especially clear in contrast with the raw surprise IRFs shown in the figure. Some of the responses, in particular that of inflation also become more persistent.

5.3 Inspecting the economic mechanisms

News about more stringent bank regulation lowers bank stock prices, decreases bank CDS premiums, reduces bank lending, and constrains economic activity. Our

Figure 8: IRFs to bank regulation news shock identified with narrative strategy



Notes: IRFs estimated with the local projection (3). The solid lines correspond to the bank regulation news shock identified based on finding the dates of the speeches in which regulatory changes are first mentioned, as summarized in Table 3. The shocks are normalized as 1% decline in bank stock prices at high frequency (which can differ from the quarterly impact). Error bands represent 90% confidence interval, based on HAC standard errors. The dashed black lines superimpose, for comparison, the responses associated with a raw surprise (see Figure 3). Sample period: 1971Q1–2023Q4.

results open further questions about the precise economic mechanisms behind these dynamics. What makes these questions critical is that the shock triggers *news* about regulation, but not necessarily actual changes in regulation. If agents in the economy learn today that bank regulation tightens or loosens in the future, what types of reaction *today* lead to the results we uncover and what types of general equilibrium effects are at play?

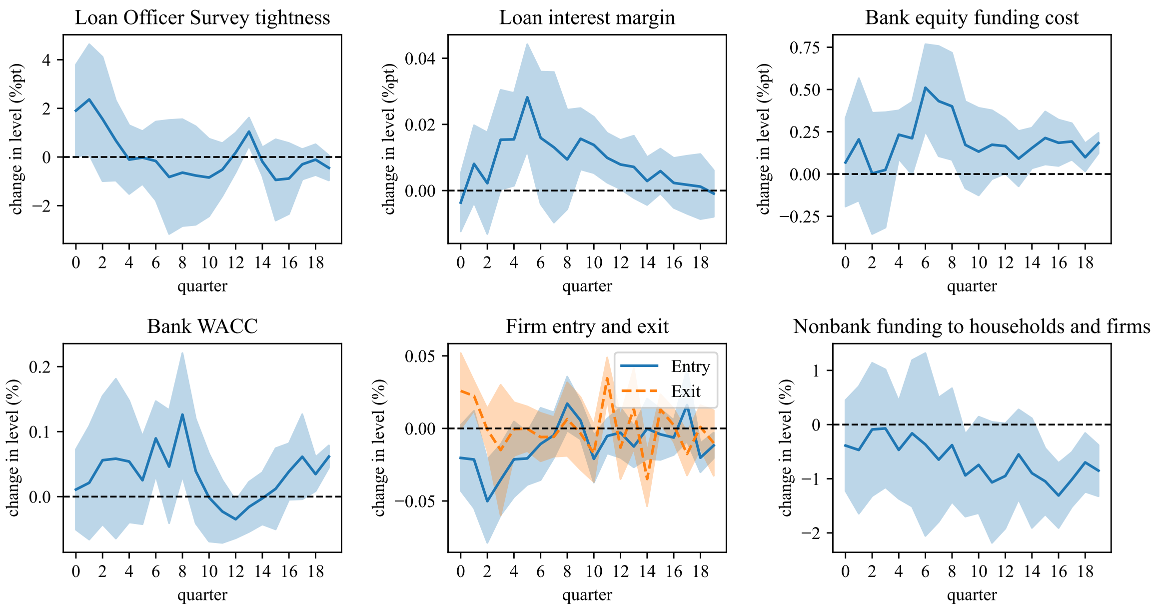
To shed more light on the underlying mechanisms, we present additional IRFs in Figure 9. Panel (a) corresponds to the intraday version based on the sign restriction refinement, using intraday data, and Panel (b) to the daily version based on the narrative refinement, using daily data. We focus our discussion on Panel (a). The results in Panel (b) are qualitatively similar and typically more statistically significant, but some of the variables are not available for the 1971-2023 sample used in the narrative strategy.

First, we test to what degree the decrease in bank loans following regulation news shocks is an active loan supply decision by banks. This is to rule out the possibility that the fall in loans comes from lower demand by firms or households. The first (top left) panel shows the response of a credit tightness index from the Fed's Senior Loan Officer Opinion Survey (SLOOS). In response to news about more regulation, banks tighten lending standards. The IRF is barely significant, but we find a much clearer response in Panel (b) for the narrative version. This finding supports the view that active reductions in loan supply are central to the transmission of regulation news. The second (top middle) panel further supports this interpretation. Here, we study banks' loan interest margin as a measure of loan pricing, and find that it increases. A fall in the quantity of loans and an increase in the price of loans is consistent with loan supply contraction following news about tighter bank regulation.

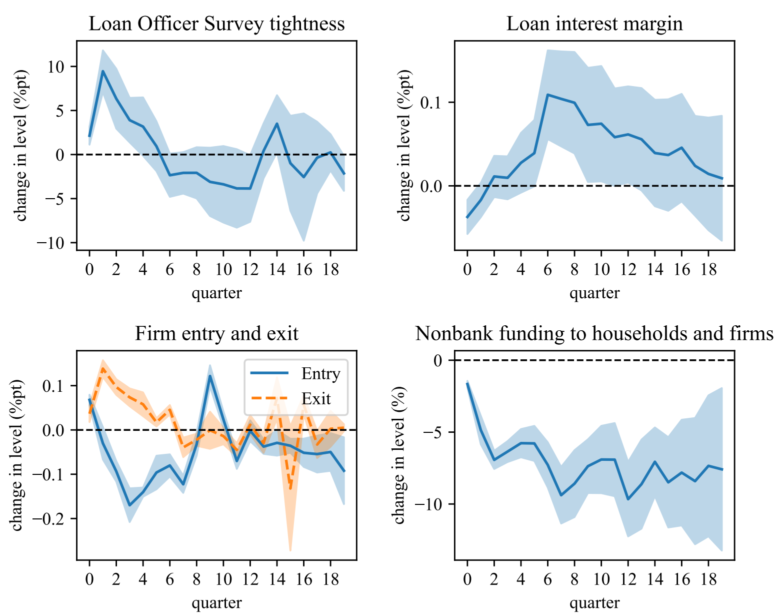
Second, an important channel through which news about bank regulation can have an effect today is through the immediate reaction of investors in banks and the associated changes in banks' funding costs. If tighter regulation makes banks less profitable, equity funding costs should increase. The third (top right) panel shows that this is indeed the case. Equity funding costs rise after the shock, and the effect is quite persistent. Since banks' have become safer and CDS premiums are lower, we would expect that debt funding costs decrease, or at least do not rise as much as equity funding costs. To confirm this logic, the fourth (bottom left) panel

Figure 9: Responses of additional variables informative of the mechanism

(a) Sign-restriction approach



(b) Narrative approach



Notes: Panels (a) and (b) extend Figure 6 and 8 to additional outcome variables. Some variables are only available for a shorter sample, so Panel (b) has fewer subpanels. The Loan Officer Survey tightness is the Net Percentage of Domestic Banks Tightening Standards for Commercial and Industrial Loans to Large and Middle-Market Firms (FRED: DRTSCILM). The loan interest margin is calculated based on the FDIC Quarterly Banking Profile as (loan interest income / total loans) minus (total interest expense / total liabilities). Bank equity funding cost and bank weighted average cost of capital (WACC) are calculated by Bloomberg and averaged across the same six large banks as used in the CDS data. Firm entry and exit are the establishment birth and death rates from the Business Employment Dynamics (BED). Nonbank funding to households and firms comes from the From-Whom-to-Whom Relationship data in the US Financial Accounts. Nonbanks are defined as money market funds, mutual funds, closed-end funds, exchange-traded funds, issuers of asset-backed securities, equity real estate investment trusts, mortgage real estate investment trusts, finance companies, security brokers and dealers, and other financial businesses.

presents the response of banks' weighted average cost of capital (WACC). Following news about tighter regulation, the WACC increases, but by much less than equity funding costs. This finding is consistent with equity and debt investors reacting to lower profitability and lower risk, respectively. These dynamics highlight that the immediate reaction of banks' funding costs to regulation news play an important role in the transmission of the shock.

Third, we study firm entry and exit, to better understand how bank regulation and the reduction in loan supply impact nonfinancial firms and whether this is consistent with the strong effects on aggregate economic activity that we uncovered. We calculate entry and exit rates using establishment data from the Business Employment Dynamics (BED). The fifth (bottom middle) panel shows that news about tighter bank regulation, and the associated reduction in credit supply, lead to an increase in firm exit and a decrease in firm entry. These effects are in line with the strong increase in unemployment and the strong reduction in real GDP that we found above. It highlights tight bank regulation as potential driver as sluggish economic dynamism in the US economy, see Decker et al. (2014) for a general discussion.

Fourth, we test whether there is increased lending activity by nonbank financial institutions, when banks get more stringently regulated. This is an important theme in the existing literature on bank regulation, see e.g. Begenau and Landvoigt (2021) or Irani et al. (2020) for discussions. We calculate the amount of nonbank funding to households and firms using the From-Whom-to-Whom Relationship data in the US Financial Accounts. Interestingly, the sixth (bottom right) panel shows that nonbank lending also falls after the bank regulation news shock. This funding at least tentatively suggests that nonbank lenders do not "fill the gap" in lending created by regulation in the banking sector. Our results should account for general equilibrium effects, so this could come from the second-round effect of lower credit demand by firms in a weaker macroeconomic environment.

Longer-run effects. An argument for tighter regulation is that a well regulated economic environment supports economic growth in the long run, even though it might harm activity at shorter horizons. In fact, this logic is often emphasized in speeches of policy makers. Such longer-term benefits are difficult to estimate with our high-frequency methodology. In the Online Appendix, we repeat Figure 8 for a 40-quarter instead of a 20-quarter IRF horizon. At an 8 to 10 year horizon, the decline in business loans reverts bank to zero, the unemployment rate response turns negative again, and nonfinancial firms' credit spreads fall. Thus, there is indeed tentative evidence of positive longer-term effects.

Responses of individual banks. In the Online Appendix, we separately estimate the responses of stock prices and CDS premiums for individual banks. We focus on the six banks that we used to calculate the average CDS premium. We find that the decline in stock prices and CDS premiums is mostly similar across banks. Citigroup experiences the largest stock price decline and Morgan Stanley the largest reduction in its CDS premium.

5.4 Additional robustness checks

Excluding the GFC. Our shocks exhibit large movements during the GFC. In the Online Appendix, we present IRFs for a sample excluding the GFC. We find that those results are generally noisier, but still statistically and economically significant. For example, the reduction in bank loans and the increase in unemployment rate have the same magnitude.

Monetary policy surprises. One concern with our approach is that speeches by Federal Reserve officials reveal information about the course of monetary policy, even when we select speeches that primarily discuss the US banking system and its regulation. To examine this concern, we also measure the monetary policy surprises on the days when bank-related speeches were given, using data on federal funds rate futures. The correlation between bank-related surprises and monetary policy surprises in time windows when bank-related speeches occur is only 0.018 (the Online Appendix provides a scatter plot). Thus, even if Fed speeches on bank regulation might reveal some information about monetary policy, the relationship does not appear to be systematic.

Macroeconomic information effects. One of the concerns addressed with our sign restriction approach is that Fed speeches reveal private information about the banking sector's health to the public. However, a related concern that our restrictions might not address is that the Fed could reveal new information about the economy's overall health. This mechanism is sometimes called information effect in the monetary policy surprise literature (Romer and Romer, 2000; Nakamura and Steinsson, 2018). While our refinement approaches might not be able to purge the raw surprise series from this effect, recent work by Bauer and Swanson (2023) casts doubt on the argument that Fed announcements give rise to such effects. Our Online Appendix shows that our shocks are uncorrelated with a variety of different macroeconomic shocks estimated in the literature.

6 Quantifying the stability–activity trade-off

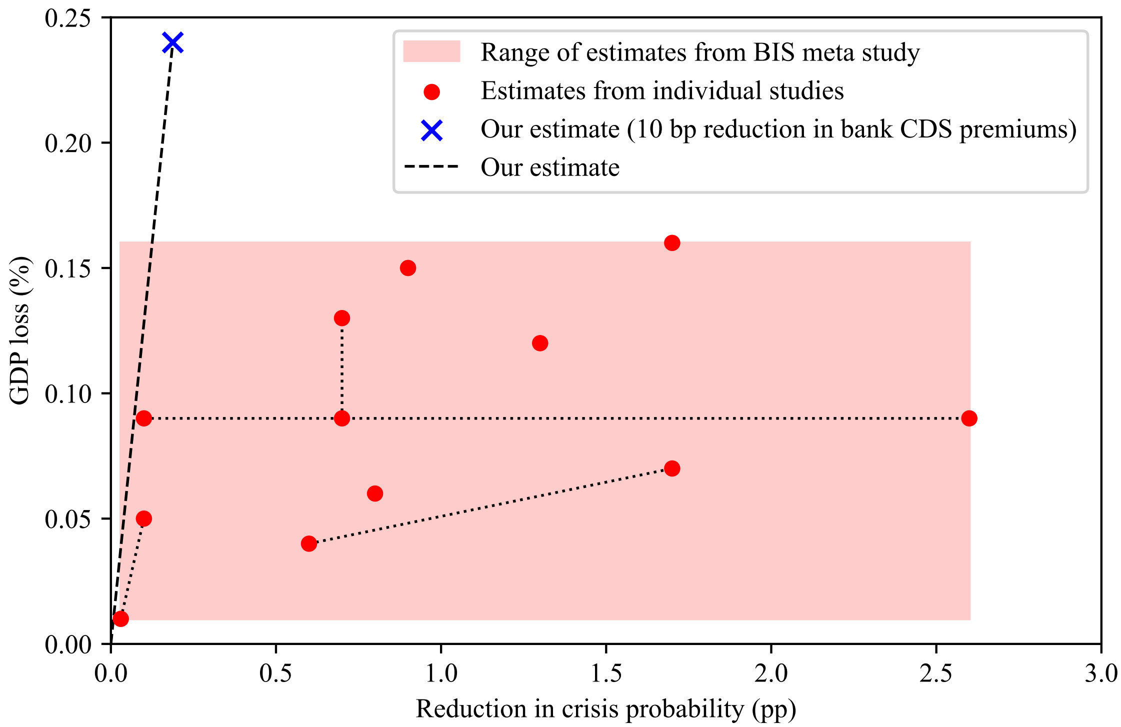
Our results suggest that financial regulation involves a trade-off between risk mitigation and economic activity. To quantify this trade-off, we use simple calculations that draw on our empirical estimates. We then put these calculations in the context of existing estimates in the literature and discuss important caveats.

Based on the results in Figure 6, a 10 bp reduction in bank CDS premiums is accompanied by a 27.5 bp peak increase in the unemployment rate. The associated GDP decline is 0.25%. To better interpret the relation between these numbers, we translate the CDS premium variation into default probabilities. A CDS premium can be interpreted as the product of the loss-given-default and the probability of default. The loss-given-default is calculated by subtracting the recovery rate from 1. This procedure yields a risk-neural probability of default, as explained in Huang et al. (2009). Assuming a recovery rate of 0.4, a 10 basis point reduction is equivalent to an 18.75 bp lower annual probability of default.[14] The average annual probability of default priced in the CDS market in our sample is 1.5%, with a standard deviation of 1.2%. When we exclude the Great Recession from the calculations, the average is 1.2% and the std is 0.36%. Therefore, 18.75 bp is a meaningful fraction of the annual probability of default of major US banks. However, a 27.5 bp increase in the unemployment rate is also a significant reduction in macroeconomic activity and thus constitutes a meaningful cost of tighter regulation.

Although comparisons are complicated, our estimate of the economic costs of bank regulation is sizable in the context of existing literature. A meta study conducted by the Bank for International Settlements (BIS) (Birn et al., 2020)

[14]Using a recovery rate of 0.4 is a common assumption in financial practice when calculating loss-given-default. See, for example, Hull (2021) (Chapter 24) for a textbook treatment.

Figure 10: Tradeoff between crisis prevention and activity loss: our estimates vs. the literature



Notes: Comparison between the tradeoff implied by our estimates (peak IRFs) and a meta study conducted by the Bank for International Settlements (BIS) (Birn et al., 2020).

summarizes nine studies that examine the reduction in the probability of a crisis and the downward impact on GDP after an increase in the bank capital ratio by 1 percentage point (pp). Given that our CDS series represents the average of major banks, the estimated probability of bank failure might very roughly be interpreted as the probability of a crisis. According to their survey, the reduction in the crisis probability ranges from -0.03 to -2.6 pp (compared to our -0.1875), while the associated GDP decline ranges from 0.02% to 0.16% (compared to our 0.24%). This is a much lower ratio of activity reduction per unit of crisis avoidance than is implied by our estimates, as illustrated graphically by Figure 10.

One possible reason for this difference is that while the BIS study focuses on bank capital ratio requirements, our regulatory shock includes a broader range of regulatory measures. Ottonello and Song (2022) estimate a broader "financial shock". A one standard deviation negative shock persistently raises the unemployment rate by more than 0.2 pp, a value broadly similar to our result.

However, the interpretation of their shock goes beyond the effects of regulation and might contain variation that should be part of the bank health shock we exclude with sign restrictions. Either way, the costs implied by our estimates appear to be quite pronounced.

There are important qualifications to our analysis of the stability–activity trade-off. First, our estimated increase in unemployment is ultimately temporary and reverts after several years. The benefits of tighter regulation might be permanent, although we also find that the CDS reduction mean-reverts quickly. The transitory nature of our high-frequency shocks might fail to capture some of the permanent effects. A similar discussion arises for high-frequency approaches to other policy changes that might be permanent, such as climate policy (Känzig, 2023).

Second, the lower annual probability of default of banks that we estimate reduces the tail risk of a severe financial crisis, which itself would likely lead to large increases in unemployment. Suppose that we again use the crude calculation that the CDS-implied default probability of banks equals the probability of a crisis and let us assume a crisis would be as bad as the 2008-2009 GFC. The unemployment rate in the GFC increased by around 5.5 pp and GDP fell by roughly 4%. Thus, a 18.75 bp lower annual probability of default avoids a 0.185 x 5.5 pp = 1.0175 pp increase in the unemployment rate in expectation and a 0.185 x 4% = 0.75% decrease in GDP in expectation. In comparison with the 0.2755 pp unemployment increase and 0.24% GDP decrease we estimate, this would imply meaningful benefits of regulation.[15]

Finally, an argument for tighter regulation is that a stable economic environment supports economic growth in the long run, despite negative effects in the short run. As discussed, our methodology provides tentative evidence for such a pattern. We think that it is a promising area for future research to use our estimates to discipline structural models that can speak to longer-term economic effects.

7 Conclusion

This paper contributes new findings on the delicate balance between macro-prudential regulation and economic activity. Studying this balance is riddled with endogeneity problems, as regulation and economic outcomes are simultaneously

[15](Jordà et al., 2021) find that an increase in bank capital might not reduce the probability of a crisis, but mitigates the economic downturn when a crisis occurs. Less severe crises conditional on their frequency would be an additional benefit that our simple calculations here do not incorporate.

determined. Using a high-frequency approach that measures the impact of Federal Reserve speeches on bank stock prices, we examine how news about banking regulation affects the economy. Regulatory news reduces bank CDS spreads, indicating improved financial stability within the banking sector. However, this comes at the cost of lower economic activity, with decreased bank lending, lower real GDP, and higher unemployment. The trade-off is quantitatively meaningful, with higher costs of regulation than typically found in the previous literature. The implications of our findings are relevant for policy makers tasked with crafting financial regulations. They should keep in mind the contractionary consequences that accompany the benefits of bank regulation according to our results.

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ONLINE APPENDIX TO

The macroeconomic effects of bank regulation:
New evidence from a high-frequency approach

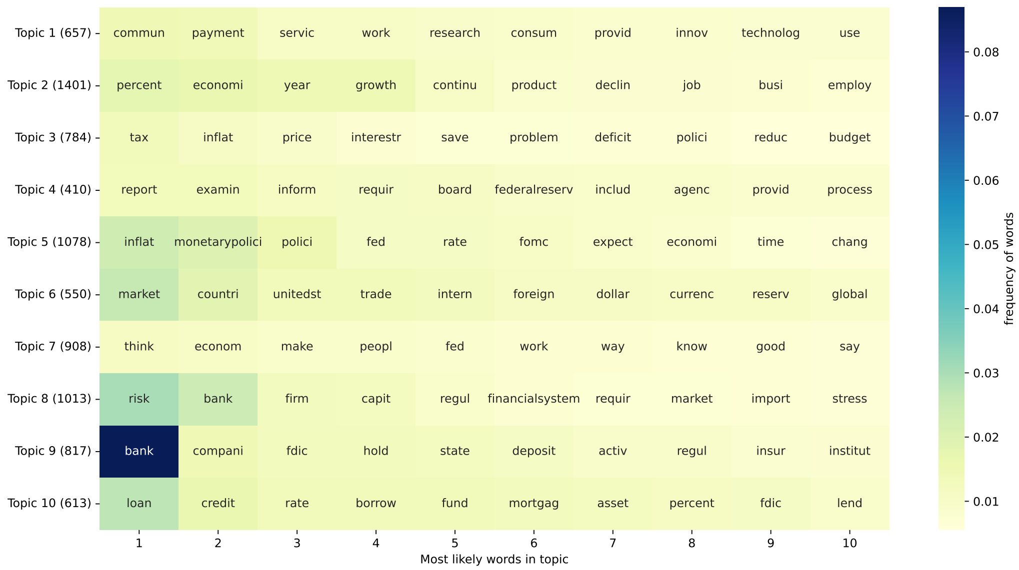
by Thomas Drechsel and Ko Miura

Contents

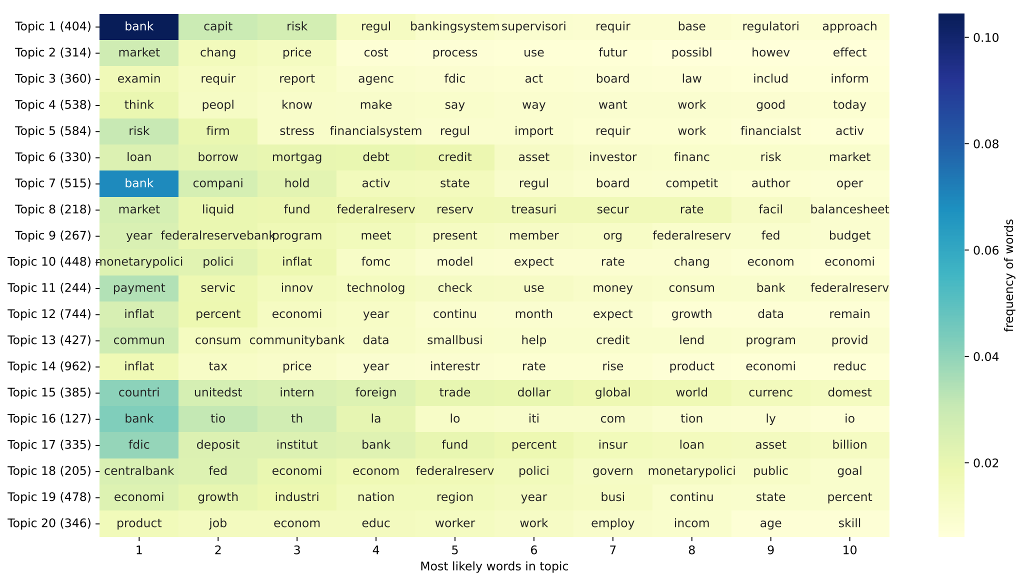
A Alternative number of topics in NLP step

Figure A.1: Topics and associated words in Fed speeches – alternative number of topics

(a) Number of topics is $K = 10$



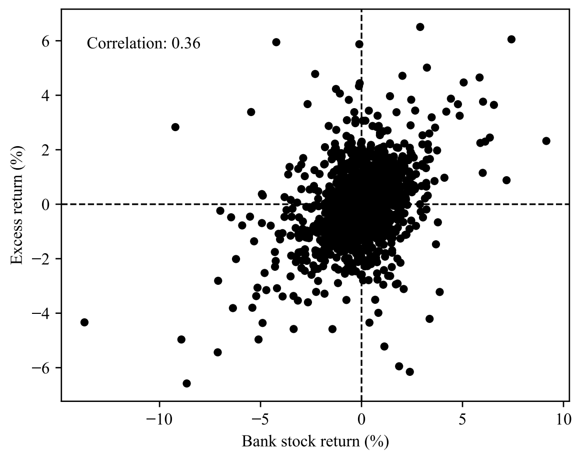
(b) Number of topics is $K = 20$



Notes: The two panels of this figure repeat Figure 1 from the main text, for alternative choices of the number of topics in the LDS algorithm of Hansen, McMahon, and Prat (2018).

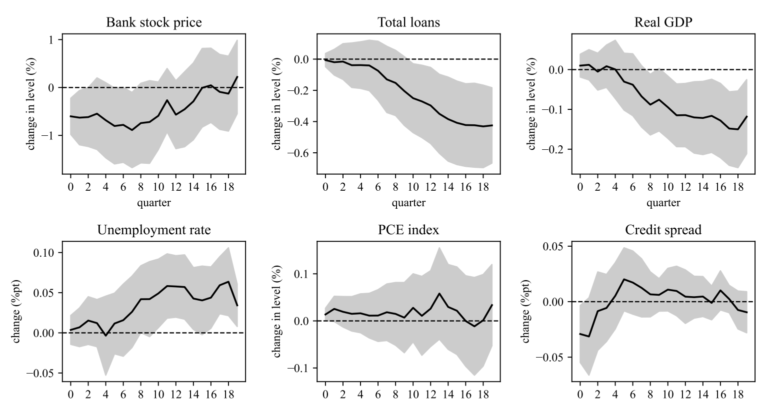
B Relation of returns vs. excess returns

Figure B.1: Bank stock returns vs. excess returns of bank stocks over stock market (NASDAQ)



Notes: Comparison between daily bank stock price index surprises and daily bank stock price index surprises when the surprise in the NASDAQ index is subtracted.

Figure B.2: IRFs to raw surprises based on excess bank stock returns



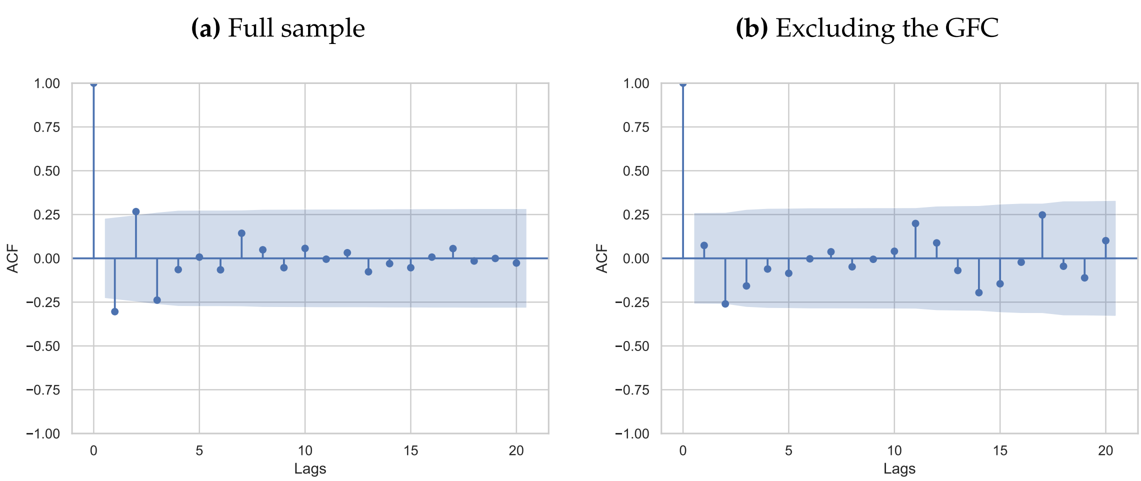
Notes: This figure repeats Panel (a) of Figure 3, but is based on surprises that subtract the change in the NASDAQ stock price index from the bank stock price index.

C Statistical properties of the shocks

To validate that our bank regulation news shocks have the statistical properties of structural shocks, we assess their autocorrelation (Figure C.1), their predictability with macroeconomic data (Table C.1), and their correlation with estimates of other types of macroeconomic shocks from the literature (Table C.2).

We find slight autocorrelation in the shocks, and some limited predictability with macro data. When we exclude the GFC from the sample, the shocks are cleanly iid across time and entirely unpredictable. This motivates us to also study the effects of the shocks without the GFC. Even including the GFC, our shocks are uncorrelated with measures of monetary policy, fiscal policy, oil supply news and uncertainty shocks.

Figure C.1: Autocorrelation of sign-restriction based bank regulation news shocks



Notes: Panel (a) is based on the full sample for the sign-restriction based shocks, 2005:Q4-2023:Q4. Panel (b) restricts the sample to start in 2010:Q1. The shaded areas represent 95% confidence bands.

Table C.1: Granger causality tests: p-values

Variable	Full sample	After GFC
Auto lag	0.971	0.882
Bank stock price	0.354	0.610
Stock price	0.131	0.137
Total loans	0.257	0.994
Business loans	0.735	0.990
Real GDP	0.840	0.438
Unemployment rate	0.932	0.730
PCE index	0.035	0.496
Federal funds rate	0.300	0.337
Credit spread	0.105	0.508
Bank CDS	0.045	0.788
Joint	0.000	0.386

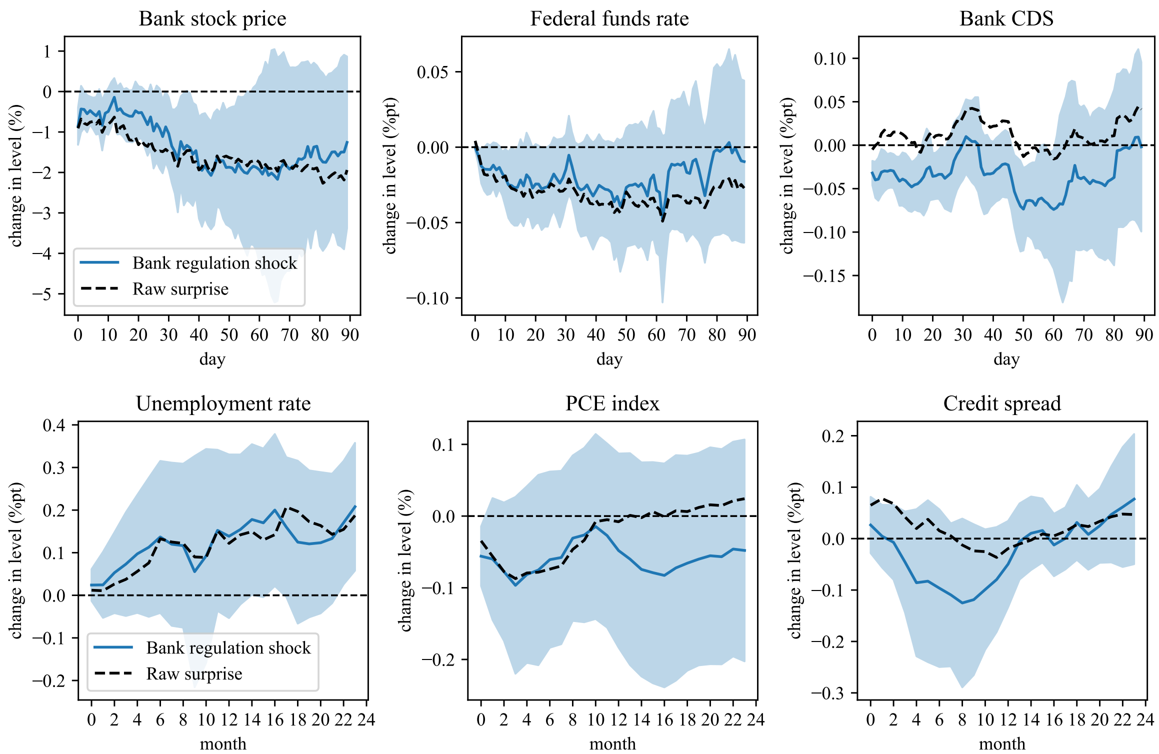
Notes: Granger causality tests, as described in the Online Appendix of Känzig (2021). We estimate a 4-quarter reduced form VAR with the bank regulation news shock as well as the above macro variables included. We then test the joint significance in the equation that has the shock series on the left hand side, for each variable (and its lags) individually, and then for all variables.

Table C.2: Correlation with other shock measures from the literature

Shock type	Correlation	p-value	Sample
Monetary (Bauer-Swanson, 2023)	0.037	0.582	2005M11-2023M12
Uncertainty (Bloom, 2009)	-0.055	0.420	2005M11-2023M12
Oil supply news (Känzig, 2021)	0.109	0.108	2005M11-2023M12
Fiscal (Ramey-Zubairy, 2014)	0.126	0.434	2005Q4-2015Q4

D Outcome variables at daily and monthly frequency

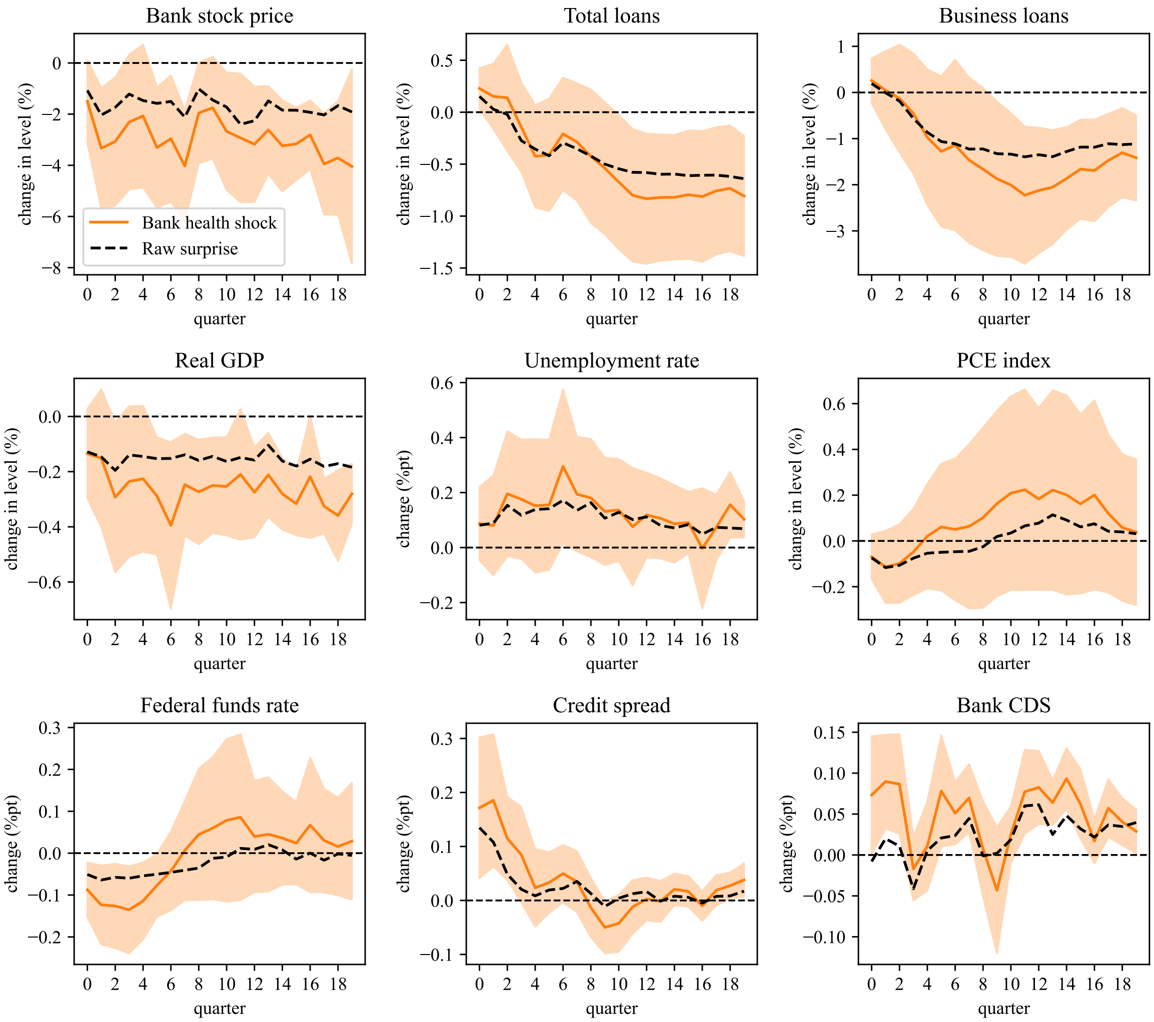
Figure D.1: IRFs to bank regulation news shock identified with sign restrictions, higher frequency



Notes: This figure shows IRFs at daily and monthly frequency. We construct these IRFs for those variables of Figure 6 for which higher frequency data is available.

E Analysis of bank health shocks

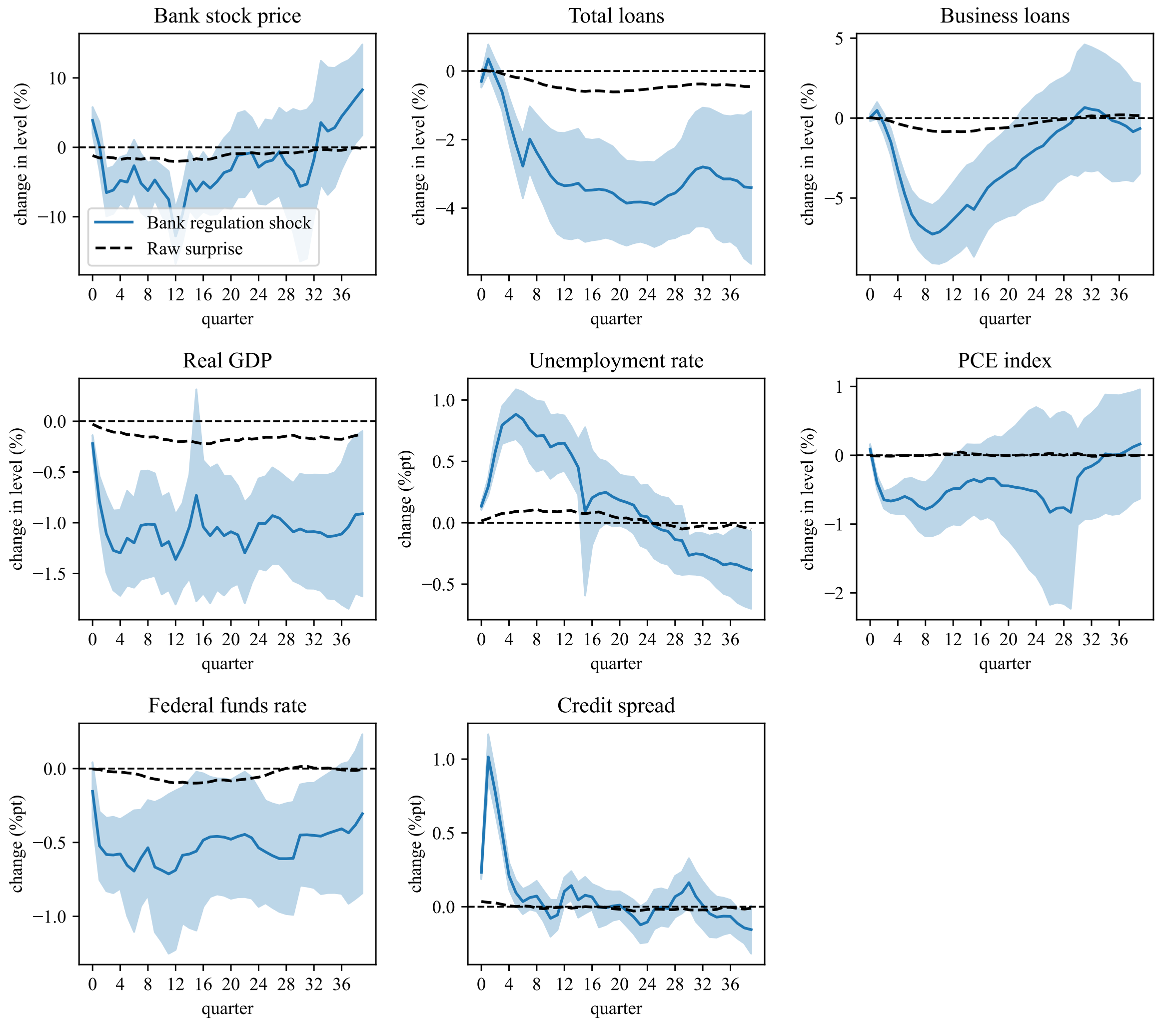
Figure E.1: IRFs to bank health (instead of bank regulation) news shock



Notes: IRFs estimated with the local projection (3). The solid lines correspond to the bank health news shock (instead of the bank regulation news shock shown in the main text), identified by the sign restrictions in Table 2. The shocks are normalized as 1% decline in bank stock prices at high frequency (which can differ from the quarterly impact). Error bands represent 90% confidence interval, based on HAC standard errors. The dashed black lines superimpose, for comparison, the responses associated with a raw surprise (see Figure 3). Sample period: 2005Q4–2023Q4.

F Longer-horizon responses

Figure F.1: IRFs to bank regulation news shock at long horizons

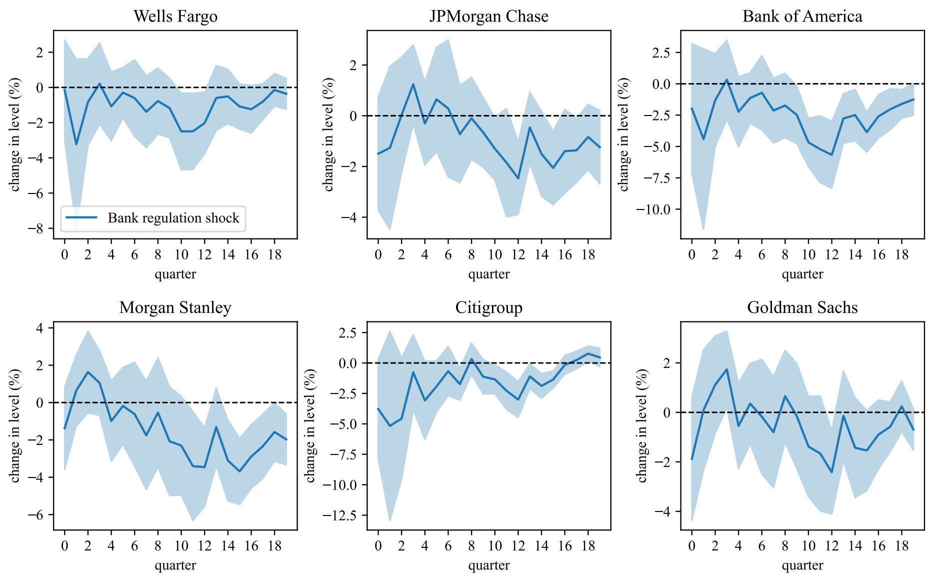


Notes: This figure repeats Figure 8 from the main text but estimates the IRFs at a 40-quarter instead of a 20-quarter horizon.

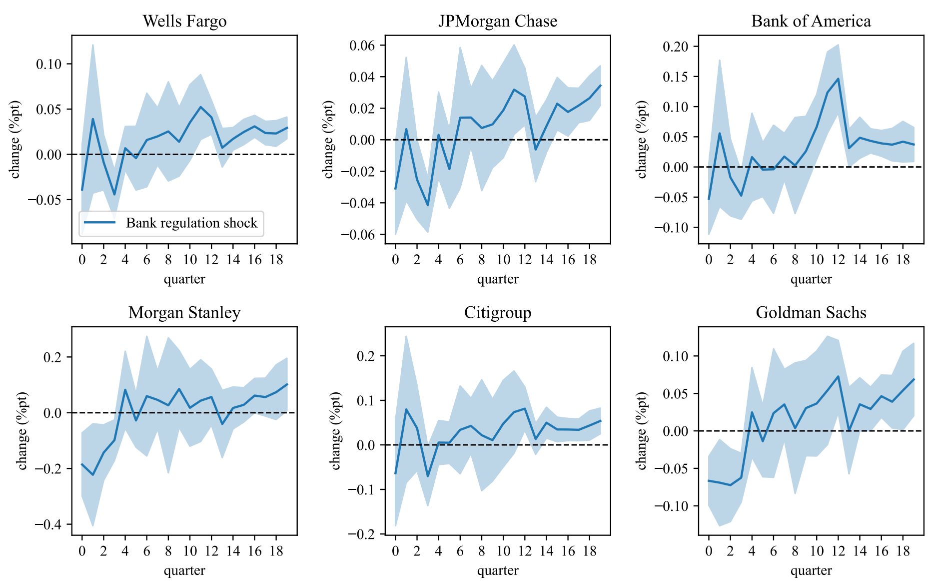
G Responses of individual banks

Figure G.1: Impulse response functions for individual banks

(a) Stock prices



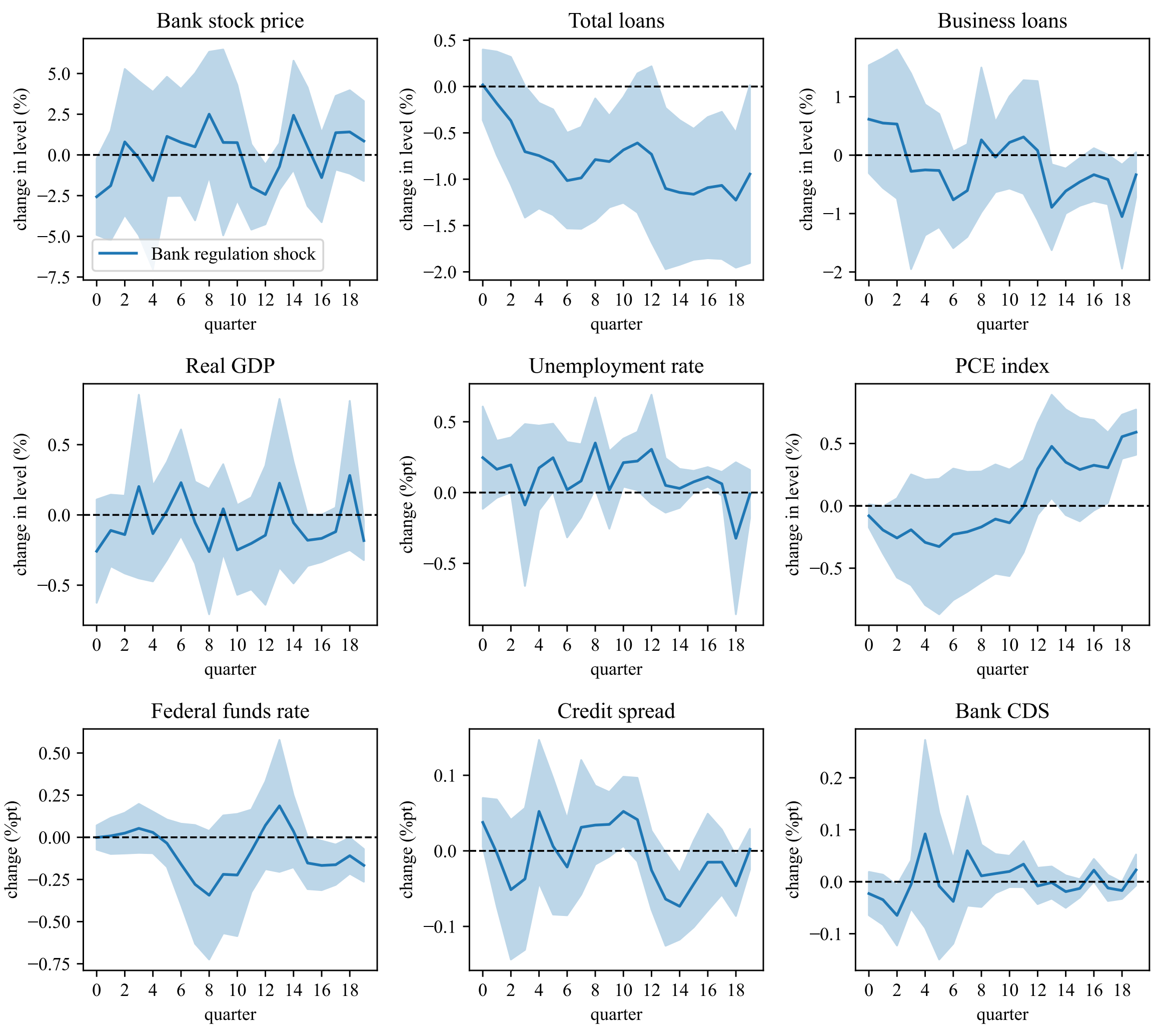
(b) CDS premiums



Notes: Based on intraday version (2005Q4-2023Q4). These 6 banks are the ones we use to calculate the average CDS premium.

H Excluding the GFC

Figure H.1: IRFs to bank regulation news shock identified with sign restrictions, excluding GFC

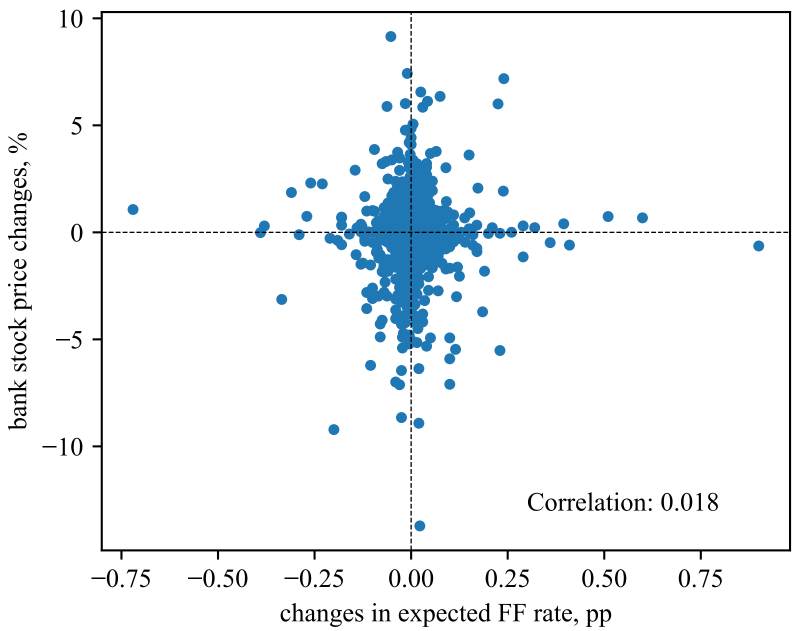


Notes: This figure constructs the IRFs shown in Figure 6 for an alternative sample starting in 2010:Q1.

I Bank regulation and monetary policy surprises

Figure I.1 plots the changes in bank stock prices on the days of bank-related speeches against changes in the federal funds rate futures. The correlation coefficient is 0.018. The low correlation suggests that even if Fed speeches on bank regulation might reveal some information about policy, the relationship does not seem to be systematic. These results are also in line with the lack of correlation between our shock and measures of other types of macroeconomic shocks studied in the literature (see Table C.2).

Figure I.1: Bank regulation surprises and monetary policy surprises



Notes: This figure plots the changes in bank stock prices and expected federal funds rate at the dates of bank-related speeches. The changes in expected federal funds rate are measured with the daily change in 3-month Eurodollar futures. Sample period: Apr 1986 to Dec 2023.