Financial Regulation Policy Uncertainty and Credit Spreads in the U.S.*

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June 2013

Abstract

This paper quantifies the macroeconomic effects of surprise movements in uncertainty about financial regulation policies in the U.S. economy. Within the context of a Structural VAR model, exogenous variations in uncertainty lead to a widening in corporate credit spreads, triggering flight-to-quality and flight-to-liquidity episodes. The underlying shock induces a strong and persistent reduction of industrial production, raises unemployment and lowers inflation, acting as a negative aggregate demand shock. A forecast error variance decomposition and robustness tests support these findings.

JEL classification: C32, E32, E44, E61.

Keywords: Economic policy uncertainty, financial regulation, credit spreads, Vector-AutoRegressions

*I would like to thank Efrem Castelnuovo for his valuable help. I am also grateful to Giovanni Caggiano, Valentina Colombo, Allin Cottrell, Riccardo Lucchetti, Stefan Notz, Peter Reusens, Peter Rosenkranz, Sven Schreiber, and participants to the XVIII Spring Metting of Young Economists (Aarhus, Denmark) for their useful feedbacks. Further, I thank Scott Baker for kindly providing the data on specific policy-related uncertainty. All errors and omissions are my responsibility.

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1 Introduction

The U.S. financial regulation system has come under criticism in the aftermath of the financial crisis of 2007-2009. Policymakers have engaged in a variety of reforms in response to the crisis, but the level of uncertainty surrounding the future financial regulatory framework is still high. A clear warning has recently been launched by the IMF Managing Director, Christine Lagarde, who stated:

> *"[...] That is the first imperative I just mentioned, which is to follow through on the policies in order to eliminate the uncertainty. The second point, which is in our [IMF] view critical, because it has been at the heart of the latest development of the crisis, is to finish the reform of the financial sector. We recognize that there has been progress, but the process has been very time consuming, and continues to contribute to uncertainty."* (IMF New Year Press Briefing. January 17th, 2013)

Regulatory reforms play an important role in re-establishing trust in the financial system. They directly influence the ways markets operate by introducing new rules and procedures that govern the financial sector. On the other hand, undesirable effects can arise when the policymaking process is surrounded by uncertainty.

This paper quantifies the impact of financial regulation policy uncertainty shocks on the macroeconomy within the context of a Structural VAR model. The empirical counterpart of uncertainty is the financial regulation policy uncertainty index, recently developed by Baker, Bloom and Davis (2013). Such index proxies the *perceived financial regulation policy-related macroeconomic uncertainty* in the U.S. economy.

I focus on the implications of financial regulation policy uncertainty shocks on credit spreads and economic activity. There is little doubt that disturbances hitting the financial system may hamper the real economy, specially during economic recoveries. After having experienced deep economic downturns, firms usually require greater access to credit markets to fund ongoing business operations. In this regard, many of the reforms underway in the U.S. financial system are intended to restore appropriate levels of credit growth in order to support the recovery. However, if these reforms are not accompanied by a decisive economic policy management in their implementation, an opposite effect may emerge, i.e., uncertainty about the future norms regulating financial institutions can increase the risk associated with lending activities, therefore raising the borrowing costs of capital and depressing investment and real activity. Indeed, this study also sheds light on the role of financial regulation uncertainty in driving some key macroeconomic variables, namely industrial production, unemployment, inflation and policy rate.

The baseline results show that financial regulation policy uncertainty shocks lead to detrimental effects on the economy. Conditional on the SVAR model, an innovation in financial regulation policy uncertainty of one standard deviation raises credit spreads, as measured by the Baa-Aaa benchmark indicator, by about 7 basis points. Although the size of this effect may not seem particularly big, two considerations are in order. First, innovations of the financial regulation policy uncertainty index of magnitude similar to the increases occurred during the recent financial crisis are estimated to raise credit spreads three times more. Second, by examining the implications of the shock conditional on the information contained in the current level of credit spreads, an unanticipated increase in financial regulation policy uncertainty has a notably less adverse effect on the real economy. This evidence suggests that financial frictions may be an important part of the transmission mechanism of financial regulation policy uncertainty shocks.

Further, the impulse response functions document a strong and persistent reduction of economic activity. One year after the shock, the level of industrial production is about 6 percent below its trend. Prices are estimated to fall by more than 1 percent, while the unemployment rate shows an increase of 0.15 percent. Consistently, policymakers react to these adverse economic developments by easing monetary policy. These dynamics demonstrate that policy-specific uncertainty shocks concerning regulation in the financial sector act as negative aggregate demand shocks.

A variance decomposition analysis indicates that the financial regulation policy uncertainty shock importantly contributes to the dynamics of credit spreads. In the baseline model, the shock accounts for about 18 percent of the forecast error variance of the Baa-Aaa spread up to five years. In contrast, a monetary policy shock explains less than 7 percent within the same forecast horizon. Moreover, the uncertainty shock is estimated to be responsible of an important share of the variance of the unemployment rate, i.e., innovations in financial regulation policy uncertainty explain more than 25 percent of the unemployment's forecast error variance at a 12 month forecast horizon.

To gain a better understanding of the effects triggered by financial regulation policy uncertainty on credit spreads, I consider alternative spread measures. These are the Aaa- and Baa-10 Year Treasury bond spreads (referred to as Aaa-GS10 and Baa-GS10, respectively), and the GZ spread, recently developed by Gilchrist and Zakrajšek (2012). All the three positively react to uncertainty innovations. In particular, the observed widening in the Baa-GS10 suggests *flight to quality* as well as *flight to liquidity* effects caused by financial regulation uncertainty shocks. The evidence for flight to liquidity is reinforced by the increase in the Aaa-GS10, as this indicator is considered as a proxy for liquidity premium in the corporate bond pricing literature. The GZ spread positively reacts to the shock as well, confirming my baseline findings. I then separately examine the reaction of the two distinct components of the GZ spread, i.e., the predicted component and the excess bond premium. As one would expect, the underlying shock causes persistent increases in the expected default risk component of credit spreads, while the positive reaction of the excess bond premium is weaker and short-lived.

Finally, a sensitivity analysis is performed. The robustness checks undertaken allow to account for the potential presence of anticipated effects in the identification of the structural shock, as well as potential omitted variables. Overall, the estimated effects of financial regulation policy uncertainty shocks do not diverge substantially across the alternative VAR specifications.

From a theoretical perspective, uncertainty effects may be transmitted to the real economy through different channels. The traditional one is highlighted within the framework of irreversible investment, where there are real options effects at play. As explained by Bloom (2009), uncertain times increase the option value of waiting for new information, causing investment as well as consumption on durable expenditures to freeze. However, once the level of uncertainty decreases, aggregate demand is unleashed. Accordingly, temporary uncertainty shocks are found to generate a rapid drop, rebound and overshoot in output. These dynamics following the shock have been dubbed in the literature as the "wait and see" effect.

An additional mechanism by which uncertainty may interact with the business cycle is given by financial frictions. Under imperfect capital markets, a shock to uncertainty may cause an actual or perceived increase in the riskiness of firms, which raises the expected probability of default and consequently makes outside borrowing more costly. This paper provides evidence in favor of this mechanism.

As documented by the results, financial regulation policy uncertainty shocks induce persistent effects on the real economy, underlying the role of frictional elements. This evidence does not supplant other channels by which policy uncertainty affects the real economy, but rather is an implication of financial regulation policy uncertainty that, to my knowledge, has not been addressed in the literature.

This work is related to a number of contributions documenting the interaction between uncertainty and macroeconomic dynamics. Bloom et al. (2013) offer a recent survey on this literature. Studies using VAR models to provide empirical evidence about uncertainty shocks on the real economy include Bloom (2009), Baker, Bloom and Davis (2013), Bachmann, Elstner and Sims (2013), Leduc and Liu (2013), Caggiano, Castelnuovo and Groshenny (2013), Jurado, Ludvigson and Ng (2013), Colombo (2013), Kamber, Karagedikli, Ryan and Vehbi (2013). A general consensus is that high uncertainty has depressing effects on output, investment and employment. Moreover, some of these studies find uncertainty shocks to act as demand shocks (Leduc and Liu 2013, Caggiano et al. 2013, Colombo 2013 and Kamber et al. 2013) which increase unemployment while inflation falls. My results offer support to this prediction.

The paper most closely related to my study is Gilchrist, Sim and Zakrajšek (2013), who find that unanticipated increases in uncertainty lead to a significant widening of corporate credit spreads. However, my analysis differs from them as I focus on uncertainty about financial regulation policies instead of idiosyncratic uncertainty based on stock market data. The links between financial markets and economic policy uncertainty are also investigated by Pástor and Veronesi (2012), Brogaard and Detzel (2012), Antonakakis, Chatziantoniou, and Filis (2012) and Sum (2012). These works, however, largely concentrate on uncertainty-stock market interactions. For instance, Pástor and Veronesi (2012), in a general equilibrium model, analyze how changes in government policy affect stock prices. Their results point to a fall in prices, and an increase in volatilities and correlations, at the announcement of a policy change. Finally, a number of additional recent contributions study the macroeconomic effects of policy-specific uncertainty (e.g., Bauer 2012, Born and Pfeifer 2012, Fernández-Villaverde, Guerrón-Quintana, Kuester, Rubio-Ramírez 2012). These studies use a variety of methodological approaches and mainly concentrate on uncertainty regarding fiscal and monetary policies. This paper builds on and extends this literature by investigating the relationship between financial regulation policy uncertainty and credit spreads.

The remainder of the paper develops as follows. Section 2 illustrates the uncertainty surrounding the U.S. financial regulatory framework. Section 3 describes the SVAR model, whose estimation results are presented in section 4. A sensitivity analysis is conducted in section 5. A few concluding remarks appear in section 6.

2 Financial Regulation Uncertainty in the U.S.

Financial crises historically produce calls for tighter regulation on financial markets. During the Great Depression, President Roosevelt shut down the U.S. banking system by proclaiming a nationwide Bank Holiday. Banks closed for a week to "reorganize" the system of payments. At the time, the U.S. economy was experiencing a period of high chaos and uncertainty, due to economic depression accompanied by several banking failures. The Emergency Banking Act of 1933 restored public confidence by reassuring depositors about banks' solidity. According to Silber (2009), the Bank Holiday and the Emergency Banking Act of 1933 together demonstrate the power of credible regime-shifting policies. He also argues that the management of the banking crisis required the U.S. Government to take bold and decisive actions regarding the financial system.

Historical episodes like the Bank Holiday underlines the crucial relevance of timely policy decisions as well as timely policy announcements. But government actions in the financial regulatory framework have not always been so. High uncertainty related to financial regulation in the last few years may be attributed to the ongoing Wall Street reform, i.e., measures to address major topics like the too-big-too-fail moral hazard problem, over-the-counter derivatives, shadow banking regulation, and macroprudential policies. The main scope of these reforms is financial stability, which should help to support growth and restore confidence. However, implementation is being delayed, making it difficult to assess how the specifics of the new regulation system will play out, and contributing to increases in uncertainty.

2.1 The FRPU index

Baker, Bloom and Davis (2013) create an empirical proxy for the U.S. financial regulation uncertainty through an analysis of articles from the Newsbank Access

World News. The Newsbank database covers about 2,000 U.S. newspapers and therefore, as highlighted by Baker et al., allows to drill down in detail on individual policy areas. Specifically, the authors first construct an index measuring economic policy uncertainty, the "Newsbank" EPU index.[1] To this end, they perform monthly searches for news articles containing references to the economy, government policies and uncertainty. Thus, they select articles including an "economic" term and a "policy uncertainty" term. To deal with changing volumes of articles, the raw counts of the articles (in each newspaper) are divided by the total number of monthly news articles in the same newspapers. They then normalize each newspaper index to have a unit standard deviation over the period 1985-2010 and add up the indices for all papers. Next, Baker et al. develop sub-indices of uncertainty for different policy areas, which are strict subsets of the "Newsbank" EPU index containing category-specific terms (e.g., financial regulation, monetary and fiscal policies, health care, national security, regulation).

I focus on the Financial Regulation Policy Uncertainty index (henceforth referred to as FRPU index) by Baker, Bloom and Davis (2013) to assess the economic impact of innovations in financial regulation policy uncertainty. Although the FRPU index is a sub-category of the "Newsbank" EPU index, the correlation between the two is 0.62, meaning that the former contains specific information about financial regulation policy uncertainty. Another commonly used proxy for economic uncertainty is the Chicago Board Options Exchange Market Volatility Index (the VIX index).[2] The VIX index is an indicator representing implied volatility of S&P500 index options, and as so directly related to uncertainty in financial markets. However, I do not use this index as a proxy for financial regulation policy uncertainty because it moves for reasons beyond (perceived) changes in financial regulation. Indeed, the correlation between the FRPU index and the VIX is equal to 0.54.

Figure 1 plots the FRPU index. It shows the evolution of uncertainty associated with financial regulation policies in the U.S. economy since 1985. The variations of the index are substantial, and clearly capture noticeable financial-related events

[1] The "Newsbank" EPU index is developed by Baker et al. (2013) for the main purpose of creating sub-indices for *specific* policy areas. However, their primary measure for economic policy uncertainty is the EPU index, which relies on three components, i.e., a news-based component, tax code expiration data, and economic forecasters' disagreement about policy relevant variables.

[2] Studies using the VIX index include, for instance, Bloom (2009), Leduc and Liu (2013), Caggiano et al. (2013), Kamber et al. (2013).

of different extents. However, it is worth stressing that the FRPU index proxies *perceived* financial regulation policy uncertainty. Thus, it also shows peaks related to events which are not strictly associate with financial regulation, such as the 9/11 terrorist attack. Other considerable increases of the index are observed in correspondence of: the "Boesky Day" (November, 1986), which documents one of the largest insider trading scandals and is considered a defining moment in the history of federal securities law enforcement; the "Friday the 13th minicrash", which refers to a stock market crash dated October, 1989; the WorldCom's collapse in July, 2002, the Black Monday, the Japanese Asset Price and the Dot.com bubbles, and more recently the Great Recession.

3 Empirical Analysis

3.1 Preliminary Evidence

Figure 2 plots the FRPU index along with the corporate yield spread between Baa- and Aaa-rated bonds. The picture points to a positive relationship between financial regulation uncertainty and credit spread dynamics. Their correlation is equal to 0.55. Looking at the period from 1985 to 2012, increases in the Baa-Aaa spread are sometimes preceded by increases in the FRPU index. As for this point, table 1 displays the results from Granger-causality tests considering different lag lengths. The null hypothesis that financial regulation uncertainty does not Granger-cause the Baa-Aaa spread is always rejected for lags ranging from 1 to 12. Differently, the Baa-Aaa credit spread is not found to Granger-cause financial regulation uncertainty for lags ranging from 4 to 7 (at a 95% confidence level). Therefore, this exercise provides some evidence in favor of unidirectional Granger-causality from financial regulation uncertainty to credit spreads. Next, I analyze this relationship within a SVAR model.

3.2 The SVAR model

I work with the following Structural-VAR model:

$$B_0 \boldsymbol{x}_t = \sum_{i=1}^{p} B_i \boldsymbol{x}_{t-i} + \boldsymbol{\varepsilon}_t \tag{1}$$

The model is estimated by using U.S. monthly data spanning the period 1985:1 – 2012:10. The choice of the sample is due to the availability of the uncertainty indicator by Baker *et al.* (2013). I model the vector $\boldsymbol{x}_t = [frpu_t, \Delta y_t, \pi_t, u_t, i_t, s_t]'$, where $frpu_t$ is the financial regulation policy uncertainty index, Δy_t denotes the annualized monthly log-difference of real industrial production, π_t stands for the annualized monthly CPI inflation rate, u_t represents the total civilian unemployment rate, i_t is the nominal effective federal funds rate, and s_t is the difference between the Moody's Baa and Aaa corporate bond yields.[3] The Baa-Aaa spread is a widely used aggregate credit spread indicator in the corporate bond pricing literature.[4] Apart from the FRPU index, the source of these data is the Federal Reserve Bank of St. Louis' database.

The reduced-form model specification includes a constant and six lags, which ensure no serial correlation in the error terms. The identification of the financial regulation policy uncertainty shock is achieved by appealing to exclusion restrictions on the instantaneous feedback from the shock to macroeconomic aggregates, i.e., the standard Cholesky approach. Thus, a recursive structure is assumed, with the ordering being the one indicated above. By placing the uncertainty measure first, I assume that financial regulation policy uncertainty responds with a lag to changes in the remaining variables,[5] a very common restriction in the literature.[6] One potential weakness related to this ordering may be that it does not allow for uncertainty to contemporaneously react to macroeconomic shocks. Section 5 presents a robustness check in which the FRPU index is ordered last and suggests that results do not diverge substantially.

[3] The results are robust to the employment of yearly-on-yearly industrial production and CPI growth rates as well as in levels (results available upon request).

[4] Chen, Collin-Dufresne and Goldstein (2009) argue that the Baa-Aaa spread is a credit risk measure which is largely unaffected by bond market frictions, such as taxes and liquidity. Moreover, empirical studies have documented its predictive power for economic activity.

[5] Notice that the ordering following the FRPU index is irrelevant since it is the only variable whose innovations I want to study.

[6] See e.g., Alexopoulos and Cohen (2009), Bachmann et al. (2013), Baker et al. (2013), Bloom (2009), Caggiano et al. (2013), Jurado et al. (2013).

4 Estimation Results

Figure 3 reports the impulse response functions following a one standard deviation shock to financial regulation policy uncertainty. For each variable in the VAR, the gray area represents the range of the 90 percent confidence band around the point estimates, calculated via Kilian's (1998) bias-corrected bootstrap-after-bootstrap procedure.

An unanticipated increase in financial regulation uncertainty causes a significant and persistent increase in the Baa-Aaa spread, which reaches a peak near to 7 basis points after three months. This result indicates that specific-policy uncertainty triggers credit spread dynamics. Although the magnitude of the response is relatively low, one should consider the extent of the observed variation in financial regulation uncertainty. A one standard deviation shock amounts to 90 points, while, for instance, the index has increased by 280 points from the end of 2007 to the end of 2008. Such a shock would cause credit spreads to raise by more than 20 basis points according the SVAR estimates. Gilchrist, Sim and Zakrajšek (2013), in their VAR exercise, find a similar increase in the 10-year BBB-Treasury spread following a shock to uncertainty, proxied by the volatility of aggregate firm-level stock market returns.

Following the shock, economic activity significantly declines. The level of industrial production bottoms out about 6 percentage points below trend roughly one year after the shock. This substantial decrease is very persistent, and there is no evidence of long-run overshooting effect. Persistent effects of uncertainty shocks on industrial production are also found by Bachmann, Elstner and Sims (2013), Baker, Bloom and Davis (2013), and Jurado, Ludvigson and Ng (2013). However, in my analysis the short-run response of industrial production is much larger, suggesting that financial regulation policy uncertainty shocks may have more severe economic consequences than shocks related to other sources of uncertainty. As evidenced by Bachmann et al. (2013), observed persistent effects may highlight the relevance of alternative channels, other than the "wait and see" mechanism, through which uncertainty shocks propagate. Indeed, including credit spreads in the SVAR model allows to shed some light on the financial frictions mechanism, which will be analyzed next.

The unemployment rate is estimated to increase by about 0.15 percentage points, and the reaction persists even after four years. Surprise increases in financial regulation uncertainty also induce a substantial disinflation over time, as evidenced by the cumulative decline in the inflation rate. Empirical evidence presented by Leduc and Liu (2013), and Caggiano, Castelnuovo and Groshenny (2013) shows that uncertainty shocks in the U.S. act as aggregate demand shocks, which raises unemployment and lowers inflation. These studies use respectively a survey-based measure and the VIX index as proxies for uncertainty. Colombo (2013) and Kamber et al. (2013) investigate international spillovers of uncertainty shocks originating in the U.S. and document macroeconomic dynamics consistent with those following demand shocks. On the other hand, Born and Pfeifer (2012) study policy risk and, as for uncertainty concerning fiscal policy, they find that shocks to capital tax risk feature the characteristics of a positive demand shock, while increases in labor tax risk induces the same effects of a negative supply shock. Fernández et al. (2012) find fiscal volatility shocks to be "stagflationary", i.e., they create inflation while output falls. My results indicate that financial regulation uncertainty shocks act as negative demand shocks, confirming those of Leduc and Liu (2013), Caggiano et al. (2013), Colombo (2013) and Kamber et al. (2013).

To counteract these adverse economic developments, and in order to return inflation to its target, monetary policy is eased, as evidenced by the reduction in the overnight policy rate, i.e., the nominal federal funds rate decreases by 0.2 percentage points after fifteen months. Indeed, monetary policy in the U.S. is designed to promote the primary goals of maximum employment and stable prices.

4.1 Evidence for *flight to quality* and *flight to liquidity* effects

The Baa-Aaa spread is considered as a proxy for the default risk premium (see e.g., Friedman and Kuttner 1993, Güntay and Hackbarth 2010). Hence, the widening in the Baa-Aaa spread in the baseline model can be interpreted as the result of an increase in the expected probability of firms' default. Accordingly, exogenous variations in financial regulation uncertainty lead to a shift in preferences, causing investors, who fear rising risks in credit markets, to demand higher returns on risky assets and lower returns on safe ones. Such changes in preferences are usually referred to as *flight to quality* episodes. Flight to quality effects triggered by uncertainty about financial regulation, and not necessarily reflecting an actual deterioration in borrowers' balance sheets, can disrupt credit, implying that even firms featuring good fundamentals, as those who issue investment-grade bonds, may find it difficult to afford the costs related to external finance. Consequently, negative real effects on the economy may occur.

To provide a basis of comparison against the reaction of the Baa-Aaa spread, I estimate the responses of different credit spread measures, which are displayed in figure 4. These responses are obtained from separately estimating VAR(6) systems (as the baseline model), with the Baa-Aaa credit spread being in turn replaced by alternative indicators.

Differences in rates offered on corporate bonds and those offered on government bonds represent another proxy for credit spreads. In this regard, I use the Baa-GS10 spread and the Aaa-GS10 spread, i.e., respectively the difference between Baa- and Aaa-rated bond yields and the 10-year U.S. Treasury yield. As explained by Krishnamurthy and Vissing-Jorgensen (2011), the Baa-GS10 spread reflects both a liquidity premium and a safety premium. On the other hand, the Aaa-GS10 is usually used as a proxy for liquidity premium only. The stronger reaction of the Baa-GS10 spread (about 12 basis points) relative to that of the Aaa-GS10 spread (about 7 basis points) gives additional support for potential flight to quality effects caused by surprising movements in financial regulation uncertainty.

Yet, the positive reaction of the Aaa-GS10 spread somehow suggests that financial regulation uncertainty shocks induce *flight to liquidity* episodes as well. Indeed, Treasury bonds are more liquid investments than corporate bonds. In particular, Chen, Collin-Dufresne and Goldstein (2009) show that the time variation of the Aaa-GS10 spread is mostly due to factors independent of credit risk, while Hakkio and Keeton (2009) argue that a widening in the Aaa-GS10 spread captures decreased willingness to hold illiquid assets, and use this spread to construct the Kansas City Financial Stress Index (KCFSI).

The finding that financial regulation uncertainty shocks increase the expected probability of default, raising thus the cost of credit, is further confirmed by the GZ credit spread, recently elaborated by Gilchrist and Zakrajšek (2012). The GZ spread is a micro-founded spread indicator, which relies on extensive micro-level data on bonds issued by U.S. non financial corporations. The aggregate index has been obtained by computing the arithmetic average of estimated individual credit spreads, reflecting the yield difference between a single corporate bond and the corresponding risk-free security.[7] Moreover, the authors, motivated by the *credit spread puzzle*,[8] also decompose the GZ spread into two components: one capturing systematic changes in default risk, i.e., the *predicted* part of the spread, and a residual component representing a risk premium above and beyond expected losses, i.e., the *excess bond premium*. I analyze the reaction of the overall GZ spread, as well as of each of its two components separately, to a surprise increase in the FRPU index.[9]

Similar to the Baa-GS10 spread, the overall GZ spread increases by 14 basis points, as reported in figure 4. By comparing the reaction of the excess bond premium to that of the predicted part of the GZ spread, it is clear that the underlying shock causes changes in the expected default risk, rather than moving the unexplained part of the spread. Thus, despite the impossibility to draw firm conclusions about the transmission mechanism through which financial regulation uncertainty shocks propagate to the real economy, the evidence presented above underlines the relevance of credit conditions, and so the importance of financial market frictions while analyzing uncertainty shocks.

4.2 Variance Decomposition Analysis

Table 2 reports the forecast error variance decomposition, over different forecast horizons, of the variables included in the baseline VAR. Financial regulation uncertainty shocks account for about 18% of the forecast error variance in the Baa-Aaa spread. By comparing this percentage to those explained by the other shocks modeled within the VAR, innovations in financial regulation uncertainty are estimated to be quantitatively relevant for movements in the spread. Moreover, they explain relative valuable shares of variations in the unemployment and the federal funds rate, respectively more than 25% and 16%. The magnitudes of the variation in the unemployment accounted for by the FRPU index innovations are similar to those

[7] The risk-free security is a hypothetical Treasury bond with exactly the same cash flows as the underlying corporate bond.

[8] Theoretically, the default risk is the main determinant of credit spreads from a no-arbitrage standpoint (see, among others, Black and Scholes 1973 and Merton 1974). However, expected losses in the event of default can account for only a small portion of observed spreads (Elton et al. 2001). This stylized fact has been dubbed in the literature as the *credit spread puzzle*.

[9] Due to data availability, the VAR models including the GZ spread and its components are estimated over the period from 1985:1 to 2010:9, while the remaining estimations follow the baseline sample period.

reported by Alexopoulos and Cohen (2009), using a newspaper based indicator of general economic uncertainty, and by Caggiano et al. (2013), conditional on their linear VAR model.

Additionally, table 3 further underlines the contribution of financial regulation uncertainty shocks for the dynamics of credit spreads. It shows that also for the alternative measures so far considered, these shocks are responsible of important shares of the total variance decomposition. For example, at a twelve month horizon, uncertainty picks up about 10, 17 and 13% of the variation in the GZ spread, the Baa-GS10, and the Aaa-GS10, respectively. On the other hand, monetary policy shocks, for instance, account for much smaller fractions. Exogenous variations in the federal funds rate explain just 2, 4, 5% of the above spread indicators at the same forecast horizon.

5 Sensitivity analysis

My baseline findings suggest flight to quality effects triggered by financial regulation uncertainty shocks. As discussed in Tang and Yan (2010), investors' sentiment is one possible proxy for observed changes in preferences. Thus, it may be that surprise movements in financial regulation uncertainty reflect confidence shocks. I address this issue by augmenting the baseline VAR with the Consumer Confidence Index (placed on top of the system), which is based on information collected via the Michigan Survey of Consumers.[10] Remarkably, this measure also allows to account for potential anticipated effects not captured by the baseline VAR system, i.e., available information about future economic developments may induce forward-looking agents to react to anticipated changes in exogenous fundamentals, usually before such changes materialize, leading to a not fully exogenous variation in the uncertainty related to financial regulation.

Next, I check whether the impact of financial regulation uncertainty shocks on credit spreads is only due to the correlation of the FRPU index with aggregate market volatility risk, with the latter being proxied by the VIX index.[11] Moreover, I also include in the VAR system, enriched with the VIX, the S&P500 index. Taking into

[10] The Consumer Confidence Index consists of an average of responses to different questions concerning the future evolution of the business cycle. For further details, see www.sca.isr.umich.edu/main.php

[11] The VIX index is a widely used proxy for volatility risk. See, e.g., Ang et al. (2006).

account stock-market levels allows to control for the impact of first-moment shocks, i.e., variations in uncertainty may confound variations in the level of the stock market index (see e.g., Bloom 2009 and Caggiano et al. 2013). Following these studies, the log of the S&P500 index is HP detrended to capture its cyclical component.[12] Therefore, I model the vector $\boldsymbol{x}_t^{s\&p} = [sp_t, vix_t, frpu_t, \Delta y_t, \pi_t, u_t, i_t, s_t]'$.

Another concern could be that the FRPU index is capturing general economic policy uncertainty. To deal with this issue, I estimate a VAR augmented with two additional indices by Baker et al. (2013), the Newsbank EPU and another sub-index capturing uncertainty about general regulation policies. The correlation between the FRPU and the regulation index is 0.74. I place the Newsbank EPU and the regulation uncertainty indices before the FRPU index in the Cholesky ordering, such that movements in the latter are already purged from uncertainty not related to the financial system.

The final robustness exercises I undertake consist in variations of the number of lags, a sub-sample analysis, and an alternative Cholesky ordering. Although the number of lags has been selected such that residual serial correlation is eliminated from the baseline model, I control whether the results are robust to varying lag lengths. The commonly applied lag length selection criteria, i.e., Akaike, Schwarz and Hannan-Quinn, suggest the use of two lags. Consider the monthly nature of the data, I estimate the baseline VAR respectively with 2 and 12 lags. Moreover, the baseline VAR is estimated over a sample spanning the period from 1985:1 to 2012:10. I rerun the model over the sub-sample 1985:1-2008:6. This time period excludes from the sample the acceleration of the financial crisis, which began with the bankruptcy of Lehman Brothers in September 2008. Finally, to account for the potential criticism to the Cholesky approach, I then consider a VAR specification that changes the causal ordering, where the FRUP index is placed last.

Figure 5 shows the results of all these robustness checks. The impulse responses following a one standard deviation shock to the FRPU index are qualitatively similar. Conditional on the sub-sample analysis, the magnitude of the reactions for all variables is lower than otherwise. This indicates that periods of crises contain much more information on uncertainty than "normal times" (see e.g., Jurado et al. 2013 and Caggiano et al. 2013). Moreover, under the alternative Cholesky scheme in which credit spreads are ordered before uncertainty, financial regulation uncertainty

[12] The results, however, are robust even using the level of the S&P500 index.

shocks have a significantly attenuated impact on the real economy. This finding, in line with those of Gilchrist et al. (2013), provides additional support for the relevant role played by credit spreads in the transmission of the underlying shock.

6 Conclusion

This paper analyzes the macroeconomic effects of uncertainty surrounding government actions in the financial regulation system. Particular attention is given to its impact on U.S. corporate credit spreads. In a SVAR model, financial regulation uncertainty shocks, as proxied by exogenous variations in the FRPU index recently developed by Baker, Bloom, and Davis (2013), raise the cost of external finance by increasing the expected probability of firms' default. Specifically, the estimated impulse response functions document robust evidence that a surprise movement in financial regulation-related uncertainty induces flight to quality as well as flight to liquidity effects.

On the real side of the economy, the underlying shocks are shown to have a negative impact on economic activity. Importantly, the strong and persistent reduction of industrial production following the shock suggests that the effects of uncertainty related to financial regulation might be more damaging than the effects of uncertainty concerning other sources. The results also document an increase in the unemployment rate and a fall in prices. These findings support previous evidence provided by Leduc and Liu (2013), among others, showing that uncertainty shocks act as negative aggregate demand shocks.

From a theoretical point of view, this work provides additional empirical support for financial frictions as a channel through which uncertainty shocks propagate to the real economy (Gilchrist et al., 2013). From a policy perspective, while the need for financial reforms is not object of discussion here, further attention should be given to their design, specially in terms of policy management credibility. Temporary lack of transparency in economic policy design is not beneficial for the economy as a whole. As highlighted by Bloom (2009), there may be a potential trade-off between policy "correctness" and "decisiveness". It may very well be desirable for governments to act decisively, but occasionally incorrectly, rather than being deliberately ambiguous on policies which many economic agents depend on for purposeful investment and consumption decisions.

References

Alexopoulos, M., and J. Cohen (2009): "Uncertain Times, Uncertain Measures," Meeting Papers 1211, Society for Economic Dynamics.

Ang, A., R. Hodrick, Y. Xing, and X. Zhang (2006): "The Cross-Section of Volatility and Expected Returns," *The Journal of Finance*, 61(1), 259–299.

Antonakakis, N., I. Chatziantoniou, and G. Filis (2012): "Dynamic Co-movements between Stock Market Returns and Policy Uncertainty," Munich Personal RePEc Archive.

Bachmann, R., S. Elstner, and E. Sims (2013): "Uncertainty and Economic Activity: Evidence from Business Survey Data," *American Economic Journal: Macroeconomics*, 5(2), 217–249.

Bachmann, R., and E. Sims (2012): "Confidence and the Transmission of Government Spending Shocks," *Journal of Monetary Economics*, 59(3), 235–249.

Baker, S., N. Bloom, and S. Davis (2013): "Measuring Economic Policy Uncertainty," Stanford University, mimeo.

Bauer, M. (2012): "Monetary Policy and Interest Rate Uncertainty," *FRBSF Economic Letter*, 2012-38 (December, 24).

Beetsma, R., and M. Giuliodori (2012): "The Changing Macroeconomic Response to Stock Market Volatility Shocks," *Journal of Macroeconomics*, 34, 281–293.

Bernanke, B. (1983): "Irreversibility, Uncertainty and Cyclical Investment," *Quarterly Journal of Economics*, 98, 85–106.

Black, F., and M. Scholes (1973): "The Pricing of Options and Corporate Liabilities," *The Journal of Political Economy*, 81(3), 637–654.

Bloom, N. (2009): "The Impact of Uncertainty Shocks," *Econometrica*, 77(3), 623–685.

Bloom, N., J. Fernández-Villaverde, and M. Schneider (2013): "The Macroeconomics of Time Varying Volatility and Uncertainty," *Journal of Economic Literature*, forthcoming.

Bloom, N., M. Floetotto, N. Jaimovich, I. Saporta-Eksten, and S. Terry (2012): "Really Uncertain Business Cycles," NBER Working Paper No. 18245.

Born, B., and J. Pfeifer (2012): "Policy Risk and the Business Cycle," University of Bonn, mimeo.

Brogaard, J., and A. Detzel (2012): "The Asset Pricing Implications of Government Economic Policy Uncertainty," University of Washington, mimeo.

Caggiano, G., E. Castelnuovo, and N. Groshenny (2013): "Uncertainty Shocks and Unemployment Dynamics: An Analysis of Post-WWII U.S. Recessions," University of Padova, mimeo.

Chen, L., P. Collin-Dufresne, and R. Goldstein (2009): "On the Relation between Credit Spread Puzzle and the Equity Premium Puzzle," *The Review of Financial Studies*, 22(9), 3367–3409.

COLOMBO, V. (2013): "Economic Policy Uncertainty in the US: Does it matter for the Euro Area?," University of Padova, Marco Fanno Working Paper N.160.

DUFFEE, G. (1998): "The Relation Between Treasury Yields and Corporate Bond Yield Spreads," *The Journal of Finance*, 53(6), 2225–2241.

ELTON, E., M. GRUBER, D. AGRAWAL, AND C. MANN (2001): "Explaining the Rate Spread on Corporate Bonds," *The Journal of Finance*, 56(1), 247–277.

FERNÁNDEZ-VILLAVERDE, J., P. GUERRÓN-QUINTANA, K. KUESTER, AND J. RUBIO-RAMÍREZ (2012): "Fiscal Volatility Shocks and Economic Activity," NBER Working Papers No.17317.

FRIEDMAN, B., AND K. KUTTNER (1993): "Why Does the Paper-Bill Spread Predict Real Economic Activity?," in *J.H. Stock and M.W. Watson (eds.), Business Cycles, Indicators and Forecasting, Studies in Business Cycles*, vol. 28. Chicago: University of Chicago Press for the NBER.

GILCHRIST, S., J. SIM, AND E. ZAKRAJŠEK (2013): "Uncertainty, Financial Frictions, and Irreversible Investment," Boston University, mimeo.

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

GÜNTAY, L., AND D. HACKBARTH (2010): "Corporate Bond Credit Spreads and Forecast Dispersion," *Journal of Banking and Finance*, 34, 2328–2345.

HAKKIO, C., AND W. KEETON (2009): "Financial Stress: What Is It, How Can It Be Measured, and Why Does It Matter?," *Economic Review, Federal Reserve Bank of Kansas City*, Second Quarter, 5–50.

JOHANNSEN, B. (2013): "When are the Effects of Fiscal Policy Uncertainty Large?," Northwestern University, mimeo.

JULIO, B., AND Y. YOOK (2012): "Political Uncertainty and Corporate Investment Cycles," *Journal of Finance*, 67(1), 45–84.

JURADO, K., S. LUDVIGSON, AND S. NG (2013): "Measuring Uncertainty," New York University, mimeo.

KAMBER, G., O. KARAGEDIKLI, M. RYAN, AND T. VEHBI (2013): "International Spill-Overs of Uncertainty Shocks: Evidence from a FAVAR," Reserve Bank of New Zealand, mimeo.

KILIAN, L. (1998): "Small-Sample Confidence Intervals for Impulse Response Functions," *Review of Economics Statistics*, 80(2), 218–230.

KRISHNAMURTHY, A., AND A. VISSING-JORGENSEN (2011): "The Effects of Quantitative Easing on Long-Term Interest Rates ," Brooking Papers on Economic Activity.

LEDUC, S., AND Z. LIU (2013): "Uncertainty Shocks are Aggregate Demand Shocks," Working Paper Series 2012-10, Federal Reserve Bank of San Francisco.

MERTON, R. (1974): "On the Pricing of Corporate Debt: The Risk Structure of Interest Rates," *Journal of Finance*, 29, 449–470.

PÁSTOR, L., AND P. VERONESI (2012): "Uncertainty about Government Policy and Stock Prices," *The Journal of Finance*, 67(4), 1219–1264.

Ramey, V. (1993): “How Important is the Credit Channel in the Transmission of Monetary Policy?,” *Carnegie-Rochester Conference Series on Public Policy*, 39(December), 1–45.

Silber, W. (2009): “Why Did FDR’s Bank Holiday Succeed?,” *Federal Reserve Bank of New York Economic Policy Review.*

Sum, V. (2012): “Financial Stress and Economic Policy Uncertainty: Impulse Response Functions and Causality,” *International Research Journal of Applied Finance*, 3(11), 1633–1637.

Tang, D., and H. Yan (2010): “Market Conditions, Default Risk and Credit Spreads,” *Journal of Banking and Finance*, 34(4), 743–753.

Tables

Table 1: Granger Causality Test, H_0:*absence of Granger causality*

Direction of causality	Number of lags 2	4	6	8	12
FRPU → Baa-Aaa	13.477	10.495	7.7928	6.4582	5.5852
	(0.0000)	(0.0000)	(0.0000)	(0.0000)	(0.0000)
Baa-Aaa → FRPU	6.3732	2.1724	1.8721	2.5141	2.5020
	(0.0019)	(0.0719)	(0.0851)	(0.0116)	(0.0038)

NOTES: The table reports the F-statistics for the Granger causality test, their p-values are reported in parentheses. Sample period from 1985:1 to 2012:10.

Table 2: Variance decomposition (baseline model)

Horizon	shock: ε^{frpu}				Baa-Aaa spread					
	Δy	π	u	i	ε^{frpu}	$\varepsilon^{\Delta y}$	ε^{π}	ε^{u}	ε^{i}	ε^{s}
6	7.96	7.21	19.64	16.14	17.99	6.15	2.32	0.87	0.13	72.54
12	8.26	7.21	26.88	17.11	17.82	7.05	5.25	1.04	2.43	66.40
36	8.53	7.25	29.57	18.37	18.29	7.24	7.54	0.99	6.35	59.59
60	9.08	7.55	29.70	17.79	18.51	7.61	7.52	1.26	6.63	58.46

NOTES: The left part of the table shows the fractions (as percentages) of the total forecast error variance, for each variable, due to innovations in financial regulation uncertainty. The right part displays the forecast error variance decomposition of the spread, i.e., the percentage explained by each shock within the baseline VAR.

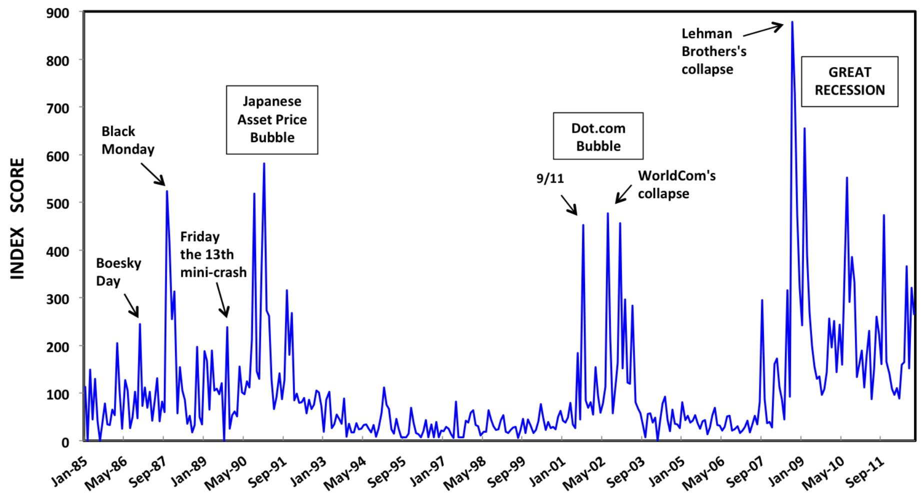
Table 3: Variance decomposition of alternative credit spreads

Horizon	GZ spread		Baa-GS10 spread		Aaa-GS10 spread	
	ε^{frpu}	ε^{i}	ε^{frpu}	ε^{i}	ε^{frpu}	ε^{i}
6	14.46	1.89	20.49	0.43	15.42	1.60
12	9.76	1.72	17.08	3.89	13.15	4.75
36	11.52	4.59	14.00	11.94	9.97	9.51
60	14.96	3.79	14.01	12.26	9.66	10.06

NOTES: The table shows the fractions (as percentages) of the total forecast error variance of alternative measures for the credit spread due to innovations either in the financial regulation uncertainty index or in the federal funds rate, estimated within the baseline VAR model.

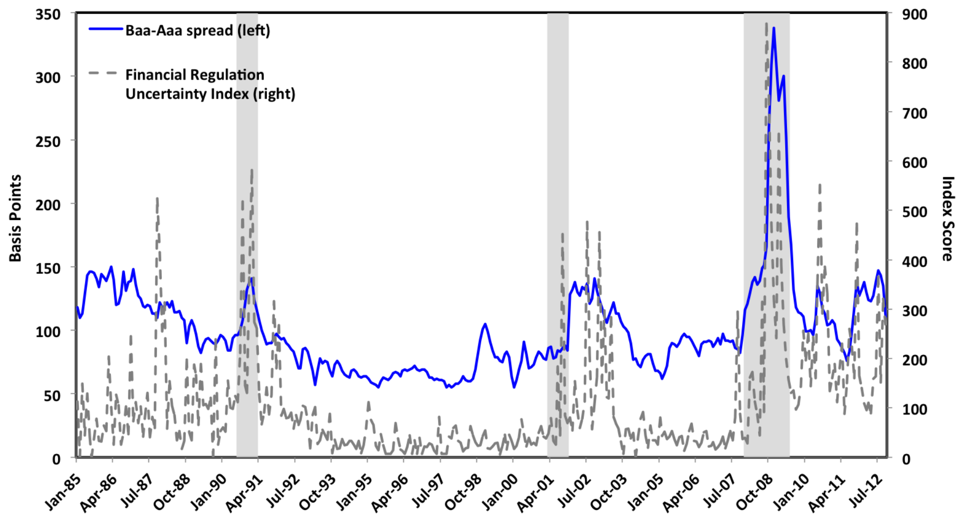
Figures

Figure 1: Financial Regulation Policy Uncertainty



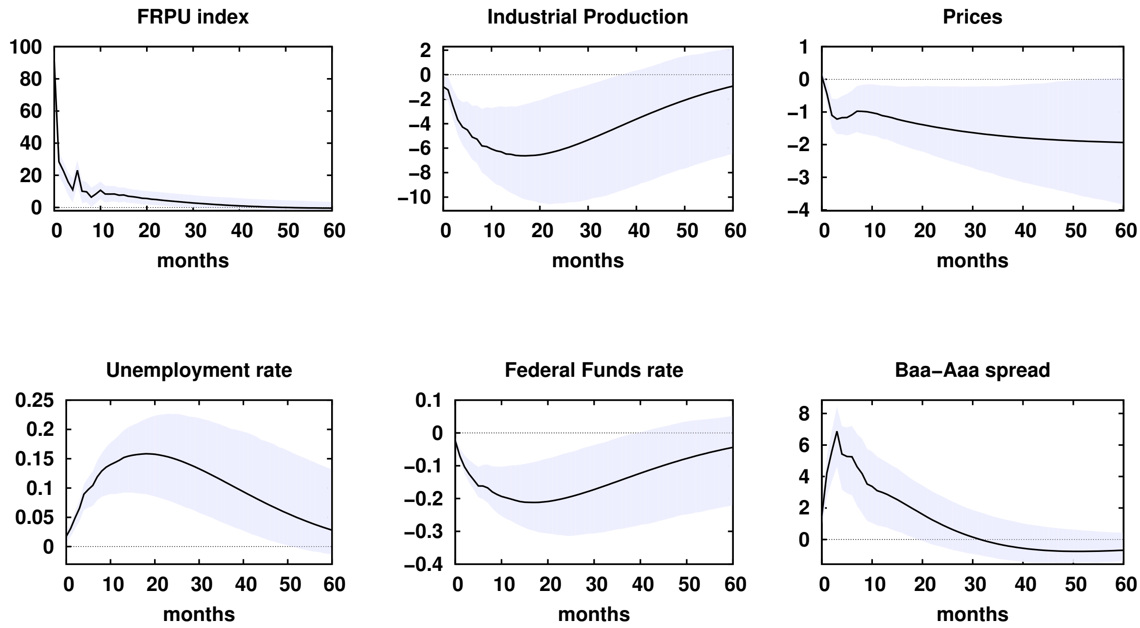
NOTES: The figure displays the evolution of U.S. financial regulation policy uncertainty, as measured by the index from Baker, Bloom and Davis (2013). Sample period: 1985:1-2012:10.

Figure 2: Uncertainty and Credit Spreads dynamics



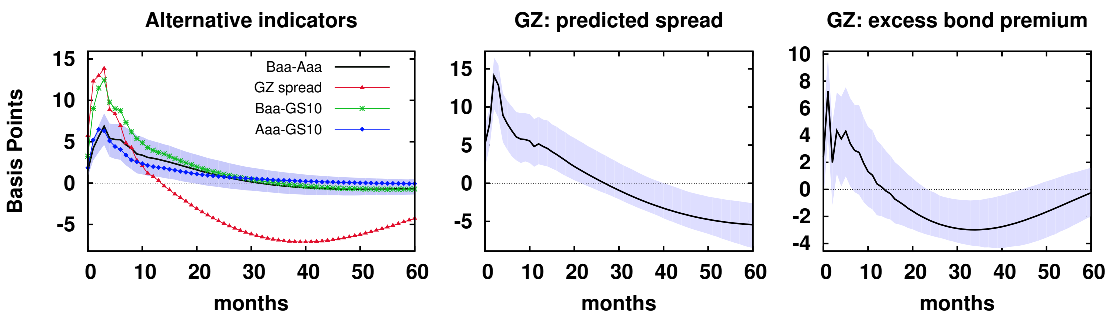
NOTES: The blue solid line depicts the spread between Baa-Aaa Moody's rated corporate bonds. The gray dashed line depicts the financial regulation policy uncertainty index (Baker *et al.*, 2013). Sample period: 1985:1-2012:10. The shaded vertical bars are the NBER-dated recessions.

Figure 3: Macroeconomic implications of Financial Regulation Uncertainty shocks



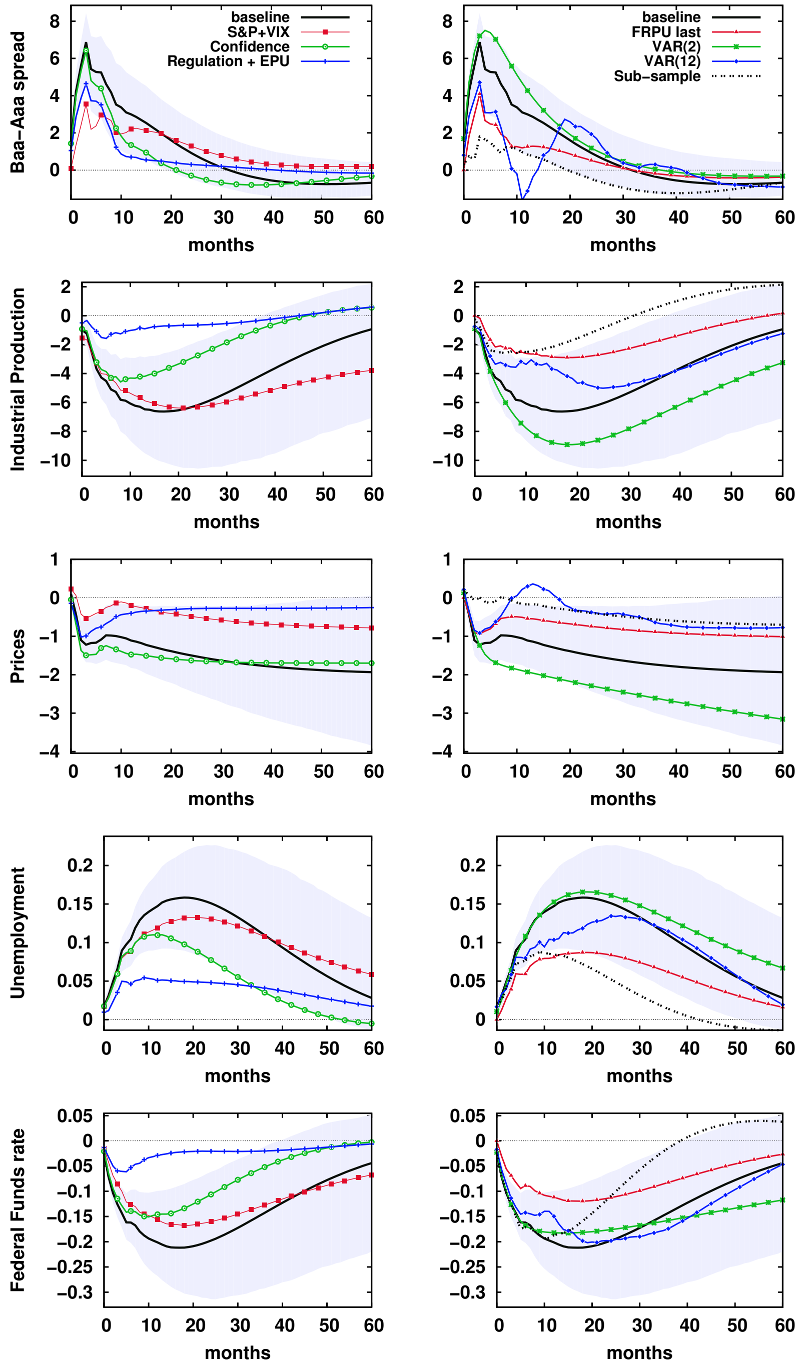
NOTES: Impulse responses to a one standard deviation orthogonalized shock to the financial regulation policy uncertainty index. Baseline VAR(6), where $\boldsymbol{x}_t = [frpu_t, \Delta y_t, \pi_t, u_t, i_t, s_t]'$. The responses of the industrial production growth and the inflation rate have been accumulated. Gray areas: 90% bootstrapped confidence intervals, calculated with the bootstrap-after-bootstrap procedure (Kilian, 1998), based on 2,000 replications.

Figure 4: Credit Spread Dynamics



NOTES: The figure shows the impulse response functions of different credit spread indicators to a one standard deviation orthogonalized shock to the FRPU index. All the responses are obtained by substituting, in turn, the Baa-Aaa benchmark measure with the alternative spread indicators in the baseline VAR specification.

Figure 5: Sensitivity Analysis



NOTES: Effects of a one standard deviation shock to the FRPU index: Robustness checks. The responses of industrial production growth and inflation rate have been accumulated. Gray areas: 90% bootstrapped confidence intervals, calculated with the bootstrap-after-bootstrap procedure (Kilian, 1998), based on 2,000 replications.