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The Influence and Policy Signaling Role of FOMC Forecasts

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Abstract
Policymakers at the Federal Open Market Committee (FOMC) publish forecasts since 1979. We examine the effects of publishing FOMC inflation forecasts in two steps using a structural VAR model. We assess whether they influence private inflation expectations and the underlying mechanism at work: do they convey policy signals for forward guidance or help interpreting current policy decisions? We provide original evidence that FOMC inflation forecasts are able to influence private ones. We also find that FOMC forecasts give information about future Fed rate movements and affect private expectations in a different way than Fed rate shocks. This body of evidence supports the use of central bank forecasts to affect inflation expectations especially while conventional policy instruments are at the zero lower bound.

JEL classification: E52, E58

Keywords: Monetary Policy, Forecasts, FOMC, Influence, Policy signals, Structural VAR.

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1. Introduction

Most theoretical models emphasize the importance of private expectations in determining macroeconomic outcomes. Managing private inflation expectations is therefore a crucial feature of monetary policymaking and matters all the more so the need for forward policy guidance is dramatically amplified when conventional monetary instruments are at the zero lower bound.

In its traditional form, the expectations channel is subtle and fragile as it depends on the private agents' interpretation of interest rate changes. King (2005) states that "because inflation expectations matter to the behavior of the households and firms, the critical aspect of monetary policy is how decisions of the central bank affect those expectations". Policy decisions can be understood in various ways and facilitating private agents' information processing is one reason why central banks complement their actions with communication to the public. Moreover, given the delay between policy actions and their real effects, central bank communication provides policymakers with a way to promptly affect private expectations to shorten the transmission lags of monetary policy.

Surprisingly, however, there has been only few works testing central bank communications that influence the formation of private inflation expectations. Most papers in this line of literature instead focus on responses of financial markets, interest rates or exchange rates to central bank communication (see Blinder et al. (2008) for a comprehensive survey). Moreover, it has to be stressed that most of this literature focus on one particular type of central bank communication: the *qualitative* one (statements, minutes, interviews or speeches), while it can take another form: the *quantitative* communication (central bank macroeconomic forecasts). The latter has the advantage that its use is not based on judgmental classifications (content analysis, word counting, etc) and it is possible to assess its quality. We are only aware of two studies that have investigated how central bank forecasts affect private expectations. Fujiwara (2005) and Ehrmann, Eijffinger and Fratzscher (2012) have tested whether central bank forecasts or the publication of central bank forecasts have an impact on the dispersion of private forecasts.

The Federal Open Market Committee (FOMC), responsible for the implementation of US monetary policy and which consists of twelve voting members including the seven members of the Board of Governors of the Federal Reserve, publishes inflation forecasts as part of its Monetary Policy Report to the Congress two times per year since 1979 and four times per year since 2007. The contribution of this paper is to investigate whether and how FOMC inflation forecasts influence private inflation expectations.

This question matters for different reasons: in practice, a central bank which is able to influence private inflation expectations is supposed to make monetary policy implementation more effective. In theory, Bernanke and Woodford (1997) have shown that a monetary policy influenced by private expectations may lead to indeterminacy, whereas Muto (2011) argues that when private agents follow the central bank, it must respond more strongly to expected inflation to achieve macroeconomic stability. In addition, influential central bank forecasts may lead private agents to stop forming their specific information set and only refer to central bank information. Morris and Shin (2002) show that there may be a crowding out effect of public information on independent sources of information. Finally, Amato and Shin (2006) develop a model in which the central bank, due to its policymaking role, shapes market expectations. This paper provides empirical evidence on the influencing ability of FOMC inflation forecasts.

If it turns out that FOMC inflation forecasts do influence private ones, three main causes may be put forward: first, central bank forecasts may have lower forecast errors than private ones and private agents use them to produce more accurate forecasts of the economic outlook. Second, central bank forecasts may convey policy signals and/or be important to understand the appropriate stance of monetary policy (referring to the uncertainty of policy actions), to shed light on monetary policy preferences, strategies and objectives. Third, central bank forecasts may also act as public signals which provide a focal point for private agents to coordinate when prices are strategic complements and agents seek to coordinate (Morris and Shin, 2002).

Romer and Romer (2008) show that FOMC inflation forecasts do not contain useful additional information compared to FRB staff's forecasts to predict future inflation, while Gavin and Pande (2008) find evidence that FOMC forecasts are not more accurate than private ones. Ellison and Sargent (2010) argue that FOMC forecasts depict a worst-case scenario used to design robust policy decisions. Finally, Orphanides and Wieland (2008) show that FOMC forecasts have a predominant explanatory power for Fed rate decisions compared to observed economic outcomes. These four papers support the idea that the source of FOMC forecasts' influence would be to convey signals rather than their forecasting accuracy.

We investigate whether and how FOMC inflation forecasts influence private inflation forecasts using a structural VAR model with a recursive identification scheme to identify FOMC inflation forecast shocks which would be independent of private inflation expectations, the Federal Reserve interest rate, inflation and real GDP. The VAR model enables one to assess the dynamics of such a shock in contrast to an event-study or a simple regression that would provide only a 1-period effect. Indeed, we are not only interested in the *immediate* influence effect but also in the *dynamics* of influence to characterize the effects of FOMC inflation forecasts. We use the Survey of Professional Forecasters (SPF) as a measure of private inflation forecasts, and add them and FOMC inflation forecasts to a standard monetary VAR with real GDP, inflation and the Fed rate. The monetary policy communication shock is identified by assuming that policymakers immediately observe the Fed rate, SPF forecasts, inflation and real GDP. Estimates are found to be strongly robust to various alternative model and estimation specifications, as well as to different data.

We find that an exogenous increase in FOMC inflation forecasts has a significant and positive effect on private inflation forecasts. The maximum effect happens after three semesters. The fact that the forecasting horizon is shorter than the influencing effect and the transmission lags of monetary policy suggests that influence stems from some signaling content.

We then aim at characterizing the influencing ability of FOMC forecasts. More precisely, we test whether FOMC forecasts enhance the implementation of policy actions or convey signals on future monetary policy. Publishing central bank forecasts may make monetary policy actions more effective if it facilitates private agents' information processing as well as it may provide different outcomes than interest rate decisions do. We test three hypotheses to analyze this question. First, we show that while FOMC inflation forecasts affect private forecasts, Fed rate shocks have no effect on private forecasts. The signaling content of FOMC forecasts seems to be about policy decisions at horizons larger than the transmission lags of monetary policy. Second, the effects of Fed rate shocks on private forecasts are not modified when artificially shutting-off or not the effect of FOMC inflation forecasts on private inflation expectations - by imposing restrictions on the FOMC forecasts coefficient in the SPF forecasts equation of the VAR model. It suggests that the publication of FOMC inflation forecasts does not help private agents interpreting interest rate changes and policy decisions, and so that the signaling content of FOMC inflation forecasts is not linked to current Fed rate changes. Third, FOMC inflation forecasts give information on the future Fed rate movements and this might be considered as the main content of FOMC inflation forecasts. An interpretation of this empirical evidence is that FOMC inflation forecasts work as signals of the future conduct of monetary policy, consistently with "open mouth operations" signaling monetary policy intentions as stressed by Guthrie and Wright (2000). By influencing private inflation expectations and signaling future policy actions, FOMC inflation forecasts may be a less-conventional tool to provide forward guidance.

These statistical results are complemented by narrative evidence from Bernanke (2011) which highlights that the FOMC "explores ways to further increase transparency about its forecasts" to provide forward guidance. It may give another option to policymakers when pursuing multiple objectives especially when the central bank interest rate is at the zero lower bound.

The rest of the paper is organized as follows. Section 2 reviews the literature, section 3 discusses the theoretical framework, section 4 presents the data and section 5 details the empirical model. We then assess whether (section 6) and how (section 7) FOMC inflation forecasts influence private forecasts. Section 8 concludes.

2. Related Literature

This paper is related to three strands of the existing literature. The first one deals with the content and the effects of the FOMC communication. Gavin (2003), Gavin and Mandal (2003), Gavin and Pande (2008), Capistran (2008), Tillmann (2010) and McCracken (2010) analyze the characteristics, biases and performance of FOMC forecasts while Meade (2005), Chappell et al. (2007), Meade and Stasavage (2008), Banternghansa and McCracken (2009) and Tillmann (2011) study how the divergence in FOMC forecasts may respond to strategic behaviours. Kohn and Sack (2004), Gürkaynak, Sack and Swanson (2005), Ehrmann and Fratzscher (2007), Rosa (2008) and Farka (2011) study how FOMC statements impact asset prices and long-term yields. Boukus and Rosenberg (2006) show that FOMC minutes also impact long-term yields. Pakko (2005) and Lucca and Trebbi (2009) assess the policy stance of FOMC statements. Last, Bauer et al. (2006) finds that private forecasts have been more synchronized since FOMC started to publish statements with Fed rate decisions, but that forecast errors have not become smaller since then.

The second strand refers to the signaling role of central bank action or communication. Geraats (2005) shows that the publication of central bank forecasts provides reputational signals on the type of central banks. Walsh (2007) analyzes the welfare effects of the publication of central bank forecasts and proposes optimal degrees of transparency according to demand and cost-push shocks. Baeriswyl and Cornand (2010) analyze how central bank actions may convey signals to the public and show that central banks may adjust their policy decisions in order to withhold some information. Empirically, the signaling role of actions has been studied by Romer and

Romer (2000), who show that ''the Federal Reserve's actions signal its information'' since private agents revise their inflation expectations in response to policy decisions. Finally, Gürkaynak, Sack and Swanson (2005) provide evidence that both monetary policy actions and FOMC statements have important and different effects on asset prices.

The third one focuses on the influence of private expectations. Fujiwara (2005) shows that the Bank of Japan influences private forecasters while the opposite is not true. Ehrmann, Eijffinger and Fratzscher (2012) analyse whether central bank transparency affect private forecasts. Both analyses however focus on the dispersion of private forecasts. Campbell, Evans, Fisher and Justiniano (2012) empirically characterize the responses of private macroeconomic forecasts to forward guidance through formal FOMC statements. They define *Delphic* forward guidance as central bank influence which shapes private macroeconomic expectations and in turn modifies private policy expectations. In related analyses, Levin, Natalucci and Piger (2004), Gürkaynak, Levin and Swanson (2010), Jansen and De Haan (2007), Cecchetti and Hakkio (2009) and Capistran and Ramos-Francia (2010) assess the effect of increased central bank communication and transparency on private expectations. Crowe (2010) provides evidence that inflation targeting adoption leads to better private forecasts. To our knowledge, the influence of FOMC inflation forecasts on private inflation forecasts is so far unexplored.

3. Theoretical Framework

This section describes the theoretical framework which motivates our empirical setup. We rely on the imperfect information literature. In the sticky information approach of Mankiw and Reis (2002), private agents do not update their expectations at each period as they face costs of absorbing and processing information. However, private agents can observe anything perfectly and if they update their information set, they gain full information rational expectations (RE). Following this work, Carroll (2003) suggests that professional forecasts spread epidemiologically to other private agents, and shows that professional forecasters pay attention to news and form their forecasts with the last information available to them. He also suggests that private agents derive their views about future inflation from professional forecasts. It leads them to formulate these equations respectively:

$$E_t\pi_{t+h} = \lambda\, RE_t\pi_{t+h} + (1 - \lambda)\, E_{t-1}\pi_{t+h} \quad (1)$$

$$E_t\pi_{t+h} = \lambda\, SPF_t\pi_{t+h} + (1 - \lambda)\, E_{t-1}\pi_{t+h} \quad (2)$$

where $E_t\pi_{t+h}$ are private inflation expectations for horizon h, RE_t the RE forecast, and SPF_t the professional forecast. Private expectations are represented as a linear combination of lagged private expectations and either a rational or boundedly rational forecast.

Sims (2003) and Mackowiak and Wiederholt (2009) focus on noisy information models: the observed inertial reaction of private agents arises from the inability to pay attention to all the noisy information available although people update continuously. It is an optimal choice for private agents – internalizing their information processing capacity constraints – to remain inattentive to a part of the available information because incorporating all signals is impossible (Moscarini, 2004). We then assume that average private inflation expectations are given by:

$$E_t\pi_{t+h} = \alpha + \beta_1\, E_{t-1}\pi_{t+h} + \beta_2\, X_t + \varepsilon_t \quad (3)$$

where $E_t\pi_{t+h}$ is determined as a linear combination of private agents that keep the average inflation expectations of the previous period ($E_{t-1}\pi_{t+h}$) and of a fraction that updates inflation expectations based on up-to-date information about the current state of the economy summarized by the vector X_t. This reduced-form equation might also be interpreted as private agents have an initial belief about the future inflation rate (their past inflation expectations) at the beginning of each period, and during each period, they incorporate some relevant - but potentially noisy - information about future inflation.

Taking this relation to the data requires an identifying assumption. Since the timing of information is paramount in this context and because the data generating process of current variables makes it inconsistent to include them in the information set of the current period, we assume that private agents form their current expectations based on the information set X_{t-1} including variables up to the previous period *t-1*:

$$\mathrm{E}_t \pi_{t+h} = \alpha + \beta_1 \mathrm{E}_{t-1} \pi_{t+h} + \beta_2 X_{t-1} + \varepsilon_t \quad (4)$$

Because of the limited adjustment mechanism of imperfect information models in which private agents keep the same information set for a period of time due to sticky information or rational inattention, one would expect that lagged inflation expectations are highly significant. To bring together these different strands of the expectations formation literature, the vector X_t might include a rational forecast, a "newspaper" forecast, a professional forecast, the central bank interest rate, and/or any other variables that might affect future inflation. We aim at investigating the effects of FOMC inflation forecasts on private inflation forecasts based on a VAR model in which the equation for private inflation forecasts is equivalent to equation (4).

4. Data

Since 1979, the Federal Reserve publishes inflation forecasts – in addition to real GDP growth and unemployment – twice each year[1] in the Monetary Policy Report to the Congress. These forecasts are reported as two ranges encompassing each individual member's forecast of the Federal Open Market Committee (FOMC): the "full range" includes the highest and the lowest forecasts while the "central tendency" removes the three highest and three lowest forecasts. The standard approach in the literature is to consider the midpoint of the range to characterize the FOMC inflation forecast. As a benchmark for this analysis, we use the midpoint of the central tendency following results of McCracken (2010) and provide sensitivity tests with the midpoint of the full range. FOMC inflation forecasts are *fixed-event* forecasts, published each year in February and July, and forecast fourth-quarter-over-fourth-quarter (Q4oQ4) growth rates. Those of February are for the current year and those of July for both the current year and the next year. For the sake of sample consistency and for comparison with SPF inflation forecasts, we focus on current year forecasts. Moreover, focusing on the shortest horizon has another advantage. The interest rate instrument gives the central bank some control over the forecasted variable. As the motivation of this study is to assess the communication effect of FOMC inflation forecasts, the control issue is circumvented when the horizon of forecasts is shorter than the transmission lag of monetary policy. Indeed, the central bank has no effective control on variables forecasted and the effect of FOMC forecasts on private ones is different from the effect of interest rate changes on private forecasts. In addition, it has to be noted that the variables forecasted have evolved over time. Different measures of inflation have been forecasted by the policymakers: the implicit

[1] Since October 2007, the publication of FOMC forecasts is quarterly and the horizon extended by one additional year.

GNP price deflator until the end of July 1988, the CPI between February 1989 and July 1999, the chain-type price index for personal consumption expenditures (PCE) between February 2000 and February 2004, and the core PCE since then. Finally, it is worth noting that these forecasts are conditioned on FOMC members' assessment of "appropriate monetary policy" which corresponds to the future interest rate path that best satisfies the Fed's dual objectives of maximum employment and price stability. The data set has a biannual frequency, starts in 1979.2, ends in 2010.2, and comprises 63 observations.

The Survey of Professional Forecasters (SPF) is collected and published by the Federal Reserve Bank of Philadelphia. Surveys are sent to approximately 40 panelists at the end of the first month of the quarter, the deadline for submission is the second week of the second month of the quarter, and at the end, forecasts are published between middle to late February, May, August, and November. GDP price index forecasts (available since 1968) are fixed-horizon forecasts for the current and the next four quarters, and a fourth-quarter *fixed-event* forecast is then constructed to match FOMC data (SPF_PGDP_Q4). In addition, we provide sensitivity tests with (annualized quarter-over-quarter growth rate) next quarter *fixed-horizon* forecasts (SPF_PGDP_Q). Consumer price index (CPI) and core PCE forecasts are already provided on the basis of fourth-quarter-over-fourth-quarter (Q4oQ4) percent changes, but not since 1979. Finally, we consider the median of individual responses as the SPF inflation forecast.

One issue arises when matching these forecast[2] data sets. First, the exact variables forecasted to capture inflation have changed over time and are not necessarily available at the same date for the two actors. Indeed, SPF has only started to forecast core PCE in 2007 and never forecasted PCE. There is therefore no exact match between 2000 and 2006. Our benchmark approach is to consider SPF GDP price index forecasts (SPF_PGDP_Q4) over the whole sample since it is the only variable constantly provided by SPF over the sample. We assess the robustness of this alternative by constructing a SPF inflation forecast series (SPF_AGG) which combines GDP price index, CPI and core PCE to match FOMC data. Figure 1 plots FOMC and SPF inflation forecasts and documents that there is no break in their level when variables change[3].

Respecting the timing of information publication is paramount in this study and the sequence of forecasts' publication needs to be stressed. FOMC forecasts are produced in early February and July but were released later on at the beginning of the sample, whereas SPF forecasts are published in mid-February and mid-August but collected before. FOMC forecasts tend to be published before SPF forecasts. While the time difference between both actors is quite large (approximately 1 month) in the third quarter, the time difference is rather small in the first quarter and calls for carefulness. We test the reliability of these timings in two ways: first with various different orderings in the VAR model and second by decomposing the biannual series in two separate annual series for either Q1 or Q3 forecasts.

[2] The rationality of the forecasts is examined in Table 1. Testing whether private forecasters take their forecasts or the FOMC ones as an input into their expectation-formation process makes sense when the forecasts are not irrational. We therefore estimate regressions of the actual inflation on a constant and the appropriate forecast and assess the implication of rationality that the constant equals zero and the coefficient associated to the forecast close to one. The null hypothesis of rationality is not rejected at conventional significance levels. This is consistent with the finding of Armantier et al. (2011) who show that inflation expectations surveys are informative and consistent. In addition, we show that the absolute forecast errors of FOMC are not smaller than those of SPF.

[3] Gavin and Pande (2008) note that no break occurs in the accuracy of FOMC forecasts when variables change.

Comparing the estimation output of the biannual series of both Q1 and Q3 with those of the two separate annual series for either Q1 or Q3 forecasts has another function. Indeed, FOMC forecasts[4] made in February and July are current year Q4oQ4 forecasts and so one might interpret that FOMC members estimate two different variables. These forecasts are based on information through February and July respectively, and for an 11-month horizon and a 6-month horizon respectively. One might therefore consider that this variable is not being drawn from the same stochastic process and should be considered as two separate variables.

The realized variables - inflation and real GDP - included in the VAR model come from the Real-Time Data Set of the Federal Reserve Bank of Philadelphia. We use for both variables a sequence of vintages: the second release, which are the vintage data published the next quarter. Since FOMC inflation forecasts are released to the public only twice a year, the frequency of the overall dataset is biannual. We therefore face a dilemma: we may only use the value of the quarter corresponding to the publication of forecasts (Q1 and Q3 only), or use the average of the corresponding 2 quarters (Q4 and Q1 for February forecasts, and Q2 and Q3 for July forecasts). Both solutions have advantages and drawbacks. The first solution focuses on the specific information set when forecasts are published but do not take into account all information of each semester (i.e. of the preceding six months) and in a VAR framework where lags matter, abstracts from part of the past information. The second solution incorporates all past information of the semester by averaging the two quarters but does not focus on the specific information set at the time of the publication. Both solutions nevertheless respect the timing of information publication. We use the first solution for benchmark estimations: real-time real GDP and inflation[5] are included in the VAR as year-over-year growth rates (Q/Q-4) for both first and third quarters only, while the values of February and August only are considered for the Federal funds target rate. We then provide robustness tests for the second solution, taking into account the previous quarter (*months* for the Federal funds target rate) and averaging data. Finally, as an additional robustness test, we also consider final revised data obtained from the FRED database.

5. Structural VAR Model

The empirical strategy used to assess whether FOMC inflation forecasts influence SPF inflation forecasts and to establish their signaling content is a structural VAR model for decomposing FOMC inflation forecasts into mutually orthogonal components with a structural economic interpretation. We augment a standard VAR for monetary policy analysis including real GDP growth, inflation and the central bank interest rate with FOMC and SPF inflation forecasts.

Let Z_t represent the (*k* x *1*) vector that contains our *k* variables of interest at date *t*. In the benchmark specification, Z_t = [Real GDP, Inflation, SPF, Fed rate, FOMC]'. The regression of Z_t on its own lags *p* produces the reduced-form VAR errors e_t:

$$Z_t = \alpha + \sum_{i=1}^{p} \beta_i Z_{t-i} + e_t \quad (5)$$

[4] The same reasoning applies to SPF (fixed-event) forecasts.

[5] Two real-time inflation variables are considered throughout this paper: our benchmark is the GDP price index (PGDP) and the second is a combination of the GDP price index, CPI, PCE and core PCE matching the different FOMC measures of inflation considered across time (AGG).

The reduced-form errors comprise the contemporaneous effects of each variable on the others and therefore combine the exogenous innovation of a given variable to the contemporaneous responses to the other variables. The identification of exogenous innovations to FOMC inflation forecasts goes through the following relation between the reduced-form errors and the exogenous innovation, called the structural errors:

$$e_t = \begin{pmatrix} e_t^{\text{real GDP}} \\ e_t^{\text{inflation}} \\ e_t^{\text{SPF}} \\ e_t^{\text{Fed rate}} \\ e_t^{\text{FOMC}} \end{pmatrix} = \begin{bmatrix} a_{11} & 0 & 0 & 0 & 0 \\ a_{21} & a_{22} & 0 & 0 & 0 \\ a_{31} & a_{32} & a_{33} & 0 & 0 \\ a_{41} & a_{42} & a_{43} & a_{44} & 0 \\ a_{51} & a_{52} & a_{53} & a_{54} & a_{55} \end{bmatrix} \begin{pmatrix} \varepsilon_t^{\text{real GDP}} \\ \varepsilon_t^{\text{inflation}} \\ \varepsilon_t^{\text{SPF}} \\ \varepsilon_t^{\text{Fed rate}} \\ \varepsilon_t^{\text{FOMC}} \end{pmatrix} \quad (6)$$

The recursive identification assumption postulates that the structural errors are independent and that the A matrix is lower triangular. This means that the covariance between the reduced-form errors is attributed to the structural error of the variable ordered previously in Z_t, and that the structural error is uncorrelated to the reduced-form errors of the preceding variables.

The recursive identification assumption depends on the ordering of the variables in the vector Z_t. Thus, shifts in the real GDP, inflation, SPF inflation forecasts or the Fed rate result in a contemporaneous change in the FOMC inflation forecasts. At the opposite, real GDP is assumed not to respond to shocks in the other variables instantaneously. This restriction seems plausible as transmission lags to the real economy are slow. Usually, the literature ranks the monetary policy instrument last in the vector of variables. We thus assume that both policy tools react to other variables contemporaneously. Concerning the relative position of FOMC inflation forecasts and the Fed rate, we suppose that if there is an exogenous shock on the Fed rate, FOMC inflation forecasts would react contemporaneously as policy decisions are set according to FOMC inflation forecasts. This implies that the Fed rate would respond with a lag to an exogenous shock to FOMC inflation forecasts. Two arguments may support this hypothesis: first, the Fed rate exhibits a strong inertia, and second, policymakers often communicate on their future policy decisions and prepare market participants. Finally, we suppose SPF inflation forecasts respond with a lag to both policy tools, but contemporaneously to changes in inflation and real GDP. The fact that surveys take time to be collected from panelists is a first argument in that direction. A second one refers to Coibion and Gorodnichenko (2008, 2010) and Andrade and LeBihan (2010) who document that private forecasters are subject to rational inattention and sticky information. This implies that the Fed reacts contemporaneously to private expectations. It is consistent with the fact that it continuously gathers information on private expectations through surveys or financial markets. In other words, we assume that the Fed policymakers are continuously aware of private inflation expectations' developments.

However, this benchmark ordering might be challenged, in particular for the relative position of FOMC and SPF forecasts variables in the vector Z_t. In order to assess the sensitivity of the results and the role of these identification assumptions, several orderings are tested (see Table 2). In addition to the benchmark VAR with real-time inflation and GDP, we also test an alternative VAR model with two intermediate targets of monetary policy. We introduce the US 3-month LIBOR rate and the 10-year Treasury bonds rate. The ordering for this alternative VAR is [SPF, 10y rate, LIBOR rate, Fed rate, FOMC]. We assume that all three interest rates and the FOMC inflation forecast respond contemporaneously to changes in the SPF inflation forecasts.

The baseline analysis is performed with 2 lags, and the validity of baseline estimates is tested with 1 lag. We also checked the eigenvalue stability condition of the VAR model in order to interpret impulse–response functions. All the eigenvalues lie inside the unit circle, so our VAR model satisfies the stability condition.

6. Do FOMC forecasts influence SPF forecasts?

We test the hypothesis that a FOMC inflation forecasts shock has an effect on private inflation forecasts. More specifically, we look at whether an increase of FOMC inflation forecasts yields to an increase in SPF forecasts with an elasticity inferior to one. A decrease of SPF forecasts after a positive FOMC inflation forecasts shock would imply that the Fed is exceptionally credible and policy actions are not necessary, and hence seems not realistic; or that the Fed is not credible at all. At the opposite, an increase of SPF inflation forecasts superior to the increase of FOMC inflation forecasts would imply that the Fed is not credible in stabilizing inflation, would render its task more difficult, and would not justify the publication of FOMC forecasts.

Figure 2 plots the impulse response of SPF inflation forecasts to a FOMC inflation forecast one-standard-deviation (S.D.) innovation[6]. It causes a significant increase in SPF inflation forecasts with a maximum magnitude of 0.14 percentage point after three semesters. In more general economic terms, it corresponds to a 0.48 percentage point increase in SPF inflation forecasts after a 1-percentage point increase in FOMC inflation forecasts. This result suggests that the FOMC inflation forecasts have a significant influence on SPF inflation forecasts, and this estimate is consistent with monetary theory and practice since the elasticity is inferior to one.[7] The fact that this effect happens after three semesters, so after the forecasting horizon, also suggests that the device at work is not linked to the forecast accuracy. Interestingly, this horizon corresponds to the transmission lags of monetary policy and it suggest that the influencing ability might be due to some signaling effect on the future "appropriate monetary policy" and so the future interest rate path. Last, Table 3 contains the variance decomposition of SPF inflation forecasts in order to evaluate the quantitative importance of FOMC inflation forecasts. The "communication channel" explains 10 percent of the variance of SPF in comparison to 1 percent for the Fed rate, while lagged SPF and inflation explain respectively 51 and 29 percent.

[6] One may argue that the FOMC inflation forecast shock captures some omitted variable bias, e.g. Fed's private information which is orthogonal to other variables. This argument reasonably applies to all 3-variable monetary VAR and the present VAR goes one step beyond by including private and FOMC inflation forecasts. Moreover, whether FOMC inflation forecasts contains Fed's private information does not alter the assessment of the effect of FOMC inflation forecasts (as soon as the Fed discloses them to the public) on private forecasts if the omitted variable is Fed's private information. A third argument is that price and price expectations are supposed to incorporate all information available and then having them in the VAR reduce the scope for a potential omitted variable bias.

[7] We acknowledge that the FOMC forecast is contaminated with measurement errors as it is the middle of a range rather than the mean or median, and hence that the reaction might be less than one-for-one due to the attenuation bias. However, the sensitivity analysis performed later on show that the FOMC forecast based on the full range (with extreme values and more variability) has a smaller effect than the FOMC forecast based on the central tendency.

Fixed-event forecasts may introduce some heteroscedasticity in the estimation process and calls for controlling that the implicit constant variance assumption of a biannual series does not bias the estimation. Considering that these fixed-event forecasts are not drawn from the same stochastic process and should be interpreted as two separate variables, Figure 3 plots the impulse response[8] of SPF inflation forecasts to a FOMC inflation forecast one-standard-deviation (S.D.) innovation for both decomposed series in annual frequency: either Q1 FOMC and SPF forecasts or Q3 FOMC and SPF forecasts. A FOMC inflation forecast shock has again a significant and positive impact on SPF inflation forecasts with a maximum magnitude of 0.25~0.30 percentage point after one or two years. It confirms that the effect of FOMC forecasts on SPF forecasts is robust to the increasing information set and decreasing horizon characteristics of these variables and to the potential associated heteroscedasticity.

Table 4 presents Granger-causality Wald tests between SPF and FOMC inflation forecasts. The null hypothesis that FOMC inflation forecasts do not Granger-cause SPF inflation forecasts is strongly rejected. At the opposite, the null hypothesis that SPF inflation forecasts do not Granger-cause FOMC inflation forecasts cannot be rejected. It has to be acknowledged that these tests do not disentangle correlation and causality, and that their power is weak with forward-looking variables. However, given the high correlation between both series of forecasts, the fact that FOMC inflation forecasts are strongly correlated to SPF inflation forecasts whereas the opposite is not true is striking. It supports that FOMC inflation forecasts influence SPF ones.

Table 5 provides a complementary set of estimates which is not based on the structural VAR model and its identification hypotheses. We proceed in two steps. First, we estimate the residuals of FOMC inflation forecasts (Resid FOMC) once regressed on one lag of each of the following variables: SPF inflation forecasts, the Fed rate, inflation, real GDP, the 10-year bonds interest rate, the LIBOR rate, FOMC inflation forecasts and a variable comprising the set of macroeconomic news[9] released between *t* and *t-1*. This residual series might be interpreted as a series of FOMC inflation forecast exogenous shocks. Second, we estimate the effect on SPF forecasts of either current FOMC inflation forecasts, the first lag of FOMC inflation forecasts, or the residuals of FOMC inflation forecasts along with the preceding macroeconomic controls and one lag of SPF inflation forecasts. Estimates show that FOMC inflation forecasts, the first lag of FOMC inflation forecasts, or the residual component of FOMC inflation forecasts are all positive and significant determinants of SPF inflation forecasts.

Sensitivity Analysis

The VAR approach relies on some assumptions that require assessing whether the main result is robust and holds with different hypotheses and estimation specifications, and different data. Concerning the estimation procedure, the first test consists of providing the impulse responses of SPF inflation forecasts to a FOMC inflation forecast shock with different orderings of Z_t than the benchmark one (see Figure 4.1). Second, we estimate a reduced-form VAR with the same variables in Z_t and plot the equivalent impulse response (Figure 4.2). Imposing some restrictions on the structure of the error variance-covariance matrix enables one to make a causal interpretation of the results. However, estimating a reduced-form VAR allows data to speak without any assumptions. Third, the impact of the number of lags is evaluated (Figure 4.3).

[8] Both VAR models are estimated with yearly data, one lag and the small sample estimator.

[9] Following the news and announcement literature (see Andersen et al. 2003), we construct the news variable by deducting the forecast of a given variable (inflation) in *t-1* from the actual value of the given variable in *t*.

Finally, because the number of observations might be considered small, the variance-covariance matrix is estimated with a small-sample degrees-of-freedom adjustment: the small-sample divisor used is *1/(T-m)* instead of the maximum likelihood divisor *1/T*; *T* being the sample size and *m* the average number of parameters in each of the equations (Figure 4.4). It is worth noting that since small samples produce greater standard errors, the related potential bias would go against the hypothesis that FOMC inflation forecasts influence private ones. Significant estimates would therefore be all the more so convincing.

Concerning the data, the first test (Figure 5.1) consists of estimating the benchmark VAR with SPF fixed-horizon forecasts of next quarter (SPF_PGDP_Q) and with SPF forecasts based on the different inflation measures as it evolved across time (SPF_AGG). Figure 5.2 plots the SPF forecasts responses when using the semester average data (we replace the value of the specific quarter considered for each semester by the average of the whole semester data) to ensure that no past information is missing in the lag structure of the VAR, and when using final data rather than real-time data for inflation and real GDP. We then test the impact of replacing the midpoint of the central tendency by the midpoint of the full range for FOMC inflation forecasts (Figure 5.3). Finally, we test the alternative VAR with the LIBOR and 10-year bonds interest rates replacing inflation and real GDP in Z_t (Figure 5.4).

These tests all strongly confirm the robustness of the baseline result that FOMC inflation forecasts influence SPF inflation forecasts. Putting the SPF behind FOMC in Z_t (as in models 2, 4 and 5) produces even higher SPF responses to a FOMC shock[10]. The same pattern emerges when using semester average data or alternative SPF forecasts data. Interestingly, the effect of the midpoint of the full range is positive and significant but smaller than the effect of the midpoint of the central tendency, consistently with McCracken (2010) who documents that full range inflation forecasts are subject to strategic behavior by individual FOMC members and so to noise. McCracken (2010) and Tillmann (2011) suggest that policymakers with extreme preferences will construct their forecasts to drive the preferred policy that they would like to see implemented. This is why removing extreme forecasts gives a better representation of the consensus between FOMC members. It also suggests that FOMC inflation forecasts may be more effective to influence private forecasts when they are not subject to strategic considerations but represent the consensus on the policy that will be implemented.

Discussion

FOMC inflation forecasts are able to influence private inflation forecasts. The positive and less than proportional effect on private forecasts suggests that the quantitative communication policy of the FOMC is not irrational and enables policymakers to shape private inflation expectations. Two possible sources of this influence are first that FOMC forecasts may have lower forecast errors than private ones and are therefore used by private agents to produce more accurate forecasts of the future economic outlook; and second that central bank forecasts may convey signals on policymakers' preferences or objectives, or on their future "appropriate monetary policy" decisions or strategies. Gavin and Pande (2008) and our own estimates in Table 1 show that FOMC inflation forecasts are not more accurate than private forecasts. These results support the second source of influence: the signaling content of FOMC inflation forecasts. In addition, it is worth noting that two interpretations of the positive-but-less-than-proportional

[10] Putting real GDP or inflation last in Z_t do not modify the effect of FOMC inflation forecasts on SPF ones.

coefficient are possible: one may argue that the Fed creates self-fulfilling prophecies by communicating on inflation. By influencing private expectations which are the main determinants of future realized inflation, the Fed somewhat set in part the future inflation rate. At the opposite, the Fed may expect an increase in inflation, communicates on it, and so inform private agents that it is aware of this future inflation increase and will respond to it. Under the assumption that the Fed is credible, private agents will expect a rise in the Fed rate and then forecast a smaller than communicated increase in inflation. The Fed would have succeeded to prevent a part of the increase of inflation by communicating on it and signaling its future intentions. To conclude, regardless of the source of central bank influence of private expectations and of the potential use of their forecasts by policymakers, estimates provide empirical support for the theoretical literature in which monetary policy is about managing private inflation expectations.

7. Assessing the signaling content of FOMC forecasts

Since FOMC inflation forecasts influence SPF inflation forecasts, we then aim at investigating how the influencing ability of FOMC inflation forecasts works and their signaling content, and what are the links between them and the policy instrument.[11] We assess whether FOMC forecasts are an improved means of implementing current policy actions to help private agents understanding policy decisions and to facilitate private agents' information processing[12] in a context where they perfectly observe the Fed rate but are unable to correctly understand the rationale underlying the implemented policy as the central bank may respond to two different variables (inflation and output) and two different shocks (supply and demand); or whether FOMC inflation forecasts signal future monetary policy decisions.

We consider three hypotheses: *(1)* a FOMC inflation forecast shock has the same effect than a Fed rate shock, *(2)* the publication of FOMC inflation forecasts modifies the effect of a Fed rate shock, and *(3)* a Fed rate shock has an impact on FOMC inflation forecasts and vice-versa.

Starting with hypothesis *(1)*, we assess whether FOMC inflation forecasts have a different effect on SPF forecasts than the Fed rate. Figure 6 plots the SPF response to both Fed rate and FOMC inflation forecast shocks based on the benchmark VAR specification. FOMC inflation forecasts positively influence SPF forecasts, as evidenced previously, whereas the Fed rate shock has no effect (or a slightly negative effect, only significant with 1 S.E. bands) on SPF inflation forecasts. Because central banks have no control on inflation within a year due to the transmission lags of monetary policy, interest rate changes should not affect the corresponding private inflation expectations. The fact that SPF current year forecasts nevertheless react to FOMC current year forecasts suggest that the signaling content is about the credibility in fighting inflation through future policy decisions rather than about the pure effect of the current policy decision.

Concerning the hypothesis *(2)*, Figure 7 shows the responses of SPF inflation forecasts to a Fed rate shock when artificially shutting-off or not the effect of FOMC inflation forecasts by imposing restrictions on the FOMC forecasts coefficient in the SPF forecasts equation of the VAR

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[11] This question is close to but differs from Ellison and Sargent (2010). Their analysis proposes to reconcile the fact that FOMC policymakers can be bad forecasters and good policymakers.
[12] See Baeriswyl and Cornand (2010) for a theoretical analysis of this issue.

model as in Bachmann and Sims (2012). We assess whether the existence and the publication of FOMC forecasts affect the interpretation of Fed rate shocks by private agents. If FOMC inflation forecasts were an improving means to implement current policy actions, to facilitate private agents' information processing and to help private agents interpreting interest rate changes, then shutting-off the effect of FOMC inflation forecasts should make the responses of private expectations unlike and would then provide an estimate of the effect of policymakers' forecasts. An interpretation of the question "Do FOMC forecasts matter in the transmission of Fed rate shocks?" would be to restrict the coefficients of the underlying VAR in such a way as to force the response of SPF forecasts to FOMC forecasts to be zero, and then to compare the restricted impulse responses with the unrestricted ones. A necessary condition for SPF forecasts to not react to FOMC forecasts at any horizon is that SPF forecasts are ordered before FOMC forecasts in the vector Z_t, so that it does not react on impact. This plus restricting the AR coefficients on lagged FOMC forecasts in the SPF forecasts equation to zero is sufficient for imposing that SPF forecasts does not react to FOMC forecasts at any horizon. These restrictions are implemented by estimating the VAR model using seemingly unrelated regressions. Although we have shown that the effect of FOMC inflation forecasts on private forecasts is sound, estimates point out that shutting-off FOMC inflation forecasts does not produce different effects of a Fed rate shock on private forecasts.[13] It suggests that publishing FOMC inflation forecasts is not an enhanced way to implement monetary policy, and rather supports the view that the signaling content of FOMC inflation forecasts is not linked to current Fed rate changes.

Figure 8 deals with the hypothesis *(3)* and plots the response of FOMC inflation forecasts to a Fed rate shock and the Fed rate response to a FOMC inflation forecast shock. Some cross-effect would evidence some complementary between both policy tools. It appears that FOMC inflation forecasts do not react to a Fed rate shock and are thus independent to current decisions, whereas a FOMC inflation forecast shock calls for a Fed rate increase of 0.33 percentage point in three quarters (1.14 percentage point after a 1-percentage point innovation in FOMC inflation forecasts). This effect might be interpreted as the signaling content of FOMC inflation forecasts and is consistent with the argument that policymakers reveal in part the future "appropriate monetary policy" when publishing FOMC inflation forecasts. An increase in FOMC inflation forecasts may be interpreted as a forward indicator for an increase in the Fed rate.

Sensitivity Analysis

The robustness of the preceding results is assessed with semester average data to check that the potential bias of abstracting from some past information in the lag structure of the VAR does not affect the results. Figures A.1 to A.3 in the Appendix show estimates for the three hypotheses and provide confirmation that baseline estimates are robust.

Discussion

Estimates from the three tests suggest that FOMC inflation forecasts signal future monetary policy intentions. First, it appears that action and communication produce different effects: FOMC inflation forecasts affect private inflation forecasts whereas the Fed rate does not. This result is consistent with Gürkaynak, Sack and Swanson (2005). They show that a large portion of variation in long-term yields is due to FOMC communication rather Fed rate changes. Second, it

[13] It is particularly interesting to compare this result with the one of a companion paper on the effect of ECB inflation projections. Hubert (2013) shows that the effects of the ECB rate on private forecasts are different when artificially shutting-off or not the effect of ECB inflation projections.

seems that the publication of FOMC inflation forecasts is not an improved way of implementing policy actions. The fact that the effects of a Fed rate shock are not modified by the disclosure of FOMC inflation forecasts suggests that the communication of FOMC forecasts does not help private agents interpreting current policy decisions. Third, it appears that FOMC inflation forecasts give information on future Fed rate movements and the future "appropriate monetary policy", and this may be interpreted as the signaling content of FOMC inflation forecasts. This is consistent with previous findings. Gürkaynak, Sack and Swanson (2005) find that FOMC statements are closely associated with the future path of policy decisions in contrast to the current Fed rate. Swanson (2006) shows that US financial markets and private forecasters have a better picture of the future Fed rate and have become less surprised by Fed decisions since the FOMC enhanced its communication policy, while Orphanides and Wieland (2008) evidence that Fed rate decisions can be explained by FOMC inflation forecasts[14]. Thus, FOMC inflation forecasts might be seen as a way to signal future policy decisions or policymakers' preferences; hence to shape private inflation expectations; and therefore to conduct policy.

8. Conclusion

This paper examines the effects of FOMC inflation forecasts in two ways. We assess whether they influence private inflation forecasts and what is their signaling content. We provide original empirical evidence that FOMC inflation forecasts are able to influence private ones. The second set of estimates provides evidence that the effects of both FOMC inflation forecasts and Fed rate shocks are different. The publication of FOMC inflation forecasts does not change the effect of Fed rate shocks on private inflation forecasts and it suggests that FOMC inflation forecasts do not enhance the implementation of standard policy actions. However, FOMC inflation forecasts give information on the future Fed rate movements. An interpretation of this empirical evidence is that FOMC inflation forecasts do not help private agents interpreting interest rate changes and current policy decisions but rather signal future monetary policy intentions. FOMC inflation forecasts may therefore be considered as a less conventional tool to provide forward guidance.

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[14] Hayo and Neuenkirch (2010) find a similar result with a communication indicator encompassing speeches of Fed's governors and regional presidents.

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Table 1 - Introductory Tests

	Constant	Std.Err	Forecast	Std.Err	N_obs
Rationality Tests for Inflation Forecasts					
Dependant variable: AGG					
FOMC	0.30	(0.18)	0.87	(0.04)	63
SPF	0.22	(0.18)	0.92	(0.07)	63
Dependant variable: PGDP					
FOMC	0.23	(0.38)	0.83	(0.08)	63
SPF	0.05	(0.32)	0.92	(0.09)	63

Descriptive Statistics of Absolute Forecast Errors	MAFE	S.D.	Min	Max	N_obs
FOMC vs. AGG	0.58	0.48	0.02	2.03	63
FOMC vs. PGDP	0.78	0.51	0.00	2.09	63
SPF vs. AGG	0.58	0.50	0.00	2.37	63
SPF vs. PGDP	0.62	0.43	0.02	1.74	63

Rationality regressions are estimated with Newey-West procedure (and maximum lag = 4) and standard errors are corrected for serial correlation. FOMC is the mid-point of the central tendancy range. SPF is SPF_PGDP_Q4. Because of the inflation measure forecasted evolved, tests are decomposed between AGG, an aggregated series of inflation based on PGDP, CPI, PCE and Core PCE following the dates when the FOMC changed, and PGDP all over the sample. MAFE stands for the Mean Absolute Forecast Error.

Table 2 – Orderings used for the structural VAR model

Benchmark VAR	[Real GDP, Inflation, SPF, Fed rate, FOMC]
Model 2	[Real GDP, Inflation, Fed rate, FOMC, SPF]
Model 3	[Real GDP, Inflation, Fed rate, SPF, FOMC]
Model 4	[Real GDP, Inflation, FOMC, Fed rate, SPF]
Model 5	[Real GDP, Inflation, FOMC, SPF, Fed rate]
Model 6	[Real GDP, Inflation, SPF, FOMC, Fed rate]
Model 7	[Fed rate, SPF, FOMC]
Alternative VAR	[SPF, 10y rate, LIBOR rate, Fed rate, FOMC]

Table 3 – Variance Decomposition of SPF inflation forecasts

Benchmark VAR model

Contribution of:	Real GDP	Inflation	SPF	Fed rate	FOMC
Average of 10 periods	0.09	0.29	0.51	0.01	0.10

Table 4 - Granger causality Wald tests

Equation	Variable	chi2	df	Prob > chi2
		Benchmark VAR		
SPF	FOMC	6.01	2	0.05
FOMC	SPF	1.09	2	0.58
		SPF_PGDP_Q		
SPF	FOMC	14.77	2	0.00
FOMC	SPF	1.79	2	0.41
		SPF_AGG		
SPF	FOMC	6.44	2	0.04
FOMC	SPF	0.66	2	0.72
		Q1 only		
SPF	FOMC	18.20	1	0.00
FOMC	SPF	2.95	1	0.10
		Q3 only		
SPF	FOMC	12.38	1	0.00
FOMC	SPF	2.15	1	0.15

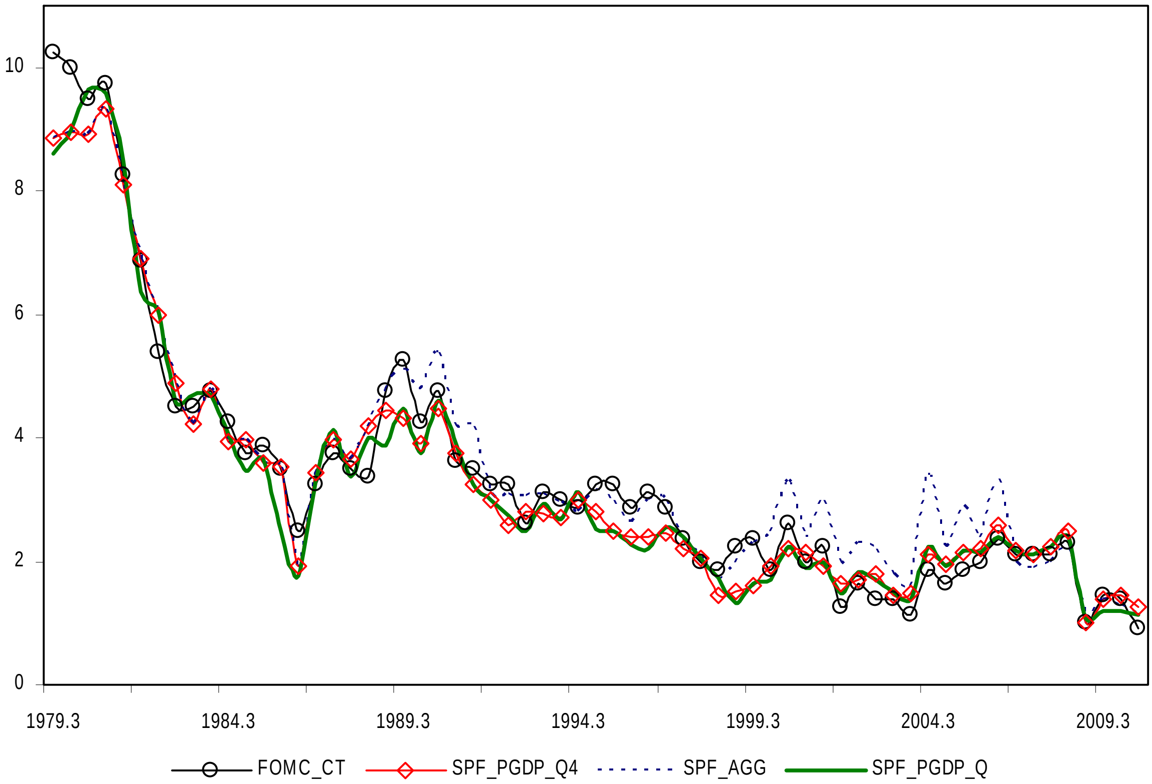
The benchmark VAR is estimated with SPF_PGDP_Q4, which is replaced by SPF_PGDP_Q and SPF_AGG in the next two estimations. *Q1 only* and *Q3 only* estimations are based on the benchmark VAR, with annual frequency, year average data for inflation, real GDP and the Fed rate, 1 lag and a small-sample estimator.

Table 5 – OLS regressions

	(1) SPF_PGDP_Q4	(2) SPF_PGDP_Q4	(3) SPF_PGDP_Q4	(4) SPF_PGDP_Q4
L. SPF_PGDP_Q4	0.788***	0.536***	0.330	-0.014
	[0.07]	[0.12]	[0.35]	[0.14]
Resid FOMC	0.696***	0.558***		
	[0.14]	[0.14]		
L.FOMC			0.405*	
			[0.23]	
FOMC				0.582***
				[0.09]
L.Fed rate	0.065		-0.014	
	[0.05]		[0.09]	
L.Inflation	0.232***		0.268**	
	[0.07]		[0.13]	
L.Real GDP	0.065***		0.065***	
	[0.01]		[0.02]	
L.10y Bonds	0.045*		0.071	
	[0.03]		[0.04]	
L.Libor	-0.144***		-0.096	
	[0.05]		[0.08]	
Fed rate		0.005		-0.090
		[0.07]		[0.06]
Inflation		0.375***		0.337***
		[0.08]		[0.06]
Real GDP		0.031		0.005
		[0.02]		[0.02]
10y Bonds		0.074		0.099**
		[0.05]		[0.04]
Libor		-0.048		0.035
		[0.08]		[0.07]
News	0.052*	-0.011	0.031	-0.001
	[0.03]	[0.04]	[0.04]	[0.03]
Constant	-0.098	-0.072	-0.126	-0.127
	[0.08]	[0.12]	[0.13]	[0.12]
N	62	62	62	62

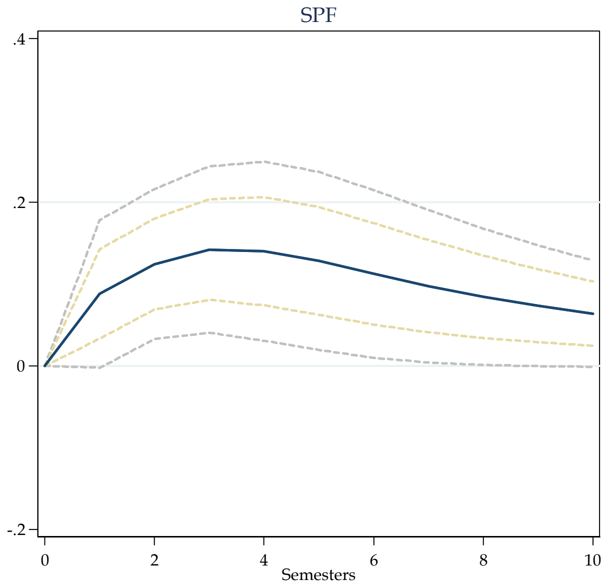
***, **, * denote significance at the 1%, 5% and 10% levels. Regression with Newey-West standard errors (in brackets) and with maximum lag = 4. The variable Resid FOMC corresponds to the residuals obtained from the Newey-West regression of FOMC inflation forecasts on one lag of the SPF inflation forecast, the Fed rate, the inflation rate, real GDP, the long-term rate, the LIBOR rate, the FOMC inflation forecasts and a variable comprising the set of macroeconomic news released between *t* and *t-1*. L is the first lag operator.

Figure 1 – FOMC and SPF inflation forecasts



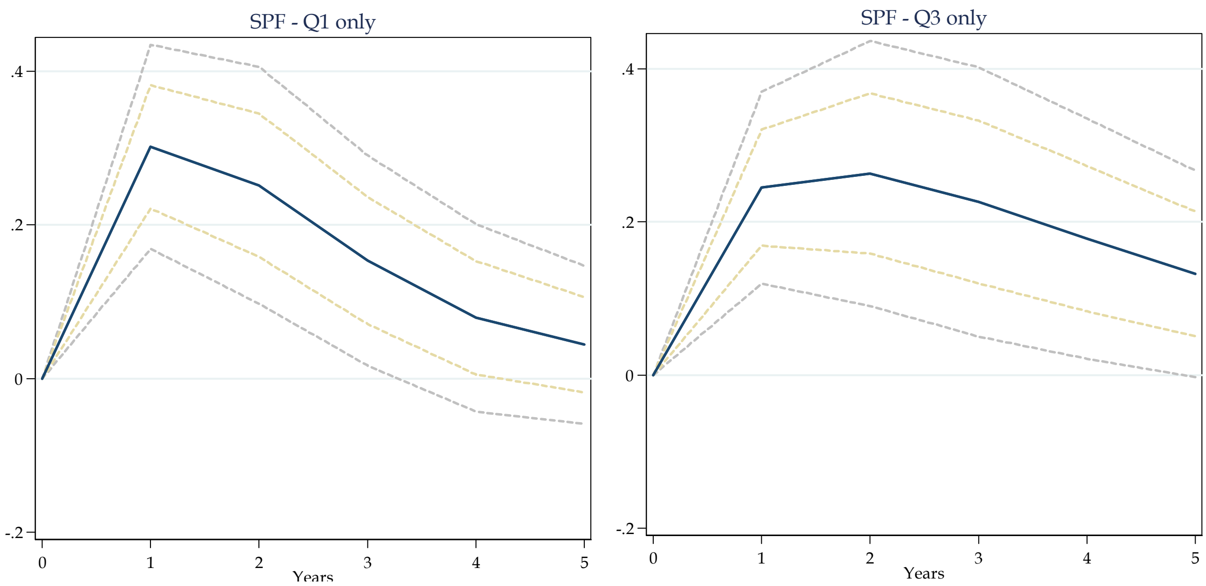
Note: FOMC_CT the mid-point of the central tendency of individual FOMC members' forecasts and is a fourth-quarter-over-fourth-quarter growth rate fixed-event forecast. SPF_PGDP_Q4 is the SPF inflation forecast for the GDP price index and is a fixed-event forecast for the fourth-quarter of the current year, SPF_PGDP_Q is a next quarter forecast (fixed-horizon) of annualized quarter-over-quarter growth rate, and SPF_AGG is a fourth-quarter of the current year forecast (fixed-event) aggregating GDP price index, PCI and core PCE to match FOMC data. The y-axis is in percent.

Figure 2 – Response to a FOMC inflation forecast shock



Note: Estimates based on the benchmark VAR. The dotted lines represent the 68% and 90% confidence intervals. The impulse response corresponds to the percentage point change in SPF inflation forecasts, in response to a one-S.D. innovation in the FOMC inflation forecast.

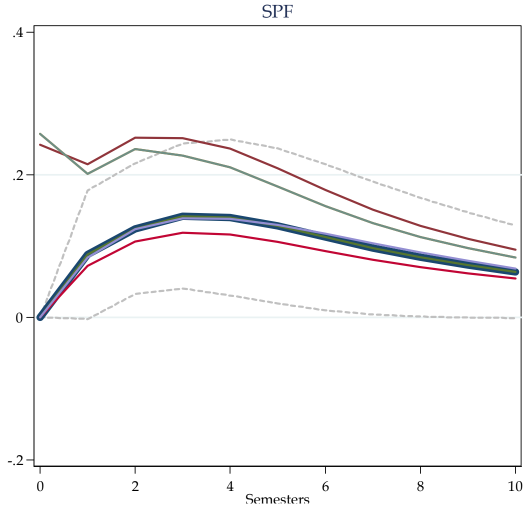
Figure 3 – Decomposing the biannual series in two separate annual series
Responses to a FOMC inflation forecast shock



Note: Estimates based on the benchmark VAR, with annual frequency, year average data, 1 lag and a small-sample estimator. The dotted lines represent the 68% and 90% confidence intervals. The impulse response corresponds to the percentage point change in SPF inflation forecasts, in response to a one-S.D. innovation in the FOMC inflation forecast.

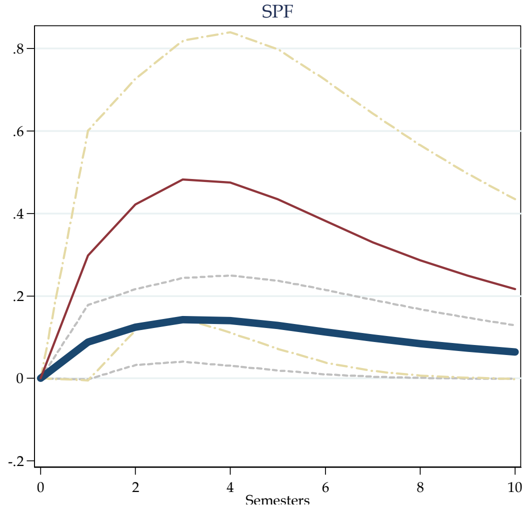
Figure 4 – Response of SPF inflation forecasts to a FOMC inflation forecast shock

4.1. Various orderings



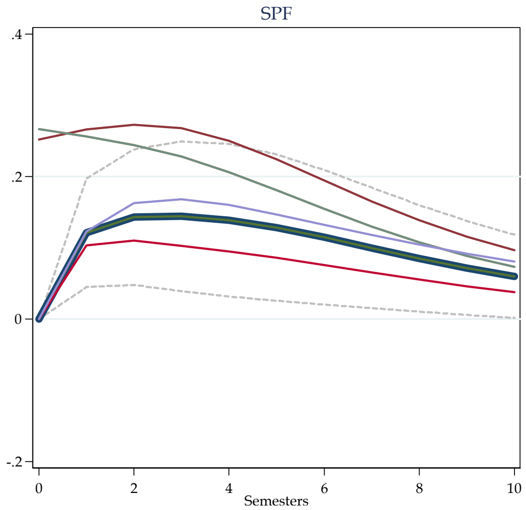
Note: Estimates based on the benchmark VAR and models 2-7. The dotted lines represent the 90% confidence intervals. The thick blue line is for benchmark VAR, maroon for model 2, green for model 3, orange for model 4, grey for model 5, red for model 6 and purple for model 7. The impulse response corresponds to the percentage point change in SPF inflation forecasts, in response to a one-S.D. innovation in the FOMC inflation forecast.

4.2. Structural vs. Reduced-form VAR



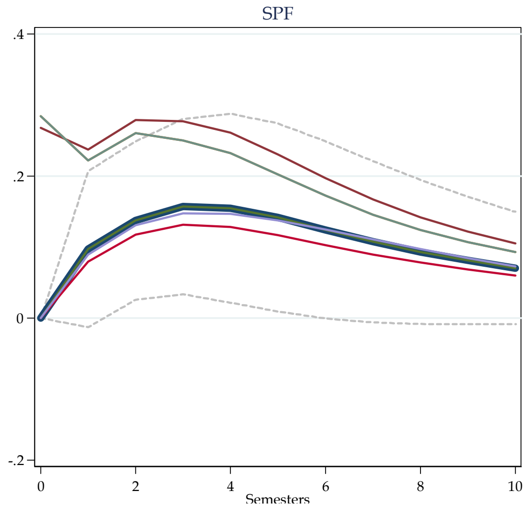
Note: Estimates based on the benchmark structural VAR (thick blue line). The dotted lines represent the 90% confidence intervals. The red line represents the SPF response based on the reduced-form VAR and the dash-dotted lines the associated 90% confidence intervals. The impulse response corresponds to the percentage point change in SPF inflation forecasts, in response to a one-S.D. innovation in the FOMC inflation forecast.

4.3. VAR with 1 lag



Note: Estimates based on the benchmark VAR and models 2-7. The dotted lines represent the 90% confidence intervals. The thick blue line is for benchmark VAR, maroon for model 2, green for model 3, orange for model 4, grey for model 5, red for model 6 and purple for model 7. The impulse response corresponds to the percentage point change in SPF inflation forecasts, in response to a one-S.D. innovation in the FOMC inflation forecast.

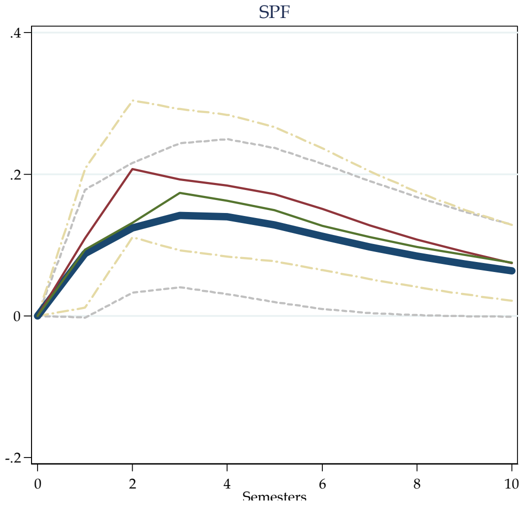
4.4. Small sample estimator



Note: Estimates based on the benchmark VAR and models 2-7. The dotted lines represent the 90% confidence intervals. The blue line is for benchmark VAR, maroon for model 2, green for model 3, orange for model 4, grey for model 5, red for model 6 and purple for model 7. The impulse response corresponds to the percentage point change in SPF inflation forecasts, in response to a one-S.D. innovation in the FOMC inflation forecast.

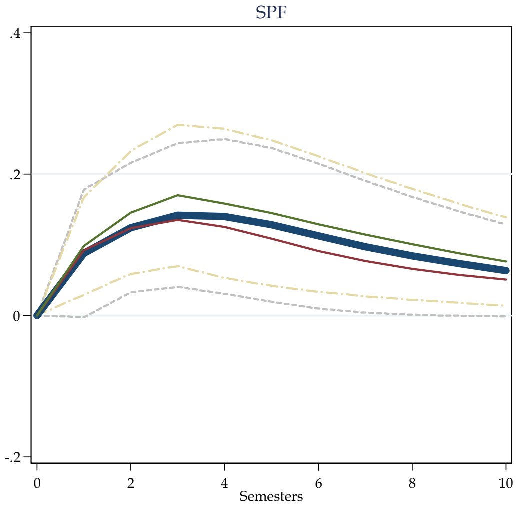
Figure 5 – Response of SPF inflation forecasts to a FOMC inflation forecast shock

5.1. SPF Alternative Data



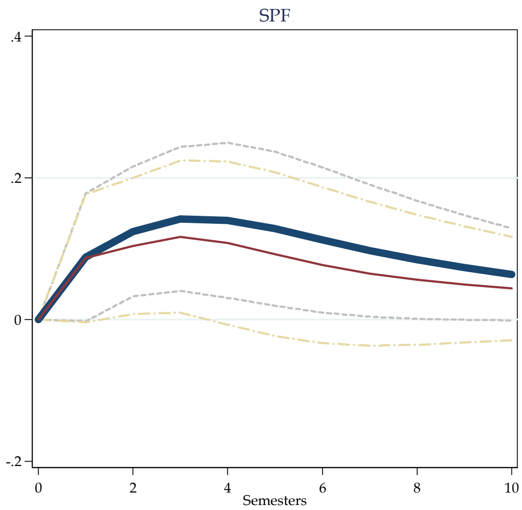
Note: Estimates based on the benchmark VAR with the SPF_PGDP_Q4 inflation forecasts (thick blue line). The dotted lines represent the 90% confidence intervals. The red line represents the SPF_PGDP_Q response (with the dash-dotted lines as its 90% confidence bands) and the green line the SPF_AGG response (based on GDP price index, CPI and core PCE to match FOMC data). The impulse response corresponds to the percentage point change in SPF inflation forecasts, in response to a one-S.D. innovation in the FOMC inflation forecast.

5.2. Final / Semester Average data



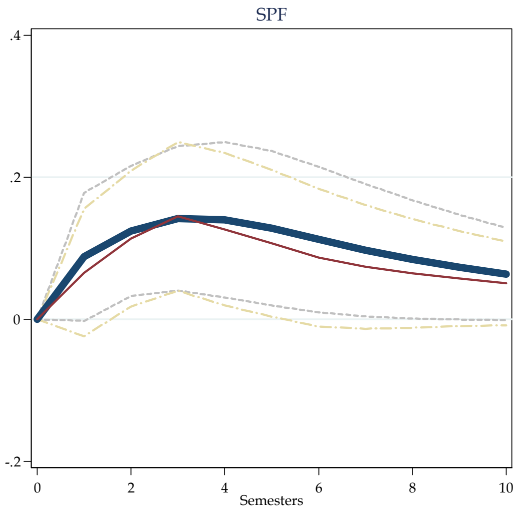
Note: Estimates based on the benchmark VAR with real-time data for inflation and real GDP (thick blue line). The dashed lines represent the 90% confidence intervals. The red line represents the SPF response based on the benchmark VAR with final data. The green line represents the SPF response with semester average data (with the dash-dotted lines as its 90% confidence bands). The impulse response corresponds to the percentage point change in SPF inflation forecasts, in response to a one-S.D. innovation in the FOMC inflation forecast.

5.3. FOMC - Full Range



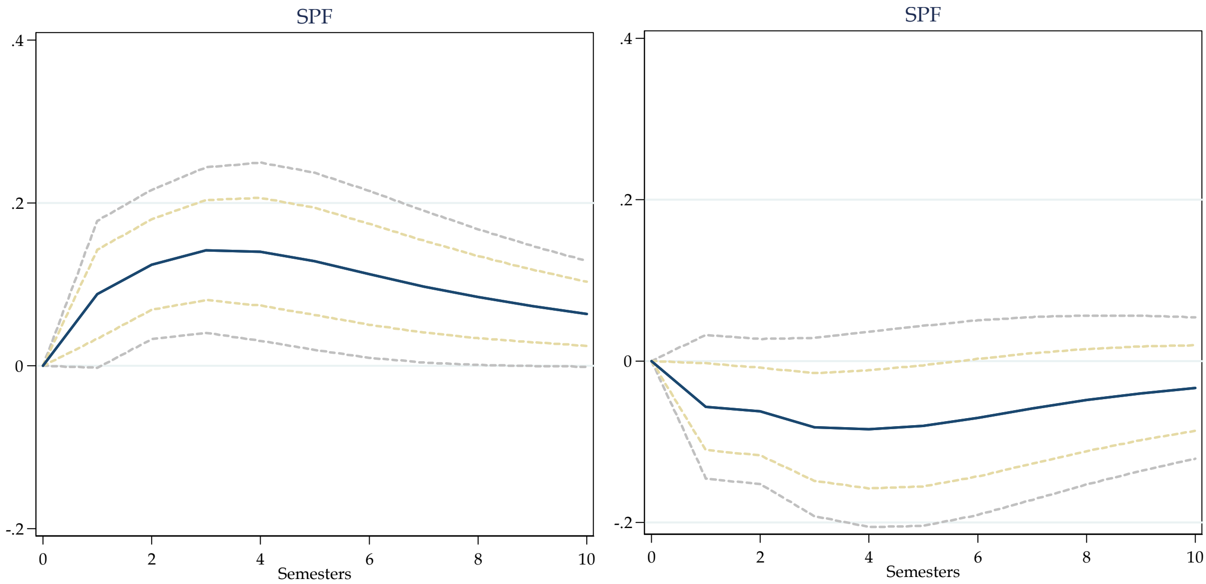
Note: Estimates based on the benchmark VAR with the mid-point of the central tendency (thick blue line). The dotted lines represent the 90% confidence intervals. The red line represents the SPF response with the mid-point of the full range (with the dash-dotted lines as its 90% confidence bands). The impulse response corresponds to the percentage point change in SPF forecasts, in response to a one-S.D. innovation in FOMC forecasts.

5.4. Alternative VAR



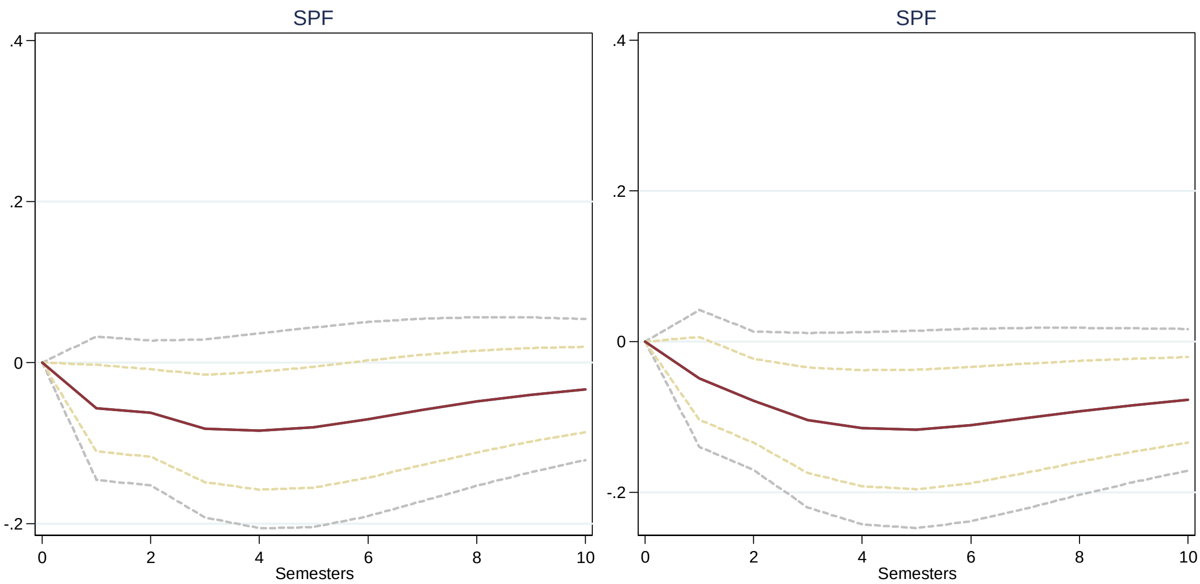
Note: Estimates based on the benchmark VAR with inflation and real GDP (thick blue line). The dotted lines represent the 90% confidence intervals. The red line represents the SPF response based on the alternative VAR with the LIBOR and 10-year bonds rates (with the dash-dotted lines as its 90% confidence bands). The impulse response is the percentage point change in SPF forecasts, after a one-S.D. innovation in FOMC forecasts.

Figure 6 – Hypothesis 1
SPF response to
FOMC inflation forecast (left column) and Fed rate (right column) shocks



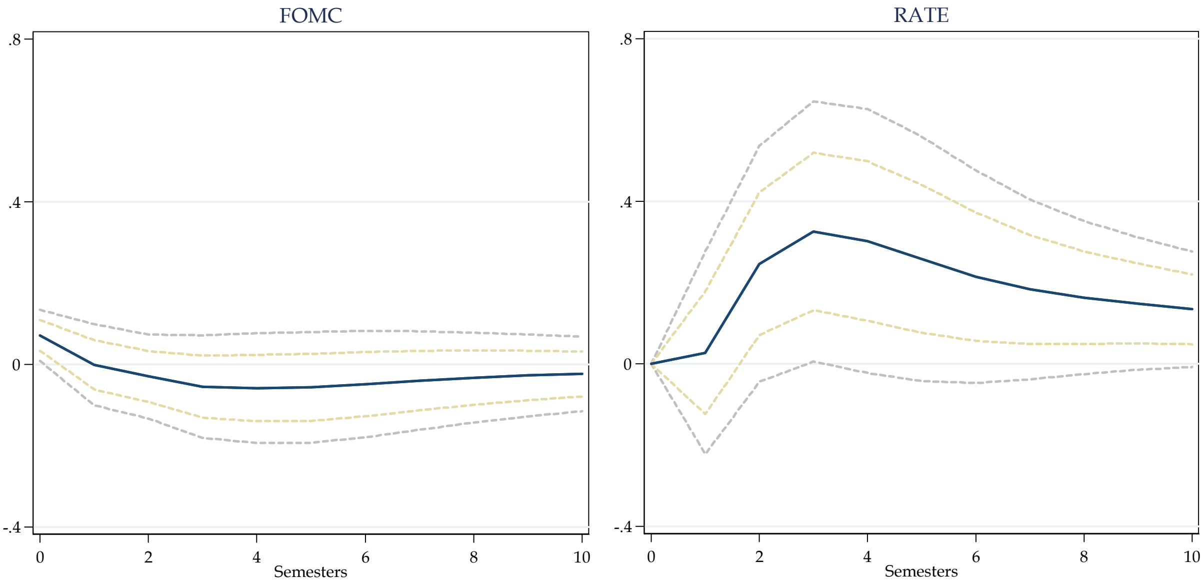
Note: Estimates based on the benchmark VAR. The dotted lines represent the 68 and 90% confidence intervals. The impulse response corresponds to the percentage point change in SPF inflation forecasts, in response to a one-S.D. innovation in the FOMC inflation forecast (left) or the Fed rate (right).

Figure 7 – Hypothesis 2
SPF response to a Fed rate shock
– Without restrictions (left column) / With restrictions (right column)
to artificially shut-off the FOMC forecasts channel



Note: Estimates based on the benchmark VAR. The dotted lines represent the 68 and 90% confidence intervals. The impulse response corresponds to the percentage point change in SPF inflation forecasts, in response to a one-S.D. innovation in the Fed rate, when restricting coefficients of FOMC inflation forecasts to zero in the SPF equation in the VAR.

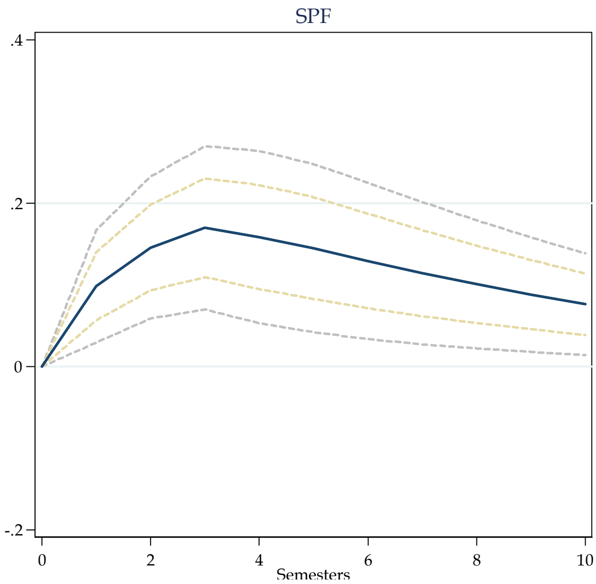
Figure 8 – Hypothesis 3
FOMC response to a Fed rate shock (left column)
and Fed rate response to a FOMC inflation forecast shock (right column)

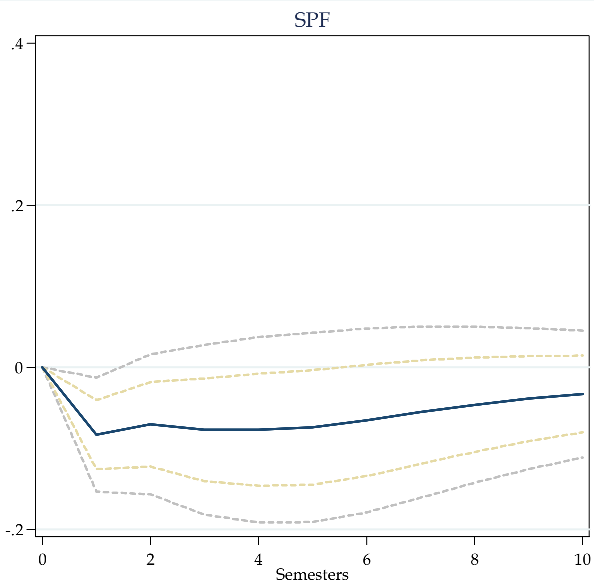


Note: Estimates based on the benchmark VAR. The dotted lines represent the 68 and 90% confidence intervals. The impulse response corresponds to the percentage point change in FOMC inflation forecasts, in response to a one-S.D. innovation in the Fed rate (left hand side), and the change in the Fed rate, in response to a one-S.D. innovation in FOMC inflation forecasts (right hand side).

APPENDIX

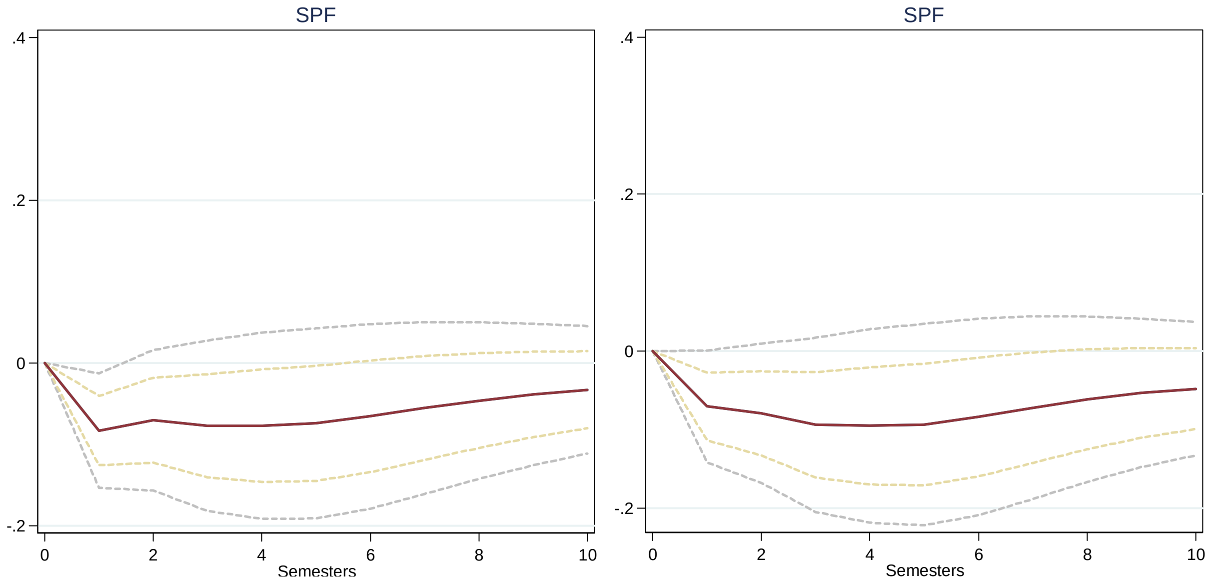
Figure A.1 – Semester Average Data
Hypothesis 1:
SPF response to a Fed rate shock
FOMC inflation forecast (left column) and Fed rate (right column) shocks





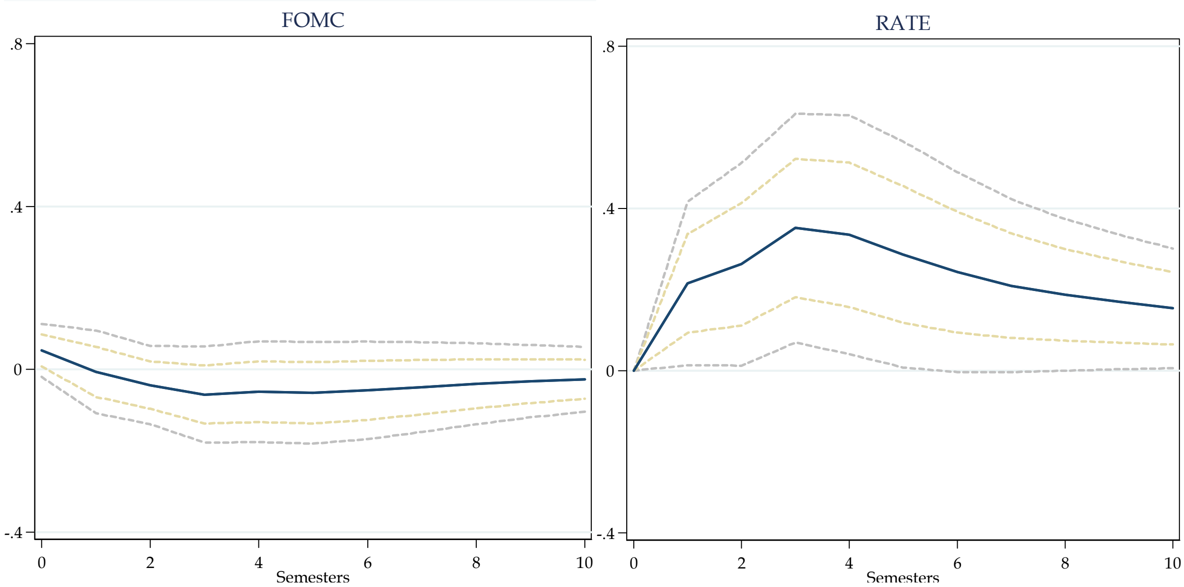
Note: Estimates based on the benchmark VAR. The dotted lines represent the 68 and 90% confidence intervals. The impulse response corresponds to the percentage point change in SPF inflation forecasts, in response to a one-S.D. innovation in the FOMC inflation forecast or the Fed rate.

Figure A.2 – Semester Average Data
Hypothesis 2:
SPF response to a Fed rate shock
– Without restrictions (left column) / With restrictions (right column)
to artificially shut-off the FOMC forecasts channel



Note: Estimates based on the benchmark VAR. The dotted lines represent the 68 and 90% confidence intervals. The impulse response corresponds to the percentage point change in SPF inflation forecasts, in response to a one-S.D. innovation in the Fed rate, when including or excluding FOMC inflation forecasts from the VAR.

Figure A.3 – Semester Average Data
Hypothesis 3:
FOMC response to a Fed rate shock (left column)
and Fed rate response to a FOMC inflation forecast shock (right column)



Note: Estimates based on the benchmark VAR. The dotted lines represent the 68 and 90% confidence intervals. The impulse response corresponds to the percentage point change in FOMC inflation forecasts, in response to a one-S.D. innovation in the Fed rate (left hand side), and the change in the Fed rate, in response to a one-S.D. innovation in FOMC inflation forecasts (right hand side).