Signals from the Government: Policy Disagreement and the Transmission of Fiscal Shocks

Giovanni Ricco[a], Giovanni Callegari[b], Jacopo Cimadomo[c]

[a]*Department of Economics, The University of Warwick, The Social Sciences Building, Coventry, West Midlands CV4 7AL, United Kingdom. Email:* `G.Ricco@warwick.ac.uk`.
[b]*Corresponding author. European Central Bank, Fiscal Policies Division, Sonnemannstrasse 20, D-60314 Frankfurt am Main, Germany, E-mail:* `giovanni.callegari@ecb.europa.eu`, *Phone: +49 69 1344 6529.*
[c]*European Central Bank, Fiscal Policies Division, Sonnemannstrasse 20, D-60314 Frankfurt am Main, Germany, E-mail:* `jacopo.cimadomo@ecb.europa.eu`.

Abstract

We investigate the effects of fiscal policy communication on the propagation of government spending shocks. To this aim, we propose a new index measuring the coordination effects of policy communication on private agents' expectations. This index is based on the disagreement amongst US professional forecasters about future government spending. The underlying intuition is that a clear fiscal policy communication can coalesce expectations, reducing disagreement. Results indicate that, in times of low disagreement, the output response to fiscal spending innovations is positive and large, mainly due to private investment response. Conversely, periods of elevated disagreement are characterised by muted output response.

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1. Introduction

The impact of economic policy decisions depends, to a great extent, on how they are communicated and affect agents' expectations, and hence their actions. Indeed, private agents can form expectations about the future course of fiscal policy by combining information conveyed by government announcements and privately collected information. In an economic system with dispersed information where the government has potentially superior information on its procedures, forecasts and policy plans, policymakers can coordinate private agents' beliefs and reduce disagreement by releasing additional information about current and future policies.

This paper focuses on the expectation coordination effects of fiscal policy communication and provides an empirical assessment of the implications of disagreement amongst agents for the transmission of fiscal impulses in the United States. We develop an indirect measure of precision of fiscal policy communication derived from forecasters' disagreement on the future path of federal fiscal spending, based on the Survey of Professional Forecasters (SPF). The underlying intuition is that a clear fiscal policy communication can coalesce private sector expectations on future policy measures, which in turn reduces agents' disagreement. Based on this, we formulate our empirical

strategy consistently with the implications of imperfect information models (see Mankiw and Reis, 2002, Woodford, 2002, Sims, 2003 and Reis, 2006a,b) by structuring it in the three following steps.

First, in order to pin down the fluctuations in disagreement that are due to policy communication and not to cyclical macroeconomic disturbances, we project the cross sectional dispersion of forecasts about future government spending onto the disagreement about current output. Second, following Ricco (2015), we identify fiscal spending shocks using individual revision of expectations at different horizons in US Survey of Professional Forecasters (SPF) data which we name 'fiscal news'. In doing this, we recognise that the presence of information frictions crucially modifies the econometric identification problem of fiscal shocks.[2] Third, we estimate an Expectational Threshold VAR (ETVAR) model using Bayesian techniques, where the proxies for fiscal news shocks are included together with a number of macroeconomic variables. The threshold variable is our disagreement index, and the threshold level is endogenously estimated.

Our results provide evidence that, during periods of high disagreement on

[2]In the presence of imperfect information, new information is only partially absorbed over time. Therefore, average forecast errors are likely to be a combination of both current and past structural shocks and cannot be thought of as being, *per se*, a good proxy for structural innovations (as, for example, proposed in Ramey, 2011).

fiscal policy, spending shocks have weak effects on the economy. Conversely, in periods of low disagreement, the output response to the spending news shock is positive, strong and significantly different from zero, reaching a cumulative medium-term multiplier of about 2.7 after 16 quarters. Our analysis also shows that the stronger stimulative effects in times of low disagreement are mainly the result of an accelerator effect of planned fiscal spending on investment. During the low disagreement regime, the Federal Reserve tends to be more reactive to spending increases than in periods of high disagreement. Overall, our analysis highlights the case for policy signalling as a tool to reduce disagreement and enhance the impact of spending shocks.

Our results speak to the literature on fiscal foresight (see Ramey, 2011, Leeper et al., 2012 and Leeper et al., 2013), and on state-dependent effects of fiscal policy (see, for example, Auerbach and Gorodnichenko, 2012, Owyang et al., 2013 and Caggiano et al., 2014).

However, differently form these works, our paper connects to the recent literature on imperfect information and on the formation of economic expectations (see, amongst others, Mankiw et al., 2004, Dovern et al., 2012, Coibion and Gorodnichenko, 2010, 2012, Andrade and Le Bihan, 2013 and Andrade et al., 2014). In fact, we employ an identification scheme of fiscal

shocks that is coherent with the implications of imperfect information models and use expectational data in order to study the effects of disagreement amongst agents. Importantly, we focus on the role of public signals in reducing disagreement and in coordinating expectations. To the best of our knowledge, this is the first empirical attempt to study how different levels of precisions in fiscal policy communication affect the transmission mechanism of fiscal shocks, through disagreement.

In doing that we also relate to the literature on policy communication. The analysis of the trade-offs underlying the provision of public signals by policy-makers to an economy in which agents have dispersed information was pioneered by Morris and Shin (2003a,b) in the context of monetary policy.[3] Differently from this literature, our paper focuses on fiscal policy and provides stylised empirical facts on the implication of increased transparency, without studying the relation between public and private signal from a welfare perspective. In this respect, it is more closely related to Melosi (2012) that proposes an econometric study of a signalling channel of monetary policy.

This paper is structured as follows: Section 2 discusses the properties of

[3]More recent theoretical contributions have been proposed, amongst others, by Angeletos et al. (2006), Baeriswyl and Cornand (2010), Hachem and Wu (2014), Frenkel and Kartik (2015).

expectational data on US fiscal spending. Section 3 is devoted to the construction of the fiscal policy disagreement index used in this paper. Section 4 comments on the identification of fiscal shocks. Section 5 illustrates our Bayesian Threshold VAR model. Section 6 presents our main results and provides insights on the transmission channels. Finally, Section 7 concludes.

2. Forecasting Fiscal Spending

In the Philadelphia Fed's quarterly SPF, professional forecasters are asked to provide expected values of a set of 32 macroeconomic variables for both the present quarter (nowcast) and up to four quarters ahead (forecast). SPF forecasters do not know the current value of these macroeconomic variables, which are only released with a lag. The panelists' information set includes the BEA's advance report data, which contains the first estimate of GDP (and its components) for the previous quarter. The deadline for responses is the second to third week of the middle month of each quarter.[4]

For 'real federal government consumption expenditures and gross investment', the main series of interest in this work, professional forecasters' in-

[4]The Survey does not report the number of experts involved in each forecast or the forecasting method used. Professional forecasters are mostly private firms in the financial sector. On average, in the sample, there are 29 respondents per period of which 22 appear in consecutive periods.

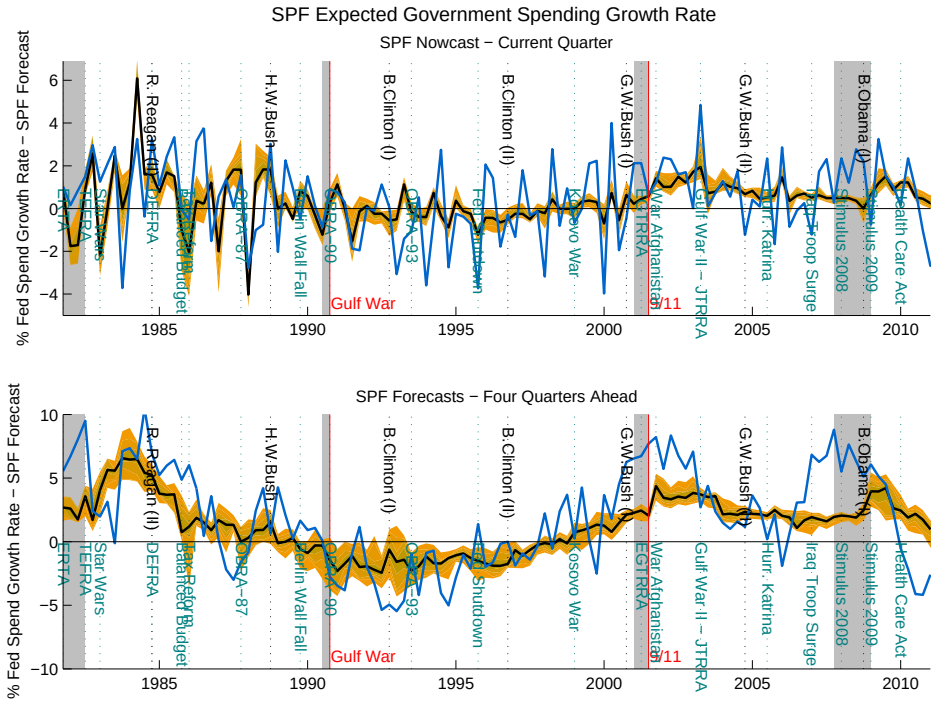

Figure 1: **Government Spending Expected Growth rates − Fan Chart**. The figure plots the SPF median expected growth rate for the current quarter and for the four future quarters, together with forecasters' disagreement up to one standard deviation (orange), and the realised growth reates (blue). Grey shaded areas indicate the NBER Business Cycle contraction dates. Vertical lines indicate the dates of the announcement of important fiscal and geopolitical events (teal), presidential elections (black), and the Ramey-Shapiro war dates (red).

dividual responses have been collected from 1981Q3 to 2012Q4. Figure 1 reports the median expected growth rate of federal spending for the current quarter and for the four quarters ahead, together with forecasters' disagreement (the cross-sectional standard deviation of individual forecasts) and the historically realised growth rates.

Some features of the SPF's survey data on fiscal spending are noteworthy and common to the forecasts of other macroeconomic variables. As is evident in Figure 1, expectations about fiscal spending are more stable than the actual series. Expectations are sluggish in that they typically underestimate the movements of the forecast variable, despite being able to capture low frequency movements. Moreover, experts' forecasts exhibit predictable errors and can be Granger-predicted (see Ricco, 2015). Experts disagree as they report different predictions at different forecast horizons and when updating their forecasts. The extent of their disagreement evolves over time (see Figure 1 and discussion in Section 4). Finally, forecast revisions at different horizons for a given event in time are positively correlated.

The above facts are broadly consistent with professional forecasters' data being generated in a model of imperfect information rational expectations. In fact, imperfect information models in the form of delayed-information or noisy-information are able to account for at least three important features of expectational data: the presence of disagreement, the forecastability of errors, and the autocorrelation of expectation revisions. As shown by Coibion and Gorodnichenko (2010), the latter can be used to evaluate the implied

degree of information rigidity.[5]

3. Disagreement over Fiscal Policy

We propose an index of precision of fiscal policy communication derived from the forecasters' disagreement on the future path of fiscal spending. The underlying intuition is that a clear fiscal policy communication can coalesce private sector expectations on future policy measures, which in turn reduces agents' disagreement. Conversely, higher than average disagreement about future government spending reveals poor communication from the government about the future stance of fiscal policies.

Developing this idea, we focus on the component of the disagreement among forecasters about the future federal spending developments that is orthogonal to the disagreement about current macroeconomic conditions. The resulting index has three main features: (1) it relies on expectational real time ex-ante data only; (2) it is linearly uncorrelated with the business cycle; (3) it is fully non-judgmental. Moreover, it is consistent with our definition of fiscal shocks that are extracted from the same expectational dataset, and on a similar time horizon.

[5] In our sample, the serial correlation between forecast revisions is around 0.2, implying a degree of information rigidity of 0.8.

To construct the index for fiscal policy disagreement, a two-step procedure is followed. First, the time-varying cross-sectional standard deviation of the SPF forecasts (disagreement) for real federal government spending is computed at the four-quarters horizon. Second, the component of disagreement related to discretionary policy is extracted by projecting the disagreement among forecasters about the future development of fiscal spending onto the disagreement about the current macroeconomic conditions. This is done in order to address the issue of exogeneity with respect to the macroeconomic cycle. We think of this component as affected by the policy communication regime.

We justify this procedure (i) theoretically, using a simple noisy-information model to discuss under which assumptions the index obtained could be correctly thought of as an approximation of the agents' disagreement about the discretionary fiscal spending and (ii) empirically, matching this index with a historical narrative.

3.1. Disagreement in a Stylised Noisy-information Model

A simple noisy-information model with Bayesian learning can help in more precisely defining the concepts used and in clarifying the assumptions underlying our approach. A stylised reduced form equation that decomposes

government spending into a discretionary component and an automatic one can be written as

$$g_t = \mu_g + g_t^d + \kappa y_{t-1} \ , \tag{1}$$

where μ_g is a constant, g_t^d is the discretionary component of fiscal spending and the term κy_{t-1} represent the (lagged) systematic response of fiscal spending to business cycle fluctuations. Similarly to Lahiri and Sheng (2010), we assume that each agent i, at each quarter t, receives a public signal from the policymaker that is informative about the future growth of discretionary fiscal spending, g_{t+h}^d, at horizon h

$$n_{t+h} = g_{t+h}^d + \eta_{t,h} \ , \qquad \eta_{t,h} \sim \mathcal{N}\left(0, \sigma^2_{(\eta)t,h}\right) . \tag{2}$$

Agents complement the information carried by the public signal using other sources of information. That is, they receive a private signal or a signal obtained by random sampling from diffuse information publicly available, i.e.,

$$s_{t+h}^i = g_{t+h}^d + \zeta_{t,h}^i \ , \qquad \zeta_{t,h}^i \sim \mathcal{N}\left(0, \sigma^2_{(\zeta)i,t,h}\right) . \tag{3}$$

Without loss of generality, we can assume that the public and the private signals are independent. Each forecaster combines the two signals, via Bayesian updating, to form conditional expectations for g^d_{t+h}:

$$\widehat{g}^d_{i,t+h} = \mathbb{E}^i \left[g^d_{t+h} | n_{t+h}, s^i_{t+h} \right] = \frac{\sigma^2_{(\eta)t,h} s^i_{t+h} + \sigma^2_{(\zeta)i,t,h} n_{t+h}}{\sigma^2_{(\zeta)i,t,h} + \sigma^2_{(\eta)t,h}} \ . \tag{4}$$

The disagreement at time t amongst forecasters about discretionary fiscal spending at time $t+h$ can be defined as:

$$\begin{aligned} \mathcal{D}_t(g^d_{t+h}) &\equiv \mathbb{E} \left[\frac{1}{N-1} \sum_{i=1}^{N} \left(\widehat{g}^d_{i,t+h} - \frac{1}{N} \sum_{j=1}^{N} \widehat{g}^d_{j,t+h} \right)^2 \right] \\ &= \frac{\sigma^2_{(\eta)t,h}}{N} \sum_{i=1}^{N} \frac{\sigma^2_{(\zeta)i,t,h}}{\sigma^2_{(\zeta)i,t,h} + \sigma^2_{(\eta)t,h}} \left(1 - \frac{1}{N-1} \sum_{j \neq i}^{N} \frac{\sigma^2_{(\zeta)j,t,h}}{\sigma^2_{(\zeta)j,t,h} + \sigma^2_{(\eta)t,h}} \right) \ , \end{aligned} \tag{5}$$

where $\widehat{g}_{i,t+h}$ is the individual forecast defined in equation (4). From Eq. (5), it is clear that when the precision of the public signal (the inverse of its variance) goes to infinity, the disagreement amongst agents goes to zero. Therefore, variations in the precision of the public signal are reflected in the variations of agents' disagreement over time. We think of the variance of the public signal on discretionary spending as dependent on the willingness of the policymaker to blur or clarify the policy indication, as well as the

policymaker's credibility.[6]

In our empirical analysis, we conceive the policy communication as roughly having two 'polar' regimes: high and low precision. While fluctuations of disagreement may be due to the endogenous dynamics of absorption of new information, as suggested by delayed-information models, we think of shifts in disagreement as a reflection of policy communication regimes.

3.2. Cyclical Variations in Disagreement

In order to pin down fluctuations in government spending disagreement that are due to policy communication and not due to cyclical macroeconomic disturbances, we need to control for variations of disagreement along the business cycle. In fact, it has been documented that disagreement about GDP growth strongly intensifies during recessions and reduces during expansions (see Dovern et al., 2012). For a linearised reduced form equation for output of the following form, which we might think as derived from a structural model

$$y_t = \mu_y + \sum_{i=1}^{n} c_n y_{t-i} + \sum_{j=0}^{m} d_j g^d_{t+j} + a_t \ , \tag{6}$$

[6]The precision of the privately extracted signal, possibly using diffused information, may depend on the information system, the policy decision process and institutional framework. We assume that, over the period of study, fluctuations in the precisions of the private signals are small compared to the variations in the variance of the public signal.

where the first sum is an autoregressive component of output up to lag n, the second is the sum of the output responses to the path of fiscal spending up to horizon m (the maximum horizon on which the government is able to release information) and a_t is a combination of macroeconomic shocks. The disagreement about total government spending (the observed quantity) is

$$\mathcal{D}_t(g_{t+1}) = (1 + d_1\kappa)\mathcal{D}_t(g^d_{t+1}) + \kappa^2\mathcal{D}_t(y_t) \ . \tag{7}$$

Hence, by regressing the disagreement amongst forecasters about the future development of fiscal spending onto the disagreement about current macroeconomic conditions, one can extract a measure of disagreement about discretionary policy measures.[7]

In light of the considerations made above, we regress the disagreement

[7]Regressing $\mathcal{D}_t(g_{t+1})$ onto $\mathcal{D}_t(y_t)$ can generate an endogeneity issue due to the fact that the residual in Eq. 7 may be correlated with the regressor. However, for our purpose, the bias introduced is likely to be small. A simple dimensional argument provides the intuition for this. Regressing $\log(\mathcal{D}_t(g_{t+1}))$ onto $\log(\mathcal{D}_t(y_t))$, one would find

$$\hat{\kappa}^2 = \frac{\mathbb{C}\text{ov}(\log(\mathcal{D}_t(g_{t+1})), \log(\mathcal{D}_t(y_t)))}{\mathbb{V}\text{ar}(\log(\mathcal{D}_t(y_t)))} = \kappa^2 + (1 + d_1\kappa)d_1^2 \frac{\mathbb{V}\text{ar}(\log(\mathcal{D}_t(g^d_{t+1})))}{\mathbb{V}\text{ar}(\log(\mathcal{D}_t(y_t)))} \ . \tag{8}$$

We can assess the order of magnitude of the second term observing that - based on SPF historical data - the ratio of disagreement on current output over disagreement on future government spending is around 10^{-1}, hence the constant d_1^2 (the output multiplier of a quarter ahead increase in fiscal spending) has to be of order 10^{-2}. Hence, we conclude that the bias is at most of order 10^{-2}, while κ^2 is likely to be of order one.

of the forecasts on real government spending for the four quarters ahead - measured as the log of the cross-sectional standard deviation - on the log-disagreement of the forecasts on current GDP, its lags, and a constant. In doing this, we assume that forecasts of future government spending do not incorporate information about other macroeconomic shocks affecting future but not current GDP. Our fiscal policy disagreement index is thus obtained by exponentiating and standardising the regression residuals. By construction, these residuals are linearly uncorrelated with the disagreement about current macroeconomic conditions.[8]

3.3. Policy Disagreement

Our fiscal policy disagreement index is reported in Figure 2. It appears to well track a narrative of the main events surrounding the management of fiscal policy in the US since the 1980s. The first peak coincides with the announcement of the "Star Wars" programme by Reagan in 1983Q1. The index then rises with the 1984 presidential elections and following the fiscal activism of President Reagan's second term. The next spike in disagreement is related to the fall of the Berlin wall. In the 1990s, the index shows increases

[8] As a robustness check, we have also added the dispersion of the forecasts on current unemployment and CPI inflation to the regressors. Results (not shown, available upon request) are broadly unchanged.

in disagreement generated by the presidential elections, the change from a Republican to a Democratic administration, the 'federal shutdown' in 1995, and the war in Kosovo. In the 2000s, the disagreement index spikes in relation to the war in Afghanistan and the 2001 and 2003 Bush tax cuts, followed by the Gulf War, Iraq War troop surge, the 2008 and 2009 stimulus acts and, finally, the 'Debt Ceiling Crisis' of 2011.

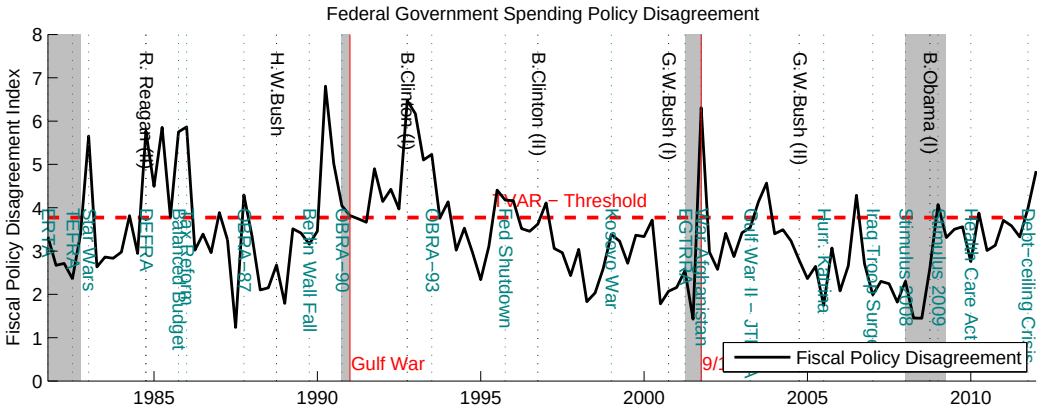

Figure 2: **Policy Disagreement Index** - Time series of the fiscal policy disagreement index based on the dispersion of SPF forecasts (black). Grey shaded areas indicate the NBER business cycle contraction dates. Vertical lines indicate the dates of the announcement of important fiscal and geopolitical events (teal), presidential elections (black), and the Ramey-Shapiro war dates (red). The thick red dashed line indicate the TVAR endogenous threshold.

4. Fiscal News

We identify fiscal shocks using SPF forecast revisions of federal government consumption and investment forecasts, which can be thought of as fiscal

news. The h quarters ahead forecast error can be decomposed into the flow of fiscal news, which updates the agents' information set $\mathcal{I}_t$ over time:

$$\underbrace{g_t - \mathbb{E}^*_{t-h} g_t}_{\substack{\text{forecast error} \\ h \text{ periods ahead}}} = \underbrace{(g_t - \mathbb{E}^*_t g_t)}_{\substack{\text{nowcast error} \\ \notin \mathcal{I}_t}} + \underbrace{(\mathbb{E}^*_t g_t - \mathbb{E}^*_{t-1} g_t)}_{\substack{\text{nowcast revision} \\ (\text{news at t}) \in \mathcal{I}_t}} + \cdots$$

$$\cdots + \underbrace{(\mathbb{E}^*_{t-h+1} g_t - \mathbb{E}^*_{t-h} g_t)}_{\substack{\text{forecast revision} \\ (\text{news at t-h+1}) \in \mathcal{I}_{t-h+1}}} \quad . \tag{9}$$

where $\mathbb{E}^*$ is the agents' expectation operator and g is government spending growth. The first term on the right-hand side corresponds to the *nowcast error*, which can be thought of as a proxy for agents' misexpectations which can be revealed only at a later date (at least after a quarter). The other components (nowcast and forecast revisions) can be seen as proxies for the *fiscal news*, which are related to current and future realisations of fiscal spending, and are received by the agents and incorporated into their expectations.

We define two measures of fiscal news in the aggregate economy that are both related to the revision of expectations of the government spending growth rate in the current quarter and in the future 3 quarters (the maximum

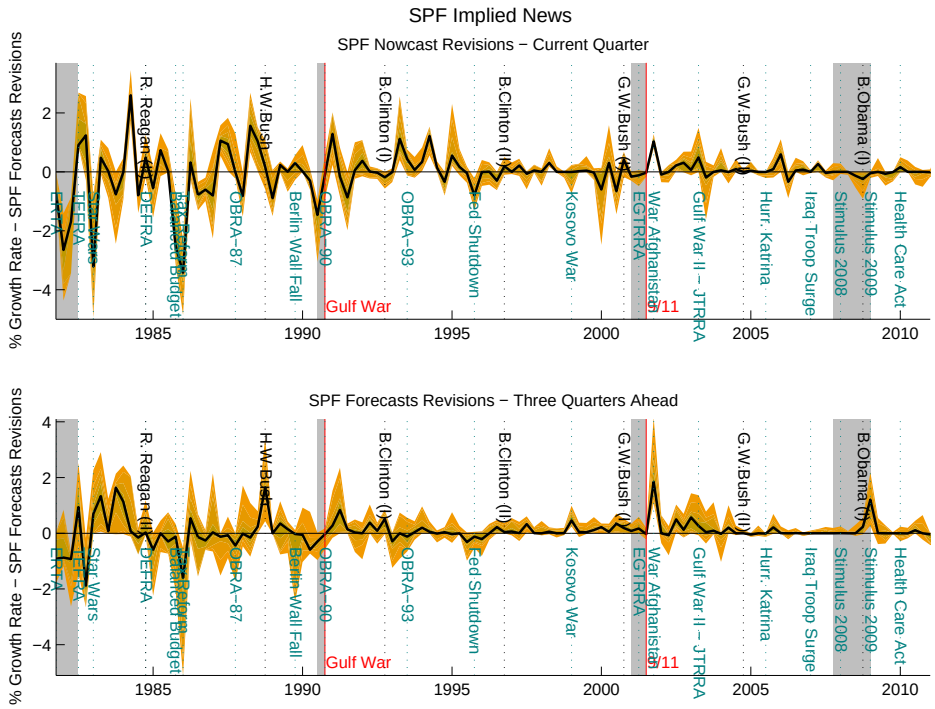

Figure 3: **Government Spending News – Fan Chart**. The figure plots the mean implied SPF news on the current quarter and for future quarters, together with forecast disagreement up to one standard deviation. Grey shaded areas indicate the NBER Business Cycle contraction dates. Vertical lines indicate the dates of the announcement of important fiscal and geopolitical events (teal), presidential elections (black), and the Ramey-Shapiro war dates (red).

horizon available in the data):

$$\mathcal{N}_t(0) = \frac{1}{N}\sum_{i=1}^{N}\left(\mathbb{E}_t^{*i} g_t - \mathbb{E}_{t-1}^{*i} g_t\right) , \tag{10}$$

$$\mathcal{N}_t(1,3) = \frac{1}{N}\sum_{i=1}^{N}\sum_{h=1}^{3}\left(\mathbb{E}_t^{*i} g_{t+h} - \mathbb{E}_{t-1}^{*i} g_{t+h}\right) , \tag{11}$$

where i is the index of individual forecasters. Figure 3 plots the mean implied SPF news on the current quarter and for future quarters, together with forecaster disagreement up to one standard deviation. In the empirical analysis which follows, we use these two news measures, labelled as *nowcast revision* (equation 10) and *forecast revision* (equation 11), respectively.

The identification of fiscal shocks using expectation revisions is consistent with an imperfect information framework. As observed in Coibion and Gorodnichenko (2010), in more general models of imperfect information, the average *ex-post* forecast errors across agents and the average *ex-ante* forecast revisions are related by the following expression:

$$\underbrace{g_t - \mathbb{E}^*_{t-h} g_t}_{\text{forecast error}} = \frac{\lambda}{1-\lambda} \underbrace{\left(\mathbb{E}^*_{t-h} g_t - \mathbb{E}^*_{t-h-1} g_t\right)}_{\text{forecast revision (news)}} + u_{t-h+1,t} \ , \tag{12}$$

where λ is the parameter of information rigidity ($\lambda = 0$ in the case of full information), $\mathbb{E}^*_{t-h} x_t$ is the average forecast at time $t-h$, and $u_{t-h+1,t}$ is a linear combination of rational expectations errors from time $t-h$ to time t. Hence, conditional on the past information set, the revision of expectations is informative about structural innovations. In fact, from Equation (12) one readily obtains:

$$\underbrace{\left(\mathbb{E}^*_{t-h} g_t - \mathbb{E}^*_{t-h-1} g_t\right)}_{\text{news at t-h}} = \lambda \underbrace{\left(\mathbb{E}^*_{t-h-1} g_t - \mathbb{E}^*_{t-h-2} g_t\right)}_{\text{news at t-h-1}} + (1-\lambda) u_{t-h} \ . \tag{13}$$

In particular, we will think of the parameter of information rigidity related to fiscal spending as having two possible values, λ_L and λ_H, reflecting the policy communication regime.

5. A Bayesian Threshold VAR

In order to study the effects of policy communication in the transmission of fiscal shocks, we estimate a Threshold Vector-Autoregressive (TVAR) model with two endogenous regimes. In the TVAR model, regimes are defined with respect to the level of our fiscal spending disagreement index (high and low disagreement). A threshold VAR is well suited to provide stylised facts about the signalling effects of fiscal policy and to capture difference in regimes with high and low disagreement. Moreover, the possibility of regime shifts after the spending shock allow us to account for possible dependency of the propagation mechanism on the size and the sign of the shock itself.

Following Tsay (1998), a two-regime TVAR model can be defined as

$$y_t = \Theta(\gamma - \tau_{t-d}) \left(C^l + A^l(L)y_{t-1} + \varepsilon_t^l\right) + \Theta(\tau_{t-d} - \gamma) \left(C^h + A^h(L)y_{t-1} + \varepsilon_t^h\right) \ , \tag{14}$$

where $\Theta(x)$ is an Heaviside step function, i.e. a discontinuous function whose value is zero for a negative argument and one for a positive argument. The TVAR model allows for the possibility of two regimes (high and low disagreement), with different dynamic coefficients $\{C^i, A_j^i\}_{i=\{l,h\}}$ and variance of the shocks $\{\Sigma_\varepsilon^i\}_{i=\{l,h\}}$. Regimes are determined by the level of a threshold variable τ_t with respect to an unobserved threshold level γ. In our case, the delay parameter d is assumed to be a known parameter and equal to one, in order to check for the role of the communication regime in place right before the shock hits the economy.[9]

We estimate the TVAR model using Bayesian technique and the standard Minnesota and sum-of-coefficients prior proposed in the macroeconomic literature. The adoption of these priors has been shown to improve the forecasting performance of VAR models, effectively reducing the estimation

[9]The baseline TVAR model is estimated with 3 lags. Results are, however, robust if 2 or 4 lags are included. Longer lag polynomial are not advisable due to the relatively short time series available.

error while introducing only relatively small biases in the estimates of the parameters (e.g., Banbura et al., 2010).

The TVAR model specified in Eq. (14) can be estimated by maximum likelihood. It is convenient to first concentrate $\{C^i, A^i_j, \Sigma^i_\varepsilon\}_{i=\{l,h\}}$, i.e., to hold γ (and d) fixed and estimate the constrained MLE for $\{C^i, A^i_j, \Sigma^i_\varepsilon\}_{i=\{l,h\}}$. In fact, conditional on the threshold value γ, the model is linear in the parameters of the model $\{C^i, A^i_j, \Sigma^i_\varepsilon\}_{i=\{l,h\}}$. Since $\{\varepsilon^i_t\}_{i=\{l,h\}}$ are assumed to be Gaussian, and the Bayesian priors are conjugate prior distributions, the Maximum Likelihood estimators can be obtained by using least squares. The threshold parameter can be estimated, using non-informative flat priors, as

$$\hat{\gamma} = \arg\max \log \mathcal{L}(\gamma) = \arg\min \log |\widehat{\Sigma}_\varepsilon(\gamma)| \ , \tag{15}$$

where $\mathcal{L}$ is the Gaussian likelihood (see Hansen and Seo, 2002). Details on the Bayesian priors adopted, on the criteria applied for the choice of the hyperparameters and on the estimation procedure are provided in the on-line appendix.

Our baseline TVAR model includes the SPF implied fiscal news, the mean SPF forecast of GDP growth for the current quarter and four quarters ahead,

the fiscal policy disagreement index, federal government spending, the Barro-Redlick marginal tax rate[10], total private consumption and investment, real GDP and the Federal Fund Rate. We use quarterly data from 1981Q3 to 2012Q4 in real log per capita levels for all variables except those expressed in rates (see on-line appendix for data description).

In order to identify fiscal news shocks inside our model, we assume that discretionary fiscal policy does not respond to macroeconomic variables within a quarter. We also assume that agents observe only lagged values of macroeconomic variables and that, in forecasting future government spending, they incorporate the discretionary policy response to the expected output. Finally, we assume that there are no shocks to future realisations of output not affecting its current realisation (e.g., technology or demand shocks) that are foreseen by the policymakers and to which the government can react. These assumptions allow for a recursive identification of the fiscal shocks in

[10]The marginal tax rate is originally produced at the annual frequency by Barro and Redlick (2009), based on the NBER's TAXSIM model (see website). To generate data at the quarterly frequency we have applied the Litterman (1983)'s random walk Markov temporal disaggregation model - which is a refinement of Chow and Lin (1971) that allows to avoid step changes due to serial correlation in the regression's residuals - using as indicators quarterly data on GDP, prices and tax receipts.

which the fiscal variables are ordered as follow

$$(\mathcal{N}_t(0) \qquad \mathbb{E}_t^* \Delta \text{GDP}_t \qquad \mathcal{N}_t(1,3) \qquad \mathbb{E}_t^* \Delta \text{GDP}_{t+4} \qquad Y_t')' \tag{16}$$

and Y_t is a vector containing the macroeconomic variables of interest. Results are robust to ordering expectations about future output before fiscal news related to future quarters.

It is worth stressing that this ordering is consistent with the structure of expectation revisions delivered by models of imperfect information (see equation 13). Indeed, the VAR structure controls for past expectations revisions for a given event in time, isolating the contemporaneous structural shocks from components due to the slow absorption of information.

6. Disagreement and the Transmission of Fiscal Shocks

Figure 4 reports the impulse responses to the 3-quarter ahead fiscal news shock, formalised in equation 11, and generated by the 11-variables TVAR described in equation 14. Indeed, our main objects of interest are the news shocks related to future changes to government spending. In fact, given the more extended time lag between news and the actual implementation of the policy change, these shocks are more likely to be affected by policy commu-

nication than the nowcast revisions.[11] The responses are 'intra-regime' IRFs, i.e, computed assuming no transition between regimes.

In order to facilitate the comparison between the two regimes, the impulse responses have been normalised to have a unitary increase in federal spending at the 4-quarters horizon. Also, the IRFs of the variables in log-levels have been re-scaled by multiplying them by the average 'Variable-to-Federal Spending' ratio. In this way, the GDP, investment and consumption IRFs can be interpreted in 'dollar' terms. The impulse responses of the Federal Funds rate, of the marginal tax rate, and of the forecast and nowcast for GDP growth can be interpreted in terms of basis points change. The blue lines with crosses (for the low-disagreement regime, hereafter "L-D") and red lines with circle markers (for the high-disagreement regime, hereafter "H-D") indicate the reaction of the endogenous variables to an innovation in the forecast spending revision, with the shaded areas describing the evolution of the 68% coverage bands.

While the response of federal spending to the policy announcement is similar across the two regimes, the TVAR results reveal a very different

[11] The forecast revisions are also of particular interest because their time horizon is likely to include the shocks relative to budgetary news (usually impacting a period of one year, i.e., four quarters).

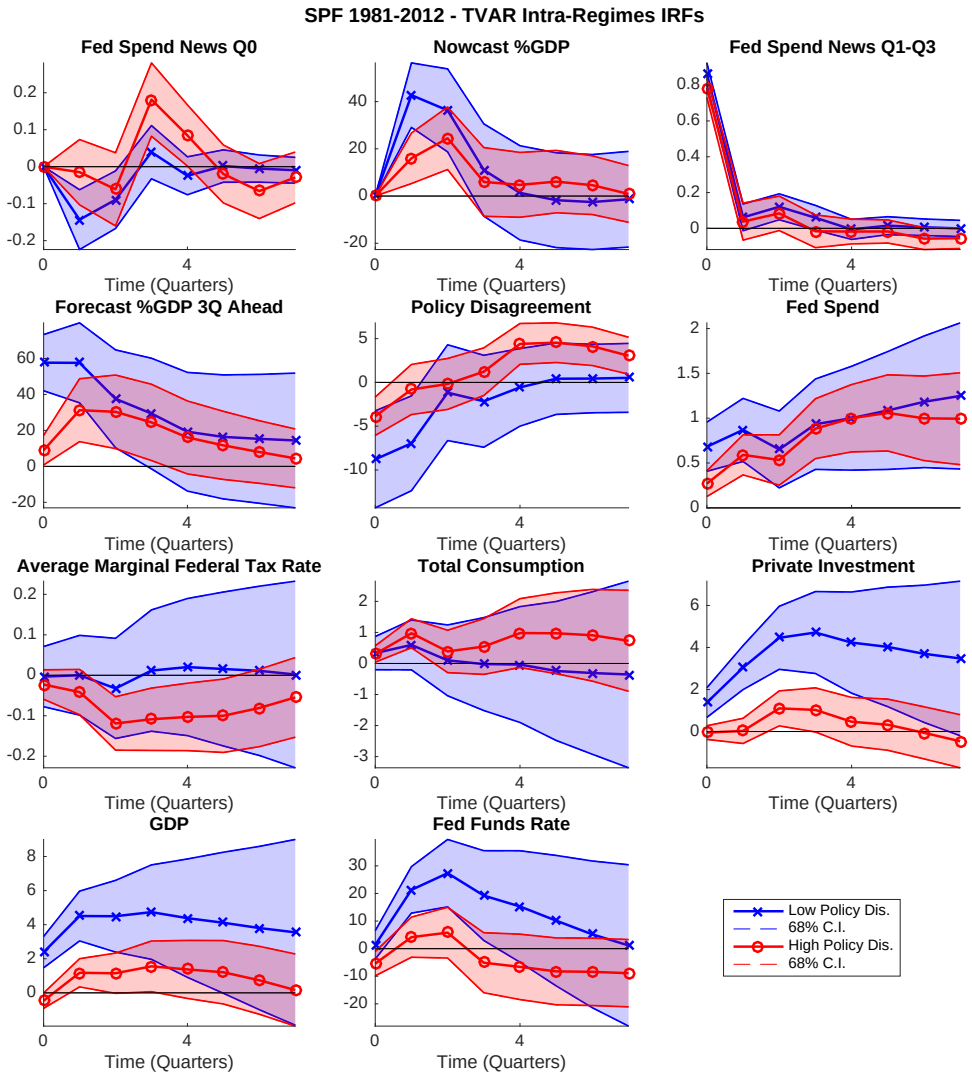

Figure 4: **Within-regime impulse responses - Impact of forecast revisions.** The shock corresponds to one standard deviation change in the revision of the spending forecasts three quarters ahead. The responses are generated under the assumption of constant disagreement regime. Impulse responses have been been normalised to have a unitary increase in Federal Spending at the 4-quarters horizon. Blue crossed line and fans (68% coverage bands) are relative to the low-disagreement regime, while the red lines with circle markers and fans (68% coverage bands) are relative to the high disagreement regime. Sample: 1981Q3-2012Q4.

transmission mechanism in the two regimes. The GDP response is always significant in the L-D regime and higher than in the H-D regime for at least three quarters after the shock. We also compute cumulative medium-run output multipliers, defined as the ratio between the sum of the GDP impulse responses up to the selected horizon (here, at horizon 16 quarters), and the corresponding sum of the responses for federal spending (see also Ilzetzki et al., 2013). The cumulative multiplier in the L-D regime is around 2.7, whereas the one in the H-D regime is around 0.5. The output multiplier from the linear model, averaging the two regimes, is about 1.2. The stronger GDP response in the L-D regime is also reflected in the impact response of 3-quarter ahead forecast GDP, thus confirming that a fiscal shock is more powerful in affecting economic expectations in the L-D than in the H-D regime.

The responses of the Federal Funds rate, and of total private consumption and investment, provide some evidence on the channels through which the two disagreement regimes are associated with a different propagation mechanism. While the response of private consumption is essentially the same in the two regimes (slightly positive on impact before becoming insignificantly different from zero), the response of private investment in the L-D

regime is significant and higher than the response in the H-D regime which, on the contrary, is never significantly different from zero. The accelerator effect of planned fiscal spending on investment in times characterised by less disagreement may be attributed to the expectation coordination effects of policy communication. The average marginal tax rate declines slightly in the medium run in the high disagreement regime, albeit it is not significantly different from the low disagreement regime response. The monetary policy stance tightens in the low disagreement case, as reflected in the more pronounced increase of the Federal Funds Rate. This may be explained by the willingness of the Fed to react to the potential inflationary pressure to the announced extra spending. This seems to reflect a response to the boost in demand observed following the news shock. Finally, our index of policy disagreement tends to decrease in the short-run after the news shock, and especially so in the low disagreement regime. This may be due to the release of information about the fiscal measure, which help to coordinate expectations and has the effect of dissipating the disagreement built-up in the policy debate prior to the announcement (as can also be inferred from Figure 2).

The evidence reported in Figure 4 highlights relevant differences between the responses under the two regimes, thus confirming the importance of tak-

ing into account the degree of disagreement about future policies when analysing the transmission mechanism of spending shocks.[12]

6.1. Exploring the Transmission Channels

In this section, we further explore the transmission channels of the fiscal spending shocks in the two regimes. In particular, we complement the baseline model with additional variables that are added to the model following a 'marginal approach'.

The first chart of Figure 5 shows the response of the Michigan's Consumer Sentiment Index to the forecast revision. The responses in the two regimes are both positive on impact and in the short-run, but the response in the L-D regime (blue line) is somewhat higher and more persistent than that of the H-D regime (red line), revealing that a clearer policy communication tends to improve private sector confidence. This result provides evidence of an additional confidence channel to the transmission of fiscal shocks (see also Bachmann and Sims, 2012). The figure also highlights that the responses of both durable and non-durable consumption tend to be positive and significant

[12]In the on-line appendix, we also provide results for a robustness exercise carried out by varying the threshold level in an interval that excludes the higher and lower 30% observations of the threshold variable, i.e., the disagreement index. These exercise shows that the different effects stemming from the two communication regimes are confirmed when using alternative values for the disagreement threshold.

in the L-D regime in the short-run, whereas the H-D regime is characterised by a negative durable consumption response in the short-run.

The responses of private investment's subcomponents help to shed more light on the main drivers of the GDP response in the L-D regime which, as highlighted in Figure 4, is mostly driven by the investment component of GDP. As shown in Figure 5, residential fixed investment and real inventories are important in explaining the strong total private investment response in the L-D regime. At the same time, the non-residential investment responses appear broadly similar, and not statistically different from zero, in the two regimes. These results provide additional evidence of the presence of an accelerator effect of planned fiscal spending on investment in times characterised by less disagreement. The private sector appears to be willing to scale up investment and inventories to accommodate the future increase in public demand. The observed persistent growth of federal spending is important in order to explain this behaviour.[13]

The response of prices, based on both CPI inflation and GDP deflator inflation, turns out to be similar between the two regimes: it is generally

[13] An average positive response of private investment to fiscal spending announcement is common to news-based identifications (e.g., Ricco, 2015, Forni and Gambetti, 2014 and Ben Zeev and Pappa, 2014).

not significantly different from zero, except in the H-D regime where the effect is somewhat negative after one year. A weak response of prices to the government spending shock is in line with related research on the US.[14]

Figure 5 also shows that civilian employment tends to rise significantly in the L-D regime following the news shock compared to the H-D regime, which instead shows a drop. This is also mirrored in the unemployment response, which falls below zero in the low disagreement scenario. The additional demand on the labour market appears to be reflected in the upward movement of wages in the L-D regime. Indeed, real wages and total hours worked significantly rise in the short-run following the news shock in the L-D scenario, whereas in the H-D scenario the response of wages remains muted. This finding adds to the literature addressing the effects of government spending shocks on real wages (e.g., Perotti, 2008 and Ramey, 2011). Our results shows that, in response to the identified news shock on government spending, real wages tend to rise in the short-run and especially so in the L-D regime.

6.2. Nonlinear Effect of Fiscal News

Figure 6 presents the Generalised Impulse Response Functions (GIRFs) generated by four different shocks: a small positive fiscal shock of half standard deviation and its symmetric negative shock (first two panels), and a large fiscal shock of 1.5 standard deviation and its symmetric negative shock (last two panels). GIRFs can help to understand how the impact on GDP may change in relationship to the size and sign of the shock, accounting for the possibility of endogenous regime shifts triggered by the propagation of the fiscal spending shock (which are not taken into account in the within-regime analysis presented in Figure 4). Unsurprisingly, the inclusion of possible regime shifts reduces the difference of the IRFs across the two regimes. A less clear-cut distinction between the two regimes is consistent with an endogenous propagation of the information about the shock in the economy.[15] It also emerges that negative and positive shocks are characterised by responses that are broadly symmetric, thus highlighting that contractionary and expansionary fiscal news have quantitatively similar effects (though, with opposite

[14]For example, Dupor and Li (2013) finds little evidence of a positive response of inflation to government expenditure shocks in the US since WWII, even during the Federal Reserve's passive period (1959-1979).

[15]The regime switching probabilities between the two regimes suggest that - in the two years following the shock - there is a probability of around 70% to switch from the L-D regime to the H-D one, and vice versa.

sign).

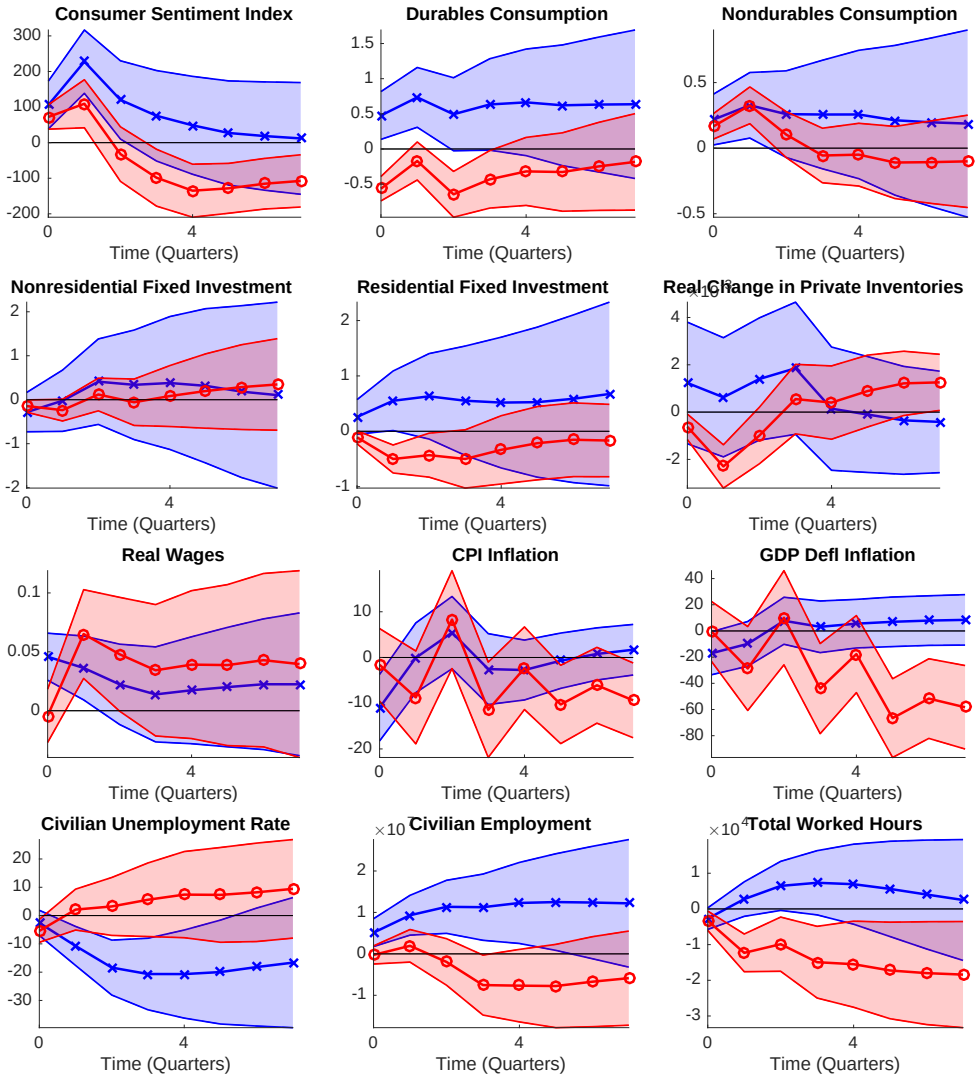

Figure 5: **Impact of forecast revisions on other variables.** Impulse responses of the Michigan's consumer sentiment index, civilian employment and unemployment, residential fixed investment, non-residential fixed investment and inventories, durable and non-durable consumption, real wages and hours worked, GDP deflator and CPI inflation. IRFs have been estimated resorting to a 'marginal approach'. For simplicity, we report here only the impulse response of the additional variable. The responses of the other variables are very similar to the baseline case, therefore we do not report them. Blue crossed line and fans are relative to the low-disagreement regime, while the red lines with circles and fans are relative to the high disagreement regime. Sample: 1981Q3-2012Q4.

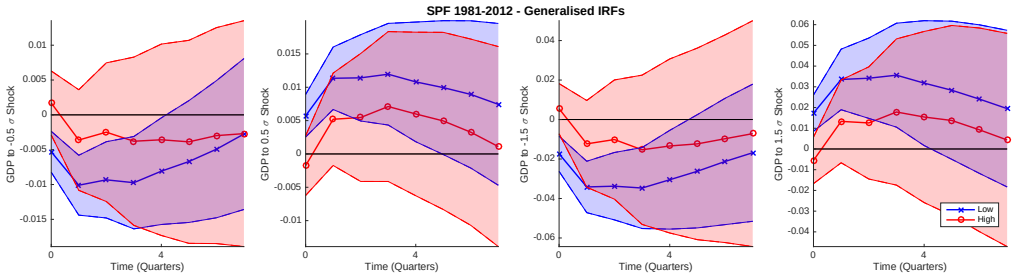

Figure 6: **Inter-regime impulse responses - Impact of forecast revisions.** The figure reports the GIRFs of a spending shock on GDP from four different shocks, detailed along the y-axis, generated from the baseline 11-variables TVAR. Blue crossed line and fans are relative to the low-disagreement regime, while the red lines with circles and fans are relative to the high disagreement regime. Sample: 1981Q3-2012Q4.

7. Conclusions

This paper offers new insights into the fiscal transmission mechanism in the US economy by studying the role of disagreement about fiscal policy in the propagation of government spending shocks. The central idea is that disagreement about future government spending reveals poor signalling from the government about the future stance of fiscal policies. At the same time, clear fiscal policy communication can coalesce agents' expectations, thereby reducing disagreement.

Our results provide some evidence that, in times of low disagreement about future policies, the output response to news about future government spending growth is positive, strong and persistent. Conversely, periods of elevated disagreement are characterised by a muted output response to fiscal news. The stronger impact of fiscal policy when expectations are coordinated is mainly the result of the positive response of investment to news on fiscal spending. This channel is different from the more standard consumption accelerator effect proposed in New Keynesian models with rule of thumb consumers, and poses an interesting modelling challenge. Overall, our analysis indicates that fiscal communication can be used as a forward guidance tool to coordinate economic agents' expectations and thus consumption, in-

vestment and savings decisions.

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