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The Cost of Political Instability: Fiscal Noise and Economic Fluctuations*

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Abstract

This paper studies how fiscal noise affects macroeconomic dynamics through the informational content of fiscal policy announcements. We develop a New Keynesian DSGE model in which government spending signals combine credible news with uninformative noise that agents cannot disentangle. In this environment, fiscal noise weakens anticipatory behavior by reducing the perceived credibility of future policy changes. As a result, households optimally adopt a wait-and-see approach, delaying consumption adjustments until implementation. The impact of a restrictive fiscal policy (through a reduction in public spending) is all the greater when the level of noise is high. In other words, the more unstable the political context, the more economic agents will distrust government announcements and underreact to any fiscal austerity measures, thus inducing a strong negative effect on output. Furthermore, the presence of non-Ricardian agents accentuates the recessionary effect of noise.

Keywords: Fiscal multiplier, Political instability, News, Noise, DSGE

JEL Codes: D84, E62, E71, H31

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1 Introduction

In recent years, several European countries have experienced episodes of political gridlock marked by fragmented parliaments and repeated elections, including France, Italy, Spain, Greece, and Romania. In some cases, the inability to form stable governing coalitions has led to reorganized or snap elections, prolonging uncertainty over fiscal priorities and reform agendas. Such recurrent electoral cycles and institutional deadlocks have blurred the policy outlook, reinforcing instability in the transmission of fiscal decisions.

These events highlight a new channel through which political instability could affect macroeconomic outcomes: the generation of what we will call fiscal "noise". In economics, "noise" refers to irrelevant, misleading, or non-fundamental information that contaminates the signals agents observe about underlying economic fundamentals. Unlike genuine shocks, noise does not reflect real changes in economic fundamentals but affects agents' expectations because it is imperfectly distinguishable from informative signals. For fiscal policy, "noise" refers to unexpected factors that affect the accuracy and credibility of policy announcements, thereby creating discrepancies between what is announced and what is implemented. Fiscal policy decisions are usually made public ahead of their implementation; this gives agents in the economy, such as households and firms, time to respond to future changes before they are implemented. These advanced communications are what we will call "news": announcements made a certain time before the policy is implemented.

Economic agents rely on their perception of the amount of news and noise in the policy signals they receive from the government to make their decisions. In the context of the Eurozone's political economy, noise captures the uncertainty agents face when domestic political constraints threaten the execution of fiscal consolidations aiming at complying with fiscal rules. In the presence of "noisy" policy environments, households and firms will have to evaluate the credibility of the fiscal policy announcements. If agents expect that political opposition or bureaucracy will disrupt the policy, they could adopt a "wait and see" approach, delaying consumption and investment, which will cause a dampening of the effectiveness of fiscal policy. Moreover, the presence of noise can lead to a lack of trust in the government, as it may not be able to deliver on its announcements and will face repeated discrepancies between announcements and outcomes.

In this context, a crucial question arises: to what extent the presence of news and noise in fiscal policy affects the behavior of economic agents and the volatility of the economy. This paper examines how political instability affects macroeconomic dynamics through fiscal policy announcements. Political instability is modeled as fiscal noise that blurs the policy signal perceived by economic agents, making it harder for economic agents to interpret future policy changes. The analysis provides a microfounded mechanism linking political instability to macroeconomic fluctuations through the informational channel of fiscal policy. Within dynamic stochastic general equilibrium (DSGE) framework with heterogeneous households, higher levels of political instability is introduced through both news and noise shocks on government spending.

This paper makes three main conceptual contributions. First, it provides a microfounded theoretical framework that rationalizes the growing empirical evidence linking political instability (through news and noise shocks) [2] to macroeconomic volatility. It models the informational mechanism through which unstable political environments affect expectations and aggregate dynamics. Second, it introduces a clear distinction be-

[2] See Forni et al.(2017) and Litainas et al. (2026).

tween fiscal news and fiscal noise in government announcements, allowing policy signals to contain both genuine forward-looking information and irrelevant or misleading components. Third, the model departs from the standard assumption of constant informational precision by allowing the volatility of fiscal noise to be time-varying, thereby capturing fluctuations in political instability over time. Together, these elements offer a consistent way to embed political instability into a DSGE framework through the informational channel of fiscal policy.

As a result, we show that when there is a mix of news and noise, agents cannot tell whether the signals are credible or misleading, so their behavior is moderated until the policy is either confirmed or disproven. When there is complete noise, they simply expect the policy not to be implemented, leading to no anticipation. As a result, their behavior is affected only after the implementation of the policy, which results in a delayed and strong effect on macroeconomic aggregates. This "wait and see" behavior weakens the effectiveness of expectations. The impact of a restrictive fiscal policy (through a reduction in public spending) is all the greater when the level of noise is high. In other words, the more unstable the political context, the more economic agents will distrust government announcements and underreact to any fiscal austerity measures, thus inducing a strong negative effect on output. Furthermore, the presence of non-Ricardian agents accentuates the recessionary effect of noise.

The rest of the paper is organized as follows. Section 2 provides an overview of the literature on news and noise, and on fiscal multipliers. Section 3 describes the DSGE model. Section 4 presents calibration and results, and section 5 concludes.

2 Related literature

This paper lies at the intersection of two major strands of the literature: the literature on news and noise, which emphasizes informational frictions and signal extraction, and the literature on the fiscal multiplier, which analyzes the transmission of fiscal policy shocks.

The literature on news/noise for fiscal policy has developed considerably in recent years. "News" refers to any announcements or disclosures about fiscal policy from various sources, including government officials, economic reports, or financial institutions (Blanchard et al., 2013; Born et al., 2013; Fève and Pietrunti, 2016; Leeper et al., 2013). News creates a time gap between the announcement of fiscal policies and their implementation, during which economic behavior might be affected even before the policy changes take effect. This suggests a foresight in fiscal policy by economic agents, anticipating and adjusting to forthcoming changes in government tax and spending policies before they are officially implemented (Fève and Pietrunti, 2016; Leeper et al., 2013; Mertens and Ravn, 2011). They could explain as much as half of the variations of macroeconomic variables, whether they concern changes in government spending (Fève and Pietrunti, 2016; Schmitt-Grohé and Uribe, 2012), taxes (Born et al., 2013; Mertens and Ravn, 2011), or productivity and investment (Jaimovich and Rebelo, 2009).

News can also be a double-edged instrument for fiscal policy. While sharing public information benefits economic agents when they lack private information, it can also be harmful if the announcements are inaccurate or misleading, especially if agents have access to independent sources of information (Morris and Shin, 2002). In this sense, the media also plays an important role in shaping economic expectations; for example, news about high inflation is more influential on household expectations than news about lower inflation (Chahrour et al., 2024).

In turn, "noise" refers to unexpected or unpredictable factors that affect the accuracy of economic forecasts and the credibility of policy-related announcements (Angeletos and La'o, 2010; Blanchard et al., 2013; Fève and Pietrunti, 2016).

We can broadly identify two major sources of noise. The first source comes from the behavior of economic agents themselves into the economy. This literature originated with noisy traders in the context of financial markets: individuals who trade even when it is often better not to (Black, 1986). One reason for it could be bounded rationality, a concept that challenges the notion of utility maximization and perfect rationality by taking into account the cognitive limitations of decision-makers (Simon, 1957). The idea that agents have cognitive limitations can be traced back to Azariadis (1981), who demonstrated the possibility of business fluctuations due to self-fulfilling beliefs. Later work introduced concepts like "sunspots" and "animal spirits" to account for the role of non-fundamental factors in business cycle fluctuations. They assume economic agents use heuristics, choosing rules that worked well in the past (De Grauwe, 2011; De Grauwe and Foresti, 2020; De Grauwe and Ji, 2024), and that optimism or pessimism can shape economic dynamics (Benhima and Poilly, 2021). Other works use cognitive discounting parameters which reflect agents' limited attention to distant or unusual events (Gabaix, 2020). In both cases, the role of information is key, as agents update their beliefs based on new, possibly noisy signals (Barsky and Sims, 2012). Some may have biased expectations, while others remain rational, and this gives rise to heterogeneous beliefs (Massaro, 2013).

The second source of noise goes the other way around: it originates from economic conditions and travels all the way to agents. It includes unexpected macroeconomic shocks, productivity changes, and policy implementation uncertainty. Compared to the first type of noise, the shocks are driven by the economy and lead agents to adjust expectations. For instance, it may indicate situations in which policymakers take measures that can be partially revoked during the legislative process, perhaps because of shifts in parliamentary majorities (Fève and Pietrunti, 2016). This type of noise creates a discrepancy between what was anticipated and what in fact occurred, which may generate uncertainty and macroeconomic volatility. This can cause an under- or overreaction of macroeconomic variables to policy announcements, causing deviations from expected outcomes (Blanchard et al., 2013; Fève and Pietrunti, 2016; Lorenzoni, 2009). "Noise" can also affect productivity: when agents overestimate or underestimate the economy's productive capacity, the impact is similar to that of aggregate demand shocks, with short-term effects on output, employment, and inflation (Lorenzoni, 2009).

The degree to which deviations occur, however, ds heavily on the level of risk aversion among households. In the presence of fiscal noise or volatility, risk-averse households are likely to increase their savings in order to mitigate the level of future income uncertainty, which in turn leads to lower levels of current consumption (Caballero, 1990; Kimball, 1990). Since risk-averse households are not in a position to distinguish between a permanent policy change and a transitory shock, this could lead to important dampening effects on aggregate demand (Born and Pfeifer, 2014; Fernández-Villaverde et al., 2015). In this sense, risk aversion could act as an amplifier of noise, transforming informational frictions into tangible welfare losses and reduced economic activity.

The uncertainty surrounding the implementation of fiscal policy is linked to government credibility, which serves as the anchor for effective expectations. As Kydland and

Prescott (1977) argued, governments face a time-inconsistency problem: the temptation to deviate from the announced policies to increase the short-term output of the economy. If governments act unpredictably given this temptation to deviate, uncertainty can lead agents to place little importance on announcements in the first place and treat them as noise rather than news, so they will not behave as planned, dampening the policy's effectiveness (Hong and End, 2022; Taylor, 1982).

The question of the size and effect of the fiscal multipliers is important and has sparked an abundant literature. The literature has established that multipliers are state-dependent, and can be affected by the business cycle, fiscal policy being usually more effective in recessions than in expansions (Auerbach and Gorodnichenko, 2012; Ramey and Zubairy, 2018 or Barbier-Gauchard and Betti, 2020) . However, informational frictions and behavioral factors play an equally important role. News could dampen the multiplier at the moment of implementation because agents have already adjusted their behavior during the anticipation period (Mertens and Ravn, 2011). Conversely, noise creates uncertainty, which can arise from the timing or composition of fiscal consolidations (Bi et al., 2013). This uncertainty yields ambiguous results, potentially raising (Goemans, 2023) or lowering (Jerow and Wolff, 2022) the multiplier, an effect that often depends too on the degree of economic agents' optimism (Barbier-Gauchard et al., 2025).

3 The model

In this model, based on Fève et Pietrunti (2016), we consider a closed economy[3] with Ricardian (forward-looking) and non-Ricardian (hand-to-mouth) households[4]. Firms are monopolistic suppliers and set their price following a standard Calvo price setting. We focus on the unexpected economic circumstances that affect economic agents' behavior, in a framework where households are fully rational but live in a partial information environment[5]. Unlike standard rational expectations models, where agents are assumed to have complete knowledge of the economy's structure and current state, these agents do not see all the shocks or variables directly, so they form expectations using the information they do observe, and they behave optimally given their information, not the true state. For that, we develop a fairly standard medium-scale DSGE model, incorporating news (credible advance announcements of future policy changes) and noise (misleading or unreliable signals about future fiscal policy) shocks affecting government spending, *à la* Fève et Pietrunti (2016).

3.1 Households

The model comprises a continuum of households divided into two types: A share $(1-\mu)$ of Ricardian households (i), who have access to financial markets, where they buy riskless assets, and invest in capital they loan to firms. The remaining share μ of households, referred to as non-Ricardian (or *hand-to-mouth* households (j)), do not trade in assets and simply consume their disposable income entirely at each period.

[3]While it would be possible to develop a more sophisticated model - for instance, by considering an open-economy within a monetary union-, we opt here for a simple and tractable model to be able to disentangle the various transmission channels through which a fiscal shock affects the economy.

[4]Unlike to Fève et Pietrunti (2016) model, the economy is also composed of non-Ricardian agents, the consumption tax is endogenous and the focus is also on the fiscal multiplier.

[5]See Pearlman et al. (1986).

3.1.1 Ricardian households

Ricardian households (i) maximize an intertemporal utility function given by:

$$E_0 \sum_{t=0}^{\infty} \beta^t \left[\frac{C_{i,t}^{1-\sigma}}{1-\sigma} - \frac{N_{i,t}^{1+\varphi}}{1+\varphi} \right] \tag{1}$$

where β is the discount factor. Utility depends positively on the consumption of goods, $C_{i,t}$, and negatively on labor supply $N_{i,t}$. σ represents the households' relative risk aversion or the inverse of the intertemporal elasticity of substitution, whereas φ denotes the inverse of the elasticity of labor effort with respect to the real wage.

Ricardian households maximize their utility function with respect to consuption, labor, investment and public bonds, subject to an intertemporal budget constraint, which is defined as follows:

$$(1+R_{t-1})B_{i,t-1} + W_t N_{i,t} + R_t^K K_{i,t-1} = B_{i,t} + P_t(1+\tau_t^c)C_{i,t} + I_{i,t} \tag{2}$$

They hold their financial wealth in the form of public bonds $B_{i,t}$, earning an interest rate R_t. Their current income consists of labor income $W_t N_{i,t}$, determined by wages W_t and labor supplied $N_{i,t}$, and capital income $R_t^K K_{i,t-1}$. Here, R_t^K is the nominal rental rate of capital, representing the return a household earns from renting out the capital accumulated until period $t-1$. Both current income and financial wealth can be used for consumption, investment in capital, and the purchase of new public bonds as savings. The variable P_t represents the level of prices and I_t denotes investment. Our model also incorporates a consumption tax resembling a Value Added Tax (VAT), denoted τ_t^c, which will affect the households' consumption decisions. This will allow us to study how tax policies influence macroeconomic variables in the presence of news and noise in addition to spending policies.

The Ricardian household maximization problem gives us the following Euler Equation:[6]

$$C_{i,t} = E_t(C_{i,t+1}) \left[\frac{1}{\beta(1+R_t)} E_t \left(\pi_{t+1} \frac{(1+\tau_{t+1}^c)}{(1+\tau_t^c)} \right) \right]^{1/\sigma} \tag{3}$$

This equation describes the intertemporal consumption choice for households, which links current consumption $C_{i,t}$ to expected future consumption $E_t(C_{i,t+1})$, the nominal interest rate R_t, the consumption tax rate τ_t^c and the inflation rate $\pi_t = P_t/P_{t-1}$. We observe that the consumption tax can have a distortionary effect on consumption. All things being equal, an increase in the current consumption tax raises the effective price of current consumption. As a result, households tend to reduce current consumption because it becomes more expensive relative to future consumption. This creates a substitution effect that moves consumption away from the present and toward saving or future consumption. However, there is also an opposing distortionary effect. If households anticipate a higher future tax rate, they view future consumption as more costly. This perception may lead to increased current consumption, partially offsetting the reduction caused by the first substitution effect.

[6] See Appendix A.1 for calculation details.

3.1.2 Non-Ricardian households

Non-Ricardian households (j) follow a rule of thumb and set nominal consumption expenditure equal to after-tax real wage income:

$$C_{j,t} = \frac{W_t N_{j,t}}{(1+\tau_t^c)P_t} \tag{4}$$

3.2 Firms

The economy includes a continuum of firms operating under monopolistic competition. All firms share identical technology using labor N_t and capital K_t, with the production function represented as:

$$Y_t = A_t K_{t-1}^{\alpha} N_t^{1-\alpha} \tag{5}$$

Here, $\alpha \in]0;1[$ denotes the output elasticity of capital, and A_t represents the total factor productivity (TFP) shock common to all firms. The TFP is defined as an AR(1) process and can be expressed as:

$$A_t = (A_{t-1})^{\rho_a} \exp(\varepsilon_t^a) \tag{6}$$

where ρ_a defines the persistence of the productivity shock and ε_t^a an independent and identically distributed (i.i.d.) disturbance.

The representative firm's profit in nominal terms is given by:

$$\Pi_t = P_t Y_t - (1+\tau_t^{sp}) W_t N_t - R_t^K K_{t-1} \tag{7}$$

Firms pay a social security contribution, denoted by τ_t^{sp}, on the wages they provide. R_t^k defines the nominal rental rate of capital. The maximization of (7) subject to (5) with respect to capital and labor[7] gives us the marginal cost of the firm MC_t:

$$MC_t = \frac{[(1+\tau_t^{sp})W_t]^{1-\alpha}(R_t^K)^{\alpha}}{A_t\, \alpha^{\alpha}\, (1-\alpha)^{1-\alpha}} \tag{8}$$

In this equation, the term $(1+\tau_t^{sp})W_t$ represents the wage cost adjusted of the tax payed by firms. We observe that this tax directly impacts the marginal cost and then the price-setting described after. With news, firms could benefit from the anticipation effect regarding future labor cost changes to adjust their production and demand for labor. However, noise shocks introduce uncertainty, making it more difficult for them to plan their production and hiring activities.

3.2.1 Price setting

In this economy, firms set their price in each period constrained by a certain degree of rigidity introduced *à la* Calvo (1983). In each period, only a fraction $(1-\theta_p)$ are allowed to reset their price, where θ_p is the fraction of firms that keep their price unchanged, thus, a measure of price stickiness. Firms maximize their price taking into account their mark-up over the marginal cost and constrained by a specific demand function. The randomly selected firms setting optimally new prices will choose the price $P_t^* = P_t(n)$

[7] See Appendix A.2

that maximizes the current market value of the profits generated while that price remains effective, while those firms that do not re-optimize leave their prices unchanged, meaning $P_t(n) = P_{t-1}(n)$. Each firm that re-optimizes at time t maximizes the discounted sum of its expected nominal profits:

$$\max_{P_t^*} E_t \sum_{k=0}^{\infty} (\theta_p)^k \Lambda_{t,t+k} \left(P_t^* Y_{t+k}(n) - MC_{t+k} Y_{t+k}(n) \right) \tag{9}$$

where $\Lambda_{t,t+k}$ is the stochastic discount factor between period t and $t+k$. This discount factor is defined as $\Lambda_{t,t+k} = \beta^k \frac{\lambda_{c,t+k}}{\lambda_{c,t}}$, where $\lambda_{c,t}$ represents the household's marginal utility of consumption.

Subject to the demand addressed to the firm:

$$Y_{t+k}(n) = \left(\frac{P_t^*}{P_{t+k}} \right)^{-\epsilon} Y_{t+k} \tag{10}$$

where ϵ defines the elasticity of substitution between goods.

The first-order condition with respect to P_t^* yields:

$$E_t \sum_{k=0}^{\infty} (\beta\theta_p)^k \lambda_{r,t+k} \left[P_t^* - \frac{\epsilon}{\epsilon - 1} MC_{t+k} \right] Y_{t+k}(n) = 0 \tag{11}$$

Let $\pi_t = P_t/P_{t-1}$ be the gross inflation rate and $mc_t = MC_t/P_t$ be the real marginal cost. The optimal relative price $p_t^* = P_t^*/P_t$ is given by:

$$\frac{P_t^*}{P_t} = \frac{\epsilon}{\epsilon - 1} \frac{q_{1,t}}{q_{2,t}} \tag{12}$$

where $q_{1,t}$ and $q_{2,t}$ are recursive auxiliary variables representing the present value of marginal costs and revenues, respectively, weighted by marginal utility:

$$q_{1,t} = \lambda_{r,t} \, Y_t \, mc_t + \beta\theta_p \, E_t \left[(\pi_{t+1})^{\epsilon} q_{1,t+1} \right] \tag{13}$$

$$q_{2,t} = \lambda_{r,t} \, Y_t + \beta\theta_p \, E_t \left[(\pi_{t+1})^{\epsilon-1} q_{2,t+1} \right] \tag{14}$$

Finally, given the Calvo pricing structure, the aggregate price index P_t evolves according to:

$$P_t^{1-\epsilon} = \theta_p P_{t-1}^{1-\epsilon} + (1 - \theta_p)(P_t^*)^{1-\epsilon} \tag{15}$$

Dividing by $P_t^{1-\epsilon}$, we obtain the law of motion for inflation:

$$1 = \theta_p \left(\frac{1}{\pi_t} \right)^{1-\epsilon} + (1 - \theta_p) \left(\frac{P_t^*}{P_t} \right)^{1-\epsilon} \tag{16}$$

3.2.2 Labor force participation and wage setting

Workers supply labor in a monopolistic competitive environment, setting wages while facing a downward-sloping labor demand from firms. In addition, analogous to price-setting, wage-setting features a degree of nominal rigidity *à la* Calvo (1983). Henceforth, in each period, workers have a probability $(1 - \theta_w)$ of reoptimizing their nominal wage.

The parameter θ_w represents a measure of wage stickiness. If employees receive such a signal in period t, they will thus set a new nominal wage, W_t^*, taking into account the probability that it will not be reoptimized in the near future. When a worker cannot reoptimize his nominal wage, there is a partial indexation of the nominal wage on past inflation according to:

$$W_t = \left(\frac{P_{t-1}}{P_{t-2}}\right)^{\gamma_w} W_{t-1} \tag{17}$$

where γ_w represents the degree of wage indexation. When $\gamma_w = 0$, there is no indexation and, the wages that can not be reoptimized, remain constant. When $\gamma_w = 1$, there is perfect indexation of nominal wage to past inflation.

Aggregate labor demand, N_t, and the aggregate nominal wage, W_t, are given by the following Dixit–Stiglitz-type aggregator functions with λ_w the elasticity of substitution between workers:

$$N_t = \left[\int_0^1 (N_t)^{1/(1+\lambda_w)} dl\right]^{1+\lambda_w} \tag{18}$$

$$W_t = \left[\int_0^1 (W_t)^{-1/\lambda_w} dw\right]^{-\lambda_w} \tag{19}$$

This maximization problem results in the following markup equation for the reoptimized wage:

$$\frac{W_t^*}{P_t} E_t \sum_{k=0}^{\infty} \beta\theta_w \left(\frac{(P_t/P_{t-1})^{\gamma_w}}{P_{t+k}/P_{t+k-1}}\right) \frac{N_{t+k}\lambda_{c,t+k}}{1+\lambda_w} = E_t \sum_{k=0}^{\infty} \beta\theta_w N_{t+k}\lambda_{n,t+k} \tag{20}$$

where $\lambda_{n,t}$ is the marginal disutility of labor and $\lambda_{c,t}$ is the marginal utility of consumption. Equation (20) shows that the nominal wage at time t of a worker that is allowed to change its wage is set so that the present value of the marginal return to working is a markup over the present value of marginal cost (the subjective cost of working). When wages are perfectly flexible ($\theta_w = 0$), the real wage will be a markup (equal to $1 + \lambda_w$) over the current ratio of the marginal disutility of labor and the marginal utility of an additional unit of consumption. Given Equation (19), the law of motion of the aggregate wage index is given by:

$$W_t = \left[\theta_w \left(W_{t-1}\left(\frac{P_{t-1}}{P_{t-2}}\right)^{\gamma_w}\right)^{-1/\lambda_w} + (1-\theta_w)(W_t^*)^{-1/\lambda_w}\right]^{-\lambda_w} \tag{21}$$

3.3 Monetary policy

Monetary policy is conducted by the central bank that sets the nominal interest rate, R_t, according to a generalized Taylor rule (1993). The monetary authority adjusts the interest rate sluggishly in response to deviations of gross inflation from its target and deviations of aggregate output from its steady-state level, while also exhibiting partial adjustment (interest rate smoothing). The rule is specified as follows:

$$\frac{R_t}{R^*} = \left(\frac{R_{t-1}}{R^*}\right)^{\rho_R} \left[\left(\frac{\pi_t}{\pi^*}\right)^{\alpha_\pi} \cdot \left(\frac{Y_t}{Y^*}\right)^{\alpha_y}\right]^{1-\rho_R} \tag{22}$$

where R^* is the steady-state nominal interest rate, π^* is the central bank's inflation target, and Y^* represents the steady-state level of output. The parameter $\rho_R \in [0, 1)$ represents the degree of interest rate smoothing. The parameters α_π and α_y capture how responsive the central bank is to deviations of the output gap and inflation, respectively.

3.4 Government

Within this framework, government spending G_t is financed through taxes, including a consumption tax τ_t^c paid by households and a social protection tax τ_t^{sp} paid by firms, as well as debt from public bonds issued to households B_t. Thus, the government's budget constraint can be written as follows:

$$G_t + (1 + R_{t-1})B_{t-1} = B_t + \tau_t^c P_t C_t + \tau_t^{sp} W_t N_t \quad (23)$$

In the model, news represents advance information about future fiscal policy actions, such as an upcoming increase in government spending, a cut in the VAT, or a reduction in the social protection tax. These changes are not implemented immediately but are anticipated to occur after a known delay of q periods. The government communicates these intentions in advance, and agents in the economy receive these announcements as signals. However, these signals are not perfectly clear. Alongside the announced policy (the news), the signals also contain irrelevant or misleading information, which is referred to as noise. Noise might come from political uncertainty, miscommunication, or the complexity of interpreting policy intentions. As a result, agents face a partial information environment: they observe the signal but cannot immediately distinguish how much of it reflects true policy changes and how much is just noise. To account for the effects of news and noise, we will partly base our work on the framework proposed by Fève and Pietrunti (2016), which involves a news shock that appears with a lag equal to q periods and a noisy signal associated to this shock. In our setting, we assume a lag of $q = 4$ periods, corresponding to four quarters or one year, emulating the government's announcement of its annual budget once per year as illustrated by Figure 1.

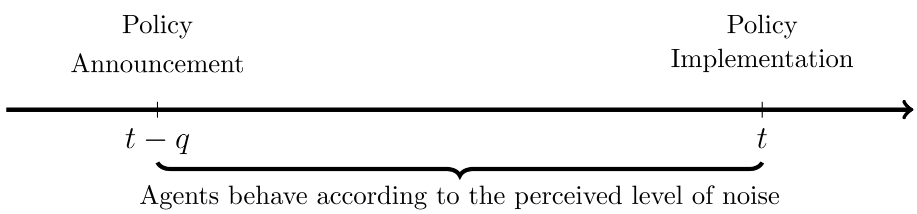

Figure 1: Timeline of policy implementation

Unlike standard models, agents receive imperfect signals about government spending and must extract true policy intentions using a signal-to-noise ratio. Tax shocks are perfectly observed, whereas government spending shocks are observed through noisy signals. The model introduces a signal-to-noise ratio that determines the credibility of announcements. Moreover, noise volatility is time-varying, allowing fiscal credibility to fluctuate over time. Consequently, the noise will then spread to expectations of public debt and taxes, and thus impact the economy as a whole. sGovernment spending G_t, consumption tax τ_t^c, and social protection tax τ_t^{sp} evolve according to an AR(1) process, and are defined as follows:

$$G_t = (G_{t-1})^{\rho_g} \exp(\varepsilon^G_{t-q}) \tag{24}$$

$$\tau^c_t = (\tau^c_{t-1})^{\rho_{\tau_c}} \left(\frac{B_{t-1}/Y_{t-1}}{B^*/Y^*}\right)^{1-\rho_{\tau_c}} \exp(\varepsilon^{\tau^c}_{t-q}) \tag{25}$$

$$\tau^{sp}_t = (\tau^{sp}_{t-1})^{\rho_{\tau_{sp}}} \exp(\varepsilon^{\tau^{sp}}_{t-q}) \tag{26}$$

where the fiscal shocks ε^f_t for $f \in \{G, \tau^c, \tau^{sp}\}$ are anticipated q periods in advance. However, the information structure differs across fiscal instruments. While agents perfectly observe the shocks to taxes ($\varepsilon^{\tau^c}_t$ and $\varepsilon^{\tau^{sp}}_t$), they face a partial information setting regarding government spending. For government spending, agents do not observe the true shock ε^G_t directly. Instead, they receive an imperfect signal s^G_t, which combines both the true fiscal news ε^G_t and a noise component ν^G_t:

$$s^G_t = \varepsilon^G_t + \nu^G_t \tag{27}$$

Here, $\varepsilon^G_t \sim \mathcal{N}(0, \sigma^2_{\varepsilon,G})$ represents the independent and identically distributed (i.i.d.) shock to government spending. This shock embodies the actual policy change that will be implemented after a delay of q periods. The signal s^G_t also includes a noise component $\nu^G_t \sim \mathcal{N}(0, \sigma^2_{\nu,G,t})$, which is i.i.d. and uncorrelated with ε^G_t. This implies that agents face uncertainty in disentangling genuine spending policy information (ε^G_t) from irrelevant noise (ν^G_t). Since tax shocks are perfectly observed, rational agents perfectly anticipate the future tax changes, meaning their conditional expectation satisfies $E_t\varepsilon^f_t = \varepsilon^f_t$ for $f \in \{\tau^c, \tau^{sp}\}$. However, for government spending, agents must estimate the true news using the observed signal s^G_t. Their forecast is given by:

$$E_t\varepsilon^G_t = \xi_t s^G_t \equiv \xi_t(\varepsilon^G_t + \nu^G_t) \tag{28}$$

where ξ_t represents the news-to-noise ratio[8] for government spending, which determines how much of the observed signal is considered reliable information:

$$\xi_t = \frac{\sigma^2_{\varepsilon,G}}{\sigma^2_{\varepsilon,G} + \sigma^2_{\nu,G,t}} \tag{29}$$

A higher value of ξ^f_t (closer to 1) indicates that the signal is predominantly composed of significant news ε^f_t, which economic agents can trust. When information is perfectly communicated to private agents in the economy (i.e., $\xi_t = 1$ and $\sigma_{\nu,G,t} = 0$), these agents fully integrate the announced government policy into their decision-making processes for the following period. As a result, they can quickly adjust their consumption and labor supply decisions in response to new economic conditions. Conversely, a lower value of ξ_t (closer to 0) suggests that the signal is mainly noise ν^G_t, making it less reliable. When the announced policy is entirely noise-driven (i.e., $\sigma_{\varepsilon,G}/\sigma_{\nu,G,t} \to 0$ and $\xi_t \to 0$), private agents do not react, as their expectations remain unaffected by the new policy.

[8] See Fève et Pietrunti (2016).

3.5 Aggregate variables and market clearing conditions

In this economy, we can define aggregate variables and the market clearing conditions. Aggregate consumption is the weighted sum of consumption by Ricardian and non-Ricardian households:

$$C_t = (1 - \mu)C_{i,t} + \mu C_{j,t} \tag{30}$$

Total employment N_t is defined as:

$$N_t = N_{i,t} + N_{j,t} \tag{31}$$

Finally, we close the model with the market clearing condition. Equilibrium in the goods market requires that the aggregate supply of goods equals the total demand for consumption, investment, and public spending:

$$Y_t = C_t + I_t + G_t \tag{32}$$

4 Calibration and results

This section presents the calibration to simulate the model and the results of simulations considering public spending shock.

4.1 Calibration

Table 1 summarizes the calibrated parameters of our model. The chosen parameter values are taken from the literature and are considered standard. Regarding the news–noise structure, we fix the variance of the news shock at $\sigma_\varepsilon^2 = 0.01^2$ and consider three alternative values for the noise variance σ_ν^2 in order to capture different degrees of noise in fiscal policy announcements. First, the benchmark case assumes $\sigma_\varepsilon^2 = \sigma_\nu^2 = 0.01^2$, corresponding to an intermediate level of noise (i.e. $\xi = 0.5$). Second, the full-information case is characterized by $\sigma_\nu^2 = 0$, implying $\xi = 1$. Third, the full-noise case assumes $\sigma_\nu^2 = 1$, implying $\xi \to 0$.

Table 1: Calibration of the model

Structural parameters		
Discount factor	β	0.995
Intertemporal marginal elasticity of consumption	σ	2
Frish elasticity of labor supply	φ	1
Depreciation rate of capital	δ	0.025
Cobb-Douglas capital share	α	0.3
Price-setting Calvo parameter	θ_p	0.75
Elasticity of substitution between goods	ϵ	6
Share of non-Ricardian households	μ	0.3
AR(1) parameter TFP shock	ρ_a	0.9
Wage-setting Calvo parameter	θ_w	0.6
Elasticity of substitution between workers	λ_w	6
Indexation of wages to past inflation	γ_w	0.5
Monetary policy		
Degree of interest rate smoothing	ρ_R	0.800
Inflation elasticity of the Taylor rule	α_π	1.500
Output elasticity of the Taylor rule	α_y	0.500
Fiscal policy		
AR(1) parameter government spending	ρ_g	0.6
AR(1) parameter consumption tax	ρ_{τ_c}	0.8
Persistence of social protection tax	$\rho_{\tau_{sp}}$	0.8
Noise		
Variance of the news shock	σ_ε^2	0.01^2
Variance of the noise shock	σ_ν^2	0.01^2

4.2 Results

We are interested in the effect of a fiscal consolidation (1% decrease in public spending) for three different levels of noise in the economy (no fiscal signal noise, intermediate case, "full noise" scenario). After considering the impulse response functions, we analyze the fiscal multiplier and the volatility of output and consumption for Ricardian households.

4.2.1 How noise affects the behavior of economic agents

We first simulate the model with a 1% decrease in public spending. Figure 2 reports the impulse response functions for three different levels of noise in the economy: a case with no fiscal signal noise ($\xi = 1$), an intermediate case with $\xi = 0.5$, and a third case considered as a "full noise" scenario with $\xi \to 0$.

Our benchmark scenario explores a situation where there is no noise in the signal, in which the announced government policy is perceived by households as perfectly credible and transparently communicated. As a result, agents fully trust the announcement and immediately incorporate the policy into their expectations and decision-making. This leads to significant anticipation effects as agents adjust their consumption behavior in preparation for the policy's implementation in period 4.

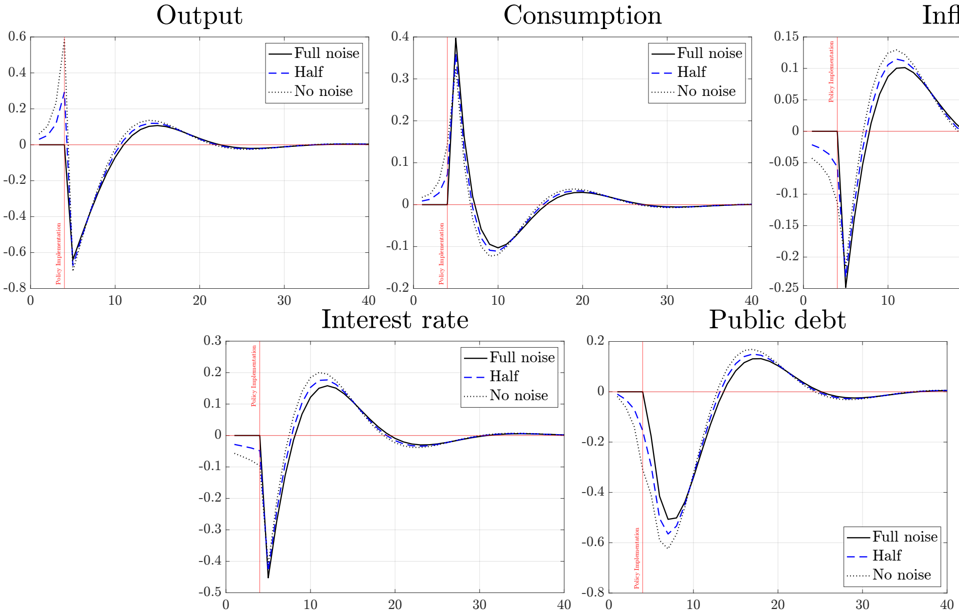

Figure 2: Impulse responses to a government spending cut when the policy is implemented

Note: All variables are expressed as percentage deviations from their steady-state values. Inflation and the interest rate are annualized.

Under this scenario, agents begin to anticipate the policy immediately after its announcement, and the response of output to the spending shock occurs in two phases. Upon the announcement, forward-looking agents immediately internalize the future fiscal consolidation. First, under the assumption of Ricardian Equivalence, households anticipate a reduction in the future tax burden, generating a positive wealth effect. Second, households anticipate that the central bank will react to the impending decline in demand by lowering the policy rate. Through the intertemporal substitution channel, this expectation of lower future real interest rates lowers the opportunity cost of current spending. These two mechanisms combined lead households to bring consumption forward, driving a slight initial increase in output. Once the spending cut is implemented in period 4, output contracts sharply, driven by the direct withdrawal of government spending from the economy. Inflation, which began its descent during the anticipation phase due to the expectation of lower future inflationary pressures, falls further at $t = 4$, allowing the central bank to lower nominal interest rates.

We now consider the case where $\xi = 0.5$. This implies that when the government announces a policy, agents cannot distinguish between genuine news and noise prior to implementation and must instead form probabilistic beliefs regarding its effective realization. Initially, variables follow a pattern similar to the benchmark case, but in a more moderate fashion. This is because agents start having doubts about the policy being implemented, and they do not respond as strongly as they would if the policy environment was clear. In the third scenario, agents interpret the signal as entirely noisy, leading to no anticipation effects. Consequently, their behavior remains unchanged during the announcement phase.

The presence of noise introduces a second possibility: the announcement proves to be false, and the policy is not implemented, as highlighted in Figure 3. When the signal contains equal news and noise, the IRFs in Figures 2 and 3 are identical until period 4.

If the planned government spending cut is not implemented, contrary to the case where the policy gets implemented, the shock will get absorbed and the variables will return to their steady state after the confirmation that the policy was not implemented.

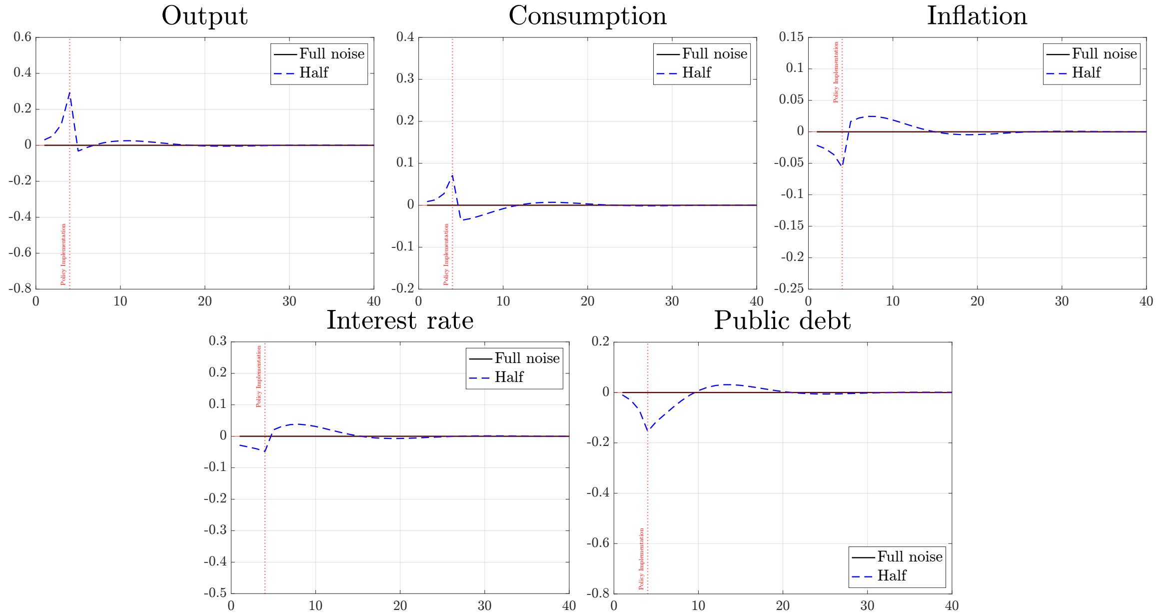

Figure 3: Impulse responses to a government spending cut when the policy is not implemented

Note: All variables are expressed as percentage deviations from their steady-state values. Inflation and the interest rate are annualized.

Finally, in the full noise scenario, agents do not change their behavior during the announcement phase. Since they correctly treat the signal as noisy, and the policy is ultimately not implemented, the economy remains at the steady state throughout the entire 40-period horizon.

4.2.2 Fiscal multiplier

In order to quantify the impact of fiscal policy across different policy environments depending on the noise level, we compute the cumulative government spending multiplier to assess how effectively the economy absorbs fiscal shocks in the presence of noise, specifically in the case of a fiscal consolidation.

As discussed, when fiscal policy announcements are free of noise, agents immediately incorporate the future policy into their decisions, leading to strong anticipation effects. When announcements combine equal parts of news and noise, agents' responses are muted, reflecting only partial adjustment to the expected policy. If the policy is ultimately not implemented, the effects are quickly absorbed as the economy returns to its steady state. Finally, when announcements are fully noisy, agents disregard them entirely, assuming no implementation will follow. As a result, no anticipation occurs.

Computing the fiscal multiplier across these scenarios allows us to test whether higher noise, by dampening these anticipation effects, exacerbates the output costs of a fiscal consolidation. We compute the cumulative multiplier M_c as the ratio of the change in output to the change in government spending:

$$M_c = \frac{\sum_{i=0}^{n} \Delta Y_{t+i}}{\sum_{i=0}^{n} \Delta G_{t+i}}$$

In our simulations, the cumulative multiplier amounts to 0.57 in the case with full noise. This indicates that for every unit decrease in government spending, output falls by 0.57 units. However, as the degree of noise decreases (and ξ increases), the multiplier diminishes significantly. In the case of clear signals (no noise), the cumulative multiplier falls to just 0.09. In this environment, when noise is low, consumption rises significantly following the announcement, reducing the output cost of the spending cuts, as illustrated by Figure 4.

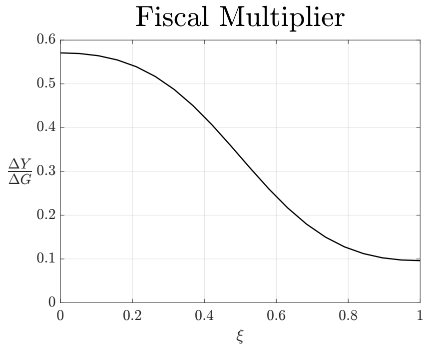

Figure 4: Fiscal Multiplier across levels of announcement noise
Note: A higher ξ represents a lower level of noise.

The shape of the curve reveals that the "cost" of consolidation is highly sensitive to noise. When noise is low, agents trust the announcement and respond instantly, minimizing the output loss. As noise increases, agents become skeptical and delay their reaction until the policy is indeed implemented. It is important to note the following point. Beyond reducing the cost of a restrictive policy, the degree of noise affects the timing of the policy's effects. Indeed, if a government aims to implement a consolidation policy in order, for example, to quickly reassure markets, we show here that announcement effects can be significant and that clear (low-noise) communication enables markets to react more rapidly to policy announcements.

Robustness checks

We aim here to analyze whether the evolution of the fiscal multiplier as a function of the degree of noise depends on key parameters of our model. Figure 5 illustrates the dynamics of the fiscal multiplier for: (1) the baseline calibration of the model; (2) a specification that includes only Ricardian agents; (3) a stronger response of the consumption tax to public debt (*i.e.*, a change in ρ_{τ_c} from 0.8 to 0.6); and (4) a case where $\rho_g = 0$, thus introducing a one-period public spending shock.

An important point is the role played by non-Ricardian agents. Indeed, we observe that the multiplier is much smaller and that the impact of the degree of noise is less noticeable. Here, we can identify two roles played by non-Ricardian agents in shaping the overall response of the economy. First, as has long been established in the literature, the presence of non-Ricardian agents in the economy increases the fiscal multiplier. Second, and more originally, we show here that the share of non-Ricardian agents plays an important role in explaining the effect of noise on the economy's response to a fiscal policy announcement. In this context, hand-to-mouth households have what could be described as a multiplier effect: following the positive response of consumption to the announcement of cuts in public spending, wages and employment increase. As a result, the consumption of non-Ricardian agents rises significantly, thereby substantially amplifying the economy's response between the announcement and the implementation of the spending cuts.

In addition, we also test the impact of the response of the consumption tax, measured by the parameter ρ_{τ_c}, and the duration of the shock by simulating the model with a purely temporary shock, setting $\rho_g = 0$. The response of the consumption tax does not appear to play an essential role, whereas a temporary shock tends to increase the multiplier and produces an even larger multiplier when the degree of noise is high. Indeed, the degree of noise mainly affects agents' responses between the announcement and the implementation of the policy. As observed in the impulse response functions, once the implementation of the policy is observed by agents, their response no longer depends significantly on the degree of noise. Thus, with $\rho_g = 0$, the shock is absorbed very quickly by the economy, giving greater prominence to what happens between the announcement and the implementation in determining the overall effect of the reduction in public spending.

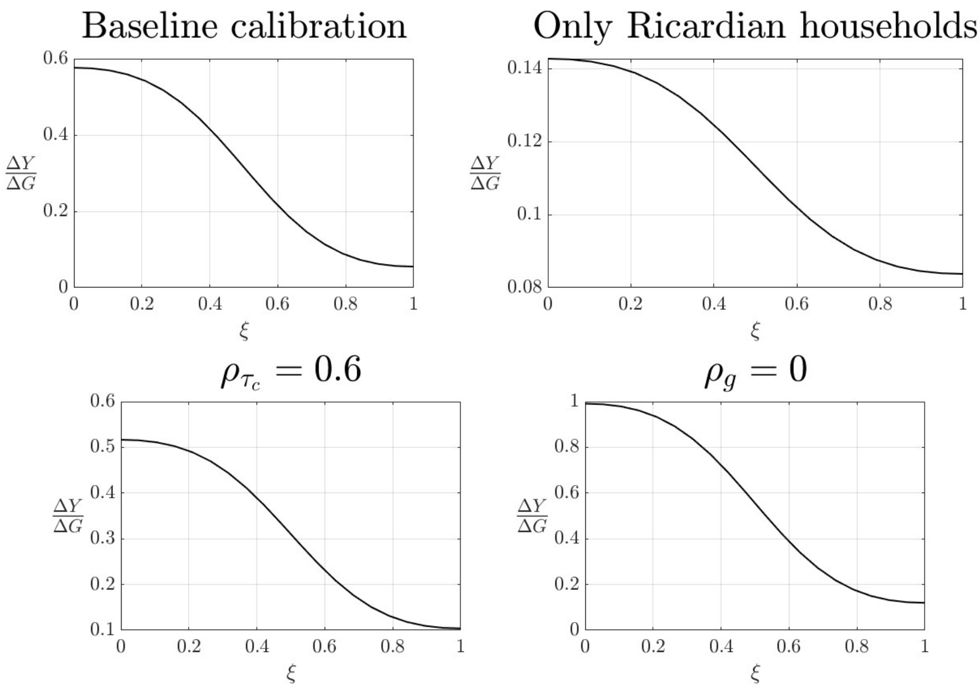

Figure 5: Robustness checks

4.2.3 Volatility of the economy and noise

To test the effects of noise on variables' volatility, we simulate our model over 3,000 periods using a random vector of public expenditure shocks and then compute the second moments of the simulated variables. Figure 6 displays the evolution of the volatility of output, Ricardian consumption, and non-Ricardian consumption for different levels of noise. As expected, a higher level of noise generates greater volatility in both output and Ricardian consumption. Indeed, in a full-information environment, agents react more sharply to fiscal policy announcements (see also Figure 2).fiscal policy announcement (see also Figure 2). Since the response of non-Ricardian consumption to the announcement of a reduction in public expenditure is driven by the reaction of Ricardian agents, it follows logically that the variance of non-Ricardian consumption is also positively associated with a low level of noise.

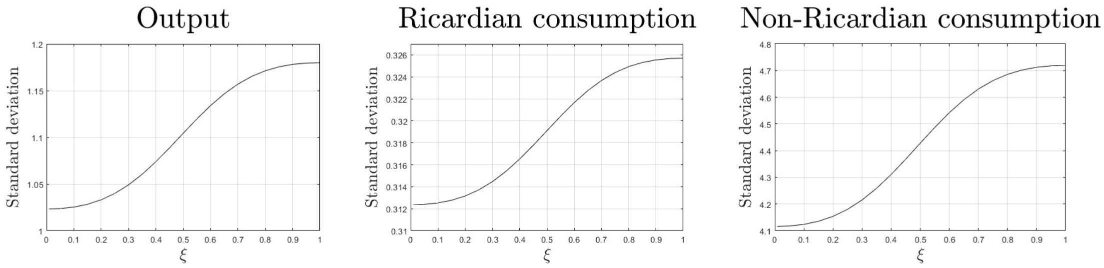

Figure 6: Volatility of Ricardian consumption across levels of announcement noise
Note: Volatility is reported as the theoretical standard deviation. A higher ξ represents a lower level of noise.

Figure 7 plots the evolution of the standard deviation of Ricardian consumption as a function of ξ and σ, where σ captures the degree of risk aversion in the CRRA utility function (a higher value of σ is associated with greater risk aversion). An interesting result concerns the role played by the degree of risk aversion. Indeed, greater risk aversion leads to a weaker response of Ricardian households to fiscal policy announcements. Consequently, higher risk aversion reduces the volatility of Ricardian consumption. More importantly, we observe that strong risk aversion mitigates the impact of noise on consumption volatility. Concretely, even though households react more strongly to announcements when noise is low, they do so in a much more measured way when risk aversion is high. The degree of risk aversion plays a predominant role in the relationship between noise, news, and the adjustment of the economy.

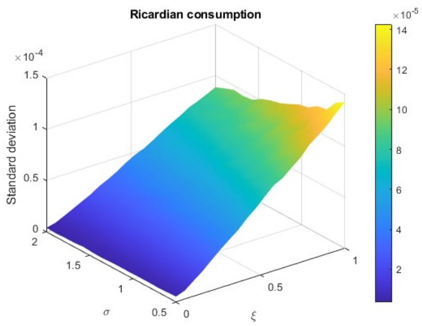

Figure 7: Volatility of Ricardian consumption as a function of announcement noise and risk aversion

5 Conclusion

This paper develops a theoretical framework to study how political instability propagates through the informational structure of fiscal policy rather than through realized policy changes alone. By embedding noisy fiscal signals into a New Keynesian DSGE model with heterogeneous households, we show that macroeconomic fluctuations can emerge not only from the stance of policy itself, but from agents' ability to interpret the credibility of future policy paths.

Our analysis highlights that fiscal noise alters equilibrium dynamics by reshaping the intertemporal allocation of adjustment. In environments where policy announcements are perceived as informative, forward-looking agents internalize future fiscal changes and smooth consumption prior to implementation, thereby diffusing the macroeconomic impact over time. By contrast, when announcements are contaminated by noise, agents optimally discount the informational content of signals and delay their response until policy realization. This "wait-and-see" behavior suppresses anticipatory dynamics and concentrates adjustment at implementation, generating sharper contractions in output despite identical underlying fiscal shocks.

The impact of a restrictive fiscal policy (through a reduction in public spending) is all the greater when the level of noise is high. In other words, the more unstable the political context, the more economic agents will distrust government announcements and non react to any fiscal austerity measures, thus inducing a strong negative effect on output and leading to a recession. Furthermore, the presence of non-Ricardian agents accentuates the recessionary effect of noise. These results suggest that fiscal policy operates partly through an informational channel, where credibility governs the distribution of adjustment across time. Political instability, by degrading the precision of policy signals, can therefore become a source of macroeconomic volatility independent of the fiscal stance itself. our findings contribute to the literature on news-driven business cycles by showing that imperfect signal extraction in the fiscal domain can generate non-linear macroeconomic responses even in the absence of behavioral departures from rational expectations. Under these conditions, if the government wants to reassure financial markets in the event of budget cuts, it has every interest in avoiding political instability in the country.

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Appendix

A Micro Foundations

A.1 Households

The Ricardian household maximizes utility with respect to consumption, labor, investment and public bonds subject to the budget constraint and capital accumulation. We define the Lagrangian $\mathcal{L}$ as follows:

$$\begin{aligned}\mathcal{L} = E_0 \sum_{t=0}^{\infty} \beta^t \Bigg\{ & \left[\frac{C_{i,t}^{1-\sigma}}{1-\sigma} - \frac{N_{i,t}^{1+\varphi}}{1+\varphi} \right] \\ & + \lambda_{c,t} \Bigg[(1+R_{t-1})B_{i,t-1} + W_t N_{i,t} + R_t^K K_{i,t-1} - B_{i,t} - (1+\tau_t^c) P_t C_{i,t} - I_{i,t} \Bigg] \\ & + \mu_{i,t} \Bigg[(1-\delta) K_{i,t-1} + \left[1 - S\left(\frac{I_{i,t}}{I_{i,t-1}} \right) \right] I_{i,t} - K_{i,t} \Bigg] \Bigg\}\end{aligned}$$

The first-order conditions (FOCs) with respect to $C_{i,t}$, $N_{i,t}$, and $B_{i,t}$ resulting from the profit maximization problem are the following:

FOC with respect to $C_{i,t}$:

$$\frac{\partial \mathcal{L}}{\partial C_{i,t}} = 0 \Leftrightarrow \lambda_{c,t} = \frac{C_{i,t}^{-\sigma}}{(1+\tau_t^c) P_t} \tag{33}$$

FOC with respect to $N_{i,t}$:

$$\frac{\partial \mathcal{L}}{\partial N_{i,t}} = 0 \Leftrightarrow N_{i,t}^{\varphi} = \lambda_{c,t} W_t \tag{34}$$

FOC with respect to $B_{i,t}$:

$$\frac{\partial \mathcal{L}}{\partial B_{i,t}} = 0 \Leftrightarrow \lambda_{c,t} = \beta\,(1+R_t)\, E_t[\lambda_{c,t+1}] \tag{35}$$

Substitute $\lambda_{c,t}$ and $\lambda_{c,t+1}$ from (33) on (35):

$$\begin{aligned}\frac{C_{i,t}^{-\sigma}}{(1+\tau_t^c)P_t} &= \beta\,(1+R_t)\, E_t \left(\frac{C_{i,t+1}^{-\sigma}}{(1+\tau_{t+1}^c) P_{t+1}} \right) \\ \Leftrightarrow\ C_{i,t}^{-\sigma} &= \beta\,(1+R_t)\, E_t \left(C_{i,t+1}^{-\sigma} \frac{(1+\tau_t^c) P_t}{(1+\tau_{t+1}^c) P_{t+1}} \right) \\ \Leftrightarrow\ C_{i,t}^{\sigma} &= \frac{1}{\beta\,(1+R_t)} E_t \left(C_{i,t+1}^{\sigma} \pi_{t+1} \frac{(1+\tau_{t+1}^c)}{(1+\tau_t^c)} \right) \\ \Leftrightarrow\ C_{i,t} &= E_t(C_{i,t+1}) \left[\frac{1}{\beta\,(1+R_t)} E_t \left(\pi_{t+1} \frac{(1+\tau_{t+1}^c)}{(1+\tau_t^c)} \right) \right]^{1/\sigma}\end{aligned}$$

Forthermore, households own the capital stock, a homogeneous factor of production, which they rent out to the firms at a rate R_t^K. Households choose the capital stock and investment in order to maximize their intertemporal objective function subject to the intertemporal budget constraint and the capital accumulation equation, which is given by:

$$K_{i,t} = (1-\delta)K_{i,t-1} + \left[1 - S\left(\frac{I_{i,t}}{I_{i,t-1}}\right)\right] I_{i,t} \tag{36}$$

where $I_{i,t}$ is gross investment, δ is the depreciation rate, and the adjustment cost function $S(I_{i,t}/I_{i,t-1}) = \frac{\zeta}{2}(I_{i,t}/I_{i,t-1} - 1)^2$ is an increasing and convex function of changes in private investment, with $\zeta > 0$ denoting a scale parameter or fixed cost to change in the level of investment. $S(\cdot)$ equals zero in a steady state with a constant investment level. In addition, we assume that the first derivative also equals zero around equilibrium so that the adjustment costs will only depend on the second-order derivative.

The first-order condition for $K_{i,t}$ and $I_{i,t}$, resulting from the intertemporal objective function maximization problem, are:

FOC with respect to $I_{i,t}$:

$$\frac{\partial \mathcal{L}}{\partial I_{i,t}} = 0 \Leftrightarrow -\lambda_{c,t} + \mu_{i,t}\left[1 - S\left(\frac{I_{i,t}}{I_{i,t-1}}\right) - S'\left(\frac{I_{i,t}}{I_{i,t-1}}\right)\frac{I_{i,t}}{I_{i,t-1}}\right] + \beta^t E_t\left[\mu_{i,t+1} S'\left(\frac{I_{i,t+1}}{I_{i,t}}\right)\left(\frac{I_{i,t+1}}{I_{i,t}}\right)^2\right] = 0 \tag{37}$$

FOC with respect to $K_{i,t}$:

$$\frac{\partial \mathcal{L}}{\partial K_{i,t}} = 0 \Leftrightarrow \mu_{i,t} = \beta\, E_t\left[\lambda_{c,t+1} R_{t+1}^K + \mu_{i,t+1}(1-\delta)\right] \tag{38}$$

where $\mu_{i,t}$ is the Lagrange's multiplier associated with private capital stock dynamics. We can define the Tobin Q marginal ratio, named $Q_{i,t}$, as:

$$Q_{i,t} = \frac{\mu_{i,t}}{\lambda_{c,t}} \tag{39}$$

which represents the ratio of the two Lagrange's multipliers.

A.2 Firms

The firm maximizes its profits subject to its production function. We define the Lagrangian $\mathcal{L}$ as follows:

$$\mathcal{L} = P_t Y_t - (1+\tau_t^{sp}) W_t N_t - R_t^K K_{t-1} + \lambda_t (A_t (K_t)^\alpha N_t^{1-\alpha} - Y_t)$$

The first-order conditions with respect to N_t and K_t resulting from the profit maximization problem are the following:

$$\frac{\partial \mathcal{L}}{\partial N_t} = 0 \Leftrightarrow \lambda_t (1-\alpha) A_t (K_{t-1})^\alpha N_t^{-\alpha} = (1+\tau_t^{sp}) W_t \tag{40}$$

$$\frac{\partial \mathcal{L}}{\partial K_t} = 0 \Leftrightarrow \lambda_t\, \alpha A_t (K_{t-1})^{\alpha-1} N_t^{1-\alpha} = R_t^K \tag{41}$$

where λ_t is the Lagrange multiplier associated with the production function and equals the firm's marginal cost MC_t.

By rearranging equations (40) and (41), we find the demand function for each input and the marginal cost MC_t:

$$K_{t-1} = \frac{\alpha}{1-\alpha}(1+\tau_t^{sp})\frac{W_t}{R_t^K}N_t \tag{42}$$

$$\lambda_t = MC_t = \frac{[(1+\tau_t^{sp})W_t]^{1-\alpha}(R_t^K)^{\alpha}}{A_t\,\alpha^{\alpha}\,(1-\alpha)^{1-\alpha}} \tag{43}$$