Rational Inattention Choices in Firms and Households [*]

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Abstract

This paper develops a dynamic general equilibrium model with rationally inattentive households and firms and shows that they have endogenous and heterogeneous attention choices. Households find it optimal to pay more attention to supply shocks because these shocks most affect their real income, while firms optimally pay more attention to demand shocks because of their larger impact on profits. These asymmetric attention choices can account for the supply side view of households and the demand side view of firms observed in survey data. Calibrating to survey evidence, the model quantifies the inattention of households and firms and their macroeconomic consequences.

Keywords: Rational inattention; Expectation formation; Firms; Households;
JEL classification: D83, E31, E32, E71.

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1 Introduction

Economic agents make decisions in an environment with abundant information, yet they cannot process everything. When attention is scarce, agents focus on the information most useful for the decisions they face. Households and firms, however, face different decision problems, as a result, the information they follow, the signals they ignore, and the mistakes they make need not to be the same. How does attention heterogeneity affect agents' beliefs and actions and the transmission of shocks to macroeconomic outcomes?

The contribution of this paper is to address this question within a micro-founded, general equilibrium, macroeconomic model. I show that households optimally allocate more attention to the supply shocks than demand shocks; whereas the optimizing firms are more attentive to the demand shocks than supply shocks. Moreover, their attention choices are endogenous, they vary with economic conditions and responds to other agents' behavior.

Preview. Our model shares the same core micro-foundations as the textbook New Keynesian economy with supply and demand shocks, except for one primary modification. I assume both households and firms are rationally inattentive, in that they can choose *"what"* and *"how much"* information to acquire, subject to an attention cost which increases with the informativeness of the signal.[1] Moreover, for ease of discussion, I do not assume exogenous nominal rigidities, rather price rigidity arises endogenously from firms' information frictions.[2]

First focus on the *"what"*. When attention is costly, optimizing agents allocate it to the information most relevant for their decision problems. Households make consumption-saving decisions, so information on the path of real income would be particularly useful: information about the current real income affect the consumption-leisure trade-off, while information about current versus future real income govern the strength of intertemporal substitution. Households therefore choose to learn about their real income. Firms, on the other hand, choose to learn about their nominal marginal cost, as their optimal price is a markup over the nominal marginal cost. In this model, with labor being the only input, nominal marginal cost equals the nominal wage.

As households and firms learn about different endogenous variables, they are differently informed about the underlying shocks through the resultant effect of those shocks on objects they follow. In particular, households are relatively more informed about supply shocks than demand shocks in the economy, as supply shocks (leads to negative comovement in output and inflation) most affect the real income.[3] Firms, by contrast, are relatively more informed about demand shocks than supply shocks, as demand shocks (which lead to positive comovement in output and inflation) have a greater impact on nominal marginal costs.

[1] Formally, I model the cost of attention as the Shannon mutual information times a scaling parameter, following Sims (2003). More precise (less noisy) signals are therefore more costly.

[2] This assumption is standard in this literature (see for example Woodford (2003); Mankiw and Reis (2002); Maćkowiak and Wiederholt (2009)), and it is not essential for the model results.

[3] The idea is, a negative supply shock reduces output but increases inflation, resulting in a large decline to real income; whereas a negative demand shock lowers both output and inflation, so the price decline partly offsets the income loss and real income is comparatively insulated.

Moreover, as households and firms observe only endogenous variables, not exogenous shocks, they cannot fully distinguish the origin of shocks. The direction of misperception is itself shaped by their attention choices. For example, households tend to read changes in real income as supply-driven, and may perceive demand shocks as potential supply shocks.

These implications find support in the data. First, survey evidence shows that households have a supply-side view, while firms have a demand-side view (Candia et al., 2020). The observed contrasting views are difficult to reconcile with standard theories of expectation formation but arises naturally from the heterogeneous attention choices in my model. Second, using monetary policy surprises as expansionary demand shocks, I document a novel fact that household inflation expectations initially decline and only later increase, mirroring the model's prediction that households first interpret such shocks as if they were favorable supply shocks.

Second turn to the *"how much"*. In partial equilibrium, households and firms would pay more attention when the variable they choose to learn about is more volatile. This feature is common in rational inattention models (see, e.g., Sims (2003); Maćkowiak and Wiederholt (2009) and a large follow-up literature). A novel interaction arises in general equilibrium: the attention effort by households and firms are substitutes for demand shocks (households pay less attention if firms pay more attention), while complements for supply shocks (households pay less attention if firms pay less).[4] These interactions arises as the variables agents choose to learn about are endogenous and depend on others' attention and behavior.

These "what" and "how much" then matter for aggregate output and inflation as households and firms act on them when choosing consumption and prices. In the model, the output and inflation responses to each shock differ from the full-information benchmark, and the direction and magnitude of these deviations depend on attention choices. In particular, I show that firms' inattention and sluggish price adjustment tend to amplify the real effects of demand shocks. By contrast, households' and firms' inattention reduces the relative importance of supply shocks in driving business cycles, not only because of their individual inattention and under-response, but also through the strategic complementarity in their attention.

Quantification. An important feature of the model is that attention choices are endogenous to monetary policy conduct and the stochastic economic environment. As conditions change, households and firms reallocate attention in ways that significantly influence macroeconomic outcomes. Specifically, a shift to more hawkish monetary policy at the beginning of the Great Moderation stabilizes prices, reducing firms' attention. This further dampens their price adjustment behavior, making prices even less sensitive to output fluctuations. It also shifts households' attention from supply shocks to demand shocks, amplifying output gap volatility. Both

[4] The strategic interactions in information acquisition have been studied in several studies, Maćkowiak and Wiederholt (2009) and Hellwig and Veldkamp (2009) among others, which argue complementarity (substitutability) in information choices arises from the complementarity (substitutability) in actions. Here I demonstrate that complementarity (substitutability) can also arise through the value of information in a general equilibrium model with multiple inattentive agents.

forces contributed to the flattening of the Phillips curve observed over recent decades.[5] In the post-pandemic period, heightened volatility of supply and demand shocks reversed this mechanism: firms increased their attention, households adjusted in tandem, and thus the Phillips curve steepened, consistent with post-pandemic U.S. aggregate and regional evidence.[6]

The model has broader implications for communication. When agents only pay attention to partial and biased information, communication policies may not work as intended. First, standard theory predicts that news about higher future inflation should raise households' spending today, a key mechanism of forward guidance. However, households with a supply-side biased information set may misinterpret the higher inflation as originating from a contractionary supply shock, leading them to lower output growth expectations and reduce spending. Second, central bank may commit to a lower interest rate path during periods of economic slack to stimulate demand. However, firms with a demand-side biased partial information set may misinterpret the systematic response in interest rate as an expansionary monetary policy shock and raise prices, which dampens the demand further. These findings highlight that policymakers need to carefully craft their communication strategies, taking into consideration how different agents perceive the information.

Related Literature. This study contributes to the research agenda that seeks to develop a data-consistent model of expectation formation. Three closely related studies are Kamdar (2018), Bhandari et al. (2024), and Han (2024). Kamdar (2018) and Bhandari et al. (2024) both look at the same facet of consumer surveys, attributing the observation to pessimism. Han (2024) explains observed heterogeneity by exogenously assuming different partial information for different agents. In contrast to these papers, I argue that agents' partial information is optimally chosen based on their respective objectives, and show that households' supply-side view arises from the optimal responses of firms.[7]

This paper broadly relates to the rational inattention literature following Sims (2003). The core premise of this literature is that incentives drive attention, implying that agents pay more attention to more volatile and more important variables (e.g., Maćkowiak and Wiederholt (2009); Kohlhas and Walther (2021); Flynn and Sastry (2024)). Here I show that agents' attention to particular shocks can be higher than their attention to others. Another contribution of this paper is that it solves a dynamic general equilibrium model in which both firms and households are rationally inattentive. While Maćkowiak and Wiederholt (2015) also features two-sided rational inattention, this paper extends the analysis by studying further expectation-

[5]The flattening of the Phillips curve in recent decades has been widely documented; see, for example, Coibion and Gorodnichenko (2015), Blanchard (2016), Bullard (2018), and Hooper et al. (2020); Kishaba and Okuda (2023).

[6]See Hobijn et al. (2023), Furlanetto and Lepetit (2024), Gelain and Lopez (2024) and Cerrato and Gitti (2022) for evidence on the post-pandemic steepening of the Phillips curve.

[7]This study also differs from Kamdar (2018) on the household side in several critical aspects. As mentioned in footnote 3, Kamdar (2018)'s results rely on information compression, as a result, agents' belief does not approach the true data-generating process as information costs decrease. In contrast, this model converges to the full-information equilibrium as information costs approach zero. Moreover, this paper focuses on the correlation of expectations rather than posterior beliefs, making the results directly relevant to survey evidence, where questions pertain to agents' expectations rather than their posterior beliefs.

related moments.

This paper also connects to a vast literature in macroeconomics on the role of imperfect information in business cycle dynamics (Lucas (1972); Woodford (2001); Eusepi and Preston (2010); Blanchard et al. (2013); Angeletos and La'o (2013); Chahrour and Ulbricht (2023) among others), and in the effect of policy (for e.g, Amador and Weill (2010); Paciello (2012); Angeletos and Lian (2018)). The contribution of this paper is to highlight the macroeconomic consequences when agents endogenously choose different partial information, and offer new insights on communication when different agents in the economy have heterogeneous attention choices and views.

Layout. The paper is organised as follows. In Section 2, I provide a closed-form characterisation of households' and firms' attention choices under rational inattention in the illustrative model. In Section 3, I study the full dynamic general equilibrium model, where I calibrate the model and analyse the impact on macroeconomic dynamics. In Section 4, I show that the model can jointly explain the flattening of the Phillips curve over recent decades and its steepening in the post-pandemic. In Section 5, I discuss the implications for communication. Section 6 concludes.

2 Attention Choices in Firms and Households

In this section, I present a simple model with rational inattention to illustrate the heterogeneous attention choices of households and firms. The full model is presented and solved quantitatively in Section 3.

2.1 Environment

Households. There is a continuum of hand-to-mouth households indexed by $i \in [0, 1]$. Household i in each period chooses consumption $C_{i,t}$ to maximise its expected utility and supplies labour $L_{i,t}$ such that the budget constraint binds. Household i's period utility at time t is

$$U\left(C_{i,t}, L_{i,t}\right) = \left[\frac{C_{i,t}^{1-\gamma}}{1-\gamma} - \frac{L_{i,t}^{1+\eta}}{1+\eta}\right] \tag{2.1}$$

$$s.t.\ P_t C_{i,t} = W_t L_{i,t}, \quad C_{i,t} = \left[\int_0^1 C_{i,j,t}^{\frac{\theta-1}{\theta}}\, dj\right]^{\frac{\theta}{\theta-1}} \tag{2.2}$$

where $C_{i,j,t}$ is household i's demand for variety j given its price $P_{j,t}$ and $C_{i,t}$ is the final consumption good aggregated with a constant elasticity of substitution $\theta > 1$ across varieties. W_t is the nominal wage, and $P_t = [\int_0^1 P_{j,t}^{1/(\theta-1)} dj]^{\theta-1}$ is the aggregate price index. The parameter $\gamma > 1$ is the risk aversion coefficient and the parameter η is the inverse of Frisch elasticity of labour supply.

Firms. There is a continuum of firms producing differentiated goods, each indexed by $j \in [0,1]$. Each firm j is a monopoly producer of its own variety and faces a demand curve $Y_{j,t} = (P_{j,t}/P_t)^{-\theta} Y_t$, where $Y_t = \int_0^1 Y_{j,t} dj$ is the aggregate output. Firm j hires labour $L_{j,t}$, pays wages W_t per worker, and produces with a linear technology

$$Y_{j,t} = A_t L_{j,t} \tag{2.3}$$

where A_t is the aggregate productivity.

In each period, firm j sets the price $P_{j,t}$ for its own product to maximise its expected profit and produces a sufficient quantity of goods to meet the demand $Y_{j,t}$. Prices are fully flexible (nonetheless, as discussed later in Section 2.5, price stickiness arises endogenously from firms' inattention). The profit of firm j at time t, discounted by the household's marginal utility of consumption, is expressed as

$$\Pi_{j,t}(P_{j,t}, L_{j,t}, Y_{j,t}) = \frac{1}{P_t C_t^{\gamma}} \left[P_{j,t} Y_{j,t} - (1-\theta^{-1}) W_t L_{j,t} \right] \tag{2.4}$$

where $(1-\theta^{-1})W_t$ denotes the subsidised wage rate, with the subsidy θ^{-1} paid to eliminate steady-state distortions introduced by monopolistic competition.

Central Bank. For analytical tractability, I assume that central bank directly controls the nominal aggregate demand $Q_t \equiv P_t Y_t$. This assumption allows for a closed-form characterisation of the solution.[8] I consider a more standard Taylor rule in the quantitative model in Section 3. I further assume that the central bank has full information and interpret it as the model counterpart of the professional forecasters in the survey.

Shocks. The economy is subject to both demand and supply shocks. I model the demand shock as a shock to the nominal aggregate demand ($q_t \equiv \log Q_t$), and the supply shock as a shock to all firms' productivity levels ($a_t \equiv \log A_t$). The two exogenous processes follow Gaussian white noise distributions with variances $\sigma_q^2 > 0$ and $\sigma_a^2 > 0$, and are mutually independent.

2.2 Attention Costs and Information Structure

Costly Attention. In this environment, agents must pay attention in order to be aware of the economic conditions. While the cost of attention can, in principle, take many different forms (see e.g., Hébert and Woodford (2018)), I follow Sims (2003) and model the attention costs as linear in Shannon's mutual information $\mu \mathcal{I}\left(X; S^t | S^{t-1}\right)$, where μ is the marginal cost of attention. Specifically, $s_t \in \mathcal{S}^t$ denotes the signals at time t, and $\mathcal{S}^t$ is the set of available

[8] Assuming that the monetary authority directly controls the nominal aggregate demand is a popular framework in the rational inattention literature to study the effects of monetary policy on pricing. See for example Mankiw et al. (2003); Woodford (2003); Maćkowiak and Wiederholt (2009); Paciello (2012); Afrouzi and Yang (2021) among others.

signals. The history of signals up to time t is denoted by $S^t = S^{t-1} \cup s_t$. Mutual information is defined as

$$\mathcal{I}\left(X; S^t | S^{t-1}\right) \equiv h(X|S^{t-1}) - \mathbb{E}\left[h(X|S^t)|S^{t-1}\right]$$

This measures the reduction in entropy of the object X due to information gained from signal S^t conditional on the history of signals S^{t-1}.

This formulation assumes that agents do not forget information over time and thus the information chosen today can have a continuation value. In the simple model presented in this section, this condition does not matter as shocks are i.i.d., so the knowledge about the shocks today does not affect future priors. However, in the full model presented in Section 3, where shock processes are more complex and intertemporal decisions are involved, past information becomes useful to agents.

Information Structure. It is necessary to specify the information structure, i.e., the available signal set $\mathcal{S}^t$. I consider two popular approaches in the literature. One approach, optimal signal design, explored by Sims (2003) and Maćkowiak et al. (2018), allows agents full flexibility when designing the conditional distribution of their signals given the state of the economy. An alternative approach, constrained information structure, restricts agents to acquiring N separate, conditionally independent signals about N different components in their optimal action.[9] In the current context, I partition the signal into one subvector that contains only information on nominal aggregate demand shock q_t and another subvector that contains only information on the productivity shock a_t.

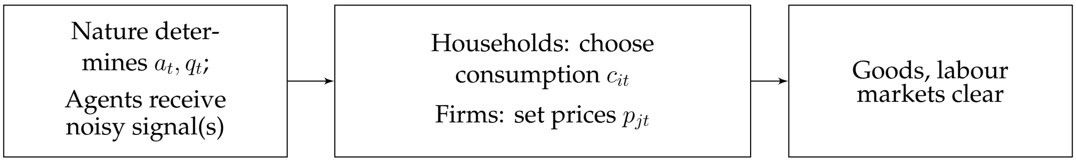
The choice of information structure typically depends on the problem at hand. In this context, optimal signal design is more realistic than restricting agents to separate signals for different shocks.[10] However, for analytical tractability and interpretability, in Section 2.4 and 2.5, I solve the attention problem under a constrained information structure. In Section 2.5, I compare the predictions of each approach and find that the choice of information structure does not significantly affect the results. In other sections, including the quantitative model in Section 3, I adopt optimal signal design to better capture how households and firms acquire information.

Timing. In the initial period $t = 0$, households and firms make their ex ante attention choices, which we can think of as determining the form and precision of the associated signals. In each subsequent period $t > 0$, shocks (q_t, a_t) realise. The economy proceeds through three stages: (i) depending on their respective attention choices, households and firms receive different forms of signals with different precision levels; (ii) based on their respective signals, households choose their consumption and firms set their prices for their own varieties. (iii) after their choices are committed, households supply labour to cover their consumption and

[9] Maćkowiak and Wiederholt (2009) partitions firms' signals into two subvectors, with one subvector containing information about idiosyncratic conditions and another about aggregate conditions.

[10] The model implied optimal signals align with the survey evidence on agents' attention choices. See Appendix A.1 for details on households' and firms' attention choices in the survey.

firms produce sufficient goods to meet the demand. Finally, the real wage adjusts to clear the labour market.



2.3 Attention Problems of Households and Firms

Households. For tractability, I simplify the households' utility function (2.1) using quadratic approximations (derivation see Appendix B.1). After the approximation, household i's objective (2.1) at time t can be expressed as the utility loss from deviating from the optimal consumption level $c^*_{i,t}$ – the consumption level that households would choose under full information[11]

$$\left[-\frac{(\gamma+\eta)}{2}\left(c_{i,t}-c^*_{i,t}\right)^2\right] + \text{terms independent of } \{c_{i,t}\} \tag{2.5}$$

Here, lowercase letters denote the logs of the corresponding variables. $c_{i,t}$ is the actual consumption choice made by the household i.

The optimal consumption under full information is obtained by equating the marginal rate of substitution between consumption and leisure to the real wage[12]

$$c^*_{i,t} = \frac{1+\eta}{(\gamma+\eta)}\left(w_t - p_t\right) \tag{2.6}$$

The equation states that optimal consumption is a function of real wage. If households know the real wage, they can achieve the optimal consumption level. This also implies that households want to learn about real wages to guide their consumption decisions. This aligns with the survey evidence from the Michigan Survey of Consumers, which shows that households pay more attention to developments related to the real labour market than to prices (see Appendix A.1 for details).

Substituting the optimal consumption from Equation (2.6) into the utility function (2.5), and adding the attention cost term, household i's attention problem is given by

$$\max_{\{s_{i,t}\in\mathcal{S}^t_h\}} \mathbb{E}^h_t\left[-\frac{(\gamma+\eta)}{2}\left(c_{i,t}-\frac{1+\eta}{\gamma+\eta}\left(w_t-p_t\right)\right)^2 - \mu^h\mathcal{I}\left(a_t,q_t;s_{i,t}\right)\right] \tag{2.7}$$

The first term in Equation (2.7) captures the benefits of attention, as $c_{i,t}$ gets closer to the optimal level, which is a function of the real wage. The second term reflects the cost of attention, measured by the marginal cost of attention $\mu^h > 0$ times the expected reduction in entropy

[11] The first-order term of this approximation drops out due to the envelope theorem: there are no first-order costs of deviating from c^*_{it}. Full derivation see B.1.

[12] The optimal consumption is derived by substituting $l_{i,t}$ using the budget constraint $p_t + c_{i,t} = w_t + l_{i,t}$ into the intra-temporal Euler equation $\gamma c_{i,t} + \eta l_{i,t} = w_t - p_t$.

after observing the signal $s_{i,t} \in \mathcal{S}_h^t$, where $\mathcal{S}_h^t$ is the set of all available signals for households at time t.

Firms. I simplify the firms' profit function (2.4) using quadratic approximations (derivation see Appendix B.2), which yields

$$\left[-\frac{\theta-1}{2}\left(p_{j,t}-p_{j,t}^*\right)^2\right] + \text{terms independent of } \{p_{j,t}\} \tag{2.8}$$

where lowercase letters denote the logs of the corresponding variables. Equation (2.8) states that firm j experiences a profit loss from setting a price $p_{j,t}$ that deviates from its optimal price level under full information $p_{j,t}^*$. Moreover, the magnitude of profit losses is proportional to firm's demand elasticity $(\theta - 1)$. In other words, firms with more elastic demand experience larger profit losses when charging a suboptimal price. In this simple setup, firm's optimal price under full information is its nominal marginal cost

$$p_{j,t}^* = w_t - a_t \tag{2.9}$$

This implies that firms seek information on nominal marginal cost to guide their pricing decisions. This aligns with the survey evidence from the Business Inflation Expectation survey, which suggests that firms have strong incentives to pay attention to unit costs when setting prices (see Appendix A.1 for details).

Substituting the optimal price using Equation (2.9) into the profit function (2.4), and adding the attention cost, firm j's attention problem is formally defined as

$$\max_{\{s_{j,t}\in\mathcal{S}_f^t\}} \mathbb{E}_t^f\left[-\frac{\theta-1}{2}\left(p_{j,t}-(w_t-a_t)\right)^2 - \mu^f\mathcal{I}\left(q_t,a_t;s_{j,t}\right)\right] \tag{2.10}$$

The first term captures the benefit of paying attention, that the firm's price $p_{j,t}$ gets closer to the optimal level, i.e., firm j's nominal marginal cost. The second term is the cost of attention, measured by firm's marginal cost of attention $\mu^f > 0$ times the expected entropy reduction about the optimal price $p_{j,t}^*$ after observing $s_{j,t} \in \mathcal{S}_f^t$.

The equilibrium of the model is defined as in Definition 1.

Definition 1 (Equilibrium). *Given the processes for the aggregate demand and productivity shocks $\{q_t, a_t\}_{t\geq 0}$, a general equilibrium of this economy is an allocation for every household $i \in [0,1]$, $\Omega_i \equiv \{s_{i,t} \in \mathcal{S}_{i,t}, C_{i,t}, L_{i,t}\}_{t=0}^{\infty}$, given their initial set of signals; an allocation for every firm $j \in [0,1]$, $\Omega_j \equiv \{s_{j,t} \in \mathcal{S}_{j,t}, P_{j,t}, L_{j,t}, Y_{j,t}\}_{t=0}^{\infty}$ given their initial set of signals; a set of prices $\{P_t, W_t\}_{t=0}^{\infty}$, such that*

1. *Given the processes for $\{P_t, W_t\}_{t=0}^{\infty}$ and all firms' decisions $\{\Omega_j\}_{j\in[0,1]}$, every household i's allocation solves the attention problem (2.7);*
2. *Given the processes for $\{P_t, W_t\}_{t=0}^{\infty}$ and all households' allocations $\{\Omega_i\}_{i\in[0,1]}$, every firm j's allocation solves the attention problem (2.10);*

3. *The equilibrium processes $\{P_t, W_t\}_{t=0}^{\infty}$ are consistent with the allocations of households and firms, $\{\Omega_i\}_{i\in[0,1]}$ and $\{\Omega_j\}_{j\in[0,1]}$.*

Solving for equilibrium with two-sided rational inattention is complex, as agents' attention choices and decisions depend on endogenous variables as well as each other's attention choices and decisions. To provide intuition for the attention choices of households and firms, I simplify the model by first considering the case where only households are subject to rational inattention, while firms have full information (Section 2.4). Next, I examine the case where only firms are rationally inattentive while households have full information (Section 2.5). Finally, in Section 2.7, I solve the general equilibrium model with two-sided rational inattention analytically, and explain the rich interactions in attention allocation between households and firms.

2.4 Households' Attention Choices

I begin by analysing the case where households are subject to rational inattention while firms have full information. In this case, firms set prices at their optimal level according to Equation (2.9), which implies that the real wage is fully determined by productivity

$$w_t - p_t = a_t \tag{2.11}$$

From Equation (2.11), the real wage is not affected by demand shocks q_t, this is due to firms' optimising behaviour – following a demand shock, nominal wages rise, firms with full information increase prices one-to-one with nominal wage, and the real wage is thus unaffected. This follows the classical dichotomy.

To develop the intuition for households' attention choices, imagine that a measure of zero of households have no information, while all others have full information. Since all other households have full information, the optimal consumption remains $c_{i,t}^* = \frac{1+\eta}{\gamma+\eta}(w_t - p_t) = \frac{1+\eta}{\gamma+\eta}a_t$. However, households with no information fail to adjust their consumption (i.e., $c_{i,t} = 0$), resulting in an expected utility loss proportional to

$$\mathbb{E}_{i,t}\left[-\left(c_{i,t} - c_{i,t}^*\right)^2\right] = \mathbb{E}_{i,t}\left[-\left(0 - \frac{1+\eta}{\gamma+\eta}a_t\right)^2\right] = -\left(\frac{1+\eta}{\gamma+\eta}\right)^2 \sigma_a^2$$

This indicates that, as long as firms have full information and adjust their prices to fully track changes in the nominal marginal cost, there is no utility loss for households from misinformation about demand shocks, even if they pay no attention to those shocks. The expected utility loss arises solely from misinformation about supply shocks. Furthermore, the expected loss is higher when (i) optimal consumption is more responsive to productivity shocks (i.e., high $(1+\eta)/(\gamma+\eta)$) (ii) shocks are more volatile (i.e., high σ_a^2). Figure 1a illustrates this with a contour plot showing the utility loss when a_t and q_t are misperceived. The plot consists of horizontal lines, indicating no loss from not attending to q_t.

Under constrained information structure, households can obtain N separate, conditionally independent signals. In this context, households can obtain one signal about the nominal aggregate demand shock and another signal about the productivity shock[13], i.e.,

$$s_{i,t} = \{s_{i,q,t}, s_{i,a,t}\} \tag{2.12}$$

where

$$s_{i,q,t} = q_t + e_{i,q,t} \quad \text{and} \quad s_{i,a,t} = a_t + e_{i,a,t} \tag{2.13}$$

and $\{s_{i,q,t}, q_t\}$ and $\{s_{i,a,t}, a_t\}$ are independent, follow stationary Gaussian processes, and all noise terms are mean-zero and independently distributed across households.

Upon receiving these signals, consumption $c_{i,t} = \mathbb{E}[c^*_{i,t}|s_{i,t}] = \frac{1+\eta}{\gamma+\eta}\,\mathbb{E}[a_t|s_{i,a,t}]$ maximises the expected utility for any given posterior belief. For ease of notation, define $\lambda_{h,a} \equiv \frac{1+\eta}{\gamma+\eta}$. And further define $\sigma^2_{a|s}$ as the posterior uncertainty about a_t. Substituting $c_{i,t}$ and real wage (2.11) into Equation (2.7) yields

$$\begin{aligned} &\max_{\{s_{i,t}\in\mathcal{S}^t_i\}} \mathbb{E}^i_t \left[-\frac{\gamma+\eta}{2} \left(\lambda_{h,a}\,\mathbb{E}[a_t|s_{i,a,t}] - \lambda_{h,a}a_t\right)^2 - \mu^h \mathcal{I}\left(a_t, q_t; s_{i,t}\right) \right] \\ &= \frac{1}{2} \max_{\sigma^2_{a|s}\le\sigma^2_a} \left[-(\gamma+\eta){\lambda_{h,a}}^2\sigma^2_{a|s} - \mu^h \ln \frac{\sigma^2_a}{\sigma^2_{a|s}} \right] \end{aligned} \tag{2.14}$$

Solving this problem characterises households' attention choices, as summarised in Proposition 1.

Proposition 1. *When firms have full information, and households can obtain a signal vector of the form* $s_{i,t} = \{s_{i,q,t}, s_{i,a,t}\}$

1. *Households only attend to signal about supply shocks $s_{i,a,t}$. The attention weight on supply shocks (the Kalman-gain) is*

$$\xi_{h,a} = \max\left(0, 1 - \frac{\mu^h}{(\gamma+\eta)\lambda^2_{h,a}\sigma^2_a}\right)$$

   and the attention weight on demand shock is $\xi_{h,q} = 0$.

2. *Households' consumption evolves according to*

$$c_{i,t} = \lambda_{h,a}\,\mathbb{E}[a_t|s_{i,a,t}] = \xi_{h,a}\lambda_{h,a}\left(a_t + e_{i,a,t}\right).$$

Proof. See Appendix B.3.

The Proposition 1 shows that households never pay attention to demand shocks, as such information has no value for them as long as firms have full information. Therefore, when at-

[13] In the households' attention problem, both the constrained and flexible information structures yield the same signal form since optimal consumption depends solely on productivity shocks.

tention is costly, households would not choose to acquire such information. Moreover, households pay more attention to supply shocks if (i) the information generates a higher payoff (i.e., higher $\lambda_{h,a}$), and (ii) households are sufficiently uncertain about it (i.e., higher prior uncertainty σ_a^2), and (iii) attention costs are relatively low (i.e., low μ^h).

Notably, if firms are inattentive, prices respond sluggishly to demand shocks. As a result, demand shocks have real effects. Information about demand shocks then becomes valuable to households (albeit secondarily), therefore, households have incentives to pay attention to demand shocks.

2.5 Firms' Attention Choices

I analyse the case where firms are subject to rational inattention while households have full information.[14] When households have full information, all households equate the marginal rate of substitution between consumption and labour to the real wage, i.e., $\gamma c_{i,t} + \eta l_{i,t} = w_t - p_t$ and the budget constraint holds as $p_t + c_{i,t} = w_t + l_{i,t}$, $\forall i$. This implies that the nominal marginal cost takes the following form

$$w_t - a_t = q_t - \frac{1+\eta}{\gamma+\eta} a_t \tag{2.15}$$

To develop the intuition for firms' attention choices, imagine that a measure of zero of firms have no information while all other firms have full information. Since all other firms have full information, the optimal price remains $p_{j,t}^* = q_t - \frac{1+\eta}{\gamma+\eta} a_t$. However, firms without information fail to adjust their prices (i.e., $p_{j,t} = 0$), resulting in expected profit losses proportional to

$$\mathbb{E}_{j,t}\left[-\left(p_{j,t} - p_{j,t}^*\right)^2\right] = \mathbb{E}_{j,t}\left[-\left(0 - \left(q_t - \frac{1+\eta}{\gamma+\eta} a_t\right)\right)^2\right] = -\left[\sigma_q^2 + \left(\frac{1+\eta}{\gamma+\eta}\right)^2 \sigma_a^2\right] \tag{2.16}$$

As shown in Equation (2.16), misinformation about both shocks are expected to cause profit loss. The magnitude of expected profit loss due to misinformation about a particular shock depends on (i) the volatility of each shock, with more volatile shocks leading to a greater expected loss from misinformation; (ii) the responsiveness of optimal price to each shock.

For relatively high values of risk aversion coefficient γ, misinformation about demand shocks can result in greater profit loss than misinformation about supply shocks. The intuition is that, following a positive productivity shock, the optimal price should decrease on impact as $p_{j,t}^* = w_t - a_t$. This reduction in prices leads to a surge in demand c_t. For $\gamma > 1$, the income effect dominates, and labour supply decreases, which in turn causes wages to rise. This offsets the initial downward pressure on prices, so the optimal price $p_{j,t}^*$ is less affected by productivity shocks when γ is large.

Under standard parameter values, I show misinformation about demand shocks may incur larger profit loss for firms (see Section 3 for detailed parameterisation). This is illustrated in

[14] For tractability, I assume that there is no general equilibrium feedback through strategic complementarity in price setting. However, this feedback effect is included in the quantitative model (see Section 3).

Figure 1b.

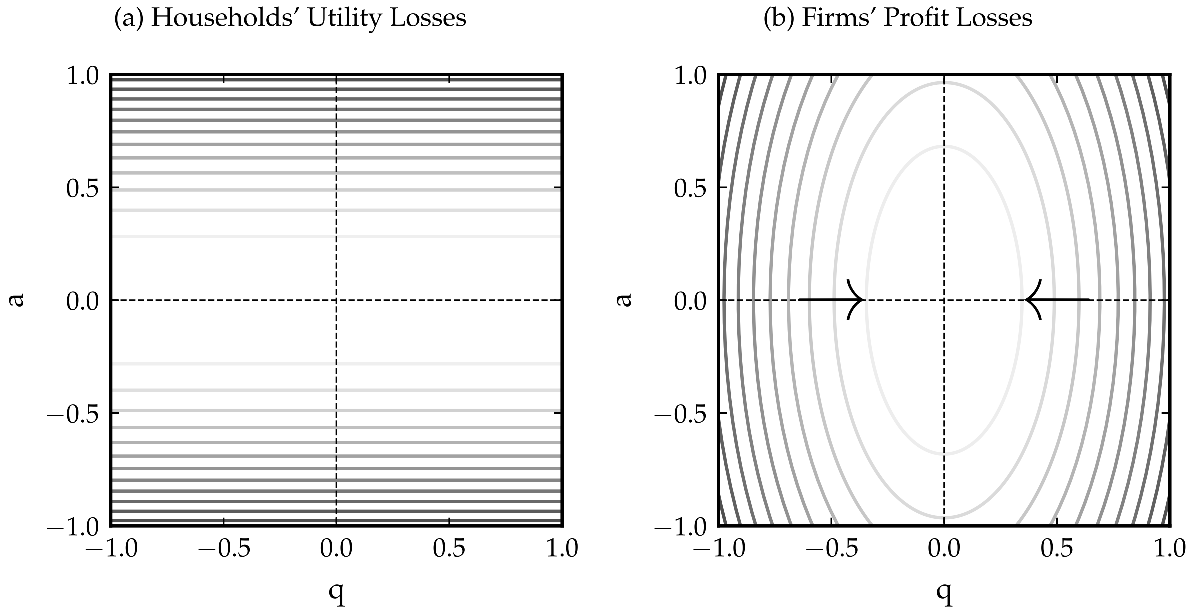


Figure 1: Losses from Misperceptions of $(q\ ,a)$

Notes: Figure 1a shows a contour plot of households' utility losses when q and a are misperceived. It shows that the losses occur only along a varying a, which is therefore the only component that households would pay attention to. Figure 1b shows a contour plot of firms' profit losses when unit shocks q and a are misperceived. It shows that the descent of losses is steeper in the case of demand shocks q, which is therefore the more important component that firms need to pay attention to.

Suppose firms can obtain separate, conditionally independent signals about q_t and a_t, as defined in Equation (2.12) and (2.13). For ease of notation, let $\lambda_{f,q} \equiv 1$ and $\lambda_{f,a} \equiv -\frac{1+\eta}{\gamma+\eta}$. Under this notation, the nominal marginal cost is given by $w_t - a_t = \lambda_{f,q} q_t + \lambda_{f,a} a_t$. Firms' attention choices are characterised by the following Proposition 2.

Proposition 2. *When households have full information, and firms can obtain a signal vector of the form* $s_{j,t} = (s_{j,q,t}, s_{j,a,t})$

1. *Firms optimally allocate attention towards both signals, $s_{j,q,t}$ and $s_{j,a,t}$. The attention weights (Kalman gain) on each signal are given by*

$$\xi_{f,q} = \max\left(0, 1 - \frac{\mu^f}{(\theta-1)\lambda_{f,q}^2 \sigma_q^2}\right), \tag{2.17a}$$

$$\xi_{f,a} = \max\left(0, 1 - \frac{\mu^f}{(\theta-1)\lambda_{f,a}^2 \sigma_a^2}\right). \tag{2.17b}$$

2. *Firms' prices evolve according to*

$$p_{j,t} = \lambda_{f,q}\xi_{f,q}\left[q_t + e_{j,q,t}\right] + \lambda_{f,a}\xi_{f,a}\left[a_t + e_{j,a,t}\right]. \tag{2.18}$$

Proof. See Appendix B.4.

The Proposition 2 shows that allocation of attention to q_t and a_t is independent, and firms have incentives to pay attention to both shocks. For relatively high values of γ, the attention weight can be higher for demand shocks, i.e., $\xi_{f,q} \gtrapprox \xi_{f,a}$, in which cases firms find it optimal to pay more attention to demand shocks.

Comparison to Optimal Signal Design. Proposition 2 characterises the solution to the attention problem under constrained information structure. Alternatively, firms can freely design their optimal signal. Following the characterisations of optimal signal design in Maćkowiak et al. (2018), the optimal signal is a single signal about their optimal action, i.e., the nominal marginal cost. The prior uncertainty about the optimal price is $\sigma_p^2 \equiv \lambda_{f,q}^2 \sigma_q^2 + \lambda_{f,a}^2 \sigma_a^2$, the solution to the firms' attention problem is characterised in Proposition 3 below.

Proposition 3. *When households have full information and firms can freely design their optimal signal, firms will pay more attention to demand shocks. Formally,*

1. *Firms optimally obtain a single signal about their optimal price $p_{j,t}^*$*

$$s_{j,t} = p_{j,t}^* + e_{j,t} = \lambda_{f,q} q_t + \lambda_{f,a} a_t + e_{j,t}$$

   where $e_{j,t}$ is the idiosyncratic noise in the signal.

2. *The optimal signal for firms skews towards nominal aggregate shocks as $|\lambda_{f,q}| > |\lambda_{f,a}|$*

3. *Firm's price evolves according to*

$$p_{j,t} = \xi_f \left(p_{j,t}^* + e_{j.t} \right) = \xi_f \lambda_{f,q} q_t + \xi_f \lambda_{f,a} a_t + \epsilon_{j,t}$$

   where the Kalman-gain of the firm's signal under optimal information structure is

$$\xi_f = \max \left(0, 1 - \frac{\mu^f}{(\theta - 1)\left(\lambda_{f,q}^2 \sigma_q^2 + \lambda_{f,a}^2 \sigma_a^2 \right)} \right).$$

Proof: See Appendix B.5.

From the first part of Proposition 3, firms optimally obtain a single signal about their optimal price $p_{j,t}^*$. The optimal signal is skewed towards q_t as optimal price is more responsive to q_t, i.e., $|\lambda_{f,q}| = 1$ is greater than $|\lambda_{f,a}| = \frac{1+\eta}{\gamma+\eta}$ when $\gamma > 1$. As a result, more attention is allocated to nominal aggregate demand shocks. The results relate to Kohlhas and Walther (2021), which shows that the asymmetry of attention under optimal signal design depends on the weights $\lambda_{f,q}$ and $\lambda_{f,a}$ in agents' optimal action through their influences on $p_{j,t}^*$. The last part of Proposition 3 shows that firms attention is higher if (i) either shock is more volatile (i.e., large σ_q^2 or σ_a^2); (ii) the loss from misinformation is high (i.e., high θ or $\lambda_{f,q}$ or $\lambda_{f,a}$); and (iii) the marginal cost of firms μ^f is relatively low.

The key difference between optimal signal design and the constrained information structure is evident from Proposition 2 and Proposition 3. With optimal signal design, a higher attention weight allocated to one shock over another is driven by the optimal signal being skewed towards that shock. As a result, the volatility of the shocks does not affect the relative attention, instead, relative attention depends solely on the relative responsiveness of price to the shock, i.e., $\lambda_{f,q}/\lambda_{f,a}$. In contrast, under the constrained information structure, higher attention weight is given to a shock either because optimal price is more responsive to that shock or because that shock is particularly volatile. In this case, relative attention depends on both $\lambda_{f,q}/\lambda_{f,a}$ and σ_q^2/σ_a^2.

So far, I have solved the attention problem assuming one side is rationally inattentive and the other side is fully informed. Before addressing the case where both households and firms are rationally inattentive, I first explain how attention choices lead to the supply-side view by households and demand-side view by firms.

2.6 Implications of Attention Choices on Beliefs

Suppose the true data-generating processes are characterised by

$$y_t = \Psi_{y,q} q_t + \Psi_{y,a} a_t, \tag{2.19}$$

$$p_t = \Psi_{p,q} q_t - \Psi_{p,a} a_t. \tag{2.20}$$

Here, Ψs denote the responses of aggregate output y_t and aggregate price p_t to demand and supply shocks. The specific values are determined endogenously in equilibrium, which depend on the equilibrium attention choices and decisions made by firms and households. The specific values are not central to the discussion in this section. Nonetheless, a positive demand shock is typically expansionary and inflationary (i.e., $\Psi_{y,q} > 0$ and $\Psi_{p,q} > 0$), while a positive supply shock tends to increase output but decrease prices (i.e., $\Psi_{y,a} > 0$ and $\Psi_{p,a} < 0$).

Define the expected output growth of agent k as $\mathbb{E}^k(y_{t+1} - y_t)$ and expected inflation as $\mathbb{E}^k(\pi_{t+1}) = \mathbb{E}^k(p_{t+1} - p_t)$, where $k = \{h, f, cb\}$ represents households, firms and professional forecasters. With these definitions in place, I can derive the unconditional covariance between expected output growth and expected inflation

$$Cov\left(\mathbb{E}^k(y_{t+1} - y_t), \mathbb{E}^k(\pi_{t+1})\right) = \Psi_{y,q}\Psi_{p,q}\xi_{k,q}^2\sigma_q^2 - \Psi_{y,a}\Psi_{p,a}\xi_{k,a}^2\sigma_a^2 \tag{2.21}$$

Equation (2.21) characterises agents' perceived correlation between expected output growth and expected inflation. Here, $\xi_{k,q}$ is the attention weight that agent k assigns to demand shocks, while $\xi_{k,a}$ is the attention weight on supply shocks. Both $\xi_{k,q}$ and $\xi_{k,a}$ range between 0 and 1, where a value of 1 corresponds to the full information case, and 0 indicates that agents receive no information. The covariance is the sum of two components: the first component is positive, indicating that conditional on demand shocks, the covariance is positive; the second component is negative, indicating that conditional on supply shocks, the covariance is negative. The unconditional covariance is the sum of these two components.

Full Information Benchmark. If all the agents have full information, then the attention weights for all agents k on both shocks equal 1. The covariance is thus the same across all agents, and it equals to

$$Cov\left(\mathbb{E}(y_{t+1}-y_t),\mathbb{E}(\pi_{t+1})\right)=\Psi_{y,q}\Psi_{p,q}\sigma_q^2-\Psi_{y,a}\Psi_{p,a}\sigma_a^2 \tag{2.22}$$

The covariance (2.22) is the same across all agents and can be either positive or negative, depending on the parameterisation, which contradicts the survey evidence showing that agents hold different views.

Rational Inattention Framework. In the current model, rationally inattentive households have little incentive to pay attention to demand shocks, i.e., $\xi_{h,q} \ll \xi_{h,a}$. As a result, the second component in Equation (2.21) dominates, leading to a negative unconditional covariance between expected output growth and expected inflation, i.e., a supply-side view. Firms allocate attention to both shocks, with slightly more attention towards demand shocks $\xi_{f,q} \gtrapprox \xi_{f,a}$, resulting in a weak positive unconditional covariance. Professional forecasters are assumed to have full information (i.e., $\xi_{cb,q} = \xi_{cb,a} = 1$), thus their view is determined by Equation (2.22), which depends on the equilibrium output and price responses. Formally, the findings are summarised in Proposition 4.

Proposition 4. *The asymmetric attention choices are sufficient on their own to explain the contrasting views held by different agents. In particular*

1. *Households optimally pay more attention to supply shocks, and thereby form a negative correlation between output growth and inflation in their expectations;*
2. *Firms find it optimal to pay attention to both shocks, with slightly more attention towards demand shocks, and thus form a weak-positive correlation between output growth and inflation in their expectations;*
3. *Professional forecasters have full information and their view reflects the correlation between output and inflation in equilibrium (Equation 2.22).*

Using the simple model, I analytically show that the proposed mechanism can potentially match survey expectations. To quantitatively evaluate the model and determine the numerical values of the covariance, I extend the simple model into a more plausible setting and solve it numerically in Section 3.

Moreover, from Proposition 4, the model generates over-identifying restrictions that I can use for calibrating the marginal cost of attention parameters (μ^h and μ^f). As the attention parameters change, they affect both (i) the attention weights that agents put on different shocks ($\xi_{k,a}$ and $\xi_{k,q}$), which then affect households' and firms' perceived correlation between expected output and inflation by Equation (2.21), and (ii) the equilibrium responses of aggregate output and prices ($\Psi_{y,q}$, $\Psi_{y,a}$, $\Psi_{p,q}$, $\Psi_{p,a}$), and thus determine the professional forecasters' perceived correlation by Equation (2.22).

2.7 Strategic Interactions in Attention Allocation

This section solves for the equilibrium where both households and firms are subject to rational inattention. For illustrative purposes, I solve the model separately for demand shocks and supply shocks, and discuss the strategic interactions in attention allocation between households and firms in each case.

Substitutability in Attention Allocation in Demand Shocks. I begin by guessing that in equilibrium, the nominal wage is a linear function of demand shock, i.e., $w_t = H_{w,q}q_t$ (this guess will be verified). Given this, the rational inattention problem of firm j (2.10) becomes[15]

$$\max_{\{s_{j,t}\in\mathcal{S}_f^t\}} \mathbb{E}_t^f\left[-\frac{\theta-1}{2}\left(p_{j,t}-(w_t-a_t)\right)^2-\mu^f\mathcal{I}\left(q_t,a_t;s_{j,t}\right)\right]$$
$$=-\frac{1}{2}\max_{\sigma^2_{f,q|s}\geq\sigma^2_q}\left[(\theta-1)\,H^2_{w,q}\sigma^2_{f,q|s}+\mu^f\ln\frac{\sigma^2_q}{\sigma^2_{f,q|s}}\right]$$

where $\sigma^2_{f,q|s}$ denotes the posterior uncertainty about q_t by firms. Solving the first-order condition gives

$$p_{j,t}=\xi_{f,q}\left(w_t+e_{j,t}\right),\qquad \xi_{f,q}\equiv\max\left(0,1-\frac{\mu^f}{(\theta-1)\,H^2_{w,q}\sigma^2_q}\right)$$

where $e_{j,t}$ is firm j's rational inattention error, assumed to be mean-zero and independently distributed across firms. Note that firms' attention $\xi_{f,q}$ increases if the equilibrium nominal wage is very responsive to demand shocks q_t, as indicated by a higher value of $H_{w,q}$.

As firms have the same prior and attention choices, and their rational inattention errors are independently distributed, I can aggregate the price decisions $p_{j,t}$ over firms, which gives the aggregate price level

$$p_t\equiv\int_0^1 p_{j,t}dj=\xi_{f,q}w_t=\xi_{f,q}H_{w,q}q_t \tag{2.23}$$

The attention weight $\xi_{f,q}$ governs how responsive the aggregate price level is to changes in the nominal wage. In particular, if $\xi_{f,q}=1$, all firms are fully attentive, and the prices move one-to-one with equilibrium nominal wage $p_t=w_t$, in which case the real wage is unaffected. If $\xi_{f,q}=0$, firms pay no attention and do not respond to q_t. When $\xi_{f,q}\in(0,1)$, the price level rises less than optimal, that is, firms make "pricing mistakes" due to incomplete information and set the price too low, i.e., $p_t<w_t$.[16]

Substituting the aggregate price level (2.23) and the guess $w_t=H_{w,q}q_t$ into households' attention problem (2.7) yields

$$\max_{\{s_{i,t}\in\mathcal{S}_h^t\}_{t\geq0}}\mathbb{E}\left[-\frac{(\gamma+\eta)}{2}\left(c_{i,t}-\frac{1+\eta}{\gamma+\eta}(w_t-p_t)\right)^2-\mu^h\mathcal{I}\left(q_t;s_{i,t}\right)\right]$$

[15] The derivation follows the same steps as in Section 2.5.

[16] Here, by "pricing mistakes" I mean deviations from the full information perspective. Under rational inattention, however, these pricing mistakes are optimal ex ante.

$$= -\frac{1}{2} \max_{\sigma^2_{h,q|s} \geq \sigma^2_q} \left[(\gamma + \eta) \left[\frac{1+\eta}{\gamma+\eta} (1 - \xi_{f,q}) H_{w,q} \right]^2 \sigma^2_{h,q|s} + \mu^h \ln \frac{\sigma^2_q}{\sigma^2_{h,q|s}} \right]$$

The first term in the equation represents the benefit of paying attention, and it decreases with firms' attention $\xi_{f,q}$. When firms pay full attention, $\xi_{f,q} = 1$ and $p_t = w_t$, households receive no benefit from paying attention (as discussed in Section 2.4). In this case, as attention is costly, households do not pay attention. However, as firms pay less attention and set the prices below the optimal level, i.e., $p_t = \xi_{f,q} w_t$ with $\xi_{f,q} < 1$, it becomes beneficial for households to pay attention. The benefit increases as firms make larger "pricing mistakes". Therefore, in the case of demand shocks, the attention levels of households and firms are substitutes, that is, if firms pay less attention to demand shocks, households will pay more attention.

Solving the first order condition in steady state, the consumption choice by household i is given by

$$c_{i,t} = \xi_{h,q} \left[\frac{1+\eta}{\gamma+\eta} (1 - \xi_{f,q}) w_t + e_{i,t} \right]$$

with

$$\xi_{h,q} \equiv \max \left(0, 1 - \frac{\mu^h}{(\gamma+\eta) \left[\frac{1+\eta}{\gamma+\eta} (1 - \xi_{f,q}) H_{w,q} \right]^2 \sigma^2_q} \right)$$

where $e_{i,t}$ is the idiosyncratic noise in the signal. Note that households have incentives to pay attention to demand shocks only when firms are sufficiently inattentive, indicated by sufficiently low $\xi_{f,q}$. Formally, the attention level of households is inversely related to the attention level of firms, i.e., $\partial \xi_{h,q} / \partial \xi_{f,q} < 0$, as illustrated in Figure 2a.

When firms are sufficiently inattentive to nominal aggregate demand shocks, the shocks can have a real impact. Aggregating over the consumption decisions over all households yields

$$c_t \equiv \int_0^1 c_{i,t} di = \xi_{h,q} \left[\frac{1+\eta}{\gamma+\eta} (1 - \xi_{f,q}) H_{w,q} \right] q_t$$

So far, I have shown that, given the guess for the nominal wage, I can solve for the attention and decisions of households and firms. However, the nominal wage is also endogenous to the equilibrium decisions of households and firms, and an equilibrium requires these two processes to be consistent.

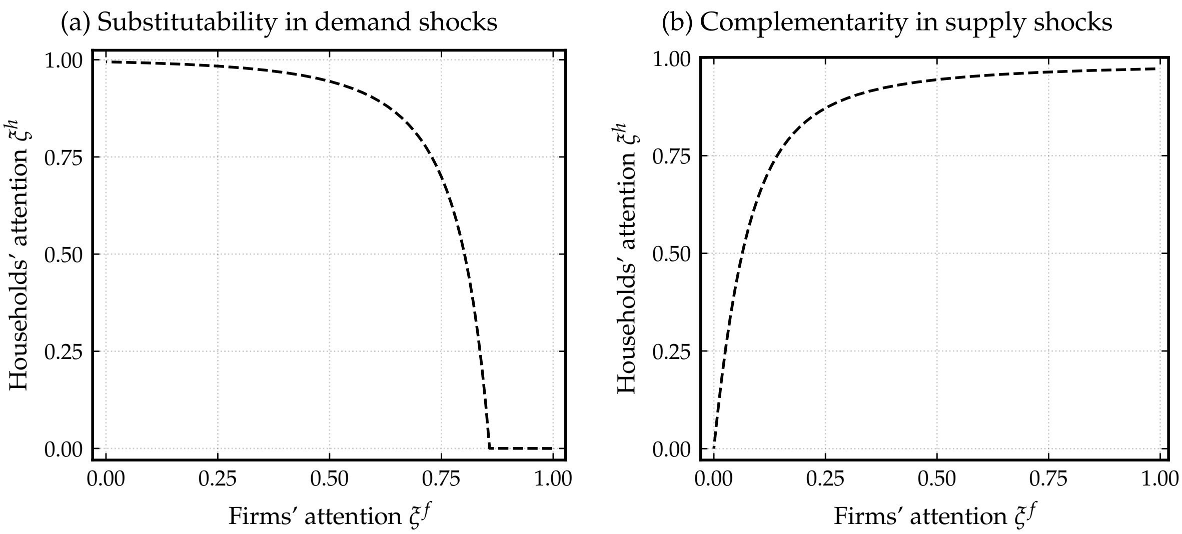


Figure 2: Strategic Interactions in Attention Allocation

Notes: The figure plots the attention levels (Kalman gain) of households and firms. I assume the marginal cost of attention of households (μ^h) is fixed and vary marginal cost of attention of firms (μ_f). As the cost of firms' information decreases (μ_f declines), the firms' attention level increases. Households' attention varies with firms' attention.

Complementarity in attention allocation in productivity shocks. In the case of productivity shocks, the optimal price $p^*_{j,t} = w_t - a_t$ is a function of both endogenous and exogenous variables.[17] While solving for the equilibrium follows the same guess-and-verify method as before, the intuition in the case of productivity shocks is less straightforward. To gain insight into the interaction between households' and firms' attention, imagine for a moment that the labour supply is *perfectly* elastic ($\eta \to \infty$), and thus the wage does not move much following a productivity shock ($w_t = 0$), and the optimal price decision simplifies to $p_{j,t} = -a_t$. Intuitively, when firms pay full attention, the price drop is the most significant. This, in turn, suggests that optimal consumption will experience the most substantial increase, incentivising households to pay more attention. Thus, in the case of a productivity shock, attention levels of households and firms are complements.

Generalising to the case where labour supply is not perfectly elastic, I first guess that in equilibrium nominal wage is a linear function of the productivity shock, i.e., $w_t = H_{w,a} a_t$. Given this guess, the rational inattention problem of firm j (2.10) becomes

$$\max_{\sigma^2_{a|f,a|s} \geq \sigma^2_a} -\frac{1}{2} \left[(\theta - 1) \, (H_{w,a} - 1)^2 \sigma^2_{f,a|s} + \mu^f \ln \frac{\sigma^2_a}{\sigma^2_{f,a|s}} \right]$$

where $\sigma^2_{f,a|s}$ denotes the posterior uncertainty about a_t of firms. Solving the attention problem gives

$$p_{j,t} = \xi_{f,a} \left(w_t - a_t + e_{j,t} \right), \qquad \xi_{f,a} \equiv \max \left(0, 1 - \frac{\mu^f}{(\theta - 1) \, (H_{w,a} - 1)^2 \sigma^2_a} \right)$$

[17]This contrasts with the case of demand shocks, where the optimal price is solely a function of endogenous variables, i.e., $p^*_{j,t} = w_t$.

where $e_{j,t}$ is firm j's idiosyncratic noise, with zero mean and independently distributed across firms. Aggregating over j gives

$$p_t \equiv \int_0^1 p_{j,t} dj = \xi_{f,a} (w_t - a_t) = \xi_{f,a} (H_{w,a} - 1) a_t \tag{2.24}$$

The aggregate price depends on the equilibrium wage, productivity shock, and firms' attention choices.

Substituting the aggregate price (2.24) and the guess $w_t = H_{w,a} a_t$ into household i's rational inattention problem (2.7) yields

$$\max_{\sigma^2_{h,a|s} \geq \sigma^2_a} -\frac{1}{2} \left[(\gamma + \eta) \left[\frac{1+\eta}{\gamma+\eta} (H_{w,a} - \xi_{f,a} (H_{w,a} - 1)) \right]^2 \sigma^2_{h,a|s} + \mu^h \ln \frac{\sigma^2_a}{\sigma^2_{h,a|s}} \right]$$

where $\sigma^2_{h,a|s}$ denotes the posterior uncertainty of households about a_t. The solution is characterised by

$$c_{i,t} = \xi_{h,a} \left[\frac{1+\eta}{\gamma+\eta} (w_t - \xi_{f,a} (w_t - a_t)) + e_{i,t} \right],$$

$$\text{with} \quad \xi_{h,a} \equiv \max \left(0, 1 - \frac{\mu^h}{(\gamma+\eta) \left[\frac{1+\eta}{\gamma+\eta} (H_{w,a} - \xi_{f,a} (H_{w,a} - 1)) \right]^2 \sigma^2_a} \right)$$

The solution implies that $\partial \xi_{h,a} / \partial \xi_{f,a} > 0$, meaning that as firms allocate more attention to supply shocks (high $\xi_{f,a}$), households tend to allocate more attention as well (high $\xi_{h,a}$), and vice versa. Consequently, in the case of a productivity shock, attention choices made by households and firms are complements, as illustrated in the right panel of Figure 2b.

3 Quantitative Model

In this section, I extend the simple model from Section 2 to a dynamic setting. The objective is to (i) assess whether the proposed mechanism can quantitatively match the survey evidence (i.e., Figure **??**); and (ii) quantify the consequences of asymmetric attention by households and firms on business cycles.

3.1 Extended model

In this section, I extend the simple model from Section 2 in three dimensions. First, I relax the assumption of hand-to-mouth behaviour and allow households to engage in intertemporal substitution through trading nominal bonds. Second, I allow for strategic complementarities in pricing by assuming segmented labour markets, which matters quantitatively for the inflation dynamics. Third, I assume the central bank sets the interest rate following a Taylor rule, which reflects a more plausible monetary policy framework. The extended model specification is summarised in Appendix C.1.

Households' Attention Problem In the extended model, household chooses real bond holdings, $\tilde{b}_{i,t}$, and consumption level, $c_{i,t}$, in each period t. This is equivalent to choosing the vector x_t in Equation (3.2) if the household knows its own past actions (derivation see Appendix C.2). Formally, household i's rational inattention problem is

$$\max_{s_{i,t}\in\mathcal{S}_h^t} \sum_{t=0}^{\infty} \beta^t \, \mathbb{E}\left[\frac{1}{2}\left(x_{i,t}-x_{i,t}^*\right)'\Theta\left(x_{i,t}-x_{i,t}^*\right)-\mu^h \mathcal{I}\left(\left\{x_{i,t-j}^*\right\}_{j=0}^{\infty}; s_{i,t}|S_i^{t-1}\right)|s_i^{-1}\right] \tag{3.1}$$

Here S_i^{t-1} denotes the history of signals up to time $t-1$. The choice vector is

$$x_{i,t} = \begin{pmatrix} \omega_B\left(\tilde{b}_{i,t}-\tilde{b}_{i,t-1}\right) \\ -\omega_B\left(\frac{1}{\beta}\tilde{b}_{i,t-1}-\tilde{b}_{i,t}\right)+\left(\gamma\frac{\omega_W}{\eta}+1\right)c_{i,t} \end{pmatrix} \tag{3.2}$$

and

$$\Theta = -\bar{C}^{1-\gamma}\begin{bmatrix} \left(\gamma-\frac{\gamma^2\omega_W}{\gamma\omega_W+\eta}\right)\frac{1}{\beta} & 0 \\ 0 & \frac{\omega_W}{\gamma\omega_W+\eta} \end{bmatrix} \tag{3.3}$$

Moreover, $x_{i,t}^*$ is the optimal choice vector for household i, which is given by

$$x_{i,t}^* = \begin{pmatrix} z_t-(1-\beta)\sum_{s=t}^{\infty}\beta^{s-t}\mathbb{E}_t\left[z_s\right]+\frac{\beta}{\gamma}\left(1+\omega_W\frac{\gamma}{\eta}\right)\sum_{s=t}^{\infty}\beta^{s-t}\mathbb{E}_t\left(i_s-\pi_{s+1}\right) \\ \omega_W\left(\frac{1}{\eta}+1\right)\tilde{w}_t+\left[\frac{1}{\beta}\omega_B\left(i_{t-1}-\pi_t\right)+\omega_D\tilde{d}_t+\omega_T\tilde{\tau}_t\right] \end{pmatrix} \tag{3.4}$$

The lowercase variables denote the log deviations of the corresponding variables, and variables with a tilde indicate that they are real variables. Moreover, $z_t \equiv \omega_W\left(1+1/\eta\right)\tilde{w}_t + \frac{1}{\beta}\omega_B\left(i_{t-1}-\pi_t\right)+\omega_D\tilde{d}_t+\omega_T\tilde{\tau}_t$. The coefficients $(\omega_B, \omega_W, \omega_D, \omega_T)$ denote the steady-state ratios of $\left(\frac{\bar{B}}{\bar{C}\bar{P}}, \frac{\bar{W}\bar{L}}{\bar{C}\bar{P}}, \frac{\bar{D}}{\bar{C}\bar{P}}, \frac{\bar{T}}{\bar{C}\bar{P}}\right)$.

The first element of the choice vector $x_{i,t}$ is the change in bond holdings, and the second element of $x_{i,t}$ is the component of the marginal rate of substitution between consumption and leisure. These two elements are directly chosen by household through their choice of real bond holdings $\tilde{b}_{i,t}$ and $c_{i,t}$. The formulation of the optimal choice vector (3.4) implies that: (i) it is optimal to increase bond holdings when income is high relative to permanent income or when the real return on bond is high; (ii) it is optimal to equate the marginal rate of substitution between consumption and leisure to the real wage.[18] When the household deviates from these optimal choices, the utility loss is determined by the matrix Θ. This matrix is diagonal, because a suboptimal marginal rate of substitution between consumption and leisure does not affect the optimal change in bond holdings, and a suboptimal change in bond holdings does not affect the optimal marginal rate of substitution between consumption and leisure.

[18]In the formulation, I replaced the labour supply using the budget constraint.

Firms' Attention Problem After a log-quadratic approximation, I derive firm j's present value of expected profit loss

$$\max_{s_{j,t}\in\mathcal{S}_f^t}\sum_{t=0}^{\infty}\beta^t\,\mathbb{E}\left[-\frac{\theta-1}{2}\left(p_{j,t}-p_{j,t}^*\right)^2-\mu^f\mathcal{I}\left(p_{j,t}^*;s_{j,t}|s_j^{t-1}\right)|s_j^{-1}\right] \tag{3.5}$$

where

$$p_{j,t}^*=w_{j,t}-a_t=p_t+\alpha\left[y_t-\frac{1+\eta}{\eta+\gamma}a_t\right] \tag{3.6}$$

where $\alpha=\frac{(\eta+\gamma)}{(1+\theta\eta)}$ is the pricing complementarity. Equation (3.6) implies it is optimal for firm j to increase its price if its nominal marginal cost increases, and vice versa.

The equilibrium is defined similarly to Definition 1, but we also requires the bond market clear.

3.2 Computing the Equilibrium

I solve a dynamic general equilibrium model in which both agents are rationally inattentive. The equilibrium is characterised by a fixed-point problem. Specifically, given the processes for the optimal actions of households and firms, $(x_{i,t}^*, p_{j,t}^*)$, I can solve their respective attention problems. In the meanwhile, the processes $(x_{i,t}^*, p_{j,t}^*)$ are endogenous to the decisions of households and firms. In equilibrium, these two processes must be consistent with each other.

I start by guessing the MA representation of the optimal actions $(x_{i,t}^*, p_{j,t}^*)$ as functions of the productivity (ε_t) and monetary policy (u_t) shocks. I then approximate the processes with truncated MA(200) processes.[19] I then solve the problem numerically using the algorithm for dynamic rational inattention problems (DRIPs) developed in Afrouzi and Yang (2021). Next, I solve the implied state-space representations of other variables in the model, based on which I update the guess for the MA representation of the optimal actions $(x_{i,t}^*, p_{j,t}^*)$, until the model converges. Online Appendix provides a detailed description of the implementation.

3.3 Calibration

The model is calibrated at a quarterly frequency. Table 1 summarises the values for the non-rational inattention parameters, which are estimated outside the model, and the calibrated values for the marginal attention costs of households and firms.

Non-Rational Inattention Parameters. I assign values for the non-rational inattention parameters following the literature. I assume the inverse of the Frisch elasticity (η) to be 2.5 and the risk aversion coefficient (γ) to be 3.5, which are standard values in business cycle models. I set the elasticity of substitution across firms (θ) to 10.

I estimate the Taylor rule using real-time U.S. data. Specifically, I use the federal funds rate as a measure of the nominal interest rate, and the Tealbook forecast of inflation and output

[19] With a length of 200, I can get arbitrarily close to the true MA(∞) processes. Increasing the length does not significantly change the results.

Table 1: Parameters Values

Parameter	Value	Source / Moment Matched
Panel A. Assigned parameters		
Time discount factor (β)	0.99	Quarterly frequency
Elasticity of substitution across firms (θ)	10	Firms' average markup
Risk aversion coefficient (γ)	3.5	Households' risk aversion level
Inverse of Frisch elasticity (η)	2.5	Aruoba et al. (2017)
Taylor rule: smoothing (ρ)	0.936	Estimates 1985-2017
Taylor rule: response to inflation (ϕ_π)	1.62	Estimates 1985-2017
Taylor rule: response to output gap (ϕ_x)	0.225	Estimates 1985-2017
Persistence of productivity shocks (ρ_a)	0.93	Estimates 1981-2022 based on Fernald (2014)
S.D of productivity shocks (σ_a)	0.86×10^{-2}	Estimates 1981-2022 based on Fernald (2014)
S.D of monetary shocks (σ_u)	0.41×10^{-2}	Estimates 1985-2017
Panel B. Calibrated parameters		
Attention cost of households (μ^h)	0.0106	Slope coefficients in Figure **??**
Attention cost of firms (μ^f)	0.0095	Slope coefficients in Figure **??**

gap. I employ quarterly data from 1985:1 to 2017:4. The point estimates suggest a smoothing factor of approximately 0.936, with responses to inflation and the output gap of 1.62 and 0.225, respectively.I then compute the model-consistent measure of the monetary policy shock u_t from the data, rewriting the monetary policy rule (A5) as $u_t = i_t - \rho i_{t-1} - (1-\rho)[\phi_\pi \pi_t + \phi_x(y_t - y_t^n)]$. The standard deviation of u_t is estimated to be 0.41×10^{-2}.

To calibrate the parameters of the stochastic process for aggregate productivity, I use data on total factor productivity (TFP) reported by Fernald (2014), from 1981:1 to 2022:4. I regress the log of TFP on a constant and a time trend. I then regress the residual on its own lag, which gives $\rho_a = 0.93$ and $\sigma_a^2 = 0.86 \times 10^{-2}$.

Rational Inattention Parameters. As described in Section 2.6, the model generates over-identifying restrictions on the attention cost parameters (μ^h and μ^f) as these parameters determine jointly agents' attention choices as well as the equilibrium responses of output and inflation to shocks, which affect the perceived correlation between output and inflation of households and firms. It also affects the perceived correlation of professional forecasters, which depends on the equilibrium correlation between expected inflation and expected output growth.

I calibrate the values for μ^h and μ^f to match the slope coefficients for the households, firms and professional forecasters in the Figure **??**. Holding the non-rational inattention parameters constant at the selected values, and solving over a grid of attention cost values, I find that $\mu^h = 0.0106$ and $\mu^f = 0.0095$ could generate data-consistent slope coefficients. The calibrated attention parameters also suggest that households face higher information frictions than firms, consistent with findings from other survey-based studies (see for e.g., Link et al. (2023)).

3.4 Results

Table 2 reports the moments for expected inflation and output growth regressions – including the slope coefficients, their associated p-values, and the R-squared values for all agents. Column 2 reports the data moments. Note that the magnitude of the slope coefficient for households does not have a meaningful quantitative interpretation; only the sign matters. This is because in the Michigan Survey of Consumers, households do not provide quantitative forecasts for growth, I assign numerical values to their growth expectations following Candia et al. (2020).[20] However, the magnitudes of slope coefficients for firms and professional forecasters are quantitatively meaningful.

I simulate the model 1,000 times and report the median of the results in Column 3, and the 90 percent confidence interval in Column 4. In each simulation, the time horizon and the numbers of households and firms align with the survey data.

Table 2: Moments in the data and the model

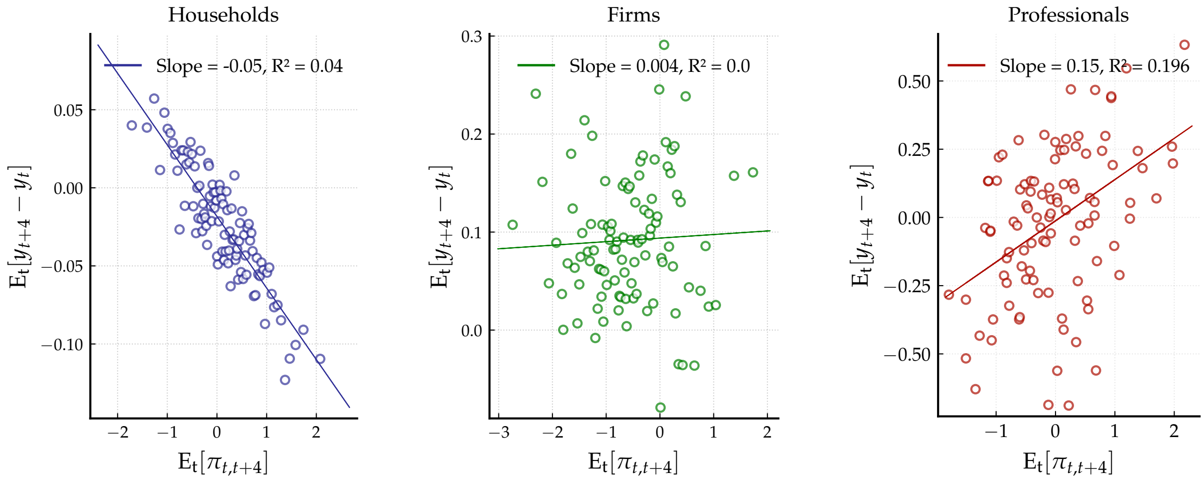
Moment	**Data**	**Model**	**90% interval**
Slope coef. of HHs' expectations	-0.038	-0.047	$[-0.061, -0.034]$
Slope coef. of Firms' expectations	0.039	0.005	$[-0.008, 0.024]$
Slope coef. of CB's expectations	0.156	0.155	$[0.103, 0.208]$
R-squared value of HHs' expectations	0.022	0.045	$[0.028, 0.063]$
R-squared value of Firms' expectations	0.002	0.001	$[0.000, 0.004]$
R-squared value of CB's expectations	0.016	0.194	$[0.089, 0.319]$
P-value of HHs' expectations	0.000	0.000	$[0.000, 0.000]$
P-value of Firms' expectations	0.428	0.406	$[0.002, 0.865]$
P-value of CB's expectations	0.000	0.000	$[0.000, 0.000]$

Notes: The table presents the data moments and model moments under calibration in Table 1. The time horizon in each simulation is consistent with the survey data. The numbers of households and firms in the simulation align with the survey sample size. I simulate 1,000 times and report the median of the results in Column 3, and the 90 percent interval in Column 4.

Figure 3 is the model counterpart of Figure **??**. These two figures exhibit striking similarities, providing support for the model's validity. It is worth noting that the survey data displays a wider dispersion than the model, potentially stemming from inherent noise in the beliefs of households and firms. Nevertheless, this specific aspect falls beyond the scope of the current model.

[20] In the Michigan Survey of Consumers, respondents are asked about whether they expect business conditions in the next year to improve, stay the same or deteriorate. Following Candia et al. (2020), I assign point values to each answer ranging from 1 (improve) to -1 (deteriorate).

Figure 3: Simulated expected inflation and expected output



Notes: The figure plots the simulated expected inflation and expected output growth for households, firms, and professional forecasters. The parameterisation values are from Table 1.

3.5 Quantifying the Consequences of Inattention

Attention choices of households and firms significantly affect the response of aggregate output to shocks compared to the full information case. In the case of supply shocks, the overall response of aggregate output under rational inattention is lower than the full information benchmark. In particular, firms' inattention and pricing complementarity dampen the aggregate output response by around 70 percent, households' inattention dampens it by 24 percent, and the strategic complementarity between households' and firms' attention allocation further dampens the response by 7 percent.

In the case of demand shocks, when firms have full information, demand shocks do not have a real impact on output, this follows the classical dichotomy. When firms are inattentive, demand shocks have real impacts. This implies that firms' inattention amplifies the real effects of demand shocks, by increasing money non-neutrality. Introducing inattentive households (without strategic interactions) lowers the output response by around 43 percent, as households are inattentive and under-react. Strategic substitutability between households and firms further reduces the output response by 24 percent. This is because as households pay less attention to demand shocks, firms pay more attention, and money is more neutral.

3.6 Empirical Validation

Attention Matters for Beliefs. The model predicts that households pay more attention to the real side of the economy, such as real wages, and their attention choice matters for their perceived relationship between inflation and output growth. To test this prediction, I utilise additional data from the Michigan Survey of Consumers. I find that households pay significantly more attention to employment-related developments than to price-related developments, and by running a simple regression, I show that households who pay attention to employment-related developments hold an even stronger supply-side view compared to those who do not. This provides further support to the model which predicts that attention choices matter for agents' perceived relationship between expected inflation and output growth. For detailed data construction and empirical specification, see Appendix A.2.

The finding persists when I divide the employment-related developments into positive and negative ones (see Columns 2 and 3 in Table A.1), which would allay any concern that the results are biased by employment-related developments more likely being negative than positive. These results also rule out pessimism as the sole explanation for the negative correlation between inflation and output. Bhandari et al. (2022) find that increased pessimism generates an upward bias in unemployment and inflation forecasts, contributing to the negative correlation between inflation and real activity. However, the results in this paper suggest that attention choices are a key driver of households' supply-side view.

Forecast Errors. The model predicts that households pay much less attention to demand shocks. If this is true, they are more likely to make larger forecast errors during periods dominated by demand shocks. To test this, I use the supply shocks and demand shocks identified by Eickmeier and Hofmann (2022).[21] The forecast error for one-year-ahead inflation is measured as the absolute difference between the median forecast from the MSC and the realised inflation for the corresponding period. I find that forecast errors during periods dominated by demand shocks are about 1.6 times larger than during periods dominated by supply shocks.

4 The Phillips Curve Dynamics

An important feature of the model is that attention choices of households and firms are endogenous to economic conditions. When the economic conditions change – due to shifts in policy or changes in stochastic environment – households and firms reallocate their attention. The reallocation of attention in turn has a significant impact on the outcomes. In this section, I show that the attention model can jointly explain the flattening of the Phillips curve in recent decades before the pandemic and its steepening in the post-pandemic period.

4.1 Flattening of the Phillips Curve in Recent Decades

The decades preceding the start of the COVID-19 pandemic saw a decline in the correlation between inflation and real activity and many raised the possibility that the Phillips curve had flattened or even disappeared (Coibion and Gorodnichenko, 2015; Blanchard, 2016; Bullard, 2018; Stock and Watson, 2020; Smith et al., 2025). Many explanations have been proposed in the literature to rationalise the flattening. Here, I show that the shift to a more hawkish monetary

[21] I use their identified shocks because their empirical analysis adopts the same definition of supply and demand shocks as in this paper: supply shocks move inflation and output in opposite directions, while demand shocks move both variables in the same direction. They estimated structural demand and supply factors for the period 1970Q1–2022Q2.

policy and the resulting reallocation of attention by households and firms are consistent with, and quantitatively relevant, for the observed flattening of Phillips curve.

To capture the shift in monetary policy, I simulate the model under two regimes: $\phi_\pi = 1.3$ (dovish) and $\phi_\pi = 1.62$ (the baseline calibration). The $\phi_\pi = 1.3$ is calibrated to match the monetary policy before the Great Moderation. This exercise follows the spirit of Maćkowiak and Wiederholt (2015) and Afrouzi and Yang (2021).[22] The model predicts a flatter Phillips curve under more hawkish policy, along with lower volatility in inflation and output (see Figure 4).

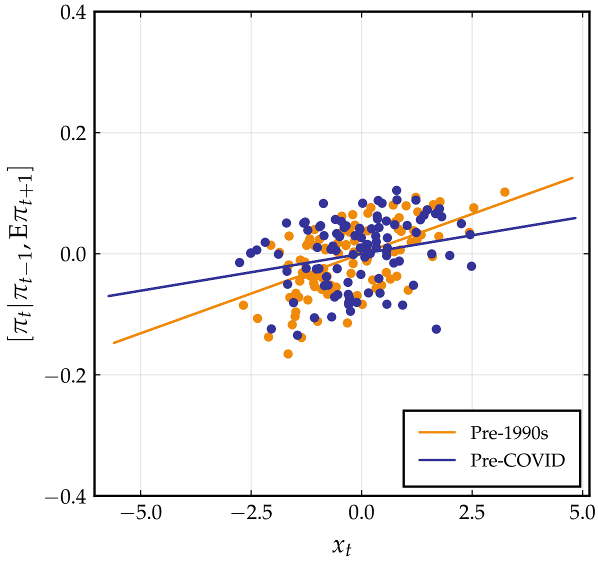


Figure 4: The flattening of the Phillips curve over recent decades

Notes: This figure compares the model-implied Phillips curve under dovish and hawkish monetary policies. In the former case, I assume $\phi_\pi = 1.3$, and in the latter case $\phi_\pi = 1.62$. The rest of the parameters are kept the same across the two regimes, as specified in Table 1. I simulate the model for 50,000 periods.

The intuition is straightforward. First, a more hawkish monetary policy stabilises the prices, reducing firms' attention. This, in turn, further dampens their price adjustment behaviour, making prices even less sensitive to output fluctuations, and the Phillips curve is flatter.

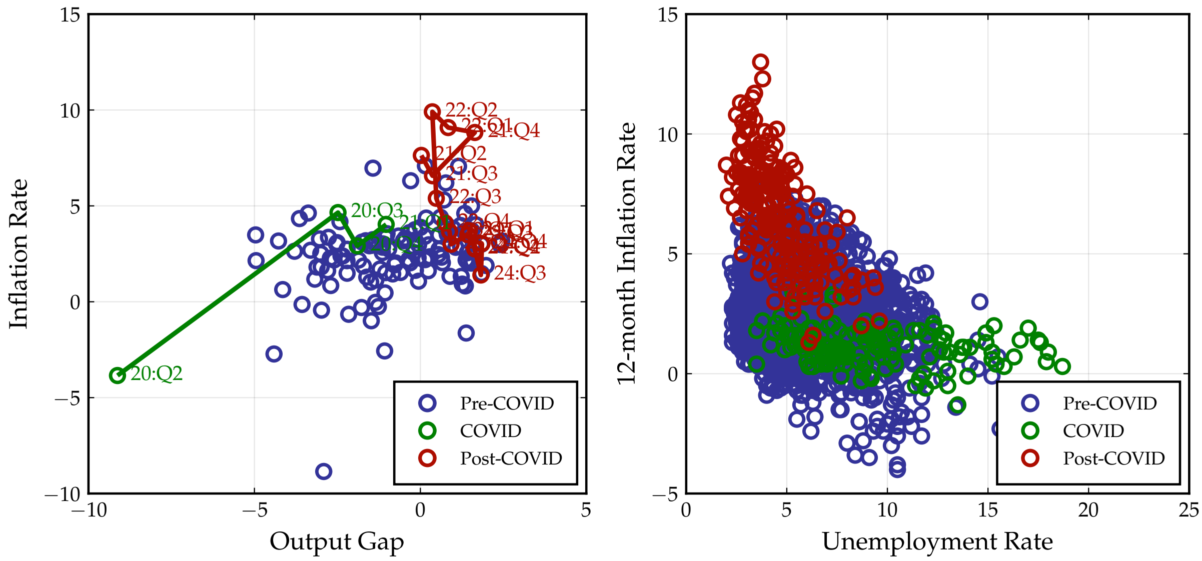
Second, households reallocate their attention as firms pay less attention. In the case of productivity shocks, households pay less attention as firms pay less attention, due to the complementarity in their attention allocations. As a result, consumption (output) responds less to the productivity shock, which increases deviations of output from the efficient output level and raises output gap volatility. In the case of monetary policy shocks, when firms pay less attention, monetary policy shocks have a larger real impact, which incentivises households

[22] Afrouzi and Yang (2021) develop a model with rationally inattentive firms and show that more hawkish monetary policy reduces firms' attention to input costs, flattening the Phillips curve. In contrast, the model here features rational inattention on both sides, which is crucial for output dynamics. Maćkowiak and Wiederholt (2015) model inattention on both sides but absent from the strategic interaction in attention allocation between households and firms.

to pay more attention to those shocks. This also leads to a more volatile output gap. These two attention channels are absent in standard New Keynesian models with full or exogenous dispersed information, and both contribute to the flattening of the Phillips curve.

4.2 Steepening of the Phillips Curve in the Post-pandemic Era

The post-COVID data signal that the Phillips curve is back. Figure 5a plots the relationship between the inflation rate and the output gap in the U.S. before, during, and after COVID. The raw data suggest a steepening of the Phillips curve in the post-COVID period. Similar findings are reported by Hobijn et al. (2023), Furlanetto and Lepetit (2024), and Gelain and Lopez (2024) among others. The MSA-level data show a similar pattern (Figure 5b).[23] Using MSA-level data, Cerrato and Gitti (2022) estimate that the slope of the Phillips curve has tripled between the pre-COVID and the post-COVID periods.



(a) Aggregate level

(b) Regional level

Figure 5: The Phillips correlation before, during, and after the COVID-19

Notes: Figure 5a shows the relationship between CPI and the output gap. Figure 5b shows the relationship between inflation rate and the unemployment rate at the US metropolitan area level. Blue dots represent observations from the pre-COVID period (Jan 1990–Feb 2020), green dots correspond to the COVID period (Mar 2020–Feb 2021), and red dots denote the post-COVID period (Mar 2021–Sep 2022). Data sources: FRED, Federal Reserve Bank of St. Louis; the U.S. Bureau of Labor Statistics.

As the post-pandemic period was characterised by large supply and demand shocks (Di Giovanni et al., 2023; Shapiro, 2024), I assume a 20 percent increase in the volatility of both shocks in the post-COVID calibration. The rest of the parameters follows the baseline model (see Table 1). I then simulate the model under these calibrations and compare the results with the pre-COVID baseline. The simulated results are shown in Figure 7, which shows a steeper Phillips

[23] Output gap data are not available at the MSA-level, but unemployment serves as a widely used proxy for economic slack.

curve in the post-COVID period relative to the baseline. Although the model relies on stylised assumptions and is not calibrated to match the data exactly, it captures the qualitative shift in slope across periods. By contrast, a standard New Keynesian model does not replicate this pattern: the slope of the Phillips curve remains roughly constant across regimes.

The intuition is straightforward. When shocks become more volatile, rationally inattentive firms increase their attention (see Proposition 2). Focusing on demand shocks, as volatility rises, firms pay more attention to them. This implies that they would raise prices more aggressively following a positive demand shock. Therefore, such shock only has moderate real impact. This led to a steepening of Phillips curve.[24]

Figure 6 illustrates this mechanism by showing simulated inflation dynamics following a demand shock under three scenarios: the pre-COVID period, the post-COVID period with heightened attention, and the post-COVID period assuming attention remains unchanged. Without the increase in attention, the rise in inflation is driven purely by larger shocks in the post-pandemic period, and the effect is relatively modest (green circles versus blue triangles). With endogenous attention, however, firms respond more aggressively to the same shocks, which amplifies the inflation response significantly (red squares). This mechanism is supported by empirical evidence on firms' price adjustment during and after the COVID period: Montag and Villar (2023) find that both the frequency and the size of price changes in the U.S. increased sharply during those periods.

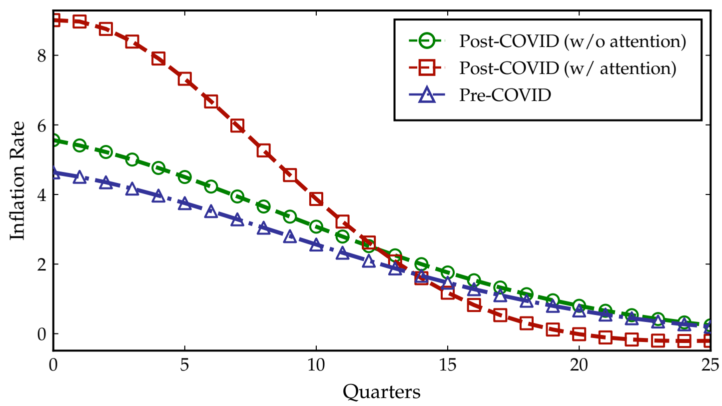


Figure 6: Inflation dynamics

Notes: This figure plots inflation dynamics following a demand shock under three scenarios: Pre-COVID (blue triangles), Post-COVID with reallocated attention (red squares), and Post-COVID with attention held constant (green circles).

Figure 5, as well as the findings of Cerrato and Gitti (2022), also suggest a brief flattening of the Phillips correlation during the COVID period. The model is also able to catch this dynamic. In particular, I calibrate the volatility of supply shocks during the COVID period to be 20 percent higher than in the pre-COVID – consistent with evidence that supply shocks were the

[24]The adjustment in household attention would depend on the calibration. On one hand, increased volatility tends to raise households' attention. On the other hand, as firms pay more attention to demand shocks, the real effects of those shocks become more muted, which reduces the incentive for households to pay attention. Nonetheless, these adjustments play a less central role in explaining the steepening.

dominant force at the time – while keeping the volatility of demand shocks at the baseline level. The result is shown in Figure 7. In response to the increased volatility of supply shocks, households rationally allocate more attention to these shocks, leading to a stronger output response and smaller deviations from the efficient level. Firms also increase their attention to supply shocks, causing prices to adjust more sharply. Together, these adjustments generate a more negative slope in the regression of inflation on the output gap following supply shocks, contributing to the temporary flattening observed during the COVID period.

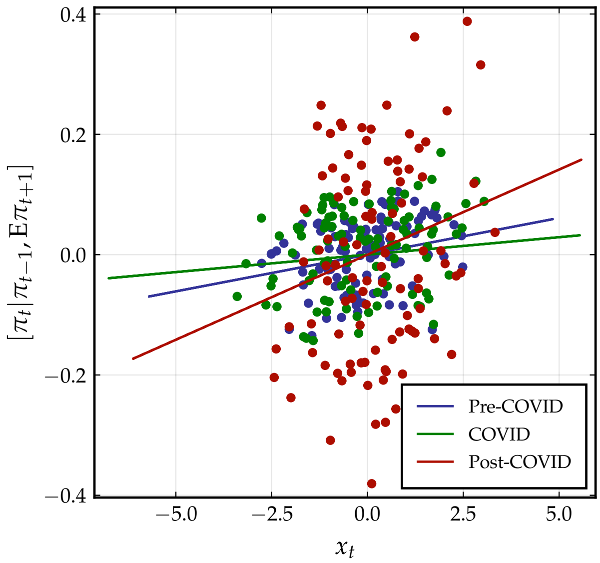


Figure 7: Model Phillips curve before, during, and after the COVID-19

Notes: This figure plots model implied Phillips curve before, during, and after the COVID-19. Most parameters are calibrated as in the baseline model (see Table 1). I assume that the volatility of supply shocks increases by 20 percent during the COVID period, and that the volatility of demand shocks also rises by 20 percent in the post-COVID period. I simulate the model for 50,000 periods.

Understanding the dynamics of the slope of the Phillips curve is crucial, as it determines the trade-off between inflation and real activity faced by the monetary authorities. In particular, the steepening of the Phillips curve during the post-COVID period might suggest that contractionary monetary policy can reduce inflation with smaller output losses, and therefore encouraging a stronger policy response to inflation. However, this argument is only partially correct. If households' and firms' attention were fixed, a stronger monetary policy response to inflation can indeed reduce inflation at a limited cost to output. But as discussed in Section 4.1, monetary policy itself can influence agents' attention, and a more hawkish stance flattens the Phillips curve, ultimately worsening the inflation-output trade-off.

5 Communication with Agents with Heterogeneous Attention Choices

Rational inattention has several implications for policy communication. In Section 5.1, I formally demonstrate how the misalignment of interests limits the effectiveness of the policy communication. In Section 5.2 and 5.3, I examine two experiments where information provision could potentially have adverse effects on the economy.

5.1 Inattention to Policy Communication

This section provides a rationale for why households and firms are inattentive to policy communication. To fix ideas, consider a central bank communicating its monetary policy actions to the public

$$S_{p,t} = i_t + \nu_t, \nu_t \sim N(0, \sigma_\nu^2)$$

However, whether households and firms choose to absorb this information depends on how relevant they believe the signal is for their decisions. Formally, the benefit of processing the central bank signal is proportional to

$$\mathbb{E}[x_t^*|S_{k,t}, S_{p,t}] - \mathbb{E}[x_t^*|S_{k,t}] \propto \underbrace{\frac{\Sigma_0}{\Sigma_0 + \Delta_{k,p}\sigma_\nu^2}}_{\text{signal-to-noise ratio}} \times \underbrace{\Delta_{k,p}}_{\text{relevance of signal}} \times \underbrace{\left(S_p - \mathbb{E}[S_{p,t}|S_k^t]\right)}_{\text{marginal new info from } S_{p,t}} \quad (5.1)$$

where Σ_0 is the prior uncertainty about the optimal action x_t^*, S_k^t is agent k's information set. $\Delta_{p,k}$, $k = \{h, f\}$ captures how relevant the central bank's signal is to agents' objective, i.e., how much $S_{p,t}$ matters for households' optimal consumption and bond decisions, or for firms' pricing decision. The benefit from processing the signal about i_t is discounted by the term $\Delta_{k,p}$ because the i_t may not be of direct relevance to households' and firms' interest. Therefore, if processing central bank information requires cognitive effort or attention costs, households and firms may rationally ignore it.[25] However, if the signal better aligns with the audience's interests, they are more likely to pay attention to the signal.

This analysis relates to Angeletos and Sastry (2021), which study whether communications should aim to anchor expectations of the policy instrument (such as interest rate path) or the targeted outcome (aggregate output or prices), while the focus of this paper is on the incentives of rationally inattentive agents. Agents are more likely to pay attention when the content is directly relevant to their decisions (in the extreme case, when the central bank provides signals about their optimal actions). In this sense, communicating targeted outcomes is better than communicating policy instruments.

5.2 Communication about Future Inflation

Even assuming that the policy communication can reach the general public, does it always improve the economic outcomes? Here, I consider the effects of releasing information about future inflation to households in response to a demand shock. As shown in the left panel of Figure 8, following a demand shock, households raise their inflation expectations. However,

[25] These cognitive costs help explain why households are generally inattentive to policy announcements but do update expectations when presented with information in randomized controlled trials (RCTs).

due to inattention, the increase in expectations (grey square) is smaller than the actual rise in inflation (grey circle).

Suppose the central bank communicates the correct expected future inflation to households (i.e., a one-time signal about $\mathbb{E}_t \pi_{t+1}$), households' inflation expectations align more closely with accurate one (black triangle line). However, as households revise their inflation expectations upward, they also adjust their output growth expectations downward (right panel of Figure 8), deviating further from the full-information benchmark. This is because rationally inattentive households' information sets primarily consist of supply shocks, they are inclined to interpret the inflation increase within this context, attributing the higher inflation as originating from a contractionary supply shock. As a result, they expect lower growth. This is consistent with findings from RCTs (Coibion et al., 2023).

Lower growth expectations, in turn, lead households to anticipate lower future income and to reduce current spending. This behaviour contrasts with the predictions of standard New Keynesian models with full information, in which an increase in inflation expectations stimulate current spending – a key mechanism of forward guidance. These results suggest that communication aimed at stimulating the economy by raising inflation expectations may backfire.

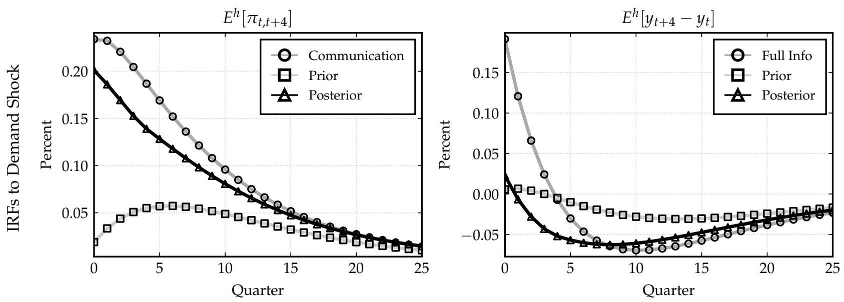


Figure 8: Communication of higher future inflation to households

Notes: The figure plots the impulse responses of households' expected inflation and expected growth following the communication of a higher future inflation trajectory.

Moreover, if the same information were provided to firms, they would raise both their inflation expectations and output growth expectations. This implies that while providing the information to households and firms might align their expectations on one dimension, it could cause even greater divergence on another. Such divergence may result in inefficient fluctuations in the economy.

5.3 Communication about Lower Interest Rate Path

In response to a positive supply shock, since agents are inattentive, the output response is lower than the potential level of output, creating a temporary negative output gap. The central bank then systematically responds to the negative output gap by lowering the interest rates. The response in interest rates is shown in the left panel of Figure 9. Suppose the central bank communicates the lower interest rate path to firms. In that case, firms might misinterpret the systematic response in interest rates as an expansionary demand shock due to their skewed information set, and thus raise their inflation expectations (middle panel) and prices (right panel). As firms raise prices, aggregate demand falls further, worsening the economic slack.

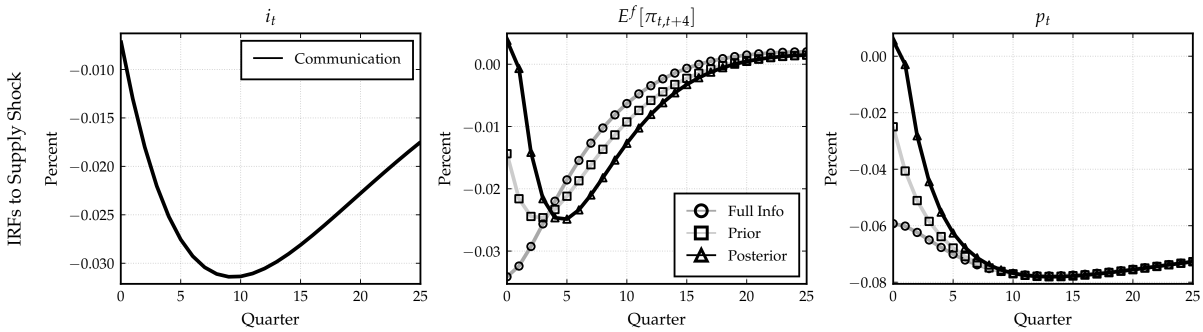


Figure 9: Communication of lower interest rate

Notes: The figure plots the impulse responses of firms' expected inflation and expected growth following the communication of a lower trajectory of future interest rates.

6 Conclusions

This paper develops a model of two-sided rational inattention to study how households and firms form beliefs, respond to shocks, and interpret policy communication. I show that households and firms have distinct incentives when deciding what economic information to pay attention to, shaping their beliefs about inflation and output. Their attention shifts with policy and economic conditions, helping to explain both the pre-pandemic flattening and the post-COVID steepening of the Phillips curve through a mechanism of attention reallocation.

This paper takes a preliminary step towards understanding the heterogeneous information choices among different groups of agents, and their consequences for business cycles and policy. While this paper compares households and firms, there is significant variation within these groups, driven by differences in characteristics such as income levels, education, or firm size. Future research can delve deeper into the heterogeneity within these groups.

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A Supplementary Evidence on Expectations and Attention Choices

A.1 Stylised Facts on Attention Choices

More evidence on attention choices can be obtained by looking at surveys of what information agents have. The MSC asks respondents to report what changes they have heard during the last few months, while making their predictions about inflation and output growth in the next year.[26] This question captures the information that households have *internalized* and therefore reflects what information they pay attention to. The answers to this question are categorized into arbitrary but well-defined groups. Figure A.1 shows spike plots for news heard that is price-related or employment-related over time. The news households consistently pay attention to is employment-related, while news about prices stands out only in particular periods, indicating a consistently high level of attention to the real side of the economy among households.

(a) News about employment (b) News about prices

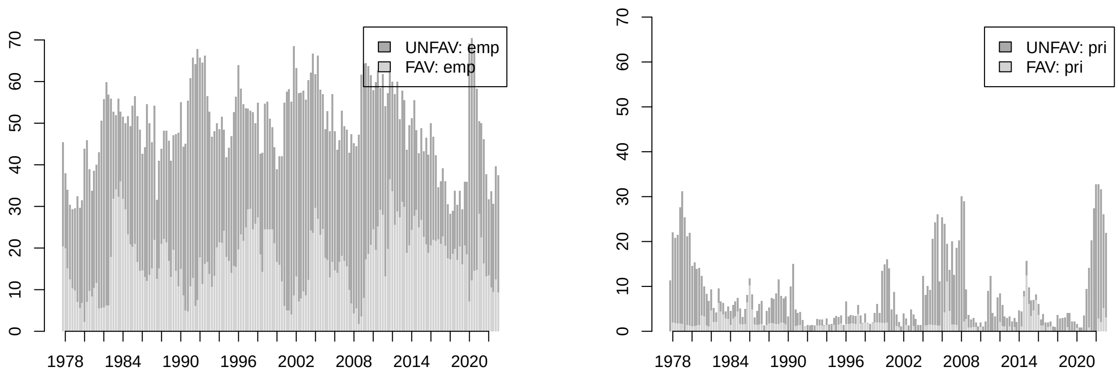

Figure A.1: Spike Plots of News Heard Categories

Note: These plots show the fraction of survey respondents having heard news in each category in the relevant quarter. Each category further distinguishes between favourable (depicted in light grey) and unfavourable news (shown in dark grey).

On the firm side, the Business Inflation Expectations (BIE) survey reveals that firms have strong incentives to pay attention to nominal marginal cost, and these play a significant role in their price-setting strategies. Specifically, from 2011 to 2023, 69% of respondents in the BIE survey indicated that labour costs would affect the prices of their products and/or services in the upcoming 12 months.

A.2 Attention Choices by Households Shape Their Beliefs

The MSC shows that consumers overall pay more attention to employment-related news, but does the degree to which individual households pay attention to the different types of news affect how they perceive the relationship between growth and inflation? To test this, I run the following regression:

$$\mathbb{E}_t^i[Growth] = \beta_0 + \beta_1 \mathbb{E}_t^i[Inflation] + \gamma_1 \mathbb{E}_t^i[Inflation] \times News_{i,t}^{labour} + \gamma_2 \mathbb{E}_t^i[Inflation] \times News_{i,t}^{price} + \alpha_1 News_{i,t}^{labour} + \alpha_2 News_{i,t}^{price} + \alpha_t + u_{i,t} \tag{A1}$$

[26] A detailed description of the question, along with a comprehensive list of categories, is available on the Michigan Survey of Consumers.

Here the labour news $News_{i,t}^{labour}$ is a binary variable, taking a value of 1 if a respondent i reports having heard news about labour market conditions recently, and 0 otherwise. Similarly, the price news variable $News_{i,t}^{price}$ is set to 1 if the respondent i has recently heard news related to prices, and 0 otherwise. A supply-side view corresponds to a negative β_1. If the coefficient of the cross term is negative $\gamma_1 < 0$ or $\gamma_2 < 0$, attention to that news contributes to a supply-side view. Conversely, a positive coefficient $\gamma_1 > 0$ or $\gamma_2 > 0$ suggests that paying attention to this news contributes to a more demand-side view.

Table A.1 reports the results of this regression and finds $\gamma_1 < 0$ and statistically significant – households who pay attention to labour market news hold an even stronger supply-side view compared to those who do not. Conversely, attention to price-related news appears to contribute to a demand-side view $\gamma_2 > 0$, though its impact is relatively muted. The results still hold when I divide the labour news into positive news and negative news (see Column 2 and 3 in Table A.1), which should allay any concern that the results are biased by labour news being more likely to be negative than positive. These results also rule out pessimism as the sole explanation for the negative correlation between inflation and output.

Table A.1: Perceived Relationship between Inflation and Growth: Households

	Growth Forecasts		
	All	labour news (+)	labour news (-)
Inflation Forecasts	-0.047^{***}	-0.047^{***}	-0.047^{***}
	(0.001)	(0.001)	(0.001)
Inflation Forecasts × labour news	-0.0186^{**}	-0.019^{*}	-0.013^{*}
	(0.007)	(0.010)	(0.008)
Inflation Forecasts × Price news	0.006	0.006	0.006
	(0.027)	(0.027)	(0.027)
labour news	-0.091^{***}	0.150^{***}	-0.237^{***}
	(0.025)	(0.025)	(0.022)
Price news	0.061	0.061	0.061
	(0.073)	(0.073)	(0.073)
Intercept	0.019	0.019	0.020
	(0.002)	(0.002)	(0.002)

Note: The table presents the results of regression (A1). Column 1 presents the results for the full sample. Column 2 and 3 show that the results are robust even when dividing labour news into favourable/unfavourable categories.

B Proofs for Section 2

The derivation in this section and Appendix C largely build on the rational inattention literature, particularly Maćkowiak and Wiederholt (2025) and Afrouzi and Yang (2021).

B.1 Approximation of household's utility function

Household i's per-period utility at time t is given by:

$$U\left(C_{i,t}, L_{i,t}\right) = \frac{C_{i,t}^{1-\gamma}}{1-\gamma} - \frac{L_{i,t}^{1+\eta}}{1+\eta} = \frac{C_{i,t}^{1-\gamma}}{1-\gamma} - \frac{\left(\frac{P_t C_{i,t}}{W_t}\right)^{1+\eta}}{1+\eta}$$

The second equation follows from the fact that, as households are hand-to-mouth, labour supply can be derived from the budget constraint: $L_{it} = (P_t C_t)/W_t$.

Expressing the per-period utility function in terms of log-deviations from the non-stochastic steady state yields

$$\hat{u}\left(c_{i,t},p_t,w_t\right)=\left[\frac{\left(\bar{C}e^{c_{i,t}}\right)^{1-\gamma}}{1-\gamma}-\frac{\left(\frac{\bar{P}e^{p_t}\bar{C}e^{c_{i,t}}}{\bar{W}e^{w_t}}\right)^{1+\eta}}{1+\eta}\right]$$

The per-period utility of household i depends on choice variable $c_{i,t}$ and variables that the household takes as given, namely $\{w_t, p_t\}$. For any given $\{w_t, p_t\}$, the consumption level that maximises utility is

$$c^*_{i,t}=\arg\max_{c_{i,t}}\hat{u}\left(c_{i,t},p_t,w_t\right)\Leftrightarrow\hat{u}_1\left(c^*_{i,t},p_t,w_t\right)=0$$

Taking a second-order approximation of the utility function $L\left(c_{i,t},p_t,w_t\right)\equiv\hat{u}\left(c_{i,t},p_t,w_t\right)-\hat{u}(c^*_{i,t},p_t,w_t)$ around the steady state yields

$$\begin{aligned}L\left(c_{i,t},p_t,w_t\right)=&\frac{1}{2}\hat{u}_{11}\left(c^2_{i,t}-{c^*_{i,t}}^2\right)+\hat{u}_{12}p_t\left(c_{i,t}-c^*_{i,t}\right)\\&+\hat{u}_{12}w_t\left(c_{i,t}-c^*_{i,t}\right)+\mathcal{O}\left(\|c_{i,t},p_t,w_t\|^3\right)\end{aligned}\tag{A1}$$

where $\hat{u}_{1,n}, n\in\{1,2,3\}$ denotes the second-order derivatives of the utility function with respect to $c_{i,t}$, $c_{i,t}$ and p_t, and $c_{i,t}$ and w_t around the approximation point. Since $c^*_{i,t}$ maximises utility for any p_t and w_t,

$$\hat{u}_1(c^*_{i,t},p_t,w_t)=0\Rightarrow\hat{u}_{11}c^*_{i,t}+\hat{u}_{12}p_t+\hat{u}_{13}w_t+\mathcal{O}\left(\|p_t,w_t\|^2\right)=0$$

Combining this with Equation (A1) I obtain

$$\begin{aligned}\hat{u}\left(c_{i,t},p_t,w_t\right)&=L\left(c_{i,t},p_t,w_t\right)+\hat{u}\left(c^*_{i,t},p_t,w_t\right)\\&=\frac{1}{2}\hat{u}_{11}\left(c_{i,t}-c^*_{i,t}\right)^2+\mathcal{O}\left(\|c_{i,t},p_t,w_t\|^3\right)+\text{terms independent of }c_{i,t}\end{aligned}$$

Given the utility specification, $\hat{u}_{11}=-(\gamma+\eta)$ in the steady state. Moreover, optimal consumption is given by

$$c^*_{i,t}=\frac{1+\eta}{\gamma+\eta}\left(w_t-p_t\right)$$

Therefore, household i's objective (2.1) can be approximated as

$$\left[-\frac{(\gamma+\eta)}{2}\left(c_{i,t}-c^*_{i,t}\right)^2\right]+\text{terms independent of }\{c_{i,t}\}_{t\geq0}$$

B.2 Approximation of firm's profit function

First, substitute the production function and demand function into firm j's per-period profit function

$$\Pi\left(P_{j,t},W_t,X_t\right)=\frac{1}{P_tC_t}\left[P_{j,t}\left(\frac{P_{j,t}}{P_t}\right)^{-\theta}Y_t-(1-\theta^{-1})\frac{W_t}{A_t}\left(\frac{P_{j,t}}{P_t}\right)^{-\theta}Y_t\right]$$

The per-period profit function can then be expressed in terms of log-deviations from the non-stochastic steady state

$$\hat{\pi}\left(p_{jt}, w_t, a_t, x_t\right) = \bar{C} e^{c_t} e^{-\theta(p_{jt}-p_t)-p_t}\left[e^{p_{jt}} - \left(1-\theta^{-1}\right) e^{w_t - a_t}\right]$$

where the lowercase letters denote the log-deviations of the corresponding variable. For any given $\{w_t, p_t, y_t, a_t\}$,

$$p_{jt}^* = \arg\max_{p_{jt}} \hat{\pi}\left(p_{jt}, p_t, w_t, y_t, a_t\right) \Leftrightarrow \hat{\pi}_1\left(p_{jt}, p_t, w_t, y_t, a_t\right) = 0$$

Define function $L\left(p_{jt}, p_t, w_t, y_t, a_t\right) \equiv \hat{\pi}\left(p_{jt}, p_t, w_t, y_t, a_t\right) - \hat{\pi}\left(p_{jt}^*, p_t, w_t, y_t, a_t\right)$, and take a second-order approximation around the steady state

$$\begin{aligned} L\left(p_{jt}, p_t, w_t, y_t, a_t\right) = &\frac{1}{2}\hat{\pi}_{11}\left(p_{jt}^2 - {p_{jt}^*}^2\right) + \hat{\pi}_{12} p_t\left(p_{jt} - p_{jt}^*\right) + \hat{\pi}_{13} w_t\left(p_{jt} - p_{jt}^*\right) \\ &+ \hat{\pi}_{14} y_t\left(p_{jt} - p_{jt}^*\right) + \hat{\pi}_{15} a_t\left(p_{jt} - p_{jt}^*\right) + \mathcal{O}\left(\|p_{jt}, p_t, w_t, y_t, a_t\|^3\right) \end{aligned} \tag{A2}$$

Here $\hat{p}_{1,n}, n \in \{1,2,3,4,5\}$ denotes second-order derivatives of the profit function with respect to p_{jt}, p_{jt} and p_t, p_{jt} and w_t, p_{jt} and y_t, and p_{jt} and a_t around the approximation point. Note that since p_{jt}^* maximises the profit function for any given $\{w_t, p_t, y_t, a_t\}$, I have

$$\hat{\pi}\left(p_{jt}^*, p_t, w_t, y_t, a_t\right) = 0 \Rightarrow \hat{\pi}_{11} p_{jt}^* + \hat{\pi}_{12} p_t + \hat{\pi}_{13} w_t + \hat{\pi}_{13} y_t + \hat{\pi}_{13} a_t + \mathcal{O}\left(\|p_t, w_t, a_t, y_t\|^2\right) = 0$$

Combining this result with Equation (A2) I obtain

$$\begin{aligned} \hat{\pi}\left(p_{jt}, p_t, w_t, y_t, a_t\right) &= L\left(p_{jt}, p_t, w_t, y_t, a_t\right) + \hat{\pi}\left(p_{jt}^*, p_t, w_t, y_t, a_t\right) \\ &= \frac{1}{2}\hat{\pi}_{11}\left(p_{jt} - p_{jt}^*\right)^2 + \mathcal{O}\left(\|p_{jt}, p_t, w_t, y_t, a_t\|^3\right) + \text{terms independent of } p_{jt} \end{aligned}$$

Given the particular profit function, $\hat{\pi}_{11} = -(\theta - 1)$ in the steady state. And the optimal price

$$p_{jt}^* = w_t - a_t$$

Hence, the firm j's objective (2.4) is approximated by

$$\sum_{t=0}^{\infty} \beta^t\, \mathbb{E}^j\left[-\frac{\theta - 1}{2}\left(p_{jt} - p_{jt}^*\right)^2\right] + \text{terms independent of } \{p_{jt}\}_{t\geq 0}$$

B.3 Proof of Proposition 1

Upon reception of a signal $s_{i,a,t} = a_t + e_{i,a,t}$, the consumption $c_{i,t} = \lambda_{h,a}\,\mathbb{E}[a_t|s_{i,a,t}]$ maximises the expected utility (2.14) for any given posterior belief. Bayesian updating with Gaussian prior uncertainty and signals delivers

$$\mathbb{E}\left[a_t|s_{i,a,t}\right] = \xi_{h,a}[a_t + e_{i,a,t}]$$

where $\xi_{h,a} \equiv (1 - \sigma_{a|s}^2/\sigma_a^2) \in [0,1]$, and $\xi_{h,a}$ is the Kalman-gain on the signal. Now rewrite the problem (2.14) in terms of choice variable $\xi_{h,a}$

$$\max_{\xi_{h,a}\in[0,1]}\left[-\left(\gamma+\eta\right)\lambda_{h,a}^2\left(1-\xi_{h,a}\right)\sigma_a^2 - \mu^h \ln\frac{1}{1-\xi_{h,a}}\right]$$

Solving the first order condition, the solution is

$$\xi_{h,a} = \max\left(0, 1 - \frac{\mu^h}{(\gamma+\eta)\lambda_{h,a}^2\sigma_a^2}\right)$$

B.4 Proof of Proposition 2

By the independence assumption, I can solve the firms attention choices for aggregate demand shock and the productivity shock separately.

In the case of demand shocks, the signals take the form $s_{j,q,t} = q_t + e_{j,q,t}$. To derive firms' attention choices, it is instructive to first express the firms' ex-ante expected utility as a function of their attention choices. Note that firm j's prior uncertainty about q_t is simply σ_q^2, and denote firm j's posterior uncertainty as $\sigma_{q|s_j} \equiv var(q_t|s_{j,q,t})$. The firm j's attention problem is then

$$\begin{aligned} &\max_{\{s_{j,q,t}\in\mathcal{S}_f^t\}} \mathbb{E}_t^f\left[-\frac{\theta-1}{2}\left(\mathbb{E}[p_{j,t}^*|s_{j,q,t}] - p_{j,t}^*\right)^2 - \mu^f\mathcal{I}\left(q_t; s_{j,q,t}\right)\right] \\ &= \frac{1}{2}\max_{\sigma_{q|s_j}^2\le\sigma_q^2}\left[-(\theta-1)\lambda_{f,q}^2\sigma_{q|s_j}^2 - \mu^f\ln\frac{\sigma_q^2}{\sigma_{q|s_j}^2}\right] \end{aligned} \tag{A3}$$

For every realisation of the signal at time t, the firm will set price $p_{j,t} = \mathbb{E}[p_{j,t}^*|s_{j,q,t}]$. Hence, the expected profit depends on the expected square deviation of $\mathbb{E}[p_{j,t}^*|s_{j,q,t}]$ from $p_{j,t}^*$, which reduces to the conditional variance in (A3).

Upon reception of a signal $s_{j,q,t} = q_t + e_{j,q,t}$, the price $p_{j,t} = \mathbb{E}[p_{j,t}^*|s_{j,q,t}]$ maximises the expected profit for any given posterior belief. Bayesian updating with Gaussian prior uncertainty and signals yields

$$\mathbb{E}\left[p_{j,t}^*|s_{j,q,t}\right] = \xi_{f,q}\lambda_{f,q}[q_t + e_{j,q,t}]$$

where $\xi_{f,q} \equiv (1 - \sigma_{q|s_j}^2/\sigma_q^2) \in [0,1]$ is the attention weight on the signal. I can now rewrite the problem (A3) in terms of the choice variable $\xi_{f,q}$

$$\max_{\xi_{f,q}\in[0,1]}\left[-(\theta-1)\lambda_{f,q}^2(1-\xi_{f,q})\sigma_q^2 - \mu^f\ln\frac{1}{1-\xi_{f,q}}\right]$$

Solving gives the expression in Equation (2.17a)

$$\xi_{f,q} = \max\left(0, 1 - \frac{\mu^f}{(\theta-1)\lambda_{f,q}^2\sigma_q^2}\right)$$

By the same procedure, I can solve the attention problem for supply shocks a_t.

In the case of productivity shocks, the firm's attention problem is

$$\max_{\sigma_{a|s_j}^2\le\sigma_a^2}\left[-(\theta-1)\lambda_{f,a}^2\sigma_{a|s_j}^2 - \mu^f\ln\left(\frac{\sigma_a^2}{\sigma_{a|s_j}^2}\right)\right]$$

where $\lambda_{f,a} = -\frac{1+\eta}{\gamma+\eta}$, σ_a^2 is the prior variance of firm j's belief about the productivity shock and $\sigma_{a|s_j}^2$ denotes the posterior variance.

Upon reception of a signal $s_{j,a,t} = a_t + e_{j,a,t}$, the price $p_{j,t} = \mathbb{E}[p_{j,t}^*|s_{j,a,t}]$ maximises the expected profit for any given posterior belief. Bayesian updating with Gaussian prior uncertainty and signals yields

$$\mathbb{E}\left[p^*_{j,t}|s_{j,a,t}\right] = \xi_{f,a}\lambda_{f,a}[a_t + e_{j,a,t}]$$

where $\xi_{f,a} \equiv (1-\sigma^2_{a|s_j}/\sigma^2_a) \in [0,1]$, and $\lambda_{f,a}\xi_{f,a}$ reflects the attention weight on the signal. I can now rewrite the firms' attention problem in terms of choice variable $\xi_{f,a}$

$$\max_{\xi_{f,a}\in[0,1]} \left[-(\theta-1)\,\lambda^2_{f,a}\,(1-\xi_{f,a})\,\sigma^2_a - \mu^f \ln\frac{1}{1-\xi_{f,a}}\right]$$

Solving gives the expression in Equation (2.17b)

$$\xi_{f,a} = \max\left(0, 1-\frac{\mu^f}{(\theta-1)\lambda^2_{f,a}\sigma^2_a}\right)$$

Combining these results together gives the Proposition 2.

B.5 Proof of Proposition 3

Under optimal signal design, firms optimally choose to receive a single signal of the optimal price, i.e., $s_{j,t} = p^*_{j,t} + e_{j,t} = \lambda_{f,q}q_t + \lambda_{f,a}a_t + e_{j,t}$ where $e_{j,t}$ is the attention error. Upon receiving this signal, the price $p_{j,t} = \mathbb{E}[p^*_{j,t}|s_{j,t}]$ maximises the expected profit for any given posterior belief. Therefore, the objective can be expressed as

$$\max_{\{s_{j,t}\in\mathcal{S}^t_f\}} \mathbb{E}^f_t\left[-\frac{\theta-1}{2}\left(\mathbb{E}[p^*_{j,t}|s_{j,t}] - p^*_{j,t}\right)^2 - \mu^f\mathcal{I}\left(q_t, a_t; s_{j,t}\right)\right]$$
$$= \frac{1}{2}\max_{\sigma^2_{p|s}\le\sigma^2_p}\left[-(\theta-1)\sigma^2_{p|s} - \mu^f \ln\left(\frac{\sigma^2_p}{\sigma^2_{p|s}}\right)\right]$$

where $\sigma^2_p \equiv \lambda^2_{f,q}\sigma^2_q + \lambda^2_{f,a}\sigma^2_a$ denotes the prior uncertainty about $p^*_{j,t}$ and $\sigma^2_{p|s}$ denotes the posterior uncertainty. Solve the model, the firm sets a price according to

$$p_{j,t} = \xi_f\left(p^*_{j,t} + e_{j.t}\right) = \xi_f\left(\lambda_{f,q}q_t + \lambda_{f,a}a_t + e_{j,t}\right) \tag{A4}$$

with

$$\xi_f = \max\left(0, 1-\frac{\mu^f}{(\theta-1)\sigma^2_p}\right)$$

From Equation (A4), the weights on the demand shock (q_t) and the supply shock (a_t) are $\xi_f\lambda_{f,q}$ and $\xi_f\lambda_{f,a}$, respectively.

C Proofs for Quantitative Model

C.1 Extended Model

Households. There is a continuum of households, indexed by $i \in [0,1]$. Each period, household i chooses the consumption level $C_{i,t}$ and bond holdings $B_{i,t}$ based on its information set $S^t_i = \{s_{i,\tau}\}^{\tau=t}_{\tau=0}$. After deciding on consumption and bond holdings, household i supplies labour $L_{i,t}$ at given wage W_t such that the budget constraint holds. Formally, household i's expected present value of utility is given by

$$\mathbb{E}^i\left[\sum_{t=0}^{\infty}\beta^t\left(\frac{C_{i,t}^{1-\gamma}}{1-\gamma}-\frac{L_{i,t}^{1+\eta}}{1+\eta}\right)\right], \quad C_{i,t}=\left[\int_0^1 C_{i,j,t}^{\frac{\theta-1}{\theta}}dj\right]^{\frac{\theta}{\theta-1}} \tag{A1}$$

less the cost of attention. The budget constraint is

$$s.t.\ P_tC_{i,t}+B_{i,t}=W_tL_{i,t}+R_{t-1}B_{i,t-1}+D_t+T_t \tag{A2}$$

Here B_t is the nominal bond holdings at t that yield a nominal return of R_t at $t+1$, D_t is the aggregate profits of firms, and T_t is the net lump-sum transfers (or taxes, if negative). Household i takes $\{P_t, R_t, W_t, D_t, T_t\}$ as given.

Firms. There is a continuum of firms producing differentiated goods, indexed by $j \in [0,1]$. Firm j faces a demand curve given by $Y_{j,t}=(P_{j,t}/P_t)^{-\theta}Y_t$. Firm j takes the wage $W_{j,t}$ and demand for its goods as given. In each period, firm j sets the price for its own variety $P_{j,t}$, based on its information, and then hires sufficient labour $L_{j,t}$ to produce to meet its demand according to production function $Y_{j,t}=A_tL_{j,t}$. Formally, firm j's expected present value of profit discounted by households' marginal utility of consumption is given by

$$\mathbb{E}^j\left[\sum_{t=0}^{\infty}C_t^{-\gamma}\left[P_{j,t}Y_{j,t}-(1-\theta^{-1})\frac{W_{j,t}}{A_t}\left(\frac{P_{j,t}}{P_t}\right)^{-\theta}Y_t\right]\right] \tag{A3}$$

less the cost of attention. Here A_t is the aggregate productivity, with $a_t \equiv \log(A_t)$ follows a AR(1) process: $a_t=\rho_a a_{t-1}+\sigma_a\varepsilon_t$, with $\varepsilon_t \sim N(0,1)$. Other variables are defined similarly as in Section 2.

Central Bank. I assume the central bank has full information – it knows the shocks, households' and firms' actions, and the equilibrium outcomes. Monetary policy is specified as the following standard Taylor rule with interest rate smoothing

$$\frac{R_t}{\bar{R}}=\left(\frac{R_{t-1}}{\bar{R}}\right)^{\rho}\left[\left(\frac{P_t}{P_{t-1}}\right)^{\phi_\pi}\left(\frac{Y_t}{Y_t^n}\right)^{\phi_y}\right]^{1-\rho}e^{-\sigma_u u_t} \tag{A4}$$

where R_t is the nominal interest rate, $\bar{R}$ is the steady state nominal rate, $Y_t=C_t$ is aggregate output, Y_t^n is natural level of output in the economy with no frictions, and $u_t \sim N(0,1)$ is a monetary policy shock. I specify the rule such that a positive u_t shock corresponds to an expansionary monetary policy shock. Denote $i_t \equiv \log(R_t)$, the log-linearised Taylor rule is

$$i_t=\rho i_{t-1}+(1-\rho)(\phi_\pi\pi_t+\phi_x x_t)-u_t \tag{A5}$$

I interpret the central bank in the model as the counterpart of professional forecasters in the survey.

Fiscal authority. The government has to finance maturing nominal government bonds and the wage subsidy, by collecting lump-sum taxes or issuing new bonds. The government's budget constraint is

$$\frac{B_t}{P_t}=\frac{R_{t-1}}{\Pi_t}\frac{B_{t-1}}{P_{t-1}}+\theta^{-1}\frac{W_tL_t}{P_t}+\frac{T_t}{P_t}$$

How the fiscal authority finances its expenditures matters a great deal for the macroeconomic outcomes. Here I consider two assumptions about how the government satisfies its intertemporal budget constraint: (i) government debt is held constant, and transfers fully adjust; (ii) let government debt absorb the majority of the fiscal imbalance in the short run, and adjust the path of lump-sum tax to satisfy long-run solvency.[27] Following common practice in the New Keynesian literature, I restrict τ such that monetary policy is active and fiscal policy is passive in the sense of Leeper (1991).

C.2 Approximation of Households' Utility

First, using the flow budget constraint (A2) to substitute for labour in the utility function and expressing all variables in terms of log-deviations from the non-stochastic steady state, I obtain the following expression for the per-period utility of household i in period t:

$$u = \left(\frac{\bar{C}^{1-\gamma}}{1-\gamma} e^{(1-\gamma)c_{i,t}} - \frac{\left[\frac{\bar{P}\bar{C}e^{p_t + c_{i,t}} + \bar{B}e^{b_{i,t}} - \bar{R}\bar{B}e^{i_{t-1}+b_{i,t-1}} - \bar{D}e^{d_t} - \bar{T}e^{\tau_t}}{\bar{W}e^{w_t}} \right]^{1+\eta}}{1+\eta} \right)$$

Here, the lowercase letters denote the log-deviations of the corresponding variables. $c_{i,t}$ is the consumption by household i, $\tilde{b}_{i,t}$ is the real bond holdings, $\tilde{d}_t$ is the real dividends, and $\tilde{\tau}_t$ is the real transfers (taxes if negative). Define the steady state ratios

$$(\omega_B, \omega_W, \omega_D, \omega_T) = \left(\frac{\bar{B}}{\bar{C}\bar{P}}, \frac{\bar{W}\bar{L}}{\bar{C}\bar{P}}, \frac{\bar{D}}{\bar{C}\bar{P}}, \frac{\bar{T}}{\bar{C}\bar{P}} \right)$$

In period t, household i chooses $v_t \equiv (\tilde{b}_{i,t}, c_{i,t})'$, the choices made in previous period represented by $v_{t-1} = (\tilde{b}_{i,t-1}, 0)'$. Households take following variables as given $\zeta_t \equiv [\tilde{d}_t, i_{t-1}, \tilde{w}_t, \tilde{\tau}_t, \pi_t]'$.

A log-quadratic approximation to the expected discounted sum of per-period utility around the non-stochastic steady state yields

$$\sum_{t=0}^{\infty} \beta^t \mathbb{E}_i^h \left[\frac{1}{2} (v_t - v_t^*)' \Theta_0 (v_t - v_t^*) + (v_t - v_t^*) \Theta_1 (v_{t+1} - v_{t+1}^*) \right] \tag{A6}$$

where

$$\Theta_0 = -\bar{C}_i^{1-\gamma} \begin{bmatrix} \frac{\eta}{\omega_W} \left[1 + \frac{1}{\beta} \right] \omega_B^2 & \frac{\eta}{\omega_W} \omega_B \\ \frac{\eta}{\omega_W} \omega_B & \left(\gamma + \frac{\eta}{\omega_W} \right) \end{bmatrix}, \qquad \Theta_1 = \bar{C}^{1-\gamma} \begin{bmatrix} \frac{\eta}{\omega_W} \omega_B^2 & \frac{\eta}{\omega_W} \omega_B \\ 0 & 0 \end{bmatrix}$$

The sequence of optimal bond holdings under full information is given by

$$\omega_B \left(\frac{1}{\beta} \tilde{b}_{i,t-1}^* - \tilde{b}_{i,t}^* \right) + c_{i,t}^* = \mathbb{E}_t \left[\omega_B \left(\frac{1}{\beta} \tilde{b}_{i,t}^* - \tilde{b}_{i,t+1}^* \right) + c_{i,t+1}^* \right] \tag{A7}$$

and the optimality choice for consumption

$$-\omega_B \left(\frac{1}{\beta} \tilde{b}_{i,t-1}^* - \tilde{b}_{i,t}^* \right) + \left(\gamma \frac{\omega_W}{\eta} + 1 \right) c_{i,t}^* = \omega_W \left(\frac{1}{\eta} + 1 \right) \tilde{w}_t + \left[\frac{1}{\beta} \omega_B (i_{t-1} - \pi_t) + \omega_D \tilde{d}_t + \omega_T \tilde{\tau}_t \right] \tag{A8}$$

[27] For the model solution under the second assumption see Online Appendix.

Together with the log-linearised budget constraint

$$c_{i,t} = \omega_W \left(\tilde{w}_t + l_{i,.t}\right) + \frac{1}{\beta}\omega_B \left(i_{t-1} - \pi_t\right) + \omega_B \left(\frac{1}{\beta}\tilde{b}_{i,t-1} - \tilde{b}_{i,t}\right) + \omega_D \tilde{d}_t + \omega_D \tilde{\tau}_t \tag{A9}$$

Under full information, combining the optimality choice for consumption (A8) with the optimal bond holdings (A7) yields the standard inter-temporal Euler equation

$$c^*_{i,t} = \mathbb{E}_t \left[c^*_{i,t+1} - \frac{1}{\gamma}\left(i_t - \pi_{t+1}\right)\right]$$

Similarly, combining the log-linearised budget constraint (A9) with the optimality condition for consumption (A8) gives the standard intra-temporal Euler equation

$$\tilde{w}_t = \gamma c^*_{i,t} + \eta l^*_{i,t} \tag{A10}$$

To solve for the optimal bond holdings under full information, I follow the transformation in Maćkowiak and Wiederholt (2025). Specifically, I substitute Equation (A10) into the budget constraint (A9) and rearranging the expression

$$\left(1 + \omega_W \frac{\gamma}{\eta}\right) c^*_{i,t} = \omega_W \left(1 + \frac{1}{\eta}\right) \tilde{w}_t + \omega_B \left(\frac{1}{\beta}\left(\tilde{b}^*_{i,t-1} + i_{t-1} - \pi_t\right) - \tilde{b}^*_{i,t}\right) + \omega_D \tilde{d}_t + \omega_D \tilde{\tau}_t$$

Sum over time from $t = 0$ to ∞, discounting each period by β^t

$$\left(1 + \omega_W \frac{\gamma}{\eta}\right) \sum_{s=t}^{t+N} \beta^{s-t} c^*_{i,s} = \omega_B \frac{1}{\beta}\tilde{b}^*_{i,t-1} + \sum_{s=t}^{t+N} \beta^{s-t}\left[z_s\right] - \omega_B \beta^N \tilde{b}^*_{i,t+N} \tag{A11}$$

Here $z_t \equiv \omega_W \left(1 + \frac{1}{\eta}\right) \tilde{w}_t + \frac{1}{\beta}\omega_B \left(i_{t-1} - \pi_t\right) + \omega_D \tilde{d}_t + \omega_D \tilde{\tau}_t$.

Taking expectations on both sides of Equation (A11), and as $N \to \infty$, I get

$$\left(1 + \omega_W \frac{\gamma}{\eta}\right) \sum_{s=t}^{\infty} \beta^{s-t} \mathbb{E}_t \left[c^*_{i,s}\right] = \omega_B \frac{1}{\beta}\tilde{b}^*_{i,t-1} + \sum_{s=t}^{\infty} \beta^{s-t} \mathbb{E}_t \left[z_s\right] \tag{A12}$$

Next, using the Euler Equation and the law of iterated expectations yields

$$\sum_{s=t}^{\infty} \beta^{s-t} \mathbb{E}_t \left[c^*_{i,s}\right] = \frac{1}{1-\beta} c^*_{i,t} + \frac{1}{\gamma}\frac{1}{1-\beta} \sum_{s=t+1}^{\infty} \beta^{s-t} \mathbb{E}_t \left(r_{s-1} - \pi_s\right) \tag{A13}$$

Combining Equation (A13) with the budget constraint (A9) yields

$$\omega_B \tilde{b}^*_{i,t} = \omega_B \tilde{b}^*_{i,t-1} + z_t - (1-\beta) \sum_{s=t}^{t+N} \beta^{s-t} \mathbb{E}_t \left[z_s\right] + \left(1 + \omega_W \frac{\gamma}{\eta}\right) \frac{1}{\gamma} \sum_{s=t+1}^{\infty} \beta^{s-t} \mathbb{E}_t \left(r_{s-1} - \pi_s\right) \tag{A14}$$

Note that the off-diagonal element of Θ_0 in Equation (A6) is non-zero, indicating that a suboptimal bond holding $b^*_{i,t}$ affects the optimal consumption choice $c^*_{i,t}$, and vice versa. Moreover, the second term in Equation (A6) shows that a suboptimal bond holding today affects tomorrow's bond holding decision. These intra-and inter-temporal relationships complicate the attention problem. Therefore, similar to Maćkowiak and Wiederholt (2025), I do the following transformation such that I could express Equation (A6) as[28]

$$\sum_{t=0}^{\infty}\beta^t\mathbb{E}_i^h\left[\frac{1}{2}\left(v_t-v_t^*\right)'\Theta_0\left(v_t-v_t^*\right)+\left(v_t-v_t^*\right)\Theta_1\left(v_{t+1}-v_{t+1}^*\right)\right]$$
$$=\sum_{t=0}^{\infty}\beta^t\mathbb{E}_{i,-1}\left[\frac{1}{2}\left(x_{i,t}-x_{i,t}^*\right)'\Theta\left(x_{i,t}-x_{i,t}^*\right)\right] \tag{A15}$$

where, instead of choosing $v_{i,t}=(\tilde{b}_{i,t},c_{i,t})'$ directly, I assume that household i chooses the a transformation of $v_{i,t}$, which is $x_{i,t}$

$$x_{i,t}=\begin{pmatrix}\omega_B\left(\tilde{b}_{i,t}-\tilde{b}_{i,t-1}\right)\\ -\omega_B\left(\frac{1}{\beta}\tilde{b}_{i,t-1}-\tilde{b}_{i,t}\right)+\left(\gamma\frac{\omega_W}{\eta}+1\right)c_{i,t}\end{pmatrix}$$

This transformation diagonalises the loss function and separates the interdependencies between bond holdings and consumption, thereby simplifying the attention allocation problem. And the corresponding Θ in Equation (A15) is

$$\Theta=-\bar{C}^{1-\gamma}\begin{bmatrix}\frac{\eta}{\omega_W}\left[1-\frac{1}{\left(1+\omega_W\frac{\gamma}{\eta}\right)}\right]\frac{1}{\beta} & 0\\ 0 & \frac{\eta}{\omega_W}\frac{1}{\left(1+\omega_W\frac{\gamma}{\eta}\right)}\end{bmatrix}$$

In this transformed space, a suboptimal choice of the first element in $x_{i,t}$ does not affect the optimal choice of the second element, and vice versa.

And the optimal choice of $x_{i,t}^*$ under full information is

$$x_{i,t}^*=\begin{pmatrix}z_t-(1-\beta)\sum_{s=t}^{\infty}\beta^{s-t}\mathbb{E}_t\left[z_s\right]+\frac{\beta}{\gamma}\left(1+\omega_W\frac{\gamma}{\eta}\right)\sum_{s=t}^{\infty}\beta^{s-t}\mathbb{E}_t\left(i_s-\pi_{s+1}\right)\\ \omega_W\left(\frac{1}{\eta}+1\right)\tilde{w}_t+\left[\frac{1}{\beta}\omega_B\left(i_{t-1}-\pi_t\right)+\omega_D\tilde{d}_t+\omega_T\tilde{\tau}_t\right]\end{pmatrix}$$

C.3 Solving the model under full information

Households. Under full information, all households will choose identical actions, satisfying the usual first-order conditions.

$$\tilde{w}_t=\gamma c_t+\eta l_t$$
$$c_t=\mathbb{E}_t\left[c_{t+1}-\frac{1}{\gamma}\left(i_t-\pi_{t+1}\right)\right]$$

I can take off the subscript i from above equations as $c_{i,t}=c_t$ and $l_{i,t}=l_t$, $\forall i$.

Firms. Firms with full information will set identical prices ($p_{j,t}=p_t,\forall j$) to track the nominal marginal cost.

$$p_t^*=w_t-a_t$$

and the total labour demand will be $l_t=c_t-a_t$.

[28]The proof of this transformation is lengthy and omitted here for brevity, but I can provide it upon request.

Equilibrium. The labour market clearing condition gives the real wage

$$\tilde{w}_t = \gamma c_t + \eta l_t = \gamma c_t + \eta \left(c_t - a_t\right) = \left(\gamma + \eta\right) c_t - \eta a_t$$

And by the pricing function, $\tilde{w}_t = w_t - p_t = a_t$. Together with the above equation I can solve for equilibrium consumption and equilibrium labour

$$c_t = \frac{1+\eta}{\gamma+\eta} a_t, \qquad l_t = \frac{1-\gamma}{\gamma+\eta} a_t$$

The real interest rate is determined by the Euler Equation. Replacing the equilibrium consumption in the Euler Equation I get

$$\frac{1+\eta}{\gamma+\eta} a_t = \mathbb{E}_t \left[\frac{1+\eta}{\gamma+\eta} a_{t+1} - \frac{1}{\gamma}\left(i_t - \pi_{t+1}\right)\right], \quad \Rightarrow r_t \equiv i_t - \mathbb{E}_t\left(\pi_{t+1}\right) = -\gamma \frac{1+\eta}{\gamma+\eta}\left(1-\rho_a\right) a_t$$

The dividend (in real term) follows $\tilde{d}_t = \frac{1+\eta}{\gamma+\eta} a_t$. All real variables are determined.

Then the monetary policy will determine the nominal variables. The monetary policy rule is reduced to

$$i_t = \rho i_{t-1} + \left(1-\rho\right) \phi_\pi \pi_t + u_t$$

as $x_t \equiv y_t - y_t^n$ is always zero as the equilibrium consumption is always efficient. The monetary policy will pin down the equilibrium inflation. (using guess and verify approach)

$$\pi_t = -\gamma \frac{1+\eta}{\gamma+\eta} \frac{\left(1-\rho_a\right)}{\left[\left(1-\rho\right)\phi_\pi - \rho_a + \rho\right]} a_t - \frac{1}{\left(1-\rho\right)\phi_\pi} u_t + \rho\gamma \frac{1+\eta}{\gamma+\eta} \frac{\left(1-\rho_a\right)}{\left[\left(1-\rho\right)\phi_\pi - \rho_a + \rho\right]} a_{t-1}$$

and interest rate

$$i_t = -\gamma \frac{1+\eta}{\gamma+\eta} \frac{\left(1-\rho_a\right)\left(1-\rho\right)\phi_\pi}{\left[\left(1-\rho\right)\phi_\pi - \rho_a + \rho\right]} a_t$$

The equilibrium bonds and lump-sum transfer will be determined by the tax rule. In particular, if the government supplies constant bonds $b_t = b_{t-1} = 0$, the transfer (or tax if negative) will adjust such that gov budget constraint binds.

$$\omega_T \tilde{\tau}_t = -\frac{1}{\beta}\omega_B i_{t-1} + \frac{1}{\beta}\omega_B \pi_t - \theta^{-1}\omega_W\left(\tilde{w}_t + l_t\right)$$

If the government assume a simple tax rule, that is, in each period, the government raises tax to repay all the interest payments and repay a portion $\bar{\tau}$ of existing debts, i.e.,

$$-\omega_T \tilde{\tau}_t = \frac{1}{\beta}\omega_B\left(i_{t-1} - \pi_t\right) + \frac{1}{\beta}\omega_B \tilde{b}_{t-1} + \bar{\tau}\omega_B \tilde{b}_{t-1}$$

The bond supply in period t will adjust such that the budget constraint holds.