Rationally Inattentive Behavior in Different Times

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Abstract

This paper investigates whether economic agents with rational inattention in a DSGE model adjust their behavior differently depending on the magnitude of aggregate economic volatility. To explore this, I compare the pre-Great Moderation period, characterized by high aggregate volatility, with the Great Moderation period, marked by a significant reduction in volatility. Households and firms with rational inattention optimally deviate from the profit- or utility-maximizing behavior under perfect information. Notably, their deviation patterns remain consistent across the two periods. The DSGE model with rational inattention successfully replicates key empirical observations, demonstrating that both firms and households allocate greater attention to aggregate economic conditions during the pre-Great Moderation period. This heightened attentiveness leads to faster behavioral adjustments in response to economic changes compared to the Great Moderation period.

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1 Introduction

"What information consumes is rather obvious: It consumes the attention of its recipients. Hence a wealth of information creates a poverty of attention, and a need to allocate that attention efficiently among the overabundance of information sources that might consume it."

(Herbert A Simon, 1971, p.40-41)

Efficient allocation of attention is essential when individuals are faced with an abundance of information. As a scarce resource, attention is allocated optimally, much like other economic resources. The rational inattention model, first proposed by Sims (1998) incorporates this cognitive process by framing attention as a costly resource. Sims (2003) introduces the concept of the rate of uncertainty reduction to quantify the flow of information, which has since become central to the literature on rational inattention. This framework has been widely used to study equilibrium behavior under limited attention.

Much of the existing research focuses on partial equilibrium analyses, examining specific sides of the economy. For example, Luo (2008) explores the joint dynamics of consumption and permanent income for rationally inattentive households and develops an analytical approach to solving the permanent income hypothesis model under rational inattention. Similarly, Tutino (2013) demonstrates that rationally inattentive households respond asymmetrically to income shocks, with negative shocks eliciting stronger and faster adjustments in consumption. On the firm side, Mackowiak and Wiederholt (2009) investigate the behavior of price-setting firms, showing that such firms prioritize firm-specific information over aggregate conditions.

Building on this foundation, Maćkowiak and Wiederholt (2015) design a DSGE model with rational inattention. In this model, households and firms deviate optimally from the behavior they would adopt under perfect information. These deviations, while incurring minor losses in utility or profit, reflect the costly nature of attention. Rationally inattentive agents determine their behavior by balancing the marginal benefit against the marginal cost of paying attention. The resulting utility or profit is slightly lower than it would be under perfect information; however, the loss is minimal and negligible. Importantly, their work demonstrates that rational inattention alone can account for the slow adjustment of macroeconomic aggregates, without relying on traditional assumptions such as Calvo pricing, habit formation in consumption, or Calvo wage-setting.

A key insight from the literature is that greater uncertainty draws more attention. For instance, both Maćkowiak and Wiederholt (2015) and Paciello (2012) find that firms are more attentive to aggregate technology shocks, which exhibit higher volatility, compared to monetary policy shocks. However, much of this research focuses on within-period variations in attention allocation, often limited to periods of low aggregate volatility, such as the Great Moderation (1982–2008). This leaves a critical gap: it remains unclear whether rational inattention models are valid across periods with markedly different levels of aggregate volatility. Validating the model in such contexts is crucial to demonstrate its robustness along both variable and temporal dimensions.

This paper addresses this gap by examining whether economic agents allocate more attention during periods of high aggregate volatility, such as the pre-Great Moderation period, and whether the DSGE model with rational inattention can consistently reproduce empirical findings across these periods. If, in the high-volatility pre-Great Moderation period, agents were perfectly attentive and adhered strictly to profit- or utility-maximizing behavior under perfect information, the model would fail to account for the slow adjustment of macroeconomic variables. This study examines whether the DSGE model with rational inattention can consistently reproduce empirical findings and capture slow adjustments, even during the pre-Great Moderation period—a context that has not been previously explored.

I make three contributions. First, I verify that the loss incurred by deviating from profit- or utility-maximizing behavior under perfect information is sufficiently small for firms and households to accept such deviations, regardless of the level of aggregate volatility. This behavior persists across both the pre-Great Moderation and Great Moderation periods. Agents facing information processing costs initially respond by deviating from the optimal behavior expected under perfect information. Subsequently, they adjust their behavior gradually toward optimal responses. In other words, rational inattention consistently serves as a source of slow adjustment in macroeconomic variables. My second contribution is that I show that economic agents allocate more attention to aggregate technology shocks during the pre-Great Moderation period, characterized by greater volatility. This finding aligns with the fact that rationally inattentive agents allocate more attention when uncertainty increases. This study extends the literature by confirming that this principle applies consistently across different periods, not just within a single time frame. Finally, I demonstrate that households and firms adjust their initially deviated responses more quickly during the pre-Great Moderation period, characterized by higher volatility. This is because agents allocate more attention and closely follow the profit-or utility-maximizing behavior under perfect information when volatility is high. Consequently, this paper reinforces the finding that firms and households pay closer attention to large uncertainties than to smaller ones over time.

This paper adopts the DSGE model developed by Maćkowiak and Wiederholt (2015), incorporating three fundamental shocks: monetary policy shocks, aggregate technology shocks, and firm-specific shocks. Consistent with their findings, both firms and households pay more attention to aggregate technology shocks than to monetary policy shocks, as the former exhibit greater volatility. Firms, in particular, prioritize firm-specific productivity and aggregate technology over monetary policy across both periods. By applying this model to periods with distinct volatility levels, this study sheds light on the temporal robustness of rational inattention as a source of macroeconomic adjustment dynamics.

2 Model Setup of DSGE

This section outlines the preferences and technology, market structure, asset structure, and monetary and fiscal policies. These features of the economy are almost identical to a simple New Keynesian model, with the key exception that assumptions such as Calvo pricing, Calvo wage-setting, and habit formation in consumption are removed. Since the model used in this research is identical to that in Maćkowiak and Wiederholt (2015), the detailed technical proofs and derivations of equations can be found in the online appendix of Maćkowiak and Wiederholt (2015).

The economy comprises three markets: the goods market, the labor market, and the asset market. In each market, one side determines the quantity, while the other sets the price. In the goods market, firms set the prices of goods, and households decide their level of consumption. In the labor market, households set wage rates, and firms determine the quantity of labor they will hire. In the sole asset market—the bond market—the government determines the interest rate, and households choose their bond holdings. Time is modeled as discrete.

2.1 Households

There are J households in the economy. These households consume goods, supply labor, and hold government bonds. Each household has market power in the labor market because they supply differentiated labor. The model assumes an infinite horizon, with each household maximizing the expected discounted sum of their period utility.

In each period, a household has a utility function of

$$U(C_{jt}, L_{jt}) = \frac{C_{jt}^{1-\gamma} - 1}{1-\gamma} - \varphi L_{jt} \tag{1}$$

with

$$C_{jt} = \left(\sum_{i=1}^{I} C_{ijt}^{\frac{\theta-1}{\theta}} \right)^{\frac{\theta}{\theta-1}} \tag{2}$$

C_{ijt} is the consumption for good i of j household at time t, and C_{jt} is the composite consumption by the household j. L_{jt} is the labor supply of household j at period t. The parameter $\theta > 1$ is the elasticity of substitution between the I different consumption goods, the parameter $\gamma > 0$ is the inverse of the intertemporal elasticity of substitution, and the parameter $\varphi > 0$ is the marginal disutility of labor.

The budget constraint of household j at time t is as follows.

$$\sum_{i=1}^{I} P_{it} C_{ijt} + B_{jt} = R_{t-1} B_{jt-1} + (1+\tau_w) W_{jt} L_{jt} + \frac{D_t}{J} - \frac{T_t}{J} \tag{3}$$

P_{it} is the price of good i at period t, and B_{jt} is the number of bonds held by household j and t. $R_{t-1}$is gross nominal interest rate on bond holdings between period $t-1$ and t, B_{jt-1} is the number of bonds held by household j from $t-1$ to t, W_{jt} is the nominal wage rate for labor supplied by household j at t,and L_{jt} is labor supplied by household j at t. τ_w is the wage subsidy, and D_t/J is a po-rata share of nominal aggregate profits and T_t/J is a pro-rata share of lump-sum taxes. Each household has initial bond holdings, and in order to prevent Ponzi schemes, bond holdings should always be positive, $B_{jt} > 0$. In every period, a vector of consumption $(C_{1jt,} \cdots, C_{Ijt})$, and wage rate W_{jt} are determined. Based on this wage rate, each household supplies any quantity of labor. Also each household takes nominal interest rate, the price of goods, and the aggregate wage index as given.

2.2 Firms

There exist I firms in the model. Each firm i supplies different good i. The production function of firm i is

$$Y_{it} = e^{a_t} e^{a_{it}} L_{it}^{\alpha} \tag{4}$$

with

$$L_{it} = \left(\sum_{j=1}^{J} L_{ijt}^{\frac{\eta-1}{\eta}} \right)^{\frac{\eta}{\eta-1}} \tag{5}$$

Y_{it} is output, L_{it} is composite labor demanded by firm i at t, and $e^{a_t} e^{a_{it}}$ is total factor productivity. e^{a_t} is aggregate component and $e^{a_{it}}$ is the idiosyncratic component of firm i's technology. L_{ijt} is labor demanded by firm i from household j at t, and the parameter $\eta > 1$ is the elasticity of substitution between different kinds of labor. The parameter $\alpha \in (0, 1]$ is the elasticity of output with respect to composite labor input.

Nominal profit function of firm i is

$$(1 + \tau_p) P_{it} Y_{it} - \sum_{j=1}^{J} W_{jt} L_{ijt}. \tag{6}$$

τ_p is production subsidy provided by the government. In every period, each firm chooses price P_{it}, a labor mix $(\hat{L}_{i1t}, \cdots, \hat{L}_{i(J-1)t})$, where $\hat{L}_{ijt} = (L_{ijt}/L_{it})$ denotes relative input of type j labor at firm i in period t. Each firm supplies any quantity of the good at the price, and the quantity is decided by the chosen labor mix. Each firm takes wage rates and the aggregate price index as given.

2.3 Government

In the government part, we have a fiscal and a monetary authority. The nominal interest rate is determined by the Taylor rule.

$$\frac{R_t}{R} = (\frac{R_{t-1}}{R})^{\rho} [(\frac{\Pi_t}{\Pi})^{\phi_\pi} (\frac{Y_t}{Y_t^P})^{\phi_y}]^{1-\rho} e^{\varepsilon_t^R} \tag{7}$$

where R_t is the nominal interest rate in period t, $\Pi_t = (P_t/P_{t-1})$ is inflation. Y_t, aggregate output, is defined as

$$Y_t = \frac{\sum_{i=1}^{I} P_{it} Y_{it}}{P_t} \tag{8}$$

Y_t^P is equilibrium output under perfect information, and ε_t^R is a monetary policy shock. R is the nominal interest rate in the non-stochastic steady state. Likewise, Π is inflation in the non-stochastic steady state. The policy parameters satisfy $\rho \in [0, 1), \phi_\pi > 1$ and $\phi_y \geq 0$.

We have the government's budget constraint in period t:

$$T_t + B_t = R_{t-1}B_{t-1} + \tau_p(\sum_{i=1}^{I} P_{it}Y_{it}) + \tau_w(\sum_{j=1}^{J} W_{jt}L_{jt}). \tag{9}$$

Equation (9) indicates that the government collects lump-sum taxes or issues new bonds to finance maturing bond B_{t-1}, production subsidy τ_p and wage subsidy τ_w. Because both households and firms have market power, the government tries to correct market distortion by providing wage subsidy and production subsidy.

$$\tau_p = \frac{\tilde{\theta}}{\tilde{\theta}-1} - 1 \tag{10}$$

where $\tilde{\theta}$ denotes the price elasticity of demand and

$$\tau_w = \frac{\tilde{\eta}}{\tilde{\eta}-1} - 1 \tag{11}$$

where $\tilde{\eta}$ denotes the wage elasticity of labor demand.

2.4 Shocks

We consider monetary policy shocks, aggregate technology shocks, and idiosyncratic technology shocks. The stochastic processes $\{\varepsilon_t^R\}$,$\{a_t\}$, $\{a_{1t}, \cdots, a_{It}\}$ are independent. The monetary policy shock ε_t^R follows a Gaussian white noise process. Log of aggregate technology a_t and log of firm-specific technology $\{a_{1t}, \cdots, a_{It}\}$ follow a stationary AR(1) process with mean zero. The shock to log of aggregate technology a_t is denoted by ε_t^A, and the shock to log of firm-specific technology a_{it} is denoted by ε_{it}^I.

2.5 Notation

Throughout the article, C_t is aggregate composite consumption, and L_t is aggregate composite labor input.

$$C_t = \sum_{j=1}^{J} C_{jt}, \;\; L_t = \sum_{i=1}^{I} L_{it} \tag{12}$$

$\hat{P}_{it}$ and $\hat{W}_{jt}$ are relative terms.

$$\hat{P}_{it} = \frac{P_{it}}{P_t},\ \hat{W}_{jt} = \frac{W_{jt}}{W_t}$$

$\tilde{W}_{jt}$ denotes the real wage rate for type j labor, and $\tilde{W}_t$ denotes the real wage index.

$$\tilde{W}_{jt} = \frac{W_{jt}}{P_t},\ \tilde{W}_t = \frac{W_t}{P_t}$$

3 Rationally Inattentive Agents Model

The principle of the rational inattention model is that economic agents decide how much they allocate their attention by equating marginal benefit and the marginal cost of attention. The benefit of paying attention lies in the ability to adhere more closely to profit-maximizing or utility-maximizing behavior under perfect information. Conversely, the cost of paying attention is associated with the time and effort required to process information. To quantify the benefit of paying attention, I evaluate the utility or profit loss resulting from deviations from optimal actions under perfect information. For households, the utility loss from suboptimal consumption is interpreted as the benefit of paying attention to shocks within the rational inattention framework. Similarly, for firms, the profit loss due to suboptimal pricing represents the benefit of paying attention to shocks.

There are two key differences between the household's and firm's problems. First, firms' pricing decisions are influenced by monetary policy shocks, firm-specific shocks, and aggregate technology shocks, whereas households' consumption decisions are influenced only by aggregate technology shocks and monetary policy shocks. Second, firms determine both the labor demand for each firm and the prices of goods, while households decide their consumption bundle, wage rate, and bond holdings.

3.1 Profit Loss of an Inattentive Firm

It is necessary to identify demand for good i to derive the objective of a firm by guessing the following demand function

$$C_{it} = \vartheta \left(\frac{P_{it}}{P_t} \right)^{-\tilde{\theta}} C_t. \tag{13}$$

Here, $P_t = d(P_{1t}, \cdots, P_{It})$ represents a price index, where the function d is homogeneous of degree one, continuously differentiable, and symmetric. The coefficients ϑ and $\tilde{\theta}$ satisfy $\vartheta > 0$ and $\tilde{\theta} > 1$. Since the economy is an incomplete market economy, we must assume a general stochastic discount factor. In different states of the economy, firm owners face uncertainty regarding the valuation of their nominal profits. Consequently, it becomes necessary to account for $Q_{-1,t}$. In period -1, a decision-maker of a firm values nominal profit with the stochastic discount factor

$$Q_{-1,t} = \beta^t \Lambda(C_{1t}, \cdots, C_{Jt}) \frac{1}{P_t}. \tag{14}$$

C_{jt} represents the composite consumption of household j, Λ is a twice continuously differentiable function, and P_t is the price index used in the demand function above. I substitute the production functions (4), (5), and the demand function (13) into the profit function (6). Multiplying the resulting profit function by the stochastic discount factor (14), summing all over the periods and taking the expectation conditional on the firm's decision-maker's information in period -1, yields the objective function for the decision-maker in firm i. By taking a log-quadratic approximation to this objective function, we derive a simple expression for the expected discounted sum of profit losses resulting from rationally inattentive behavior that deviates from optimal behavior under perfect information:

$$\sum_{t=0}^{\infty} \beta^t \mathbb{E}_{i,-1} [\frac{1}{2} (x_t - x_t^*)' H (x_t - x_t^*)] \tag{15}$$

where

$$x_t = \begin{pmatrix} p_{it} \\ \hat{l}_{i1t} \\ \vdots \\ \hat{l}_{i(J-1)t} \end{pmatrix}, \quad H = -\Lambda(C_1, \cdots, C_J)\hat{P}_i\hat{C}_i \begin{pmatrix} \tilde{\theta}(1+\frac{1-\alpha}{\alpha}\tilde{\theta}) & 0 & \cdots & \cdots & 0 \\ 0 & \frac{2\alpha}{\eta^J} & \frac{\alpha}{\eta^J} & \cdots & \frac{\alpha}{\eta^J} \\ \vdots & \frac{\alpha}{\eta^J} & \ddots & \ddots & \vdots \\ \vdots & \vdots & \ddots & \ddots & \frac{\alpha}{\eta^J} \\ 0 & \frac{\alpha}{\eta^J} & \cdots & \frac{\alpha}{\eta^J} & \frac{2\alpha}{\eta^J} \end{pmatrix} \tag{16}$$

and the optimal actions under perfect information are given by

$$p^*_{it} = p_t + \frac{\frac{1-\alpha}{\alpha}}{1+\frac{1-\alpha}{\alpha}\tilde{\theta}}\left(\frac{1}{J}\sum_{j=1}^{J} c_{jt}\right) + \frac{1}{1+\frac{1-\alpha}{\alpha}\tilde{\theta}}\left(\frac{1}{J}\sum_{j=1}^{J} \tilde{w}_{jt}\right) - \frac{\frac{1}{\alpha}}{1+\frac{1-\alpha}{\alpha}\tilde{\theta}}(a_t + a_{it}) \tag{17}$$

and

$$\hat{l^*}_{ijt} = -\eta\left(\tilde{w}_{jt} - \frac{1}{J}\sum_{j=1}^{J} \tilde{w}_{jt}\right) \tag{18}$$

p^*_{it} is the log deviation from the non-stochastic steady-state price p under perfect information, and p_t denotes the log deviation from the non-stochastic steady-state price under rational inattention. In summary, lowercase letters represent log deviations from the non-stochastic steady-state variables.

Equation (17) represents the log-linear optimal price. The profit-maximizing price in period t is expressed as a log-linear function of the price level, aggregate composite consumption, real wage rate, and total factor productivity. Equation (18) indicates that the relative labor input maximizing profit in period t depends solely on the relative wage rate of type j labor. Furthermore, as indicated by equation (15), the profit loss resulting from actual actions under rational inattention is only of the second order.

3.2 Attention Problem of a Decision-maker in a Firm

We now turn to the attention allocation problem faced by a rationally inattentive firm. In period -1, a rationally inattentive decision-maker in firm i determines how much attention to allocate over the infinite horizon to pricing decisions, labor mix decisions, and the laws of motion governing these variables. His objective is to maximize the firm's expected sum of discounted profit, net of the cost of paying attention:

$$\max_{\kappa,B(L),C(L),\tilde{\eta},\chi}\{\sum^{\infty}\beta^{t}E_{i,-1}[\frac{1}{2}(x_t-x_t^*)'H(x_t-x_t^*)]-\frac{\mu}{1-\beta}\kappa\}, \tag{19}$$

subject to the law of motion for profit-maximizing actions under perfect information

$$p^*_{it}=A_1(L)\varepsilon^A_t+A_2(L)\varepsilon^R_t+A_3(L)\varepsilon^I_{it} \tag{20}$$

$$\hat{l^*}_{ijt}=-\eta\hat{w}_{jt}, \tag{21}$$

the law of motion for the actual actions under rational inattention when a decision-maker has a non-zero cost for paying attention

$$p_{it}=B_1(L)\varepsilon^A_t+C_1(L)\nu^A_{it}+B_2(L)\varepsilon^R_t+C_2\nu^R_{it}+A_3(L)\varepsilon^I_{it}+C_3(L)\nu^I_{it}, \tag{22}$$

$$\hat{l}_{ijt}=-\tilde{\eta}\hat{w}_{jt}+\chi\nu^L_{ijt}, \tag{23}$$

and the information constraint is

$$I(\{p^{*A}_{it},p^{*R}_{it},p^{*I}_{it},\hat{l}^*_{i1t},\cdots,\hat{l^*}_{i(J-1)t}\};\{p^A_{it},p^R_{it},p^I_{it},\hat{l}_{i1t},\cdots,\hat{l}_{i(J-1)t}\})\leq\kappa \tag{24}$$

$A_s(L),B_s(L),C_s(L)$ with $s=1,2,3$ are infinite-order lag polynomials. The noise terms $\nu^A_{it},\nu^R_{it},\nu^I_{it},\nu^L_{ijt}$ follow Gaussian white noise processes with unit variance. These terms are independent of the underlying fundamentals, independent of each other, and independent across firms. The first term in equation (19) represents the expected discounted sum of profit losses resulting from deviations of actual actions under rational inattention from the profit-maximizing actions under perfect information. As previously discussed, the profit loss incurred from not closely tracking the profit-maximizing law of motion reflects the additional profit that could be earned with greater attention. Thus, these losses quantify the benefit of paying attention. The second term in (19) is the cost of paying attention. The parameter $\mu \geq 0$ is the per-period marginal cost of attention for the firm's decision maker, and the variable $\kappa \geq 0$ denotes the amount of attention allocated to shocks.

The profit-maximizing actions under perfect information are given by equations (20) and (21). According to equation (20), the optimal price identified in equation (17) is a linear function of current and past shocks, i.e., monetary policy shocks, aggregate technology shocks and idiosyncratic technology shocks in equilibrium. For example, $A_1(L)$ is the response of the optimal price to an aggregate technology shock in equilibrium.

The actual price and hiring of labor under rational inattention are specified in equations (22) and (23). There are two types of deviation in the law of motion for actual price. First, the price may behave differently under rational inattention than it would under perfect information ($B_s(L) \neq A_s(L)$ for some s). Second, the decision-maker may have some noises observing structural shocks ($C_s(L) \neq 0$ for some s). If there were no cost for acquiring and processing information, the law of motion for the actual price would be identical to that for the optimal price under perfect information. It implies ($B_s(L) = A_s(L)$) and ($C_s(L) = 0$) for $s = 1,2,3$. However, due to costly attention, the decision-maker sets an actual price that deviates. Similarly, labor mix decisions may diverge from their optimal responses under perfect information, as indicated by differences in relative wage rates ($\tilde{\eta} \neq \eta$), and the presence of noise ($\chi > 0$) in hiring decisions.

Finally, The left-hand side of the information flow constraint in equation (24) measures the quantity of information incorporated into the agent's actions relative to profit-maximizing actions under perfect information. Agents should pay more attention if they want to follow the law of motion for profit-maximizing pricing and labor-mix decisions under perfect information. Furthermore, it quantifies the amount of information included in the agent's actions in relation to the underlying shocks to optimal behaviors with perfect information. This constraint, rooted in Sims (2003), quantifies the amount of information embedded in the agent's actions relative to underlying shocks. Further details can be found in Appendix C of Maćkowiak and Wiederholt (2015).

A rationally inattentive decision-maker equates the marginal benefit of paying attention to each shock with its marginal cost, μ. For a given marginal cost, the optimal amount of attention to a particular shock is independent of the amount of attention to other shocks. For example, increasing attention to ε_t^A does not affect the attention allocated to ε_{it}^I and ε_t^R; Instead, κ increases by the amount of the additional attention. As a result, p_{it}^A more closely follows the optimal p_{it}^{*A}, whereas p_{it}^R and p_{it}^I remain unaffected.

3.3 Utility Loss of an Inattentive Household

Households also allocate their limited attention rationally. We begin by deriving a simple expression for the utility loss incurred when their actions, constrained by limited attention, deviate from the utility-maximizing actions under perfect information. We guess the following demand function for type j labor

$$L_{jt} = \zeta \left(\frac{W_{jt}}{W_t} \right)^{-\tilde{\eta}} L_t \tag{25}$$

Here $W_t = h(W_{1t}, \cdots, W_{Jt})$ is a wage index, where the function h is homogeneous of degree one, continuously differentiable, and symmetric. The coefficients ζ and $\tilde{\eta}$ satisfy $\zeta > 0$ and $\tilde{\eta} > 1$. When the labor demand function (25), the budget constraint (3), and the composite consumption (2) are substituted into the period utility function (1), an equation for period utility with those three constraints is obtained. By taking the expectation conditional on the information available to household j in period -1, multiplying it by β^t, and summing over all periods, we derive the household's objective. Using a log quadratic approximation, we estimate the following expression: the household's objective at a non-stochastic steady state. A household's actual actions with limited attention may differ from its utility-maximizing actions in the absence of information-processing costs. As a result, the discounted sum of utility losses is expressed as follows. This total utility loss represents the benefit of paying attention under the rational inattention framework.

$$\sum_{t=0}^{\infty} \beta^t \mathbb{E}_{j,-1} [\frac{1}{2} (x_t - x_t^*)' H_0 (x_t - x_t^*) + (x_t - x_t^*) H_1 (x_{t+1} - x_{t+1}^*)] \tag{26}$$

where

$$x_t = \begin{pmatrix} \tilde{b}_{jt} \\ \tilde{w}_{jt} \\ \hat{c}_{1jt} \\ \vdots \\ \hat{c}_{I-1jt} \end{pmatrix}, H_0 = -C_j^{1-\gamma} \begin{pmatrix} \gamma\omega_B^2 (1 + \frac{1}{\beta}) & \gamma\omega_B \tilde{\eta}\omega_W & 0 & \cdots & 0 \\ \gamma\omega_B \tilde{\eta}\omega_W & \tilde{\eta}\omega_W (\gamma\tilde{\eta}\omega_W + 1) & 0 & \cdots & 0 \\ 0 & 0 & 0 & \cdots & 0 \\ \vdots & \vdots & \vdots & \ddots & \vdots \\ 0 & 0 & 0 & \cdots & 0 \end{pmatrix} \tag{27}$$

and

$$H_1 = C_j^{1-\gamma} \begin{pmatrix} \gamma\omega_B^2 & \gamma\omega_B\tilde{\eta}\omega_W & 0 & \cdots & 0 \\ 0 & 0 & 0 & \cdots & 0 \\ 0 & 0 & 0 & \cdots & 0 \\ \vdots & \vdots & \vdots & \ddots & \vdots \\ 0 & 0 & 0 & \cdots & 0 \end{pmatrix} \tag{28}$$

Here $\tilde{b}_{jt}$ denotes real bond holdings, $\tilde{w}_{jt}$ denotes the real wage rate, and $\hat{c}_{ijt}$ denotes relative consumption of good i of household j. After taking the log-quadratic approximation, the optimal actions under perfect information (no information processing cost) are derived as follows:

$$\omega_B \tilde{b^*}_{jt} = \frac{\omega_B}{\beta}(r_{t-1} - \pi_t + \tilde{b}^*_{jt-1}) + \omega_w \frac{\tilde{\eta}}{\tilde{\eta}-1}[(1-\tilde{\eta})\tilde{w}^*_{jt} + \tilde{\eta}\tilde{w}_t + l_t] + \omega_D \tilde{d}_t - \omega_T \tilde{t}_t - c^*_{jt}, \tag{29}$$

$$c^*_{jt} = \mathbb{E}_t[-\frac{1}{\gamma}(r_t - \pi_{t+1}) + c^*_{jt+1}], \tag{30}$$

$$\tilde{w}^*_{jt} = \gamma c^*_{jt} \tag{31}$$

and

$$\hat{c}^*_{ijt} = -\theta \hat{p}_{it}. \tag{32}$$

The expectation operator $\mathbb{E}_t$ represents conditional expectation given the complete history of the economy up to the current period t, and the ω's denote steady-state ratios, as provided in online Appendix D of Maćkowiak and Wiederholt (2015). Equations (29)-(32) are the standard log-linear optimality conditions that are general in the New Keynesian literature. The flow budget constraint (29) implies the following bond-holding deviation.

$$\omega_B(\tilde{b}_{jt} - \tilde{b}^*_{jt}) = \frac{\omega_B}{\beta}(\tilde{b}_{jt-1} - \tilde{b}^*_{jt-1}) - \tilde{\eta}\omega_W(\tilde{\omega}_{jt} - \tilde{\omega}^*_{jt}) - (c_{jt} - c^*_{jt}). \tag{33}$$

Substituting this equation for the bond deviation into equation (26) and rearranging it yields a simple expression for the expected utility loss from actual actions under rational inattention:

$$-C_j^{1-\gamma}\sum_{t=0}^{\infty}\beta^t\mathbb{E}_{j,-1}\left[\begin{array}{c}\frac{\gamma}{2}(c_{jt}-c_{jt}^*)^2+\frac{\tilde{\eta}\omega_W}{2}(\tilde{w}_{jt}-\tilde{w}_{jt}^*)\\ +\frac{1}{2}\begin{pmatrix}\hat{c}_{1jt}-\hat{c}_{1jt}^*\\ \vdots\\ \hat{c}_{I-1jt}-\hat{c}_{I-1jt}^*\end{pmatrix}'\begin{bmatrix}\frac{2}{\theta I} & \cdots & \frac{1}{\theta I}\\ \vdots & \ddots & \vdots\\ \frac{1}{\theta I} & \cdots & \frac{2}{\theta I}\end{bmatrix}\begin{pmatrix}\hat{c}_{1jt}-\hat{c}_{1jt}^*\\ \vdots\\ \hat{c}_{I-1jt}-\hat{c}_{I-1jt}^*\end{pmatrix}\end{array}\right]. \quad (34)$$

3.4 Attention Problem of a Household

Household j decides the amount of attention allocated to the intertemporal consumption decision, the wage-setting decision, and the consumption mix as well as the law of motion for composite consumption, wage rate, and consumption mix that maximize the expected discounted sum of utility net of the cost of paying attention in period -1.

$$\max_{\kappa,B(L),C(L),\tilde{\theta},\xi}\{\sum_{t=0}^{\infty}\beta^t E_{j,-1}[\frac{1}{2}(x_t-x_t^*)'H_0(x_t-x_t^*)+(x_t-x_t^*)'H_1(x_{t+1}-x_{t+1}^*)]-\frac{\lambda}{1-\beta}\kappa\} \quad (35)$$

subject to equations (27) , (28) and (33), the law of motion for utility-maximizing actions under perfect information

$$c_{jt}^*=A_1(L)\varepsilon_t^A+A_2(L)\varepsilon_t^R, \quad (36)$$

$$\tilde{w}_{jt}^*=\gamma c_{jt}^*, \quad (37)$$

$$\hat{c}_{ijt}^*=-\theta\hat{p}_{it} \quad (38)$$

the law of motion for actual actions under rational inattention

$$c_{jt} = B_1(L)\varepsilon_t^A + C_1(L)\nu_{jt}^A + B_2(L)\varepsilon_t^R + C_2\nu_{jt}^R \tag{39}$$

$$\tilde{w}_{jt} = \gamma c_{jt} \tag{40}$$

$$\hat{c}_{ijt} = -\tilde{\theta}\hat{p}_{it} + \xi\nu_{ijt}^I \tag{41}$$

$$I(\{c_{jt}^{*A}, c_{jt}^{*R}, \hat{c^*}_{1jt}, \cdots, \hat{c^*}_{I-1jt}\}; \{c_{jt}^A, c_{jt}^R, \hat{c}_{1jt}, \cdots, \hat{c}_{I-1jt}\}) \leq \kappa \tag{42}$$

$A_s(L), B_s(L)$ and $C_s(L)$ with $s = 1,2$ are infinite-order lag polynomials. The noise terms $\nu_{jt}^A, \nu_{jt}^R, \nu_{ijt}^I$ follow Gaussian white noise processes with unit variance. These noise terms are independent of the underlying fundamentals, independent of each other, and independent across households. Similar to a firm's decision-maker, a household equates the marginal benefit of paying attention with its marginal cost. The benefit of paying attention lies in the household's ability to track the law of motion for optimal actions under perfect information. For instance, if a household pays closer attention to a monetary policy shock, ε_t^R,its consumption response to that shock c_{jt}^R tracks more closely optimal response c_{jt}^{R*}. The first term in the objective function (35) is the expected utility loss of deviating from the law of motion for the utility-maximizing actions under perfect information. The per-period cost of paying attention is $\lambda \geq 0$, and the variable $\kappa \geq 0$ denotes the amount of attention allocated to intertemporal consumption decisions, wage-setting decisions, and consumption mix.

Unlike the attention problem faced by a firm's decision-maker, a household must also address deviations in bond holdings (33), wage-setting equations (37) and (40) additionally. First of all, equation (33) implies that the current bond holding deviation is a linear combination of past bond-holding deviations, current real wage deviations, and current consumption deviations.

Second, a household makes consumption and wage-setting decisions. A household sets the real wage rate according to equation (37) under perfect information. However, with limited attention, a household determines the actual real wage rate using equation (40). This reflects a fundamental result: a household always equates the real wage rate to the marginal rate of substitution between consumption and leisure.

This intratemporal optimality is expressed in equation (40) as log-deviations from a non-stochastic steady-state. Furthermore, because the household decides on the real wage rate and consumption, the household can satisfy the intratemporal optimality condition regardless of the nature of information flows available to the household[1]. Hence, a solution to the household's attention problem has to satisfy equation (40).

3.5 Equilibrium definition

An equilibrium with rational expectations is characterized as follows: firms solve equations (19)-(24), households solve equations (35)-(42), and aggregate variables are obtained by averaging individual actions. The nominal interest rate is determined according to the Taylor rule (7). Firms and households perceive the deviated actual laws of motion under rational inattention as identical to the perceived laws of motion for p^*_{it}, $\hat{l}^*_{ijt}$, c^*_{jt},and $\hat{c}^*_{ijt}$. In my DSGE model, inattentive households and firms recognize that the actual laws of motion, which account for attention costs, align with the optimal laws of motion for profit-maximizing or utility-maximizing behavior. Thus, agents have rational expectations.

4 How to solve the model and calibration

4.1 How to solve the model

I derive the aggregate dynamics through an iterative procedure. First, I make an initial guess about the law of motion for the optimal actions under perfect information p^*_{it} and c^*_{jt}. Second, I solve the attention problem for firms and households separately. This step converts infinite-order lag polynomial terms into finite-order lag polynomial terms. As a result, each infinite-order lag polynomials $B_s(L)$ and $C_s(L)$ becomes a finite-order ARMA process. Following that, a standard non-linear optimization method is used to solve the attention problem. Third, I compute aggregate variables by averaging individual variables:

[1]Since composite consumption and the real wage rate contain the same information, it does not matter whether one uses the composite consumption behavior or the wage setting behavior in equation (42) to quantify the information flow to the household.

$p_t = \frac{1}{I}\sum_{i=1}^{I} p_{it}$, $c_t = \frac{1}{J}\sum_{j=1}^{J} c_{jt}$, and the real wage rate $\tilde{w}_t = \frac{1}{J}\sum_{j=1}^{J} \tilde{w}_{jt}$. Fourth, I compute the law of motion for the nominal interest rate and set $y_t = c_t$, since there is no government expenditure or investment in the economy. Finally, I derive the laws of motion for profit-maximizing price and utility-maximizing consumption under perfect information by following equations (17) and (30). If the derived law of motion for the optimal actions differs from the initial guess, I update the guesses and repeat the process until a fixed point is obtained[2].

4.2 Calibration

Maćkowiak and Wiederholt (2015) first divide the parameters into two groups. The first group of parameters is rational inattention-related parameters. Therefore, the marginal cost of paying attention for the decision-maker in a firm μ and the marginal cost of paying attention for a household λ are included in the rational inattention-related parameter group. The other parameters are non-rational inattention parameters. They start by calibrating the non-rational-inattention parameters. Thereafter, they solve the model for a grid of values of μ and λ. The values of μ and λ are set in such a way as to minimize the gap between the impulse response to a monetary policy shock in the model and the impulse response to the same shock in the VAR of Altig et al. (2011).

I accept the values of λ, μ, and other non-rational-inattention parameters found in Maćkowiak and Wiederholt (2015), except for the persistence of aggregate productivity, the volatility of aggregate productivity shocks, and the volatility of monetary policy shocks. whether there are distinct rational inattentive responses during the pre-Great Moderation compared to the Great Moderation.The defining feature of the Great Moderation relative to the pre-Great Moderation is the significant decline in macroeconomic volatility. In this context, I calibrate parameter values to reflect differences in shock volatility, assuming other parameters remain stable across the periods. Additionally, the volatility of idiosyncratic technology shocks is assumed to remain constant across both periods. To calibrate the parameters for the stochastic processes of firm-specific productivity, Maćkowiak and Wiederholt (2015) follow a common strategy in the menu cost literature. They determine the standard deviation of firm-specific shocks such that the absolute magnitude of price changes in the model aligns with the observed absolute magnitude of price changes in microdata. First, I assume the autocorrelation of idiosyncratic firm-specific productivity

[2] See online Appendix E of Maćkowiak and Wiederholt (2015) for more details.

	pre-GM	GM
β	0.99	
μ[a]	0.0006	
λ[b]	0.0006	
γ	1	
ϕ_π	1.5	
ϕ_y	0.125	
$\tilde{\theta}$	4	
$\tilde{\eta}$	4	
α	2/3	
ρ_I	0.3	
$sd(\varepsilon_{it}^I)$	0.231	
ρ_A	0.97	0.96
$sd(\varepsilon_t^A)$	0.0094	0.0055
$sd(\varepsilon_t^R)$	0.0018	0.0015

[a] marginal cost of information flow to firms as the fraction of revenue in non-stochastic steady state

[b] marginal cost of information flow to households as the fraction of consumption in non-stochastic steady state

Table 1: The Value of Parameters

processes is 0.3, following Klenow and Willis (2007) and Nakamura and Steinsson (2008). Klenow and Kryvtsov (2008) find that the median absolute size of price changes equals 9.7% from 1988 to 2004. Consequently, the standard deviation of the firm-specific productivity shock, ε^I_{it}, is calibrated to 0.231 to match this observed absolute price change magnitude in the model. According to Nakamura et al. (2018), earlier studies focused solely on the Great Moderation period when inflation was low and stable. They overcome this obstacle by extending the microdata set on US consumer prices back to 1977. Their findings show no evidence that the absolute magnitude of price movements increased between 1977 and 1987, prior to the Great Moderation. They conclude that despite lower inflation during the Great Moderation, the average absolute magnitude of price changes from 1978 to 1987 was nearly comparable to that from 1988 to 2014. Based on these findings, I set the standard deviation of idiosyncratic productivity shocks, $\varepsilon^I_{it} = 0.231$ for both periods.

The monetary policy shock $\varepsilon^R_t = r_t - \rho r_{t-1} - (1-\rho)[\phi_\pi \pi_t + \phi_y(y_t - y^p_t)]$ is specified by equation (7). I use quarterly data on federal funds rate, the difference of the log of the GDP deflator, and the difference between the log of real GDP and the log of real potential GDP as measures of nominal interest rate, inflation, and the output gap, respectively. The standard deviation of the monetary policy shock, ε^R_t, is 0.0018 for the pre-Great Moderation period, and 0.0015 for the Great Moderation period.

For the stochastic process of aggregate technology, I use total factor productivity (TFP) data from Fernald (2014) , following Nakamura and Steinsson (2008). I first regress the log of TFP on a constant and a time trend and then regress again the residual on its own lag. The persistence of aggregate technology, ρ_A, ia 0.97 for the pre-Great Moderation period, and 0.96 for the Great Moderation period. The standard deviation of the aggregate technology shock, ε^A_t, is 0.0094 for the pre-Great Moderation period and 0.0055 for the Great-Moderation period.

The datasets are divided into two groups for parameter calibration: the pre-Great Moderation period (1960Q1–1983Q4) and the Great Moderation period (1984Q1–2007Q2). Data on the federal funds rate, GDP deflator, real GDP, and real potential GDP are obtained from the Congressional Budget Office. I set $\beta = 0.99$, assuming that one period in the model corresponds to one quarter. In line with standard practice in business cycle models, the inverse of the intertemporal elasticity of substitution, γ , is set to 1, and the elasticity of output with respect to composite labor input, α, is set to 2/3. Following Clarida et al. (1999), I set $\rho = 0.85$, and following Taylor (1993), I set $\phi_\pi = 1.5$ and $\phi_y = 0.125$.

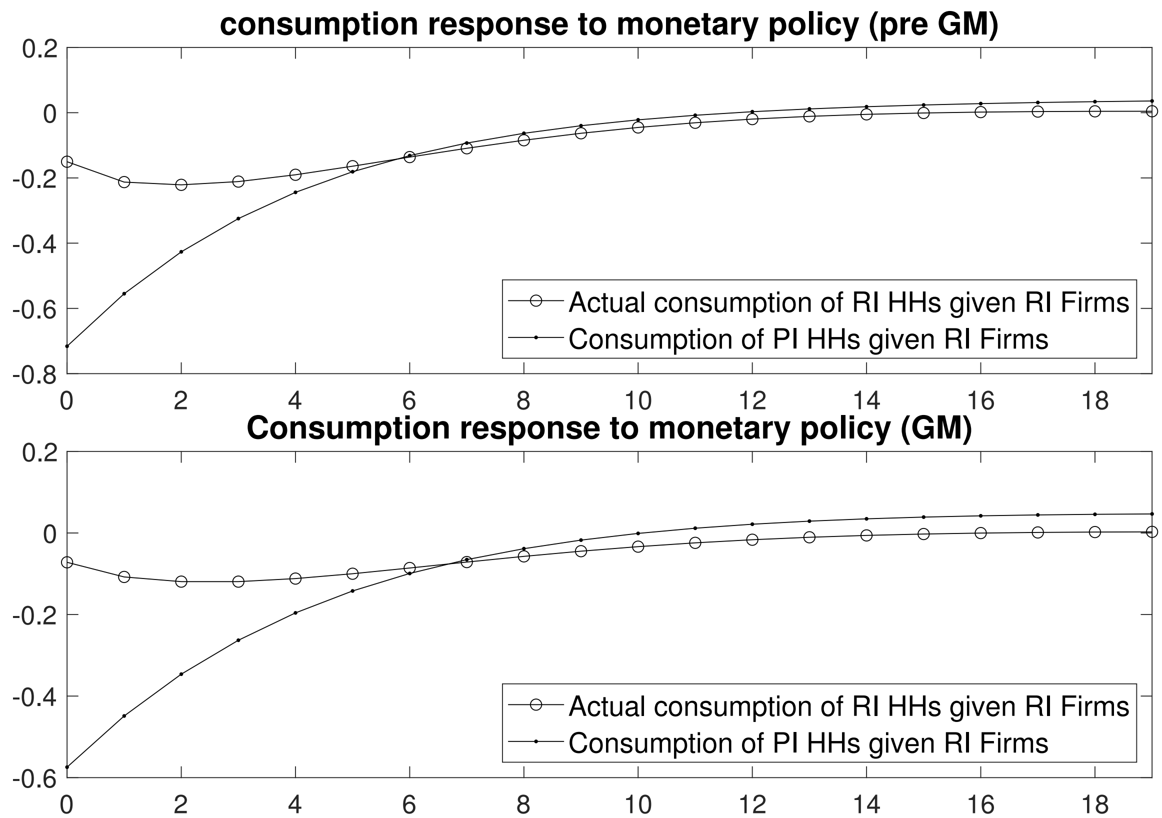
The preference parameter θ and the technology parameter η are determined to match a price elasticity of demand, $\tilde{\theta} = 4$, and a wage elasticity of labor demand, $\tilde{\eta} = 4$. Using the approach of Maćkowiak and Wiederholt (2015), I first set $\tilde{\theta} = \tilde{\eta} = 4$ and then compute the values of θ and η that satisfy these conditions. A price elasticity of demand of 4 lies within the range of estimates from Nakamura and Steinsson (2008; 2010). In the model, $I = J = 100$, representing 100 households and 100 firms. The ratio of wage income to consumption expenditure in the non-stochastic steady state, ω_W, is equivalent to 1.06, while $\omega_B, \omega_T, \omega_D$ do not influence the variables of interest. Parameters ω_B, ω_T and ω_D do not affect the solution to the household's attention problem. Holding the non-rational inattention parameters constant, the values of attention parameter λ and μ are set as $\lambda = 0.0006 * C_j^{1-\gamma}$ and $\mu = 0.0006 * \Lambda(C_1, \cdots, C_J)\hat{P}_i C_i$. These values are consistent with the settings in Maćkowiak and Wiederholt (2015).

5 Comparison of Impulse Responses Between in the Pre-Great Moderation and in the Great Moderation

5.1 Understanding Households' Behavior

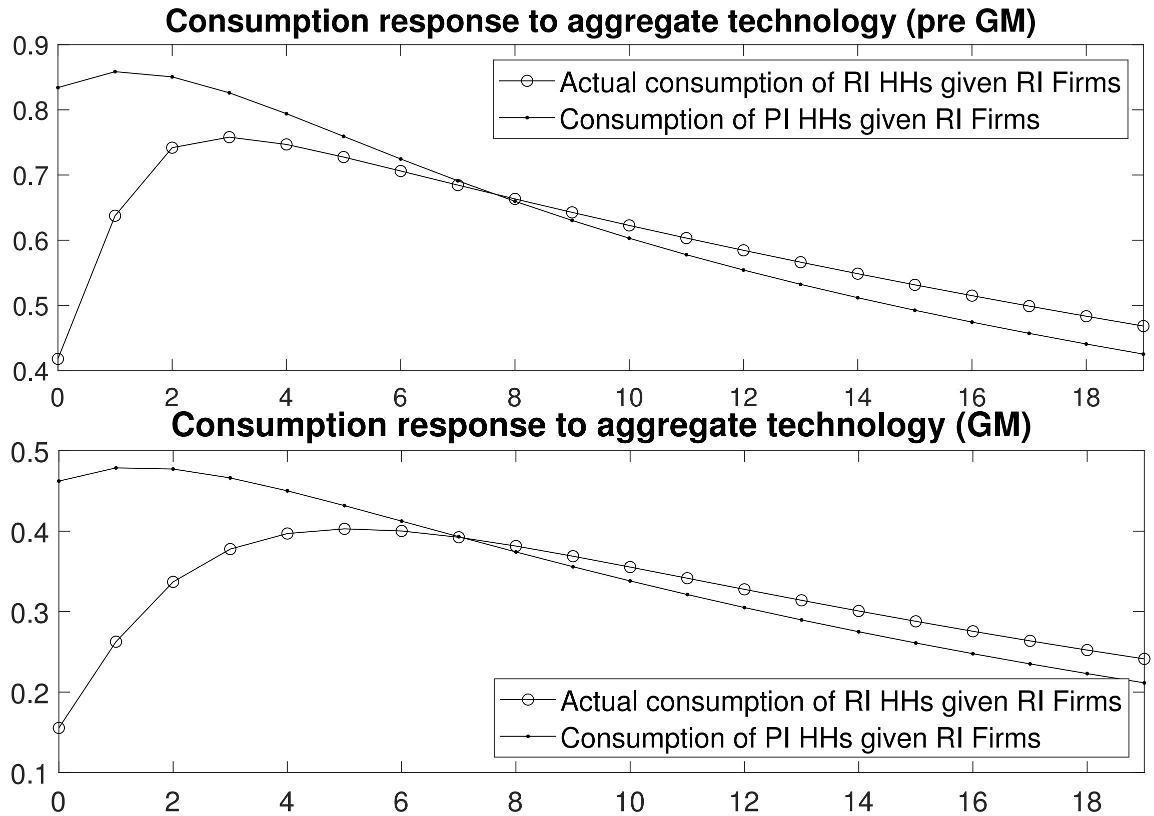
Figure 1 documents the consumption response to a monetary policy shock. In the pre-Great Moderation period, households reduce consumption by 0.15%, while the utility-maximizing consumption under perfect information (henceforth, optimal consumption under PI) would decrease by 0.72%. This results in a deviation of 0.57% from the optimal consumption path when a contractionary monetary policy shock occurs in period zero. Households overconsume until the sixth quarter, incurring a utility loss. After the sixth quarter, households gradually adjust their consumption to restore the budget constraint while minimizing utility loss. This consumption pattern results in a utility loss equivalent to $0.0002 \times \gamma$ of steady-state consumption. Given the minimal magnitude of this utility loss, households tolerate the deviation from the optimal consumption path. This model aligns well with empirical findings. Empirically, output exhibits a hump-shaped response following a monetary policy shock, a feature that the model replicates. Rationally inattentive households with costly attention adjust their consumption gradually, supporting the empirical observation. When firms also have costly attention, prices evolve slowly after the shock; because of this, consumption is also affected by the monetary policy shock.

In the Great Moderation period, households initially respond to a contractionary monetary policy shock by overconsuming for the first seven quarters. The deviation from op-



An impulse response equal to 1 means a 1% deviation from the non-stochastic steady state.

Figure 1: Impulse responses of consumption to a monetary policy shock



An impulse response equal to 1 means a 1% deviation from the non-stochastic steady state.

Figure 2: Impulse Responses of consumption to an aggregate technology shock

timal consumption due to the shock is 0.5%. Households adjust their consumption to an optimal level by approximately the seventh quarter, one quarter later than in the pre-Great Moderation period. The utility loss per period from this deviation is $0.00003 \times \gamma$ of steady-state consumption. Across both periods, the utility loss from consumption deviation is negligible. This suggests that households consistently respond to contractionary monetary policy shocks by overconsuming in the early stages, irrespective of the volatility of the shock.

Figure 2 presents the case of a positive aggregate technology shock in the economy. Rationally inattentive households consume less than the optimal consumption under PI in both periods. In the pre-Great Moderation period, households consume more by 0.42%

on impact, deviating from the optimal level of 0.83%. This results in a consumption deviation of 0.41% in period zero, which is gradually adjusted over time. By the seventh quarter, the deviated consumption converges to the optimal consumption under PI. The utility loss from this deviation is $0.0002 \times \gamma$ of steady-state consumption.

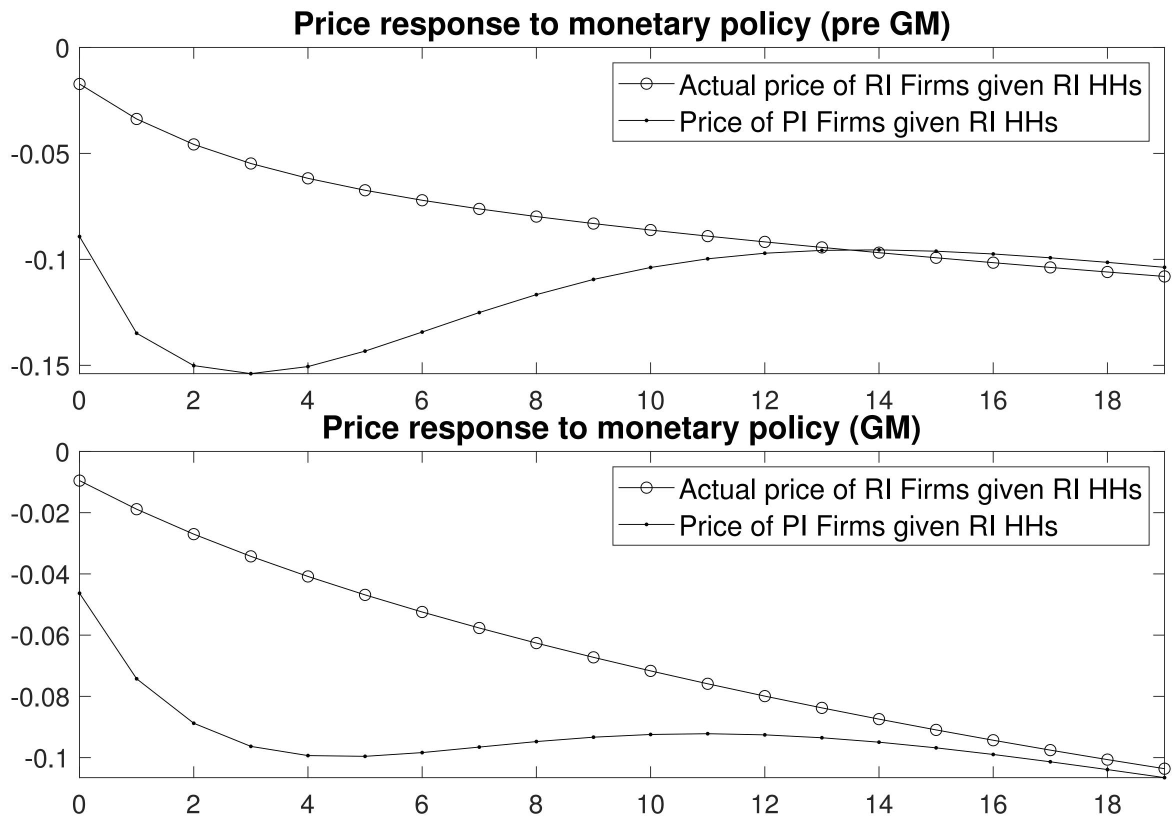
In the Great Moderation period,households with limited attention increase consumption by 0.16%, compared to an optimal PI increase of 0.46%. The deviation of 0.3% in period zero similarly diminishes over time, with actual consumption converging to the PI optimal level by the seventh quarter. The utility loss in the Great Moderation period is $0.00009 \times \gamma$ of steady state consumption. In both periods, the expected utility loss is negligible, making it optimal for households to allocate only limited attention to aggregate technology shocks. Regardless of the period, households with limited attention consume less than the optimal PI consumption in response to a positive technology shock.

The utility loss that inattentive households tolerate per period remains trivial, regardless of the type or volatility of the shock. Consequently, households consistently choose to deviate from optimal PI consumption rather than closely track and respond to shocks, irrespective of the size or nature of aggregate volatility.

5.2 Understanding Firms' Behavior

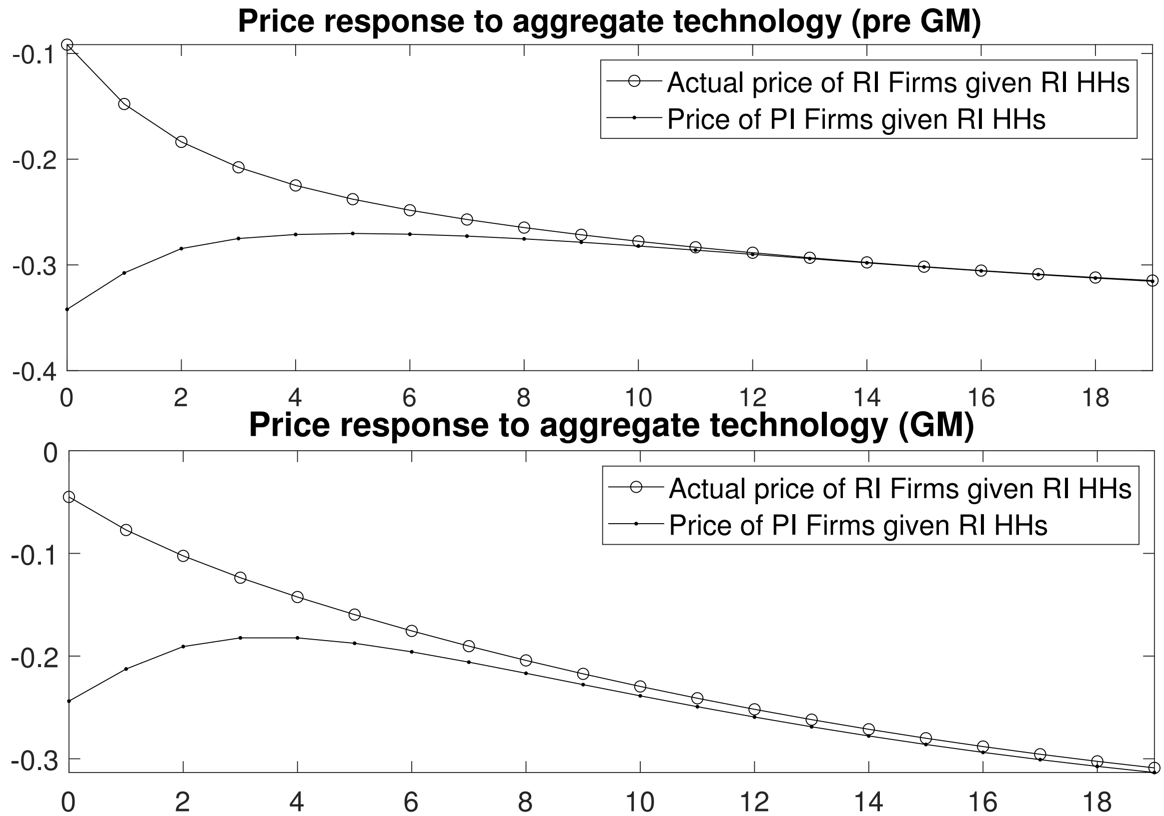
Now we turn to price-setting firms' responses to aggregate shocks. Figure 3 displays the impulse responses of price to a contractionary monetary policy shock. In the pre-Great Moderation period, the price adjusts around the fourteenth quarter after impact. A rationally inattentive decision-maker in a firm decides to lower the price of his product by 0.017%, responding to a contractionary monetary policy shock. The magnitude of the decrease is relatively smaller than the reduction in profit maximizing price - by 0.089% - under perfect information. As a result, the firm makes the expected loss per period (0.00006) of a firm's steady-state revenue due to imperfect tracking of aggregate technology.

In the Great Moderation period, the actual price set by a rationally inattentive firm converges to the profit-maximizing price under perfect information around the nineteenth quarter. This is because a decision-maker in a firm pays less attention in the Great Moderation period when the volatility of a technology shock significantly declines. The expected loss per period by deviating from the optimal course under PI is (0.00017) of a firm's steady-state revenue. The decision-maker reasonably pays little attention in both periods since the expected loss per period is insignificant enough. The endogenous attention allocation



An impulse response equal to 1 means a 1% deviation from the non-stochastic steady state.

Figure 3: Impulse responses of prices to a monetary policy shock

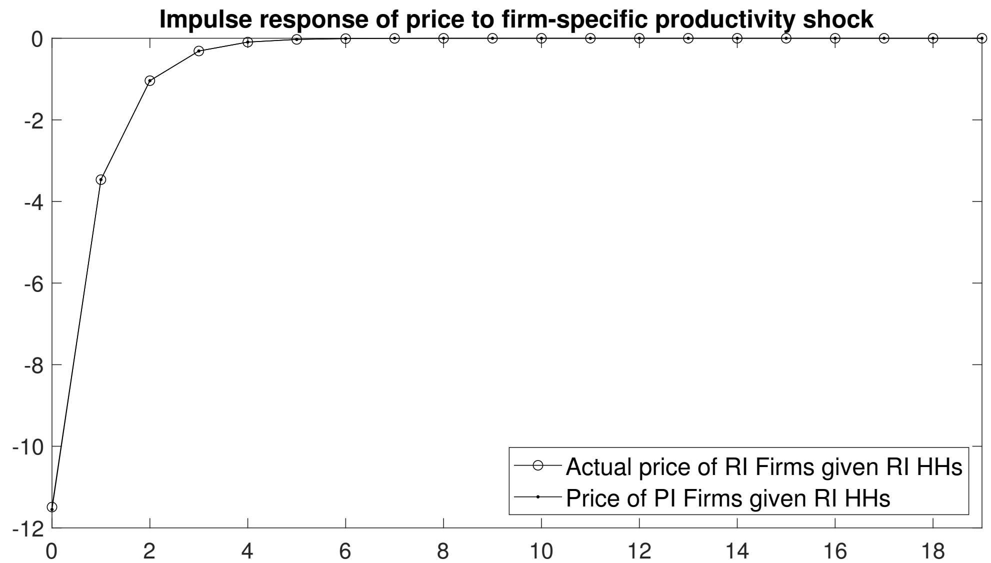


An impulse response equal to 1 means a 1% deviation from the non-stochastic steady state.

Figure 4: Impulse responses of prices to an aggregate technology shock

also implies that a monetary policy shock has a real effect while the profit loss is small. Firms respond slowly but surely to monetary policy.

Figure 4 shows that a decision-maker in a firm with limited attention consistently decides to cut the price down in response to a positive aggregate technology shock, with a relatively less than optimal price under PI in both periods. The expected loss per period is (0.00013) of a firm's steady-state revenue in both periods. Firms pay more attention to aggregate technology shocks than to monetary policy shocks. The actual price under rational inattention converges to the optimal price more quickly in the case of monetary policy shocks. Firms attend to more variable technology shocks closely. This supports the finding that the empirical impulse response of the price level responds much faster to



An impulse response equal to 1 means a 1% deviation from the non-stochastic steady state.

Figure 5: Impulse responses of prices to a firm-specific technology shock

aggregate technology shocks than to monetary policy shocks.

However, as you see, it still takes some time for the deviated price to monitor and keep up with the optimal price. It is because decision-makers still devote most of their attention to idiosyncratic technology. Figure 5 shows that the actual response of price to a firm-specific shock is almost identical to the optimal response of price under PI. That is, he tracks the optimal price under PI caused by an idiosyncratic shock very closely because the firm-specific shock is the most volatile and important[3]. This aligns well with findings of Mackowiak and Wiederholt (2009). They point out that firms decide to pay more attention to idiosyncratic variables when idiosyncratic conditions are more volatile and important than aggregate conditions.

[3]The value of the amount of attention, κ,to the firm-specific shock is ten times greater than that to aggregate technology shock.

	Quantified Attention	pre-GM	GM	Δ%
Firm	Aggregate technology shock	0.2366	0.1842	-22.1
	Monetary policy shock	0.0946	0.0841	-11.1
Household	Aggregate technology shock	0.4713	0.2669	-43.4
	Monetary policy shock	0.1655	0.0903	-45.4

Table 2: Amount of allocated attention to each aggregate shock

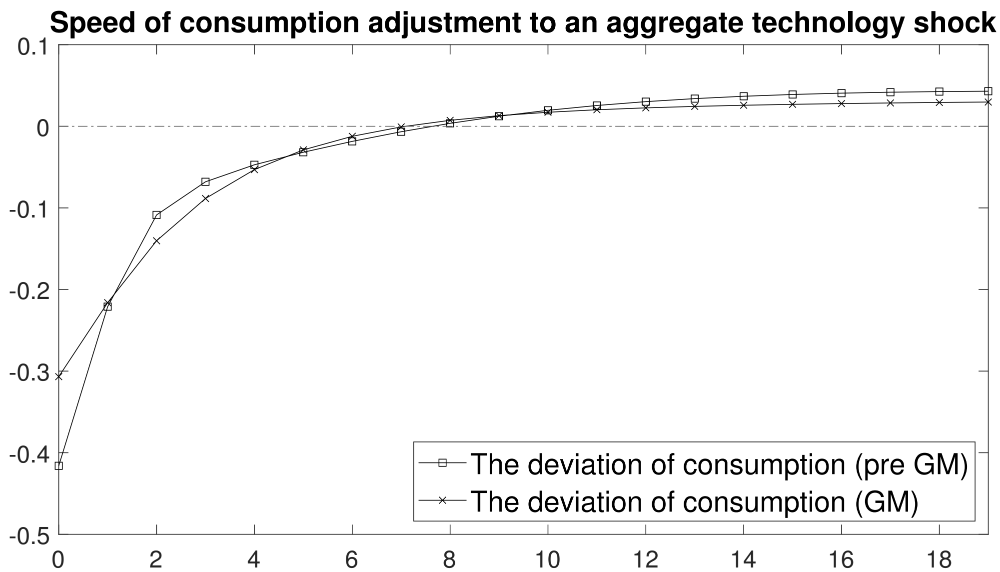
5.3 Allocations of Attention

Table 2 shows the amount of attention across the two periods. The amount of allocated attention is decided following an information flow constraint. For instance, a firm's decision-maker's attention is quantified as the reduction in uncertainty about the optimal price. Specifically, it is measured by the difference between the prior uncertainty regarding the optimal price and the posterior uncertainty after observing the actual price response to shocks. This reduction in uncertainty is interpreted as the per-period amount of information acquired by the decision-maker. In the model's information flow constraint, the information about economic conditions is limited to not exceed the allocated attention κ. Therefore, the amount of information is processed is equated to the amount of attention allocated[4].

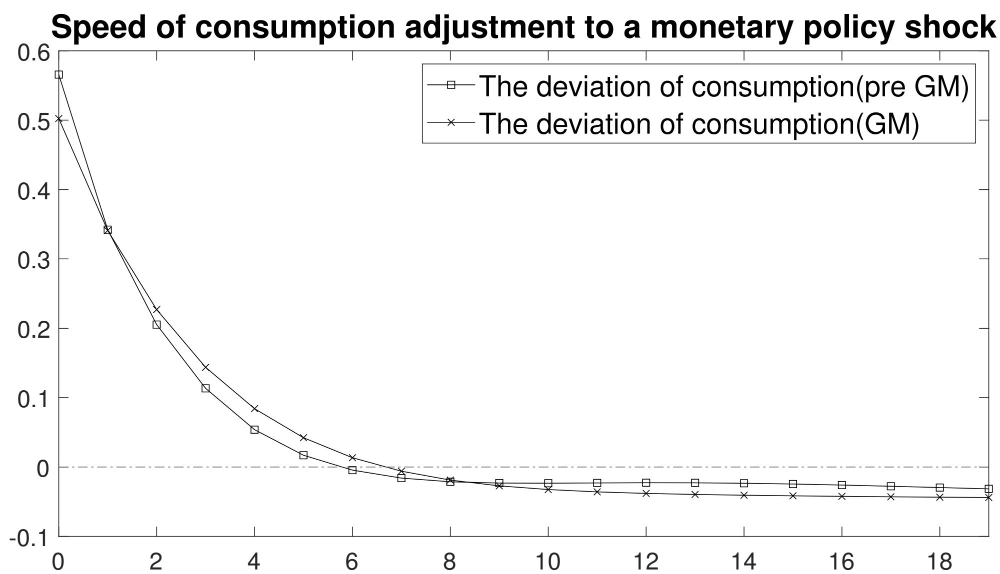
Both firms and households cut their attention during the Great Moderation period due to the decline in shock volatility. Households, in particular, cut their attention to both types of shocks by over 40%. In contrast, the reduction in firms' attention is relatively smaller. This difference arises because firm decision-makers primarily focus on idiosyncratic shocks, which are less affected by changes in aggregate volatility. Even in the pre-Great Moderation period, firms allocate less attention to aggregate shocks. As a result, the magnitude of the attention reduction for firms is not as pronounced as it is for households.

Figure 6 illustrates that households adjust their consumption more rapidly during the pre-Great Moderation period. The deviation in consumption is defined as the difference between actual consumption under rational inattention and optimal consumption under perfect information. This result can be attributed to differences in the amount of atten-

[4]Find more details in the online Appendix C of Maćkowiak and Wiederholt (2015)



(a) The Adjustment of Consumption to an Aggregate Technology shock



(b) The Adjustment of Consumption to a Monetary Policy shock

Figure 6: The Speed of Consumption Adjustment

tion allocated. Households pay more attention to the volatility of each shock in the pre-Great Moderation period than in the Great-Moderation period. For aggregate technology shocks, the actual consumption response converges to the optimal level under perfect information at the same time in both periods, with the adjustment finalized by the seventh quarter after impact. However, the size of the initial deviation is larger in the pre-Great Moderation period, resulting in a faster adjustment speed during this period.

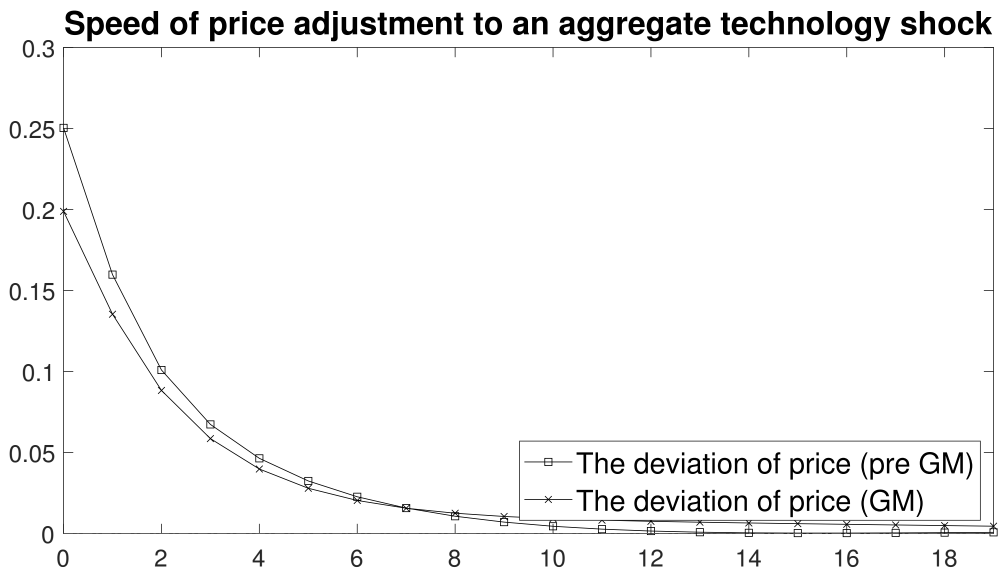
In the case of monetary policy shocks, consumption adjusts one quarter faster in the pre-Great Moderation period compared to the Great Moderation period. Additionally, the size of the initial deviation is larger in the pre-Great Moderation period. These findings confirm that households allocate more attention to shocks when volatility is higher, which in turn leads to faster behavioral adjustments.

Figure 7 displays the differing speeds of price adjustment across the two periods. The price deviation is defined as the difference between the actual price set by firms and the optimal price under perfect information. Firms correct the deviated price more quickly in response to each aggregate shock during the pre-Great Moderation period. This pattern is analogous to the adjustment of households' actual consumption.

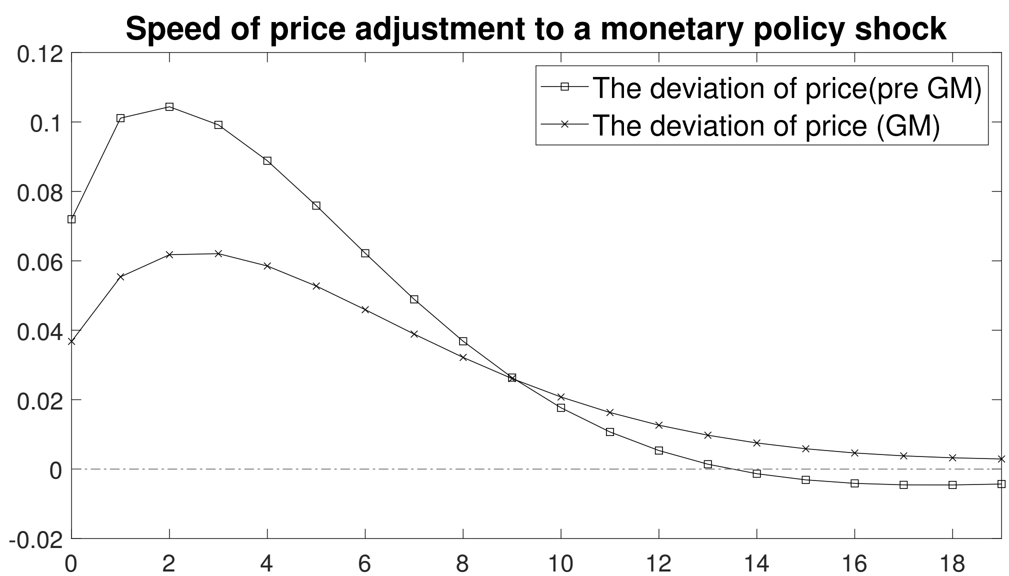
6 Forecast Error Variance Decomposition

Figure 8 shows the contribution of each shock to the forecast error variance of consumption. It is evident that the contribution of each structural shock decreases during the Great Moderation period. This is a natural consequence of the reduced volatility of aggregate shocks during this time. Instead, noise in observing structural shocks plays a larger role in explaining the variation in consumption during the Great Moderation. This aligns with the observation that households allocate less attention to shocks as they become less volatile. As a result, noise in observing fundamental shocks accounts for a larger share of consumption variation because households are less attentive to these shocks compared to the pre-Great Moderation period. Among the structural shocks, aggregate technology shocks contribute more to consumption variation than other shocks.

Figure 9 highlights that idiosyncratic shocks dominate other aggregate shocks in explaining the variation in prices. Interestingly, monetary policy shocks do not consistently



(a) The Adjustment of Price to an Aggregate Technology shock



(b) The Adjustment of Price to a Monetary Policy shock

Figure 7: The Speed of Price Adjustment

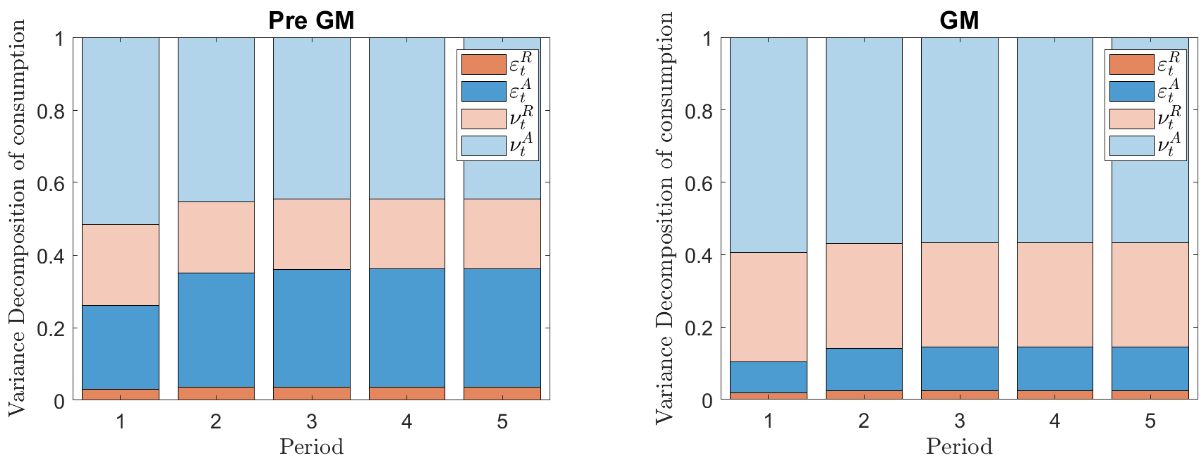


Figure 8: Forecast Error Variance Decomposition of Consumption

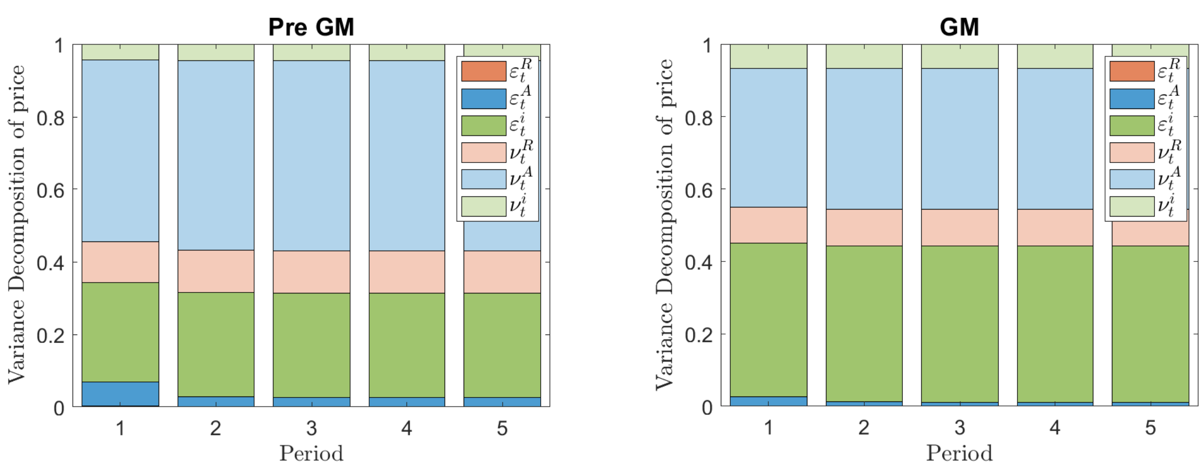


Figure 9: Forecast Error Variance Decomposition of Price

contribute to price variation, while firm-specific technology shocks explain a significant portion. This finding supports the conclusion of Paciello (2012) that the higher volatility of aggregate technology shocks compared to monetary policy shocks leads firms to allocate more attention to aggregate technology shocks. However, with the reduced volatility of aggregate technology shocks during the Great Moderation, their contribution to price variation diminishes significantly. Instead, the relative contribution of firm-specific shocks to price variation increases considerably.

7 Concluding remarks

Maćkowiak and Wiederholt (2015) demonstrate that rational inattention is another source of slow adjustment in macroeconomic variables. Their analysis focuses primarily on the Great Moderation period, spanning from the early 1980s to 2008. In this study, I assess whether their model is applicable to the pre-Great Moderation period, characterized by substantially higher volatility in macroeconomic variables. The model successfully matches empirical impulse responses to monetary policy shocks and aggregate technology shocks in both periods. Regardless of the level of volatility, the DSGE model with rational inattention consistently supports the observation of slow adjustment in real and nominal macroeconomic variables.

Furthermore, my findings reaffirm conclusions from existing literature: both firms and households allocate less attention to monetary policy shocks compared to aggregate technology shocks, irrespective of the period. This disparity arises because monetary policy shocks consistently exhibit lower variability than aggregate technology shocks. Notably, firm decision-makers allocate the majority of their attention to idiosyncratic technology shocks, which have the highest standard deviations.

The speed of behavioral adjustment is also slightly faster in the pre-Great Moderation period, as firms and households allocate more attention during this time. For households, increased attention to macroeconomic shocks means they monitor optimal consumption under perfect information more closely, leading to a faster reduction in deviations from optimal consumption. Similarly, firms take macroeconomic shocks more seriously in the pre-Great Moderation period. As a result, the actual prices set by firms converge more quickly to the optimal prices during this time.

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