Heterogeneous Attention to Inflation and Monetary Policy*

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Abstract

We study how heterogeneous attention to inflation affects the aggregate economy. Using household-level surveys for the US and Australia we first show that households' attention to inflation varies with the income level. We find that high-income households pay more attention to inflation compared to other income groups. To quantify the effects for the aggregate economy, we build a Heterogeneous-Agent New Keynesian model with endogenous income inequality arising through an endogenous occupational choice where the level of attention varies along the income distribution. compared to fully rational inflation expectations, we find that monetary policy faces a better inflation-output trade-off when expectations are stable due to larger perceived fall in labor income of low-income households incentivizing an increase in their labor supply after a monetary policy tightening. The better trade-off however is achieved amid a larger decrease in welfare among low-earners.

Keywords: Inattention, HANK, Monetary Policy, Inflation Expectations
JEL Codes: D84, D91, E21, E71, E52

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1. Introduction

How much attention do households pay towards inflation? And does the level of attention vary with their income level? . In particular, income and wealth inequality as well as heterogeneous exposure to shocks play a central role for the aggregate economy in the transmission of monetary policy (Auclert, 2019). Additionally, having limited information about the state of the economy substantially changes monetary policy transmission in the aggregate economy (Gabaix, 2020) reinforcing the importance of quantifying how micro-level evidence about households' attention and consumption-saving choices affect macro dynamics.

We address these questions by showing that high-income households pay more attention to inflation than low-income households. First, we provide new empirical evidence on cross-sectional inflation expectations. In particular, we run regressions of forecast errors of one-year-ahead inflation expectations on monetary policy and oil supply news shocks across income groups akin to the regressions in Kučinskas and Peters (2022) applying it to the Survey of Consumer Expectations from the New York Fed (SCE) for the US and the Consumer Attitudes, Sentiments and Expectations in Australia Survey (CASiE) for Australia. We use the set of monetary policy shocks of Nakamura and Steinsson (2018) and Bauer and Swanson (2023) for the US and Beckers et al. (2020) and Hambur and Haque (2023) for Australia. To capture supply side effects in our model we use the oil supply news shocks constructed by Känzig (2021). We find no significant heterogeneity in inflation forecast errors to both types of shocks between high- and low-income groups. However, we find heterogeneity in the forecast errors about aggregate inflation indicating that households with different income levels form different subjective beliefs about inflation and eventually pay heterogeneous amounts of attention to it. To estimate these levels of attention, we extend the framework by Pfäuti (2021) by controlling for household income in the empirical specification. We estimate attention to inflation for both countries from the data as the income-group-specific weight placed on the current-state estimate of inflation relative to the previous household's subjective inflation forecasts following a shock to inflation. We find that high-income households pay significantly higher attention to inflation than low-income households. This pattern emerges robustly across countries and a variety of regression specifications we consider.

To match and quantify the effects of our empirical results about heterogeneous attention on the aggregate economy, we propose a Heterogeneous-Agent New Keynesian (HANK) model with three dimensions of heterogeneity. First, as standard in the HANK literature, all households in the economy are subject to uninsurable, transitory, idiosyncratic income risk which they can self-insure against through their asset of liquid savings. Second, households differ in their permanent income level. We model the permanent income component as a function of endogenous occupation choice with occupation-specific labor income following Faia et al. (2022). Depending on their skills each household chooses an occupation and receives some occupation-specific labor income. We collect households into two groups: households with high occupational skills get a high level of labor income while low-skill households receive lower labor income[1]. Thus, household's income is now a function of idiosyncratic risk and occupational choice. Third, to account for the empirically found inattention, we draw on Gabaix (2014) and assume that households are inattentive to parts of the economy and face a constraint on how much information they can process. Specifically, households have a "sparse" representation of the world meaning that they only observe variables which are of first order importance to their decision-making. We assume, that they are inattentive to the aggregate price level and inflation, while being fully attentive to the rest of the state of the economy. Households then have to decide once and for all how much attention they want to allocate towards prices and inflation which ultimately affects their subjective inflation expectations. This misperception of prices leads to a suboptimal consumption choice and households experience a loss in utility. Moreover, attention depends on the income-level.

We calibrate the model to our evidence on attention and the standard targets for the rest of the model found in the literature. We consider the response of aggregate output to mainly monetary policy shocks, although we provide additional results for markup and TFP shocks. Our model results, obtained through the sequence-space Jacobian method by Auclert et al. (2021), show that after a contractionary monetary policy shock, the economy experiences a lower drop in aggregate demand under inattention due to a larger perceived fall in real labor income of the low income households, in spite of a subdued intertemporal substitution effect. The intuition is that households fully observe the state of the economy but they do not fully anticipate the drop in inflation, such that they perceive the fall in real wages as larger than it actually is and cut consumption by more than they would have under full information rational expectations. Additionally households now experience an increase in their marginal propensity to consume such that they are incentivized to increase their labor supply to compensate for their subjectively experienced drop in income and consumption. Due to capital labor complementarity firms increase their labor and capital demand. This leads to an increase in the aggregate output making the recession after a monetary policy shock less severe than in a standard fully attentive economy. This effect dominates the intertemporal substitution effect that stimulates consumption making labor supply the main channel of attention propagation in the economy. This result however is mainly driven by the increasing labor supply of low income households such that the cost of a better inflation-output trade-off is a much larger drop in their welfare due to their sizable disutility from more labor supply. Welfare in our model is evaluated across the different economies and income types by calculating the implied consumption equivalent variation as the change in the permanent consumption of a household needed to make him just as well off as the monetary policy (or any other) shock does. We find that

1 The model can be extended to more than 2 groups, however the main results from a model with two groups still hold through.

idiosyncratic risk amplifies the difference in welfare costs between low- and high-income earners in response to monetary policy shocks. Counterfactual analysis of our model with wage rigidity provides additional evidence that the main channel of inattention is through the perceived drop in real wages.

We add to the literature in multiple ways. First, we provide new empirical cross-country evidence on household-level inattention to prices and their effects on inflation expectations in both US and Australian data. Cross-sectional variations in inflation expectations have been studied before. Early contributions include Malmendier and Nagel (2016) and Ehrmann and Tzamourani (2012) who show that cohorts build their inflation expectations depending on their lifetime inflation experiences, a fact complemented by recent contributions from Coibion et al. (2020), Weber et al. (2023) and Pfäuti (2021) who observe that households' inattention varies with economic conditions. Link et al. (2023) find that attention to macroeconomic variables is strongly persistent at the individual level, specifically, more attentive households are more likely to adjust inflation expectations during a shock to inflation as the cost of acquiring new information is lower for an attentive household than for an inattentive household which translates to an adjustment of expectations - a finding consistent with theories of inattention (Sims, 2003; Gabaix, 2014). In a recent paper by D'Acunto et al. (2023) the authors document a systematic relation between cognitive abilities and the formation of inflation expectations, in particular agents with high cognitive abilities have lower forecast errors for inflation compared to other groups of agents with lower levels of cognitive abilities. We formalize this finding in our theoretical HANK model by assuming that households' cognitive skills affect their inflation beliefs via their occupational skills. This evidence is supported by D'Acunto et al. (2019) who highlight that consumers' inflation expectations are strongly affected by the frequency with which households observe goods price changes which in turn affects their inflation expectation formation.

Second, our paper adds to the growing literature of macroeconomic models with information frictions. Recently, these frictions have also incorporated into models with heterogeneous agents and incomplete markets to not only match macroeconomic moments but to also reconcile them with microeconomic evidence on marginal propensities to consume. One application is Angeletos and Huo (2021) who analyze the consequences of noisy information for agents with different wealth levels. They show that "the habit-like sluggishness generated by informational frictions is amplified when the agents with the highest marginal propensity to consume are also the ones with the most cyclical income". A recent paper by Pfäuti and Seyrich (2022) introduces cognitive discounting in the sense of Gabaix (2020) into a model with wealth heterogeneity. They show that this generates amplification of monetary policy through indirect effects and has strong implications for the business cycle due to unequal exposure of households to different shocks. In a methodologically related paper to ours, Guerreiro (2022) pushes this further in a HANK model with households who have endogenous but heterogeneous beliefs about their cyclical income. Households are heterogeneously exposed to business cycle shocks which affect their beliefs about future income through their levels of attention they pay to these shocks which eventually amplifies business cycle fluctuations. We add to this literature by applying the sparsity-based model by Gabaix (2014) to a HANK model, allowing agents with heterogeneous income levels to endogenize their attention choice towards prices, ultimately resulting in heterogeneous inflation expectations.

Third, we contribute to the heterogeneous agent literature studying monetary policy transmission[2] The closest paper to ours on this front is Auclert et al. (2020). In their paper, the authors study monetary policy transmission in a HANK model in which household are assumed to have sticky expectations. Contrary to them, our model features heterogeneous inflation expectations, whereas in their framework, all households update their expectations and beliefs about their value of illiquid assets infrequently, but with the same probability. Further, the information choice in our framework is endogenized and source-dependent while theirs is not. Broer et al. (2021) study wealth taxation and document the impact of heterogeneous expectations on the equilibrium properties of the economy relative to FIRE benchmark resulting in higher macroeconomic volatility. In a partial equilibrium heterogeneous agent model, Laibson et al. (2024) show that present bias increases households' marginal propensity to consume and amplifies the effect of monetary policy, leading to an increase in households' consumption, which however also decelerates monetary transmission. Finally, Pfäuti and Seyrich (2022) show that their framework allows to generate amplification of conventional monetary policy through indirect effects as households are unequally exposed to monetary policy, while also simultaneously ruling out the forward guidance, which is in contrast to standard traditional rational models. We add to this literature by quantifying the effects of heterogeneity and information frictions for inflation expectations in a sticky-price model with permanent and idiosyncratic heterogeneity and document the transmission channels in a structural model.

The paper is structured as follows. Section 2 provides the empirical estimation strategy to measure over- and under-reaction in the data, followed by our approach to estimate heterogeneous attention levels to monetary policy and oil supply news shocks. Section 3 presents the empirical aggregate and cross-sectional results we find for US and Australian survey data. Then, section 4 introduces our HANK model featuring inattentive agents. We use the model to quantify the structural implications of inattention on inflation expectations. Section 5 shows our model results and discusses the monetary policy implications. Section 6 concludes.

2 See also Auclert (2019); Acharya et al. (2023); Bayer et al. (2024)

2. Measuring Attention

This section presents our empirical strategy to estimate heterogeneous attention to inflation from micro-level data. We follow Pfäuti (2021), whose approach we describe in the following subsection, and control for cross-sectional household characteristics. We also derive shock-specific attention and use the derived specification to compare changes in inflation expectations to domestic and foreign monetary versus oil supply news shocks.

2.1. Attention to Inflation

Assume that households perceive the following law of motion for inflation

$$\pi_t = \rho\pi_{t-1} + \xi_t \tag{1}$$

where π_t is the inflation rate in year t, $\rho \in (-1, 1]$ is the autocorrelation coefficient and $\xi_t \sim i.i.d.N(0, \sigma_\xi^2)$ is the inflation innovation in year t. Every household belongs to a group $g = 1, 2, \ldots, n$, based on some specific characteristic (in our model this will be income). In every period, each household receives a noisy signal on inflation which according to him is generated as

$$s_{j,t} = \pi_t + \varepsilon_{j,t} \tag{2}$$

where $\varepsilon_{j,t} \sim i.i.d.N(0, \sigma_{\varepsilon^g}^2)$ is the noise in the signal. The noise term is perceived to have different variances σ_g^2 across household groups due to limited attention[3]: different types of households pay different amount of attention to inflation and the larger their attention, the lower the variation in their error about an observed variable, $\varepsilon_{j,t}$. Applying the standard Kalman filter equations allows to generate conditional forecast of future inflation as

$$\begin{aligned} E[\pi_{t+1}|\mathcal{I}_{j,t}] = \rho E[\pi_t|\mathcal{I}_{j,t}] &= \rho E[\pi_t|\mathcal{I}_{j,t-1}] + \rho\gamma^g \left(s_{j,t} - E[\pi_t|\mathcal{I}_{i,t-1}]\right) \\ &= \rho E[\pi_t|\mathcal{I}_{i,t-1}] + \rho\gamma^g \left(\pi_t - E[\pi_t|\mathcal{I}_{i,t-1}]\right) + \nu_{j,t} \end{aligned} \tag{3}$$

where $E[\pi_t|\mathcal{I}_{j,t}]$ is the nowcast for inflation of household j once he receives new information, $E[\pi_t|\mathcal{I}_{j,t-1}]$ is the household's prior mean, $\nu_{j,t}$ is the noise. The inflation forecast of household j is a linear combination of the household's prior mean, the product of the Kalman gain, which is the measure of attention towards inflation, γ^g, and the difference between the realized inflation and the previous period inflation forecast. When the household forecasts inflation he corrects his forecast error partially by the amount of attention he pays towards inflation: the lower its level of attention, the less strong the

3 This is different to Pfäuti (2021) who doesn't distinguish between household characteristics and the observed volatility of the shock is the same across households; see also Vellekoop and Wiederholt (2019)

update and the more anchored the prior beliefs. Averaging across j for each group allows us to estimate group-specific attention from the data via the following equation

$$\pi^e_{t+1,t} = \beta_j + \beta_1 \pi^e_{t,t-1} + \beta^g_2 I_g \left(\pi_t - \pi^e_{t,t-1}\right) + \nu_{i,t} \tag{4}$$

where β_j are the potentially different mean expectations of the households, I_g are type-g dummies, $\beta_1 = \rho$, and $\gamma^g = \frac{\beta^g_2 I_g}{\beta_1}$ is the group-specific level of attention. The mean 1-year ahead inflation expectation of households in group g is a linear combination of its own lag and the latest observed forecasting error after the agent observed his signal about inflation. Alternatively, one can further derive the forecast errors of inflation starting from equation (3) by rewriting it for notational convenience as

$$E_{i,t}\pi_{t+1} = \gamma^g E_t \pi_{t+1} + (1-\gamma^g)\, E_{i,t-1}\pi_{t+1} \tag{5}$$

Rewriting inflation as a function of structural shocks

$$\pi_{t+1} = \sum_{s=-\infty}^{\infty} J_{t+1-s} u_{t+1-s} \tag{6}$$

where u_t is a vector of structural shocks that are uncorrelated across time and with each other, and J_t represents impulse response functions (IRFs) of inflation to them, gives the forecast errors as

$$\begin{aligned}\pi_{t+1} - E_{j,t}\pi_{t+1} &= \sum_{s=-\infty}^{\infty} J_{t+1-s}u_{t+1-s} - \gamma^g E_t\pi_{t+1} - (1-\gamma^g)E_{i,t-1}\pi_{t+1} \\ &= \sum_{s=-\infty}^{0} J_{t+1-j}u_{t+1-j} + \sum_{s=1}^{\infty} J_{t+1-s}u_{t+1-s}\left[1 - \gamma^g \sum_{k=0}^{s-1}(1-\gamma^g)^k \rho^k\right]\end{aligned} \tag{7}$$

The first term denotes unpredictable at time t future shocks that affect inflation (i.e. shocks that occur in periods $t+1$ or later). The second term shows how forecast errors depend on past shocks - for example the coefficient in front of the shock in period t, u_t, is simply $J_t(1-\gamma^g)$. Shock-specific attention can then be estimated by regressing forecast errors on past shocks

$$e_{j,t+1} = \beta_j + \beta^g_1 I_g u^m_t + \nu_{j,t} \tag{8}$$

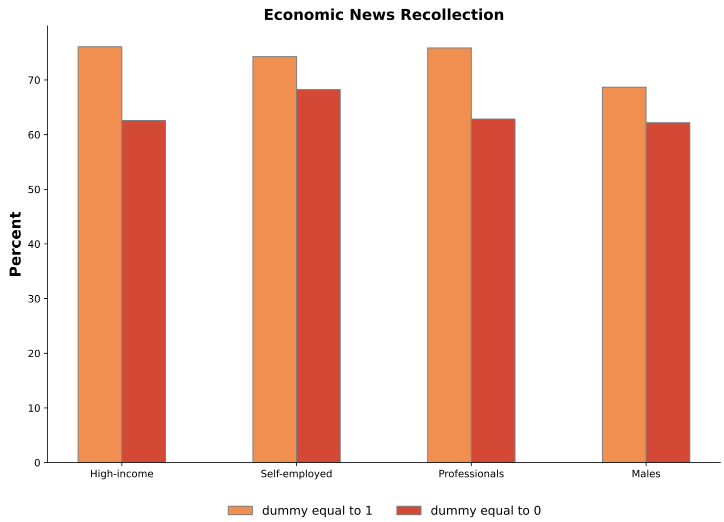
where $e_{j,t+1} = \pi_{t+1} - E_{j,t}\pi_{t+1}$ are the forecast errors of inflation, m stands for the shock of interest (for example, monetary policy shock), and $\gamma^g = 1 - \frac{\hat{\beta}^g_1 I_g}{J^m_t}$ is the group-g specific attention level. J^m_t can be estimated or taken from other studies. Note, that this equation allows us to estimate attention using different series of shocks[4].

4 The regression can either be estimated with each shock individually or with all shocks together. These shocks are structural shocks with the assumption that they are uncorrelated with each other and the regression results will be equivalent

2.2. Estimation Results

To motivate our cross-sectional analysis, we first plot a suggestive evidence for Australia. Figure 1 shows the percentage of households who answer "Yes" to the question "During the last few months, have you read or heard any news of changes in economic conditions?" in CASiE for different groups of households. The orange bar shows the response of households who belong to the according groups, the red bar shows the response for households who don't belong to the group of interest. High-income households in Australia have a total pre-tax income of ≥\$90k and are the top 25% earners in the economy while low income have an income of \$40k - \$90k. Self-employed households work for themselves and not self-employed agents work for an employer. Professional households work in economic-related fields where non-professional work in other occupations[5]. In the figure we see that households who are high-income, self-employed, professionals or of male sex collect economic news more often than the other groups. High-income households thereby pay the most attention to changes in the economy.

Figure 1: Percentage of Households Recalling Economic News



Notes: The figure shows the percentage of households who answer "Yes" to the question "During the last few months, have you read or heard any news of changes in economic conditions?" in the CASiE Australian survey. The answers are shown by groups depending on income, occupation, sex and whether a household is self-employed. "1" indicates that the percentage is calculated among households who belong to the category (so the first bar is the percentage of "yes" answers among income rich) and "0" indicates that the percentage is calculated among households who do not belong to the category.

5 See Appendix A.1 and A.2 for descriptive statistics

2.2.1. Cross-sectional Variation

We analyze cross-sectional[6] variation across households' inflation expectations shown in Table 1 by regressing absolute (columns 2 and 4) or squared (columns 3 and 5) forecast errors about one year ahead CPI inflation on household characteristics specified in column 1. Columns 2 and 3 show the results for Australia, while columns 4 and 5 show the results using US data. The results can be interpreted as follows. In general each household makes an average forecast error, independent of his specific group, denoted in the constant $\hat{\beta}_j$ of the regression. If a household belongs to either of the income, sex, or occupational groups[7], the error is changed by the amount of the coefficient shown in the according columns. To

Table 1: Cross-sectional Distribution of Inflation Expectations

	AUS		USA	
	Abs. Errors	Squared Errors	Abs. Errors	Squared Errors
Income				
Mid Income	-0.68*** (0.22)	-8.04*** (2.99)	-1.45*** (0.14)	-39.35*** (5.42)
High Income	-1.26*** (0.20)	-13.97*** (2.82)	-1.78*** (0.13)	-39.83*** (4.21)
Sex				
male	-0.39*** (0.08)	-3.48*** (0.80)	-2.15*** (0.13)	-49.81*** (4.29)
Occupation				
self-employed	-0.96*** (0.16)	-12.09*** (1.81)	-0.73** (0.24)	-27.78** (8.73)
Demographics	X	X	X	X
Constant	4.42*** (0.33)	32.20*** (4.09)	16.14*** (2.78)	450.14** (141.66)
No. of observations	7151	7151	14,816	14,816
R-squared	0.07	0.05	0.12	0.07

Notes: The table shows regression coefficients for inflation expectation errors on different demographics. Errors are clustered at the time-period level. Results are shown for both Australia and the US. Demographics includes

fix idea let's focus on the column 2: on average households in Australia make a significant inflation forecast error of the magnitude of 4.42. If the household however is a high-income household, this error significantly diminishes by 1.26, such that the error decreases to 3.16. If the household however is self-employed the unconditional error diminishes as well by the magnitude of 0.96, but the forecast error remains higher than that of a high-income household (3.96>3.16). Similar reasoning is applicable to the other categories. In general we see that being a high-income household significantly reduces the magnitude of the average individual forecast error of the household robustly across our sample. The results are robust to stricter winsorizing, the inclusion of time fixed effects and macro controls.

6 Appendix B shows results for aggregate over- and under-reaction, which complement our analysis and strengthen our results presented in the cross-sectional analysis

7 In the following analysis we disregard the effects for professionals since it is not available in the SCE

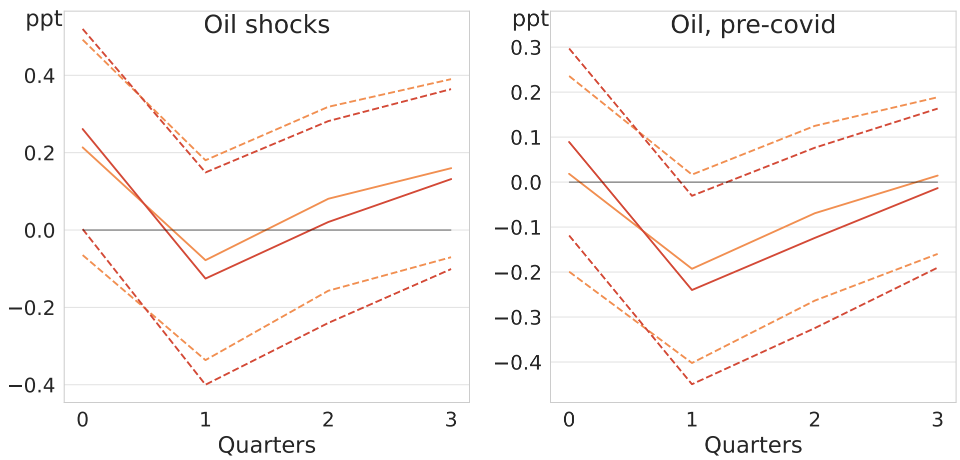
Hence, as this characteristic is the most robust in our datasets, we will in the rest of the paper focus on the analysis of subjective inflation expectations of high- versus low-income households.

2.2.2. Heterogeneous Beliefs

Shock-specific attention Before we proceed with the estimation about attention to aggregate inflation expectations, we first need to assess if there is identifiable and heterogeneous underlying uncertainty about the source of forecast errors as a response to different shocks. To analyze shock-specification attention, we estimate local projections following Jordà (2005) using the process for shock-specific attention specified in expression (8). To capture supply- and demand-side shocks we consider externally constructed oil supply news shocks by Känzig (2021) and different sets of monetary policy shocks which we interact with the income-level of the household. Figure 2 shows the impulse response functions of inflation forecast errors of low-income and high-income households to externally constructed oil supply news shocks for Australia. We see that high-income households tend to overshoot their expectations on impact a bit more relative to low-income households, implying a slightly higher level of attention to oil supply news shocks which results in a quick update of their expectations such that forecast errors become smaller after 0.5 quarters and stay lower for high-income households over the next quarters relative to low-income households. To capture the effect monetary policy has on households' forecast errors, we consider a set of monetary policy shocks. In particular, we use externally constructed monetary policy shocks for Australia by Beckers et al. (2020) following Romer and Romer (2004) methodology and high-frequency identified monetary policy shocks constructed by Hambur and Haque (2023) following Gürkaynak et al. (2005) with the Kaminska et al. (2021) extension that decomposes shocks into level, path and term-premia components. Figure 3 shows the impulse response functions of inflation forecast errors of low- and high-income households to the externally constructed sets of monetary policy shocks. Both income groups react on impact to the change in monetary policy, however with slightly different magnitudes: low-income households react more on impact, as shown be the slightly higher magnitude of forecast errors, however over the period of 4 quarters inflation expectations adapt to the levels of actual inflation and forecast errors decrease. However these differences are negligibly small such that overall the heterogeneous effects for both monetary and supply shocks are insignificant.

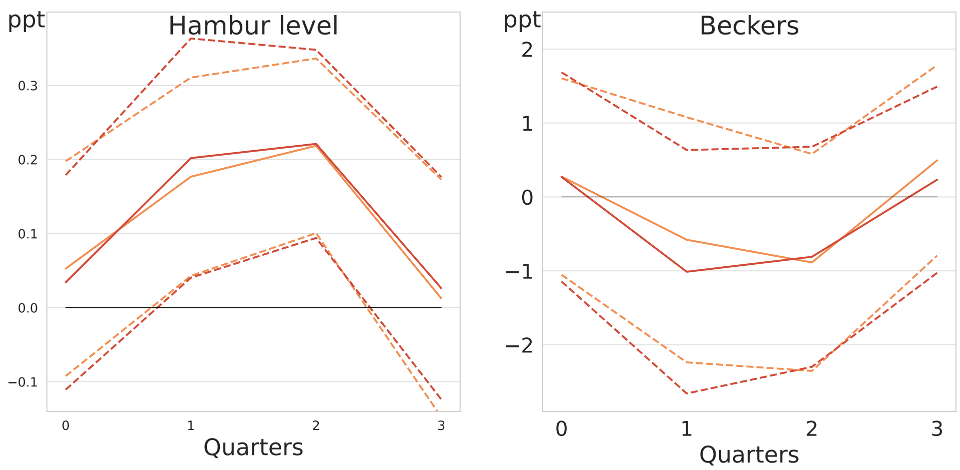
To study spillover effects of foreign monetary policy on Australia we additionally estimate local projections using externally constructed monetary policy shocks for the US from Bauer and Swanson (2023) and Nakamura and Steinsson (2018). The results are depicted in Figure 4. The impulse responses show a similar pattern as in Figure 3 reinforcing previous results of insignificant heterogeneity between forecast errors of high-income households even to external monetary policy.

Figure 2: Responses of Inflation Forecast Errors to Oil Supply News Shocks



Notes: The figure shows in percentage points the impulse-responses of inflation forecast errors to externally constructed oil supply news shocks. Responses of high-income households are shown in red, responses of lower-income households are shown in orange. Dotted lines show 90% confidence intervals.

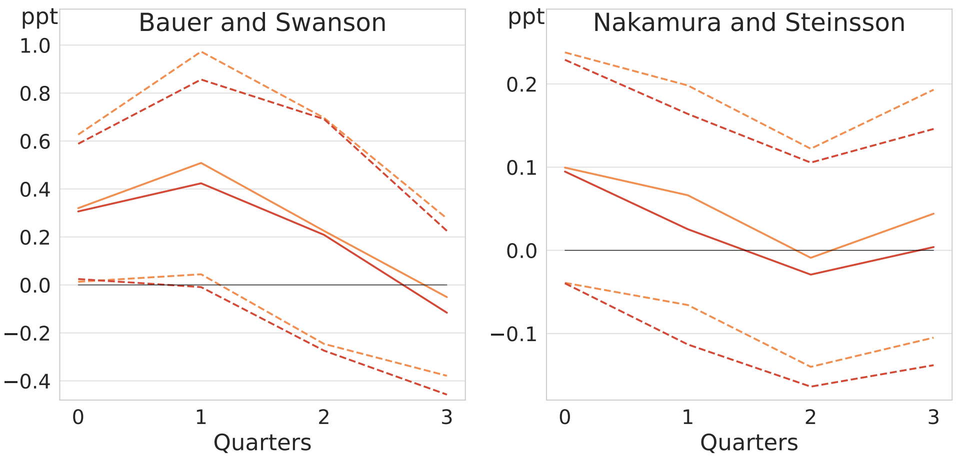
Figure 3: Responses of Inflation Forecast Errors to Domestic Monetary Policy Shocks



Notes: The figure shows in percentage points the impulse-responses of inflation forecast errors to externally constructed monetary policy shocks. Responses of high-income households are shown in red, responses of lower-income households are shown in orange. Dotted lines show 90% confidence intervals.

For the US, Figure 5 shows the impulse response functions of the households' forecast errors to Känzig (2021) oil supply news shocks for both the pre- and post-Covid period. We find a same patter as in Figure 2: we find slightly higher attention of high-income households to oil supply news shocks. Figure 6 shows the impulse response functions of inflation forecast errors to externally constructed Bauer and Swanson (2023) and Nakamura

Figure 4: Responses of Inflation Forecast Errors to US Monetary Policy Shocks



Notes: The figure shows in percentage points the impulse-responses of inflation forecast errors to externally constructed US monetary policy shocks. Responses of high-income households are shown in red, responses of lower-income households are shown in orange. Dotted lines show 90% confidence intervals.

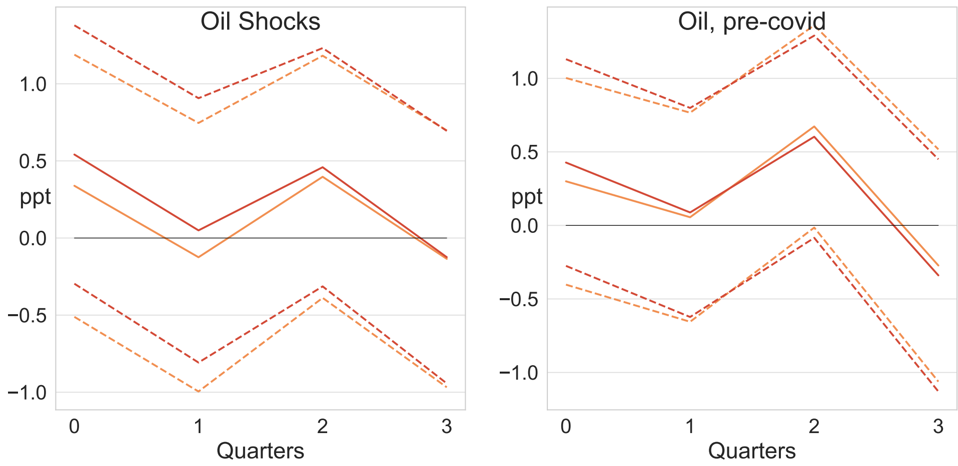
and Steinsson (2018) monetary policy shock. For both shocks we see that the magnitude of the response of forecast errors to the monetary policy shock is higher for the high-income households than for the low-income households, showing a similar pattern as in CASiE for Australia. The high-income households slightly over-react more to monetary policy shocks than low income households on impact. Over time both groups adapt their inflation expectations, such that the forecast errors decrease as the shock is mitigated. However, just as in the Australian data, the difference to low-income households is still insignificant suggesting that there is no identifiable heterogeneous uncertainty about the underlying economy. Therefore, in the following we proceed with aggregate CPI inflation irrespective of the economic shock.

Heterogeneous attention to CPI inflation for income groups The estimated attention levels for the two income-groups groups for both countries are shown in Table 2. γ^1 shows the attention to inflation of high-income households and γ^2 shows the attention for low-income households. We find that there is a significant difference between the attention levels of the household groups. In particular attention levels are higher for high-income groups than for low-income groups.

These results are mostly robust for both estimators, the Arellano-Bond estimator[8] and the pooled OLS estimator. Table 2 confirms our hypothesis that high-income households are more attentive to inflation than low-income households. Further, the results are robust

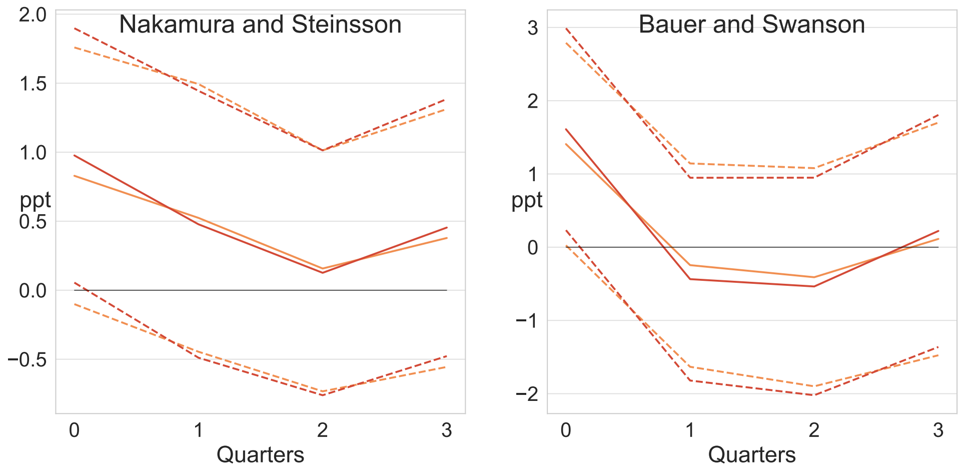
8 The Arellano-Bond estimator is applied since the dependent variable in specification (8) includes a lag on the right-hand side. See also Pfäuti (2021)

Figure 5: Responses of Inflation Forecast Errors to Oil Supply News Shocks



Notes: The figure shows in percentage points the impulse-responses of inflation forecast errors to Känzig (2021) oil supply news shocks. Responses of high-income households are shown in red, responses of lower-income households are shown in orange. Dotted lines show 90% confidence intervals.

Figure 6: Responses of Inflation Forecast Errors to Monetary Policy Shocks



Notes: The figure shows in percentage points the impulse-responses of inflation forecast errors to Bauer and Swanson (2023) and Nakamura and Steinsson (2018) monetary policy shocks. Responses of high-income households are shown in red, responses of lower-income households are shown in orange. Dotted lines show 90% confidence intervals.

to stricter winsorizing and using an AR(2)-process as a perceived inflation process as well as to the inclusion of macro controls.

Table 2: Heterogeneous Attention of High- and Low-Income Households

	AUS		USA	
	Arellano Bond	Pooled OLS	Arellano Bond	Pooled OLS
γ^1	0.24***	0.24***	0.09***	0.09
γ^2	0.11**	0.10**	0.06***	0.06
No. of observations	214	216	68	70
Robust to AR(2) specification	Yes	Yes	No	No

Notes: The table shows estimated level of attention across income households groups using (4). Attention of households belonging to the group is shown in row with γ^1, and attention of households not belonging to the group is shown in row γ^2. Stars indicate significance relative to the other group.

3. The Household's Attention Choice Problem

To quantify the results from the empirical analysis we propose a HANK model with inattentive households and permanent income heterogeneity. In this section we give some intuition and introduce a reduced form of the full HANK model generalized in Section 4 by abstracting from idiosyncratic risk and focusing on permanent income and attention heterogeneity. We present the general attention choice problem the household faces, following the framework by Gabaix (2014), further developed in Gabaix (2016) for dynamic programming problems.

Consider an economy that is populated by a continuum of households $j \in [0, 1]$. Each household belongs to a group $g \in \{1, 2\}$ and gets group-specific labor income $Y_{g,t} \equiv \eta_g^o W_t^o n_t$ which depends on his occupational skill-level η_g^o and where W_t^o is the occupation-o-specific nominal wage, where $o \in \{1, 2\}$ denotes the household's occupational choice. n_t are fixed labor hours the household has to work and which are equal for both household groups. If the household has high occupational skills, he belongs to $g = 1$, works in $o = 1$ and gets income Y_1, otherwise the household belongs to the group of households with low occupational skills $g = 2$, works in $o = 2$ and gets income Y_2. We assume that the high-skill occupation pays a higher nominal wage than the low-skill occupation, $Y_1 > Y_2$. Households further hold a risk-free nominal asset a_t^n with nominal interest rate i_t^a between periods $t - 1$ and t. Borrowing constraints prevent these households from taking negative bond positions. The household gets utility from consumption c_t and has discount factor β.

At every point in time, the household forms beliefs about the behavior of future variables relevant to his decision problem, in particular, the aggregate price level, labor income and the nominal interest rate. However, to focus on the effects of attention to inflation, we assume that households have correct expectations about their future income $E_t(\{Y_{g,t+h}\}_{h=1}^{\infty})$, they fully observe the correct interest rate and therefore have correct expectations about $i^a_{t+h}, h = 1, 2, \ldots$. We further assume that people know the current aggregate price level. Thus, the only variable to which the household may be inattentive to and forms subjective beliefs about is the future aggregate price level $P_{t+h}, h = 1, 2 \ldots$. The household solves the following maximization problem:

$$\begin{aligned} V_{j,t}(a^n_{t-1}) &= \max_c \{u(c_t) + \beta E[V_{j,t+1}(a^n_t)]\} \\ s.t. \quad P_t c_t + a^n_t &= Y_{g,t} + (1 + i^a_t)a^n_{t-1}, \quad a^n_t \geq 0 \end{aligned} \tag{9}$$

where E is the expectation operator we define in Definition 1.

Definition 1. Subjective Beliefs. *Suppose the inattentive agent observes variable z_t and forms expectations about $\{z_{t+h}\}^{\infty}_{h=1}$. Then, the expectations about the future variable are:*

$$E(z_{t+h}) = \gamma^g E_t(z_{t+h}) \; if \; \gamma^g \in [0, 1) \tag{10}$$

$$E(z_{t+h}) = E_t(z_{t+h}), \; if \; \gamma^g = 1 \tag{11}$$

where E_t is the traditional rational expectation operator, γ^g is the attention level to the future variable and we define $E_{j,t} \equiv \gamma^g E_t(z_{t+h})$ as the subjective beliefs operator.

With an increasing amount of attention the quality of his subjective beliefs about inflation increases. Based on Definition 1 we get the following. The *rational* household who observes the variables fully rationally and pays full attention to the entire state of the economy has utility

$$v_{j,t}(a^n, 1) \equiv u(c) + \beta E_t[V_{j,t+1}(Y_g + (1 + i^a_t)a^n - P_t c, 1)] \tag{12}$$

The *inattentive* household in the simplified model that we described above is inattentive to prices and has utility

$$v_{j,t}(a^n, \gamma^g) \equiv u(c) + \beta E_{j,t}[V_{j,t+1}(Y_{g,t} + (1 + i^a_t)a^n - P_t c, \gamma^g)]$$

where $E_{j,t}$ are his subjective beliefs about the state of the economy. Being inattentive however leads to an imperfect policy choice $c^*_g(\gamma^g)$ and a loss in utility

$$\mathcal{L} = v_{j,t}(a^n, \gamma^g) - v_{j,t}(a^n, 1) \tag{13}$$

measured as the difference between the utility under optimal policy $c^*_g(a^n_t, 1)$ under full information for a household j in group g and the imperfect policy $c^*_g(a^n_t, \gamma^g)$ for a household j in group g under inattention. The household thereby wants to minimize his expected loss in utility. However, he can only process a limited amount of information and therefore faces a cognitive constraint, $\chi\gamma^g$, where χ measures the amount of sparsity. When $\chi = 0$, the agent is the traditional rational agent and can acquire new information at 0 cost. Minimizing the expected loss in utility subject to the cognitive constraint[9]

$$\min_{\gamma^g} -\frac{1}{2}\frac{\partial^2 v(a^n,\gamma^g)}{\partial c^2}\sum_{h=1}^{\infty}\sum_{h'=1}^{\infty}\frac{\partial c}{\partial P_h}\frac{\partial c}{\partial P_{h'}}(\gamma^g-1)^2\sigma_{P_hP_{h'}}+\chi\gamma^g \tag{14}$$

where $\frac{\partial c}{\partial P_h}$ denotes the household's change in consumption due to a change in the price level at period h, $\sigma_{P_hP_{h'}} = E(P_hP_{h'})$ the perceived variance of the aggregate price level at periods h and h', and $\frac{\partial^2 v(a^n,\gamma^g)}{\partial c^2}$ is the disutility from misoptimized consumption such that $\frac{\partial c}{\partial P_h}(\gamma^g-1)P_{t+h}$ denotes the error due to inattention, gives optimal attention of the household j to inflation which is group-specific based on his income-level resp. occupational choice.

Proposition 1. Optimal Attention. *The optimal level of attention $\gamma^g \in [0,1]$ towards inflation is given by*

$$\gamma^g = \max\left\{0, 1-\frac{\chi}{\Lambda}\right\} \tag{15}$$

with the cost-of-inattention factor $\Lambda := \frac{1}{2}\frac{\partial^2 v(a^n,\gamma^g)}{\partial c^2}\sum_{h=1}^{\infty}\sum_{h'=1}^{\infty}\frac{\partial c}{\partial P_h}\frac{\partial c}{\partial P_{h'}}\sigma_{P_hP_{h'}}$.

Proof. See Appendix C.1 □

Optimal level of attention (15), depends on the state of the economy. In particular, it depends on how much the agent changes his consumption today when the aggregate price level changes in period h, his perceived variance of the aggregate price level at future periods and the disutility from choosing suboptimal consumption. When the cost of cognition χ increases, the quality of decisions falls since it is too costly for households to pay attention to inflation. When the cost of cognition however is low, the cost of acquiring information about attention is low such that the household's subjective expectations get closer to the true value of inflation expectations, making their beliefs more precise. Optimal attention increases also when the cost-of-inattention factor increases holding everything else fixed, i.e. when the change in consumption due to a change in prices is high. A household that has lower income is constrained in his income. As such, he has to consume whatever he can afford. Therefore has less incentives to pay attention to changes in prices and the aggregate inflation as it doesn't affect him much. Remember that mistakes in the household's expectations lead to a misoptimized consumption decision (see expression (22)). A high-income household suffers more from a misoptimized consumption-saving decision and therefore choose to pay as much attention to changes in the economic environment as possible, i.e. increasing the attention they pay to inflation.

9 Following Gabaix (2014) we approximate the household's utility function with a second order Taylor approximation; see Appendix C.1 for a detailed derivation.

4. Quantitative model

In this section we generalize the model from Section 3 to a canonical HANK model with incomplete markets and heterogeneous beliefs. In particular, we allow households to differ in three dimensions of heterogeneity. First, each household belongs to a group g characterized by the idiosyncratic, transitory income. Second, we assume that households additionally differ in their permanent income by making labor income skill- and occupation-specific. This allows us to match the household's income-dimension we found in the data. Next, we assume that households are inattentive to future inflation and that households endogenously decide how much attention they want to allocate towards inflation. The firm optimizes production same as in the canonical model by McKay et al. (2016), while the central bank sets the nominal interest rate.

4.1. Household Problem

In the following we present the household problem of our model. In general, the timing as follows. First, the household makes his attention choice evaluating his loss in utility from misoptimized consumption due to being inattentive. Second he makes his occupational choice by evaluating different consumption levels for different occupations. Lastly, the household makes his optimal consumption-saving and labor supply decision.

4.1.1. Baseline problem: transitory income inequality

In the following we lay out the general setup of a standard one-asset HANK model in which income is determined by an idiosyncratic income shock, against which we benchmark our results.

The economy is populated by a continuum of households $j \in [0, 1]$. Each household belongs to a group $g = 1, 2, ..., n$, has preferences over consumption c_t, hours worked n_t and gets income $e_t W_t n_t$. He also faces a nominal budget and a borrowing constraint for nominal assets. Specifically, each household solves the following Bellman equation

$$\begin{aligned} V_j(a_{t-1}^n, e_t) &= \max_{c_t, n_t, a_t^n} u(c_t, n_t) + \beta E_t V_j(a_t^n, e_{t+1}) \\ \text{s.t.} \quad & P_t c_t + a_t^n = e_t W_t n_t + (1 + i_{t-1}^a) a_{t-1}^n \\ & a_t^n \geq 0, \quad u(c_t, n_t) = \frac{c_t^{1-\sigma} - 1}{1 - \sigma} - \varphi \frac{n_t^{1+\nu}}{1 + \nu} \end{aligned} \tag{16}$$

where W_t is the nominal wage, P_t is the price index, e_t are Bewley-type idiosyncratic income shocks creating transitory income inequality in the economy. Households hold only one risk-free asset which are the nominal savings a_t^n with nominal interest rate i_t^a between periods $t - 1$ and t. We assume that they have rational expectations with respect to each variable relevant to their consumption-saving decisions except for inflation.

4.1.2. Beliefs

At every point in time, the household forms beliefs about the future behavior of variables relevant to his decision-making. We maintain the assumption that households have correct expectations about their future income, they also fully observe the correct interest rate and therefore have correct expectations about the nominal interest rate. Thus, the only variable relevant to their decision-making to which the agent is inattentive to, is the future aggregate price level. We assume that households observe all current and past prices and only form subjective beliefs about future price levels and inflation rates. In the model with borrowing constraints this assumption also guarantees that the constraints are not violated due to misperceptions of current prices. We follow the same formulation of expectations for inflation that we use in our empirical estimations and generalize it for group-specific expectations. We specify subjective beliefs in the following.

Definition 2. Subjective Beliefs, HANK. *Suppose the inattentive agent observes variable z_t and forms expectations about $\{z_s\}_{s>t}$. Then, the expectations about the future variable are:*

$$\begin{aligned} E(z_s) &= \gamma^g E_{j,t}\pi_s + (1-\gamma^g)\,E_{j,t-1}\pi_s \,\forall s>t,\ if\ \gamma^g \in [0,1) && (17) \\ E(z_s) &= E_t(z_s),\ if\ \gamma^g = 1 && (18) \end{aligned}$$

where E_t is the traditional rational expectation operator, γ^g is the attention level to the future variable and we define $E_{j,t} \equiv \gamma^g E_{j,t}\pi_s + (1-\gamma^g)\,E_{j,t-1}\pi_s$ as the subjective beliefs operator.

Definition 2 formalizes the same idea as in the Kalman gain, namely that households learn about the state of the economy if they receive a new signal about inflation which allows them to form new beliefs about future inflation. If agents decide to pay attention to inflation, they update their old inflation beliefs and learn from new information. With an increasing amount of attention the quality of his subjective beliefs about inflation increases, eventually minimizing the importance of the previous inflation expectations, which is totally mitigated under $\gamma^g = 1$.

Numerical Solution We solve the model using the Sequence Space Jacobian method by Auclert et al. (2020) which allows us to easily introduce behavioral frictions into the model. For that, we define the expectation matrix as

$$E = \begin{pmatrix} 1 & \gamma^g & \gamma^g & \gamma^g & \cdots \\ 1 & 1 & \gamma^g + (1-\gamma^g)\gamma^g & \gamma^g + (1-\gamma^g)\gamma^g & \cdots \\ 1 & 1 & 1 & \gamma^g + (1-\gamma^g)(\gamma^g + (1-\gamma^g)\gamma^g) & \cdots \\ \vdots & \vdots & \vdots & \vdots & \ddots \end{pmatrix}$$

The lower triangular of the expectations captures the fact that households have full information about current and past prices. γ^g is the attention level of a household in group g towards the input variable (in our case we only focus on π_t) which affects his consumption, labor and savings choice. If the household holds FIRE, $E(r,m) = 1 \ \forall r, m$, i.e. he has rational expectations E_t and pays full attention to the economy with $\gamma^g = 1$, whereby in case of inattention the household has beliefs deviating from FIRE and $\gamma^g \in [0,1)$ given by Definition 2.. Using the fact that a change in expectations at time τ for the household is equivalent to a news shock

$$J_{t,s}^{o,\pi} = \sum_{\tau=0}^{\min\{s,t\}} (E_{\tau,s} - E_{\tau-1,s}) J_{t-\tau,s-\tau}^{FI,o,\pi}, \tag{19}$$

the relationship between behavioral Jacobians and FIRE Jacobians can be obtained in the following.

Proposition 2. Behavioral Jacobian. *In the outlined setting, behavioral Jacobians with respect to inflation are related to FIRE Jacobians in the following form*

$$J_{t,s}^{o,\pi} = \begin{cases} \gamma^g J_{t,s}^{FI,o,\pi}, & t = 0, \ s > 0 \\ J_{t,s}^{FI,o,\pi}, & s = 0 \\ \gamma^g J_{t,s}^{FI,o,\pi} + (1-\gamma^g) J_{t-1,s-1}^{o,\pi}, & t > 0, s > 0 \end{cases} \tag{20}$$

where J^{FI} stands for FIRE Jacobians.

Proof. See Appendix D.1 □

The Jacobian $J_{t,s}^{o,\pi}$ describes the marginal change in period t of the output variable o to a period-s-change in the input variable π. For consumption, the Jacobian would be given by $J_{t,s}^{C,\pi} = \delta C_t / \delta \pi_s$ quantifying the partial response in consumption in t to a partial change in inflation in s. Inattention thereby enters the household's beliefs via the expectation matrix, affecting the household's Jacobian as seen in equation (19). Note that we assume $\gamma^g \neq 1$ only for π_t and $P_t \ \forall s, t$, but remain the assumption of FIRE for every other input variable. In line with the literature, we assume that the price in period t is fully observed. Next, we endogenize γ^g and assume that households solve an attention allocation problem.

4.1.3. The attention choice

We assume that households choose their attention level optimally facing a cognitive capacity constrain in the vein of Gabaix (2014). Being inattentive leads to a suboptimal consumptions choice $c_g^*(a^n, e, \gamma^g)$ resulting in a loss in utility compared to the consumption choice under FIRE. The household wants to minimize the loss by choosing his optimal level of attention γ^g.

The *rational* household who observes the variables fully rationally and pays full attention to the entire state of the economy has utility

$$v_{j,t}(a^n, e, 1) \equiv u(c) + \beta E_t[V_{j,t+1}(Y_g + (1+i_t^a)a^n - P_t c, e', 1)] \tag{21}$$

where e_t and a_t^n are the state variables characterizing the economy at point t.

The *inattentive* household is inattentive to prices and has utility

$$v_{j,t}(a^n, e, \gamma^g) \equiv u(c) + \beta E_{j,t}[V_{j,t+1}(Y_{g,t} + (1+i_t^a)a^n - P_t c, e', \gamma^g)]$$

where $E_{j,t}$ are his subjective beliefs about the macro economy which we defined above. Being inattentive leads to an imperfect policy choice $c_g^*(\gamma^g)$ and a loss in utility

$$\mathcal{L} = v_{j,t}(a^n, e, \gamma^g) - v_{j,t}(a^n, e, 1) \tag{22}$$

where $c_{g,t}^*(1)$ is the optimal policy under full information and $c_g^*(\gamma^g)$ is the imperfect policy under inattention. The household wants to minimize his expected loss in utility and faces a cognitive constraint on how much information to process, $\chi\gamma^g$. Replacing the households utility function by a linear quadratic approximation allows us to state the household's attention optimization problem

$$\min_{\gamma^g} \; -\frac{1}{2}(\gamma^g - 1)^2 \sigma_P^2 \sum_e \int \left(\frac{\partial c}{\partial P}\right)^2 \frac{\partial^2 v(a^n, e, \gamma^g)}{\partial (c)^2} dD^g(e, da) + \chi\gamma^g \tag{23}$$

where σ_P^2 the perceived future variance of the aggregate price level, and $\frac{\partial^2 v(a,e,\gamma^g)}{\partial c^2}$ the disutility from misoptimized consumption. The first term in (23) is the leading term of the second order Taylor approximation of the utility loss of a household in (22). The second term, $\chi\gamma^g$, is the linear psychic cost attention creates, whereby under $\chi = 0$ the household is the rational agent. Solving (23) gives the household's optimal level attention to inflation.

Proposition 3. Optimal Attention, HANK. *The optimal level of attention to inflation is given by*

$$\gamma^g = \max\left\{0, 1 - \frac{\chi}{\sigma_p^2 \sum_e \int \left(\frac{\partial c}{\partial p}\right)^2 \frac{\partial^2 v^g(a^n, e, \gamma^g)}{\partial (c)^2} dD^g(e, da)}\right\} \tag{24}$$

Lemma 1. The derivative of the value function is $\frac{\partial^2 v(a^n,e,\gamma^g)}{\partial c^2} = u''(c) + \beta P^2 E_j u''(c') \frac{1+i}{P'} \frac{\partial c'}{\partial a^{n\prime}}$. For unconstrained households $\frac{\partial c}{\partial P} = -\frac{1}{\sigma}$, for borrowing-constrained households $\frac{\partial c}{\partial P} =$

$-\frac{(1+i_{-1})a^n+eW}{P^2}$.

Proof. See Appendix D.2 □

When $\gamma^g = 0$, the household "does not think about π" and sets a default value for inflation (e.g. a past level of inflation the agent assumes to be true) and doesn't update his inflation expectations, and when $\gamma^g = 1$ the household pays full attention, perceives the true value of inflation and updates his inflation expectations if necessary. Given our definition of expectations, attention accumulates over time and includes new information about the state of inflation in period s. It thereby depends on the volatility of the price level, σ_P^2, the change of group-specific consumption given a change in the equilibrium price level, $\frac{\partial c_g}{\partial P}$, the disutility from misoptimized consumption, $\frac{\partial^2 v^g(a^n,e,\gamma^g)}{\partial (c_g)^2}$.

4.1.4. Endogenizing income: the permanent component of income inequality

In the baseline model income inequality is exogenous and is fully driven by the persistence and the standard deviation of the Bewley-type idiosyncratic income shocks. We augment the model by introducing occupational choice following Faia et al. (2022). Households thereby differ in their skills and efficiency units of labor that they can provide in each occupation which delivers endogenous labor income inequality. Each household in group g has the same set of skills. He then optimizes his consumption c_t, labor n_t and occupational choice $o \in \{1, ..., O, O+1\}$, by solving the following Bellman equation

$$\begin{aligned} V_j^g(a_{t-1}^n, e_t, \boldsymbol{\phi_t}) &= \max_{o_t, c_t, n_t, a_t^n} u(c_t, n_t) + \phi_t^o + \beta E_{j,t}^g V_j^g(a_t^n, e_{t+1}, \boldsymbol{\phi_{t+1}}) \\ \text{s.t.} \quad & P_t c_t + a_t^n = \eta_g^o e_t W_t^o n_t + (1 + i_{t-1}^a) a_{t-1}^n \\ & a_t^n \geq 0 \end{aligned} \tag{25}$$

Each household j in group g makes an occupational choice o based on his occupation-specific vector of skills $\boldsymbol{\eta}_g$. The vector of shocks $\boldsymbol{\phi_t}$ is the $(O+1)$-vector of occupational amenities across all occupations and the non-employment state in which shocks are i.i.d. and drawn from a Gumbel distribution. This allow us to obtain occupational probabilities in a closed form, i.e. the household in group g chooses occupations o with probability

$$\theta_j^g(o|a_{t-1}^n, e_t) = \frac{\exp(\tilde{V}_j^{o,g}(e_t, a_{t-1}^n))}{\sum_o \exp(\tilde{V}_j^{o,g}(a_{t-1}^n, e_t))} \tag{26}$$

where $\tilde{V}_j^{o,g}$ is the value function in occupation o of type g household, $V_j^{o,g}(a_{t-1}^n, e_t)$, evaluated at the optimal consumption-saving and labor supply policies $c_j^o(a_{t-1}^n, e_t)$, $a_j^o(a_{t-1}^n, e_t)$ and $n_j^o(a_{t-1}^n, e_t)$. Note that the occupation choice is not a one-time choice and introduces heterogeneity in permanent income of the households. Heterogeneity in labor income is now given by first, the occupation-specific wage, W_t^o, determined by the labor market, and second, exogenous idiosyncratic productivity shock e_t. The occupation-specific wage thereby captures the heterogeneity in workers' skills as they affect the wages (e.g. high-skill households earn higher wages). Given that labor supply is occupation-specific, labor demand is also occupation-specific, see the modification of the production function at the end of Section 4.2.1.

4.2. Rest of the model

4.2.1. Production

Monopolistic competitive firms produce output by combining total labor input and capital using the production function: $y_t = z_t k_{t-1}^{\nu} L_t^{1-\nu}$, where y_t is the variety, z_t is the total factor productivity, ν is the capital share, k_t is capital and L_t is labor input. The optimal demand for each variety is given by $p_t = \left(\frac{Y_t}{y_t}\right)^{\frac{1}{\eta}} P_t$, where P_t is the aggregate price level and is normalized to 1 in the steady state. Firms choose labor demand, capital demand, k_t, and investment, I_t, to maximize the sum of future discounted real profits, which recursively reads as follows

$$\begin{aligned} J_t\left(k_{t-1}\right) = \max_{p_t, k_t, I_t, L_t} \quad & \left\{ \frac{p_t}{P_t} y_t - w_t L_t - I_t - \frac{\eta}{2\kappa} (\ln(1+\pi_t))^2 Y_t + \frac{J_{t+1}(k_t)}{1+r_{t+1}} \right\} \\ \text{s.t.} \quad & k_t = (1-\delta) k_{t-1} + I_t; \\ & p_t = \left(\frac{Y_t}{y_t}\right)^{\frac{1}{\eta}} P_t; \quad y_t = z_t k_{t-1}^{\nu} L_t^{1-\nu} \end{aligned} \tag{27}$$

where the first constraint is the capital accumulation equation, δ is the depreciation rate of capital, and $\frac{\eta}{2\kappa}(\ln(1+\pi_t))^2 Y_t$ is the quadratic price adjustment cost which is necessary to study monetary policy. The first order condition with respect to prices leads to the Phillips curve

$$\ln(1+\pi_t) = \kappa \left(mc_t - \frac{1}{\mu_p} \right) + \frac{Y_{t+1}}{Y_t} \ln(1+\pi_{t+1}) \Psi_{t,t+1} \tag{28}$$

where $\mu_p = \frac{\eta}{\eta-1}$ and $\Psi_{t,t+1}$ is the stochastic discount factor and is equal to $\frac{1}{1+r_{t+1}}$ and $\pi_t \equiv P_t/P_{t-1} - 1$. κ is the coefficient for the slope of the Phillips curve.

Occupational choice In the case of occupational choice (seesection 4.1.4), the production function is modified to include a CES aggregator of occupation-specific labor: $L_t = \left(\sum_{o=1}^{O} \alpha_o l_{o,t}^{\sigma}\right)^{\frac{1}{\sigma}}$ and the cost of labor for firms are therefore $\sum_{o=1}^{O} w_t^o l_t^o$, such that the labor market clearing is occupation-specific and yields $l_{o,t} = \sum_g m_g \int \gamma_g^o e_t n^o \theta^o dD_g(e_t, a_{t-1}^n)$.

4.2.2. Asset market and equilibrium conditions

Let v_t denote the price of equity and d_{t+1} the firm dividend. The real return on equity is $\frac{d_{t+1}+v_{t+1}}{v_t}$. The no-arbitrage condition is: $v_t = \frac{d_{t+1}+v_{t+1}}{1+r_{t+1}}$. The return on households' assets is: $(1+i_t^a) = \frac{d_t+v_t}{v_{t-1}}(1+\pi_t)$.

The supply of efficient labor is equal to the demanded labor $\int n_t e_t dD_t(e_t, a_t^n) = L_t$. Aggregate supply of goods is equal to aggregate demand of goods, hence: $Y_t = \mathcal{C}_t + I_t$, where consumption is aggregated through the joint distribution, D_t. Finally, asset markets clearing implies: $\mathcal{A}_t = v_t$, where again aggregation is obtained through the joint distribution D_t.

4.2.3. Policy

Monetary policy follows a classical Taylor-type rule, which endogenously responds to macroeconomic conditions as follows: $i_t = r_t^* + \phi_\pi \pi_t + \phi_y(Y_t - Y_{ss})$, where i_t is the monetary policy interest rate, ϕ_π is the weight on inflation π_t, ϕ_y is the weight on output gap, $(Y_t - Y_{ss})$ iwth Y_{ss} as the steady state value of output Y_t, r_t is the real interest rate, r_t^* is the natural interest rate, which is equal to the real interest rate in the steady state, and $1 + r_t = \frac{1+i_{t-1}}{1+\pi_t}$.

Definition 3. Competitive Equilibrium. *A competitive equilibrium of the economy satisfies the following definition: the sequence $[c_t, a_t, n_t]_{t=0}^{\infty}$ solves households' consumption-saving and labor supply decisions in Equation (16), given the distribution of idiosyncratic shocks, $P(e_{t+1}|e_t)$ and the sequence of prices i_t^a, W_t, π_t and the attention choices. The policy functions resulting from the consumption-saving and attention problem solve a fixed point equilibrium. Aggregate asset holdings and consumption of the households are equal to the product of the individual optimal functions and the distribution of households across occupations and assets. Firms choose labor demand, and capital inputs to solve discounted profit optimization, given in Equation (28). Market clearing and the aggregate resource constraints are satisfied. Monetary policy determines the short term interest rate according to the Taylor rule.*

4.2.4. Calibration

For the calibration we follow the literature and assume that the steady state is common knowledge. This means that the steady state is solved under fully rational expectations. The occupational choice is calibrated following Faia et al. (2022). For the dynamics, we then incorporate first, the households' beliefs and second, the choice of attention.

In calibrating the model to the US economy we follow Auclert et al. (2021). Calibration to Australian economy is based on Gibbs et al. (2018).

Table 3: Calibration

Parameter	Description	Value US	Value AUS
Production Function			
δ	Capital depreciation	0.02	0.0175
K	Capital to output ratio	10.0	12.23
κ	Slope of the price Phillips curve	0.1	0.06
Households			
σ	EIS	0.5	0.5
ρ	Inverse Frisch elasticity	1	1
ρ_z	Autocorrelation of earnings	0.966	0.973
σ_z	Cross-sectional std of log earnings	0.92	1.08
A	Total wealth	14.0	21.19
Asset Markets			
r	Real interest rate	0.0125	0.00875
Monetary and Fiscal Policy			
ϕ	Coefficient on inflation in Taylor rule	1.5	1.5
ϕ_y	Coefficient on output gap in Taylor rule	0	0.0

Moments for the idiosyncratic income process were obtained using PLIDA administrative dataset from ABS. Wealth statistics are also taken from ABS. Attention is matched to the empirical results through the calibration of the cost of attention parameter λ. Output, labor hours and price level are normalized to 1. In the case of occupations, the share of high-income households is $m_2 = 0.3$, there are two occupations and the wages in those occupations are: 0.43 and 1.21 (wage distribution pins down α_o), labor substitutability across occupations is measured through $\sigma = 0.2$, high-income households have a comparative advantage in high-wage occupation $\eta_2^2 = 1.0$ and $\eta_2^1 = 0.68$, low-income households have a comparative advantage in occupation 1 $\eta_1^1 = 1.0$ and $\eta_1^2 = 0.16$. The occupational wages and skill-distribution is based on O*NET and KLEMS data, see Faia et al. (2022) for details[10].

We derive optimal attention analytically and find that it is an inverse function of the volatility of inflation. We simulate the model under three shocks: monetary policy, markup and technology shocks. Table 4 shows the values for the shock process parameters we used in the calibration. The values for monetary policy and markup shocks are taken from Smets and Wouters (2007), parameters for the technology shocks are calibrated to match output and consumption volatility from the data (US, since 1966, HP filter). We find attention for different values of ϕ_π by solving a fixed point between the attention levels of

10 The analysis can of course be extended to more than 2 occupation-specific income levels, see also Faia et al. (2022) who analyze 8 occupational groups

Table 4: Shock process parameters

Shocks	Monetary Policy	Markup	TFP
ρ	0.15	0.69	0.98
σ	0.24	0.04	0.14

Notes: The table shows the parameters used for the specification of the shock process. The values for the monetary policy and markup shocks are taken from Smets and Wouters (2007) and the values for TFP shocks are calibrated to match output and consumption volatility from the US data for the period of 1996-2023.

two types of households and the volatility of inflation. Particularly, we guess the volatility for inflation σ_π, solve for attention levels given the volatility of inflation, simulate the model with the found levels of attention under the above specified calibration of shocks, verify that the guessed volatility of inflation is close to the levels we find in the data and if not, we update the guess of inflation volatility and repeat until we converge.

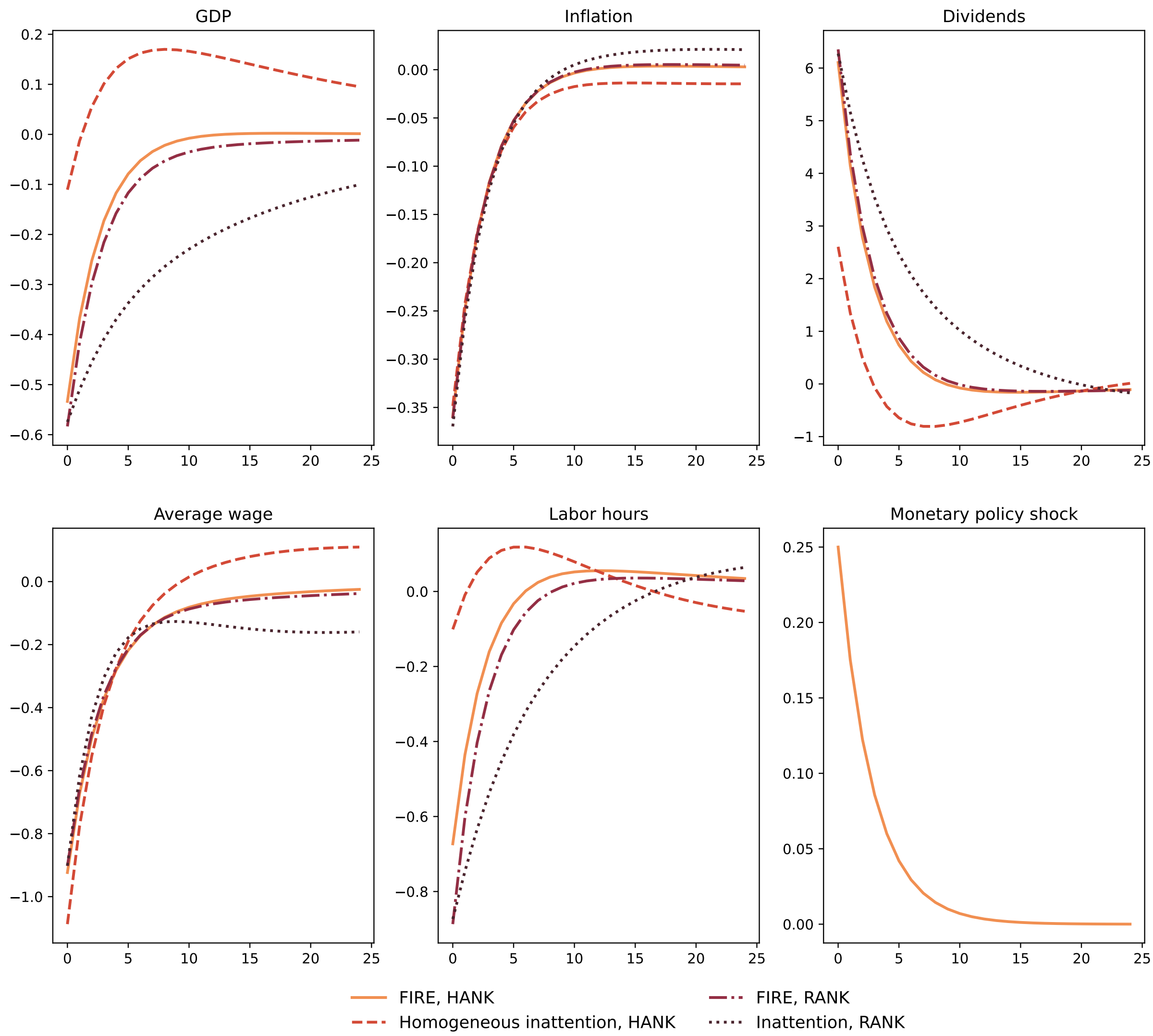
5. Model results

The following section presents the model results for our HANK model. The shock we consider is the monetary policy shock. Impulse Response functions to TFP and markup shocks can be found in the Appendix E. We compare results for HANK and RANK economies, both under FIRE and endogenous inattention.

5.1. Homogeneous inattention

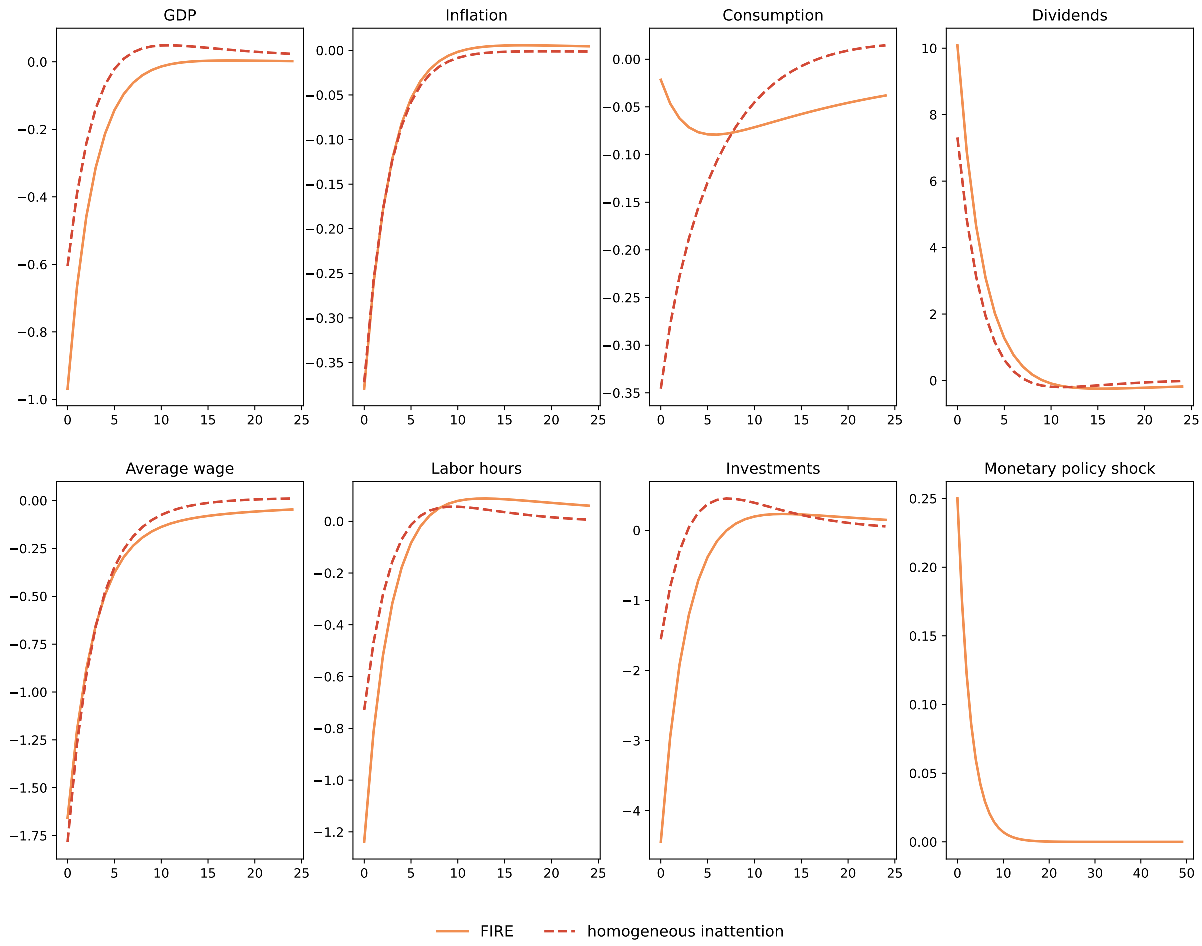
Figure 7 and Figure 8 show the impulse response functions for Australia and the US to a 25 basis points contractionary monetary policy shock. We compare results of the traditional, FIRE baseline model with exogenous wage inequality to the responses in a homogeneous inattention economy in which households have the same level of inattention. For the mdoel calibrated to the US we also show how those responses compare to RANK with FIRE and with inattention. In both countries, the US and Australia, a contractionary monetary policy shock induces a recession and a decrease in inflation (see first row, the first two graphs). In all cases, wages go down because of the decrease in labor demand which follows a decrease in investments (see second row, the first and the third graphs). As a result of a decrease in wages, labor supply and consumption also fall (see second row, second graph). However, with inattentive households the perceived wages fall by more and the perceived interest rate increases by less. Reason being that due to inattention to prices, the household doesn't realize that a decrease in inflation or the price level actually implies an increase in his real wage, but he rather perceives himself to be poorer as he actually is, inclining him to work more to compensate for his perceived loss in income and the drop in macroeconomic conditions he observes. The larger perceived drop in labor income leads to a larger decrease in consumption which dominates the more muted intertemporal substitution effect that stimulates consumption. This is another manifestation of a larger indirect effect compared to a direct effect in models with heterogeneous households. As a result, in RANK, where indirect effects are small, the difference between FIRE and the model with inattention is less.

Figure 7: Impulse Response Functions to a monetary policy shock, US



Notes: The figure shows in percentage points the impulse-responses of output, inflation, dividends, average wage and labor hours to a contractionary 25 bps monetary policy shock for the USA. The orange line shows the impulse response function under full information rational expectations for the HANK model, the dashed dark red line shows the results under FIRE in RANK model, the dashed light red line shows the results under homogeneous inattention in HANK model and the dotted dark red line shows the results under homogeneous inattention in a RANK model.

Figure 8: Impulse Response Functions to a monetary policy shock, AUS



Notes: The figure shows in percentage points the impulse-responses of output, inflation, consumption, dividends, average wage, labor hours, investments to a contractionary 25 bps monetary policy shock for Australia. The orange line shows the impulse response function under full information rational expectations and the red line shows the results under homogeneous inattention.

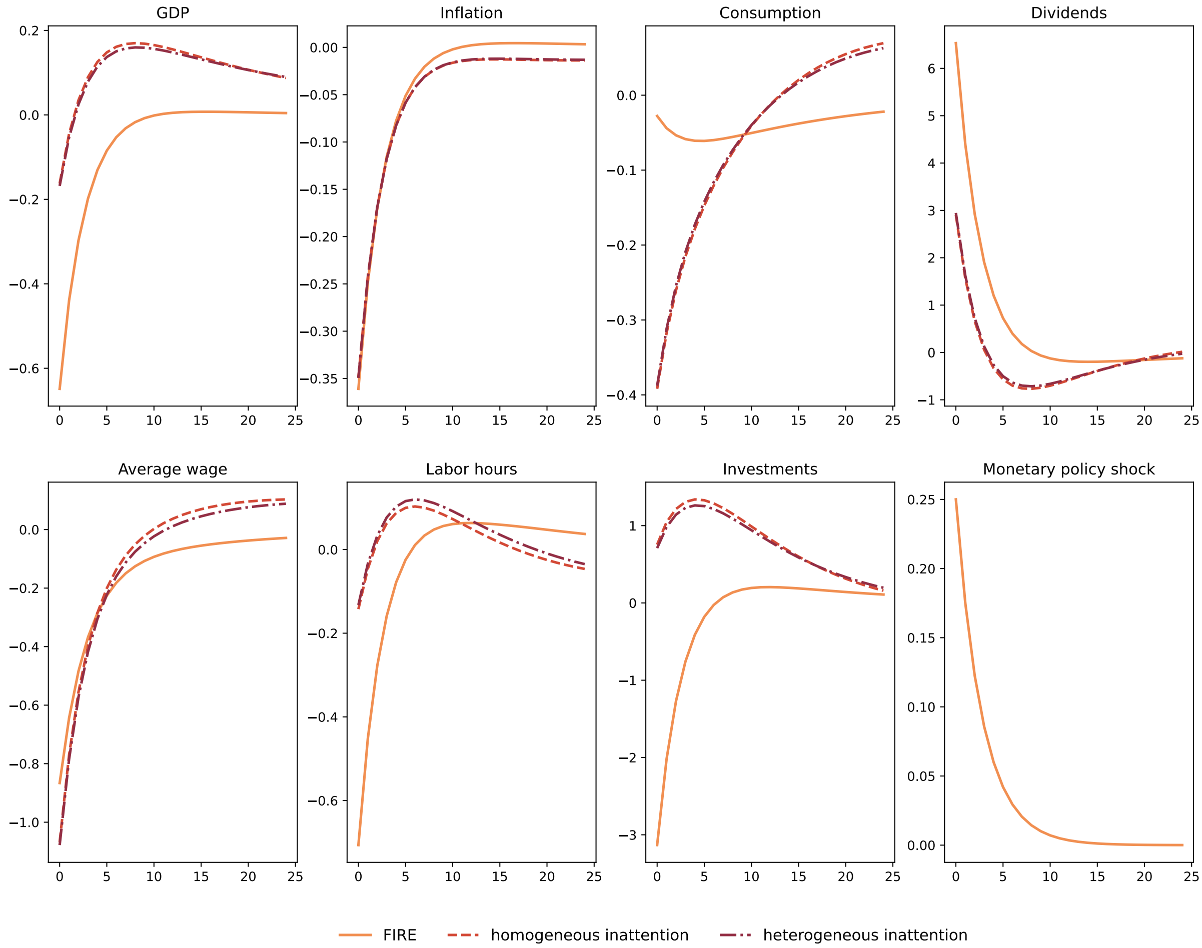
Additionally, the increase in the household's marginal propensity to consume incentives the agent to increase his labor supply and due to labor capital complimentarity, also incentives firms to increase investments, stimulating the overall economy, making the recession less deep. The inflation-output trade-off thereby is better in an inattentive economy reinforcing the importance of anchored expectations for stabilizing an economy.

Results with real wage rigidity are shown in the Appendix E.5 in Figure 18 and show less of a difference between the responses of the economy under FIRE HANK and HANK with inattention. This provides additional evidence that that the main channel of inattention is through the perceived drop in wages. When there are real wages rigidities and agents anticipate that, they perceive the drop in real incomes as less severe.

5.2. Heterogeneous inattention along the endogenous income dimension

To study the effects of heterogeneous inattention we now extend the model by the endogenous income inequality dimension allowing for occupational choice. We compare impulse-responses in our model with heterogeneous inattention ($\gamma^1 \neq \gamma^2$ for groups $g = 1, 2$) to the two counterfactual economies: homogeneous inattention (every household group has the same level of inattention, $\gamma^1 = \gamma^2 \neq 1$) and the traditional full information rational expectations (every household group has full attention, $\gamma^g = 1 \forall g$). As the results are mostly the same for both countries we focus on the US in the following.

Figure 9: Impulse Response Functions to a Monetary Policy Shock with endogenous occupation, US



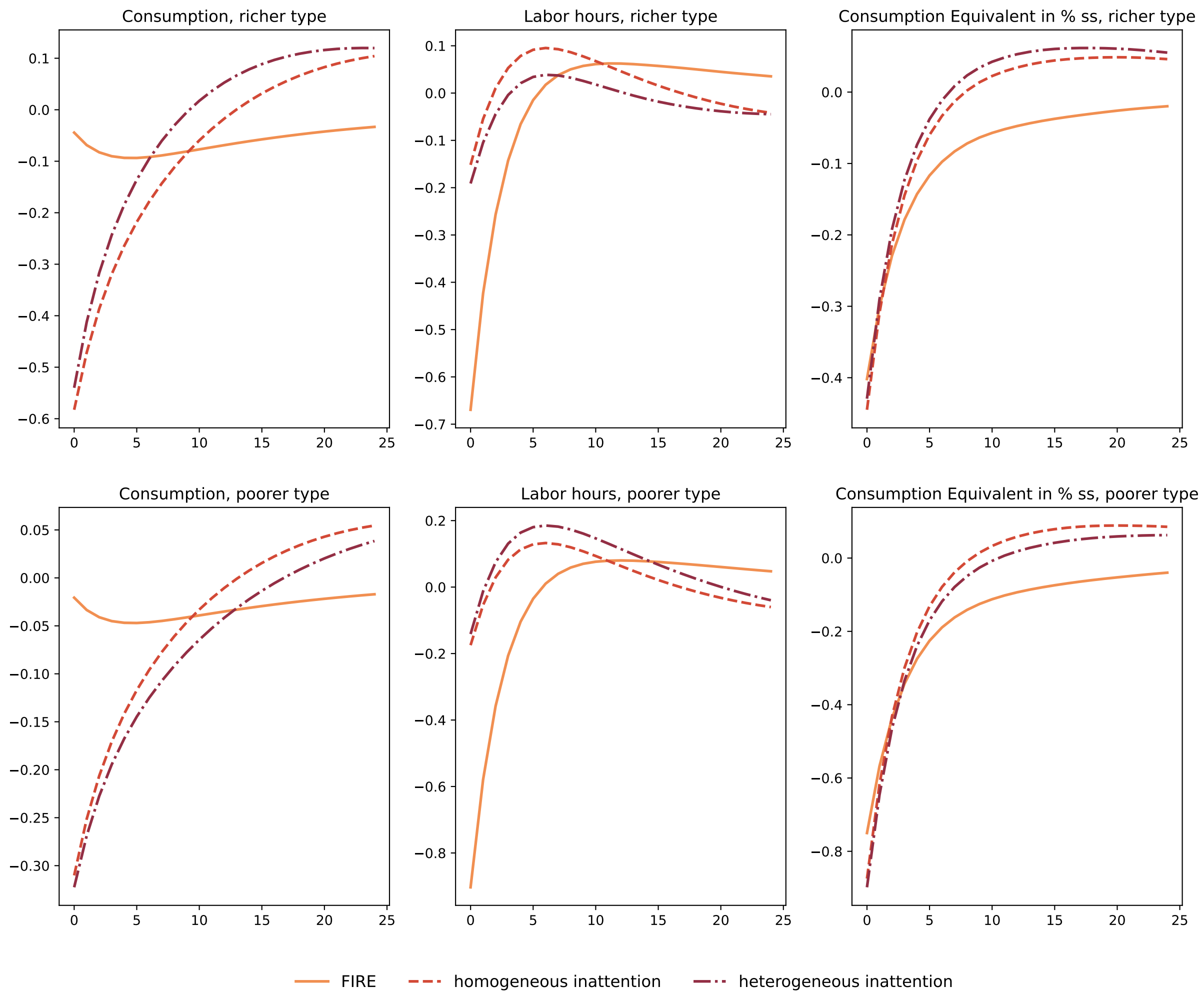
Notes: The figure shows in percentage points the impulse-responses of output, inflation, consumption, dividends, average wage, labor hours and investments to a contractionary 25 bps monetary policy shock for the USA in the HANK model with endogenous occupation. The orange line shows the impulse response function under full information rational expectations, the dashed light red line shows the results under homogeneous inattention in HANK model and the dashed dark red line shows the results under heterogeneous inattention.

Figure 9 shows impulse response functions to the same 25 basis points contractionary monetary policy shock for the aggregate variables as in the previous exercise. The monetary policy shock again creates a recession in the traditional economy as well as in the economies with homogeneous and heterogeneous inattention, whereby again, the output-inflation trade-off is better in an economy with anchored expectations allowing households to be inattentive to inflation. However, with heterogeneous inattention, the consumption drop is mostly concentrated among more constrained households. Their lower attention and larger perceived drop in wages leads to an even larger increase in labour hours, which can be seen in the lower panel of Figure 9, elucidating the dominance of the income effect in an economy with inattentive households, amplified with heterogeneous levels of attention.

Welfare analysis Figure 10 extends this analysis and decomposes the aggregate effect into its income-specific components. The figure shows the responses of consumption, labor hours and the welfare into the responses for high-income (richer type) households in the top panel and the low-income (poor type) households in the bottom panel. Although at the aggregate in Figure 9 the responses between homogeneous and heterogeneous attention do not differ much, Figure 10 shows that there are significant differences in the type-specific responses. If all household groups have the same level of attention (homogeneous attention), consumption of the high-income households decreases more in response to a contractionary monetary policy shock, compared to the poor households. Given that high-income households observe the changes in price levels more correctly than low-income households and they also observe the general recession induced by an increase in inflation, they smooth their consumption, while increasing their savings benefiting off of the increase in interest rates. Constrained households on the other side don't have a consumption-smoothing motive as they are constrained and therefore have to consume most of their income.

With income-specific attention, the consumption response becomes even more different: poor households decrease their consumption even more while rich households have a slightly higher consumption level compared to the homogeneous attention level. Reason being is the response in labor hours and the perceived drop in real wages (see dark red vs. light red lines): with low levels of attention low-income households work due to the misperception of the change in real wage more while high-income households decrease their hours worked as they understand that their real income improves after a decrease in the equilibrium price level. Thereby the welfare is more negative under both types of inattention for both types of income-level whereby we observe the same pattern for heterogeneous inattention as for consumption and labour supply implying an increase in welfare with a higher level of attention or high income (dark red dotted line in the top panel) and a decrease in welfare with low levels of attention or low income (dark red dotted line in the lower panel). This result is supported by the consumption-equivalent welfare across the economies: the drop

Figure 10: Heterogeneity across income types, US



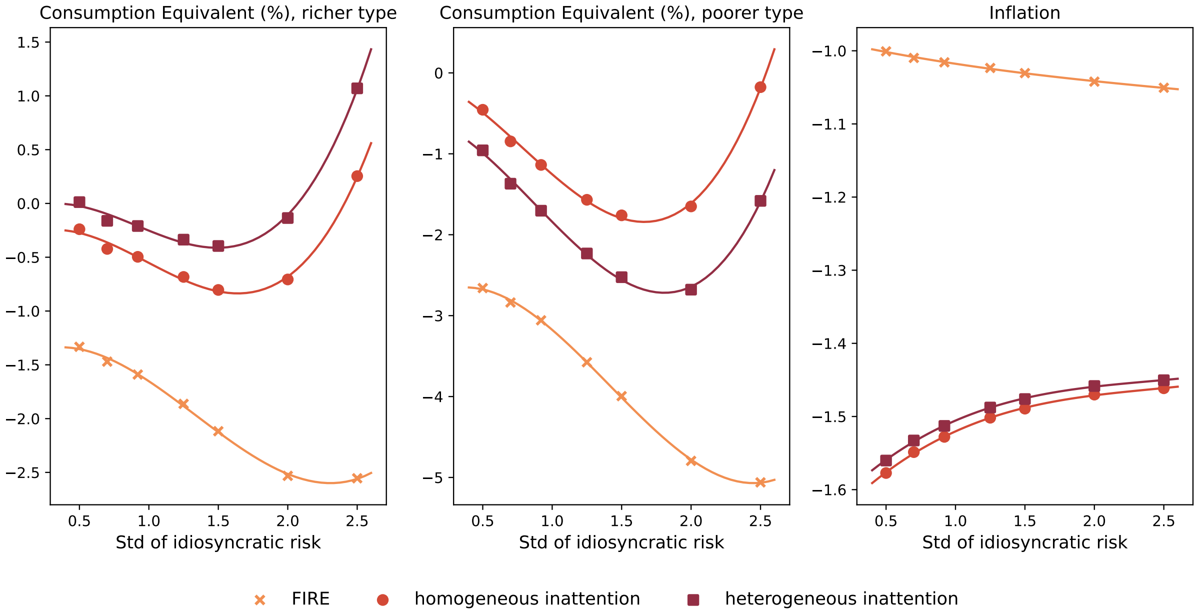
Notes: The figure shows in percentage points the impulse-responses of consumption, labor hours and the consumption equivalent welfare variation to a 25 bps monetary policy shock for the USA in the HANK model with endogenous occupation. The orange line shows the impulse response function under full information rational expectations, the dashed light red line shows the results under homogeneous inattention in HANK model and the dashed dark red line shows the results under heterogeneous inattention. The top panel shows the results for high-income households, the lower panel shows the results for low-income households

in welfare is larger for poorer households as these households who are at the bottom of the distribution lack the smoothing mechanism.

The role of transitory income inequality Figure 11 shows how idiosyncratic risk amplifies the difference in welfare costs between inattentive low- and high-income earners[11] measured as the consumption equivalent welfare variation. The results reinforce our previous conclusions: along the increase in idiosyncratic risk, heterogeneous attention has opposite effects on high- and low-income households compared to homogeneous attention -

11 see Appendix E for an analysis without permanent, occupation-induced income inequality

Figure 11: Welfare analysis



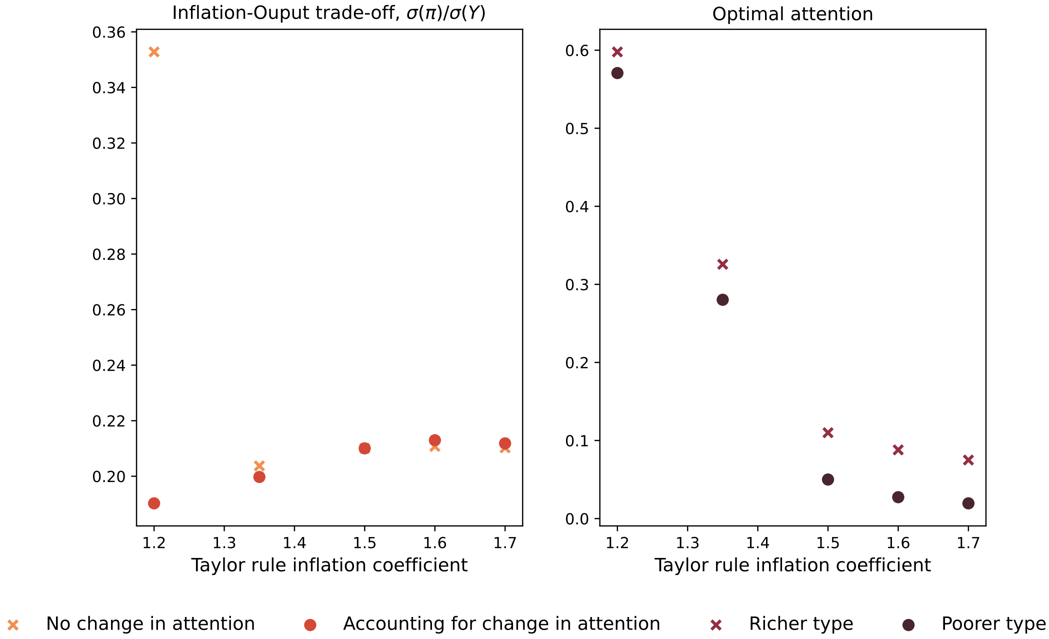
Notes: The figure shows the change of consumption equivalent welfare variation and inflation relative to the change of the standard deviation of idiosyncratic risk for high-income (top panel) and low-income (bottom panel) households under full information rational expectations, homogeneous and heterogeneous inattention. Each dot shows a cumulative loss in consumption equivalent terms.

it increases welfare for high-income households and decreases it for low-income households due to the lack in the smoothing mechanism of poor households - while the change in welfare with the increase in idiosyncratic risk remains relatively constant under full attention. The effects on inflation are even more pronounced.

5.3. The Role of Monetary Policy

To analyze the effects of attention on monetary policy we simulate the model for different attention parameters shown in Figure 12. This figure shows both the inflation-output trade-off the central bank faces and the optimal attention level of the household dependent on the Taylor rule coefficient. The left panel shows the inflation-output trade-off in the economy by evaluation the ratio of inflation-output volatility for different values of the inflation coefficient ϕ_π. The right panel shows the optimal levels of attention corresponding to those different weights on inflation ϕ_π from the left panel. We assess the trade-off when first, households have a constant level of attention and don't change their attention to the central bank reacts to inflation, and second, when the households change their attention level in response to the central bank's policy. The according optimal attention levels consistent with the ϕ_π values are evaluated for low-income (poorer type) and high-income (richer type) households shown in the right panel. The central bank faces a better inflation-

Figure 12: The Role of Monetary Policy



Notes: The figure shows the ratio between the Taylor coefficient and output volatility σ_π/σ_y for different values of ϕ_π (panel on the left side) with the optimal level of attention that is consistent with the volatility of inflation (panel on the right side) for high-income (richer type) and low-income (poorer type) households.

output trade-off ($\frac{\sigma_\pi}{\sigma_y} = 0.35$) when households have a high and constant level of attention ($\gamma^g \approx 0.6, g = 1, 2$), i.e. when expectations are anchored and the reaction to inflation is low ($\phi_\pi = 1.2$). The economy is better off, household inflation expectations are anchored and output is stable. When the households however change their attention as a reaction to the central bank's policy, the inflation-output gets worse ($\phi_\pi = 0.1$) and the economy crashes. The inflation-output trade-off worsens when the central bank reacts more to inflation ($\phi_\pi > 1.2$), independent of the fact if the households change their attention or not. Household's optimal level of attention decreases with an increasing Taylor rule coefficient while it also leads to a worse inflation-output trade-off in the economy. This decrease is steeper for low-income than for high-income households, worsening their economic welfare. Therefore, in an economy with inattentive households monetary policy has a larger effect on inflation, stimulating the macro economy, and it is preferable for households to have stable inflation expectations due to a constant and high level of attention as their optimal consumption choice is closer to the optimum under full information such that their loss in utility is minimized, stimulating the aggregate economy.

6. Conclusion

This paper studies how attention varies across distribution of households and what implications it has for monetary policy transmission. We have shown empirical cross-country evidence for varying attention across demographic groups, specifically income levels. We find significant results for higher attention of high-income households. Among different shocks, we find higher reaction to oil price shocks compared to monetary policy ones (domestic and foreign). To quantify the results we introduce behavioral inattention into a one-asset HANK model in which households are inattentive to inflation. We calibrate our model to match empirical evidence on inattention that we find in the data. Counterfactual exercises show that compared to the fully rational expectations monetary policy has more of an effect on inflation, and the inflation-output trade-off is better with anchored expectations. However the better trade-off is achieved through a larger decrease in welfare among low-earners following a contractionary monetary policy shock. Idiosyncratic risk amplifies the difference in welfare costs between low- and high-income earners in response to monetary policy shocks.

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A. Data

In this section we describe the data used in Section 2.2. For the US we us the Survey of Consumer Expectations (SCE) provided by the New York Fed, the St. Louis Fed FRED data to recover macro variables and the administrative dataset PLIDA to match moments for the idiosyncratic income process. For Australia we use data from the Consumer Attitudes, Sentiments and Expectations in Australia Survey (CASiE).

A.1. Australia Descriptive Statistics

Table 5 shows the summary statistics for data in CASiE and the monetary shocks by Romer and Romer (2004); Hambur and Haque (2023); Beckers et al. (2020) and the oil supply news shocks by Känzig (2021). We use quarterly data for the period of 1974 - 2023.

To quantify heterogeneous inflation expectations from the data we use responses to the following question: "By what percentage do you think prices will have gone up by this time next year?" Respondents are asked to assign probabilities to values between 0 and 100.

Table 5: Summary Statistics, AUS

Variable	Median	25%	75%	1%	99%
Inflation expectations	5.0	2.0	6.0	-2.0	15.0
CPI inflation	2.5	1.7	3.1	-0.3	7.3
Romer-Romer shocks	0.008	-0.06	0.08	-0.40	0.35
Romer-Romer aug. shocks	0.008	-0.07	0.09	-0.50	0.38
Level shocks	0.0	-0.10	0.03	-2.16	2.24
Path shocks	0.0	-0.20	0.0	-1.46	2.36
Term-premia shocks	0.0	-0.04	0.13	-1.94	2.07
Oil news shocks	-0.05	-0.35	0.37	-1.58	1.30
Oil news shocks precovid	-0.005	-0.38	0.39	-1.44	1.35
Male	1.0	0.0	1.0	0.0	1.0
Income level	\$40-90k	$\leq$ \$40k	$\geq$ \$90k	$\leq$ \$40k	$\geq$ \$90k
Self-employed	0.0	0.0	0.0	0.0	1.0
Education	above school	school or below	above school	school or below	above school
Home-owners	1.0	1.0	1.0	0.0	1.0
Age	$\geq$ 45	34-45	$\geq$ 45	18-34	$\geq$ 45
Full-time workers	1.0	0.0	1.0	0.0	1.0

Note: The table shows summary statistics of the Australian data. We show the statistics for 1-year-ahead inflation expectations and the households characteristics we consider from CASiE, CPI inflation and the monetary and oil supply news shocks we consider for the analysis.

A.2. US Descriptive Statistics

Table 6 shows the summary statistics of the SCE data from the New York Fed for the period June 2013 - January 2023. For the US we consider two sets of monetary policy shocks, in particular we use shocks constructed by Nakamura and Steinsson (2018) and Bauer and Swanson (2023) and for the oil supply shocks we again consider the shocks constructed by Känzig (2021). We define a similar set of variables and cross-sectional characteristics for the US data as we did for the Australian survey. Income is categorized into three groups: the bottom 25.5% are those households that had a pre-tax income in the last 12 months of less than $\$40,000$, that of the 44.7% mid income households is $\$40,000 - \$99,999$ and high income households are the top 29.8% of our total population and have a total pre-tax income level of $\geq \$100,000$. CPI Inflation is the annualized, quarterly CPI inflation rate constructed using the US consumer price index from the St. Louis Fed FRED database (CPIAUCSL). For inflation expectations, we use responses to the following question: "What do you expect the rate of inflation/deflation to be over the next 12 months?" Respondents are asked to assign some probabilities. For the analysis we drop extreme values of $> |50|\%$.

Table 6: Summary Statistics, USA

Variable	Median	25%	75%	1%	99%
Inflation expectation	3.0	2.0	6.0	-25.0	49.0
CPI Inflation	2.17	1.41	3.35	-3.86	9.21
Nakamura and Steinsson	0.00	0.00	0.19	-1.37	1.99
Bauer and Swanson	0.0	0.0	0.01	-0.08	0.05
Oil news shocks, pre-Covid	-0.09	-0.46	0.39	-1.69	1.36
Oil news shocks	-0.05	-0.36	0.38	-1.66	1.49
Male dummy	1.0	0.0	1.0	0.0	1.0
Income level	\$40-99k	$<$ \$40k	$\geq$ \$100k	$<$ \$40k	$\geq$ \$100k
Self-employed	0.0	0.0	0.0	0.0	1.0
Education	College	Some College	College	High School	College
Home-owners	1.0	0.0	1.0	0.0	1.0
Age	40-60	$<$ 40	$>$ 60	$<$ 40	$>$ 60
Full-time workers	1.0	0.0	1.0	0.0	1.0

Note: The table shows summary statistics of the relevant variables for the New York Fed CSE. Nakamura and Steinsson are the monetary policy shocks constructed by Acosta (2022) following Nakamura and Steinsson (2018). Bauer and Swanson are the monetary policy shocks constructed by Bauer and Swanson (2023) using high-frequency data. Oil news shocks are taken from Känzig (2021). CPI Inflation is the quarterly change of the CPI.

B. Additional Results to Section 2.2

B.1. Aggregate Regressions

Based on group-specific inflation expectation equation (4) we can derive an equivalent equation for the average inflation expectation by averaging across g to get the expression for average inflation expectations as

$$\bar{\pi}_{t+1,t} = \bar{\beta} + \beta_1 \bar{\pi}_{t,t-1} + \beta_2(\pi_t - \bar{\pi}_{t,t-1}) + \bar{\epsilon}_t \tag{B.1}$$

where $\bar{\pi}_{t+1,t}$ denotes the average one period ahead inflation expectation in year t and $\bar{\beta}$ denotes the average of β_i. Following the same steps as in (7) we derive an equation of aggregate forecast errors of inflation, in the vein of Kučinskas and Peters (2022). In particular, we estimate the following regression

$$\bar{e}_{t+1} = \beta_0 + \beta_1 u_t^m + \bar{\nu}_t \tag{B.2}$$

where $\bar{e}_{t+1} = \pi_{t+1} + \bar{\pi}_{t+1,t}$ are the average forecast errors of inflation across groups, u_t^m is either the shock of interest (monetary policy or oil price news shock) directly or is used as an instrument for the central bank interest rate (if we consider monetary policy shocks) or the oil price change (if we consider oil price news shocks).

Table 7 shows the results for equation (B.2). The first row of Panel A and B shows the regression coefficients if we use the shocks, noted in the header, as an instrument for the central bank interest rate (columns 2-6) and the oil price change (columns 7-8), whereby the second row of Panel A and B shows the regression output when we regress forecast errors on the shocks specified in columns 2-8 directly.

Table 7: Forecast errors on shocks, aggregate level

	Panel A: AUS						
	Romer-Romer	Romer-Romer aug.	Level	Path	Term-premia	Oil News	Oil News pre-covid
IV	0.10 (0.61)	-0.05 (1.17)	0.03 (0.58)	6.08 (25.94)	-0.42 (4.70)	1.75 (1.21)	0.59 (1.00)
Reduced Form	0.12 (0.78)	-0.03 (0.81)	-0.01 (0.10)	-0.06 (0.10)	-0.01 (0.10)	0.23 (0.16)	0.07 (0.13)
No. of observations	96	96	109	109	109	109	100
	Panel B: USA						
	NS	GSS target	GSS path	Acosta	MPS	Oil News	Oil News pre-covid
IV	-2.36 (8.45)	0.03 (0.31)	-0.56 (0.86)	-0.09 (0.37)	4.13 (19.67)	1.77 (3.63)	1.99 (2.55)
Reduced Form	0.33 (0.51)	0.06 (0.64)	0.29 (0.51)	-4.92 (19.08)	10.92 (9.25)	0.25 (0.50)	0.25 (0.32)
No. of observations	36	36	36	36	27	36	27

Note: The table shows regression coefficients for aggregated across households inflation forecasting errors regressed on different shocks either directly (reduced form) or using IV (where shocks are used as an instrument for central bank interest rate or oil price changes) estimating (B.2). Panel A shows the result for Australia using a set of externally constructed monetary policy shocks and oil price new shocks.Romer-Romer shocks are monetary policy shocks constructed for Australia by Beckers et al. (2020) following Romer and Romer (2004). Level, path and term-premia shocks are high-frequency identified monetary policy shocks constructed by Hambur and Haque (2023) following Gürkaynak et al. (2005) with the Kaminska et al. (2021) extension that decomposes shocks into level, path and term-premia components. Oil news shocks are taken from Känzig (2021). Panel B shows the regression results of (B.2) for the US using a set of monetary policy and oil price news shocks. Acosta shocks contain the 30-minute change in expectations of the FFR immediately after each FOMC meeting, constructed by Acosta (2022). NS shocks are the monetary policy shocks constructed by Acosta (2022) following Nakamura and Steinsson (2018). Target and path shocks are high-frequency identified monetary policy shocks all constructed by Acosta (2022) following Gürkaynak et al. (2005). MPS shocks are the monetary policy shock instrument constructed by Bauer and Swanson (2023) using high-frequency data. Oil news shocks are taken from Känzig (2021).

B.2. Panel Regressions

Table 8: Forecast errors on shocks, cross-section

	Panel A: AUS						
	Romer-Romer	Romer-Romer aug.	Level	Path	Term-premia	Oil News	Oil News pre-covid
IV	-0.52*** (0.19)	-0.57* (0.31)	-0.23 (0.20)	-5.01** (2.50)	-11.00 (16.50)	1.13** (0.47)	-0.39 (0.38)
Reduced form	-0.93*** (0.33)	-0.67* (0.37)	0.04 (0.03)	-0.13*** (0.03)	0.11*** (0.03)	0.14** (0.06)	-0.05 (0.05)
No. of observations	832	832	1035	1035	1035	1035	896
	Panel B: USA						
	NS	GSS target	GSS path	Acosta	MPS	Oil News	Oil News pre-covid
IV	-2.20 (3.21)	-0.01 (0.13)	-0.51* (0.37)	-0.14 (0.14)	3.27 (4.58)	1.97 (1.49)	2.29* (1.13)
Reduced Form	0.26 (0.20)	-0.01 (0.26)	0.25 (0.20)	-7.24 (7.37)	10.17** (3.46)	0.28 (0.20)	0.29* (0.14)
No. of observations	284	284	284	284	212	284	212

Note: The table shows regression coefficients for aggregated across households inflation forecasting errors regressed on different shocks either directly (reduced form) or using IV (where shocks are used as an instrument for central bank interest rate or oil price changes) estimating (B.2). Panel A shows the result for Australia using a set of externally constructed monetary policy shocks and oil price new shocks.Romer-Romer shocks are monetary policy shocks constructed for Australia by Beckers et al. (2020) following Romer and Romer (2004). Level, path and term-premia shocks are high-frequency identified monetary policy shocks constructed by Hambur and Haque (2023) following Gürkaynak et al. (2005) with the Kaminska et al. (2021) extension that decomposes shocks into level, path and term-premia components. Oil news shocks are taken from Känzig (2021). Panel B shows the regression results of (B.2) for the US using a set of monetary policy and oil price news shocks. Acosta shocks contain the 30-minute change in expectations of the FFR immediately after each FOMC meeting, constructed by Acosta (2022). NS shocks are the monetary policy shocks constructed by Acosta (2022) following Nakamura and Steinsson (2018). Target and path shocks are high-frequency identified monetary policy shocks all constructed by Acosta (2022) following Gürkaynak et al. (2005). MPS shocks are the monetary policy shock instrument constructed by Bauer and Swanson (2023) using high-frequency data. Oil news shocks are taken from Känzig (2021).

Table 9: Forecast errors on foreign shocks for AUS, cross-section

	NS	GSS target	GSS path	Acosta	MPS
IV	4.11*** (1.23)	-3.63 (2.34)	9.36*** (1.98)	-1.26 (1.79)	3.22*** (0.74)
Reduced Form	0.10*** (0.03)	-0.09* (0.05)	0.20*** (0.03)	-0.89 (1.18)	0.38*** (0.08)
No. of observations	1003	1003	1003	1003	864

Note: The table shows regression coefficients for households inflation forecasting errors regressed on different shocks either directly (reduced form) or using IV (where shocks are used as an instrument for FFR rate changes). Acosta shocks contain the 30-minute change in expectations of the FFR immediately after each FOMC meeting (first component of the policy news shock), constructed by Acosta (2022). NS shocks are the monetary policy shocks constructed by Acosta (2022) following Nakamura and Steinsson (2018). Target and path shocks are high-frequency identified monetary policy shocks all constructed by Acosta (2022) following Gürkaynak et al. (2005). MPS shocks are the monetary policy shock instrument constructed by Bauer and Swanson (2023) using high-frequency data.

Table 10: Group-specific forecast errors on shocks, AUS

	Romer-Romer	Romer-Romer aug.	Level	Path	Term-premia	Oil News	Oil News pre-covid
				Income level			
High-income	-0.88* (0.46)	-0.50 (0.49)	-0.01 (0.04)	-0.13*** (0.04)	0.12** (0.05)	0.10 (0.08)	-0.04 (0.06)
Mid and low-income	-0.98** (0.48)	-0.85 (0.55)	0.09* (0.05)	-0.13*** (0.04)	0.10** (0.05)	0.18** (0.09)	-0.05 (0.07)
				Entrepreneurs			
Self-employed	-1.36*** (0.52)	-1.09* (0.58)	0.04 (0.04)	-0.16*** (0.04)	0.13*** (0.05)	0.08 (0.09)	-0.10 (0.07)
Not self-employed	-0.50 (0.41)	-0.26 (0.45)	0.03 (0.04)	-0.10*** (0.04)	0.09** (0.04)	0.20*** (0.07)	0.01 (0.05)
				Occupation			
Professionals	-1.14** (0.46)	-0.91* (0.51)	0.05 (0.04)	-0.11*** (0.04)	0.12*** (0.05)	0.06 (0.08)	-0.07 (0.07)
Not professionals	-0.72 (0.47)	-0.43 (0.53)	0.03 (0.04)	-0.14*** (0.04)	0.10** (0.05)	0.22*** (0.08)	-0.03 (0.06)
				Sex dummy			
Female	-0.85* (0.47)	-0.76 (0.53)	0.02 (0.05)	-0.17*** (0.04)	0.14*** (0.05)	0.10 (0.08)	-0.06 (0.07)
Male	-1.01** (0.46)	-0.58 (0.52)	0.05 (0.04)	-0.08** (0.04)	0.08* (0.05)	0.19** (0.08)	-0.04 (0.06)
No. of observations	832	832	1034	1034	1034	1034	896

Note: The table shows regression coefficients for households inflation forecasting errors regressed on different shocks (reduced form) interacted with different dummies (one at a time). Romer-Romer shocks are monetary policy shocks constructed for Australia by Beckers et al. (2020) following Romer and Romer (2004) methodology. Level, path and term-premia shocks are high-frequency identified monetary policy shocks constructed by Hambur and Haque (2023) following Gürkaynak et al. (2005) with the Kaminska et al. (2021) extension that decomposes shocks into level, path and term-premia components. Oil news shocks are taken from Känzig (2021)

Table 11: Panel Regressions of Inflation Expectations Across Household Characteristics, USA

	NS	GSS target	GSS path	Acosta	MPS	Oil News	Oil News pre-covid
				Income level			
High-income	0.29 (0.30)	-0.03 (0.40)	0.27 (0.30)	-7.99 (11.05)	11.28* (4.65)	0.34 (0.29)	0.39 (0.19)
Mid and low-income	0.25 (0.27)	0.01 (0.32)	0.23 (0.27)	-6.38 (9.43)	8.97 (5.17)	0.21 (0.28)	0.18 (0.21)
				Entrepreneurs			
Self-employed	0.19 (0.31)	-0.09 (0.39)	0.19 (0.26)	-9.68 (10.61)	8.62 (5.21)	0.29 (0.31)	0.31 (0.24)
Not self-employed	0.36 (0.26)	0.07 (0.35)	0.31 (0.30)	-4.48 (10.12)	11.88** (4.47)	0.27 (0.26)	0.28 (0.16)
				Sex dummy			
Female	0.08 (0.33)	-0.08 (0.41)	0.10 (0.32)	-10.93 (11.10)	8.69 (5.29)	0.15 (0.32)	0.24 (0.23)
Male	0.46 (0.24)	0.06 (0.32)	0.40 (0.23)	-3.32 (9.56)	11.70* (4.55)	0.41 (0.24)	0.34* (0.17)
No. of observations	284	284	284	284	212	284	212

Note: The table shows regression coefficients for households inflation forecasting errors regressed on different shocks (reduced form) interacted with different dummies (one at a time). Acosta shocks contain the 30-minute change in expectations of the FFR immediately after each FOMC meeting (first component of the policy news shock), constructed by Acosta (2022). NS shocks are the monetary policy shocks constructed by Acosta (2022) following Nakamura and Steinsson (2018). Target and path shocks are high-frequency identified monetary policy shocks all constructed by Acosta (2022) following Gürkaynak et al. (2005). MPS shocks are the monetary policy shock instrument constructed by Bauer and Swanson (2023) using high-frequency data. Oil news shocks are taken from Känzig (2021). Oil news shocks are taken from Känzig (2021).

C. Appendix to Section 3

C.1. Attention Choice

In general, the household in our economy solves the following problem:

$$\begin{aligned} V_{j,t}(a^n_{t-1}) &= \max_c \{u(c_t) + \beta E[V_{j,t+1}(a^n_t)]\} \\ s.t. \quad P_t c_t + a^{'}_{t-1} &= Y_g + (1+i^a_t)a^n_t \end{aligned} \tag{C.1}$$

where E is the expectation operator, we define in Definition 1.

In the traditional, fully attentive economy, the household pays full attention to all variables that are relevant to his decision making. He thereby has fully rational expectations about the entire state of the economy. If the household however is even only slightly inattentive to some state variable, he has a "sparse" representation of the world and anchors expectations about this state variable on a default value which is equal to some level of deviation form the fully rational observed value.

The *rational* household who observed the variables fully rational and pays full attention to the entire state of the economy solves

$$V_{j,t}(a^n, 1) = \max_c \{u(c) + \beta E_t[V_{j,t+1}(Y_g + (1+i^a_t)a^n - P_t c, 1)]\} \tag{C.2}$$

where we define his utility as $v_{j,t}(a^n, \gamma^g) \equiv u(c) + \beta E_t[V_{j,t+1}(Y_g + (1+i^a_t)a^n - P_t c)]$.

The *inattentive* household is inattentive to prices and solves

$$V_{j,t}(a^n) = \max_c \{u(c) + \beta E_{j,t}[V_{j,t+1}(Y_g + (1+i^a_t)a^n - P_t c)]\}$$

with utility $v_{j,t}(a^n, 1) \equiv u(c) + \beta E_{j,t}[V_{j,t+1}(Y_{g,t} + (1+i^a_t)a^n - P_t c)]$.
Taking the imperfect policy $c^*_g(\gamma^g)$ however leads to a loss in the agent's utility

$$\mathcal{L} = v_{j,t}(a^n, \gamma^g) - v_{j,t}(a^n, 1) \tag{C.3}$$

which is the difference between the optimal consumption $c^*_g(a^n, 1)$ the household chooses under full information and the imperfect consumption $c^*_g(a^n, \gamma^g)$ the household chooses under imperfect information.

To quantify (C.3), we follow Gabaix (2014) and replace $v_{j,t}$ by a second order Taylor approximation around small deviations of the state variables from their default (long-run) values. We define the default model as the model at the steady state with steady state values for consumption, wealth and income, and only prices P_t potentially variable. The household pays full attention to all the variables, except for prices for which the default attention value is $\gamma^g_d = 0$. He now has to decide how much he wants to deviate from this default attention in order to make an optimal consumption choice. Assuming perfect foresight and resorting to the recursive nature of the optimization problem allows us to rewrite the agent's utility, independent of the attention level, as

$$\begin{aligned} v_{j,t} &= v_i + v_c \hat{c}_t + v_{a^n} \hat{a}_t^n + v_Y \hat{Y}_{g,t} + \sum_{h=1}^{\infty} v_P \hat{P}_{t+h} \\ &+ \frac{1}{2} \left(\frac{\partial^2 v}{\partial c^2} \hat{c}_t^2 + \frac{\partial^2 v}{\partial c \partial Y_g} \hat{c}_t \hat{Y}_g + \frac{\partial^2 v}{\partial c \partial a^n} \hat{c}_t \hat{a}^n + \sum_{h=1}^{\infty} \frac{\partial^2 v}{\partial c \partial P_h} \hat{c}_t \hat{P}_{t+h} + \dots \right) \end{aligned}$$

where we use the notation $\hat{x}_t = x_t - \bar{x}$ as the deviation of x_t from the long-run value of the variable, $v_x \equiv \frac{\partial v_j(a^n, \gamma^g)}{\partial x}\Big|_{c=\bar{c}, a^n=\bar{a}^n, P=\bar{P}, Y_g=\bar{Y}_g}$.

Notice that from the household's Euler equation that $v_c = 0$. Since inattention enters the model linearly, we can rewrite the expected loss from being inattentive as

$$\begin{aligned} L &= E_{j,t}(v_{j,t}(a^n, \gamma^g) - v_{j,t}(a^n, 1)) \\ &= \frac{1}{2} \frac{\partial^2 v}{\partial c^2} \left(\sum_{h=1}^{\infty} \frac{\partial c}{\partial P_h} (\gamma^g - 1) P_{t+h} \right)^2 = \frac{1}{2} \frac{\partial^2 v}{\partial c^2} \left(\sum_{h=1}^{\infty} \frac{\partial c}{\partial P_h} (\gamma^g P_{t+h} - P_{t+h}) \right)^2 \\ &= \frac{1}{2} \frac{\partial^2 v}{\partial c^2} \sum_{h=1}^{\infty} \sum_{h'=1}^{\infty} \frac{\partial c}{\partial P_h} \frac{\partial c}{\partial P_{h'}} (\gamma^g - 1)^2 P_{t+h} P_{t+h'} \end{aligned}$$

The household wants to minimize his expected loss in consumption by choosing his optimal inflation-attention level γ^g facing a cognitive constraint $\chi \gamma^g$

$$\min_{\gamma^g} L = \min_{\gamma^g} -\frac{1}{2} \frac{\partial^2 v}{\partial c^2} \sum_{h=1}^{\infty} \sum_{h'=1}^{\infty} \frac{\partial c}{\partial P_h} \frac{\partial c}{\partial P_{h'}} (\gamma^g - 1)^2 \sigma_{P_h P_{h'}} + \chi \gamma^g \tag{C.4}$$

with the cost-of-inattention factor $\Lambda := -\frac{1}{2} \frac{\partial^2 v}{\partial c^2} \sum_{h=1}^{\infty} \sum_{h'=1}^{\infty} \frac{\partial c}{\partial P_h} \frac{\partial c}{\partial P_{h'}} \sigma_{P_h P_{h'}}$. Solving optimization problem (C.4) gives the result in Proposition 1.

D. Appendix to Section 4

D.1. Behavioral Jacobians

Here we derive the Jacobians of our model with inattentive households. To solve for the behavioral Jacobians we closely follow Auclert et al. (2020) section **D.3**.

Our model considers two groups of households: first, those households who have paid attention to the macroeconomy at $t \geq \tau$ and have all information about the shock arising in $t = 0$ and second, those households who didn't pay attention and still have to learn about the shock to inflation. Learning has probability $\gamma^g(1-\gamma^g)^\tau$, where γ^g is the attention parameter we use in (5). Aggregating across the households gives the following Jacobian which specifies the response of output o to inflation π:

$$J^{o,\pi} = \gamma^g \sum_{\tau=0}^{\infty} (1-\gamma^g)^\tau J^{o,\pi,\tau} \tag{D.1}$$

where $J^{o,\pi,\tau}$ is the Jacobian for the group of households learning about the shock to inflation π at date τ. It is the policy at t that responds to the shock to π at date s. The Jacobian for a given s is given by:

$$\begin{aligned} J^{o,\pi,\tau}_{t,s} &= \gamma^g \sum_{\tau=0}^{s} (1-\gamma^g)^\tau J^{o,\pi,\tau}_{t,s} \\ &= \gamma^g (J^{o,\pi,0}_{t,s} + (1-\gamma^g) J^{o,\pi,1}_{t,s} + \ldots + (1-\gamma^g)^s J^{o,\pi,s}_{t,s}) \\ &= (1-\gamma^g)^s J^{o,\pi,s}_{t,s} + \gamma^g \sum_{\tau=0}^{s-1} (1-\gamma^g)^\tau J^{o,\pi,\tau}_{t,s} \end{aligned} \tag{D.2}$$

To derive the Jacobians for each period t we further observe:

1. for $s \geq \tau$, we assume that households respond to a news shock about the date-s-change in π similarly to a news shock about the date-$(s-\tau)$-change in π, i.e. $J^{o,\pi,\tau}_{t,s} = \ldots = J^{o,\pi,0}_{t-\tau,s-\tau}$.
2. for $\tau > s$ the household has already updated her information in s about the news shock to π in s and therefore is irrelevant, such that $J^{o,\pi,\tau}_{t,s} = J^{o,\pi,s}_{t,s}, \forall t$

For any $t, s > 0$ this allows us to rewrite (D.2) as:

$$\begin{aligned} J^{o,\pi,\tau}_{t,s} &= (1-\gamma^g)^s J^{o,\pi,s}_{t,s} + \gamma^g J^{o,\pi,0}_{t,s} + \gamma^g \sum_{\tau=1}^{s-1} (1-\gamma^g)^\tau J^{o,\pi,\tau}_{t,s} \\ &= (1-\gamma^g)^s J^{o,\pi,s}_{t-1,s-1} + \gamma^g J^{o,\pi,0}_{t,s} + \gamma^g \sum_{\tau=0}^{s-2} (1-\gamma^g)^{\tau+1} J^{o,\pi,\tau}_{t-1,s-1} \\ &= (1-\gamma^g)^s J^{o,\pi}_{t-1,s-1} + \gamma^g J^{o,\pi,0}_{t,s} \end{aligned} \tag{D.3}$$

For $s = 0$, $\forall t$ (D.2) simplifies to

$$J_{t,s}^{o,\pi,\tau} = (1-\gamma^g)J_{t,s}^{o,\pi,0} + \gamma^g J_{t,s}^{o,\pi,0} = J_{t,s}^{o,\pi,0} \tag{D.4}$$

For $t = 0, s > 0$, and since $t \geq \tau$, the impulse response functions are only relevant if $\tau = 0$, such that

$$J_{t,s}^{o,\pi,\tau} = (1-\gamma^g)^s J_{t,s}^{o,\pi,s} + \gamma^g J_{t,s}^{o,\pi,\tau} = \gamma^g J_{t,s}^{o,\pi,0} \tag{D.5}$$

In period $\tau = 0$ the household has full information, i.e. paid fully attention. Since $J_{t,s}^{o,\pi,0}$ is the Jacobian for households that learn at $\tau = 0$ about shocks and as in Auclert et al. (2020) define the FIRE-Jacobian $J_{t,s}^{o,\pi,FI} \equiv J_{t,s}^{o,\pi,0}$, we get (20).

D.2. Attention Choice

Here we follow the same procedure as in Section C while also extending to idiosyncratic income shocks. The *rational* household who observed the variables fully rational and pays full attention to the entire state of the economy solves

$$V_{i,t}(a^n, e, 1) = \max_c \{u(c) + \beta E_t[V_{i,t+1}(Y_g + (1+i_t^a)a^n - P_t c, e, 1)]\} \tag{D.6}$$

where we define his utility as $v_{i,t}(a^n, e, \gamma^g) \equiv u(c) + \beta E_t[V_{i,t+1}(Y_g + (1+i_t^a)a^n - P_t c, e, 1)]$.

The *inattentive* household is inattentive to prices and solves

$$V_{i,t}(a^n, e, \gamma^g) = \max_c \{u(c) + \beta E_{i,t}[V_{i,t+1}(Y_g + (1+i_t^a)a^n - P_t c, e, \gamma^g)]\}$$

with utility $v_{i,t}(a^n, e, \gamma^g) \equiv u(c) + \beta E_{i,t}[V_{i,t+1}(Y_{g,t} + (1+i_t^a)a^n - P_t c, e)]$.
The loss in the agent's utility from choosing suboptimal consumption is

$$L = v_{i,t}(a_t^n, e_t, \gamma^g) - v_{i,t}(a_t^n, e_t, 1) \tag{D.7}$$

The household's expected loss in consumption from being inattentive is weighted by the ergodic distribution as

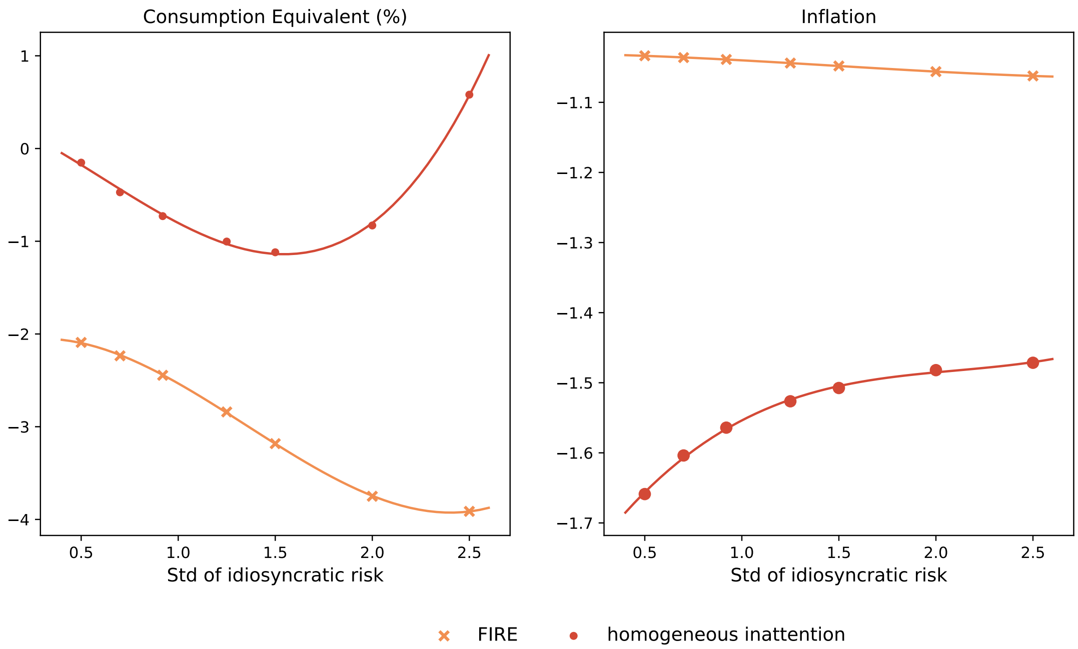
$$\min_{\gamma^g} \; -\frac{1}{2}(\gamma^g - 1)^2 \sigma_P^2 \sum_e \int \left(\frac{\partial c}{\partial P}\right)^2 \frac{\partial^2 v(a^n, e, \gamma^g)}{\partial (c)^2} dD^g(e, da) + \chi\gamma^g \tag{D.8}$$

with the cost-of-inattention factor $\Lambda := -\frac{1}{2}\sum_e \int \left(\frac{\partial c}{\partial p}\right)^2 \frac{\partial^2 v^g(a^n, e, \gamma^g)}{\partial (c)^2} dD^g(e, da)$. Solving (D.8) gives the solution we propose in Proposition 3.

E. Appendix to Section 5: Additional Results and Figures

E.1. The Role of Transitory Income Inequality

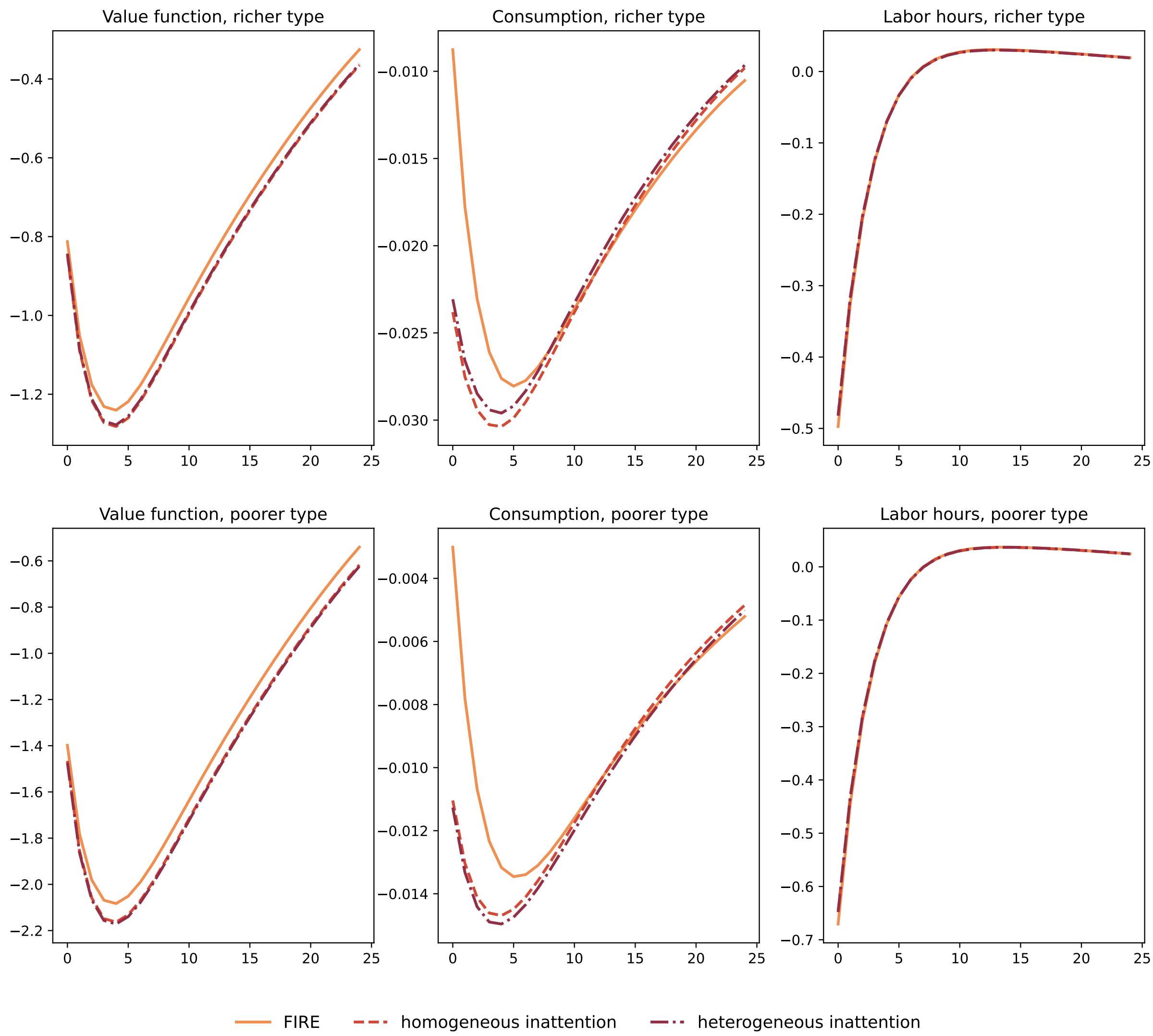
Figure 13: The role of transitory income inequality



Notes: The figure shows the change of consumption equivalent welfare variation and inflation relative to the change of the standard deviation of households' idiosyncratic risk under full information rational expectations and homogeneous inattention. Each dot shows a cumulative loss in consumption equivalent terms.

E.2. Markup Shocks

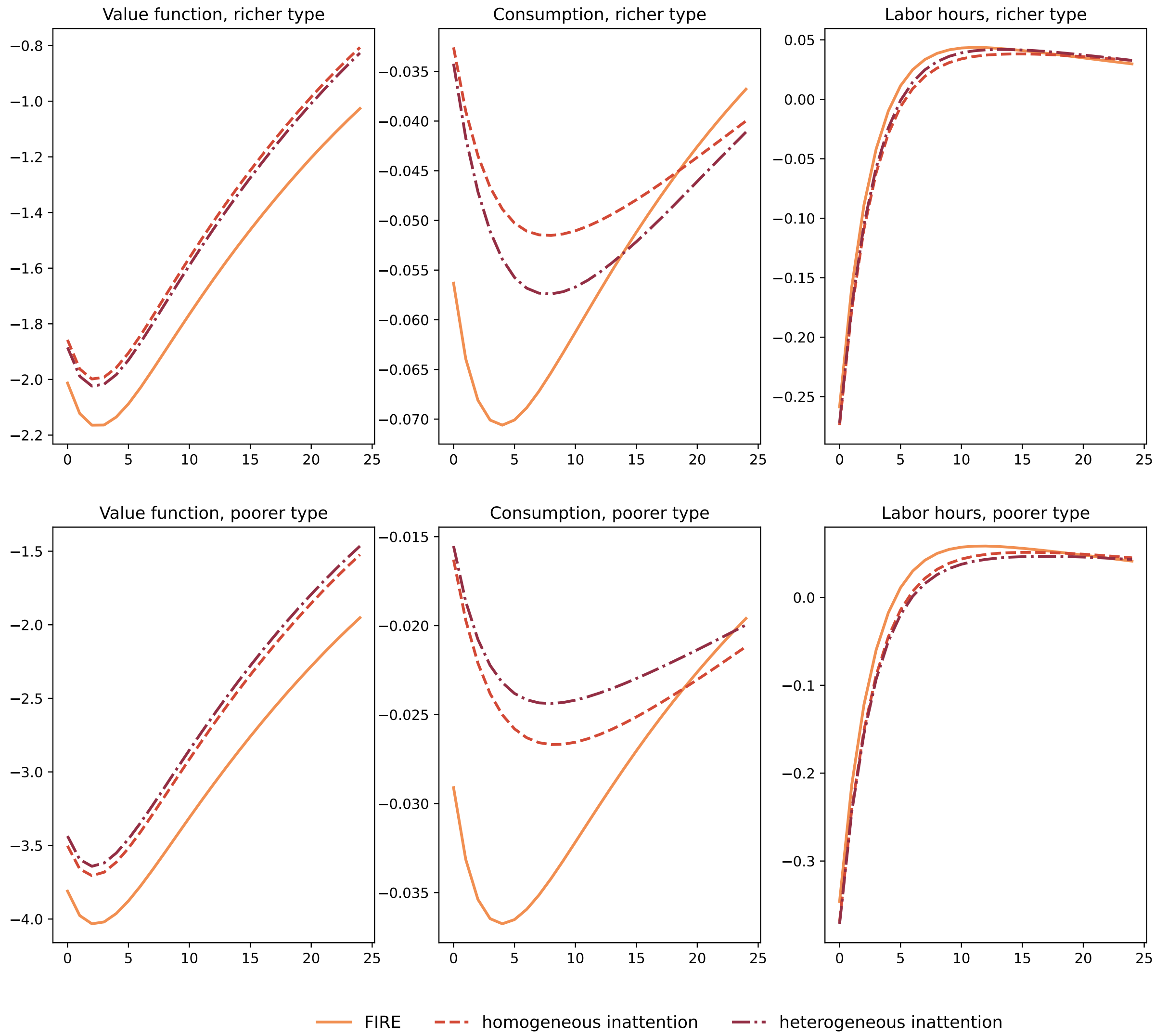
Figure 14: Markup shock, heterogeneity across types



Notes: The shows the value function and impulse responses to a 1% markup shock. The orange line shows the responses in a HANK with FIRE, the light red dotted for the HANK with homogeneous inattention and the dark red line for the HANK with heterogeneous inattention.

E.3. TFP shocks

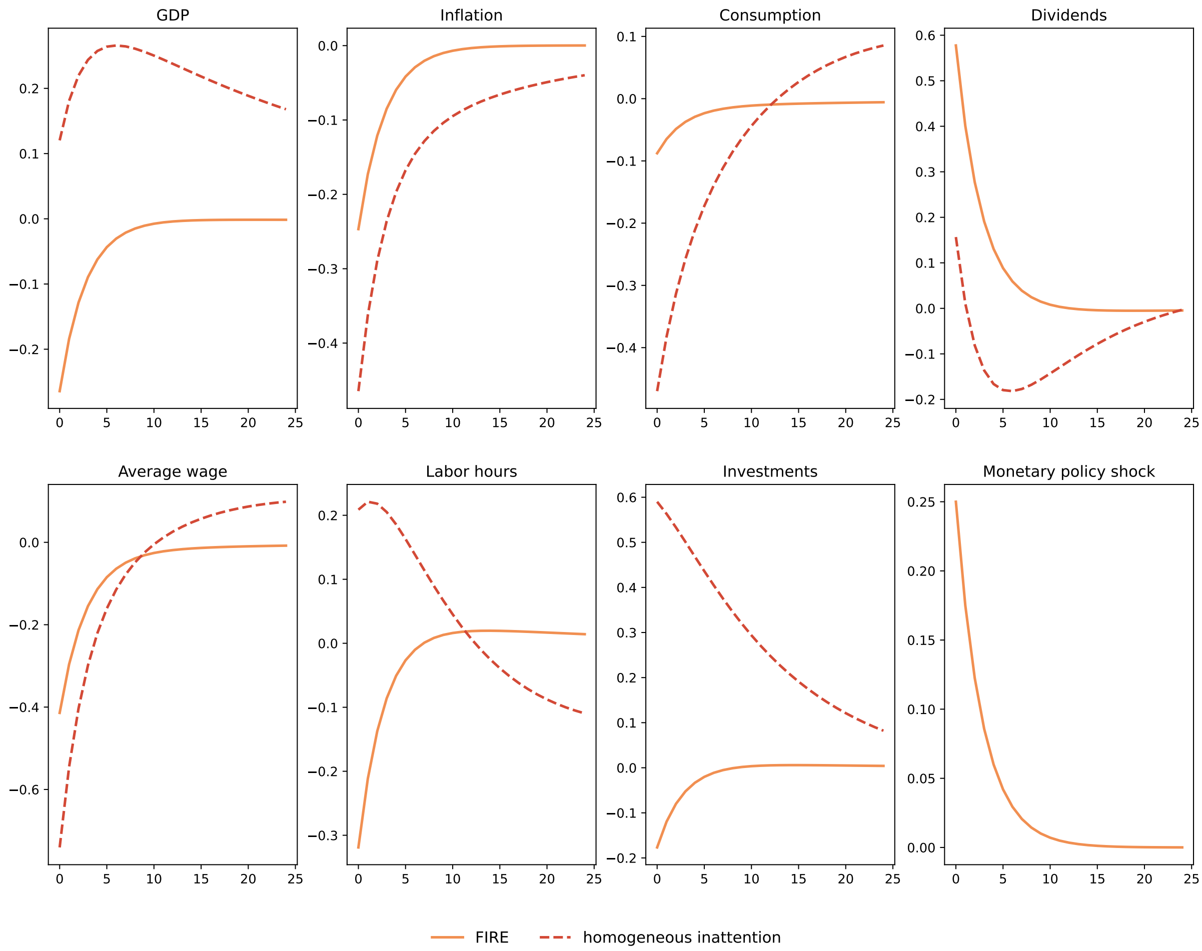
Figure 15: TFP shock, heterogeneity across types



Notes: The shows the impulse responses to a 1% TFP shock. The orange line shows the responses in a HANK with FIRE, the light red dotted for the HANK with homogeneous inattention and the dark red line for the HANK with heterogeneous inattention.

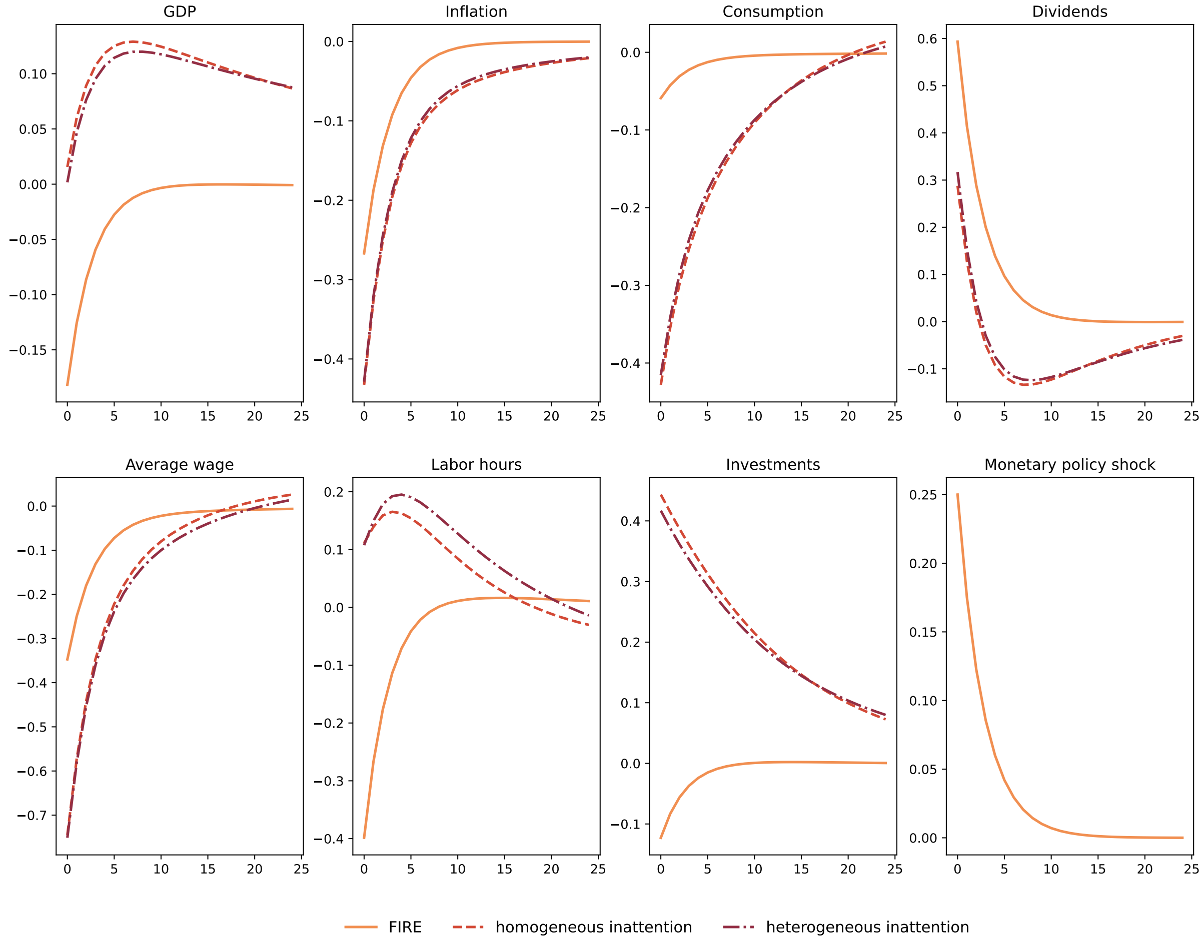
E.4. Capital Adjustment Costs

Figure 16: Model with capital adjustment costs



Notes: The shows the impulse responses to a contractionary 25 bps monetary policy shock in a model with capital adjustment costs. The orange line shows the responses in a HANK with FIRE and the red dotted line for the HANK with homogeneous inattention.

Figure 17: Model with capital adjustment costs and occupation

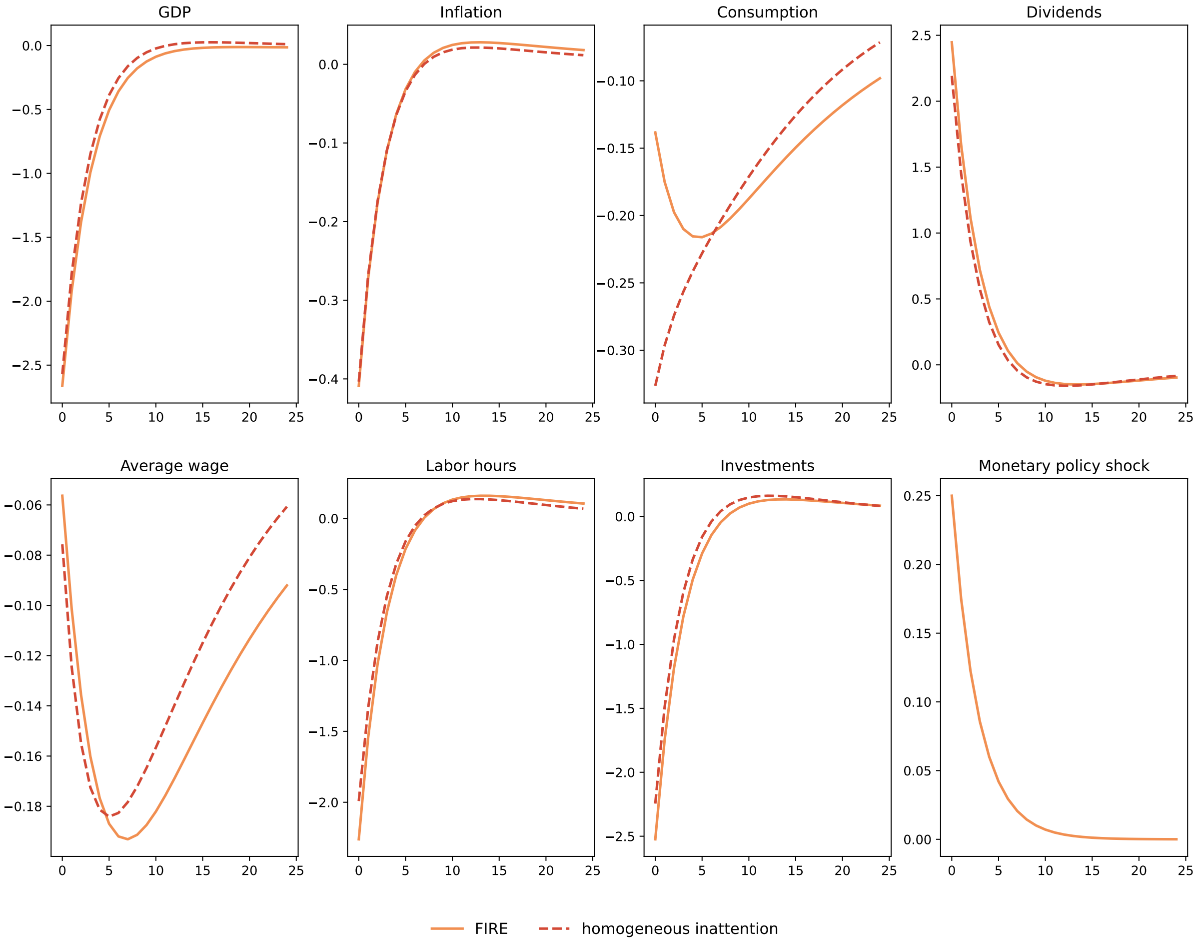


Notes: The shows the impulse responses to a contractionary 25 bps monetary policy shock in a model with capital adjustment costs. The orange line shows the responses in a HANK with FIRE, the light red dotted for the HANK with homogeneous inattention and the dark red line for the HANK with heterogeneous inattention.

E.5. Sticky Wages

Figure 18 shows the impulse response functions in the model with sticky wages and fully-flexible prices after a contractionary 25 bps monetary policy shock.

Figure 18: Real wage rigidity



Notes: The shows the impulse responses to a contractionary 25 bps monetary policy shock in a model with real wage rigidity. The orange line shows the responses in a HANK with FIRE and the red dotted line shows the responses in a HANK with homogeneous inattention.