Online Appendix for
"Effects of Monetary Policy on Household Expectations: The Role of Homeownership"*

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Contents

A Supplementary empirical results **2**

A.1 Robustness checks: different interest rate change horizons . . . 2

A.2 Additional analysis: effects of mortgage-rate changes on labor market outlooks and future business conditions . . . 4

A.3 Additional analysis: effects of mortgage-rate changes on interest rate expectations . . . 9

B Additional survey evidence **11**

B.1 SCE Housing Survey . . . 11

B.2 SCE Special Module on households' attention to macroeconomic news . . . 12

B.3 Attention to news on interest rates . . . 13

B.4 Evidence from American Time Use Survey . . . 14

B.5 Evidence from the Indirect Consumer Inflation Expectations . . . 15

C A full-information rational expectations model **18**

C.1 A system of nonlinear equilibrium conditions . . . 18

C.2 Non-stochastic steady-states . . . 21

C.3 A system of log-linearized model equilibrium conditions . . . 22

D The baseline model with rationally inattentive homeowners and renters **24**

D.1 Second-order approximation for homeowner's utility . . . 24

D.2 Second-order approximation for renter's utility . . . 32

D.3 Solution algorithm . . . 37

D.4 Model impulse responses to a forward guidance shock . . . 44

*The views expressed herein are those of the authors, and do not reflect the views of the Federal Reserve Board or any person associated with the Federal Reserve System.

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E Model sensitivity analyses **45**
E.1 Lowering homeownership ratio 45
E.2 Mortgage accessibility 47
E.3 ARM vs FRM 48
E.4 Expectation-augmented Taylor rules 49
E.5 Forward guidance horizons 50

References **52**

A Supplementary empirical results

A.1 Robustness checks: different interest rate change horizons

Table A.1: Robustness Check: sensitivity of revisions in homeowners and renters' inflation expectations to changes in mortgage rates

	1-year ahead inflation expectations		5-year ahead inflation expectations	
Interactions	(1) ΔR_t	(2) $\Delta \tilde{R}_{t,FG}$	(3) ΔR_t	(4) $\Delta \tilde{R}_{t,FG}$
Panel A. Mortgage rate changes over past 3 months				
Homeowner (β_1)	-0.8128***	-0.5158***	0.0006	-0.0000
	(0.1488)	(0.1326)	(0.1027)	(0.0910)
Renter (β_2)	-0.2955	0.0900	-0.3416	-0.2089
	(0.2781)	(0.2537)	(0.2141)	(0.1842)
Number of obs.	21,338	20,722	20,731	20,455
Adj. R^2	0.0373	0.0355	0.0185	0.0188
***F*-test** ($\beta_1 = \beta_2$)	2.73*	4.47**	2.14	1.06
Panel B. Mortgage rate changes over past 9 months				
Homeowner (β_1)	-0.6991***	-0.5628***	-0.2143***	-0.0014
	(0.0909)	(0.0812)	(0.0637)	(0.0564)
Renter (β_2)	-0.3138*	-0.1253	-0.1613	0.0147
	(0.1672)	(0.1477)	(0.1318)	(0.1141)
Number of obs.	21,338	20,722	20,455	20,455
Adj. R^2	0.0402	0.0402	0.0195	0.0193
***F*-test** ($\beta_1 = \beta_2$)	4.34**	6.94***	0.14	0.02

Notes: This table reports the regression results from Equation (2). Dependent variables are the six-month change in the MSC's 12-month ahead inflation expectations (Columns (1) and (2)) and the six-month change in the MSC's 5-year ahead inflation expectations (Columns (3) and (4)). "Homeowner" and "Renter" indicate dummies for homeowner and renter respectively. ΔR_t refers to changes in interest rate over the past 3 months (Panel A) or 9 months (Panel B). Columns (1) and (3) report responses to changes in 30-year mortgage rate; Columns (2) and (4) report responses to the changes in 30-year mortgage rate predicted by forward guidance shocks. We control for the respondent's demographic fixed effects including gender, education, birth cohort, homeownership, marriage status, region, income quartiles, and respondent's revisions in gas price expectations, as well as macroeconomic conditions including changes in the unemployment rate and federal funds rate during the past three or nine months. Robust standard errors are reported in the parenthesis. ***, **, * denotes statistical significance at 1%, 5%, and 10% levels respectively.

Table A.2: Robustness check: asymmetric effects of mortgage-rate changes

Interactions	1-year ahead inflation expectations (1) ΔR_t	(2) $\Delta \tilde{R}_{t,FG}$	5-year ahead inflation expectations (3) ΔR_t	(4) $\Delta \tilde{R}_{t,FG}$
Panel A. Mortgage rate changes over past 3 months				
Homeowner$\times I_t^+$ (β_1)	-0.0355	0.1165	0.3755**	0.1827
	(0.2512)	(0.2340)	(0.1833)	(0.1648)
Renter$\times I_t^+$ (β_2)	-0.2424	0.9153**	-0.0385	-0.0183
	(0.4446)	(0.4351)	(0.3703)	(0.3581)
Homeowner$\times I_t^-$ (β_3)	-1.7390***	-0.8726***	-0.4401**	-0.1017
	(0.3251)	(0.1725)	(0.2147)	(0.1130)
Renter$\times I_t^-$ (β_4)	-0.4452	-0.3388	-0.7665	-0.3081
	(0.6799)	(0.3239)	(0.4706)	(0.2233)
Number of obs.	21,338	20,772	20,731	20,455
Adj. R^2	0.0365	0.0363	0.0187	0.0188
***F*-test** ($\beta_1 = \beta_3$)	11.89***	10.62***	5.73**	1.93
Panel B. Mortgage rate changes over past 9 months				
Homeowner$\times I_t^+$ (β_1)	-0.1354	-0.7726***	-0.0042	-0.0317
	(0.1643)	(0.1208)	(0.1223)	(0.0871)
Renter$\times I_t^+$ (β_2)	0.3100	-0.0904	-0.0484	0.0753
	(0.3156)	(0.2012)	(0.2539)	(0.1620)
Homeowner$\times I_t^-$ (β_3)	-1.2258***	-0.3642***	-0.4094***	0.0226
	(0.1871)	(0.1206)	(0.1238)	(0.0847)
Renter$\times I_t^-$ (β_4)	-1.0032	-0.1051	-0.2946	-0.0289
	(0.3825)	(0.2166)	(0.2952)	(0.1645)
Number of obs.	21,338	20,772	20,731	20,455
Adj. R^2	0.0409	0.0404	0.0195	0.0192
***F*-test** ($\beta_1 = \beta_3$)	12.93***	5.23**	3.70*	0.18

Notes: This table reports the regression results from Equation (4). Dependent variables are the six-month change in the MSC's 12-month ahead inflation expectations (Columns (1) and (2)) and the six-month change in the MSC's 5-year ahead inflation expectations (Columns (3) and (4)). ΔR_t refers to changes in interest rate over the past 3 months (Panel A) or 9 months (Panel B). "Homeowner" and "Renter" indicate dummies for homeowner and renter respectively. I_t^+ and I_t^- indicate dummies for periods of increase and decrease in 30-year mortgage rates respectively. Columns (1) and (3) report responses to changes in 30-year mortgage rate; Columns (2) and (4) report responses to the changes in 30-year mortgage rate predicted by forward guidance shocks. We control for the respondent's demographic fixed effects including gender, education, birth cohort, homeownership, marriage status, region, income quartiles, and respondent's revisions in gas price expectations, as well as macroeconomic conditions including changes in the unemployment rate and federal funds rate during the past three or six months. Robust standard errors are reported in the parenthesis. ***, **, * denotes statistical significance at 1%, 5%, and 10% levels respectively.

A.2 Additional analysis: effects of mortgage-rate changes on labor market outlooks and future business conditions

In this appendix, we conduct an additional analysis of the effects of mortgage rate changes on labor market outlooks. In the MSC, for example, the question on expectations of joblessness in the next 12 months is postulated as follows:

> *How about people out of work during the coming 12 months—do you think that there will be more unemployment than now, about the same, or less?*
>
> 1. More unemployment
> 3. About the same
> 5. Less unemployment

We construct a categorical variable that reflects the direction of expectation revisions. This variable has three outcomes—*improved*, *unchanged*, and *worsened*. If the numeric value of the response in the original question increases, we regard the expectation to have "*improved*." If the numeric value decreases, we interpret the expectation to have "*worsened*." If the numeric value stays the same, we assign "*unchanged*."

With the constructed categorical variable capturing households' revision of unemployment expectations, we run a multivariate *logit* regression to examine how a change in the interest rate six months ago affects the revision. The model is specified as follows:

$$\log\left(\frac{p_{ik,t}}{p_{ij,t}}\right) = \alpha_0 + \beta_1\, homeowner_i \times \Delta R_t + \beta_2\, renter_i \times \Delta R_t + \gamma Z_t + \delta X_{i,t} + \epsilon_{i,t}, \tag{A.1}$$

where $p_{ik,t}$ is the probability that household i's response is $k \in \{$"*improved*","*worsened*"$\}$ from period t to $t+6$, and $p_{ij,t}$ is the probability that household i's response is $j =$ "*unchanged*" from period t to $t+6$. The regressors $homeowner_i$ and $renter_i$ are dummies for homeowner and renter, respectively; ΔR_t is a change in the mortgage rate or changes in mortgage rate predicted by forward guidance shocks during the past six months. We include the same set of household-level controls and aggregate variables as Equation (2). We treat the response "*unchanged*" as the base category and estimate the probability of household i to respond "*improved*" or "*worsened*" relative to that of household i to respond "*unchanged*." The coefficient estimates are reported in Table A.3.

To make the results more interpretable, we compute the marginal probabilities of households to change their unemployment expectations and display the probabilities in Figure A.1. As depicted by the downward-sloping lines in the top-left panel, households become less likely to expect that the labor market conditions will improve, when 30-year mortgage rates rise. Consistent with this observation, households become more likely to anticipate that the labor market conditions will deteriorate with a rise in the 30-year mortgage rate, as indicated by the upward-sloping lines (top right panel). However, we find statistically significant differences in the optimistic revisions between homeowners and renters (top left panel) but not in the pessimistic revisions (top

Table A.3: Sensitivity of revisions in homeowners and renters' unemployment expectations to changes in interest rates

Interactions	(1) ΔR_t	(2) $\Delta \tilde{R}_{t,FG}$
Panel A. Unemployment: Improve		
Renter (α_1)	1.100**	1.089**
	(0.046)	(0.046)
Homeowner$\times\Delta R_t$ (β_1)	0.908**	0.094***
	(0.036)	(0.051)
Renter$\times\Delta R_t$ (β_2)	1.068	0.179*
	(0.076)	(0.170)
Panel B. Unemployment: Worsen		
Renter (α_1)	1.037	1.034
	(0.044)	(0.045)
Homeowner$\times\Delta R_t$ (β_1)	0.977	0.307**
	(0.039)	(0.171)
Renter$\times\Delta R_t$ (β_2)	0.936	0.110**
	(0.071)	(0.113)
Number of obs.	24,483	23,890
Pseudo R^2	0.0108	0.0111

Notes: This table reports the multinomial logit regression results from Equation (3). Dependent variables are the log of the probability that unemployment rate will be improved (Panel A) or worsened (Panel B) in the next six months relative to the probability that unemployment rate will be unchanged in the next six months. "Homeowner" and "Renter" indicate dummies for homeowner and renter respectively. The coefficients are reported in relative-risk ratios. ΔR_t and $\Delta \tilde{R}_{t,FG}$ refer to the six-month change in 30-year mortgage rate and forward guidance shocks respectively. We control for the respondent's demographic fixed effects including gender, education, birth cohort, homeownership, marriage status, region, income quartiles, and respondent's revisions in gas price expectations, as well as macroeconomic conditions including changes in the unemployment rate and federal funds rate during the past six months. Robust standard errors are reported in the parenthesis. ***, **, * denotes statistical significance at 1%, 5%, and 10% levels respectively.

right panel). Homeowners lower their optimism more in response to an increase in the mortgage rate than renters do. We find similar results with changes in the mortgage rate predicted by forward guidance shocks as reported in the lower panel.

To examine the contractionary effect of interest-rate changes on overall economic conditions, we also consider expectations on future business conditions as dependent variables. As shown in Table A.4 and Figure A.2, our main conclusion remains robust.

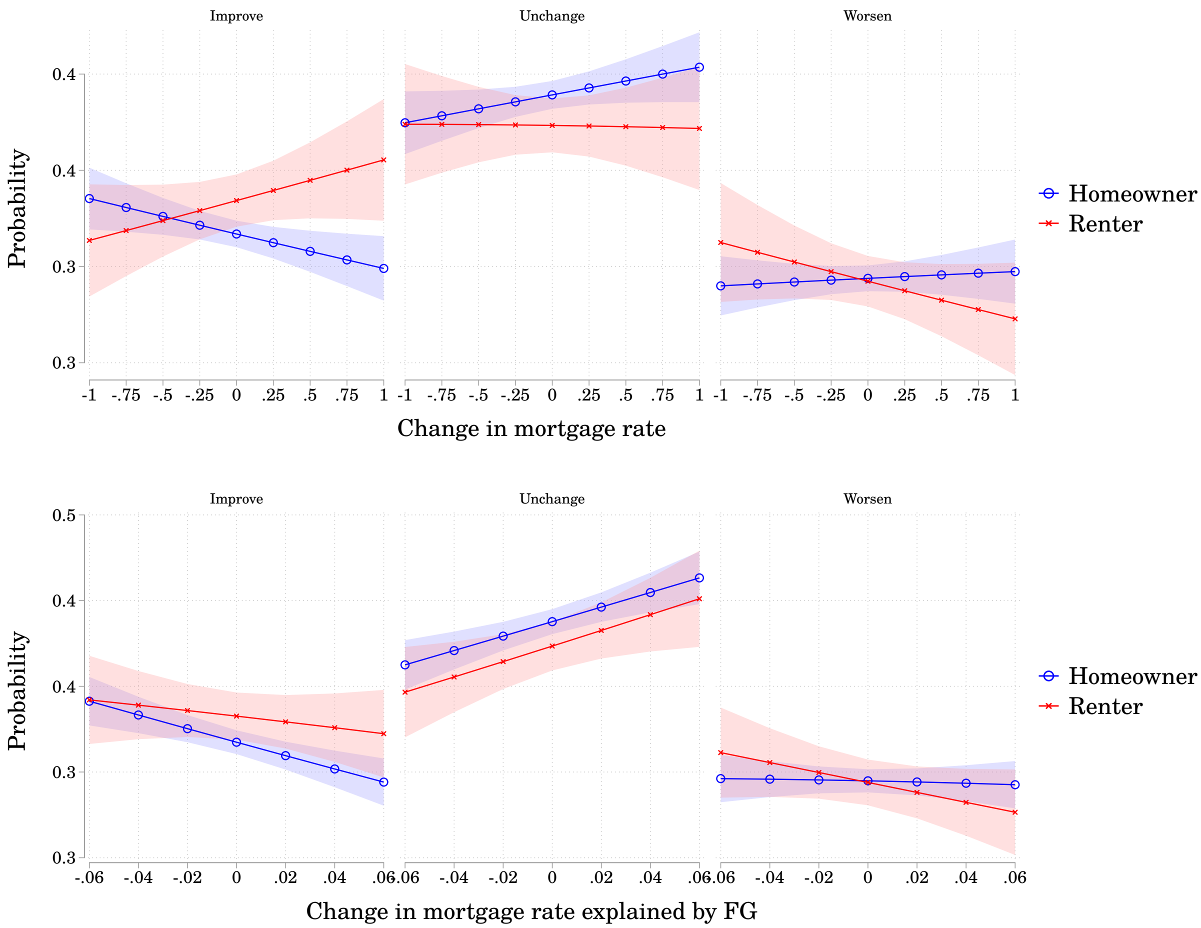


Figure A.1: Marginal probability of changes in household expectations of unemployment

Notes: This figure reports the marginal probabilities of changes in household expectations of unemployment to changes in mortgage rates. The explanatory variable considered is the changes in the 30-year mortgage rate (top panel) and forward guidance shocks (bottom panel). The results are calculated based on the estimates of the logit regression results from Equation (A.1) as reported in Online Appendix Table A.3. We control for the respondent's gender, education, birth cohort, homeownership, marriage status, region, income quartiles, and respondent's revisions in gas price expectations, as well as unemployment rate and federal funds rate changes during the past six months. Shaded areas represent 95% confidence intervals.

Table A.4: Sensitivity of revisions in homeowners and renters' expectations on future business conditions to changes in interest rates

Interactions	(1) ΔR_t	(2) $\Delta\tilde{R}_{t,FG}$
Panel A. Future Business Conditions: Improve		
Renter (α_1)	1.108**	1.108**
	(0.046)	(0.047)
Homeowner$\times\Delta R_t$ (β_1)	0.953	0.652
	(0.038)	(0.358)
Renter$\times\Delta R_t$ (β_2)	1.000	0.505
	(0.072)	(0.494)
Panel B. Future Business Conditions: Worsen		
Renter (α_1)	1.058	1.064
	(0.046)	(0.047)
Homeowner$\times\Delta R_t$ (β_1)	0.99	1.023
	(0.873)	(0.569)
Renter$\times\Delta R_t$ (β_2)	0.913	1.190
	(0.069)	(1.202)
Number of obs.	24,024	23,434
Pseudo R^2	0.0105	0.0104

Notes: This table reports the multinomial logit regression results from Equation (3). Dependent variables are the log of the probability that future business conditions will be improved (Panel A) or worsened (Panel B) in the next six months relative to the probability that future business conditions will be unchanged in the next six months. "Homeowner" and "Renter" indicate dummies for homeowner and renter respectively. The coefficients are reported in relative-risk ratios. ΔR_t and $\Delta\tilde{R}_{t,FG}$ refer to the six-month change in 30-year mortgage rate and forward guidance shocks respectively. We control for the respondent's demographic fixed effects including gender, education, birth cohort, homeownership, marriage status, region, income quartiles, and respondent's revisions in gas price expectations, as well as macroeconomic conditions including changes in the unemployment rate and federal funds rate during the past six months. Robust standard errors are reported in the parenthesis. ***, **, * denotes statistical significance at 1%, 5%, and 10% levels respectively.

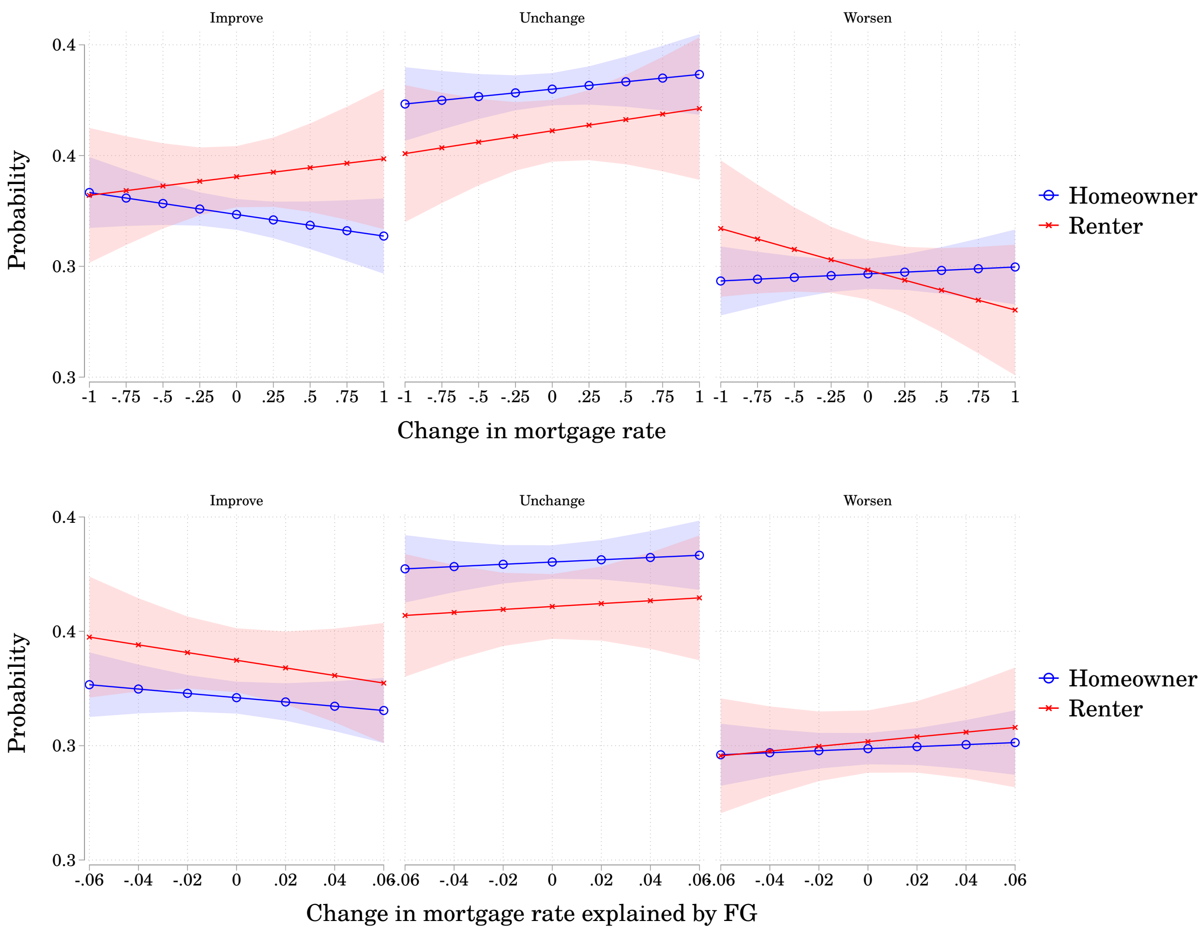


Figure A.2: Marginal probability of changes in household expectations of future business conditions

Notes: This figure reports the marginal probabilities of changes in household expectations of future business conditions to changes in mortgage rates over the past six months. The explanatory variable considered is the changes in the 30-year mortgage rate (top panel) and forward guidance shocks (bottom panel). The results are calculated based on the estimates of the logit regression results from Equation (A.1). We control for the respondent's gender, education, birth cohort, homeownership, marriage status, region, income quartiles, and respondent's revisions in gas price expectations, as well as unemployment rate and federal funds rate changes during the past six months. Shaded areas represent 95% confidence intervals.

Source: Authors' calculation.

A.3 Additional analysis: effects of mortgage-rate changes on interest rate expectations

We conduct additional analysis of the effects on interest rate expectations by employing the same specification Equation (A.1), but change the dependent variable to expectations of future interest rates. The question on interest rate expectations is postulated as follows:

> *No one can say for sure, but what do you think will happen to interest rates for borrowing money during the next 12 months—will they go up, stay the same, or go down?*
>
> 1. Go up
> 3. Stay the same
> 5. Go down

We treat the response *"stay the same"* as the base category and estimate the probability of household i responding *"go up"* or *"go down"* relative to that of household i responding *"the same"*. Therefore, in the dependent variable, $p_{ik,t}$ is the probability that household i's response is $k =$*go up/go down*, and $p_{ij,t}$ is the probability that household i's response is $j =$*stay the same*.

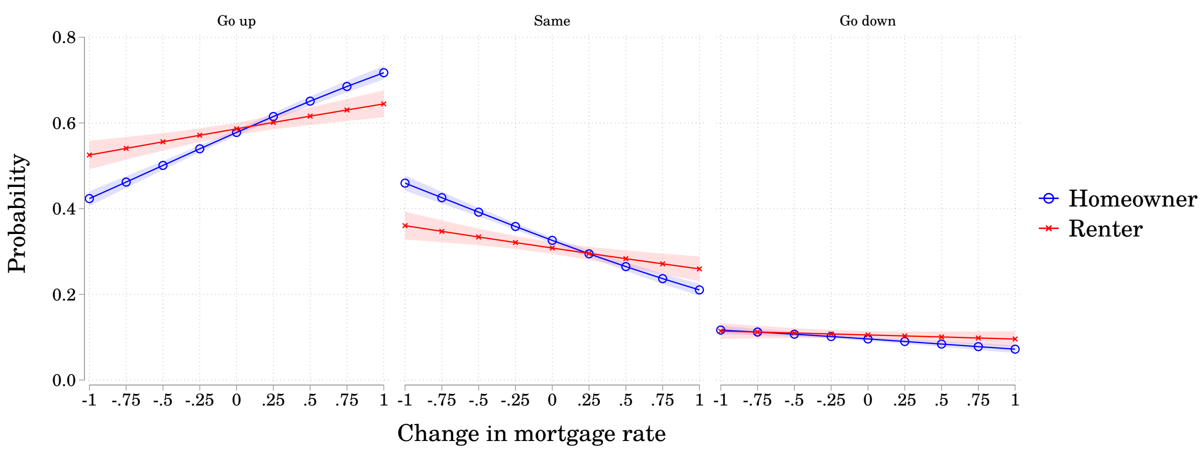


Figure A.3: Marginal probability of household expectations of interest rates

Notes: This figure reports the marginal probabilities of household expectations of 1-year ahead interest rates to past changes in interest rates. The explanatory variable considered is the changes in the 30-year mortgage rate. The results are calculated based on the estimates of the logit regression results from Equation (A.1) as reported in Column (1) of Table A.5. We control for the observed survey respondents' characteristics, including gender, education, birth cohort, and the level of income. Shaded areas represent 95% confidence intervals. The confidence bands are so narrow that they do not clearly show through to the figures.

Figure A.3 displays the marginal probability estimates. The coefficient estimates are reported in Table A.5. When there is an increase in the interest rate, households become more optimistic about future interest rate rises but become less likely to believe that the interest rate would either stay the same or go down. The upside revisions to the belief in an interest rate increase are

Table A.5: Sensitivity of revisions in homeowners and renters' expectations on future interest rates to changes in interest rates

Interactions	(1) ΔR_t	(2) $\Delta \tilde{R}_{t,FG}$
Panel A. Interest rate increase		
Renter (α_1)	1.073*	1.087**
	(0.042)	(0.043)
Homeowner$\times\Delta R_t$ (β_1)	1.945***	107.451***
	(0.073)	(54.050)
Renter$\times\Delta R_t$ (β_2)	1.312***	67.566***
	(0.092)	(63.626)
Panel B. Interest rate decrease		
Renter (α_1)	1.164**	1.141**
	(0.076)	(0.043)
Homeowner$\times\Delta R_t$ (β_1)	1.139**	7.6181.087**
	(0.067)	(6.074)
Renter$\times\Delta R_t$ (β_2)	1.071	4.214
	(0.503)	(5.697)
Number of obs.	24,505	23,907
Pseudo R^2	0.0444	0.0392

Notes: This table reports the multinomial logit regression results from Equation (3). Dependent variables are the log of the probability that interest rate will increase (Panel A) or decrease (Panel B) in the next six months relative to the probability that interest rate will stay the same in the next six months. "Homeowner" and "Renter" indicate dummies for homeowner and renter respectively. The coefficients are reported in relative-risk ratios. ΔR_t and $\Delta \tilde{R}_{t,FG}$ refer to the six-month change in 30-year mortgage rate and changes in forward guidance shocks respectively. We control for the respondent's demographic fixed effects including gender, education, birth cohort, homeownership, marriage status, region, income quartiles, and respondent's revisions in gas price expectations, as well as macroeconomic conditions including changes in the unemployment rate and federal funds rate during the past six months. Robust standard errors are reported in the parenthesis. ***, **, * denotes statistical significance at 1%, 5%, and 10% levels respectively.

larger than the downside revisions to the belief in either an unchanged or decreased interest rate. In addition, the responsiveness of homeowners is larger than that of renters with statistical significance. Similar to the case of other expectations, the upward revisions of homeowners are the largest when there is a rise in the mortgage rate. Again, the difference in the upward revision between homeowners and renters is also the greatest.

B Additional survey evidence

B.1 SCE Housing Survey

The SCE Housing Survey identifies homeowners' mortgage status with the following question:

> *Do you have any outstanding loans against the value of your home, including all mortgages, home equity loans, and home equity lines of credit?*

(1) Yes, mortgage(s) only

(2) Yes, home equity loans/lines of credit only

(3) Yes, both mortgage(s) and home equity loans/lines of credit

(4) No.

We consider individuals whose responses are (1) - (3) as homeowners with mortgages and those with response (4) as outright homeowners. According to the housing module, about 67 percent of homeowners carry mortgages and 33 percent are outright homeowners.

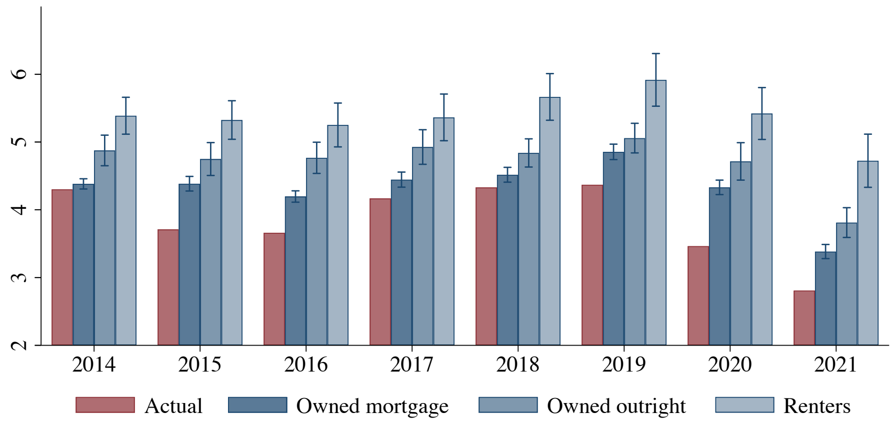
Moreover, for homeowners, the housing module also asks whether they recently refinanced their mortgages and their probability of refinancing their current mortgages in the next 12 months. In addition, the module contains information on households' knowledge about current and future mortgage rates. Concerning knowledge of current mortgage rates and expectations about future mortgage rates, the survey asks the following questions:

- *"What do you think is the average interest rate (for all borrowers) on a new 30-year fixed-rate mortgage as of today?"*
- *"What do you think is the average interest rate (for all borrowers) on a new 30-year fixed-rate mortgage one year from today?"*

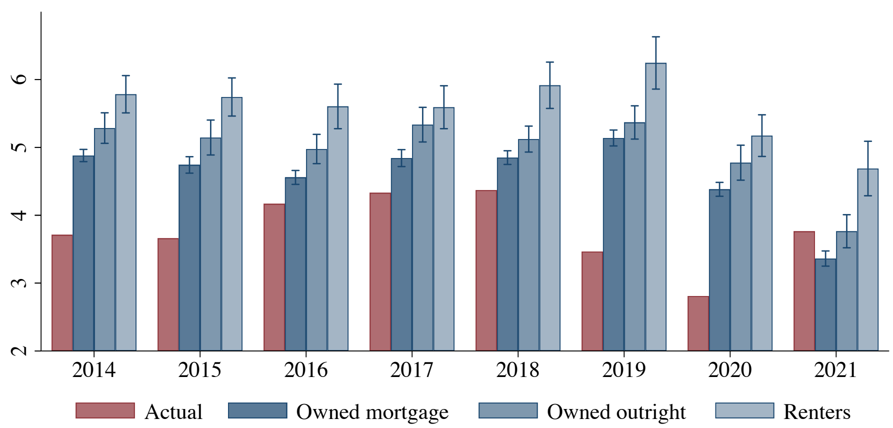
Figure B.4 reports the mortgage rate perceptions and forecasts by homeownership and mortgage holding status. Panel A displays the perception of current 30-year mortgage rates along with the actual 30-year mortgage rates. Homeowners, particularly those with mortgages, have a more accurate perception of current mortgage rates, compared to the realized 30-year mortgage rates. Panel B displays one-year-ahead forecasts of 30-year mortgage rates along with the realized 30-year mortgage rates. Again, homeowners with mortgages have the most accurate mortgage rate expectations followed by outright homeowners. One exception is 2021, when outright homeowners' forecasts essentially match the realized mortgage rates, whereas those with mortgages produced lower forecasts. In particular, renters produce the most inaccurate perceptions of mortgage rates for the current year and forecasts of future mortgage rates.

Figure B.4: Accuracy of perceived and predicted current mortgage rates by homeownership status (SCE housing module)

Panel A. Perception of current mortgage rates



Panel B. Forecast of mortgage rates 1 year ahead



Notes: Panel A documents responses to the survey question, "What do you think is the average interest rate (for all borrowers) on a new 30-year fixed-rate mortgage as of today?" Panel B documents responses to the survey question "What do you think is the average interest rate (for all borrowers) on a new 30-year fixed rate mortgage one year from today?

Source: Survey of Consumer Expectations, Housing Module.

B.2 SCE Special Module on households' attention to macroeconomic news

The sample of the SCE special module is composed of 2,155 individuals who are nationally representative and have participated in the main SCE survey. The special module asks the survey respondents about their frequency of information acquisition about various economic and financial news and variables. The topic includes six different interest rates including mortgage interest rates and federal funds rate, and six economic news including stock market prices, news on inflation, and that on the Federal Reserve. For each topic, the survey asks the respondent whether the person checks the information (1) daily, (2) weekly, (3) monthly, (4) quarterly, (5) yearly, (6) not at all or (7) has no knowledge about it. The last two categories are used to measure the extensive margin of information acquisition. The extensive margin captures whether an individual checks the news on a particular topic: It takes value 0 if the response is either “not at all" or “has no knowledge about it, or takes value 1, otherwise. The survey contains the basic socioeconomic attributes of survey participants including homeownership status. In addition, the respondents in the sample are matchable with the main SCE survey and a subset of the sample is also matchable with the SCE housing survey.

B.3 Attention to news on interest rates

This section provides direct evidence that homeowners pay more attention to news on interest rates based on newly constructed indicators. We construct several variables to measure households' attention toward news on interest rates using the MSC. First, we consider how interest rates directly affect households' home-buying and home-selling attitudes.[1] The variable $HomeBuy_{it}$ ($HomeSell_{it}$) takes value 1 if the household's home-buying (home-selling) attitude is affected by interest rate-related reasons and 0 otherwise. These measures suggest that interest rate is a primary reason affecting households' home-buying and home-selling attitudes. On average, over 45 percent of households reported interest rates being a factor affecting their home-buying attitudes and the fraction is about 15 percent for home-selling.

Our next measure is based on whether a household recalls any news on interest rates related to changes in business conditions. The variable $Business_{it}$ takes value 1 if the household recalls at least one change related to interest rates and 0 otherwise. Therefore, $Business_{it}$ is an indicator variable for whether an individual household pays attention to news on interest rates related to business conditions. Based on our sample, about 4.5 percent of the households recalled news on interest rates related to business conditions.

Our last measure is based on whether a household identifies interest rates as a factor driving personal finances. The variable $Finance_{it}$ takes value 1 if the household selects at least one reason related to interest rates and 0 otherwise. Therefore, $Finance_{it}$ is an indicator variable for whether an individual household pays attention to interest rates related to personal finances. Based on our sample, about 0.11 percent of the households mentioned interest rates being a factor affecting their personal financial conditions.

We consider the following linear regression model:

$$Y_{it} = \alpha + \beta_1 \text{homeowner}_{it} + \delta X_{it} + \zeta_t + \epsilon_{it} \tag{B.1}$$

where $Y_{it} = \{HomeBuy_{it};\ HomeSell_{it};\ Business_{it};\ Finance_{it}\}$. The control variables X_{it} are respondent's demographic fixed effects including gender, education, birth cohort, marriage status, re-

[1]Notice that these questions are designed to assess general home-buying or home-selling attitudes, not the respondents' attitude towards buying or selling houses for their own use.

Table B.6: Homeownership and attention to news on interest rates

Dependent variables	(1) HomeBuy	(2) HomeSell	(3) Business	(4) Finance
Homeowner	0.0850^{***}	0.0416^{***}	0.0074^{***}	0.0006^{***}
	(0.0031)	(0.0022)	(0.0013)	(0.0.0002)
Demographic FE	Y	Y	Y	Y
Year-month FE	Y	Y	Y	Y
Number of obs.	153,347	145,268	156,098	156,098
Adj. R^2	0.1567	0.0997	0.0368	0.0037

Notes: This table reports the estimates of β_1's from Equation (B.1). The dependent variables are dummies indicating whether news on interest rates affects the respondent's home-buying attitudes (Column 1), home-selling attitude (Column 2), perception of business conditions (Column 3), and personal finances (Column 4). "Homeowner" indicates a dummy for the respondent being a homeowner. We control for the respondent's gender, education, birth cohort, homeownership, marriage status, region, income quartiles, and time-fixed effects. Robust standard errors are reported in the parenthesis. ***, **, * denotes statistical significance at 1%, 5%, and 10% levels respectively.

gion, and income quartiles, which is the same set of fixed effects in our baseline specification. We include time-fixed effects ζ_t to control for aggregate business cycles. A statistically positive coefficient for the *homeowner* dummy suggests that homeowners pay more attention to interest rates compared to renters.

Table B.6 reports the coefficient estimates. Columns (1) and (2) show that homeowners have a significantly higher probability of reporting interest rates as one of the reasons affecting their home-buying and home-selling attitudes respectively. Column (3) reveals that homeowners are more likely to recall news on interest rates related to changes in business conditions. Column (4) suggests that the same result holds for personal finances. In summary, this evidence shows that homeowners pay more attention to information on interest rates and are more likely to use this information in their assessments of macroeconomic conditions.

B.4 Evidence from American Time Use Survey

This section provides corroborating evidence that homeowners are more attentive to macroeconomic developments than renters based on analysis with ATUS. The ATUS collects data on the time that an individual spends on various activities during the day. The sample of ATUS is from the eighth outgoing rotation group of the Current Population Survey. Therefore, each individual in the ATUS is surveyed once. The ATUS has information on an individual's time spent on finance-related activities, which is a natural measure of households' attentiveness to financial markets and macroeconomic developments. In addition, the ATUS has respondents' socio-economic characteristics including homeownership and other demographic attributes. Therefore, the data allow us to analyze the association between homeownership and attentiveness to economic conditions. The ATUS is a monthly survey beginning in 2003. Hence, the sample period of our analysis with ATUS is from 2003:M1 to 2020:M12.

We consider two types of activities, "financial management" and "purchasing financial and banking services", to measure their attention to macroeconomic developments. Activities in financial management include trading and checking stocks, researching investments, paying mortgages, checking cryptocurrency or bitcoin balance, and so on. Activities in purchasing financial and banking services include applying for a loan or mortgage, talking to/with a loan officer, meeting with a stockbroker, insurance agent, bank manager, etc[2]

We consider the following linear regression model:

$$Y_i = \alpha + \beta_1 \text{homeowner}_i + \delta X_i + \epsilon_i \tag{B.2}$$

where $Y_i = \{\text{Time}_i;\ E_i;\ N_i\}$. Time_i is individual i's time spent on financial management, E_i denotes the indicator of respondent i's participating in the activity, and N_i is minutes spent for financial management conditional on reporting nonzero minutes for the activity. Notice that E_i is the extensive margin of financial management which takes value 1, if an individual reports a nonzero minute for financial management, but is zero, otherwise. The notation N_i is the intensive margin and takes always a positive value. Individual characteristics, denoted by X_i, include gender (female), age (16-24, 55 and over), race (white), education (high-school graduation or less, some college and associate degree), labor force status (unemployment and out of the labor force).[3]

Table B.7 reports the coefficient estimates. Being a homeowner raises the probability of engaging in financial management and also time spent on financial management among those who engage in the activity with statistical significance (Panel A). Similar results are obtained if we replace the dependent variable with time spent for purchasing financial and banking services (Panel B). This result suggests that homeowners are more likely to engage in activities that expose them to current macroeconomic conditions and interest rates and also to spend more time on these activities. All told, this direct evidence from ATUS confirms that homeowners tend to pay more attention to overall macroeconomic conditions than renters, corroborating why homeowners' expectations of the macroeconomy are more sensitive to interest-rate changes than others.

B.5 Evidence from the Indirect Consumer Inflation Expectations

Hajdini et al. (2024) propose a new indirect way to measure consumers' expectations for inflation over the next 12 months based on indirect utility theory and a novel survey. The survey asks a representative sample of about 20,000 adults in the US about how their incomes would have to change to make them equally well off relative to their current situation such that they could buy the same amount of goods and services as they can today. For the question, the individuals in the sample receive consumers' expectations about the developments in the prices of goods and services during the next 12 months. This survey is conducted weekly and is implemented through

[2]The ATUS may understate time spent on financial management and purchasing financial and banking services because the ATUS surveys the respondent's primary activity only. If an individual checks stock prices while working or watching TV, this activity may be classified as "*working*" or "*TV watching*."

[3]We consider a linear probability model for the extensive margin as the baseline. We further consider a *logit* and *probit* model for the extensive margin, but the overall conclusion is the same as that from the linear probability model. Our results are robust once we control for occupation, region, and/or time-fixed effects.

Table B.7: Homeownership and time spent on finance-related activities

Dependent variable	(1) Extensive (E_i)	(2) Intensive (N_i)	(3) Time (Time_i)
Panel A. Financial management			
Homeowner	0.0076***	4.6085***	0.5331***
	(0.0010)	(1.7788)	(0.0810)
Number of obs.	219,368	8,583	219,368
R^2	0.0084	0.0366	0.0064
Panel B. Purchasing financial and banking services			
Homeowner	0.0029***	0.6366***	0.0636***
	(0.0010)	(0.7869)	(0.0228)
Number of obs.	219,368	5,618	219,368
R^2	0.0020	0.0366	0.0008

Notes: This table reports the estimates of β_1's from Equation (B.2). Panel A shows the results when we use time spent on financial management as the dependent variable. Panel B shows the results when we use time spent on purchasing financial banking services as the dependent variable. In Column (1), we use the indicator of respondents participating in the activity (extensive margin). In Column (2), we use minutes spent for the activity conditional on reporting nonzero minutes for the activity (intensive margin). Lastly, in Column (3), we use the total time spent on the activity. "Homeowner" indicates a dummy for the respondent being a homeowner. We control for the respondents' gender, age, race, education, and labor force status. Robust standard errors are reported in the parenthesis. ***, **, * denotes statistical significance at 1%, 5%, and 10% levels respectively.

Morning Consult's proprietary survey infrastructure.

The data have limited disaggregate information. Unfortunately, information on home ownership and mortgage-holding status is not available. However, the data have inflation expectations by four age groups–18-34; 35-44; 45-64; and over 65. Given the data limitation, we use the grouped age information to infer the effect of homeownership on the degree of attention to macroeconomic conditions and monetary policy. Individuals aged 18-34 are likely to be renters, those aged 35-44 and 45-64 are likely to be current buyers or homeowners with mortgages, and those aged 65+ are likely to be homeowners without mortgages.

We use errors in current inflation perceptions and inflation forecasts to proxy the degree of attention to macroeconomic news. We examine whether individuals who are likely to be homeowners and those who are likely to hold mortgages have better inflation perceptions and forecasts than others.

We compare the weekly inflation expectations in the next 12 months against the year-over-year CPI inflation of the current month (t) and 12 months ahead (t+12). The current-month price changes are also considered, although the CPI inflation one year ahead should be the right point of comparison. This is because Hajdini et al. (2024) note that the ICIE largely reflects current inflation expectations. The sample period of this analysis is from 13-Feb-21 to 30-Dec-23.

Table B.8 reports the root-mean-squared deviations from the CPI inflation of the current month and one year ahead by age. The first row reports the deviations from the current CPI inflation. The average difference is smallest among individuals aged 35-44, followed by individuals aged 45-64.

Table B.8: Root mean squared deviations from CPI inflation of current month and one-year ahead by age (percentage point)

	18-34	35-44	45-64	65+
[1] Current month (t)	2.28	1.48	1.57	2.11
[2] One-year ahead (t+12)	2.75	1.69	0.98	0.97

Note: The perception error is the difference between reported inflation forecasts and year-over-year percent change in headline CPI of the current month. The sample period for the perception accuracy spans from 13-Feb-21 to 30-Dec-23. The CPI data are available through December 2023, so our analyses end in 30-Dec-23. The prediction error is the difference between reported inflation forecasts and year-over-year percent changes in headline CPI 12 months from the current month. The sample period for the perception accuracy spans from 13-Feb-21 to 29-Dec-22.
Source: CEBRA website (`https://cebra.org/indirect-consumer-inflation-expectations`)

The average deviation from the current-month inflation is quite large among individuals aged 65 and over. The second row reports the deviations from the CPI inflation 1 year ahead. The average difference is the smallest in the group aged 45 and over. Individuals aged 45-64 have weekly inflation expectations, of which the differences from the current and one-year-ahead CPI inflation are consistently small, relative to other age groups. Considering that this age group is likely to be homeowners and to hold mortgages, we tentatively interpret that homeowners, particularly those with mortgages, are likely to pay more attention to inflation than others.

However, one caveat of this analysis is that we do not separate the cohort effects capturing individuals' inflation experiences, which is important in the formation of inflation expectations (Malmendier and Nagel, 2015). Since the data have limited information on households' attributes, controlling for the individual inflation experiences is not feasible. Including more comprehensive individual attributes in the analyses on high-frequency inflation expectations can be pursued in future research.

C A full-information rational expectations model

In this appendix, we present the equilibrium conditions of the model with full information rational expectations.

C.1 A system of nonlinear equilibrium conditions

- Homeowner

$$\psi C_t^o = P_t^s S_t^o \tag{C.1}$$

$$1 + \psi_{b^o} b_t^o = \beta R_t E_t \left[\frac{C_t^o}{C_{t+1}^o} \frac{1}{\Pi_{t+1}} \right] \tag{C.2}$$

$$\begin{aligned} \frac{P_t^s}{Q_t} - (1-\theta) = \beta E_t \left[\frac{C_t^o}{C_{t+1}^o} \frac{1}{\Pi_{t+1}} \left(\left(\frac{P_{t+1}^s}{Q_{t+1}} - 1 \right) (1-\gamma) + \theta R_t^M \right) \right] \\ - \theta C_t^o \left\{ (1-\phi_t^o) \frac{\mu_t}{D_t^o} \left(R_t^F - R_{t-1}^M \right) - \beta (1-\gamma) E_t \left[\frac{\mu_{t+1}}{D_{t+1}^o} \frac{1}{\Pi_{t+1}} \left(R_{t+1}^F - R_t^M \right) \right] \right\} \end{aligned} \tag{C.3}$$

$$\mu_t = \begin{cases} 0 & \text{if ARM} \\ \beta E_t \left[\left(1 - \phi_{t+1}^o\right) \mu_{t+1} - \frac{D_t^o}{\Pi_{t+1}} \frac{1}{C_{t+1}^o} \right] & \text{if FRM} \end{cases} \tag{C.4}$$

$$D_t^o = (1-\gamma) \frac{D_{t-1}^o}{\Pi_t} + L_t^o \tag{C.5}$$

$$M_t^o = \left(R_{t-1}^M - 1 + \gamma \right) \frac{D_{t-1}^o}{\Pi_t} \tag{C.6}$$

$$L_t^o = \theta Q_t H_t \tag{C.7}$$

$$\phi_t^o = \frac{L_t^o}{M_t^o} \tag{C.8}$$

$$C_t^o + P_t^s S_t^o + Q_t H_t + b_t^o + \frac{\psi_{b^o}}{2} (b_t^o)^2 = W_t N^o + \frac{R_{t-1}}{\Pi_t} b_{t-1}^o + P_t^s S_t + L_t^o - M_t^o \tag{C.9}$$

- Renter

$$1 = \beta R_t E_t \left[\frac{C_t^r}{C_{t+1}^r} \frac{1}{\Pi_{t+1}} \right] \tag{C.10}$$

$$\psi C_t^r = P_t^s S_t^r \tag{C.11}$$

- Mortgage lender

$$1 + \psi_{b^l} b_t^l = \beta R_t E_t \left[\frac{C_t^l}{C_{t+1}^l} \frac{1}{\Pi_{t+1}} \right] \tag{C.12}$$

$$C_t^l + b_t^l + \frac{\psi_{b^l}}{2} \left(b_t^l \right)^2 + L_t^l = W_t N^l + W_t^H N^{l,H} + \frac{R_{t-1}}{\Pi_t} b_{t-1}^l + M_t^l + \Phi_t^l - T_t \tag{C.13}$$

$$\Lambda_{t,t+1} = \frac{C_t^l}{C_{t+1}^l} \frac{1}{\Pi_{t+1}} \tag{C.14}$$

$$\begin{aligned} \frac{1}{C_t^l} - \beta R_t^M E_t \left[\frac{1}{C_{t+1}^l} \frac{1}{\Pi_{t+1}} \right] &= \frac{\mu_t^l}{D_t^l} \left(R_t^F - R_{t-1}^M \right) \left(1 - \phi_t^l \right) \\ &- \beta \left(1 - \gamma \right) E_t \left[\frac{\mu_{t+1}^l}{D_{t+1}^l} \frac{1}{\Pi_{t+1}} \left(R_{t+1}^F - R_t^M \right) \right] \end{aligned} \tag{C.15}$$

$$\mu_t^l = \begin{cases} 0 & \text{if ARM} \\ \beta E_t \left[\frac{D_t^l}{C_{t+1}^l} \frac{1}{\Pi_{t+1}} + \mu_{t+1}^l \left(1 - \phi_{t+1}^l \right) \right] & \text{if FRM} \end{cases} \tag{C.16}$$

$$\phi_t^l = \frac{L_t^l}{M_t^l} \tag{C.17}$$

- Construction firm

$$Q_t = W_t^H \tag{C.18}$$

- Non-construction firm

$$p_t^* = \frac{\varepsilon}{\varepsilon - 1} \frac{Z_{1,t}}{Z_{2,t}} \tag{C.19}$$

$$Z_{1,t} = W_t Y_t + \alpha \beta E_t \left[\Lambda_{t,t+1} Z_{1,t+1} \left(\Pi_{t+1} \right)^{\varepsilon + 1} \right] \tag{C.20}$$

$$Z_{2,t} = Y_t + \alpha \beta E_t \left[\Lambda_{t,t+1} Z_{2,t+1} \left(\Pi_{t+1} \right)^{\varepsilon} \right]. \tag{C.21}$$

- Equilibrium and market clearing:

$$\lambda^o H_t = \lambda^l \bar{N}^{l,H} \tag{C.22}$$

$$\lambda^o S_t = \lambda^o S_t^o + \lambda^r S_t^r \tag{C.23}$$

$$S_t = H_t \tag{C.24}$$

$$0 = \lambda^l b_t^l + \lambda^o b_t^o + \lambda^r b_t^r \tag{C.25}$$

$$C_t = \lambda^l C_t^l + \lambda^o C_t^o + \lambda^r C_t^r \tag{C.26}$$

$$Y_t = C_t + \frac{\psi_b}{2}\left(\lambda^l \left(b_t^l\right)^2 + \lambda^o \left(b_t^o\right)^2 + \lambda^r \left(b_t^r\right)^2\right) + \lambda^l T_t \tag{C.27}$$

$$\bar{N} = Y_t \Xi_t \tag{C.28}$$

$$\Xi_t = (1-\alpha)\left(p_t^*\right)^{-\varepsilon} + \alpha\left(\Pi_t\right)^{\varepsilon} \Xi_{t-1} \tag{C.29}$$

$$\Pi_t^{1-\varepsilon} = (1-\alpha)\left(p_t^* \Pi_t\right)^{1-\varepsilon} + \alpha \tag{C.30}$$

$$\lambda^l L_t^l = \lambda^o L_t^o \tag{C.31}$$

$$\lambda^l M_t^l = \lambda^o M_t^o \tag{C.32}$$

$$\lambda^l D_t^l = \lambda^o D_t^o \tag{C.33}$$

$$\lambda^l \Phi_t^l = \int \left(\frac{P_t\left(i\right)}{P_t} Y_t\left(i\right) - w_t N_t^F\left(i\right)\right) di = Y_t - w_t \bar{N} \tag{C.34}$$

$$T_t = \Phi_t^l \tag{C.35}$$

and

$$\bar{N} = \lambda^l N^l + \lambda^o N^o + \lambda^r N^r$$

- Monetary policy and mortgage rates

$$\frac{R_t}{\bar{R}} = \left(\frac{R_t}{\bar{R}}\right)^{\rho}\left(\frac{\Pi_t}{\bar{\Pi}}\right)^{(1-\rho)\phi_\pi} \exp\left(\varepsilon_{t-k}\right) \tag{C.36}$$

$$R_t^M = \begin{cases} R_t & \text{if ARM} \\ \left(1-\phi_t^o\right) R_{t-1}^M + \phi_t^o R_t^F & \text{if FRM} \end{cases} \tag{C.37}$$

- 37 Variables and 37 equations
  - Real allocations: (13 variables)

$$\left\{C_t^l, C_t^o, C_t^r, C_t, S_t^o, S_t^r, S_t, H_t, Y_t, \Phi_t^l, T_t, \lambda_{2t}, \lambda_{2t}^l\right\}$$

  - Bonds: (3 variables)

$$\left\{b_t^l, b_t^o, b_t^r\right\}$$

– Prices and interest rates: (13 variables)

$$\left\{P_t^s, Q_t R_t, R_t^M, R_t^F, W_t, W_t^H, \Pi_t, p_t^*, Z_{1,t}, Z_{2,t}, \Xi_t, \Lambda_{t,t+1}\right\}$$

– Mortgages: (8 variables)

$$\left\{M_t^l, L_t^l, D_t^l, \phi_t^l, M_t^o, L_t^o, D_t^o, \phi_t^o\right\}$$

C.2 Non-stochastic steady-states

In this subsection, we define a non-stochastic steady-state equilibrium of the baseline model. We first fix $\bar{N} = 0.3$, $\bar{N}^l = 0.8\bar{N}$, and $\bar{N}^{l,H} = 0.2\bar{N}$ which implies about 5% or workers work for construction sector. We consider the model with zero net inflation steady-state ($\bar{\Pi} = 1$). Then, Equations (C.19), (C.20), (C.21), (C.19), and (C.19) imply that $\bar{p}^* = 1$, $\bar{\Xi} = 1$, $\bar{W} = \frac{\epsilon-1}{\epsilon}$, $\bar{Z}_1 = \frac{1}{1-\alpha\beta}\bar{W}\bar{Y}$, and $\bar{Z}_2 = \frac{1}{1-\alpha\beta}\bar{W}$ where $\bar{Y} = \bar{N}$ from Equation (C.28). Also, from Equations (C.27), (C.34) and (C.35), we have $\bar{T} = \bar{\Phi}^l = \frac{1}{\lambda^l}\left(1-\bar{W}\right)\bar{N}$ and $\bar{C} = \bar{Y} - \lambda^l \bar{T}$.

We assume the steady-state consumption for homeowners and renters are the same ($\bar{C}^o = \bar{C}^r = \bar{C}^{or}$) and the steady-state bond holdings are zero ($\bar{b}^o = \bar{b}^r = \bar{b}^l = 0$). We calibrate the population share of mortgage lenders λ^l to match the ratio of personal consumption expenditure (PCE) excluding housing services to disposable income ratio ($\frac{\bar{C}^{or}}{\bar{W}\bar{N}}$) of 0.59 observed in the data. First, observe that Equation C.22 implies the steady-state housing stock $\bar{H} = \frac{\lambda^l}{\lambda^o}\bar{N}^{l,H}$. Note that we set $\lambda^o = \frac{2}{3}\left(1-\lambda^l\right)$ to match the 2/3 homeownership ratio observed in the data. Also, from Equation (C.24), we have $\bar{S} = \bar{H}$. Then, we take the ratio of PCE excluding housing services to PCE housing services ($\frac{\bar{C}^{or}}{\bar{S}} = 4.7$) from the data and set $\bar{C}^{or} = \frac{\bar{C}^{or}}{\bar{S}}\bar{S} = \frac{\bar{C}^{or}}{\bar{S}}\frac{\lambda^l}{\lambda^o}\bar{N}^{l,H}$. Now, we find λ^l which satisfies $\frac{\bar{C}^{or}}{\bar{W}\bar{N}} = 0.59$. We get $\bar{C}^l = \frac{1}{\lambda^l}\bar{C} - \left(\frac{1-\lambda^l}{\lambda^l}\right)\bar{C}^{or}$ from Equation (C.26).

The steady-state nominal interest rates and mortgage rates are derived from Equations (C.2), (C.15), (C.37), $\bar{R} = \bar{R}^M = \bar{R}^F = \frac{1}{\beta}$.

Then, from Equation (C.3), we have the steady-state rent-to-price ratio of 1 ($\bar{P}^s = \bar{Q}$).

Now, we calibrate ψ to match $\frac{\bar{C}^{or}}{\bar{S}} = 4.7$ as following. First, from mortgage lenders' budget constraint (C.13) and Equations (C.31) and (C.32), we get

$$\begin{aligned}
\bar{C}^l &= \bar{W}N^l + \bar{W}^H N^{l,H} + M^l - \bar{L}^l \\
&= \bar{W}N^l + \bar{W}^H N^{l,H} + \frac{\lambda^o}{\lambda^l}\bar{M}^o - \frac{\lambda^o}{\lambda^l}\bar{L}^o \\
&= \bar{W}N^l + \frac{\lambda^o}{\lambda^l}\left(1 + \frac{\theta}{\gamma}\left(\frac{1}{\beta} - 1\right)\right)\bar{Q}\bar{H}
\end{aligned}$$

where we use Equations (C.5), (C.6), (C.7), (C.18), and (C.22) to derive the last equality. From this, we can get $\bar{Q}$. Second, from Equations (C.1), (C.11), and (C.23), we can get

$$\psi = \frac{\lambda^o}{1-\lambda^l}\frac{\bar{Q}}{\frac{\bar{C}^o}{\bar{S}}}.$$

Then, we get $\bar{S}^o = \bar{S}^r = \psi \frac{\bar{C}^o}{\bar{P}^s}$, $\bar{L}^o = \theta \bar{Q}\bar{H}$, $\bar{D}^o = \frac{1}{\gamma}\bar{L}^o$ and $\bar{M}^o = \left(\frac{1}{\beta} - 1 + \gamma\right)\bar{D}^o$. Then, using the homeowners' budget constraint (C.9), we get

$$
\begin{aligned}
N^o &= \frac{1}{\bar{W}}\left(\bar{C}^o + \bar{P}^S\bar{S}^o - \bar{L}^o + \bar{M}^o\right), \\
N^r &= \frac{1}{\lambda^r}\bar{N} - \frac{1}{\lambda^r}\left(\lambda^l N^l + \lambda^o N^o\right).
\end{aligned}
$$

Lastly, Equations (C.8) and (C.17) imply that $\bar{\phi}^o = \bar{\phi}^l = \frac{\gamma}{\frac{1}{\beta}-1+\gamma}$, and Equations (C.4) and (C.16) imply that

$$
\bar{\mu}^o = \begin{cases} 0 & \text{if ARM} \\ -\frac{\beta}{1-\beta(1-\gamma)}\frac{\bar{D}^o}{\bar{C}^o} & \text{if FRM} \end{cases}
$$

$$
\bar{\mu}^l = \begin{cases} 0 & \text{if ARM} \\ \frac{\beta}{1-\beta(1-\gamma)}\frac{\bar{D}^l}{\bar{C}^l} & \text{if FRM} \end{cases}
$$

C.3 A system of log-linearized model equilibrium conditions

In this subsection, we derive the equilibrium conditions for the log-linearized model. We denote small letters as the log deviation from its steady-state ($x_t = \log X_t - \log \bar{X}$).

- Homeowner

$$
c_t^o = p_t^s + s_t^o \tag{C.38}
$$

$$
\psi_{b^o} b_t^o = c_t^o - E_t c_{t+1}^o + r_t - E_t \pi_{t+1} \tag{C.39}
$$

$$
\frac{1}{\theta}\left(p_t^S - q_t\right) = \begin{cases} c_t^o - E_t c_{t+1}^o + r_t^M - E_t\pi_{t+1} + \beta\frac{1-\gamma}{\theta}E_t\left[p_{t+1}^S - q_{t+1}\right] & \text{if ARM} \\ c_t^o - E_t c_{t+1}^o + r_t^M - E_t\pi_{t+1} + \beta\frac{1-\gamma}{\theta}E_t\left[p_{t+1}^S - q_{t+1}\right] & \\ -\frac{1-\gamma}{1-\beta(1-\gamma)}\left(r_{t-1}^M - r_t^F - \beta E_t\left[r_t^M - r_{t+1}^F\right]\right) & \text{if FRM} \end{cases} \tag{C.40}
$$

$$
d_t = (1-\gamma)\left(d_{t-1} - \pi_t\right) + \gamma l_t^o \tag{C.41}
$$

$$
m_t^o = \frac{\frac{1}{\beta}}{\frac{1}{\beta} - 1 + \gamma} r_{t-1}^M + d_{t-1} - \pi_t \tag{C.42}
$$

$$
l_t^o = q_t + h_t \tag{C.43}
$$

$$
\begin{aligned}
\bar{C}^o c_t^o + \bar{P}^s\bar{S}^o\left(p_t^s + s_t^o\right) + \bar{Q}\bar{H}\left(q_t + h_t\right) + b_t^o &= \bar{W}N^o w_t + \frac{1}{\beta}b_{t-1}^o + \bar{P}^s\bar{S}\left(p_t^s + s_t\right) \\
&+ \bar{L}^o l_t^o - \bar{M}^o m_t^o
\end{aligned} \tag{C.44}
$$

- Renter

$$
0 = c_t^r - E_t c_{t+1}^r + r_t - E_t\pi_{t+1} \tag{C.45}
$$

$$
c_t^r = p_t^s + s_t^r \tag{C.46}
$$

- Lender

$$\psi_{b^l} b_t^l = c_t^l - E_t c_{t+1}^l + r_t - E_t \pi_{t+1} \tag{C.47}$$

$$0 = \begin{cases} r_t^M - r_t^F & \text{if ARM} \\ c_t^l - E_t c_{t+1}^l + r_t^M - E_t \pi_{t+1} + \frac{1-\gamma}{1-\beta(1-\gamma)} \left(r_t^F - r_{t-1}^M - \beta E_t r_{t+1}^F - r_t^M \right) & \text{if FRM} \end{cases} \tag{C.48}$$

$$\bar{C}^l c_t^l + b_t^l + \bar{L}^l l_t^l = \bar{W} N^l w_t + \bar{W}^H N^{l,H} w_t^H + \frac{1}{\beta} b_{t-1}^l + \bar{M}^l m_t^l + \bar{\Phi}^l \Phi_t^l - \bar{T} T_t \tag{C.49}$$

- Firms

$$w_t^H = q_t \tag{C.50}$$

$$\pi_t = \beta E_t \pi_{t+1} + \frac{(1-\omega)(1-\omega\beta)}{\omega} w_t \tag{C.51}$$

- Equilibrium and market clearing:

$$h_t = 0 \tag{C.52}$$

$$\lambda^o \bar{S} s_t = \lambda^o \bar{S}^o s_t^o + \lambda^r \bar{S}^r s_t^r \tag{C.53}$$

$$s_t = h_t \tag{C.54}$$

$$0 = \lambda^l b_t^l + \lambda^o b_t^o + \lambda^r b_t^r \tag{C.55}$$

$$\bar{C} c_t = \lambda^l \bar{C}^l c_t^l + \lambda^o \bar{C}^o c_t^o + \lambda^r \bar{C}^r c_t^r \tag{C.56}$$

$$\bar{Y} y_t = \bar{C} c_t + \lambda^l \bar{T} \tilde{T}_t \tag{C.57}$$

$$y_t = 0 \tag{C.58}$$

$$l_t^l = l_t^o \tag{C.59}$$

$$m_t^l = m_t^o \tag{C.60}$$

$$\tilde{\Phi}_t^l = -\frac{\bar{W}}{1-\bar{W}} w_t \tag{C.61}$$

$$\tilde{T}_t = \tilde{\Phi}_t^l \tag{C.62}$$

- Monetary policy and mortgage rates

$$r_t = \rho^R r_{t-1} + \left(1 - \rho^R\right) \phi_\pi \pi_t + \varepsilon_{t-k} \tag{C.63}$$

$$r_t^M = \begin{cases} r_t & \text{if ARM} \\ (1-\gamma) r_{t-1}^M + \gamma R_t^F & \text{if FRM} \end{cases} \tag{C.64}$$

- 27 Variables and 27 equations

– Real allocations: (11 variables)

$$\left\{c_t^l, c_t^o, c_t^r, c_t, s_t^o, s_t^r, s_t, h_t, y_t, \tilde{\Phi}_t^l, \tilde{T}_t\right\}$$

– Bonds: (3 variables)

$$\left\{b_t^l, b_t^o, b_t^r\right\}$$

– Prices and interest rates: (8 variables)

$$\left\{p_t^s, q_t r_t, r_t^M, r_t^F, w_t, w_t^H, \pi_t\right\}$$

– Mortgages: (5 variables)

$$\left\{m_t^l, l_t^l, m_t^o, l_t^o, d_t^o\right\}$$

D The baseline model with rationally inattentive homeowners and renters

In this section, we derive decision problems for rationally inattentive homeowners and renters. We formulate the dynamic rational inattention problem (DRIP) of homeowners and renters in a Linear-Quadratic-Gaussian (LQG) setup to use the solution method developed in Afrouzi and Yang (2021). The approach used to derive the DRIP of homeowners and renters in an LQG setup parallels that of Maćkowiak and Wiederholt (2023).

D.1 Second-order approximation for homeowner's utility

Notice that a homeowner's problem is as follows (we omit an individual i-index for a notation simplicity):

$$\max_{\{C_t^o, S_t^o, b_t^o, L_t^o, D_t^o,\}} E_0 \sum_{t=0}^{\infty} \beta^t u\left(C_t^o, S_t^o\right)$$

subject to

$$\begin{aligned} C_t^o + P_t^s S_t^o + b_t^o + \frac{\psi_{b^o}}{2}\left(b_t^o\right)^2 &= W_t N^o + \frac{R_{t-1}}{\Pi_t} b_{t-1}^o + \frac{1}{\theta}\left(\frac{P_t^s}{Q_t} - (1-\theta)\right) L_t^o \\ &\quad - \left(R_{t-1}^M - 1 + \gamma\right) \frac{D_{t-1}^o}{\Pi_t} \\ R_t^M &= \left(1 - \frac{L_t^o}{D_t^o}\right) R_{t-1}^M + \frac{L_t^o}{D_t^o} R_t^F \\ D_t^o &= (1-\gamma) \frac{D_{t-1}^o}{\Pi_t} + L_t^o \end{aligned}$$

First, using the constraints for the optimization problem to substitute for consumption and housing services in the utility function and expressing all variables in terms of log deviations from the non-stochastic steady state yields the following expression for the period utility of the homeowner in period t:

$$f\left(\chi_t^o, z_t^o\right) = \log\Bigg\{\bar{w}\bar{N}^o \exp\left(w_t\right) + \bar{R}\exp\left(r_{t-1}-\pi_t\right) b_{t-1}^o + \frac{1}{\theta}\bar{D}^o\left(\exp\left(p_t^s - q_t\right) - (1-\theta)\right)\exp\left(d_t^o\right)$$

$$- \bar{D}^o\left(\frac{1-\gamma}{\theta}\left(\exp\left(p_t^s - q_t\right) - 1\right) + \bar{R}^M \exp\left(r_{t-1}^M\right)\right)\exp\left(d_{t-1}^o - \pi_t\right)$$

$$- \bar{p}^S\bar{S}^o \exp\left(p_t^S + s_t^o\right) - b_t^o - \frac{\psi_b}{2}\left(b_t^o\right)^2\Bigg\} + \psi\left(s_t^o + \log\left(\bar{S}^o\right)\right)$$

$$- \frac{1}{1-\beta(1-\gamma)}\frac{\bar{D}^o}{\bar{C}^o}\exp\left(\mu_t^o\right)\Big(\left(1-\gamma\right)\exp\left(d_{t-1}^o - d_t^o - \pi_t\right)\left(\exp\left(r_{t-1}^M\right) - \exp\left(r_t^F\right)\right)$$

$$+ \exp\left(r_t^F\right) - \exp\left(r_t^M\right)\Big)$$

where $\chi_t^o = \left(b_t^o, d_t^o s_t^o, \mu_t\right)'$ denotes a set of choice variables and $z_t^o = \left(\pi_t, w_t, p_t^s, q_t, r_{t-1}, r_{t-1}^M r_t^F\right)$ denotes a set of state variables at time t. Let $\varrho_t = \left(\chi_t^o, z_t^o, 1\right)'$.

Now, define

$$g\left(\left\{\chi_{t-1}^o, z_t^o\right\}_{t\geq 0}\right) = \sum_{t=0}^{\infty}\beta^t f\left(\chi_t^o, \chi_{t-1}^o, z_t^o\right).$$

Suppose that the homeowner knows in period -1 its initial bond holdings (b_{-1}^o) and debt holdings (d_{-1}^o) and $s_{-1}^o = \mu_{-1} = 0$. Suppose also that there exist two constants $\delta < 1/\beta$ and such that, for each period $t \geq 0$, for all $m, n \in \{1, 2, \cdots, 11\}$, and for $\tau = 0, 1$,

$$E_{-1}\left|\varrho_{m,t}\varrho_{n,t+\tau}\right| < \delta^t A.$$

Then, Proposition 3 in Appendix of Maćkowiak and Wiederholt (2023) implies that after the second-order Taylor approximation of f at the non-stochastic steady state, the loss in expected utility when the law of motion for the actions differs from the law of motion for the optimal actions under perfect information is given by

$$\sum_{t=0}^{\infty}\beta^t E_{-1}\left[\frac{1}{2}\left(\chi_t^o - \chi_t^{o,*}\right)'\Theta_0^o\left(\chi_t^o - \chi_t^{o,*}\right) + \left(\chi_t^o - \chi_t^{o,*}\right)'\Theta_1^o\left(\chi_{t+1}^o - \chi_{t+1}^{o,*}\right)\right]$$

where Θ_0^o is defined as the Hessian matrix of second derivatives of g with respect to χ_t^o evaluated at the non-stochastic steady state and divided by β^t,$\Theta_1^o$is defined as the Hessian matrix of second derivatives of g with respect to χ_t^o and χ_{t+1}^oevaluated at the non-stochastic steady state and divided by β^t,and the process $\{\chi_t^{o,*}\}$ is defined as the sequence of actions that the homeowner would take if it had perfect information in each period $t \geq 0$. In our setup of homeowner's problem, Θ_0^o and

Θ_1^o are given by:

$$\Theta_0^o = \begin{pmatrix} -\frac{\psi_b}{\bar{C}^o} - \left(\frac{1}{\bar{C}^o}\right)^2 \left(1+\frac{1}{\beta}\right), & \left(\frac{1}{\bar{C}^o}\right)^2 \bar{D}^o \left(1+\frac{1}{\beta}\right), & -\frac{\psi}{\bar{C}^o}, & 0 \\ \left(\frac{1}{\bar{C}^o}\right)^2 \bar{D}^o \left(1+\frac{1}{\beta}\right), & -\left(\frac{\bar{D}^o}{\bar{C}^o}\right)^2 \left(1+\frac{1}{\beta}\right), & \psi\frac{\bar{D}^o}{\bar{C}^o}, & 0 \\ -\frac{\psi}{\bar{C}^o}, & \psi\frac{\bar{D}^o}{\bar{C}^o}, & -\psi\left(1+\psi\right), & 0 \\ 0, & 0, & 0, & 0 \end{pmatrix}$$

$$\Theta_1^r = \begin{pmatrix} \left(\frac{1}{\bar{C}^o}\right)^2, & -\left(\frac{1}{\bar{C}^o}\right)^2 \bar{D}^o, & \frac{\psi}{\bar{C}^o} & 0, \\ -\left(\frac{1}{\bar{C}^o}\right)^2 \bar{D}^o, & \left(\frac{\bar{D}^o}{\bar{C}^o}\right)^2, & -\psi\frac{\bar{D}^o}{\bar{C}^o} & 0, \\ 0, & 0, & 0 & 0, \\ 0, & 0, & 0 & 0, \end{pmatrix}.$$

Also, the optimal actions under perfect information, $\{\chi_t^{o,*}\}_{t=0}^{\infty}$, is defined by the initial condition $\chi_{-1}^{o,*} = \left(b_{-1}^o, d_{-1}^o, 0, 0\right)'$ and the optimality condition

$$E_t\left[\theta_0^o + \Theta_{-1}^o \chi_{t-1}^{o,*} + \Theta_0^o \chi_t^{o,*} + \Theta_1^o \chi_{t+1}^{o,*} + \Phi_0^o z_t^o + \Phi_1^o z_{t+1}^o\right] = 0$$

where θ_0^o is the vector of first derivatives of g w.r.t. χ_t^o at the non-stochastic steady state, Θ_{-1}^o is the matrix of second derivatives of g w.r.t. χ_t^o and χ_{t-1}^o at the non-stochastic steady state, Φ_0^o is the matrix of second derivatives of g w.r.t. χ_t^o and z_t^o at the non-stochastic steady state, and Φ_1^o is the matrix of second derivatives of g w.r.t. χ_t^o and z_{t+1}^o at the non-stochastic steady state. In our setup, these objects are defined as follows:

$$\Theta_{-1}^o = \begin{pmatrix} \frac{1}{\beta}\left(\frac{1}{\bar{C}^o}\right)^2, & -\frac{1}{\beta}\left(\frac{1}{\bar{C}^o}\right)^2 \bar{D}^o, & 0, & 0 \\ -\frac{1}{\beta}\left(\frac{1}{\bar{C}^o}\right)^2 \bar{D}^o, & \frac{1}{\beta}\left(\frac{\bar{D}^o}{\bar{C}^o}\right)^2, & 0, & 0 \\ \frac{1}{\beta}\frac{\psi}{\bar{C}^o}, & -\frac{1}{\beta}\psi\frac{\bar{D}^o}{\bar{C}^o}, & 0, & 0 \\ 0, & 0, & 0, & 0 \end{pmatrix}$$

$$\Theta_0^o = \begin{pmatrix} -\left\{\frac{\psi_b}{\bar{C}^o} + \left(\frac{1}{\bar{C}^o}\right)^2 \left(1+\frac{1}{\beta}\right)\right\}, & \left(\frac{1}{\bar{C}^o}\right)^2 \bar{D}^o \left(1+\frac{1}{\beta}\right), & -\frac{\psi}{\bar{C}^o} & 0, \\ \left(\frac{1}{\bar{C}^o}\right)^2 \bar{D}^o \left(1+\frac{1}{\beta}\right), & -\left(\frac{\bar{D}^o}{\bar{C}^o}\right)^2 \left(1+\frac{1}{\beta}\right), & \psi\frac{\bar{D}^o}{\bar{C}^o} & 0, \\ -\frac{\psi}{\bar{C}^o}, & \psi\frac{\bar{D}^o}{\bar{C}^o}, & -\psi\left(1+\psi\right) & 0, \\ 0, & 0, & 0 & 0, \end{pmatrix}$$

$$\Theta_1^o = \begin{pmatrix} \left(\frac{1}{\bar{C}^o}\right)^2, & -\left(\frac{1}{\bar{C}^o}\right)^2 \bar{D}^o, & \frac{\psi}{\bar{C}^o} & 0, \\ -\left(\frac{1}{\bar{C}^o}\right)^2 \bar{D}^o, & \left(\frac{\bar{D}^o}{\bar{C}^o}\right)^2, & -\psi\frac{\bar{D}^o}{\bar{C}^o} & 0, \\ 0, & 0, & 0 & 0, \\ 0, & 0, & 0 & 0, \end{pmatrix}$$

$$\Phi_0^o = \begin{pmatrix} \frac{1}{\beta}\left(\frac{1}{\bar{C}^o}\right)^2 \bar{D}^o, & \left(\frac{1}{\bar{C}^o}\right)^2 \bar{w}\bar{N}^o, & \left(\frac{1}{\bar{C}^o}\right)^2 \left(\frac{\gamma}{\theta}\bar{D}^o - \psi\bar{C}^o\right), & -\left(\frac{1}{\bar{C}^o}\right)^2 \frac{\gamma}{\theta}\bar{D}^o, & 0, & -\frac{1}{\beta}\left(\frac{1}{\bar{C}^o}\right)^2 \bar{D}^o, & 0 \\ -\frac{1}{\beta}\left(\frac{\bar{D}^o}{\bar{C}^o}\right)^2, & -\left(\frac{1}{\bar{C}^o}\right)^2 \bar{D}^o\bar{w}\bar{N}^o, & \left(\frac{1}{\theta}+\psi\right)\frac{\bar{D}^o}{\bar{C}^o} - \frac{\gamma}{\theta}\left(\frac{\bar{D}^o}{\bar{C}^o}\right)^2, & -\frac{1}{\theta}\frac{\bar{D}^o}{\bar{C}^o} + \frac{\gamma}{\theta}\left(\frac{\bar{D}^o}{\bar{C}^o}\right)^2, & 0, & \frac{1}{\beta}\frac{\bar{D}^o}{\bar{C}^o}\left(\frac{\bar{D}^o}{\bar{C}^o} + \frac{\beta(1-\gamma)}{1-\beta(1-\gamma)}\right), & -\frac{(1-\gamma)}{1-\beta(1-\gamma)}\frac{\bar{D}^o}{\bar{C}^o} \\ \frac{1}{\beta}\psi\frac{\bar{D}^o}{\bar{C}^o}, & \psi\frac{1}{\bar{C}^o}\bar{w}\bar{N}^o & -\psi\left(1+\psi-\frac{\gamma}{\theta}\frac{\bar{D}^o}{\bar{C}^o}\right), & -\psi\frac{\bar{D}^o}{\bar{C}^o}\frac{\gamma}{\theta}, & 0, & -\frac{1}{\beta}\psi\frac{\bar{D}^o}{\bar{C}^o} & 0 \\ 0, & 0, & 0, & 0, & 0, & -\frac{1}{\beta}\left(\frac{\beta(1-\gamma)}{1-\beta(1-\gamma)}\right)\frac{\bar{D}^o}{\bar{C}^o}, & -\frac{\gamma}{1-\beta(1-\gamma)}\frac{\bar{D}^o}{\bar{C}^o} \end{pmatrix}$$

$$\Phi_1^o = \begin{pmatrix} -\frac{1}{\bar{C}^o} - \frac{1}{\beta}\left(\frac{1}{\bar{C}^o}\right)^2 \bar{D}^o, & -\left(\frac{1}{\bar{C}^o}\right)^2 \bar{w}\bar{N}^o, & -\left(\frac{1}{\bar{C}^o}\right)^2 \left(\frac{\gamma}{\theta}\bar{D}^o - \psi\bar{C}^o\right), & \left(\frac{1}{\bar{C}^o}\right)^2 \frac{\gamma}{\theta}\bar{D}^o, & \frac{1}{\bar{C}^o}, & \frac{1}{\beta}\left(\frac{1}{\bar{C}^o}\right)^2 \bar{D}^o, & 0 \\ \frac{\bar{D}^o}{\bar{C}^o} + \left(\frac{\bar{D}^o}{\bar{C}^o}\right)^2 \frac{1}{\beta}, & \left(\frac{1}{\bar{C}^o}\right)^2 \bar{D}^o\bar{w}\bar{N}^o, & \frac{\bar{D}^o}{\bar{C}^o}\left(\frac{\gamma}{\theta}\frac{\bar{D}^o}{\bar{C}^o} - \beta\left(\frac{1-\gamma}{\theta}\right) - \psi\right), & -\frac{\bar{D}^o}{\bar{C}^o}\left(\frac{\gamma}{\theta}\frac{\bar{D}^o}{\bar{C}^o} - \beta\left(\frac{1-\gamma}{\theta}\right)\right), & 0, & -\frac{\bar{D}^o}{\bar{C}^o}\left(1 + \frac{1}{\beta}\frac{\bar{D}^o}{\bar{C}^o} + \frac{\beta(1-\gamma)}{1-\beta(1-\gamma)}\right), & \frac{\beta(1-\gamma)}{1-\beta(1-\gamma)}\frac{\bar{D}^o}{\bar{C}^o} \\ 0, & 0, & 0, & 0, & 0, & 0 & 0 \\ 0, & 0, & 0, & 0, & 0, & \frac{1}{1-\beta(1-\gamma)}\frac{\bar{D}^o}{\bar{C}^o}, & 0 \end{pmatrix}.$$

Then, we now have

$$E_t\left[\Theta_{-1}^o\begin{pmatrix} b_{t-1}^{o,*} \\ d_{t-1}^{o,*} \\ \mu_{t-1}^{o,*} \\ s_{t-1}^{o,*} \end{pmatrix} + \Theta_0^o\begin{pmatrix} b_t^{o,*} \\ d_t^{o,*} \\ \mu_t^{o,*} \\ s_t^{o,*} \end{pmatrix} + \Theta_1^o\begin{pmatrix} b_{t+1}^{o,*} \\ d_{t+1}^{o,*} \\ \mu_{t+1}^{o,*} \\ s_{t+1}^{o,*} \end{pmatrix} + \Phi_0^o\begin{pmatrix} \pi_t \\ p_t^s \\ q_t \\ r_{t-1} \\ r_{t-1}^M \\ r_{t-1}^F \end{pmatrix} + \Phi_1^o\begin{pmatrix} \pi_{t+1} \\ p_{t+1}^s \\ q_{t+1} \\ r_t \\ r_t^M \\ r_t^F \end{pmatrix}\right] = 0. \quad \text{(D.1)}$$

Notice that from the log-linearized budget constraint of the homeowner, we can derive the homeowner's consumption from the full information model as follows:

$$\bar{C}^o c_t^* = \frac{1}{\beta}b_{t-1}^{o,*} - b_t^{o,*} - \bar{D}^o\left(\frac{1}{\beta}d_{t-1}^{o,*} - d_t^{o,*}\right) + \bar{w}\bar{N}^o w_t + \frac{\gamma}{\theta}\bar{D}^o\left(p_t^s - q_t\right) - \psi\bar{C}^o\left(s_t^{o,*} + p_t^s\right) - \frac{1}{\beta}\bar{D}^o\left(r_{t-1}^M - \pi_t\right).$$

Then, we can derive each entry of the matrix equation (D.1) as follows:

- The first entry is

$$\psi_b b_t^{o,*} = c_t^* - c_{t+1}^* + r_t - \pi_{t+1}$$

- The second entry

$$\begin{aligned} \frac{1}{\theta}\left(p_t^s - q_t\right) &= c_t^* - c_{t+1}^* + \left(r_t^M - \pi_{t+1}\right) + \beta\frac{1-\gamma}{\theta}\left(p_{t+1}^s - q_{t+1}\right) \\ &\quad - \frac{1-\gamma}{1-\beta\left(1-\gamma\right)}\left(\left(r_{t-1}^M - r_t^F\right) - \beta\left(r_t^M - r_{t+1}^F\right)\right) \end{aligned}$$

- The third entry

$$s_t^{o,*} + p_t^s = c_t^*$$

- The fourth entry

$$r_t^M = \left(1-\gamma\right)r_{t-1}^M + \gamma r_t^F$$

Now we have

$$c_t^{o,*} = \frac{1}{\bar{C}^o}\left[\frac{1}{\beta}b_{t-1}^{o,*} - b_t^{o,*} - \bar{D}^o\left(\frac{1}{\beta}d_{t-1}^{o,*} - d_t^{o,*}\right) + \frac{\gamma}{\theta}\bar{d}\left(p_t^s - q_t\right) + \bar{\varpi}\bar{N}^o w_t - \frac{1}{\beta}\bar{D}^o\left(r_{t-1}^M - \pi_t\right) - \bar{C}^o\psi\left(s_t^o + p_t^s\right)\right] \tag{D.2}$$
$$c_{t+1}^{o,*} = \frac{1}{\bar{C}^o}\left[\frac{1}{\beta}b_t^{o,*} - b_{t+1}^{o,*} - \bar{D}^o\left(\frac{1}{\beta}d_t^{o,*} - d_{t+1}^{o,*}\right) + \frac{\gamma}{\theta}\bar{d}\left(p_{t+1}^s - q_{t+1}\right) + \bar{\varpi}\bar{N}^o w_{t+1} - \frac{1}{\beta}\bar{D}^o\left(r_t^M - \pi_{t+1}\right) - \bar{C}^o\psi\left(s_{t+1}^{o,*} + p_{t+1}^s\right)\right]$$

Then,

$$\psi_b b_t^{o,*} = c_t^{o,*} - c_{t+1}^{o,*} + \left(r_t - \pi_{t+1}\right) \tag{D.3}$$
$$\begin{aligned}\frac{1}{\theta}\left(p_t^s - q_t\right) = {} & c_t^{o,*} - c_{t+1}^{o,*} + \beta\frac{1-\gamma}{\theta}\left(p_{t+1}^s - q_{t+1}\right) + \left(r_t^M - \pi_{t+1}\right) \\ & - \frac{1-\gamma}{1-\beta\left(1-\gamma\right)}\left(\left(r_{t-1}^M - r_t^F\right) - \beta\left(r_t^M - r_{t+1}^F\right)\right)\end{aligned} \tag{D.4}$$
$$c_t^{o,*} = s_t^{o,*} + p_t^s \tag{D.5}$$

Then, combine Equation (D.5) with Equation (D.2) to get

$$\left(1+\psi\right)c_t^{o,*} = \frac{1}{\bar{C}^o}\left[\frac{1}{\beta}b_{t-1}^{o,*} - b_t^{o,*} - \bar{D}^o\left(\frac{1}{\beta}d_{t-1}^* - d_t^*\right) + \frac{\gamma}{\theta}\bar{D}^o\left(p_t^s - q_t\right) + \bar{\varpi}\bar{N}^o w_t - \frac{1}{\beta}\bar{d}\left(r_{t-1}^M - \pi_t\right)\right]$$

which implies

$$\begin{aligned}\bar{C}^o\left(1+\psi\right)\sum_{s=t}^{t+N}\beta^{s-t}c_s^{o,*} = {} & \frac{1}{\beta}\left(b_{t-1}^{o,*} - \bar{D}^o d_{t-1}^{o,*}\right) - \frac{1}{\beta}\bar{d}\left(r_{t-1}^M - \pi_t\right) \\ & - \beta^N\left(b_{t+N}^{o,*} - \bar{D}^o d_{t+N}^{o,*}\right) + \beta^N\bar{d}\left(r_{t+N}^M - \pi_{t+N+1}\right) \\ & + \frac{\gamma}{\theta}\bar{d}\sum_{s=t}^{t+N}\beta^{s-t}\left(p_s^S - q_s\right) + \bar{\varpi}\bar{N}^o\sum_{s=t}^{t+N}\beta^{s-t}w_s - \bar{d}\sum_{s=t}^{t+N}\beta^{s-t}\left(r_s^M - \pi_{s+1}\right).\end{aligned}$$

Taking the expectation $E_t\left[\cdot\right]$ and the limit as $N \to \infty$ and using the transversality condition, we get

$$\begin{aligned}\bar{C}^o\left(1+\psi\right)\sum_{s=t}^{\infty}\beta^{s-t}E_t\left[c_s^{o,*}\right] = {} & \frac{1}{\beta}\left(b_{t-1}^{o,*} - \bar{D}^o d_{t-1}^{o,*}\right) - \frac{1}{\beta}\bar{d}\left(r_{t-1}^M - \pi_t\right) \\ & + \bar{D}^o\sum_{s=t}^{\infty}\beta^{s-t}E_t\left[\frac{\gamma}{\theta}\left(p_s^S - q_s\right) - \left(r_s^M - \pi_{s+1}\right)\right] + \bar{\varpi}\bar{N}^o\sum_{s=t}^{\infty}\beta^{s-t}E_t w_s\end{aligned} \tag{D.6}$$

Now, using Equation (D.3) and the law of iterated expectations, we get

$$\begin{aligned}c_t^{o,*} &= c_t^{o,*} \\ c_{t+1}^{o,*} &= c_t^{o,*} + \left(r_t - \pi_{t+1}\right) - \psi_b b_t^{o,*} \\ c_{t+2}^{o,*} &= c_t^{o,*} + \left(r_t - \pi_{t+1}\right) - \psi_b b_t^{o,*} + \left(r_{t+1} - \pi_{t+2}\right) - \psi_b b_{t+1}^{o,*} \\ c_{t+3}^{o,*} &= c_t^{o,*} + \left(r_t - \pi_{t+1}\right) - \psi_b b_t^{o,*} + \left(r_{t+1} - \pi_{t+2}\right) - \psi_b b_{t+1}^{o,*} + \left(r_{t+2} - \pi_{t+3}\right) - \psi_b b_{t+2}^{o,*} \\ &\vdots\end{aligned}$$
$$\sum_{s=t}^{\infty}\beta^{s-t}E_t\left[c_s^{o,*}\right] = \frac{1}{1-\beta}c_t^{o,*} + \frac{\beta}{1-\beta}\sum_{s=t}^{\infty}\beta^{s-t}E_t\left[\left(\left(r_s - \pi_{s+1}\right) - \psi_b b_s^{o,*}\right)\right]$$

Then, combine Equation (D.3) and (D.4) to get

$$
\begin{aligned}
\sum_{s=t}^{\infty}\beta^{s-t}E_t\left[c_s^{o,*}\right] &= \frac{1}{1-\beta}c_t^{o,*}+\frac{\beta}{1-\beta}\sum_{s=t}^{\infty}\beta^{s-t}E_t\left[\left(\left(r_s-\pi_{s+1}\right)-\psi_b b_s^{o,*}\right)\right] \\
&= \frac{1}{1-\beta}c_t^{o,*}-\frac{\beta}{1-\beta}\sum_{s=t}^{\infty}\beta^{s-t}E_t\left[\frac{1}{\theta}\left(p_s^s-q_s\right)-\beta\frac{1-\gamma}{\theta}\left(p_{s+1}^s-q_{s+1}\right)\right] \\
&+\frac{\beta}{1-\beta}\sum_{s=t}^{\infty}\beta^{s-t}E_t\left[\left(r_s^M-\pi_{s+1}\right)-\frac{1-\gamma}{1-\beta\left(1-\gamma\right)}\left(\left(r_{s-1}^M-r_s^F\right)-\beta\left(r_s^M-r_{s+1}^F\right)\right)\right] \qquad \text{(D.7)}
\end{aligned}
$$

Then, by combining Equations (D.6) and (D.7), we have

$$
\begin{aligned}
\left(b_t^{o,*}-\bar{D}^o d_t^{o,*}\right)-\left(b_{t-1}^{o,*}-\bar{D}^o d_{t-1}^{o,*}\right) &= \varpi\bar{N}^o\left(w_t-\left(1-\beta\right)\sum_{s=t}^{\infty}\beta^{s-t}E_t w_s\right)-\bar{D}^o\left(r_{t-1}^M-\pi_t\right) \\
&+\left(\frac{\gamma}{\theta}\bar{D}^o-\bar{C}^o\beta\frac{1-\gamma}{\theta}\left(1+\psi\right)\right)\left(p_t^s-q_t\right) \\
&+\left(\bar{D}^o\left(1-\beta\right)+\bar{C}^o\beta\left(1+\psi\right)\right)\sum_{s=t}^{\infty}\beta^{s-t}E_t\left[\left(r_s^M-\pi_{s+1}\right)-\frac{\gamma}{\theta}\left(p_s^S-q_s\right)\right] \\
&-\bar{C}^o\left(1+\psi\right)\frac{\beta\left(1-\gamma\right)}{1-\beta\left(1-\gamma\right)}\sum_{s=t}^{\infty}\beta^{s-t}E_t\left[\left(r_{s-1}^M-r_s^F\right)-\beta\left(r_s^M-r_{s+1}^F\right)\right]
\end{aligned}
$$

Then, we now have a system of four equations

$$
\begin{aligned}
\psi_b b_t^{o,*} &= \frac{1}{\theta}\left(p_t^s-q_t\right)+\left(r_t-\pi_{t+1}\right)-\beta\frac{1-\gamma}{\theta}\left(p_{t+1}^s-q_{t+1}\right)-\left(r_t^M-\pi_{t+1}\right) \\
&+\frac{1-\gamma}{1-\beta\left(1-\gamma\right)}\left(\left(r_{t-1}^M-r_t^F\right)-\beta\left(r_t^M-r_{t+1}^F\right)\right)
\end{aligned}
$$

$$
\begin{aligned}
\left(b_t^{o,*}-\bar{D}^o d_t^{o,*}\right)-\left(b_{t-1}^{o,*}-\bar{D}^o d_{t-1}^{o,*}\right) &= \varpi\bar{N}^o\left(w_t-\left(1-\beta\right)\sum_{s=t}^{\infty}\beta^{s-t}E_t w_s\right)-\bar{D}^o\left(r_{t-1}^M-\pi_t\right) \\
&+\left(\frac{\gamma}{\theta}\bar{D}^o-\bar{C}^o\beta\frac{1-\gamma}{\theta}\left(1+\psi\right)\right)\left(p_t^s-q_t\right) \\
&+\left(\bar{D}^o\left(1-\beta\right)+\bar{C}^o\beta\left(1+\psi\right)\right)\sum_{s=t}^{\infty}\beta^{s-t}E_t\left[\left(r_s^M-\pi_{s+1}\right)-\frac{\gamma}{\theta}\left(p_s^S-q_s\right)\right] \\
&-\bar{C}^o\left(1+\psi\right)\frac{\beta\left(1-\gamma\right)}{1-\beta\left(1-\gamma\right)}\sum_{s=t}^{\infty}\beta^{s-t}E_t\left[\left(r_{s-1}^M-r_s^F\right)-\beta\left(r_s^M-r_{s+1}^F\right)\right]
\end{aligned}
$$

$$
\begin{aligned}
\frac{1}{\beta}\left(b_{t-1}^{o,*}-\bar{D}^o d_{t-1}^{o,*}\right)-\left(b_t^{o,*}-\bar{D}^o d_t^{o,*}\right)-\bar{C}^o\left(1+\psi\right)s_t^{o,*} &= -\frac{\gamma}{\theta}\bar{d}\left(p_t^s-q_t\right)-\varpi\bar{N}^o w_t+\frac{1}{\beta}\bar{d}\left(r_{t-1}^M-\pi_t\right) \\
&+\bar{C}^o\left(1+\psi\right)p_t^s
\end{aligned}
$$

and

$$
r_t^M=\left(1-\gamma\right)r_{t-1}^M+\gamma r_t^F,
$$

which characterizes the homeowner's optimal allocations under the full information rational expectations.

Now, we can use a change of variables approach to derive a DRIP which is applicable to the solution method in Afrouzi and Yang (2021). Formally, we use Proposition 4 of the appendix in MW (2023) to show that

$$\begin{aligned}
&\sum_{t=0}^{\infty} \beta^t \left[\frac{1}{2} \left(\chi_t^o - \chi_t^{o,*} \right)' \Theta_0^o \left(\chi_t^o - \chi_t^{o,*} \right) + \left(\chi_t^o - \chi_t^{o,*} \right)' \Theta_1^o \left(\chi_{t+1}^o - \chi_{t+1}^{o,*} \right) \right] \\
= &\sum_{t=0}^{\infty} \beta^t \left[\frac{1}{2} \left(\tilde{x}_t^o - \tilde{x}_t^{o,*} \right)' \tilde{\Theta}^o \left(\tilde{x}_t^o - \tilde{x}_t^{o,*} \right) \right].
\end{aligned}$$

In our model setup,

$$\tilde{x}_t^o - \tilde{x}_t^{o,*} = \begin{pmatrix} \left(b_t^o - b_t^{o,*} \right) \\ \left(b_t^o - b_t^{o,*} \right) - \bar{d} \left(d_t - d_t^* \right) - \left(\left(b_{t-1}^o - b_{t-1}^{o,*} \right) - \bar{d} \left(d_{t-1} - d_{t-1}^* \right) \right) \\ \frac{1}{\beta} \left(\left(b_{t-1}^o - b_{t-1}^{o,*} \right) - \bar{d} \left(d_{t-1} - d_{t-1}^* \right) \right) - \left(\left(b_t^o - b_t^{o,*} \right) - \bar{d} \left(d_t - d_t^* \right) \right) \\ \quad -\bar{C}^o \left(1 + \psi \right) \left(s_t^o - s_t^{o,*} \right) \end{pmatrix}$$

and

$$\tilde{\Theta}^o = \begin{pmatrix} -\frac{\psi_b}{\bar{C}^o}, & 0 & 0 \\ 0, & -\left(\frac{1}{1+\psi} \right) \frac{1}{\beta} \left(\frac{1}{\bar{C}^o} \right)^2, & 0 \\ 0, & 0, & -\left(\frac{\psi}{1+\psi} \right) \left(\frac{1}{\bar{C}^o} \right)^2 \end{pmatrix}.$$

To show this, the loss in expected utility when the law of motion for the actions differs from the law of motion for the optimal actions under perfect information is given by:

$$
\begin{aligned}
&\frac{1}{2}\left(\chi_t^o-\chi_t^{o,*}\right)'\Theta_0^o\left(\chi_t^o-\chi_t^{o,*}\right)+\left(\chi_t^o-\chi_t^{o,*}\right)'\Theta_1^o\left(\chi_{t+1}^o-\chi_{t+1}^{o,*}\right)\\
=&-\frac{1}{2}\frac{\psi_b}{\bar{C}^o}\left(\tilde{x}_{1,t}^o-\tilde{x}_{1,t}^{o,*}\right)^2\\
&-\frac{1}{2}\left(\frac{1}{1+\psi}\right)\left(\frac{1}{\bar{C}^o}\right)^2\left(\tilde{x}_{2,t+1}^o-\tilde{x}_{2,t+1}^{o,*}\right)^2\\
&-\frac{1}{2}\left(\frac{\psi}{1+\psi}\right)\left(\frac{1}{\bar{C}^o}\right)^2\left(\tilde{x}_{3,t}^o-\tilde{x}_{3,t}^{o,*}\right)^2\\
&+\frac{1}{2}\left(\frac{1}{1+\psi}\right)\left(\frac{1}{\bar{C}^o}\right)^2\left[\left(\left(b_{t+1}^o-b_{t+1}^{o,*}\right)-\bar{D}^o\left(d_{t+1}^o-d_{t+1}^{o,*}\right)\right)^2-\frac{1}{\beta}\left(\left(b_t^o-b_t^{o,*}\right)-\bar{D}^o\left(d_t^o-d_t^{o,*}\right)\right)^2\right]\\
&+\frac{1}{2}\left(\frac{\psi}{1+\psi}\right)\frac{1}{\beta}\left(\frac{1}{\bar{C}^o}\right)^2\left[\left(\left(b_t^o-b_t^{o,*}\right)-\bar{D}^o\left(d_t^o-d_t^{o,*}\right)\right)^2-\frac{1}{\beta}\left(\left(b_{t-1}^o-b_{t-1}^{o,*}\right)-\bar{D}^o\left(d_{t-1}^o-d_{t-1}^{o,*}\right)\right)^2\right]\\
&-\frac{\psi}{1+\psi}\left(\frac{1}{\bar{C}^o}\right)^2\left[\left(\left(b_t^o-b_t^{o,*}\right)-\bar{D}^o\left(d_t^o-d_t^{o,*}\right)\right)\left(\tilde{x}_{3,t+1}-\tilde{x}_{3,t+1}^*\right)\right]\\
&+\frac{\psi}{1+\psi}\left(\frac{1}{\bar{C}^o}\right)^2\left[\frac{1}{\beta}\left(\left(b_{t-1}^o-b_{t-1}^{o,*}\right)+\bar{D}^o\left(d_{t-1}^o-d_{t-1}^{o,*}\right)\right)\left(\tilde{x}_{3,t}-\tilde{x}_{3,t}^*\right)\right]\\
&-\frac{\psi}{1+\psi}\left(\frac{1}{\bar{C}^o}\right)^2\left[\left(\left(b_t^o-b_t^{o,*}\right)-\bar{D}^o\left(d_t^o-d_t^{o,*}\right)\right)\left(\tilde{x}_{3,t+1}-\tilde{x}_{3,t+1}^*\right)\right]\\
&+\frac{\psi}{1+\psi}\left(\frac{1}{\bar{C}^o}\right)^2\left[\frac{1}{\beta}\left(\left(b_{t-1}^o-b_{t-1}^{o,*}\right)+\bar{D}^o\left(d_{t-1}^o-d_{t-1}^{o,*}\right)\right)\left(\tilde{x}_{3,t}-\tilde{x}_{3,t}^*\right)\right]
\end{aligned}
$$

Then, using $\tilde{x}_{2,0}-\tilde{x}_{2,0}^*=\left(b_0^o-b_0^{o,*}\right)-\bar{d}\left(d_0-d_0^*\right)$

$$
\begin{aligned}
&\sum_{t=0}^{T}\beta^t\left[\frac{1}{2}\left(\chi_t^o-\chi_t^{o,*}\right)'\Theta_0^o\left(\chi_t^o-\chi_t^{o,*}\right)+\left(\chi_t^o-\chi_t^{o,*}\right)'\Theta_1^o\left(\chi_{t+1}^o-\chi_{t+1}^{o,*}\right)\right]\\
=&\sum_{t=0}^{T}\beta^t\left[-\frac{1}{2}\frac{\psi_b}{\bar{C}^o}\left(\tilde{x}_{1,t}^o-\tilde{x}_{1,t}^{o,*}\right)^2-\frac{1}{2}\left(\frac{1}{1+\psi}\right)\left(\frac{1}{\bar{C}^o}\right)^2\frac{1}{\beta}\left(\tilde{x}_{2,t}^o-\tilde{x}_{2,t}^{o,*}\right)^2-\frac{1}{2}\left(\frac{\psi}{1+\psi}\right)\left(\frac{1}{\bar{C}^o}\right)^2\left(\tilde{x}_{3,t}^o-\tilde{x}_{3,t}^{o,*}\right)^2\right]\\
&-\beta^T\frac{1}{2}\left(\frac{1}{1+\psi}\right)\left(\frac{1}{\bar{C}^o}\right)^2\frac{1}{\beta}\left(\tilde{x}_{2,T+1}^o-\tilde{x}_{2,T+1}^{o,*}\right)^2\\
&+\beta^T\frac{1}{2}\left(\frac{1}{1+\psi}\right)\left(\frac{1}{\bar{C}^o}\right)^2\left[\left(\left(b_{T+1}^o-b_{T+1}^{o,*}\right)-\bar{d}\left(d_{T+1}^o-d_{T+1}^{o,*}\right)\right)^2\right]\\
&+\beta^T\frac{1}{2}\left(\frac{\psi}{1+\psi}\right)\frac{1}{\beta}\left(\frac{1}{\bar{C}^o}\right)^2\left[\left(\left(b_T^o-b_T^{o,*}\right)-\bar{d}\left(d_T^o-d_T^{o,*}\right)\right)^2\right]\\
&-\beta^T\frac{\psi}{1+\psi}\left(\frac{1}{\bar{C}^o}\right)^2\left[\left(\left(b_T^o-b_T^{o,*}\right)-\bar{d}\left(d_T^o-d_T^{o,*}\right)\right)\left(\tilde{x}_{3,T+1}-\tilde{x}_{3,T+1}^*\right)\right]
\end{aligned}
$$

Taking the expectation and taking the limit as $T\to\infty$,

$$
\begin{aligned}
&\sum_{t=0}^{\infty}\beta^t\left[\frac{1}{2}\left(\chi_t^o-\chi_t^{o,*}\right)'\Theta_0^o\left(\chi_t^o-\chi_t^{o,*}\right)+\left(\chi_t^o-\chi_t^{o,*}\right)'\Theta_1^o\left(\chi_{t+1}^o-\chi_{t+1}^{o,*}\right)\right]\\
=&\sum_{t=0}^{\infty}\beta^t\left[-\frac{1}{2}\frac{\psi_b}{\bar{C}^o}\left(\tilde{x}_{1,t}^o-\tilde{x}_{1,t}^{o,*}\right)^2-\frac{1}{2}\left(\frac{1}{1+\psi}\right)\frac{1}{\beta}\left(\frac{1}{\bar{C}^o}\right)^2\left(\tilde{x}_{2,t}^o-\tilde{x}_{2,t}^{o,*}\right)^2-\frac{1}{2}\left(\frac{\psi}{1+\psi}\right)\left(\frac{1}{\bar{C}^o}\right)^2\left(\tilde{x}_{3,t}^o-\tilde{x}_{3,t}^{o,*}\right)^2\right]\\
=&\sum_{t=0}^{\infty}\beta^t\left[\frac{1}{2}\left(\tilde{x}_t^o-\tilde{x}_t^{o,*}\right)'\tilde{\Theta}^o\left(\tilde{x}_t^o-\tilde{x}_t^{o,*}\right)\right]
\end{aligned}
$$

where

$$\tilde{\Theta}^o = \begin{pmatrix} -\frac{\psi_b}{\bar{C}^o}, & 0 & 0 \\ 0, & -\left(\frac{1}{1+\psi}\right)\frac{1}{\beta}\left(\frac{1}{\bar{C}^o}\right)^2, & 0 \\ 0, & 0, & -\left(\frac{\psi}{1+\psi}\right)\left(\frac{1}{\bar{C}^o}\right)^2 \end{pmatrix}$$

and

$$\tilde{x}_t^{o,*} = \begin{pmatrix} b_t^{o,*} \\ \left(b_t^{o,*} - \bar{d}d_t^*\right) - \left(b_{t-1}^{o,*} - \bar{d}d_{t-1}^*\right) \\ \frac{1}{\beta}\left(b_{t-1}^{o,*} - \bar{d}d_{t-1}^*\right) - \left(b_t^{o,*} - \bar{d}d_t^*\right) - \bar{C}^o(1+\psi)s_t^{o,*} \end{pmatrix}$$

$$= \begin{pmatrix} \frac{1}{\psi_b}\left[\frac{1}{\theta}\left(p_t^s - q_t\right) + \left(r_t - r_t^M\right) - \beta\frac{1-\gamma}{\theta}\left(p_{t+1}^s - q_{t+1}\right) + \frac{1-\gamma}{1-\beta(1-\gamma)}\left(\left(r_{t-1}^M - r_t^F\right) - \beta\left(r_t^M - r_{t+1}^F\right)\right)\right] \\ \bar{w}\bar{N}^o\left(w_t - (1-\beta)\sum_{s=t}^{\infty}\beta^{s-t}E_t w_s\right) - \bar{D}^o\left(r_{t-1}^M - \pi_t\right) + \left(\frac{\gamma}{\theta}\bar{D}^o - \bar{C}^o\beta\frac{1-\gamma}{\theta}(1+\psi)\right)\left(p_t^s - q_t\right) \\ +\left(\bar{D}^o(1-\beta) + \bar{C}^o\beta(1+\psi)\right)\sum_{s=t}^{\infty}\beta^{s-t}E_t\left[\left(r_s^M - \pi_{s+1}\right) - \frac{\gamma}{\theta}\left(p_s^S - q_s\right)\right] \\ -\bar{C}^o(1+\psi)\frac{\beta(1-\gamma)}{1-\beta(1-\gamma)}\sum_{s=t}^{\infty}\beta^{s-t}E_t\left[\left(r_{s-1}^M - r_s^F\right) - \beta\left(r_s^M - r_{s+1}^F\right)\right] \\ -\frac{\gamma}{\theta}\bar{d}\left(p_t^s - q_t\right) - \bar{w}\bar{N}^o w_t + \frac{1}{\beta}\bar{d}\left(r_{t-1}^M - \pi_t\right) + \bar{C}^o(1+\psi)p_t^s \end{pmatrix}$$

$$c_t^{o,*} = \frac{1}{(1+\psi)\bar{C}^o}\left[\frac{1}{\beta}b_{t-1}^{o,*} - b_t^{o,*} - \bar{D}^o\left(\frac{1}{\beta}d_{t-1}^* - d_t^*\right) + \frac{\gamma}{\theta}\bar{D}^o\left(p_t^s - q_t\right) + \bar{w}\bar{N}^o w_t - \frac{1}{\beta}\bar{D}^o\left(r_{t-1}^M - \pi_t\right)\right]$$
$$c_t^{o,*} = s_t^{o,*} + p_t^s$$

D.2 Second-order approximation for renter's utility

Notice that a renter's problem is as follows (we omit an individual i-index for a notation simplicity):

$$\max E_0 \sum \beta^t u\left(C_t^r, S_t^r\right)$$
$$\text{s.t. } C_t^r + p_t^S S_t^r + b_t^r = w_t N_t^r + \frac{R_{t-1}}{\Pi_t} b_{t-1}^r$$

First, using the budget constraint for the renter's optimization problem to substitute for consumption and housing services in the utility function and expressing all variables in terms of log-deviations from the non-stochastic steady state yields the following expression for the period utility of the homeowner in period t:

$$f\left(\chi_t^r, z_t^r\right) = \log\left(\bar{w}\exp\left(w_t\right)\bar{N}^r + \bar{R}\exp\left(r_{t-1} - \pi_t\right)b_{t-1}^r - \bar{p}^S\bar{S}^r\exp\left(p_t^S + s_t^r\right) - b_t^r\right)$$
$$+ \psi\left(s_t^r + \log\left(\bar{S}^r\right)\right)$$

where $\chi_t^r = \left(b_t^r, S_t^r\right)'$ and denotes a set of choice variables and $z_t^r = \left(\pi_t, w_t, p_t^s, r_{t-1}\right)$ denotes a set of state variables at time t. Let $\varrho = \left(\chi_t^r, z_t^r, 1\right)'$.

Now, define

$$g\left(\left\{\chi_{t-1}^r, z_t^r\right\}_{t\geq 0}\right) = \sum_{t=0}^{\infty}\beta^t f\left(\chi_t^r, \chi_{t-1}^r, z_t^r\right).$$

Suppose that renter knows in period -1 its initial bond holdings (b^r_{-1}). Suppose also that there exist two constants $\delta < 1/\beta$ and such that, for each period $t \geq 0$, for all $m, n \in \{1, 2, \cdots, 11\}$, and for $\tau = 0, 1$,

$$E_{-1} \left| \varrho_{m,t} \varrho_{n,t+\tau} \right| < \delta^t A.$$

Then, Proposition 3 of MW (2023) appendix implies that after the second-order Taylor approximation of f at the non-stochastic steady state, the loss in expected utility when the law of motion for the actions differs from the law of motion for the optimal actions under perfect information is given by

Optimal actions under perfect information: $\{\chi^{r,*}_t\}_{t=0}^{\infty}$ with a initial condition $\chi^{r,*}_{-1} = \left(b^r_{-1}, 0\right)'$ and

$$E_t \left[\theta^r_0 + \Theta^r_{-1}\chi^{r,*}_{t-1} + \Theta^r_0 \chi^{r,*}_t + \Theta^r_1 \chi^{r,*}_{t+1} + \Phi^r_0 z^r_t + \Phi^r_1 z^r_{t+1}\right] = 0$$

where θ^r_0 is the vector of first derivatives of g w.r.t. χ^r_t at the non-stochastic steady state, Θ^r_{-1} is the matrix of second derivatives of g w.r.t. χ^r_t and χ^r_{t-1} at the non-stochastic steady state, Φ^r_0 is the matrix of second derivatives of g w.r.t. χ^r_t and z^r_t at the non-stochastic steady state, and Φ^r_1 is the matrix of second derivatives of g w.r.t. χ^r_t and z^r_{t+1} at the non-stochastic steady state. In our setup, these objects are defined as follows:

$$\Theta^r_{-1} = \begin{pmatrix} \frac{1}{\beta}\left(\frac{1}{\bar{C}^r}\right)^2, & 0 \\ \frac{1}{\beta}\frac{\psi}{\bar{C}^r_t}, & 0 \end{pmatrix}$$

$$\Theta^r_0 = \begin{pmatrix} -\left(\frac{1}{\bar{C}^r}\right)^2\left(1+\frac{1}{\beta}\right), & -\frac{\psi}{\bar{C}^r} \\ -\frac{\psi}{\bar{C}^r}, & -\psi\left(1+\psi\right) \end{pmatrix}$$

$$\Theta^r_1 = \begin{pmatrix} \left(\frac{1}{\bar{C}^r}\right)^2, & \frac{\psi}{\bar{C}^r} \\ 0, & 0 \end{pmatrix}$$

$$\Phi^r_0 = \begin{pmatrix} 0, & \left(\frac{1}{\bar{C}^r}\right)^2 \bar{\varpi}\bar{N}^r, & -\frac{\psi}{\bar{C}^r}, & 0 \\ 0, & \psi\frac{1}{\bar{C}^r}\bar{\varpi}\bar{N}^r, & -\psi\left(1+\psi\right), & 0 \end{pmatrix}$$

$$\Phi^r_1 = \begin{pmatrix} -\frac{1}{\bar{C}^r}, & -\left(\frac{1}{\bar{C}^r}\right)^2\bar{\varpi}\bar{N}^r, & \frac{\psi}{\bar{C}^r}, & \frac{1}{\bar{C}^r} \\ 0, & 0, & 0, & 0 \end{pmatrix}$$

Then, we now have

$$E_t\left[\Theta^r_{-1}\begin{pmatrix} b^{r,*}_{t-1} \\ s^{r,*}_{t-1}\end{pmatrix} + \Theta^r_0\begin{pmatrix} b^{r,*}_{t} \\ s^{r,*}_{t}\end{pmatrix} + \Theta^r_1\begin{pmatrix} b^{r,*}_{t+1} \\ s^{r,*}_{t+1}\end{pmatrix} + \Phi^r_0\begin{pmatrix}\pi_t \\ p^s_t \\ r_{t-1}\end{pmatrix} + \Phi^r_1\begin{pmatrix}\pi_{t+1} \\ q_{t+1} \\ r_t\end{pmatrix}\right] = 0 \quad \text{(D.8)}$$

Notice that from the log-linearized budget constraint of the renter, we can derive the renter's consumption in the full information model as follows:

$$c_t^{r,*} = \frac{1}{\bar{C}^r}\left[\frac{1}{\beta}b_{t-1}^{r,*} - b_t^{r,*} + \varpi\bar{N}^r w_t - C_t^r\psi\left(p_t^s + s_t^{r,*}\right)\right]$$

Then, we can derive each entry of the matrix equation (D.8) as follows:

- The first entry is
$$0 = c_t^{r,*} - c_{t+1}^{r,*} + (r_t - \pi_{t+1})$$
- The second entry is
$$\bar{C}^r\left(s_t^r + p_t^s\right) = \frac{1}{\beta}b_{t-1}^r - b_t^r + \varpi\bar{N}^r w_t - \bar{C}^r\psi\left(s_t^r + p_t^s\right)$$

Now we have

$$c_t^{r,*} = \frac{1}{\bar{C}^r}\left[\frac{1}{\beta}b_{t-1}^{r,*} - b_t^{r,*} + \varpi\bar{N}^r w_t - C_t^r\psi\left(p_t^s + s_t^{r,*}\right)\right] \tag{D.9}$$
$$c_{t+1}^{r,*} = \frac{1}{\bar{C}^r}\left[\frac{1}{\beta}b_t^{r,*} - b_{t+1}^{r,*} + \varpi\bar{N}^r w_{t+1} - C_t^r\psi\left(p_{t+1}^s + s_{t+1}^{r,*}\right)\right]$$

Then,

$$0 = c_t^{r,*} - c_{t+1}^{r,*} + (r_t - \pi_{t+1}) \tag{D.10}$$
$$c_t^{r,*} = s_t^{r,*} + p_t^s \tag{D.11}$$

Then, combine Equation (D.11) with Equation (D.9) to get

$$\bar{C}^r\left(1+\psi\right)c_t^{r,*} = \frac{1}{\beta}b_{t-1}^{r,*} - b_t^{r,*} + \varpi\bar{N}^r w_t$$

which implies

$$\bar{C}^r\left(1+\psi\right)\sum_{s=t}^{t+N}\beta^{s-t}c_s^{r,*} = \frac{1}{\beta}b_{t-1}^{r,*} + \varpi\bar{N}^r\sum_{s=t}^{t+N}\beta^{s-t}w_s - \beta^N b_{t+N}^{r,*}.$$

Taking the expectation $E_t\left[\cdot\right]$ and the limit as $N \to \infty$ and using the transversality condition, we get

$$\bar{C}^r\left(1+\psi\right)\sum_{s=t}^{\infty}\beta^{s-t}E_t\left[c_s^{r,*}\right] = \frac{1}{\beta}b_{t-1}^{r,*} + \varpi\bar{N}^r\sum_{s=t}^{t+N}\beta^{s-t}w_s \tag{D.12}$$

Then, using Equation (D.10) and the law of iterated expectations, we get

$$
\begin{aligned}
c_t^{r,*} &= c_t^{r,*} \\
c_{t+1}^{r,*} &= c_t^{r,*} + (r_t - \pi_{t+1}) \\
c_{t+2}^{r,*} &= c_t^{r,*} + (r_t - \pi_{t+1}) + (r_{t+1} - \pi_{t+2}) \\
c_{t+3}^{r,*} &= c_t^{r,*} + (r_t - \pi_{t+1}) + (r_{t+1} - \pi_{t+2}) + (r_{t+2} - \pi_{t+3}) \\
&\vdots \\
\sum_{s=t}^{\infty} \beta^{s-t} E_t\left[c_s^{r,*}\right] &= \frac{1}{1-\beta} c_t^{r,*} + \frac{\beta}{1-\beta} \sum_{s=t}^{\infty} \beta^{s-t} E_t\left[r_s - \pi_{s+1}\right]
\end{aligned}
$$

$$
\begin{aligned}
0 &= c_t^{r,*} - E_t c_{t+1}^{r,*} + (r_t - E_t \pi_{t+1}) \\
c_t^{r,*} &= s_t^{r,*} + p_t^s \\
\bar{C}^r c_t^{r,*} &= \frac{1}{(1+\psi)} \left(\frac{1}{\beta} b_{t-1}^{r,*} - b_t^{r,*} + \varpi \bar{N}^r w_t \right)
\end{aligned}
$$

Then, we now have a system of two equations

$$
\frac{1}{\beta} b_{t-1}^{r,*} - b_t^{r,*} - \bar{C}^r \left(1+\psi\right) s_t^{r,*} = \bar{C}^r \left(1+\psi\right) p_t^s - \varpi \bar{N}^r w_t
$$

$$
b_t^{r,*} - b_{t-1}^{r,*} = \varpi \bar{N}^r \left(w_t - (1-\beta) \sum_{s=t}^{t+N} \beta^{s-t} w_s \right) + \bar{C}^r \left(1+\psi\right) \beta \sum_{s=t}^{\infty} \beta^{s-t} E_t\left[r_s - \pi_{s+1}\right]
$$

which characterizes the renter's optimal allocations under the full information rational expectations.

Now, we can use a change of variables approach to derive a DRIP which is applicable to the solution method in Afrouzi and Yang (2021). Formally, we use Proposition 4 of the appendix in MW (2023) to show that

$$
\begin{aligned}
&\sum_{t=0}^{\infty} \beta^t \left[\frac{1}{2} \left(\chi_t^r - \chi_t^{r,*}\right)' \Theta_0^r \left(\chi_t^r - \chi_t^{r,*}\right) + \left(\chi_t^r - \chi_t^{r,*}\right)' \Theta_1^r \left(\chi_{t+1}^r - \chi_{t+1}^{r,*}\right) \right] \\
=&\sum_{t=0}^{\infty} \beta^t \left[\frac{1}{2} \left(\tilde{x}_t^r - \tilde{x}_t^{r,*}\right)' \tilde{\Theta}^r \left(\tilde{x}_t^r - \tilde{x}_t^{r,*}\right) \right].
\end{aligned}
$$

In our model setup,

$$
\tilde{x}_t^r - \tilde{x}_t^{r,*} = \begin{pmatrix} \left(b_t^r - b_t^{r,*}\right) - \left(b_{t-1}^r - b_{t-1}^{r,*}\right) \\ \frac{1}{\beta}\left(b_{t-1}^r - b_{t-1}^{r,*}\right) - \left(b_t^r - b_t^{r,*}\right) - \bar{C}^r \left(1+\psi\right) \left(s_t^r - s_t^{r,*}\right) \end{pmatrix}
$$

and

$$\tilde{\Theta}^r = \begin{pmatrix} -\left(\frac{1}{1+\psi}\right)\frac{1}{\beta}\left(\frac{1}{\bar{C}^r}\right)^2 & 0 \\ 0 & -\frac{\psi}{1+\psi}\left(\frac{1}{\bar{C}^r}\right)^2 \end{pmatrix}.$$

To show this, the loss in expected utility when the law of motion for the actions differ from the law of motion for the optimal actions under perfect information is given by:

$$\begin{aligned}
&\frac{1}{2}\left(\chi_t^r - \chi_t^{r,*}\right)' \Theta_0^r \left(\chi_t^r - \chi_t^{r,*}\right) + \left(\chi_t^r - \chi_t^{r,*}\right)' \Theta_1^r \left(\chi_{t+1}^r - \chi_{t+1}^{r,*}\right) \\
= &-\frac{1}{2}\left(\frac{1}{1+\psi}\right)\left(\frac{1}{\bar{C}^r}\right)^2 \left(\tilde{x}_{1,t+1}^r - \tilde{x}_{1,t+1}^{r,*}\right)^2 \\
&-\frac{1}{2}\left(\frac{\psi}{1+\psi}\right)\left(\frac{1}{\bar{C}^r}\right)^2 \left(\tilde{x}_{2,t}^r - \tilde{x}_{2,t}^{r,*}\right)^2 \\
&+\frac{1}{2}\left(\frac{1}{1+\psi}\right)\left(\frac{1}{\bar{C}^r}\right)^2 \left[\left(b_{t+1}^r - b_{t+1}^{r,*}\right)^2 - \frac{1}{\beta}\left(b_t^r - b_t^{r,*}\right)^2\right] \\
&+\frac{1}{2}\left(\frac{\psi}{1+\psi}\right)\frac{1}{\beta}\left(\frac{1}{\bar{C}^r}\right)^2 \left[\left(b_t^r - b_t^{r,*}\right)^2 - \frac{1}{\beta}\left(b_{t-1}^r - b_{t-1}^{r,*}\right)^2\right] \\
&-\frac{\psi}{1+\psi}\left(\frac{1}{\bar{C}^r}\right)^2 \left[\left(b_t^r - b_t^{r,*}\right)\left(\tilde{x}_{2,t+1}^r - \tilde{x}_{2,t+1}^{r,*}\right) - \frac{1}{\beta}\left(b_{t-1}^r - b_{t-1}^{r,*}\right)\left(\tilde{x}_{2,t}^r - \tilde{x}_{2,t}^{r,*}\right)\right]
\end{aligned}$$

Then, using $\tilde{x}_{2,0} - \tilde{x}_{2,0}^* = b_0^o - b_0^{o,*}$

$$\begin{aligned}
&\sum_{t=0}^{T}\beta^t\left[\frac{1}{2}\left(\chi_t^r - \chi_t^{r,*}\right)' \Theta_0^r \left(\chi_t^r - \chi_t^{r,*}\right) + \left(\chi_t^r - \chi_t^{r,*}\right)' \Theta_1^r \left(\chi_{t+1}^r - \chi_{t+1}^{r,*}\right)\right] \\
= &\sum_{t=0}^{T}\beta^t\left[-\frac{1}{2}\left(\frac{1}{1+\psi}\right)\frac{1}{\beta}\left(\frac{1}{\bar{C}^r}\right)^2\left(\tilde{x}_{1,t}^r - \tilde{x}_{1,t}^{r,*}\right)^2 - \frac{1}{2}\frac{\psi}{1+\psi}\left(\frac{1}{\bar{C}^r}\right)^2\left(\tilde{x}_{2,t}^r - \tilde{x}_{2,t}^{r,*}\right)^2\right] \\
&-\beta^T\frac{1}{2}\left(\frac{1}{1+\psi}\right)\frac{1}{\beta}\left(\frac{1}{\bar{C}^r}\right)^2\left(\tilde{x}_{1,T+1}^r - \tilde{x}_{1,T+1}^{r,*}\right)^2 \\
&+\beta^T\frac{1}{2}\left(\frac{1}{1+\psi}\right)\left(\frac{1}{\bar{C}^r}\right)^2\left(b_{T+1}^r - b_{T+1}^{r,*}\right)^2 \\
&+\beta^T\frac{1}{2}\left(\frac{\psi}{1+\psi}\right)\frac{1}{\beta}\left(\frac{1}{\bar{C}^r}\right)^2\left(b_T^r - b_T^{r,*}\right)^2 \\
&-\beta^T\frac{\psi}{1+\psi}\left(\frac{1}{\bar{C}^r}\right)^2\left(b_T^r - b_T^{r,*}\right)\left(\tilde{x}_{2,T+1}^r - \tilde{x}_{2,T+1}^{r,*}\right)
\end{aligned}$$

Taking the expectation and taking the limit as $T \to \infty$,

$$\begin{aligned}
&\sum_{t=0}^{\infty} \beta^t \left[\frac{1}{2} \left(\chi_t^r - \chi_t^{r,*} \right)' \Theta_0^r \left(\chi_t^r - \chi_t^{r,*} \right) + \left(\chi_t^r - \chi_t^{r,*} \right)' \Theta_1^r \left(\chi_{t+1}^r - \chi_{t+1}^{r,*} \right) \right] \\
&= \sum_{t=0}^{\infty} \beta^t \left[-\frac{1}{2} \left(\frac{1}{1+\psi} \right) \frac{1}{\beta} \left(\frac{1}{\bar{C}^r} \right)^2 \left(\tilde{x}_{1,t}^r - \tilde{x}_{1,t}^{r,*} \right)^2 - \frac{1}{2} \frac{\psi}{1+\psi} \left(\frac{1}{\bar{C}^r} \right)^2 \left(\tilde{x}_{2,t}^r - \tilde{x}_{2,t}^{r,*} \right)^2 \right] \\
&= \sum_{t=0}^{\infty} \beta^t \left[\frac{1}{2} \left(\tilde{x}_t^r - \tilde{x}_t^{r,*} \right)' \tilde{\Theta}^r \left(\tilde{x}_t^r - \tilde{x}_t^{r*} \right) \right]
\end{aligned}$$

where

$$\tilde{\Theta}^r = \begin{pmatrix} -\left(\frac{1}{1+\psi} \right) \frac{1}{\beta} \left(\frac{1}{\bar{C}^r} \right)^2 & 0 \\ 0 & -\frac{\psi}{1+\psi} \left(\frac{1}{\bar{C}^r} \right)^2 \end{pmatrix}$$

and

$$\begin{aligned}
\tilde{x}_t^{r,*} &= \begin{pmatrix} b_t^{r,*} - b_{t-1}^{r,*} \\ \frac{1}{\beta} b_{t-1}^{r,*} - b_t^{r,*} - \bar{C}^r \left(1+\psi \right) s_t^{r,*} \end{pmatrix} \\
&= \begin{pmatrix} \varpi \bar{N}^r \left(w_t - (1-\beta) \sum_{s=t}^{t+N} \beta^{s-t} w_s \right) + \bar{C}^r \left(1+\psi \right) \beta \sum_{s=t}^{\infty} \beta^{s-t} E_t \left[r_s - \pi_{s+1} \right] \\ \bar{C}^r \left(1+\psi \right) p_t^s - \varpi \bar{N}^r w_t \end{pmatrix}
\end{aligned}$$

$$\bar{C}^r c_t^{r,*} = \frac{1}{(1+\psi)} \left(\frac{1}{\beta} b_{t-1}^{r,*} - b_t^{r,*} + \varpi \bar{N}^r w_t \right)$$

D.3 Solution algorithm

1. Let $\mathbf{U}_t = \left(\varepsilon_t, \varepsilon_{t-1}, \varepsilon_{t-2}, \cdots, \varepsilon_{t-T} \right)'$. Then, as in Afrouzi and Yang (2021), we define an MA representation of the state space for the homeowner's problem as:

$$\mathbf{U}_t = \mathbf{A} \mathbf{U}_{t-1} + \mathbf{Q} \varepsilon_t$$

where $\mathbf{A} = \mathbf{M} = \begin{pmatrix} \mathbf{0}_{1\times T}, & 0 \\ \mathbf{I}_{T\times T}, & \mathbf{0}_{T\times 1} \end{pmatrix}$ is a shift matrix and $\mathbf{Q} = \mathbf{e}_1$ is a $(T+1 \times 1)$ vector whose first element is one and others are zero.

2. We start by gussing $\{\pi_t, p_t^s, q_t, r_t^F\}$ as follows:

$$\begin{aligned}
\pi_t &= \mathbf{G}_\pi' \mathbf{U}_t \\
p_t^s &= \mathbf{G}_{p^s}' \mathbf{U}_t \\
q_t &= \mathbf{G}_q' \mathbf{U}_t \\
r_t^F &= \mathbf{G}_{R^F}' \mathbf{U}_t
\end{aligned}$$

Then, we get $\mathbf{G}_w, \mathbf{G}_R, \mathbf{G}_{R^M}$ as follows:

$$\pi_t = \beta E_t \pi_{t+1} + \kappa w_t$$
$$\mathbf{G}_w = \frac{1}{\kappa}\left(\mathbf{I} - \beta \mathbf{M}'\right)\mathbf{G}_\pi$$

where $\mathbf{I}$ is an identify matrix and $\kappa = \frac{(1-\omega)(1-\omega\beta)}{\omega}$.

$$\begin{aligned} r_t &= \rho^R r_{t-1} + \left(1 - \rho^R\right)\phi_\pi \pi_t + \varepsilon_{t-k} \\ &= (\mathbf{I} - \mathbf{M})^{-1}\left(\phi_\pi \mathbf{G}_\pi + \mathbf{M}^k \mathbf{e}_1\right)' \mathbf{U}_t \\ &= \mathbf{G}_R' \mathbf{U}_t \end{aligned}$$

and

$$\begin{aligned} r_t^M &= (1-\gamma)\, r_{t-1}^M + \gamma r_t^F \\ &= \mathbf{G}_{R^M}' \mathbf{U}_t \end{aligned}$$

where

$$\mathbf{G}_{R^M} = \left(\frac{1}{\gamma}\mathbf{I} - \frac{1-\gamma}{\gamma}\mathbf{M}\right)^{-1} \mathbf{G}_{R^F}$$

3. Solve rational inattention problem for homeowners:

(a) Homeowner's problem can be written as

$$\begin{aligned} \min \sum_{t=0}^{\infty} \beta^t & \left[\frac{1}{2}\left(\tilde{x}_t^o - \tilde{x}_t^{o,*}\right)' \tilde{\Theta}^o \left(\tilde{x}_t^o - \tilde{x}_t^{o,*}\right)\right] + \lambda \sum_{t=0}^{\infty} \mathbf{I}\left(\tilde{x}_t^o; \tilde{x}_t^{o,*} | \tilde{x}^{o,t-1}\right) \\ s.t. \tilde{x}_t^{o,*} &= \mathbf{G}_o' \mathbf{U}_t \\ \mathbf{U}_t &= \mathbf{M}\mathbf{U}_{t-1} + \mathbf{e}_1 \varepsilon_t \\ x_t^o &= \mathbb{E}\left[\tilde{x}_t^{o,*} | \mathcal{I}_t^o\right] \\ \tilde{x}^{o,t} &= \tilde{x}^{o,t-1} \cup \tilde{x}_t^o \end{aligned}$$

Notice that in our setup,

$$\frac{1}{2}\left(\tilde{x}_t^o - \tilde{x}_t^{o,*}\right)' \tilde{\Theta}^o \left(\tilde{x}_t^o - \tilde{x}_t^{o,*}\right) = \frac{1}{2}\left(\mathbf{U}_{t|t} - \mathbf{U}_t\right)' \mathbf{G}_o \tilde{\Theta}^o \mathbf{G}_o' \left(\mathbf{U}_{t|t} - \mathbf{U}_t\right)$$

(b) Then, as shown in Lemma 2.4 a of Afrouzi and Yang (2021), the DRIP for homeowner can be written as

$$
\begin{aligned}
&\min \sum \beta^t \left[tr\left(\Omega^o \Sigma^o_{t|t}\right) + \omega \ln\left(\left|\Sigma^o_{t|t-1}\right|\right) - \omega \ln\left(\left|\Sigma^o_{t|t}\right|\right)\right] \\
&s.t. \Sigma^o_{t+1|t} = \mathbf{M}\Sigma^o_{t|t}\mathbf{M}' + \mathbf{e}_1\mathbf{e}_1' \\
&\quad \Sigma^o_{t|t-1} - \Sigma^o_{t|t} \succeq 0
\end{aligned}
$$

where $\Sigma^o_{t|t} = var\left(\mathbf{U}_t|\mathcal{I}^o_t\right)$ is the posterior covariance matrix given information set $\mathcal{I}_t$ for homeowner, $\Sigma^o_{t|t-1} = var\left(\mathbf{U}_t|\mathcal{I}^o_{t-1}\right)$ is the prior covariance matrix, $\succeq$ denotes positive semidefiniteness, and $\Omega^o = \mathbf{G}_o\tilde{\Theta}^o\mathbf{G}_o'$ is the benefit matrix where

$$
\tilde{\Theta} = \begin{pmatrix} -\frac{\psi_b}{\bar{C}^o}, & 0 & 0 \\ 0, & -\left(\frac{1}{1+\psi}\right)\frac{1}{\beta}\left(\frac{1}{\bar{C}^o}\right)^2, & 0 \\ 0, & 0, & -\left(\frac{\psi}{1+\psi}\right)\left(\frac{1}{\bar{C}^o}\right)^2 \end{pmatrix}.
$$

(c) The optimal action under the full information satisfies

$$
\begin{aligned}
\tilde{x}^{o,*}_t &= \begin{pmatrix} b^{o,*}_t \\ \left(b^{o,*}_t - \bar{d}d^*_t\right) - \left(b^{o,*}_{t-1} - \bar{d}d^*_{t-1}\right) \\ \frac{1}{\beta}\left(b^{o,*}_{t-1} - \bar{d}d^*_{t-1}\right) - \left(b^{o,*}_t - \bar{d}d^*_t\right) - \bar{C}^o(1+\psi)s^{o,*}_t \end{pmatrix} \\
&= \begin{pmatrix} \frac{1}{\psi_b}\left[\frac{1}{\theta}\left(p^s_t - q_t\right) - \beta\frac{1-\gamma}{\theta}\left(p^s_{t+1} - q_{t+1}\right) + \left(r_t - r^M_t\right) + \frac{1-\gamma}{1-\beta(1-\gamma)}\left(\left(r^M_{t-1} - r^F_t\right) - \beta\left(r^M_t - r^F_{t+1}\right)\right)\right] \\ \bar{w}\bar{N}^o\left(w_t - (1-\beta)\sum_{s=t}^{\infty}\beta^{s-t}E_t w_s\right) - \bar{D}^o\left(r^M_{t-1} - \pi_t\right) + \left(\frac{\gamma}{\theta}\bar{D}^o - \bar{C}^o\beta\frac{1-\gamma}{\theta}(1+\psi)\right)\left(p^s_t - q_t\right) \\ \quad + \left(\bar{D}^o(1-\beta) + \bar{C}^o\beta(1+\psi)\right)\sum_{s=t}^{\infty}\beta^{s-t}E_t\left[\left(r^M_s - \pi_{s+1}\right) - \frac{\gamma}{\theta}\left(p^S_s - q_s\right)\right] \\ \quad -\bar{C}^o(1+\psi)\frac{\beta(1-\gamma)}{1-\beta(1-\gamma)}\sum_{s=t}^{\infty}\beta^{s-t}E_t\left[\left(r^M_{s-1} - r^F_s\right) - \beta\left(r^M_s - r^F_{s+1}\right)\right] \\ \frac{1}{\beta}\bar{D}^o\left(r^M_{t-1} - \pi_t\right) - \frac{\gamma}{\theta}\bar{D}^o\left(p^s_t - q_t\right) - \bar{w}\bar{N}^o w_t + \bar{C}^o(1+\psi)p^s_t \end{pmatrix}.
\end{aligned}
$$

which implies that

$$
\tilde{x}^{o,*}_t = \mathbf{G}_o'\mathbf{U}_t
$$

where

$$
\begin{aligned}
\mathbf{G}_o(:,1) =& \frac{1}{\psi_b}\left\{\frac{1}{\theta}\left(\left(\mathbf{I} - \beta(1-\gamma)\mathbf{M}'\right)\left(\mathbf{G}_{p^s} - \mathbf{G}_q\right)\right)\right. \\
&\left. + \left(\left(\mathbf{G}_R - \mathbf{G}_{R^M}\right) + \frac{1-\gamma}{1-\beta(1-\gamma)}\left(\left(\mathbf{M}\mathbf{G}_{R^M} - \mathbf{G}_{R^f}\right) - \beta\left(\mathbf{G}_{R^M} - \mathbf{M}'\mathbf{G}_{R^f}\right)\right)\right)\right\} \\
\mathbf{G}_o(:,2) =& \bar{w}\bar{N}^o\left(\mathbf{I} - (1-\beta)\left(\mathbf{I} - \beta\mathbf{M}'\right)^{-1}\right)\mathbf{G}_w - \bar{D}^o\left(\mathbf{M}\mathbf{G}_{R^M} - \mathbf{G}_\pi\right) \\
&+ \left(\frac{\gamma}{\theta}\bar{D}^o - \bar{C}^o\beta\frac{1-\gamma}{\theta}(1+\psi)\right)\left(\mathbf{G}_{p^s} - \mathbf{G}_q\right) \\
&+ \left(\bar{D}^o(1-\beta) + \bar{C}^o\beta(1+\psi)\right)\left(\mathbf{I} - \beta\mathbf{M}'\right)^{-1}\left(\left(\mathbf{G}_R - \mathbf{M}'\mathbf{G}_\pi\right) - \frac{\gamma}{\theta}\left(\mathbf{G}_{p^s} - \mathbf{G}_q\right)\right) \\
&- \bar{C}^o(1+\psi)\frac{\beta(1-\gamma)}{1-\beta(1-\gamma)}\left(\mathbf{I} - \beta\mathbf{M}'\right)^{-1}\left(\left(\mathbf{M}\mathbf{G}_{R^M} - \mathbf{G}_{R^F}\right) - \beta\left(\mathbf{G}_{R^M} - \mathbf{M}'\mathbf{G}_{R^F}\right)\right) \\
\mathbf{G}_o(:,3) =& -\frac{\gamma}{\theta}\bar{d}\left(\mathbf{G}_{p^s} - \mathbf{G}_q\right) - \bar{w}\bar{N}^o\mathbf{G}_w + \frac{1}{\beta}\bar{d}\left(\mathbf{M}\mathbf{G}_R - \mathbf{G}_\pi\right) + \bar{C}^o(1+\psi)\mathbf{G}_{p^s}
\end{aligned}
$$

(d) As $\tilde{\Theta}$ matrix is a diagonal, we know that the optimal action under the rational inattention satisfies

$$\tilde{x}_t^o = \mathbf{G}_o' \mathbf{U}_{t|t}$$

where $\mathbf{U}_{t|t} = \mathbb{E}\left[\mathbf{U}_t | \mathcal{I}_t^o\right]$. From this, we can get $\{\mathbf{G}_{b^o}, \mathbf{G}_{d^o}, \mathbf{G}_{s^o}\}$

$$\begin{aligned}
b_t^o &= \mathbf{G}_o\left(:,1\right)' \mathbf{U}_{t|t} = \mathbf{G}_{b^o}' \mathbf{U}_t \\
d_t &= \frac{1}{\bar{d}}\left(\mathbf{G}_{b^o} - \left(\mathbf{I} - \mathbf{M}\right)^{-1} \mathbf{X}' \mathbf{G}_o\left(:,2\right)\right)' \mathbf{U}_t = \mathbf{G}_{d^o}' \mathbf{U}_t \\
s_t^o &= \frac{1}{\bar{C}^o\left(1+\psi\right)}\left[\left(\frac{1}{\beta}\mathbf{M} - \mathbf{I}\right)\left(\mathbf{G}_{b^o} - \bar{d}\mathbf{G}_d\right) - \mathbf{X}'\mathbf{G}_o\left(:,3\right)\right]' \mathbf{U}_t = \mathbf{G}_{s^o}' \mathbf{U}_t
\end{aligned}$$

Note that using the Kalman updating equation, we get

$$\begin{aligned}
\mathbf{U}_{t|t} &= \left(\mathbf{I} - \mathbf{K}\mathbf{Y}'\right)\mathbf{U}_{t|t-1} + \mathbf{K}\mathbf{Y}'\mathbf{U}_t \\
&= \left(\mathbf{I} - \mathbf{K}\mathbf{Y}'\right)\mathbf{A}\mathbf{U}_{t-1|t-1} + \mathbf{K}\mathbf{Y}'\mathbf{U}_t \\
&= \left\{\left(\mathbf{I} - \mathbf{K}\mathbf{Y}'\right)\mathbf{A}\right\}^2 \mathbf{U}_{t-2|t-2} + \left(\mathbf{I} - \mathbf{K}\mathbf{Y}'\right)\mathbf{A}\mathbf{K}\mathbf{Y}'\mathbf{U}_{t-1} + \mathbf{K}\mathbf{Y}'\mathbf{U}_t \\
&\vdots \\
&= \mathbf{K}\mathbf{Y}'\mathbf{U}_t + \left(\mathbf{I} - \mathbf{K}\mathbf{Y}'\right)\mathbf{A}\mathbf{K}\mathbf{Y}'\mathbf{M}'\mathbf{U}_t + \left\{\left(\mathbf{I} - \mathbf{K}\mathbf{Y}'\right)\mathbf{A}\right\}^2 \mathbf{K}\mathbf{Y}'\left(\mathbf{M}'\right)^2\mathbf{U}_t + \cdots \\
&= \sum_{j=0}^{\infty}\left\{\left(\mathbf{I} - \mathbf{K}\mathbf{Y}'\right)\mathbf{A}\right\}^j \mathbf{K}\mathbf{Y}'\left(\mathbf{M}'\right)^j \mathbf{U}_t \\
&= \mathbf{X}^o \mathbf{U}_t
\end{aligned}$$

where $\mathbf{K} = \Sigma_{-1}^o \mathbf{Y}\left(\mathbf{Y}'\Sigma_{-1}^o\mathbf{Y} + \Sigma_z\right)^{-1}$ is the implied Kalman gain, Σ_{-1}^o is the steady-state prior covariance matrix, and $\mathbf{Y}$ is the signal matrix from homeowner's DRIP. With this, we also get $\mathbf{G}_{c^o}$ using

$$\begin{aligned}
c_t^o &= s_t^o + \mathbb{E}_t^o\left[p_t^s | \mathcal{I}_t\right] \\
\mathbf{G}_{c^o}'\mathbf{U}_t &= \mathbf{G}_{s^o}'\mathbf{U}_t + \mathbf{G}_{p^s}'\mathbf{U}_{t|t} \\
\mathbf{G}_{c^o} &= \mathbf{G}_{s^o} + \mathbf{X}^{o'}\mathbf{G}_{p^s}.
\end{aligned}$$

4. Solve rational inattention problem for renters:

(a) Renter's problem can be written as

$$
\begin{aligned}
&\min \sum_{t=0}^{\infty} \beta^t \left[\frac{1}{2}\left(\tilde{x}_t^r - \tilde{x}_t^{r,*}\right)' \tilde{\Theta}^r \left(\tilde{x}_t^r - \tilde{x}_t^{r,*}\right)\right] + \lambda \sum_{t=0}^{\infty} \mathbf{I}\left(\tilde{x}_t^r ; \tilde{x}_t^{r,*} | \tilde{x}^{r,t-1}\right) \\
&s.t. \tilde{x}_t^* = \mathbf{G}_r' \mathbf{U}_t \\
&\quad \mathbf{U}_t = \mathbf{M}\mathbf{U}_{t-1} + \mathbf{e}_1 \varepsilon_t \\
&\quad x_t^r = \mathbb{E}\left[\tilde{x}_t^{r,*} | \mathcal{I}_t^r\right] \\
&\quad \tilde{x}^{r,t} = \tilde{x}^{r,t-1} \cup \tilde{x}_t^r
\end{aligned}
$$

Note that

$$
\frac{1}{2}\left(\tilde{x}_t^r - \tilde{x}_t^{r,*}\right)' \tilde{\Theta} \left(\tilde{x}_t^r - \tilde{x}_t^{r,*}\right) = \frac{1}{2}\left(\mathbf{U}_{t|t} - \mathbf{U}_t\right)' \mathbf{G}_r \tilde{\Theta}^r \mathbf{G}_r' \left(\mathbf{U}_{t|t} - \mathbf{U}_t\right)
$$

(b) Then, as shown in Lemma 2.4 of Afrouzi and Yang (2021), the DRIP for renter can be written as

$$
\begin{aligned}
&\min \sum \beta^t \left[tr\left(\Omega^r \Sigma_{t|t}^r\right) + \omega \ln\left(\left|\Sigma_{t|t-1}^r\right|\right) - \omega \ln\left(\left|\Sigma_{t|t}^r\right|\right)\right] \\
&s.t. \Sigma_{t+1|t}^r = \mathbf{M}\Sigma_{t|t}^r \mathbf{M}' + \mathbf{e}_1 \mathbf{e}_1' \\
&\quad \Sigma_{t|t-1}^r - \Sigma_{t|t}^r \succeq 0
\end{aligned}
$$

where $\Sigma_{t|t}^r = var\left(\mathbf{U}_t | \mathcal{I}_t^r\right)$ is the posterior covariance matrix given information set $\mathcal{I}_t$ for renter, $\Sigma_{t|t-1}^r = var\left(\mathbf{U}_t | \mathcal{I}_{t-1}^r\right)$ is the prior covariance matrix, $\succeq$ denotes positive semidefiniteness, and $\Omega^r = \mathbf{G}_r \tilde{\Theta}^r \mathbf{G}_r'$ is the benefit matrix where

$$
\tilde{\Theta}^r = \begin{pmatrix} -\left(\frac{1}{1+\psi}\right)\frac{1}{\beta}\left(\frac{1}{\bar{C}^r}\right)^2 & 0 \\ 0 & -\frac{\psi}{1+\psi}\left(\frac{1}{\bar{C}^r}\right)^2 \end{pmatrix}
$$

(c) The optimal action under the full information satisfies

$$
\begin{aligned}
\tilde{x}_t^{r,*} &= \begin{pmatrix} b_t^{r,*} - b_{t-1}^{r,*} \\ \frac{1}{\beta} b_{t-1}^{r,*} - b_t^{r,*} - \bar{C}^r (1+\psi) s_t^{r,*} \end{pmatrix} \\
&= \begin{pmatrix} \bar{\varpi}\bar{N}^r \left(w_t - (1-\beta)\sum_{s=t}^{t+N} \beta^{s-t} w_s\right) + \bar{C}^r (1+\psi) \beta \sum_{s=t}^{\infty} \beta^{s-t} E_t\left[r_s - \pi_{s+1}\right] \\ \bar{C}^r (1+\psi) p_t^s - \bar{\varpi}\bar{N}^r w_t \end{pmatrix}
\end{aligned}
$$

which implies that

$$
\tilde{x}_t^{r,*} = \mathbf{G}_r' \mathbf{U}_t
$$

where

$$\begin{aligned}\mathbf{G}_r(:,1) &= \bar{w}\bar{N}^r\left(\mathbf{I}-(1-\beta)\left(\mathbf{I}-\beta\mathbf{M}'\right)^{-1}\right)\mathbf{G}_w \\ &\quad + \bar{C}^r(1+\psi)\beta\left(\mathbf{I}-\beta\mathbf{M}'\right)^{-1}\left[\mathbf{G}_R-\mathbf{M}'\mathbf{G}_\pi\right] \\ \mathbf{G}_r(:,2) &= \bar{C}^r(1+\psi)\mathbf{G}_{p^s}-\bar{w}\bar{N}^r\mathbf{G}_w\end{aligned}$$

(d) As $\tilde{\Theta}$ matrix is a diagonal, we know that the optimal action under the rational inattention satisfies

$$\tilde{x}_t^r = \mathbf{G}_r'\mathbf{U}_{t|t}$$

where $\mathbf{U}_{t|t} = \mathbb{E}\left[\mathbf{U}_t|\mathcal{I}_t^r\right]$. From this, we can get $\{\mathbf{G}_{b^r}, \mathbf{G}_{s^r}, \mathbf{G}_{c^r}\}$:

$$\begin{aligned}b_t^r &= \left[(\mathbf{I}-\mathbf{M})^{-1}\mathbf{X}'\mathbf{G}_r(:,1)\right]'\mathbf{U}_t \\ &= \mathbf{G}_{b^r}'\mathbf{U}_t \\ s_t^r &= \frac{1}{\bar{C}^r(1+\psi)}\left[\left(\frac{1}{\beta}\mathbf{M}-\mathbf{I}\right)\mathbf{G}_{b^r}-\mathbf{X}'\mathbf{G}_r(:,2)\right]'\mathbf{U}_t \\ &= \mathbf{G}_{s^r}'\mathbf{U}_t\end{aligned}$$

Note that using the Kalman updating equation, we get

$$\begin{aligned}\mathbf{U}_{t|t} &= \left(\mathbf{I}-\mathbf{K}\mathbf{Y}'\right)\mathbf{U}_{t|t-1}+\mathbf{K}\mathbf{Y}'\mathbf{U}_t \\ &= \left(\mathbf{I}-\mathbf{K}\mathbf{Y}'\right)\mathbf{A}\mathbf{U}_{t-1|t-1}+\mathbf{K}\mathbf{Y}'\mathbf{U}_t \\ &= \left\{\left(\mathbf{I}-\mathbf{K}\mathbf{Y}'\right)\mathbf{A}\right\}^2\mathbf{U}_{t-2|t-2}+\left(\mathbf{I}-\mathbf{K}\mathbf{Y}'\right)\mathbf{A}\mathbf{K}\mathbf{Y}'\mathbf{U}_{t-1}+\mathbf{K}\mathbf{Y}'\mathbf{U}_t \\ &\vdots \\ &= \mathbf{K}\mathbf{Y}'\mathbf{U}_t+\left(\mathbf{I}-\mathbf{K}\mathbf{Y}'\right)\mathbf{A}\mathbf{K}\mathbf{Y}'\mathbf{M}'\mathbf{U}_t+\left\{\left(\mathbf{I}-\mathbf{K}\mathbf{Y}'\right)\mathbf{A}\right\}^2\mathbf{K}\mathbf{Y}'\left(\mathbf{M}'\right)^2\mathbf{U}_t+\cdots \\ &= \sum_{j=0}^{\infty}\left\{\left(\mathbf{I}-\mathbf{K}\mathbf{Y}'\right)\mathbf{A}\right\}^j\mathbf{K}\mathbf{Y}'\left(\mathbf{M}'\right)^j\mathbf{U}_t \\ &= \mathbf{X}^r\mathbf{U}_t\end{aligned}$$

where $\mathbf{K} = \Sigma_{-1}^o\mathbf{Y}\left(\mathbf{Y}'\Sigma_{-1}^o\mathbf{Y}+\Sigma_z\right)^{-1}$ is the implied Kalman gain, Σ_{-1}^o is the steady-state prior covariance matrix, and $\mathbf{Y}$ is the signal matrix from renter's DRIP. With this, we also get $\mathbf{G}_{c^r}$ using

$$\begin{aligned}c_t^r &= s_t^r + E_t^r\left[p_t^s\right] \\ &= \mathbf{G}_{s^r}'\mathbf{U}_t+\mathbf{G}_{p^s}'\mathbf{X}^r\mathbf{U}_t \\ &= \mathbf{G}_{c^r}'\mathbf{U}_t\end{aligned}$$

5. Then, get the lender's equilibrium allocations using the market clearing conditions:

$$
\begin{aligned}
b_t^l &= -\frac{1}{\lambda^l}\left(\lambda^o b_t^o + \lambda^r b_t^r\right) \\
c_t^l &= \frac{1}{\lambda^l \bar{C}^l}\left(\bar{C} c_t - \lambda^o \bar{C}^o c_t^o - \lambda^r \bar{C}^r c_t^r\right)
\end{aligned}
$$

$$
\begin{aligned}
\mathbf{G}_{b^l} &= -\frac{1}{\lambda^l}\left(\lambda^o \mathbf{G}_{b^o} + \lambda^r \mathbf{G}_{b^r}\right) \\
\mathbf{G}_{c^l} &= \frac{1}{\lambda^l \bar{C}^l}\left(\lambda^o \mathbf{G}_c - \lambda^o \bar{C}^o \mathbf{G}_{c^o} - \lambda^r \bar{C}^r \mathbf{G}_{c^r}\right)
\end{aligned}
$$

6. Update new p_t^s, q_t, π_t, r_t^F using the remaining equilibrium conditions. From lender's optimal conditions and the Taylor rule,

$$
\begin{aligned}
\psi_b b_t^l &= C_t^l - E_t\left[C_{t+1}^l\right] + R_t - E_t\left[\pi_{t+1}\right] \\
\bar{C}^l C_t^l + b_t^l + \bar{l} l_t &= \bar{w} N^l w_t + \frac{1}{\beta} b_{t-1}^l + \bar{m} m_t + \bar{\Phi}\Phi_t^l - \bar{T} T_t \\
R_t &= \rho^R R_{t-1} + \left(1-\rho^R\right)\phi_\pi \pi_t + \varepsilon_t \\
l_t &= q_t + H_t \\
H_t &= 0,
\end{aligned}
$$

we update

$$
\begin{aligned}
\mathbf{G}_R^{new} &= \psi_{b^l} \mathbf{G}_{b^l} - \left(\mathbf{I} - \mathbf{M}'\right)\mathbf{G}_{c^l} + \mathbf{M}'\mathbf{G}_\pi \\
\mathbf{G}_\pi^{new} &= \frac{1}{\left(1-\rho^R\right)\phi_\pi}\left(\left(\mathbf{I} - \rho^R \mathbf{M}\right)\mathbf{G}_R^{new} - \mathbf{e}_1\right) \\
\mathbf{G}_q^{new} &= \frac{1}{\bar{l}}\left(\bar{w}\left(N^l - \frac{1}{1-\bar{w}}\bar{\Phi}\right)\mathbf{G}_w + \left(\frac{1}{\beta}\mathbf{M} - \mathbf{I}\right)\mathbf{G}_{b^l} + \bar{m}\mathbf{G}_m - \bar{C}^l \mathbf{G}_{c^l}\right)
\end{aligned}
$$

Also, from

$$
\begin{aligned}
C_t^o &= E_t^o p_t^s + S_t^o \\
C_t^r &= E_t^r p_t^s + S_t^r \\
\lambda^o \bar{S} S_t &= \lambda^o \bar{S}^o S_t^o + \lambda^r \bar{S}^r S_t^r,
\end{aligned}
$$

we have

$$
\begin{aligned}
0 &= \lambda^o \bar{S}^o\left(C_t^o - E_t^o p_t^s\right) + \lambda^r \bar{S}^r\left(C_t^r - E_t^o p_t^s\right) \\
\mathbf{G}_{p^s} &= \left(\lambda^o \bar{S}^o \mathbf{X}_o' G_{p^s} + \lambda^r \bar{S}^r \mathbf{X}_r'\right)^{-1}\left(\lambda^o \bar{S}^o \mathbf{G}_{c^o} + \lambda^r \bar{S}^r \mathbf{G}_{c^r}\right).
\end{aligned}
$$

Lastly, we update the mortgage rates using

$$0 = c_t^l - E_t c_{t+1}^l + r_t^M - E_t \pi_{t+1} + \frac{1-\gamma}{1-\beta(1-\gamma)} \left(r_t^F - r_{t-1}^M - \beta E_t r_{t+1}^F - r_t^M \right)$$

$$r_t^M = (1-\gamma) r_{t-1}^M + \gamma r_t^F$$

such that

$$\mathbf{G}_{R^M}^{new} = \left(\frac{1}{\gamma} \mathbf{I} - \frac{1-\gamma}{\gamma} \mathbf{M} \right)^{-1} \mathbf{G}_{R^F}^{new}$$

where

$$\left(\mathbf{I} - \beta \mathbf{M}' \right) \mathbf{G}_{R^F}^{new} = \left(\mathbf{M} - \beta \mathbf{I} \right) \mathbf{G}_{R^M} - \frac{1-\beta(1-\gamma)}{1-\gamma} \left(\left(\mathbf{I} - \mathbf{M}' \right) \mathbf{G}_{c^l} + \mathbf{G}_{R^M} - \mathbf{M}' \mathbf{G}_{\pi} \right).$$

D.4 Model impulse responses to a forward guidance shock

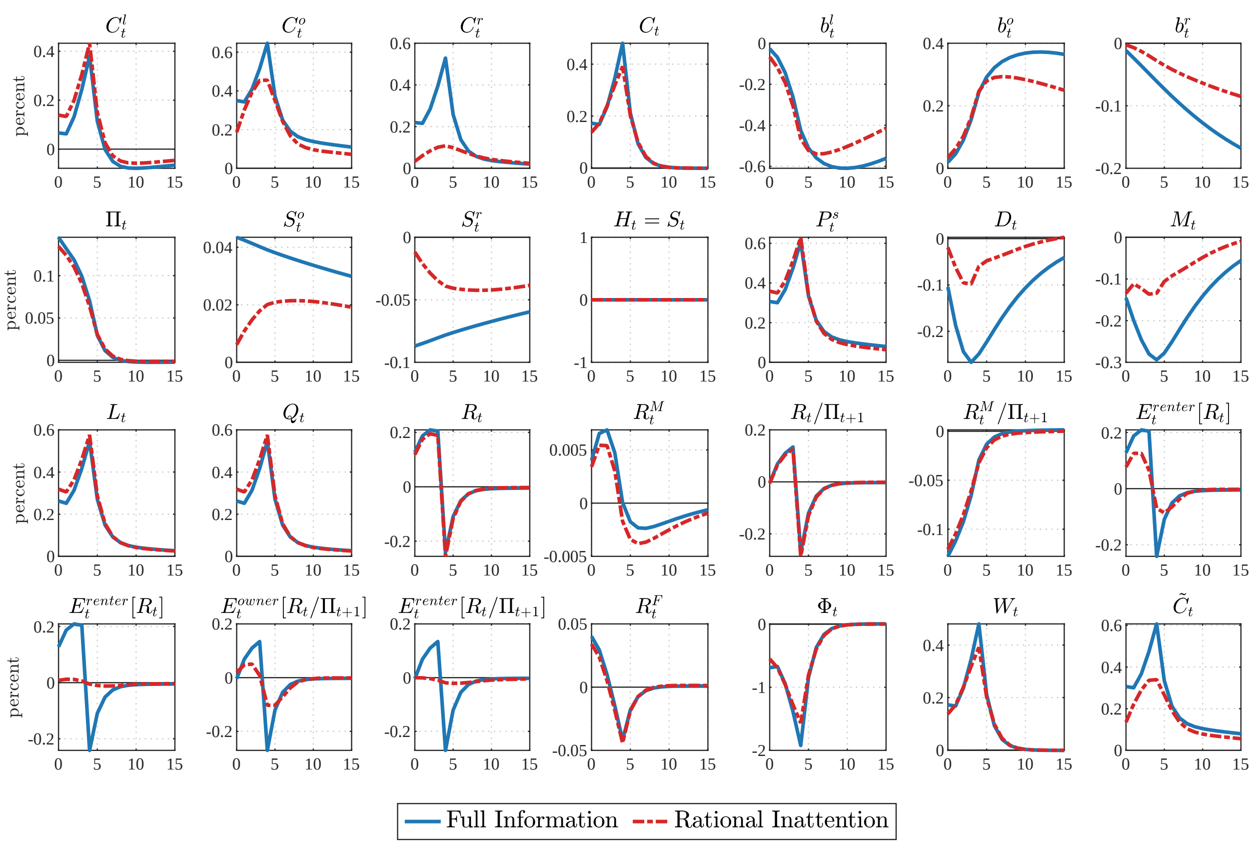


Figure D.5: Model impulse responses to a 1 S.D. 4-period ahead forward guidance shock

Notes: This figure reports the model impulse responses to a forward guidance shock that lowers the 4-period ahead interest rate by one standard deviation. The solid blue lines plot the case of full information rational expectations. The dot-dashed red lines plot the case under rational inattention.

E Model sensitivity analyses

In this appendix, we provide more details on the model sensitivity analyses and discuss two additional analyses.

E.1 Lowering homeownership ratio

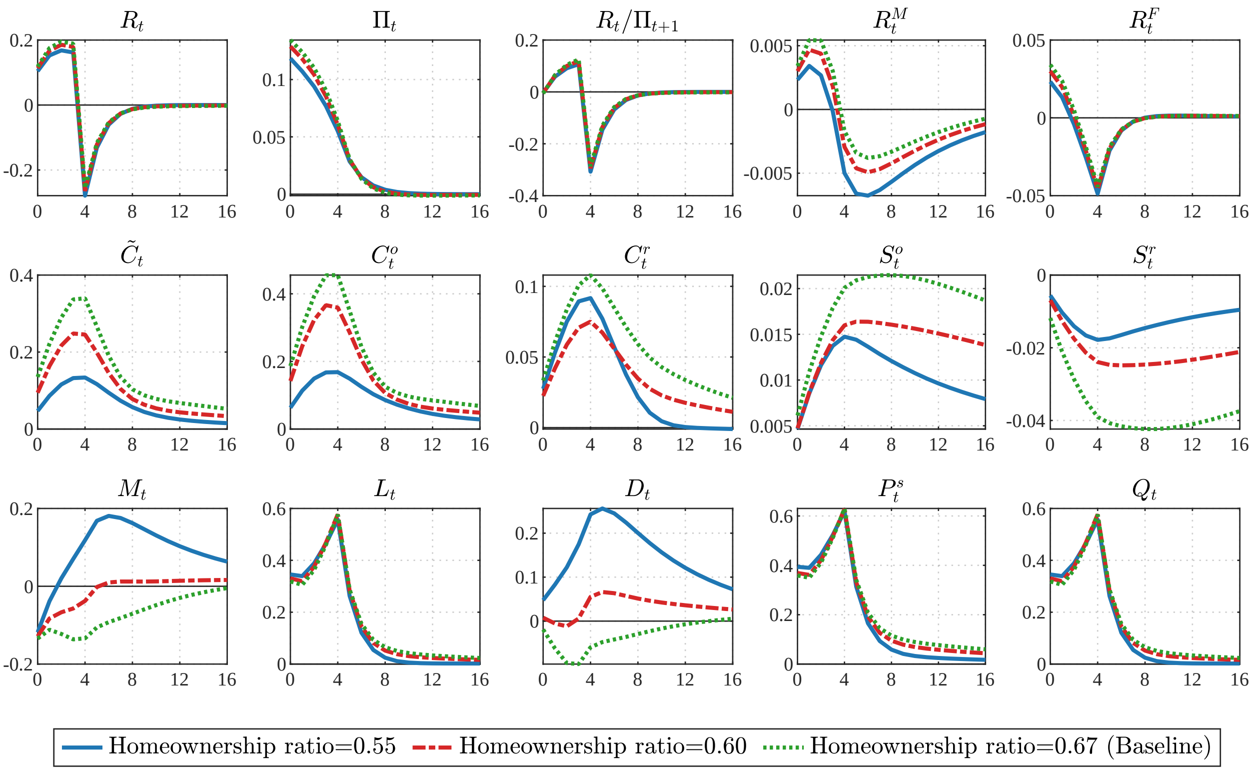


Figure E.6: Model impulse responses to a 1 S.D. 4-period ahead forward guidance shock by different homeownership ratio

Notes: This figure reports the model impulse responses to a forward guidance shock that lowers the 4-period ahead interest rate by one standard deviation under rational inattention. The solid blue lines plot the case with a homeownership ratio of 0.55. The dot-dashed red lines plot the case with a homeownership ratio of 0.60. The dotted green lines plot the baseline case with a homeownership ratio of 0.67.

Table E.9: Welfare costs by homeownership ratios

Households	(A) Total welfare costs (μ^i)	(B) Welfare costs under full-information	(C) Welfare gains from unresponsiveness	(D) Costs of attention
Panel A. Homeownership ratio= 0.67 *(Baseline)*				
Homeowner	0.2415	0.0065	0.0020	0.2370
Renter	0.0389	0.0005	0.0004	0.0388
Panel B. Homeownership ratio= 0.60				
Homeowner	0.1436	0.0062	0.0028	0.1402
Renter	0.0230	0.0009	0.0007	0.0228
Panel C. Homeownership ratio= 0.55				
Homeowner	0.0457	0.0058	0.0039	0.0438
Renter	0.0248	0.0012	0.0009	0.0245

Notes: This table shows the implicit welfare costs in economies with different homeownership ratios in responses to forward guidance shocks under rational inattention. Panels A, B, and C represent economies with homeownership ratios of 0.67 (baseline), 0.60, and 0.55 respectively. Note that Columns (A) = (B) - (C) + (D). See Equation (5) for the decomposition.

E.2 Mortgage accessibility

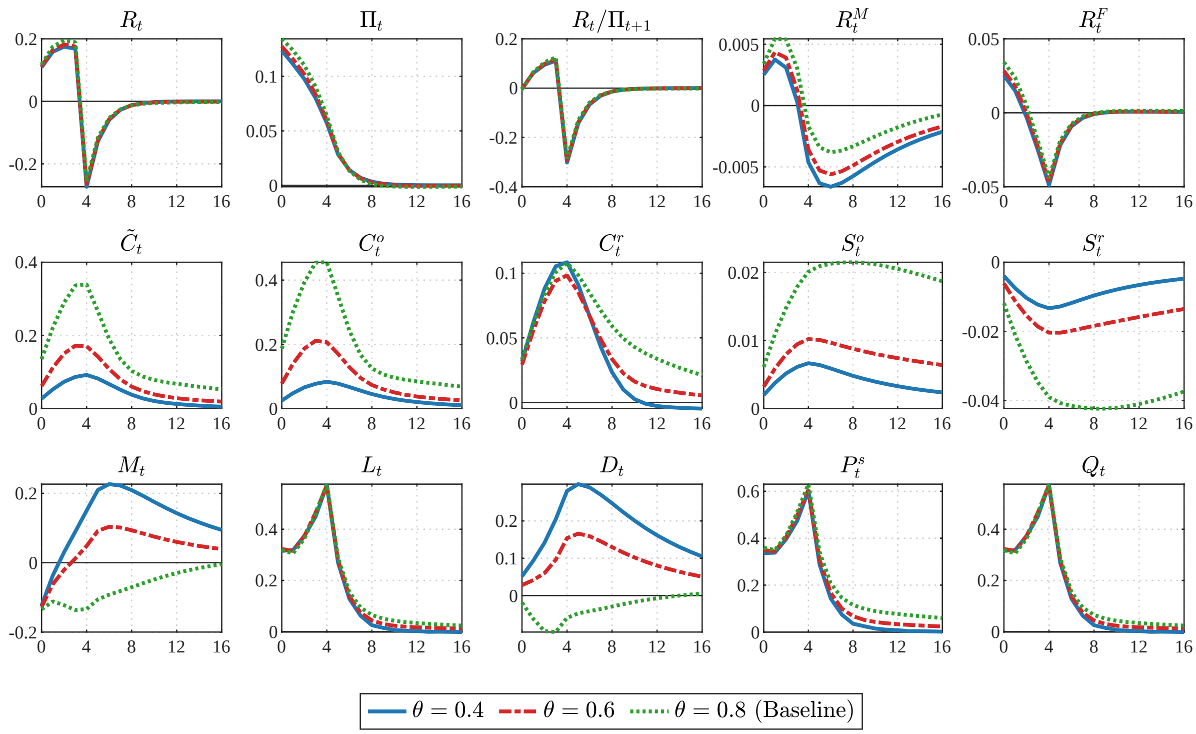


Figure E.7: IRFs to a 1 S.D. 4-period ahead forward guidance shock by different LTV ratios (θ)

Notes: This figure reports the model impulse responses to a forward guidance shock that lowers the 4-period ahead interest rate by one standard deviation under rational inattention. The solid blue lines plot the case with an LTV ratio of 40%. The dot-dashed red lines plot the case with an LTV ratio of 60%. The dotted green lines plot the baseline case with an LTV ratio of 80%.

Table E.10: Welfare costs by LTV ratios

Households	(A) Total welfare costs (μ^i)	(B) Welfare costs under full-information	(C) Welfare gains from unresponsiveness	(D) Costs of attention
Panel A. $\theta = 0.8$ (Baseline)				
Homeowner	0.2415	0.0065	0.0020	0.2370
Renter	0.0389	0.0005	0.0004	0.0388
Panel B. $\theta = 0.6$				
Homeowner	0.0662	0.0053	0.0032	0.0641
Renter	0.0290	0.0008	0.0005	0.0287
Panel C. $\theta = 0.4$				
Homeowner	0.0215	0.0041	0.0032	0.0207
Renter	0.0310	0.0011	0.0008	0.0307

Notes: This table shows the implicit welfare costs in economies with different LTV ratios in responses to forward guidance shocks under rational inattention. Panel A - C represents economies with LTV ratios of 80% (baseline), 60%, and 40% respectively. Note that Columns (A) = (B) - (C) + (D). See Equation (5) for the decomposition.

E.3 ARM vs FRM

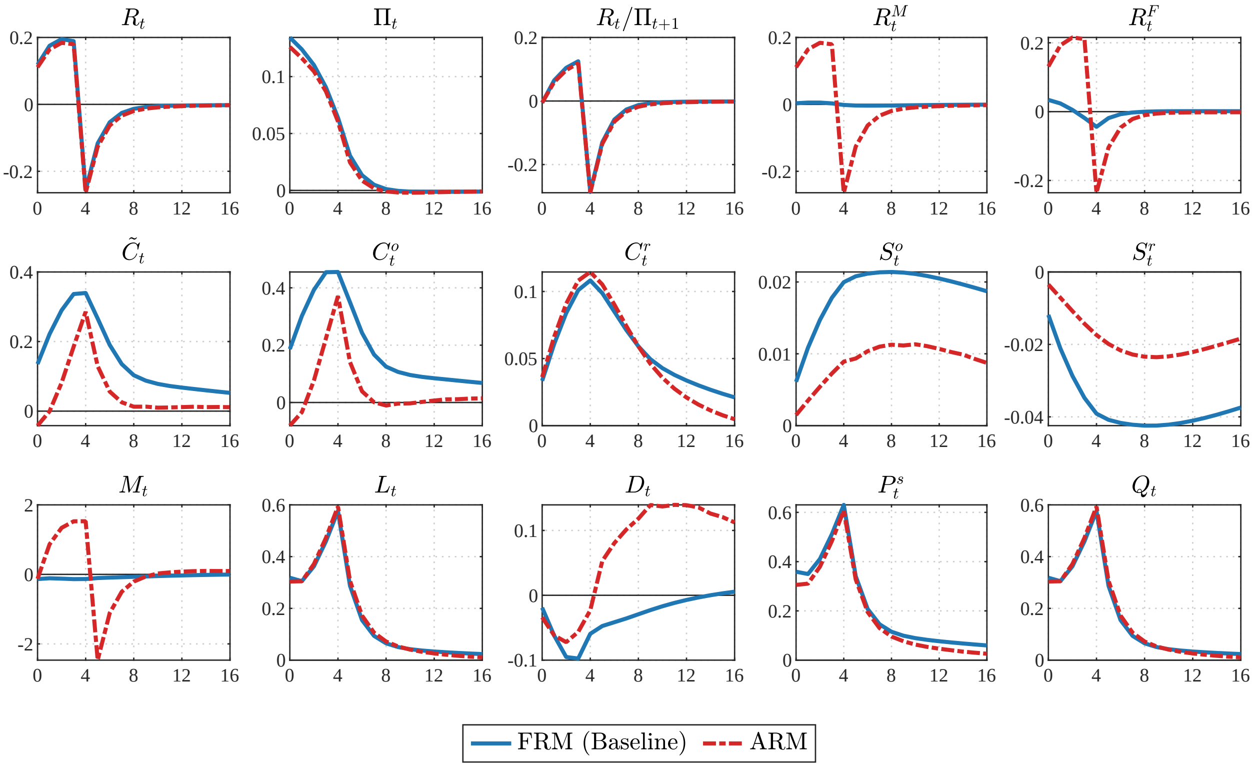


Figure E.8: IRFs to a 1 S.D. 4-period ahead forward guidance shock under FRM vs. ARM

Notes: This figure reports the model impulse responses to a forward guidance shock that lowers the 4-period ahead interest rate by one standard deviation under rational inattention. The solid blue lines plot the baseline case with fixed-rate mortgages (FRM). The dot-dashed red lines plot the case with adjustable-rate mortgages (ARM).

Table E.11: Welfare costs: ARM vs. FRM

Households	(A) Total welfare costs (μ^i)	(B) Welfare costs under full-information	(C) Welfare gains from unresponsiveness	(D) Costs of attention
Panel A. Fixed rate mortgage				
Homeowner	0.2415	0.0065	0.0020	0.2370
Renter	0.0389	0.0005	0.0004	0.0388
Panel B. Adjustable rate mortgage				
Homeowner	0.7467	0.0041	0.003	0.7456
Renter	0.0352	0.0012	0.0008	0.0349

Notes: This table shows the implicit welfare costs in economies with different mortgage structures in responses to forward guidance shocks under rational inattention. Panel A represents the baseline economy with flexible-rate mortgages (FRM). Panel B represents the economy with adjustable-rate mortgages (ARM). Note that Columns (A) = (B) - (C) + (D). See Equation (5) for the decomposition.

E.4 Expectation-augmented Taylor rules

To understand the optimal design of monetary policy in the presence of the mortgage channel, we consider the following modified Taylor rule where the central bank responds to actual inflation and the average inflation expectations:

$$\hat{R}_t = \rho \hat{R}_{t-1} + (1-\rho)\phi_\pi \left(k_\pi \pi_t + (1-k_\pi)\bar{E}_t[\pi_t]\right) + \varepsilon_{R,t-4}$$

where $\bar{E}_t[\pi_t]$ is the average inflation expectations across homeowners and renters and k_π is the relative weight on the actual inflation rate in the Taylor rule. As shown in Figure E.9, the policy becomes more stimulative when the central bank places more weight on inflation expectations. Since the average inflation expectations under-react to shocks compared to the actual inflation rate, the policy becomes more dovish when targeting expectations. As a result, inflation and consumption responses are stronger with a lower k_π. In terms of welfare, a lower k_π leads to much more volatile responses in households' consumption and housing services choices. Consequently, the welfare costs increase with the more intensive efforts on information acquisition (see Table E.12).

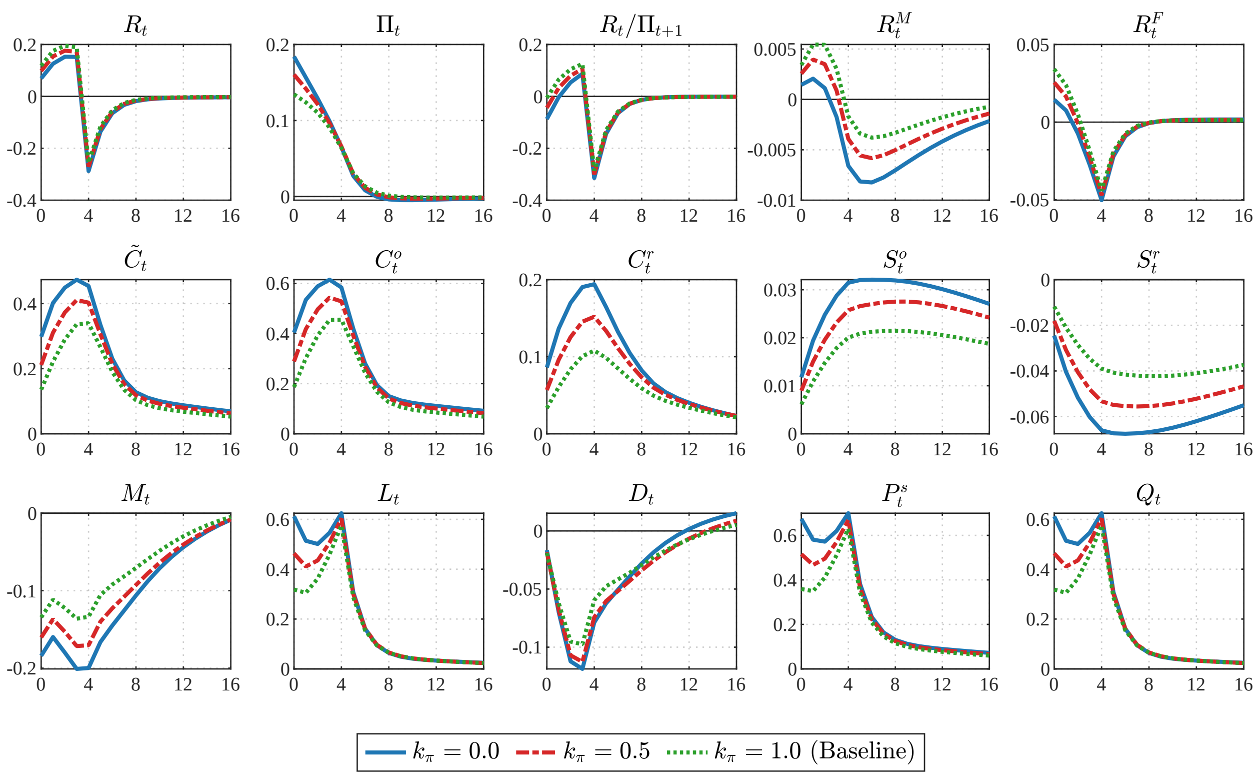


Figure E.9: Model impulse responses to a 1 S.D. 4-period ahead forward guidance shock with the central bank response to inflation expectations

Notes: This figure reports the model impulse responses to a forward guidance shock that lowers the 4-period ahead interest rate by one standard deviation under rational inattention. The solid blue lines plot the case where the central bank only responds to inflation expectations. The dot-dashed red lines plot the case where the central bank places equal weights on actual inflation and inflation expectations. The dotted green lines plot the baseline case where the central bank only responds to actual inflation.

Table E.12: Welfare costs: expectation-augmented Taylor rules

Households	(A) Total welfare costs (μ^i)	(B) Welfare costs under full-information	(C) Welfare gains from unresponsiveness	(D) Costs of attention
Panel A. $k_\pi = 1.0$ (Baseline)				
Homeowner	0.2415	0.0065	0.0020	0.2370
Renter	0.0389	0.0005	0.0004	0.0388
Panel B. $k_\pi = 0.5$				
Homeowner	0.2931	0.0065	0.0010	0.2876
Renter	0.0521	0.0005	0.0003	0.0519
Panel C. $k_\pi = 0.0$				
Homeowner	0.3398	0.0065	0.0002	0.3335
Renter	0.0637	0.0005	0.0003	0.0634

Notes: This table shows the implicit welfare costs in economies with different Taylor rules in responses to forward guidance shocks under rational inattention. Panel A is the baseline case where the central bank only responds to actual inflation. Panel B is based on the case where the central bank places equal weights on actual inflation and inflation expectations. Panel C is based on the case where the central bank only responds to inflation expectations. Note that Columns (A) = (B) - (C) + (D). See Equation (5) for the decomposition.

E.5 Forward guidance horizons

Our final exercise considers the sensitivity of forward guidance shocks over different targeting horizons. Notice that the linearized Taylor rule is given by

$$\hat{R}_t = \rho \hat{R}_{t-1} + (1-\rho)\phi_\pi \pi_t + \varepsilon_{R,t-T}$$

where T is the forward guidance horizon. In this exercise, we consider $T = 0, 2, 4, 6$ to examine how the forward guidance horizons affect the economy in this model. In general, forward guidance becomes more expansionary in consumption and inflation as the target horizon increases (Figure E.10). This is consistent with common predictions of forward guidance in full information rational expectations models, known as the forward guidance puzzle (e.g., Del Negro et al. 2023; Bilbiie 2020). However, the power of forward guidance is smaller with rationally inattentive households compared to the economy with full-information rational expectations. The limited attention leads to a weaker pass-through of the future interest rate cut into the economy. As for welfare costs, the economy becomes more volatile as the power of forward guidance increases with horizons. Consequently, information acquisition costs increase with horizons, especially for homeowners.

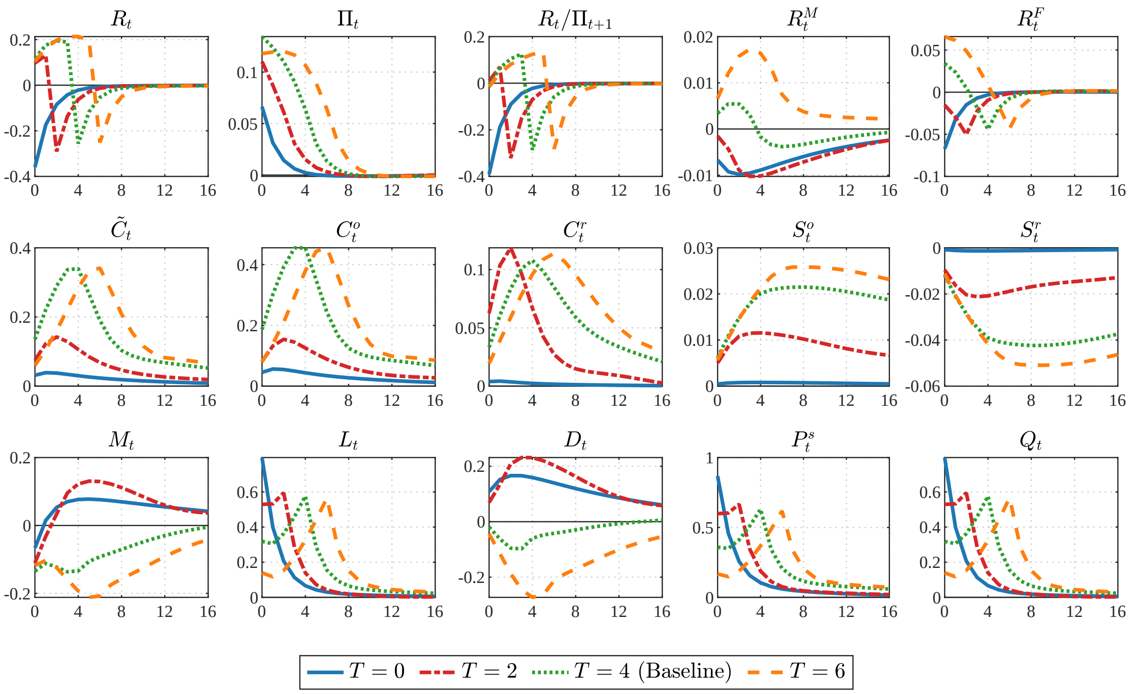


Figure E.10: IRFs to a 1 S.D. forward guidance shock with different forward guidance horizons

Notes: This figure reports the model impulse responses to a forward guidance shock over different horizons. The solid blue lines plot the case where the forward guidance lowers the current period interest rate. The dot-dashed red lines plot the case where the forward guidance lowers the 2-period ahead interest rate. The dotted green lines plot the baseline case where the forward guidance lowers the 4-period ahead interest rate. The dashed yellow lines plot the case where the forward guidance lowers the 6-period ahead interest rate.

Table E.13: Welfare costs by forward guidance horizons

Households	(A) Total welfare costs (μ^i)	(B) Welfare costs under full-information	(C) Welfare gains from unresponsiveness	(D) Costs of attention
Panel A. $T = 0$				
Homeowner	0.0280	0.0034	0.0028	0.0274
Renter	0.0023	0.0007	0.0007	0.0023
Panel B. $T = 2$				
Homeowner	0.0492	0.0055	0.0038	0.0475
Renter	0.0403	0.0008	0.0006	0.0401
Panel C. $T = 4$ (Baseline)				
Homeowner	0.2415	0.0066	0.0020	0.2370
Homeowner	0.0389	0.0005	0.0004	0.0388
Panel D. $T = 6$				
Homeowner	0.2561	0.0065	0.0015	0.2511
Renter	0.0412	0.0001	0	0.0411

Notes: This table shows the implicit welfare costs in responses to forward guidance shocks over different horizons. Panel A is based on the case where the forward guidance lowers the current period interest rate. Panel B is based on the case where the forward guidance lowers the 2-period ahead interest rate. Panel C is the baseline case where the forward guidance lowers the 4-period ahead interest rate. Panel D is based on the case where the forward guidance lowers the 6-period ahead interest rate. See Equation (5) for the decomposition.

References

Afrouzi, H., Yang, C., 2021. Dynamic rational inattention and the Phillips curve. CESifo Working Paper No. 8840. CESifo.

Bilbiie, F.O., 2020. The new keynesian cross. Journal of Monetary Economics 114, 90–108.

Del Negro, M., Giannoni, M.P., Patterson, C., 2023. The forward guidance puzzle. Journal of Political Economy Macroeconomics 1, 43–79.

Hajdini, I., Knotek, E.S., Leer, J., Pedemonte, M., Rich, R., Schoenle, R., 2024. Indirect consumer inflation expectations: Theory and evidence. Journal of Monetary Economics , 103568.

Maćkowiak, B., Wiederholt, M., 2023. Rational inattention and the business cycle effects of productivity and news shocks. Working Paper Series 2827. European Central Bank.

Malmendier, U., Nagel, S., 2015. Learning from inflation experiences. The Quarterly Journal of Economics 131, 53–87.