Aggregate Implications of Heterogeneous Inflation Expectations: The Role of Individual Experience[1]

Mathieu Pedemonte
IADB

Hiroshi Toma
University of Michigan

Esteban Verdugo
University of Michigan

[1]The views expressed herein are those of the individual authors and do not necessarily reflect the official positions of the IADB.

Overview

Introduction

- Inflation expectations...
  - ...matter for decisions at firm and household levels (Coibion et al. 2023, Hajdini et al. 2022)
  - ...are heterogeneous and depend on past individual experiences (Malmendier and Nagel 2016, Malmendier 2021)
- Previous empirical evidence: Focus on how differences arise at individual level
- Issue: Less understanding on aggregate implications of heterogeneity

What are the macro implications of heterogeneity in inflation rate expectations?

- Important implications in current macroeconomic environment
  - New cohorts being exposed to high inflation environment
- Long lasting effects of high inflation
  - Even though current inflationary episode may be transitory

This paper

1. Consumer inflation expectations depend on their history
   - New evidence for the US and abroad

2. Model consumers expectations to incorporate heterogeneity in experiences: Diagnostic expectations
   - Consumers use memory to forecast, bias due to own small sample (Kahneman and Tversky 1972, Bordalo et al. 2023)
   - Estimate diagnostic parameter
   - Approach is successful in explaining survey data, only using CPI information of common and heterogeneous past experiences

3. Introduce mechanism in a New Keynesian model with different cohorts

4. Additional exercises
   - Optimal Taylor rules
   - Episode of high inflation

Overview

Introduction

Empirical facts

Modeling heterogeneous expectations

Aggregate implications of heterogeneous expectations

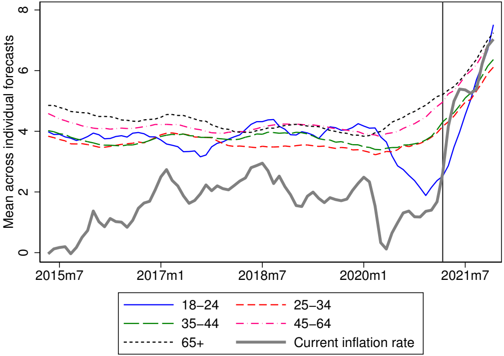
Conclusions

Data

- Survey of Consumer Expectations (SCE) of the New York Fed
  - Monthly rotating panel
  - March 2013 to December 2021
  - 12-month ahead inflation rate point forecast

Fact 1: Inflation expectations are heterogeneous across cohorts

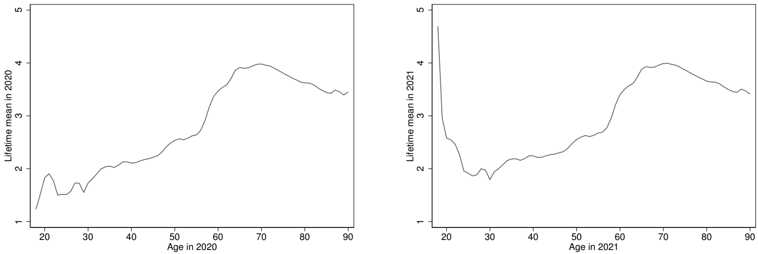
Figure 1: Average 12-month ahead inflation rate expectations



Note: Graph shows the 12-month moving average for the 10% and 90% trimmed mean for each cohort using the point forecast. We use population weights. Data goes from June 2013 to December 2021. Ages correspond to the interviewee's age in the moment of the survey. Vertical line denotes March 2021.
Source: Survey of Consumer Expectations.

Fact 2: Inflation experiences are clustered by age

Figure 2: Lifetime average inflation rate among respondents

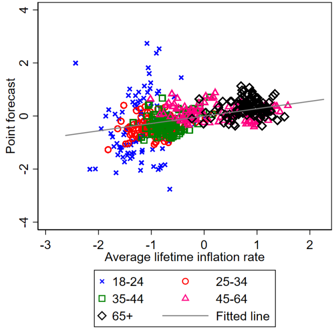


(a) 2020 (b) 2021

Note: Graph shows the mean of the monthly YoY inflation rate that a people of the shown age in the years 2020 and 2021 have experienced in their lifetimes, starting when they were aged 18.
Source: FRED.

Fact 3: A higher average lifetime inflation rate is correlated to higher point forecast

Figure 3: Inflation rate point forecast and average lifetime inflation rate



Note: Binned scatterplot across lifetime average inflation rate bins. Variables residualized by respondent gender and commuting zone. Data goes from June 2013 to December 2021. Ages correspond to the interviewee's age in the moment of the survey.
Source: Survey of Consumer Expectations.

Fact 4: No cohort differences when updating to current information

- We evaluate if:
  - History matters
  - Current inflation matters
  - Cohorts react differently to current inflation

$$\mathbb{E}_{i,t}\left[\pi_{t+1}\right] = \alpha_i + \beta_1 \overline{\pi_{i,t}} + \beta_2 \pi_t + \gamma_i I_i \times \pi_t + \varepsilon_{i,t}$$

Fact 4: No cohort differences when updating to current information

Dep. var.: Inflation expectations	(1)	(2)
Average lifetime inflation	0.332***	0.269***
	(0.029)	(0.080)
Current inflation	0.524***	0.632***
	(0.056)	(0.121)
Current inflation × 25-34		-0.163
		(0.127)
Current inflation × 35-44		-0.099
		(0.125)
Current inflation × 45-64		-0.080
		(0.127)
Current inflation × 65+		-0.141
		(0.127)
Observations	105,415	105,415
R-squared	0.057	0.058

Overview

Modeling consumer inflation expectations

- Consumers want to forecast inflation and face signal extraction problem
- Expectations have two main components
  - A common component: Signals from prices seen by everybody (D'Acunto et al. 2021)
  - An heterogeneous reference: History of inflation experienced by each cohort (our results + Malmendier and Nagel 2016)
- Structural estimation of weights using CPI data

Standard Kalman filter: Setup

- Monthly setting
- Economy composed by different cohorts i
  - Heterogeneous by age and past inflation rate experiences
  - Each summarized by a representative agent
- Agents want to forecast the future inflation rate but face signal extraction problem
  - Believe inflation is RW process

$$\pi_{t+1} = \pi_t + \varepsilon_t$$

  - Only observe a public signal: food CPI

$$s_t = \zeta \pi_{t+1} + \upsilon_t$$

  - $\sigma_\varepsilon = 0.15$, $\sigma_\upsilon = 4.09$, and $\sigma_{\varepsilon\upsilon} = -0.03$ from monthly inflation rate data
  - $K = 0.1751$

Standard Kalman filter

- Agent i uses a standard Kalman filter to forecast the inflation rate for $t+1$

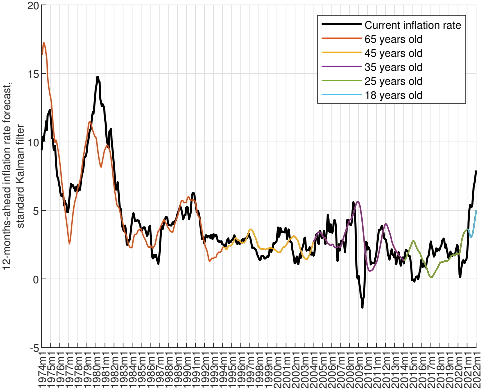
$$\mathbb{E}_{i,t}^{KF}[\pi_{t+1}] = (1-\zeta K)\,\mathbb{E}_{i,t-1}^{KF}[\pi_{t+1}] + Ks_t \tag{1}$$

- Agent i produces a forecast for $t+h$ conditional on forecast for $t+1$ and RW assumption

$$\mathbb{E}_{i,t}^{KF}[\pi_{t+h}] = \mathbb{E}_{i,t}^{KF}[\pi_{t+1}]$$

Standard Kalman filter: Forecasting exercise

Figure 4: Standard Kalman filter-based inflation rate forecasts by cohort



Note: Selected cohorts are differentiated by their age in the year 2021. We further assume each cohort starts forecasting when they become 18 years old.

Diagnostic Kalman filter: Setup

- Based on Bordalo et al. (2018, 2019, 2020)
- True conditional distribution

$$f\left(\pi_{t+1} | \mathcal{I}_t\right)$$

- Diagnostic belief distribution

$$f_{i,t}^{\theta}\left(\pi_{t+1}\right) = f\left(\pi_{t+1} \mid \mathcal{I}_{i,t}\right) D_{i,t}^{\theta}\left(\pi_{t+1}\right) Z_{i,t} \tag{2}$$

$$D_{i,t}^{\theta}\left(\pi_{t+1}\right) = \left[\frac{f\left(\pi_{t+1} \mid \mathcal{I}_{i,t}\right)}{f\left(\pi_{t+1} \mid \mathcal{I}_{i,t}^{ref}\right)^{t-k_i}} \right]^{\theta}$$

- Diagnostic parameter $\theta \in \mathbb{R}$ governs level of distortion

Diagnostic Kalman filter: Setup

- Based on Bianchi et al. (2021); L'Huillier et al. (2021)
- Linear representation of diagnostic forecast

$$\mathbb{E}^{\theta}_{i,t}\left[\pi_{t+1}\right] = \mathbb{E}^{KF}_{i,t}\left[\pi_{t+1}\right] + \theta\left(\mathbb{E}^{KF}_{i,t}\left[\pi_{t+1}\right] - \mathbb{E}^{ref}_{i,t}\left[\pi_{t+1}\right]\right) \tag{3}$$

- Reference term

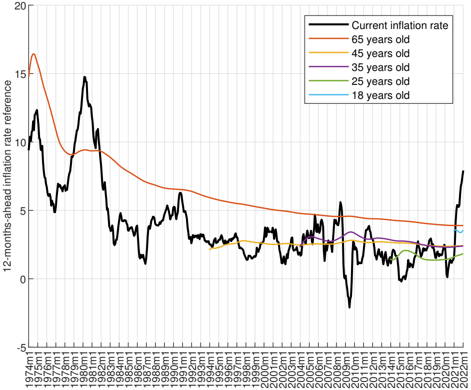
$$\mathbb{E}^{ref}_{i,t}\left[\pi_{t+1}\right] = \frac{\sum_{j=1}^{t-k_i} \mathbb{E}^{KF}_{i,t-j}\left[\pi_{t+1}\right]}{t-k_i} \tag{4}$$

- $\mathbb{E}^{KF}_{i,t}\left[\pi_{t+1}\right] = \mathbb{E}^{KF}_{t}\left[\pi_{t+1}\right]$: Same for all, based on current public signal
- $\mathbb{E}^{ref}_{i,t}\left[\pi_{t+1}\right]$: Unique for each cohort, based on past experiences

- $\theta > 0$: agents overreact to current information wrt reference
- $\theta < 0$: agents underreact to current information wrt reference
- $\theta = 0$: no belief distortions

Diagnostic Kalman filter: Reference term

Figure 5: Inflation rate reference by cohort



Note: Selected cohorts differentiated by their age in the year 2021. We further assume each cohort starts forecasting when they become 18 years old.

Diagnostic Kalman filter: Estimating θ

- Diagnostic forecast for agent i
$$\mathbb{E}^{\theta}_{i,t}\left[\pi_{t+12}\right] = \mathbb{E}^{KF}_{i,t}\left[\pi_{t+12}\right] + \theta\left(\mathbb{E}^{KF}_{i,t}\left[\pi_{t+12}\right] - \mathbb{E}^{ref}_{i,t}\left[\pi_{t+12}\right]\right)$$

- But we know that $\mathbb{E}^{KF}_{i,t}\left[\pi_{t+12}\right] = \mathbb{E}^{KF}_{t}\left[\pi_{t+12}\right]$, $\forall i$
$$\mathbb{E}_{i,t}\left[\pi_{t+12}\right] = \underbrace{(1+\theta)\,\mathbb{E}^{KF}_{t}\left[\pi_{t+12}\right]}_{\text{period FE}} - \theta\,\underbrace{\mathbb{E}^{ref}_{i,t}\left[\pi_{t+12}\right]}_{\text{from KF}} \tag{5}$$

- Estimate θ by regressing
$$\mathbb{E}^{SCE}_{m,i,t}\left[\pi_{t+12}\right] = \gamma_t + \varphi\mathbb{E}^{ref}_{i,t}\left[\pi_{t+12}\right] + \varepsilon_{m,i,t}$$

- $\theta = -\widehat{\varphi}$

Diagnostic Kalman filter: Underreaction to current events

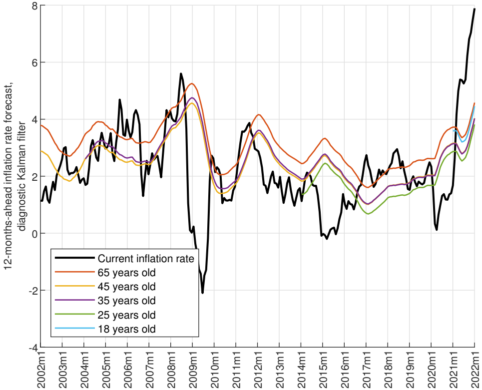
- $\theta = -\widehat{\varphi} = -0.374 \Rightarrow$ Put weight on reference

Table 1: Diagnostic parameter estimation

$\mathbb{E}_{i,t}^{ref}[\pi_{t+12}]$	0.374*** (0.045)
Time FE	Yes
Controls	No
Observations	83,991
R-squared	0.100

Diagnostic Kalman filter: Forecasting exercise

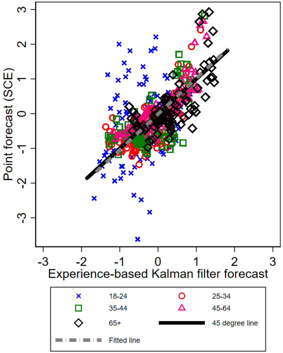
Figure 6: Diagnostic Kalman filter-based inflation rate forecasts by cohort



Note: Selected cohorts differentiated by their age in the year 2021. We further assume each cohort starts forecasting when they become 18 years old.

Diagnostic Kalman filter: Goodness of fit

Figure 7: Observed inflation rate forecasts and diagnostic Kalman filter forecasts



Note: Binned scatterplot across diagnostic Kalman filter forecasts. Variables residualized by respondent gender and commuting zone. Data goes from June 2013 to December 2021. Ages correspond to the interviewee's age in the moment of the survey. Slope is 0.848.

Departure from FIRE

- We built a measure of inflation forecasts for each cohort at each period
  - Only uses past inflation data and an estimated parameter (no survey data)
  - Consumers *overweight* their history, relative to a common optimal forecast
  - Our measure predicts heterogeneity across cohorts and time

- Consumer expectations from surveys contain relevant, meaningful and systematic information

▸ Europe

Overview

Setup

- New Keynesian model
- Overlapping generations: Perpetual youth
- Heterogeneous inflation rate forecasts
  - Diagnostic Kalman filter (DE-KF)

- Summary
  - Consumers have DE-KF expectations
  - Firms are rational: Focus on effect of heterogeneity where we can measure it
  - Firms: Standard PC
  - Monetary authority with standard Taylor rule

Households: Setup

- Infinite amount of cohorts
  - Each summarized by a representative household
  - Cohorts heterogeneous in age and past inflation rate experiences

- Perpetual youth approach of Blanchard (1985) and Yaari (1965)
  - Households uncertain about date they will die
  - Mortality rate λ

Households: Setup

- A representative household of cohort i solves

$$\max \left[\frac{C_{i,t}^{1-\sigma}}{1-\sigma} - \frac{L_{i,t}^{1+\eta}}{1+\eta} \right] + \sum_{j=1}^{\infty} \beta^{j-t} (1-\lambda)^{j-t} \mathbb{E}_{i,t}^{\theta} \left[\frac{C_{i,t+j}^{1-\sigma}}{1-\sigma} - \frac{L_{i,t+j}^{1+\eta}}{1+\eta} \right]$$

subject to

$$P_t C_{i,t} + (1-\lambda) \frac{B_{i,t+1}}{(1+i_t)} = W_t L_{i,t} + B_{i,t} + T_{i,t}$$

- Transfers $T_{i,t}$ are crucial: 2 different mechanisms
  - Blanchard (1985) and Yaari (1965): HH insure themselves to receive flow of income in exchange of not leaving accidental bequests
  - Mankiw and Reis (2006): Flow of income is such that HH start each period with same wealth, do not worry about wealth distribution

Households: Diagnostic IS curve

- IS curve for cohort i

$$c_{i,t} = \left\{-\frac{i_t}{\sigma} + \mathbb{E}^{\theta}_{i,t}\left[c_{i,t+1}\right] + \mathbb{E}^{\theta}_{i,t}\left[\frac{\pi_{t+1}}{\sigma}\right]\right\}$$

- Using definition for diagnostic expectations

$$c_{i,t} = \begin{array}{c} \left\{-\frac{i_t}{\sigma} + \mathbb{E}^{KF}_{t}\left[c_{i,t+1}\right] + \mathbb{E}^{KF}_{t}\left[\frac{\pi_{t+1}}{\sigma}\right]\right\} \\ +\theta\left\{\left(\mathbb{E}^{KF}_{t}\left[c_{i,t+1}\right] - \mathbb{E}^{ref}_{i,t}\left[c_{i,t+1}\right]\right) + \left(\mathbb{E}^{KF}_{t}\left[\frac{\pi_{t+1}}{\sigma}\right] - \mathbb{E}^{ref}_{i,t}\left[\frac{\pi_{t+1}}{\sigma}\right]\right)\right\} \end{array}$$

- Aggregation

$$c_t = \lambda \sum_{k=0}^{\infty} (1-\lambda)^k c_{k,t}$$

- Aggregate diagnostic IS curve

$$y_t = \begin{array}{c} \left\{-\frac{i_t}{\sigma} + \mathbb{E}^{KF}_{t}\left[y_{t+1}\right] + \mathbb{E}^{KF}_{t}\left[\frac{\pi_{t+1}}{\sigma}\right]\right\} + \theta\left\{\mathbb{E}^{KF}_{t}\left[y_{t+1}\right] + \mathbb{E}^{KF}_{t}\left[\frac{\pi_{t+1}}{\sigma}\right]\right\} \\ -\theta\lambda \sum_{k=0}^{\infty} (1-\lambda)^k \left\{\mathbb{E}^{ref}_{k,t}\left[y_{t+1}\right] + \mathbb{E}^{ref}_{k,t}\left[\frac{\pi_{t+1}}{\sigma}\right]\right\} \end{array}$$

Summary

$$y_t = \begin{array}{c} \left\{-\frac{i_t}{\sigma} + \mathbb{E}_t^{KF}\left[y_{t+1}\right] + \mathbb{E}_t^{KF}\left[\frac{\pi_{t+1}}{\sigma}\right]\right\} + \theta\left\{\mathbb{E}_t^{KF}\left[y_{t+1}\right] + \mathbb{E}_t^{KF}\left[\frac{\pi_{t+1}}{\sigma}\right]\right\} \\ -\theta\lambda\sum_{k=0}^{\infty}\left(1-\lambda\right)^k\left\{\mathbb{E}_{k,t}^{ref}\left[y_{t+1}\right] + \mathbb{E}_{k,t}^{ref}\left[\frac{\pi_{t+1}}{\sigma}\right]\right\} + u_t^{taste} \end{array} \tag{6}$$

$$\pi_t = \frac{\left(1-\phi\right)\left(1-\phi\beta\right)}{\phi}\left(\sigma+\eta\right)\left(y_t + u_t^{cost}\right) + \beta\mathbb{E}_t\left[\pi_{t+1}\right] \tag{7}$$

$$i_t = \chi_\pi \pi_t + \chi_y y_t \tag{8}$$

$$u_t^{cost} = \rho_{cost} u_{t-1}^{cost} + \epsilon_t^{cost} \tag{9}$$

$$u_t^{taste} = \rho_{taste} u_{t-1}^{taste} + \epsilon_t^{taste} \tag{10}$$

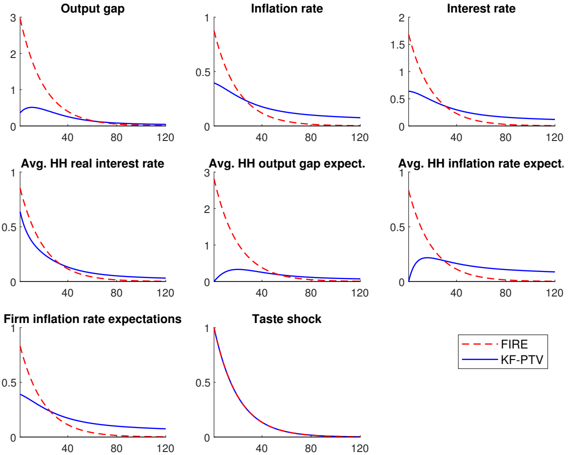
Monthly calibration with underreaction to current information

Table 2: Model calibration

Parameter	Value	Parameter	Value
β	0.9967	χ_y	0.125
η	1	ρ^{cost}	0.9
ϕ	0.9167	ρ^{taste}	0.9
σ	1	λ	**0.001**
ε	9	K	**0.1751**
χ_π	1.5	θ	**-0.374**

Hump-shaped expectations and overextrapolation

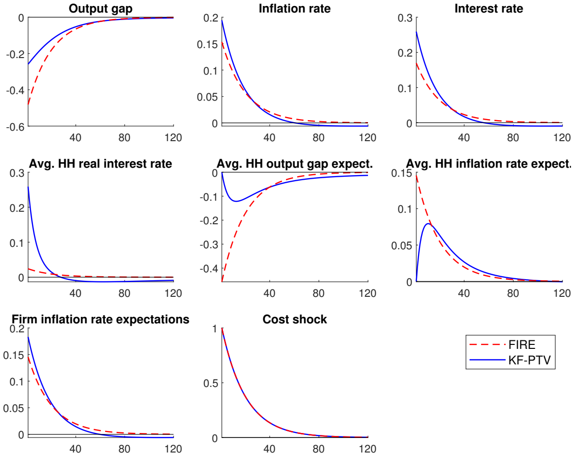
Figure 8: IRFs, taste shock



Note: Horizontal axis denotes months after the shock.

Hump-shaped expectations and overextrapolation

Figure 9: IRFs, cost shock



Note: Horizontal axis denotes months after the shock.

Aggregate implications of heterogeneous expectations

- Diagnostic expectations with anchoring-to-the-past mechanism $\Rightarrow$ Hump-shaped expectations
- Heterogeneity $\Rightarrow$ Longer duration of effects
- Inflationary shocks
  - Old cohorts remember past
  - New cohorts enter in an inflationary environment, carry this memories into the future

Opt. Taylor rule | High infl. ep.

Overview

Conclusions

- Inflation expectations heterogeneous across cohorts
  - Differences depend on past experiences
  - Diagnostic Kalman filter with underreaction to current events is suitable for modeling this
- Aggregate implications
  - Diagnostic expectations with underreaction $\Rightarrow$ Anchoring-to-the-past
  - Heterogeneity $\Rightarrow$ Longer duration of effects
  - Optimal policy $\Rightarrow$ CB has to be more active Opt. Taylor rule
- Relevance
  - Important implications in the current macroeconomic environment
    - New cohorts being exposed to high inflation
  - Long lasting effects of current high inflation episode High infl. ep.

Aggregate Implications of Heterogeneous Inflation Expectations: The Role of Individual Experience[1]

Mathieu Pedemonte
IADB

Hiroshi Toma
University of Michigan

Esteban Verdugo
University of Michigan

[1]The views expressed herein are those of the individual authors and do not necessarily reflect the official positions of the IADB.

[1]The views expressed herein are those of the individual authors and do not necessarily reflect the official positions of the IADB.

References I

Bianchi, F., Ilut, C. L., and Saijo, H. (2021). Implications of diagnostic expectations: Theory and applications.

Blanchard, O. J. (1985). Debt, deficits, and finite horizons. *Journal of Political Economy*, 93(2):223–247.

Bordalo, P., Conlon, J. J., Gennaioli, N., Kwon, S. Y., and Shleifer, A. (2023). Memory and probability. *The Quarterly Journal of Economics*, 138(1):265–311.

Bordalo, P., Gennaioli, N., Ma, Y., and Shleifer, A. (2020). Overreaction in macroeconomic expectations. *American Economic Review*, 110(9):2748–82.

Bordalo, P., Gennaioli, N., Porta, R. L., and Shleifer, A. (2019). Diagnostic expectations and stock returns. *Journal of Finance*, 74(6):2839–2874.

Bordalo, P., Gennaioli, N., and Shleifer, A. (2018). Diagnostic expectations and credit cycles. *Journal of Finance*, 73(1):199–227.

Coibion, O., Georgarakos, D., Gorodnichenko, Y., and Van Rooij, M. (2023). How does consumption respond to news about inflation? Field evidence from a randomized control trial. *American Economic Journal: Macroeconomics*, 15(3):109–152.

References II

D'Acunto, F., Malmendier, U., Ospina, J., and Weber, M. (2021). Exposure to grocery prices and inflation expectations. *Journal of Political Economy*, 129(5):1615–1639.

Hajdini, I., Knotek II, E. S., Leer, J., Pedemonte, M., Rich, R., and Schoenle, R. (2022). Indirect consumer inflation expectations: Theory and evidence. *Federal Reserve Bank of Cleveland Working Paper*.

Kahneman, D. and Tversky, A. (1972). Subjective probability: A judgment of representativeness. *Cognitive psychology*, 3(3):430–454.

L'Huillier, J.-P., Singh, S. R., and Yoo, D. (2021). Diagnostic expectations and macroeconomic volatility.

Malmendier, U. (2021). Experience effects in finance: Foundations, applications, and future directions. *Review of Finance*, 25(5):1339–1363.

Malmendier, U. and Nagel, S. (2016). Learning from inflation experiences. *Quarterly Journal of Economics*, 131(1):53–87.

Mankiw, N. G. and Reis, R. (2006). Pervasive stickiness. *American Economic Review*, 96(2):164–169.

References III

Yaari, M. E. (1965). Uncertain lifetime, life insurance, and the theory of the consumer. *Review of Economic Studies*, 32(2):137–150.

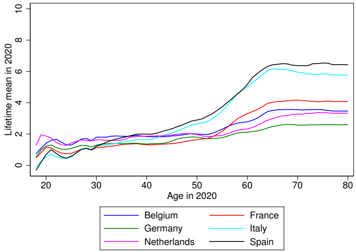
APPENDIX: External validity with European data

Consumer Expectations Survey

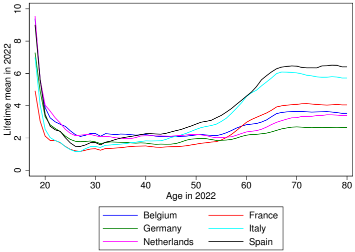
- Use Consumer Expectations Survey of the European Central Bank
  - Monthly data between April 2020 and September 2022
  - Six countries: Belgium, France, Germany, Italy, Netherlands and Spain

Inflation experiences are clustered by age

Figure 10: Lifetime average inflation rate among respondents



(a) 2020

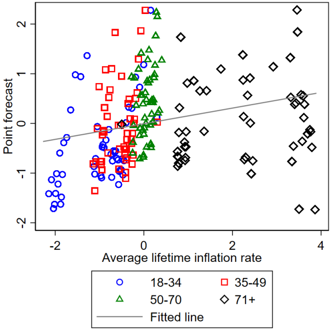


(b) 2022

Note: Graph shows the mean of the monthly YoY inflation rate that a people of the shown age in the years 2020 and 2022 have experienced in their lifetimes, starting when they were aged 18.
Source: FRED.

A higher average lifetime inflation rate is correlated to higher point forecast

Figure 11: Inflation rate point forecast and average lifetime inflation rate, Europe



Note: Binned scatterplot across lifetime average inflation rate bins. Variables residualized by respondent gender and commuting zone. Data goes from April 2020 to September 2022. Ages correspond to the interviewee's age in the moment of the survey.
Source: Consumer Expectations Survey.

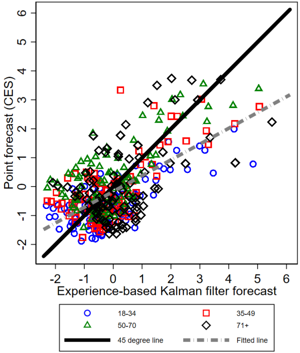
Diagnostic Kalman filter: Underreaction to current events, put weight on reference

- $\theta = -\widehat{\varphi} = -0.156$

	(1)	(2)	(3)	(4)
$\mathbb{E}^{ref}_{i,t}[\pi_{t+12}]$	0.156*** (0.011)	0.208*** (0.016)	0.094*** (0.011)	0.060*** (0.018)
Time FE	Yes	Yes	Yes	Yes
Controls	No	Cohort	Country	Cohort, country
Observations	271,311	271,311	271,311	271,311
R-squared	0.122	0.130	0.132	0.140

Diagnostic Kalman filter: Goodness of fit

Figure 12: Observed inflation rate forecasts and diagnostic Kalman filter forecasts

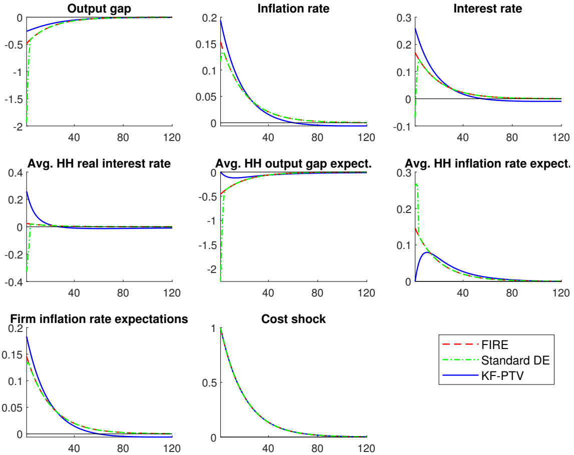


Note: Binned scatterplot across diagnostic Kalman filter forecasts. Variables residualized by respondent gender and commuting zone. Data goes from April 2020 to September 2022. Ages correspond to the interviewee's age in the moment of the survey.

APPENDIX: Additional figures

Hump-shaped expectations and overextrapolation

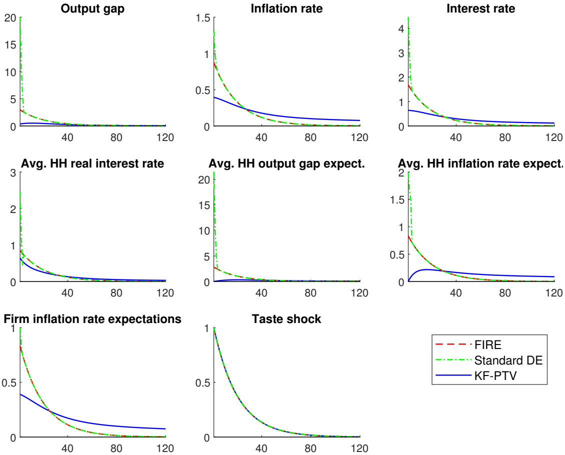
Figure 13: IRFs, cost shock



Note: Horizontal axis denotes months after the shock. For the no heterogeneity case we assume $\mathbb{E}_t^{nh}[X_{t+h}] = \mathbb{E}_t[X_{t+h}] + \varpi(\mathbb{E}_t[X_{t+h}] - \mathbb{E}_{t-3}[X_{t+h}])$ with $\varpi > 0$.

Hump-shaped expectations and overextrapolation

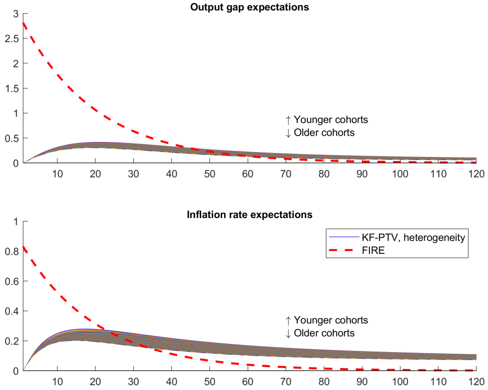
Figure 14: IRFs, taste shock



Note: Horizontal axis denotes months after the shock. For the no heterogeneity case we assume $\mathbb{E}_t^{nh}\left[X_{t+h}\right] = \mathbb{E}_t\left[X_{t+h}\right] + \varpi\left(\mathbb{E}_t\left[X_{t+h}\right] - \mathbb{E}_{t-3}\left[X_{t+h}\right]\right)$ with $\varpi > 0$.

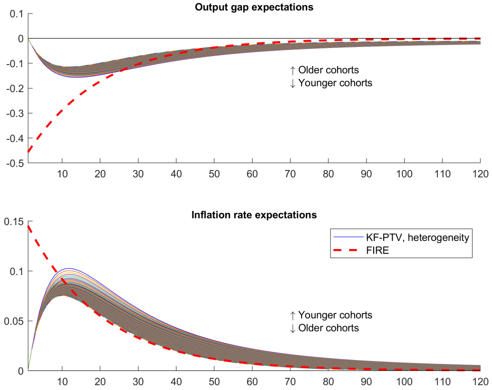
Heterogeneous expectations

Figure 15: IRFs, inflation rate diagnostic expectations by cohort, taste shock



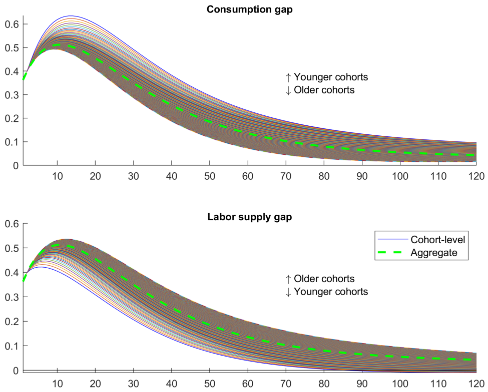
Heterogeneous expectations

Figure 16: IRFs, inflation rate diagnostic expectations by cohort, cost shock



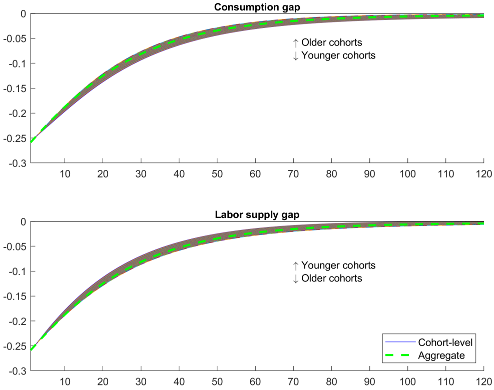
Consumption and labor supply

Figure 17: Consumption and labor supply, taste shock



Consumption and labor supply

Figure 18: Consumption and labor supply, cost shock



APPENDIX: Optimal Taylor rules

Optimal Taylor rules

- Taylor rule

$$i_t = \chi_\pi^* \pi_t + \chi_y^* y_t$$

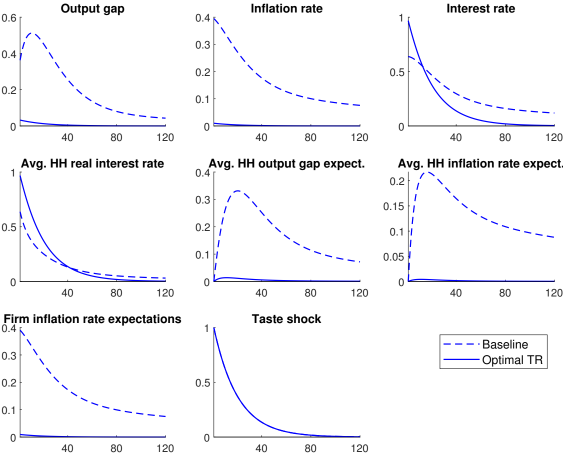
- Central Bank chooses the time-invariant parameters χ_π^* and χ_y^* such that it solves

$$\min \mathbb{E}_t \left[\pi_t^2 + \vartheta y_t^2\right]$$

- Central Bank has rational expectations

Optimal Taylor rules

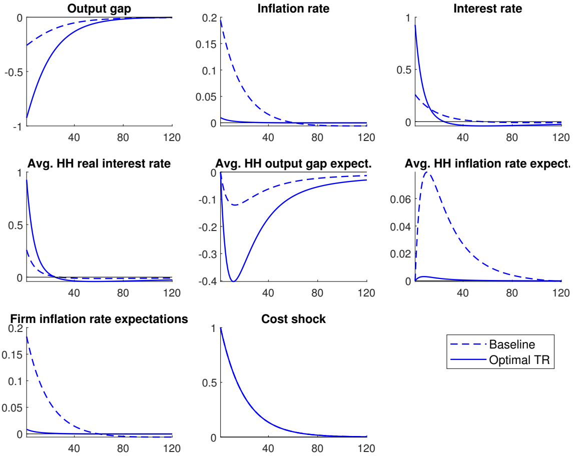
Figure 19: IRFs, optimal Taylor rule, taste shock



Note: Horizontal axis denotes months after the shock.

Optimal Taylor rules

Figure 20: IRFs, optimal Taylor rule, cost shock



Note: Horizontal axis denotes months after the shock.

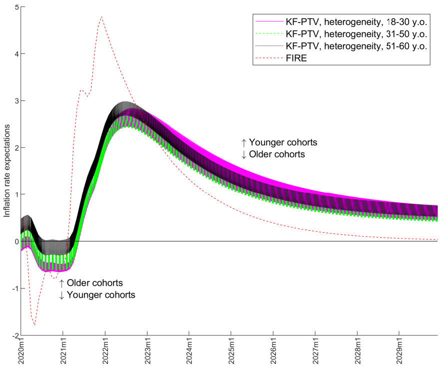
APPENDIX: Episode of high inflation

Episode of high inflation

- Analyze behavior of model after high inflation episode of 2021
- Feed model with monthly data
  - March 1967 to December 2021 (to build memory)
  - Inflation rate: CPI 12-month percentage change
  - Output gap: National Activity Index (CFNAI) from Chicago Fed
  - Interest rate: Effective federal funds rate
- Produce forecasts using different versions of the model

Episode of high inflation

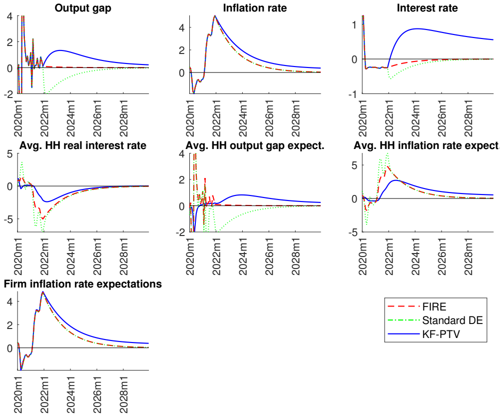
Figure 21: IRFs, inflation rate diagnostic expectations by cohort, forecast



Note: Figure shows the heterogeneous expectations generated by the diagnostic Kalman filter and the data (up to December 2021). Cohorts denote age in 2020. Horizontal axis denotes months.

Episode of high inflation

Figure 22: IRFs, forecast



Note: Figure shows the paths variables follow according to the model and the data (up to December 2021). For the no heterogeneity case we assume $\mathbb{E}_t^{nh}[X_{t+h}] = \mathbb{E}_t[X_{t+h}] + \varpi(\mathbb{E}_t[X_{t+h}] - \mathbb{E}_{t-3}[X_{t+h}])$ with $\varpi > 0$.