

Who's on FIRE? Household characteristics and the formation of inflation expectations

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Introduction

- Understanding formation of household inflation forecasts is important, since they determine consumption, savings, investment and debt choices, as well as reactions to monetary and fiscal policy (D'Acunto & Weber 2024).
- Increasingly rich literature on household inflation expectations has relied on departures from the Full Information Rational Expectations (FIRE) hypothesis.
- Little is known about individual-level revisions and perceived persistence of inflation for households. We address this gap by using unique panel of Dutch households (DHS Satellite Survey) sponsored by the Dutch central bank (DNB) to examine individual-level forecasting behaviour over longer time series.
- DHS satellite survey was conducted over sample period which includes high-inflation period in wake of Covid pandemic; attention to inflation increases in high-inflation environments (Weber et al. 2024).
- Our forecasting types are derived from literature on forecasting, as summarized in Pesaran & Weale (2006). We also introduce simple framework for Bayesian updating and show how rule-of-thumb forecasts ("heuristics") are nested therein.

DHS satellite survey

Satellite survey of the Dutch Household Panel (DHS), runs for consecutive months, starting in December 2019 (Galati et al., 2023):

- Panel of over 3000 household members representative for the (Dutch-speaking) population in the Netherlands. Monthly participation rates typically vary from 70 to 80 percent; annual refresher samples to correct for attrition.
- Inflation expectations one year and ten years ahead; our paper focusses on one-year ahead expectations.

Distinctive features of DHS satellite survey compared with other consumer surveys, which makes it particularly well suited for studying the formation of inflation expectations:

- In contrast to other consumer surveys, such as Michigan Survey of Consumers or New York Fed Survey of Consumer Expectations in US, it provides more balanced panel, where median respondent participates in 30 survey waves, so that longer time series are available for individuals.
- Respondents were randomly assigned to four different groups, of which two were asked about inflation expectations in Netherlands, and two about expectations in euro area. By contrast, most surveys of inflation expectations in euro-area member countries only ask for inflation expectations in that country, rather than in the euro area as a whole.
- Randomised control trial, where half of respondents have been provided with information about ECB's inflation target and actual euro-area or Dutch inflation in each survey wave since its start. This allows to study how information provision affects households' forecasting behaviour (Minina et al., 2024).

Forecasting types

Forecasting types other than FIRE

Extrapolative models of expectation formation, where point expectations are determined by weighted averages of past realizations of inflation (Pesaran & Weale 2006) such that all weights sum to unity:

- Naive expectations:** A static model, where agents' inflation forecasts are given by the current realization. In our framework, this implies that agents over-extrapolate from the signal they receive relative to their prior.
- Adaptive expectations:** agents form a weighted average of the current realization and a previous forecast of the current period. Agents thus update according to a Kalman filter, assuming inflation is fully persistent.
- Mean-reverting expectations:** given by a weighted average of current and lagged inflation realizations; this arises if agents receive an additional signal about past values of inflation, and thus ignore their own prior.
- Fundamentalists:** choose a constant anchor for inflation and ignore all new information. Thus, they perceive inflation to be constant and disregard all signals. Fundamentalists can have expectations anchored at an inflation target, although this does not need to be the case.

References

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Method

Tests for FIRE

Unbiasedness ($\alpha_{i,0}=0$) and efficiency ($\alpha_{i,1}=0$) of forecasts of respondent i at time t for inflation $k=12$ months ahead, $f_{i,t}^k$:

$$\pi_{t+k} - f_{i,t}^k \pi_{t+k} = \alpha_{i,0} + \zeta_{i,t}$$

$$\pi_{t+k} - f_{i,t}^k \pi_{t+k} = \alpha_{i,0} + \alpha_{i,1} \pi_t + \zeta_{i,t}.$$

Forecasting types

Different forecasting heuristics are nested in the following equation:

$$f_{i,t}(\pi_{t+k}) = \gamma_i + \beta_0 + \beta_1(1 - \mathbb{I}_i)f_{i,t-1}(\pi_{t+k-1}) + \beta_2\pi_t + \beta_3\mathbb{I}_i\pi_{t-1} + \zeta_{i,t}.$$

where \mathbb{I}_i is an indicator variable which equals 1 if respondent i receives information about lagged inflation. β_2 is only identified for observations with $\mathbb{I}_i=0$, and β_3 is only identified for observations with $\mathbb{I}_i=1$.

Results

Below are results on the formation of household inflation expectations at the aggregate and individual levels.

On average, household forecasts suggest model parameters that align with those of professional forecasters (ECB's SPF) and true data generating process, Table 1:

	Dutch Households Dec 2019 - Aug 2024			SPF Q4 1999 - Q2 2024
	(1)	(2)	(3)	(4)
Constant	2.548*** (0.022)	2.588*** (0.030)	2.403*** (0.033)	0.543*** (0.187)
$f_{i,t-1}\pi_{t+11}$	0.325*** (0.004)	0.307*** (0.006)	0.329*** (0.006)	0.499*** (0.148)
π_t	0.345*** (0.005)	0.294*** (0.006)	0.453*** (0.010)	0.248*** (0.044)
π_{t-1}	0.211*** (0.007)	0.206*** (0.009)	0.193*** (0.013)	-0.0984** (0.045)
Region	All	NL	EA	EA
Observations	115887	57008	58879	98
R ²	0.190	0.196	0.191	

Thus we reject FIRE at aggregate level (Table 1). At an individual level we find that only 5% of respondents adhere to FIRE.

- Individuals on FIRE tend to be less educated and predominantly female (see Table 2); during high-inflation period in wake of pandemic; one interpretation is that they may have updated their expectations optimally since they understood higher persistence of inflation shock better than agents otherwise often seen as better informed in economics literature; consistent with many professionals initially incorrectly interpreting inflationary shock in wake of Covid pandemic as transitory (ECB 2022).

Average hides substantial heterogeneity: Many households employ fundamentalist rules (23% of sample), followed by other extrapolating heuristics (22%, of which 9% naive, 10% adaptive and 2% mean-reverting); around 50% of sample reject FIRE but do not conform to simple rule.

Table 2: Share of demographic characteristics and average birth year for forecasting types

	FIRE		Naive		Adaptive		Mean-rev.		Fund.		Other
	$\beta_0=0$	$\beta_0 \neq 0$	$\beta_0=0$	$\beta_0 \neq 0$	$\beta_0=0$	$\beta_0 \neq 0$	$\beta_0=0$	$\beta_0 \neq 0$	$\beta_0 \neq 0$	$\beta_0=2$	
Panel A: Demographics											
Female	0.62 (0.49)	0.57 (0.50)	0.42 (0.50)	0.68 (0.47)	0.50 (0.50)	0.46 (0.52)	0.57 (0.50)	0.52 (0.50)	0.51 (0.50)	0.35 (0.48)	
Birth year	1960.22 (17.23)	1960.17 (13.82)	1957.19 (13.76)	1965.73 (15.27)	1960.51 (12.67)	1957.77 (13.62)	1961.95 (15.90)	1963.90 (15.40)	1958.49 (13.41)	1960.38 (14.90)	
High educ.	0.26 (0.44)	0.27 (0.45)	0.35 (0.48)	0.38 (0.49)	0.34 (0.48)	0.31 (0.48)	0.32 (0.47)	0.32 (0.47)	0.36 (0.48)	0.43 (0.49)	
High income	0.46 (0.50)	0.54 (0.50)	0.51 (0.50)	0.50 (0.50)	0.44 (0.50)	0.62 (0.51)	0.41 (0.50)	0.45 (0.50)	0.46 (0.50)	0.59 (0.49)	

Conclusions

- Reject FIRE at aggregate level and find that only 5% of the respondents adhere to FIRE.
- On average, household forecasts suggest model parameters that align with those of professional forecasters and true data generating process. But average hides substantial heterogeneity.
- Heuristics used are correlated with demographics of households and with forecast errors. Rule-of-thumb forecasters tend to be more frequently female and less educated, and have higher forecast errors than those who do not employ such simple heuristics.
- Our findings suggest that while consumers' inflation expectations are mostly not on FIRE, there is still information content in them which is relevant for monetary policy. Understanding heterogeneity in forecasting approaches may help to understand responses of level and dispersion of inflation expectations in response to periods of high inflation.
- Policy implication: when confronted with sudden surge in inflation, policymakers should closely monitor inflation expectations of households with different socio-economic characteristics, which could be important input in assessment of persistence of inflationary pressures.