

# Beyond the Headline: How Personal Inflation Exposure Shapes Households' Financial Choices

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# Motivation

- Since autumn 2021 in developed countries - inflation is back.
- Households experience different inflation rates based on consumption habits, consumption baskets and life-cycle positions.
- Studies find that backward-looking behaviour explains the formation of expectations more than forward-looking behaviour of consumers (Mendonca 2018, Wimanda et al. 2011, Rudd & Whelan 2005).

**Purpose:** To understand how households react to inflation that they personally experience  $\Rightarrow$  consumption and saving-borrowing decisions.

# Inflation heterogeneity

Households experience different inflation rates based on consumption habits, consumption baskets and life-cycle positions:

- Large dispersion of inflation rate that households are exposed to → originates from household-specific consumption baskets and from changes in household-level prices, rather than from aggregate inflation.
  - Hobijn & Lagakos (2005), Fessler & Fritzer (2013), Kaplan & Schulhofer-Wohl (2017), Gürer & Weichenrieder (2020), Jaravel (2021), Argente & Lee (2021), Basso et al. (2023), Pallotti et al. (2023), Strasser et al. (2023), Kiss & Strasser (2024), Messner & Rumler (2024).
- Elderly and low income households are more exposed to price increases - *inflation inequality*.

## Intertemporal substitution channel

- The Euler equation for consumption implies that households increase their current consumption when they expect a rise in the price level, hence lower real interest rate, *ceteris paribus* ← intertemporal substitution.
- So that their consumption will be lower during the period of high prices.
- Large heterogeneity in inflation expectations → household-level Euler equation:

$$u'(C_{h,t}) = \beta \mathbf{E}_{h,t} \left( u'(C_{h,t+1}) \frac{1 + i_{t+1}}{1 + \pi_{h,t+1}^e} \right), \quad (1)$$

## Intertemporal substitution channel

- Adaptive expectations → Pedemonte et al. (2023), Campos et al. (2022), Hajdini et al. (2022), Malmendier & Nagel (2016), Bruine de Bruin et al. (2010) and others show that households form their inflation expectations from previous experiences in inflation.
- Cavallo et al. (2017), D'Acunata et al. (2021), Georganas et al. (2014), Kumar et al. (2015), Weber et al. (2024) and others document that households overweight frequently observed prices (e.g. food prices) when forming inflation expectations.
- If households use experienced price signals when forming inflation expectations, higher experienced inflation implies higher inflation expectations → the front-loading of consumption.

# Inflation and consumption

⇒ If  $\pi_h^e = f(\pi_{h,t}^{pers}, l_{h,t})$ , we expect **positive** relationship between inflation and consumption.

- Some studies have found a positive effect of inflation expectations on spending plans (Coibon et al. 2022, D'Acunata et al. 2022), some provide mixed or negative results (Burke and Ozdagli 2023, Coibon et al. 2024, Weber et al. 2022).
- The front-loading of consumption can be hampered by liquidity and credit constraints (see HANK models by Kaplan et al. 2018, Auclert 2019, McKay et al. 2016).

⇒ Our study links experienced inflation directly to actual consumption spending.

# Inflation and consumption - other channels

## Income channel

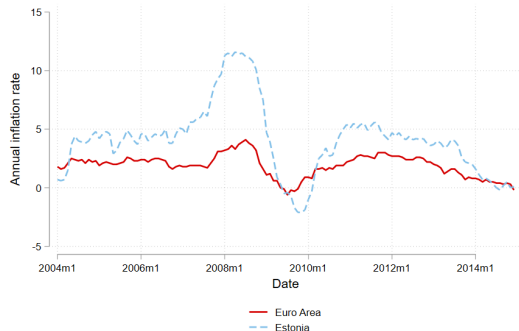
- Inflation is a tax on nominal assets and nominal earnings → **negative** effect on real consumption.
- If income groups that face higher inflation have higher MPC (Ampudia et al. 2024, Auclert, 2019, Kaplan et al. 2018), the dispersion in inflation amplifies the effect on real consumption.

## Wealth channel

- Inflation decreases real value of outstanding debt and assets (Yang 2022, Schnorpfeil et al. 2023, Pallotti et al. 2024) → more indebted households increase their consumption more in response to higher inflation.
- However, budget constraints can be binding due to the cost of debt servicing, consumption could be crowded out (Du Caju et al. 2023, Dynan et al. 2012, Kukk 2016).
- Households are more aware of the erosion of nominal assets than of nominal debt (Schnorpfeil et al. 2023), so the outcome is not clear.

# The choice of sample country

We need enough variation in inflation, both over time and between individuals  $\Rightarrow$  high and volatile inflation since 2000s in Estonia.



Estonia is a small open economy where inflation is largely driven by global shocks (Brixiova et al. 2010, Fan et al. 2024) and where nominal interest rates have followed the rates abroad (a currency board with a euro peg  $\rightarrow$  uncovered interest parity).

# Calculation of personal inflation

Heterogeneity in experienced inflation due to different consumption baskets of households:

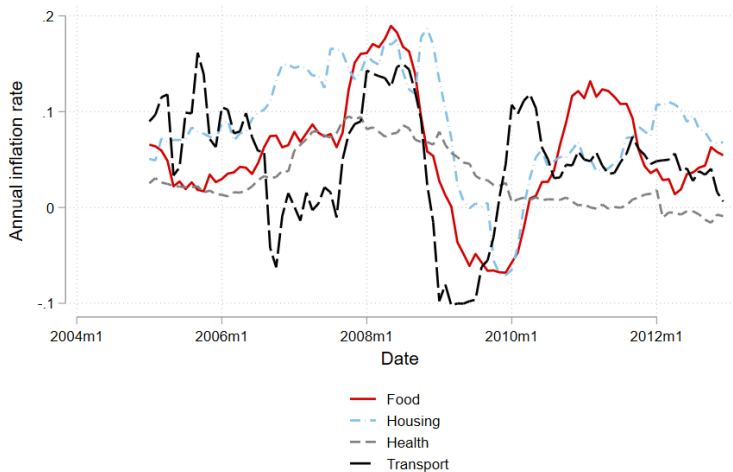
$$\text{INFL}_h = \sum_{c=1}^W w_{c,h} \text{INFL}_c, \quad (2)$$

where  $w_{i,h}$  is expenditure share of a product or a product category  $c$  in the total consumption basket of a household.

Granular product level data and variables describing households economic and financial behaviour in a panel setup not easily available → several studies use consumer expenditure surveys where each households expenditure shares (by product category) are linked with the respective price index.

- Hobijn & Lagakos (2005), Fessler & Fritzer (2013), Jaravel (2019), Güler & Weichenrieder (2020), Basso et al. (2023), Pallotti et al. (2023).

# Inflation in Estonia - sub-indices



**1) Account dataset** - quarterly account-level data from a large commercial bank, covering around 12% of working-age population from 2005 to 2011.

- Bank's regular customers for whom full picture of finances available.
- Outflows and inflows on checking accounts → proxies for income and spending.
  - Cleaned from transactions between saving and investment accounts, debt repayments, house purchases etc.
- Balances on checking accounts, term deposits, stocks, bonds and funds → holding of financial assets.
- Balances on loans: housing and consumer loans, overdraft.
- Socioeconomic characteristics: age, gender, region, nationality, education.

No expenditure shares in account dataset to calculate individual inflation  
→ we impute the weights of consumption categories based on households' characteristics → *group-specific inflation*.

## 2) Household Budget Survey (HBS)

- Household level data containing detailed data on the monetary expenditures on goods and services.
- We use data on households' consumption expenditures - 12 consumption categories (e.g. food, transport, housing ...).
- Rich set of socio-economic characteristics.
- Exclude self-employed households in both datasets (Kukk et al. 2020).

# Imputation of consumption shares

Imputation strategy takes into account features of the weights of consumption categories:

- Weights need to be non-negative, between 0 and 1, and add up to 1.
- → Multinomial Fractional Logit (MFL); non-linear simultaneous estimation of the vector of weights.

$$E[w_{i,h}|X_h] = \frac{e^{\beta_i X_h}}{\sum_{k=1}^N e^{\beta_k X_h}}, \quad (3)$$

where  $X_h$  is a vector of explanatory variables (10 income deciles, 10 age groups, capital/other region and gender) and  $w_{i,h}$  is a vector of expenditure weights.

- For each household/individual we impute **constant** weights so that the variability in inflation over time is only due to changes in category prices and not in changes in expenditure weights.

# Empirical approach

**Step 1:** estimate the MFL model of consumption shares on HBS data using characteristics  $X_h$  and obtain the vector of parameters  $\hat{\beta}$ .

**Step 2:** using estimated  $\hat{\beta}$  to calculate consumption shares  $\hat{w}_{i,h}$  using account level data.

**Step 3:** Calculate the quarterly price index for each individual:

$$\text{IndCPI}_{it} = \sum_{cat=1}^{12} \hat{w}_{cat,i,t} \text{CPI}_{cat,t} \quad (4)$$

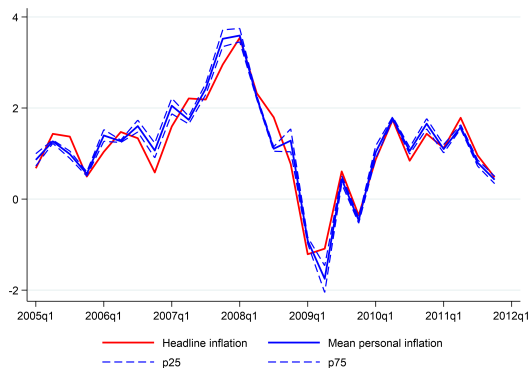
where  $\text{CPI}_{cat,t}$  is average category price index in quarter  $t$ .

**Step 4:** Calculate quarterly inflation from individual CPI.

$$\text{IndINFL}_{it} = \frac{(\text{IndCPI}_{it} - \text{IndCPI}_{it-1})}{\text{IndCPI}_{it-1}} \quad (5)$$

Due to imputation we obtain a proxy for the inflation that individuals experience in 400 groups  $\rightarrow$  *group-specific inflation*.

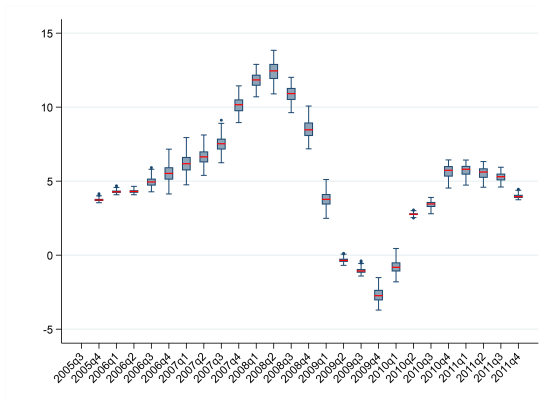
# Experienced inflation and headline inflation



- Imputed inflation follows quite closely the headline inflation.
- We run out-of-sample imputation on HBS data and compare the actual and imputed inflation → the coefficient close to 1.
- Additional robustness estimations with different set of regressors in the imputation model.

# Experienced inflation - the distribution

Yearly inflation:



- The differences in experienced inflation in 2005-2011 was up to 3.2pp; the average difference over the period is 1.8pp ← Some heterogeneity is lost due to imputed group-specific inflation.
- The differences are larger in periods of rapid changes in prices.

# Inflation exposure by income groups



- The *lowest income* group experiences higher inflation when prices increase.
- Differences in personal quarterly inflation reach 0.54pp and in yearly inflation 1.4pp for income quintiles while the differences are more significant for income deciles.

# Inflation exposure by age groups



- The *oldest age* group experiences the highest inflation while middle-aged are exposed to lowest inflation; differences in quarterly inflation are up to 0.5pp and in yearly inflation up to 1.2pp.
- When regressing income and age groups on individual inflation, both are statistically significant → both matter for inflation heterogeneity.

# Empirical model

Individual-level panel data and two-way fixed-effects (TWFE):

- Standard consumption function (Attanasio and Weber 2010; Jappelli and Pistaferri 2010) where real consumption ( $C$ ) responds to the changes in real income ( $INC$ ) and wealth ( $FIN$ ).
- Add individual inflation  $IndINFL_{it}$  into the model:

$$\Delta \ln C_{it} = \beta_1 \Delta \ln INC_{it} + \beta_2 \Delta \ln FIN_{it-1} + \beta_3 IndINFL_{it} + \lambda_i + \gamma_t + \epsilon_{it}, \quad (6)$$

- Nominal income and financial assets are turned into real using individual inflation.
- Financial assets are from the end of previous quarter.
- We also check how *future* income ( $\ln INC_{it+1}$ ) and inflation ( $IndINFL_{it+1}$ ) are related to the spending this period (realization of forward-looking expectations).
- We also check the relevance of the *lagged* inflation ( $IndINFL_{it-k}$ ).

# Empirical model

$$\Delta \ln C_{it} = \beta_1 \Delta \ln INC_{it} + \beta_2 \Delta \ln FIN_{it-1} + \beta_3 \text{IndINFL}_{it} + \lambda_i + \gamma_t + \epsilon_{it}$$

- Quarterly panel data → control for unobserved *time-invariant* individual effects. Alternatively, use interactive fixed effects.
- Adding time fixed effects → captures the response to common aggregate shocks, including *headline inflation*.
- Clustered standard errors (groups defined as interactions of the variables used in the imputation procedure).
- The estimated coefficient  $\beta_3$  captures the response of consumption to the experienced inflation *conditional on the headline inflation*.
- *Implicit* interpretation → provides the direction of the response to the exposure to total individual inflation.

# Empirical model

Interactive fixed effects (IFE) model:

$$\Delta \ln C_{it} = \beta_1 \Delta \ln INC_{it} + \beta_2 \Delta \ln FIN_{it-1} + \beta_3 \text{IndINFL}_{it} + \lambda_i \times F_t + e_{it}, \quad (7)$$

Allows to model unobserved heterogeneity in much more flexibly than standard TWFE model:

- The interactive fixed effects component  $\lambda_i \times F_t$  where  $F_t$  is a vector of unobserved common factors and  $\lambda_i$  is a vector of unobserved factor loadings.
- The regressors are allowed to be correlated with the factors  $F_t$  or with the loadings  $\lambda_i$  alone or simultaneously with both.
- Apply the methods of Bai (2009) that estimates simultaneously  $\beta$ ,  $F_t$  and  $\lambda_i$ . However, computationally burdensome and requires  $N \rightarrow \infty$  and  $T \rightarrow \infty$ .
- Alternatively, Vogt et al. (2022) provide an extension to CEE approach (Pesaran 2006) that is also suitable for short panels.

# Results 1) - Main model

	TWFE		IFE Vogt et al. (2022)	IFE Bai (2009)	
	(1)	(2)	(3)	(4)	(5)
$IndINFL_{it}$	0.014*** (0.003)	0.007** (0.003)	0.015*** (0.004)	0.014*** (0.003)	0.014*** (0.003)
$IndINFL_{it}^2$		0.005*** (0.001)			
$\Delta \log INC_{it}$	0.481*** (0.006)	0.481*** (0.006)	0.490*** (0.006)	0.515*** (0.006)	0.517*** (0.006)
$\Delta \log FIN_{it-1}$	0.108*** (0.001)	0.108*** (0.001)	0.107*** (0.001)	0.106*** (0.001)	0.105*** (0.001)
Individual FE	Yes	Yes	X	X	X
Time FE	Yes	Yes	X	X	X
Number of factors	X	X	1	1	2
Observations	2,352,678	2,352,678	1,979,235	1,781,325	1,781,325
$R^2$	0.200	0.200			

- *Positive* relationship between experienced inflation and consumption spending → 1pp higher inflation brings along  $\approx 1.4\%$  larger spending.
- Nonlinear → The positive reaction is stronger the higher is inflation.
- Possible explanation by the intertemporal substitution channel.

# Spending response to category level inflation

	Food inflation	Transport inflation	Housing inflation
IndINFL <sub>it</sub>	0.009*** (0.003)	0.063*** (0.006)	0.006 (0.004)
$\Delta \log \text{INC}_{it}$	0.481*** (0.006)	0.481*** (0.006)	0.481*** (0.006)
$\Delta \log \text{Fin}_{i,t-1}$	0.108*** (0.001)	0.108*** (0.001)	0.108*** (0.001)
Individual FE	Yes	Yes	Yes
Time FE	Yes	Yes	Yes
Observations	2,352,678	2,352,678	2,352,678

- Inflation variable captures inflation of the given category given as  $w_{cat,i} \times \text{Infl}_{cat,t}$ , where  $w_{cat,i}$  is the expenditure weight of the given category and  $\text{Infl}_{cat,t}$  is the category level inflation rate;
- Spending responses to the price signals from food and transport prices - everyday purchases matter;
- Central bank focuses on core inflation rate that excludes food and energy inflation.

# Results 1) - extension with lags

lag	Dependent variable: $\Delta \log C_{it}$		
	IndINFL	$\Delta \log INC$	$\Delta \log FIN$
t+1	-0.003 (0.003)	0.042 <sup>***</sup> (0.001)	-0.016 <sup>***</sup> (0.000)
t	0.012 <sup>***</sup> (0.003)	0.568 <sup>***</sup> (0.005)	-0.053 <sup>***</sup> (0.001)
t-1	0.024 <sup>***</sup> (0.004)	0.114 <sup>***</sup> (0.001)	0.088 <sup>***</sup> (0.001)
t-2	-0.028 <sup>***</sup> (0.004)	0.016 <sup>***</sup> (0.001)	0.014 <sup>***</sup> (0.000)
Individual FE		yes	
Time FE		yes	
Observations		2146595	
Within $R^2$		0.213	

- Individuals respond positively to inflation they experienced in the current and previous quarter.
- The downward adjustment in spending follows after two quarters → delayed response to the rise in inflation.

## Results 2) - The role of liquidity

Add interaction with  $(\frac{LiqAssets}{Yincome})_{t-1}$  ratio, with yearly income while assets include those on checking or term deposits, respectively, or both (Total):

	Checking account	Term deposit	Total
$IndINFL_{it}$	-0.011** (0.004)	0.012*** (0.003)	-0.004 (0.003)
$IndINFL_{it} \times (LiqAssets/Yincome)_{i,t-1}$	0.083*** (0.010)	0.007*** (0.001)	0.033*** (0.003)
$\Delta \log INC_{it}$	0.480*** (0.006)	0.479*** (0.006)	0.479*** (0.006)
$\Delta \log Fin_{i,t-1}$	0.107*** (0.001)	0.109*** (0.001)	0.108*** (0.001)
Individual FE	Yes	Yes	Yes
Time FE	Yes	Yes	Yes
Observations	2,261,849	2,261,849	2,261,849

- Relatively larger liquid assets are related to stronger spending response.
- When no liquid assets, the front-loading of consumption is hampered → liquidity constraints.

## Results 3) - How do households finance consumption?

The first step: selection model to calculate Inverse Mills Ratio ( $\overline{IMR}_{it}$ ).  
The second step (with bootstrapped standard errors):

$$\Delta \log(BalAccount)_{it} = \beta_1 IndINFL_{it} + \beta_2 X_{it} + \psi \overline{IMR}_{it} + \alpha_i + \gamma_t + \epsilon_{it} \quad (8)$$

	Checking acc.	Term deposit	Inv. funds	Stocks
$IndINFL_{it}$	0.008 (0.010)	-0.119*** (0.020)	0.050 (0.035)	0.093*** (0.018)
$\Delta \log INC_{it}$	0.952*** (0.012)	0.307*** (0.009)	0.116*** (0.016)	0.068*** (0.009)
$IMR$ (respective) $_{it}$		0.376*** (0.080)	0.656*** (0.159)	1.047*** (0.124)
Controls for other savings	Yes	Yes	Yes	Yes
Individual FE	Yes	Yes	Yes	Yes
Time FE	Yes	Yes	Yes	Yes
Observations (2-nd step)	2,351,269	301,180	46,339	72,507

- Households reduce their savings on term deposits in response to higher inflation exposure.
- Higher inflation  $\rightarrow$  lower real interest rate from term deposit  $\leftarrow$  Fisher effect.
- Households increase stock holdings  $\rightarrow$  hedging against inflation (Agarwal et al. 2022).

## Results 4) - How do households finance consumption?

Two-step model, the odds ratio for taking out new or additional loans:

$$\text{Log} \frac{p(\text{NewLoan}_{it} = 1)}{1 - p(\text{NewLoan}_{it} = 1)} = \beta_1 \text{IndINFL}_{it} + \beta_2 X_{it} + \psi \overline{\text{IMR}}_{it} + \lambda_i + \gamma_t + \epsilon_{it} \quad (9)$$

	Housing Loan	Consumer Loan	Overdraft
$\text{IndINFL}_{it}$	1.004 (0.054)	1.146 <sup>***</sup> (0.053)	1.043 <sup>***</sup> (0.014)
$\Delta \log \text{INC}_{it}$	1.247 <sup>***</sup> (0.025)	1.000 (0.013)	0.720 <sup>***</sup> (0.005)
$\Delta \log \text{FIN}_{it-1}$	1.024 <sup>***</sup> (0.007)	0.989 <sup>***</sup> (0.004)	0.986 <sup>***</sup> (0.002)
$\text{IMR (respective)}_{it}$	0.460 <sup>***</sup> (0.074)	0.263 <sup>***</sup> (0.025)	0.153 <sup>***</sup> (0.010)
Individual FE	Yes	Yes	Yes
Time FE	Yes	Yes	Yes
Observations (2-nd step)	231,025	207,067	693,707

- Higher experienced inflation increases the probability to take out a *consumer loan* and *overdraft*.
- No significant effect on the demand of housing loans.

## Results 5) - Does indebtedness matter?

Add total debt  $\Delta \log DEBT_{it-1}$  and the interaction with  $(\frac{DEBT}{Yincome})_{t-1}$  ratio or with the debt service ratio (DSR):

	Total	Housing	Consumer	DSR
$IndINFL_{it}$	0.023 <sup>***</sup> (0.003)	0.023 <sup>***</sup> (0.007)	0.089 <sup>***</sup> (0.008)	0.030 <sup>***</sup> (0.003)
$\Delta Debt_{it-1}$	-0.065 <sup>***</sup> (0.001)	-0.038 <sup>***</sup> (0.002)	-0.124 <sup>***</sup> (0.002)	-0.065 <sup>***</sup> (0.001)
$IndINFL_{it} \times (Debt/Yincome)_{it-1}$	-0.003 <sup>*</sup> (0.0015)	-0.002 (0.000)	-0.184 <sup>***</sup> (0.010)	-0.039 <sup>***</sup> (0.001)
$IMR (Respective)_{it}$	0.036 <sup>**</sup> (0.011)	0.046 <sup>**</sup> (0.016)	0.131 <sup>***</sup> (0.023)	0.031 <sup>***</sup> (0.011)
Other controls	Yes	Yes	Yes	Yes
Individual FE	Yes	Yes	Yes	Yes
Time FE	Yes	Yes	Yes	Yes
Observations (2-nd step)	1,029,230	359,715	213,326	1,074,958

- The interaction term is negative  $\Rightarrow$  households increase their spending in response to higher inflation exposure less when indebtedness is higher.
- Debt servicing burden might crowd out consumption (Kukk 2016).
- No evidence for positive debt depreciation effect as individuals might not be aware of debt erosion effect (Schnorpfel et al. 2023).

# Conclusion

- **Heterogeneity** in experienced inflation across age and income groups, differences in experienced quarterly inflation in 2005-2011 was up to 2pp.
- Individuals experiencing higher inflation **increase** their consumption spending → 1pp higher quarterly inflation corresponds to  $\approx 1\%$  increase in real spending.
- Results can be explained by **backward looking expectations** and intertemporal allocation of consumption.
- Increased spending is financed by the combination of drawing from **savings** (term deposits) and **borrowing** (consumer loans and overdraft).
- When individuals are liquidity constrained, they cannot frontload their spending.
- No evidence for the debt depreciation effect but the opposite: indebtedness hampers the front-loading of consumption.
- ⇒ **Liquidity** and **indebtedness** determine how consumers respond to the experienced inflation.

THANK YOU!

QUESTIONS?

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