

Monetary Policy and Earnings Inequality: Inflation Dependencies

Jaanika Meriküll^{1,3} Matthias Rottner²

¹Eesti Pank, ²Bundesbank, ³University of Tartu

August 27, 2024
EEA, Rotterdam

The views expressed are those of the authors and do not necessarily represent the official views of Eesti Pank, Deutsche Bundesbank or the Eurosystem.

Aim and contribution

We ask:

- 1 whether the monetary policy affects labour earnings differently dependent on **income level**

Aim and contribution

We ask:

- ① whether the monetary policy affects labour earnings differently dependent on **income level**
- ② ... and whether these distributional effects vary by **inflation regime**

Aim and contribution

We ask:

- ① whether the monetary policy affects labour earnings differently dependent on **income level**
- ② ... and whether these distributional effects vary by **inflation regime**
- ③ ... and how the distributional effects amplify **aggregate consumption**

Aim and contribution

We ask:

- 1 whether the monetary policy affects labour earnings differently dependent on **income level**
- 2 ... and whether these distributional effects vary by **inflation regime**
- 3 ... and how the distributional effects amplify **aggregate consumption**

Contribute by:

- A novel focus on periods of **high vs low inflation**
- Quantification of the **aggregate amplification** of the monetary policy shock due to the earnings heterogeneity channel
- **High-frequency earnings data** on the whole population that matches the frequency of monetary policy shocks
 - ▶ New infrastructure - confidential data is accessible internationally

Earnings heterogeneity channel and consumption

- **Low-income workers** are affected the most by monetary policy (Coibion et al. 2017 on US, Andersen et al. 2023 on NO, Lenza and Slacalek 2024 on DE, FR, IT, ES)
 - ▶ or the effect has a **weak U-shape**, low-wage earners are affected the most (Amberg et al. 2022 SE, Hubert and Savignac 2023 on FR, Holm et al. 2021 DE)
- Tighter monetary policy → higher inequality in **labour income**
- Redistributive effects **amplify** the response of consumption, individuals more likely exposed to monetary policy have **higher MPCs** (Auclert 2019, Slacalek et al. 2020, Lenza and Slacalek 2024)
 - ▶ It is not analysed how different **inflation regimes** affect this channel
 - ▶ Nor it is quantified the contribution of this channel to **aggregate consumption**

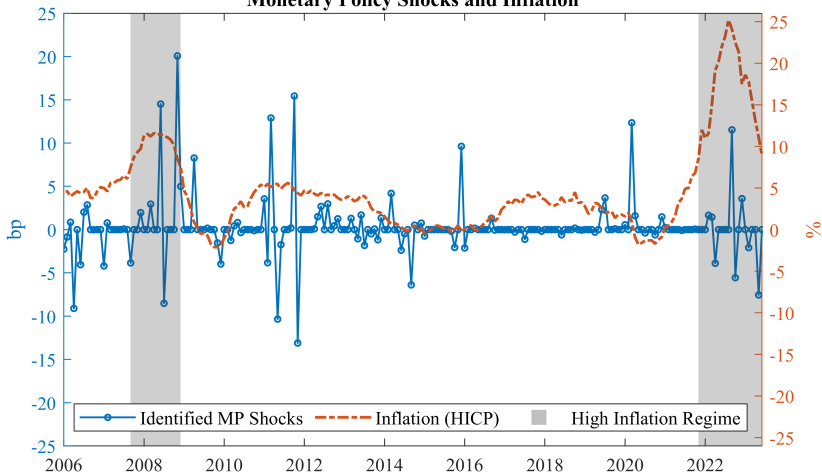
- From **macro to micro** and **back to macro**, 2006M1-2023M9
 - 1 **Macro**: Identify monetary policy shock at a monthly frequency a la Jarocinski and Karadi (2020) (Eurostat, ECB)
 - 2 **Micro**: Estimate the effect of monetary policy shock over the distribution of labour income (Tax and Customs Board)
 - 3 **Macro**: Link heterogeneous monetary policy reaction to the heterogeneous marginal propensity to consume (Household Finance and Consumption Survey, 2021) and aggregate up

- From **macro to micro** and **back to macro**, 2006M1-2023M9
 - ① **Macro**: Identify monetary policy shock at a monthly frequency a la Jarocinski and Karadi (2020) (Eurostat, ECB)
 - ② **Micro**: Estimate the effect of monetary policy shock over the distribution of labour income (Tax and Customs Board)
 - ③ **Macro**: Link heterogeneous monetary policy reaction to the heterogeneous marginal propensity to consume (Household Finance and Consumption Survey, 2021) and aggregate up
- Data from Estonia
 - ▶ High-quality **admin data on earnings at monthly frequency**
 - ▶ Part of the euro area, monetary policy has a strong effect (Almgren et al. 2022)
 - ▶ Institutional setting close to USA, flexible labour market and similar GDP betas a la Guvenen et al. (2017)

Monetary policy shock

- Use the Euro Area Monetary Policy Event-Study Database (Altavilla et al., 2019)
 - ▶ Take the changes in the 1 month, 3 month, 6 month and 1 year OIS rates by the **Monetary Event Window**, i.e. change in the median quote from 13:25-13:35 before the GC press release to the median quote in 15:40-15:50 after the press conference
 - ▶ Create the **principal component** of these changes in quotes
- Identify the surprise monetary policy shock
 - ▶ By disentangling it from **central bank information effects** following Jarocinski and Karadi (2020)
 - ▶ Use the poor man's sign restriction approach, which imposes restrictions on the rates and stock market response
 - ★ If an interest rate increase brings along a **decline** in stock markets → **monetary policy shock**
 - ★ If an interest rate increase brings along a **increase** in stock markets → **central bank's information shock**
- Robustness tests: Bayesian VAR-based median reaction (more structure); change in 3M OIS rate (less structure)

Monetary Policy Shocks and Inflation



- Monetary policy shock is measured at **monthly frequency** as our wage data
- Define a high inflation regime as periods, in which inflation is **higher than 7%** (approx. one standard deviation above its mean)

Earnings data

- Estonian administrative data on **labour income at monthly frequency** (TSD)
 - ▶ Source: Tax and Customs Board
 - ▶ Available: 2006M1-2023M9
 - ▶ No top coding!!! The whole population of wage-earners is covered
 - ▶ Summarise all labour income in a month, i.e. income from all employers and by type (wage income or board member fees)
 - ▶ **Labour income** in gross terms
 - ▶ Keep workers at **primary working age**, from 26 to 65
- Earnings heterogeneity:
 - ▶ Derive population into 12 labour income groups, using the 10th, 20th, . . . , 90th, 99th, 99.9th percentiles, and **conditional on their gender and age group** (26-35, 36-45, 46-55, 56-65)
 - ▶ Results in a database of 400-500 Th workers observed each month, almost 1 Mil unique individuals and 90 Mil observations in total

Empirical specification

Following **the non-overlapping dynamic structure** in Guvenen et al. (2017), we estimate:

$$\Delta y_{i,t} = \alpha_g + \beta_g \Delta i_{t-12} + \gamma_g \Delta GDP_{t-13} + \epsilon_{i,t}, \quad (1)$$

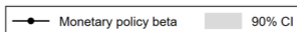
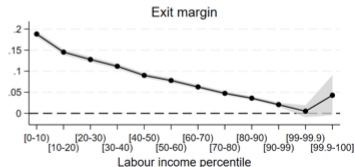
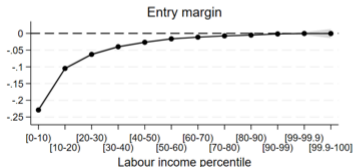
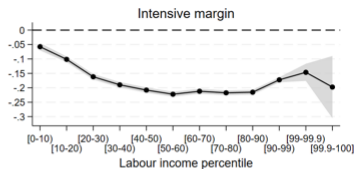
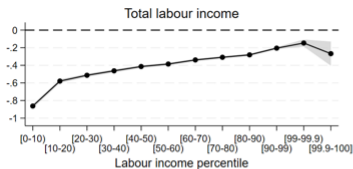
where

- $\Delta y_{i,t} = (y_{i,t} - y_{i,t-12}) / ((y_{i,t} + y_{i,t-12})/2)$ is the mid-point average growth of labour income of individual i at month t , a la Davis et al. (1996) where -2 denotes exit and 2 entry
- Δi_{t-12} is the monetary policy shock 12 months ago
- ΔGDP_{t-13} is the y-o-y monthly GDP growth 13 months ago

Estimate equation (1) separately for each of 12 income groups g , which are defined by **the average monthly labour income** from $t - 13$ to $t - 25$

- β_g captures the income group-specific effect of monetary policy and
- γ_g the income group-specific effect of past GDP growth on labour income

Baseline results, MP impact by M12

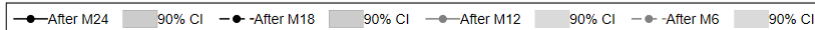
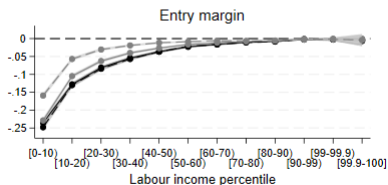
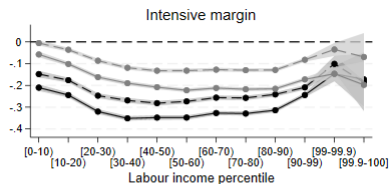
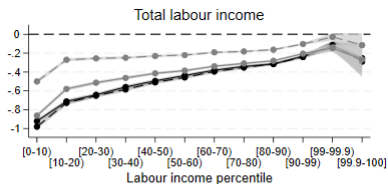


- **Low-wage earners** affected the most, small swing up at 0.01%
- **Extensive margin** more important for low-wage earners and intensive margin for high-wage earners (like in Hubert and Savignac 2023, Broer et al. 2022)

Yearly data underestimates extensive margin

	Monthly frequency 2008M1-2023M9 (1) Total labour income	(2) Intensive margin	Yearly frequency 2008-2022 (3) Total labour income	(4) Intensive margin
[0 – 10)	-0.027***	-0.002***	-0.108***	-0.061***
[10 – 20)	-0.018***	-0.003***	-0.090***	-0.055***
[20 – 30)	-0.016***	-0.005***	-0.074***	-0.050***
[30 – 40)	-0.015***	-0.006***	-0.065***	-0.047***
[40 – 50)	-0.013***	-0.007***	-0.057***	-0.044***
[50 – 60)	-0.012***	-0.007***	-0.051***	-0.043***
[60 – 70)	-0.011***	-0.007***	-0.044***	-0.040***
[70 – 80)	-0.010***	-0.007***	-0.038***	-0.036***
[80 – 90)	-0.009***	-0.007***	-0.035***	-0.033***
[90 – 99)	-0.006***	-0.005***	-0.029***	-0.029***
[99 – 99.9)	-0.005***	-0.005***	-0.023***	-0.025***
[99.9 – 100]	-0.008***	-0.006***	-0.027***	-0.031***
All sample	-0.015***	-0.006***	-0.057***	-0.043***

Robustness: time horizon



- Most of the monetary policy effect takes place by month 12
- Extensive margin materialises quicker than intensive margin

Monetary policy by inflation regime

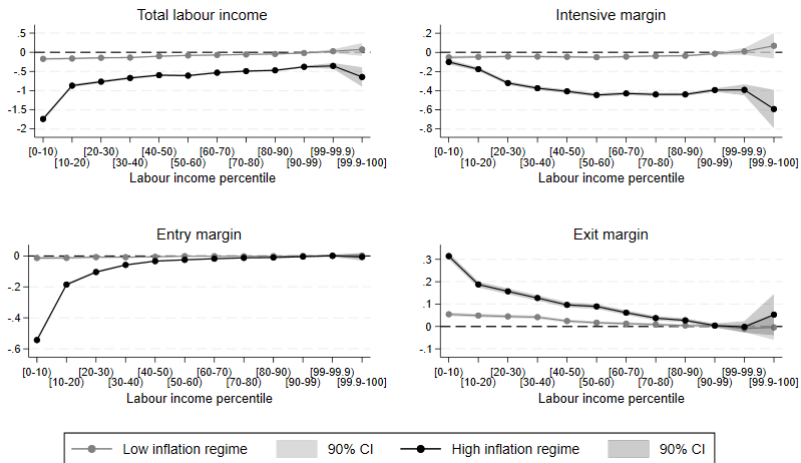
Add interaction terms of high and low inflation periods with MP and GDP

$$\Delta y_{i,t} = \alpha_g + \beta_g^L \Delta i_{t-12} (\pi_{t-13} < 7.0) + \beta_g^H \Delta i_{t-12} (\pi_{t-13} \geq 7.0) \\ + \gamma_g^L \Delta GDP_{t-13} (\pi_{t-13} < 7.0) + \gamma_g^H \Delta GDP_{t-13} (\pi_{t-13} \geq 7.0) + \epsilon_{i,t}$$

where

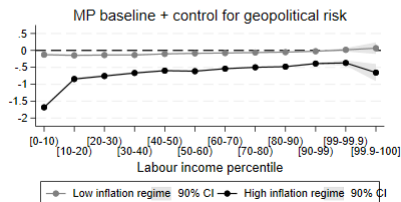
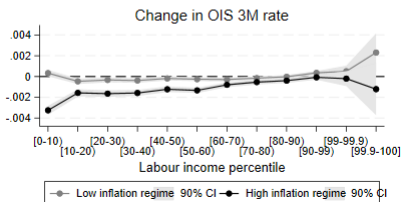
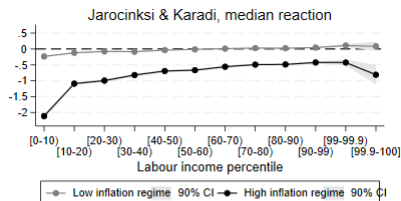
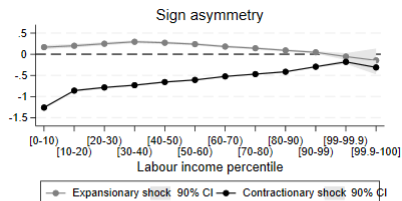
- β_g^L captures the impact of monetary policy **in the low inflation regime** and β_g^H **in the high inflation regime** for the income group g
 - ▶ Inflation regime is defined at 7% threshold and **1 month before the MP shock**, at $t - 13$
- γ_g^L captures the impact of past GDP growth in the low inflation regime and γ_g^H in the high inflation regime for the income group g
 - ▶ Control for potentially heterogeneous impact of **economic growth** on labour income growth **by the regime**

Results by inflation regime



- MP effect is **dominated by the high-inflation** period, in line with Gargiulo et al. (2024) and MP less powerful in recessions by Tenreiro and Thwaites (2016)
- Low-wage workers affected more during a high-inflation period

Robustness: sign asymmetry, MP and controls



- Contractionary shocks have a stronger effect, but there are both shocks during the high-inflation period
- MP has a dominant effect during high-inflation periods: robust to different MP shocks and to geopolitical risk

Reaction in aggregate consumption: Matching multipliers

- Following Patterson (2023) the aggregate MPC can be disentangled into two components, the income-weighted average MPC and the covariance between the individual-level response to aggregate shocks and MPC:

$$MPC = \sum_j \frac{dC_j}{dE_j} \frac{dE_j}{dY} = \sum_j \frac{E_j}{Y} \frac{dC_j}{dE_j} + cov\left(\frac{dC_j}{dE_j}, \gamma_j\right)$$

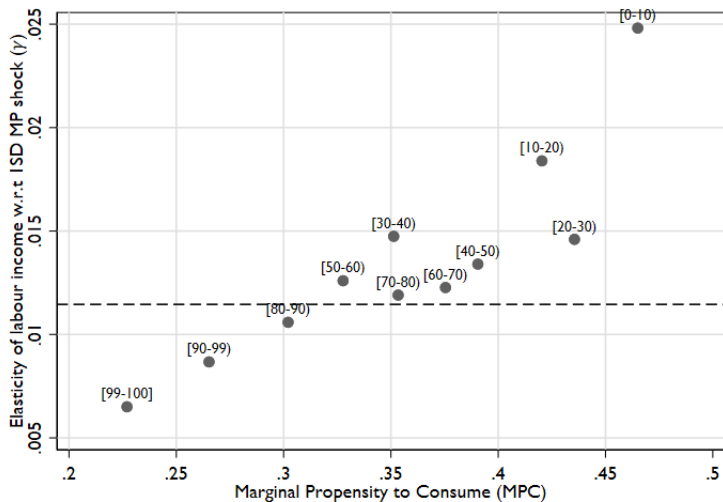
where

- MPC denotes aggregate MPC
- E_j is the income of household j
- C_j is the consumption of household j
- Y is the aggregate output
- $\gamma_j = \frac{dE_j}{dY} \frac{Y}{E_j}$ is the elasticity of household j labour income to aggregate shock

Matching MP reaction with MPC

- Match our effects of MP by income distribution with household-level estimates of MPC from **the Household Finance and Consumption Survey (HFCS)** for Estonia in 2021
 - ▶ MPC in HFCS collected by self-reported windfall gain question **at the level of household**
 - ▶ → switch to the household level, j
- Steps to derive MP elasticity γ_j for j :
 - ▶ Estimate β_g for 11 labour income groups and for each gender and four age groups, merge the two highest income groups → obtain 88 different β_g
 - ▶ Derive for each household member i their gain/loss from MP **in euros**, conditional on income, gender age
 - ▶ Sum the gains/losses to the household level and derive the hhs change in labour income due to monetary policy shock
 - ★ Keep only these hhs with at least one person with labour income and at age 26-65
 - ▶ Derive γ_j , the elasticity of household j labour income to MP shock

Covariation btw MP reaction and MPC



Note: Horizontal dashed line refers to the income-weighted average elasticity.

Aggregate implications

Earnings percentile	MPC	(1) Income weight	(2) MP effect weight	(3) MP weight by regime Low	(4) MP weight by regime High
[0 – 10)	0.465	0.013	0.026	0.038	0.028
[10 – 20)	0.420	0.033	0.052	0.084	0.047
[20 – 30)	0.436	0.046	0.059	0.088	0.054
[30 – 40)	0.351	0.061	0.078	0.113	0.071
[40 – 50)	0.391	0.073	0.085	0.114	0.079
[50 – 60)	0.328	0.086	0.095	0.098	0.093
[60 – 70)	0.375	0.105	0.112	0.106	0.111
[70 – 80)	0.353	0.130	0.135	0.134	0.133
[80 – 90)	0.302	0.169	0.155	0.131	0.157
[90 – 99)	0.265	0.229	0.172	0.093	0.186
[99 – 100]	0.227	0.056	0.032	0.000	0.040
Weighted Aggregate MPC		0.328	0.347	0.367	0.345
Consumption response to MP shock		0.49%	0.52%	0.11%	0.83%
Income Gini response to MP shock		-	0.35%	0.15%	0.42%

Take-aways

- 1 **Low-income workers** are exposed to the monetary policy the most
 - ▶ **Inequality increases** with tightening and declines with expansionary policy
 - ▶ **Extensive margin** plays the largest role for low-income workers - transitions into and out of employment

Take-aways

- 1 **Low-income workers** are exposed to the monetary policy the most
 - ▶ **Inequality increases** with tightening and declines with expansionary policy
 - ▶ **Extensive margin** plays the largest role for low-income workers - transitions into and out of employment
- 2 The effects are dominated by the periods of **high inflation**
 - ▶ Suggests non-linearity of Phillips curve
 - ▶ Stronger cost pressure for firms and price rigidity
 - ▶ Rational inattention during low inflation periods and increasing degree of attention during high inflation periods

Take-aways

- ① **Low-income workers** are exposed to the monetary policy the most
 - ▶ **Inequality increases** with tightening and declines with expansionary policy
 - ▶ **Extensive margin** plays the largest role for low-income workers - transitions into and out of employment
- ② The effects are dominated by the periods of **high inflation**
 - ▶ Suggests non-linearity of Phillips curve
 - ▶ Stronger cost pressure for firms and price rigidity
 - ▶ Rational inattention during low inflation periods and increasing degree of attention during high inflation periods
- ③ The earnings heterogeneity channel amplifies reaction in **aggregate consumption**
 - ▶ Accounts for 5% of the reaction

THANK YOU!

Comments and questions:

jaanika.merikyll@eestipank.ee

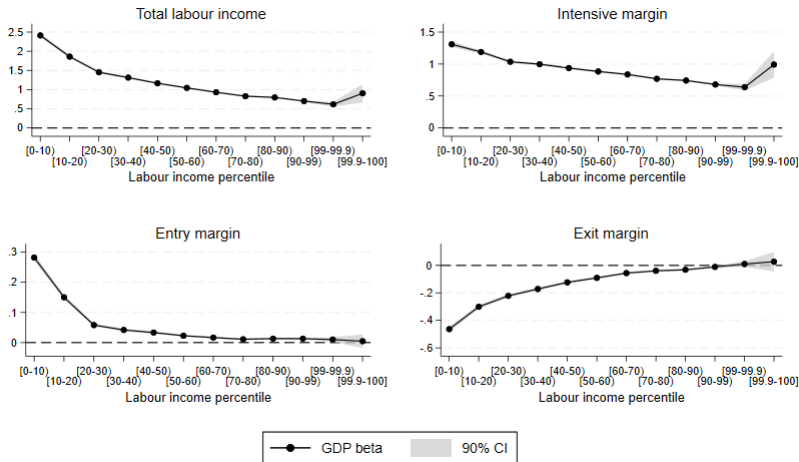
Descriptives on earnings, 2008M1-2023M9

Labour income p	(1) Mean income in 2015 prices	(2) Mid-point average income growth over 12 months	(3) Intensive margin growth over 12 months	(4) Entry rate over 12 months	(5) Exit rate over 12 months	(6) Number of observations
[0 – 10)	548.9	0.351	0.140	0.316	0.175	11,431,991
[10 – 20)	564.5	0.014	0.073	0.110	0.130	8,933,066
[20 – 30)	641.8	-0.053	0.045	0.066	0.111	8,677,750
[30 – 40)	747.1	-0.088	0.023	0.043	0.096	8,534,858
[40 – 50)	862.1	-0.101	0.010	0.029	0.084	8,494,491
[50 – 60)	992.0	-0.109	0.004	0.019	0.075	8,465,227
[60 – 70)	1147.2	-0.111	0.000	0.013	0.068	8,453,494
[70 – 80)	1349.0	-0.114	-0.005	0.009	0.063	8,446,902
[80 – 90)	1670.5	-0.117	-0.011	0.006	0.060	8,455,514
[90 – 99)	2558.4	-0.127	-0.021	0.004	0.058	7,617,517
[99 – 99.9)	5196.1	-0.138	-0.040	0.005	0.055	764,947
[99.9 – 100]	11183.0	-0.186	-0.062	0.006	0.070	86,012
All sample	1135.1	-0.032	0.022	0.070	0.095	88,361,769

External validity

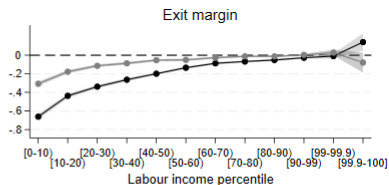
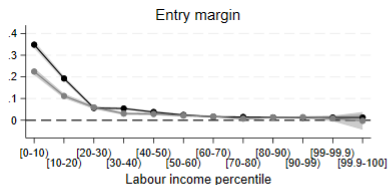
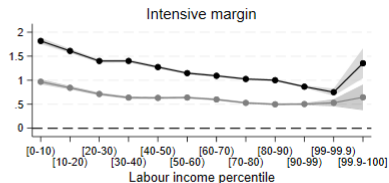
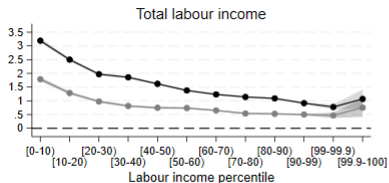
- Estonia is a member of the euro area since 2011 and imported **ECB's monetary policy** before that (Estonian crown was pegged to euro)
- Estonian **labour market has high flexibility** and is much closer to the US than the labour markets of related papers on Scandinavian or French and German data
- **Monetary policy has a stronger effect** than in other euro area countries (Almgren et al. 2022), e.g. due to flexible interest rates, high share of liquidity constrained hhs
- As an external validity exercise, we **derive GDP betas** in our data using the approach of Guvenen et al. (2017)
 - ▶ Heterogenous response of growth of individual earnings on aggregate GDP growth
 - ▶ ... dependent past labour income groups
 - ▶ U-shaped reaction in the US, low-wage workers gain the most and lose the most from aggregate fluctuations

GDP betas - heterogenous gains from economic growth



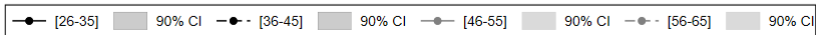
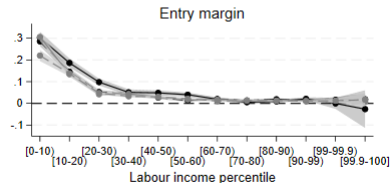
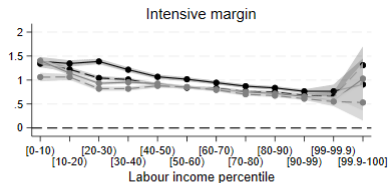
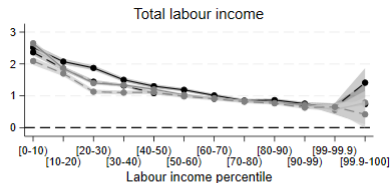
- Low-wage earners get the most out of economic growth
- Weak U-shape, the top 0.1% earners obtain increasing gains

GDP betas - men vs women



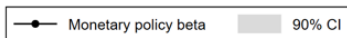
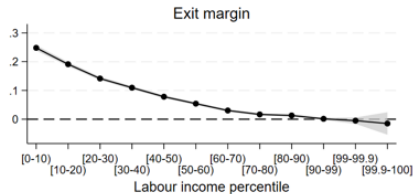
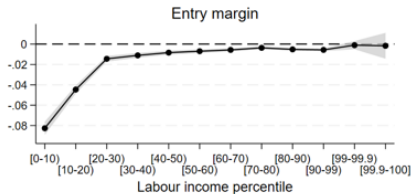
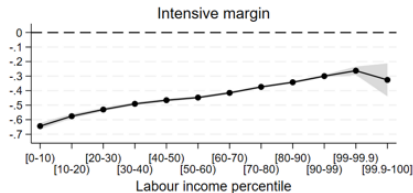
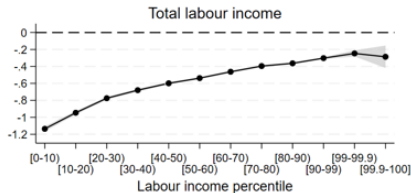
- Men gain the most, especially at the lower end
- Men's higher sensitivity to BC is similar to US (Guvenen et al. 2017)

GDP betas - young vs old

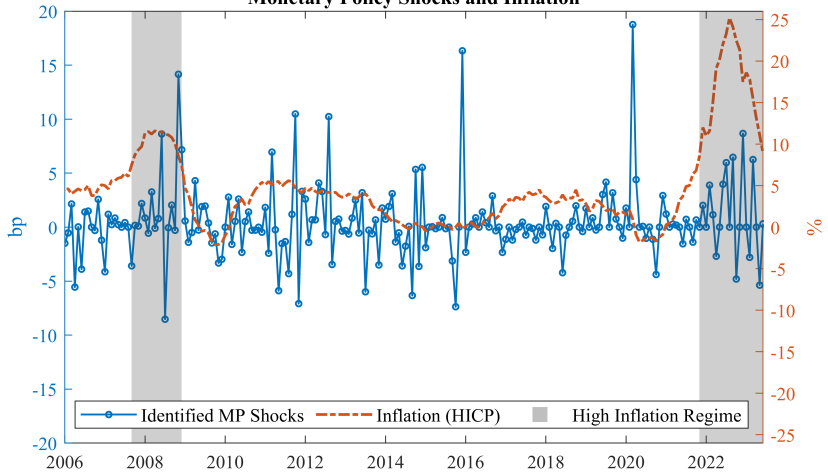


- Little differences by age group
- Old people tend to gain the least, similar to US (Guvenen et al. 2017)

MP impact by M12: yearly data

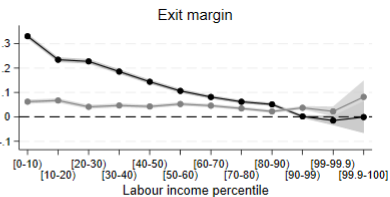
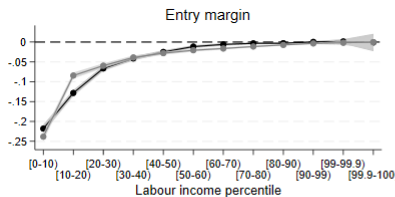
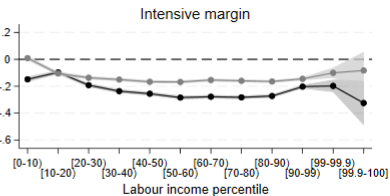
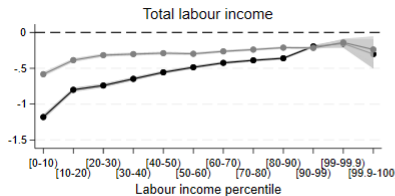


Monetary Policy Shocks and Inflation

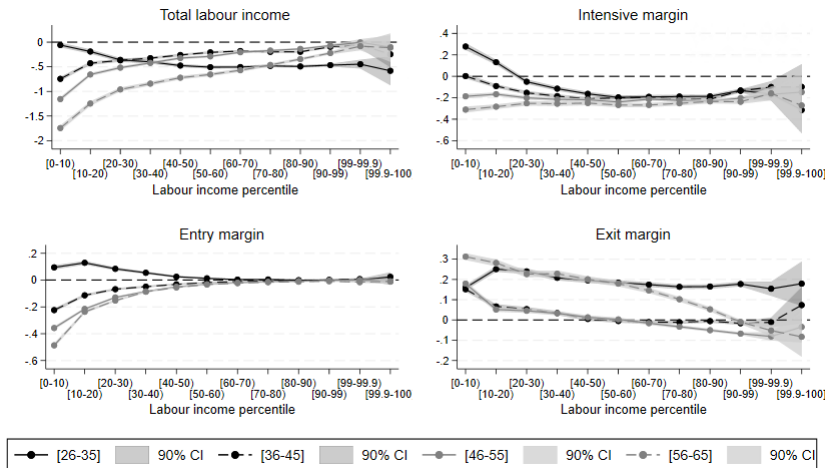


- Jarocinski and Karadi (2020) Bayesian VAR-based median reaction

The effect of monetary policy shock by gender



The effect of monetary policy shock by age



Monetary policy effect by regime, 2008M1-2023M9

	Low inflation		High inflation	
	(1) Total labour income	(2) Intensive margin	(3) Total labour income	(4) Intensive margin
[0 – 10)	-0.005***	-0.002***	-0.055***	-0.003***
[10 – 20)	-0.005***	-0.001***	-0.028***	-0.006***
[20 – 30)	-0.005***	-0.001***	-0.024***	-0.010***
[30 – 40)	-0.004***	-0.001***	-0.021***	-0.012***
[40 – 50)	-0.003***	-0.001***	-0.019***	-0.013***
[50 – 60)	-0.003***	-0.002***	-0.019***	-0.014***
[60 – 70)	-0.002***	-0.001***	-0.017***	-0.014***
[70 – 80)	-0.002***	-0.001***	-0.016***	-0.014***
[80 – 90)	-0.001***	-0.001***	-0.015***	-0.014***
[90 – 99)	-0.001**	0.000**	-0.012***	-0.012***
[99 – 99.9)	0.001	0.000	-0.011***	-0.012***
[99.9 – 100]	0.002	0.002	-0.020***	-0.019***
All sample	-0.003***	-0.001***	-0.024***	-0.012***

Deriving contribution of the covariation term

- Derive the **income-weighted average MPC** as follows:

$$MPC_{iw} = \sum_j \frac{E_j}{Y} \frac{dC_j}{dE_j} = \sum_j iw_j \frac{dC_j}{dE_j}$$

where

- iw_j denotes labour income weight of household j that is a combination of hhs survey weight and its' contribution to total labour income
- Derive the **total MPC** to monetary policy shock:

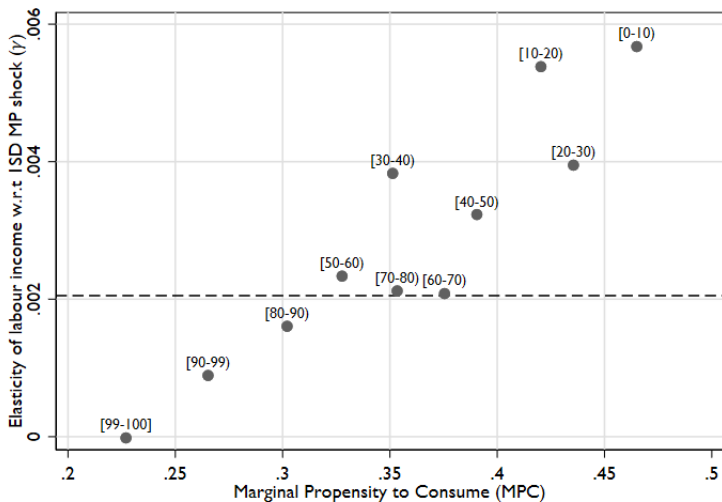
$$MPC = \sum_j iw_j \frac{\gamma_j}{\bar{\gamma}} \frac{dC_j}{dE_j}$$

where

- $\frac{\gamma_j}{\bar{\gamma}}$ denotes household j relative response to monetary policy shock, i.e. the ratio of household j response γ_j to income-weighted average response of all households $\bar{\gamma}$
- The **contribution of the covariation term** can be found as:

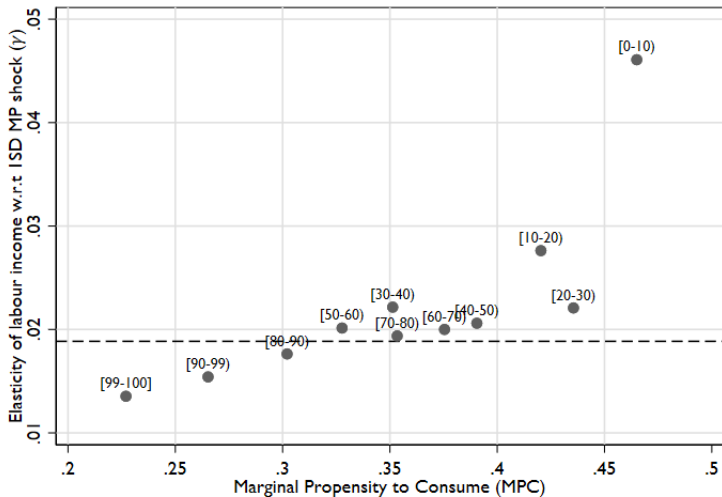
$$\text{cov}\left(\frac{dC_j}{dE_j}, \gamma_j\right) = MPC - MPC_{iw}$$

Covariation btw MP reaction and MPC: low inflation



Note: Horizontal dashed line refers to the income-weighted average elasticity.

Covariation btw MP reaction and MPC: high inflation



Note: Horizontal dashed line refers to the income-weighted average elasticity.

- Almgren, M., J.-E. Gallegos, J. Kramer, and R. Lima (2022). Monetary Policy and Liquidity Constraints: Evidence from the Euro Area. *American Economic Journal: Macroeconomics* 14(4), 309 – 340.
- Altavilla, C., L. Brugnolini, R. S. Gürkaynak, R. Motto, and G. Ragusa (2019). Measuring euro area monetary policy. *Journal of Monetary Economics* 108, 162–179.
- Amberg, N., T. Jansson, M. Klein, and A. R. Picco (2022). Five Facts about the Distributional Income Effects of Monetary Policy Shocks. *American Economic Review: Insights* 4, 289 – 304.
- Andersen, A. L., N. Johannesen, M. Jorgensen, and J.-L. Peydró (2023). Monetary Policy and Inequality. *The Journal of Finance* 78, 2945 – 2989.
- Auclert, A. (2019). Monetary Policy and the Redistribution Channel. *American Economic Review* 109(6), 2333 – 2367.
- Broer, T., J. Kramer, and K. Mitman (2022, August). The Curious Incidence of Monetary Policy Across the Income Distribution. Sveriges Riksbank Working Paper Series 416.
- Coibion, O., Y. Gorodnichenko, L. Kueng, and J. Silvia (2017). Innocent Bystanders? Monetary policy and inequality. *Journal of Monetary Economics* 88, 70–89.

- Davis, S. J., J. C. Haltiwanger, and S. Schuh (1996). *Job Creation and Destruction*. The MIT Press: MIT Press Books.
- Gargiulo, V., C. Matthes, and K. Petrova (2024). Monetary policy across inflation regimes. FRB of New York Staff Report 1083.
- Guvenen, F., S. Schulhofer-Wohl, J. Song, and M. Yogo (2017). Worker Betas: Five Facts about Systematic Earnings Risk. *American Economic Review: Papers & Proceedings* 107, 398 – 403.
- Holm, M. B., P. Paul, and A. Tischbirek (2021). The Transmission of Monetary Policy under the Microscope. *Journal of Political Economy* 129, 2861 – 2904.
- Hubert, P. and F. Savignac (2023). Monetary policy and labor income inequality: the role of extensive and intensive margins. CEPR Discussion Paper 18310.
- Jarocinski, M. and P. Karadi (2020). Deconstructing Monetary Policy Surprises – The Role of Information Shocks. *American Economic Journal: Macroeconomics* 12(2), 1 – 43.
- Lenza, M. and J. Slacalek (2024). How does monetary policy affect income and wealth inequality? evidence from quantitative easing in the euro area. *Journal of Applied Econometrics* Early view.

Patterson, C. (2023). The matching multiplier and the amplification of recessions. *American Economic Review* 113(4), 982–1012.

Slacalek, J., O. Tristani, and G. L. Violante (2020). Household balance sheet channels of monetary policy: A back of the envelope calculation for the euro area. *Journal of Economic Dynamics Control* 115, 103879.

Tenreyro, S. and G. Thwaites (2016). Pushing on a string: Us monetary policy is less powerful in recessions. *American Economic Journal: Macroeconomics* 8(4), 43–74.