Monetary Policy and Earnings Inequality: Inflation Dependencies

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September 26, 2025
Second Annual Czech National Bank Conference
Prague

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1. whether the monetary policy (MP) affects **earnings** inequality
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
  - Link responses in earnings to household MPC-s
- **High-frequency earnings data** on the whole population that matches the frequency of monetary policy shocks
  - Most papers use yearly data

Literature

- Distributional impact of MP using survey and admin data
  - Coibion et al. (2017), Holm et al. (2021), Andersen et al. (2023), Amberg et al. (2022), Broer et al. (2022), Hubert and Savignac (2024)
- State-dependent impact of MP
  - Tenreyro and Thwaites (2016), Gargiulo et al. (2024), Canova and Pérez Forero (2024)
- Aggregate amplification due to heterogeneity
  - Auclert (2019), Slacalek et al. (2020), McKay and Wolf (2023), Patterson (2023), Lenza and Slacalek (2024)
  - RANK models $\rightarrow$ weak response in consumption vs
  - HANK models $\rightarrow$ strong response in consumption due to hand-to-mouth hhs (Kaplan et al. 2018), **heterogenous exposure** to interest rates and of earnings (Auclert 2019)

Outline of talk

1. Data and Methods
2. Results - one regime
3. Results - inflation regimes
4. Aggregate implications
5. Take-aways

Data

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

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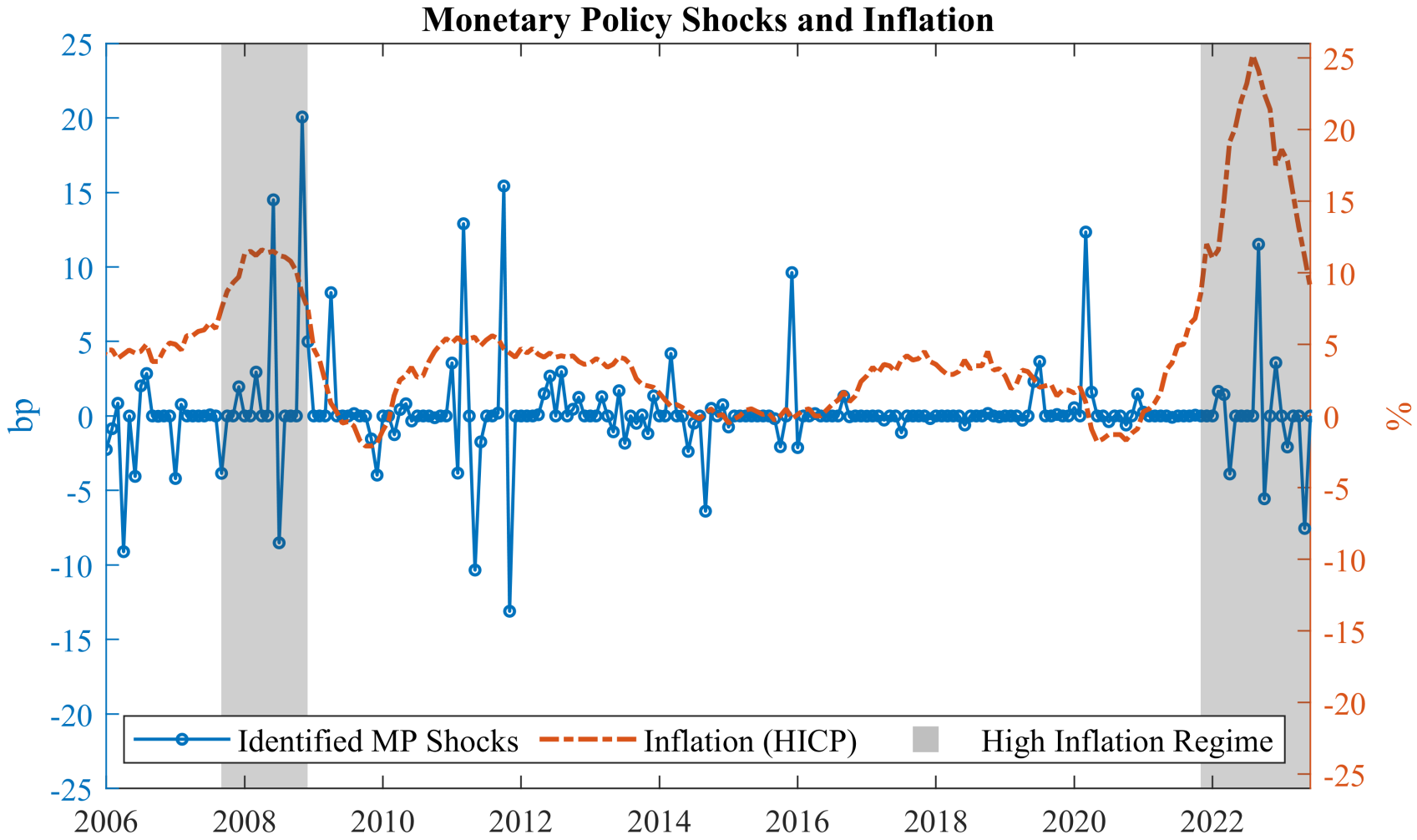
- Data from Estonia
  - Administrative data on earnings at **monthly frequency, no top coding**
  - Part of the **euro area**, monetary policy has a strong effect (Almgren et al. 2022), likely due to **adjustable rate loans**
  - Institutional setting close to USA, flexible labour market and similar GDP betas a la Guvenen et al. (2017)



- 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)

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 observa-tions
$[0-10)$	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

Empirical specification

Following **the non-overlapping dynamic structure** in Guvenen et al. 2017:

$$\Delta y_{i,t+h} = \alpha_g^h + \beta_g^h \Delta i_t + \Gamma_g^h \Delta X_{t-1} + \epsilon_{i,t+h}, \tag{1}$$

- $\Delta y_{i,t+h} = (y_{i,t+h} - y_{i,t}) \,/\, ((y_{i,t+h} + y_{i,t})/2)$ is the mid-point average growth of labour income of individual i at month $t+h$, where -2 denotes exit and 2 entry
- baseline horizon is 12 months, $h = 12$, robustness tests $h = 6, 18, 24$
- Δi_t is monetary policy shock at month t
- X_{t-1} denotes control variable y-o-y monthly GDP growth

Estimate this specification for each of our **12 income groups**

- Labour income groups based on average income in previous 12 months

Disentangling the total effect: **Extensive and intensive margin**

- Extensive margin consists of entry and exit

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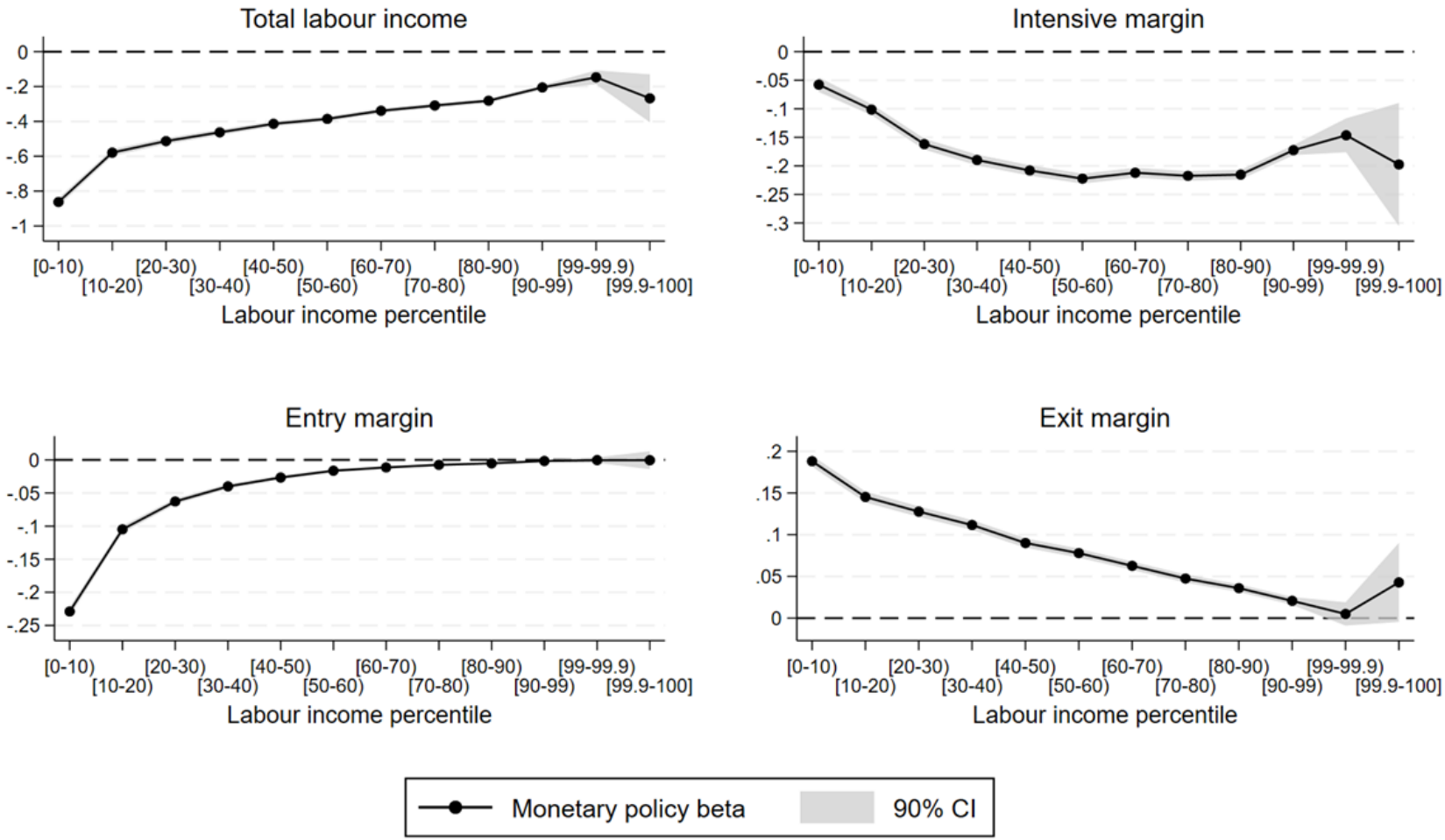
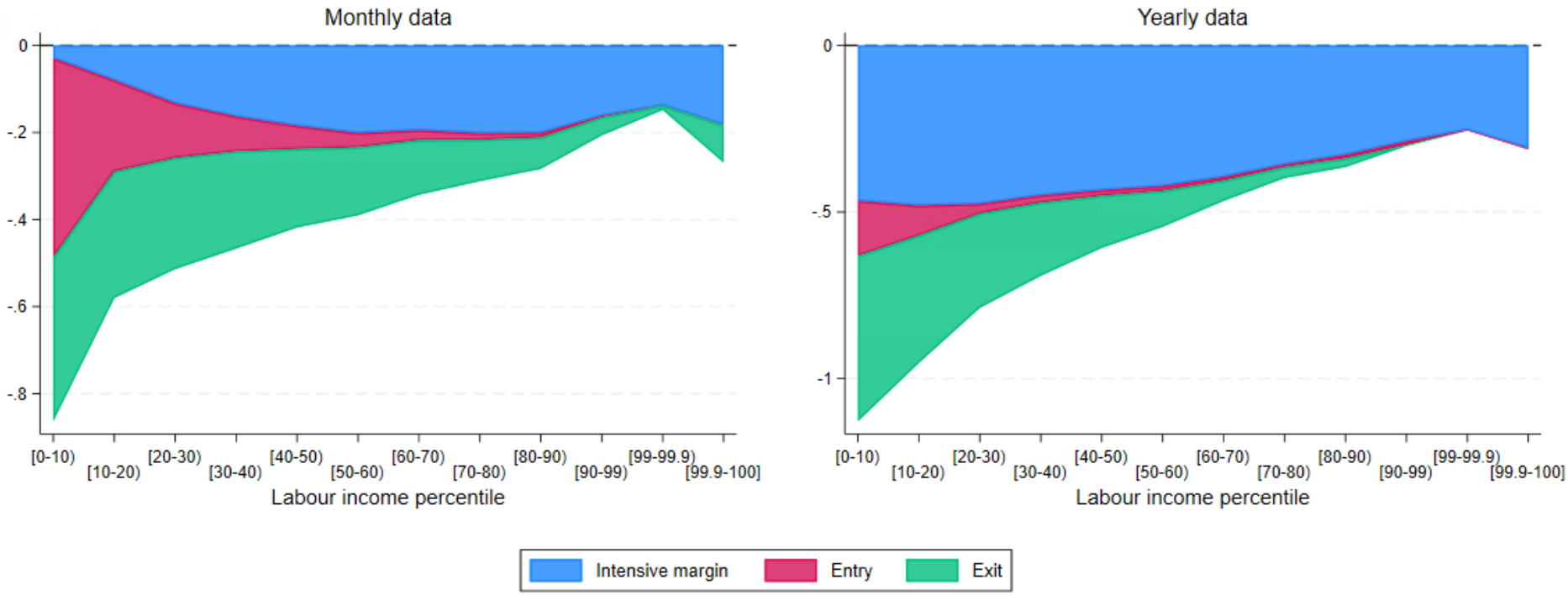
Baseline results: 100bp MP impact by M12



- **Low-wage earners** affected the most, small swing up at 0.1%
- **Extensive margin** more important (Hubert and Savignac 2024, Broer et al. 2022)

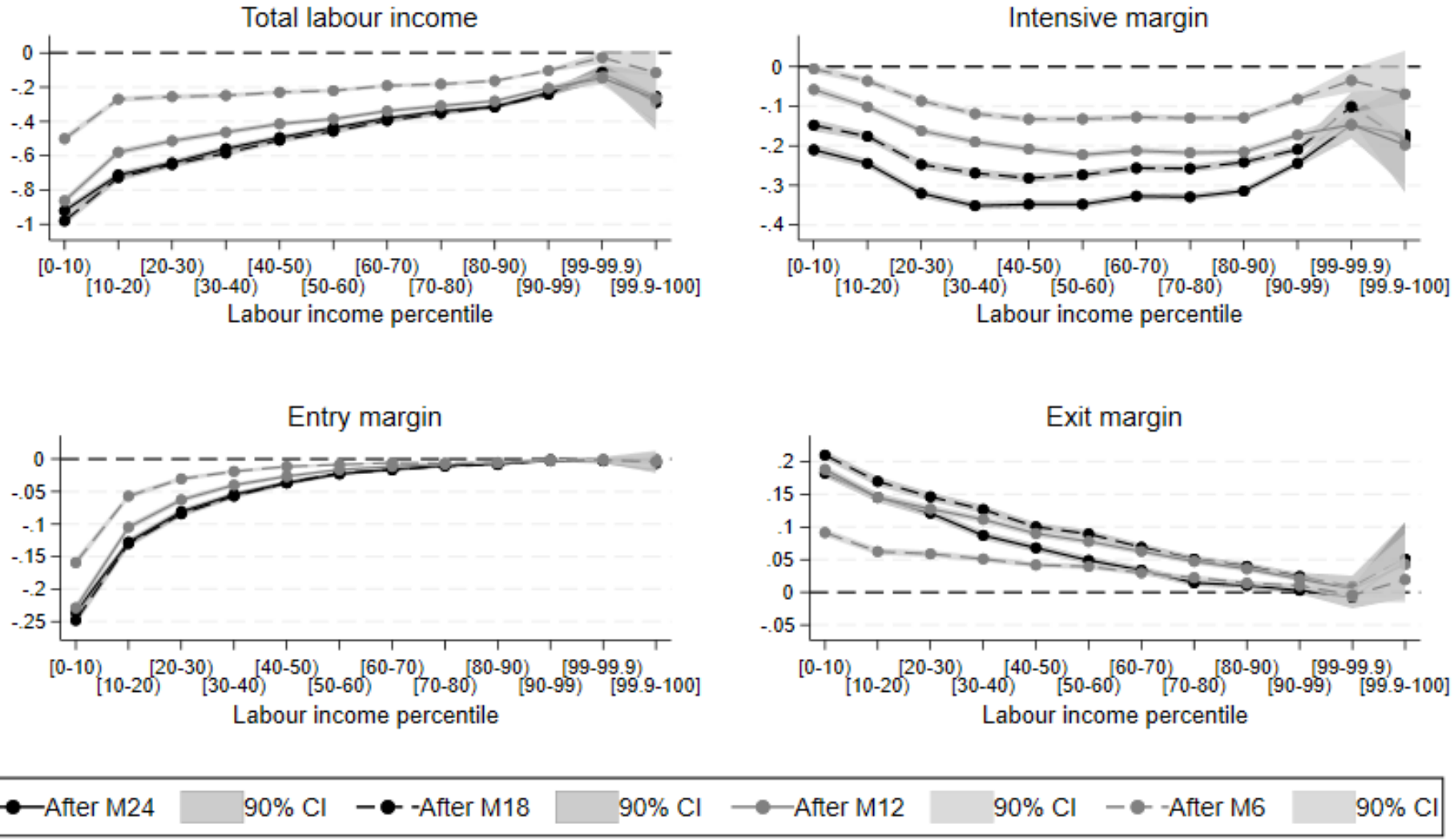
Robustness: monthly vs yearly data



Extensive margin, entry and exit, accounts for

- 2/3 of the effect at **monthly** frequency vs 1/3 of the effect at **yearly** frequency

Robustness: 100bp MP impact by time horizon



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

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Empirical specification by inflation regime

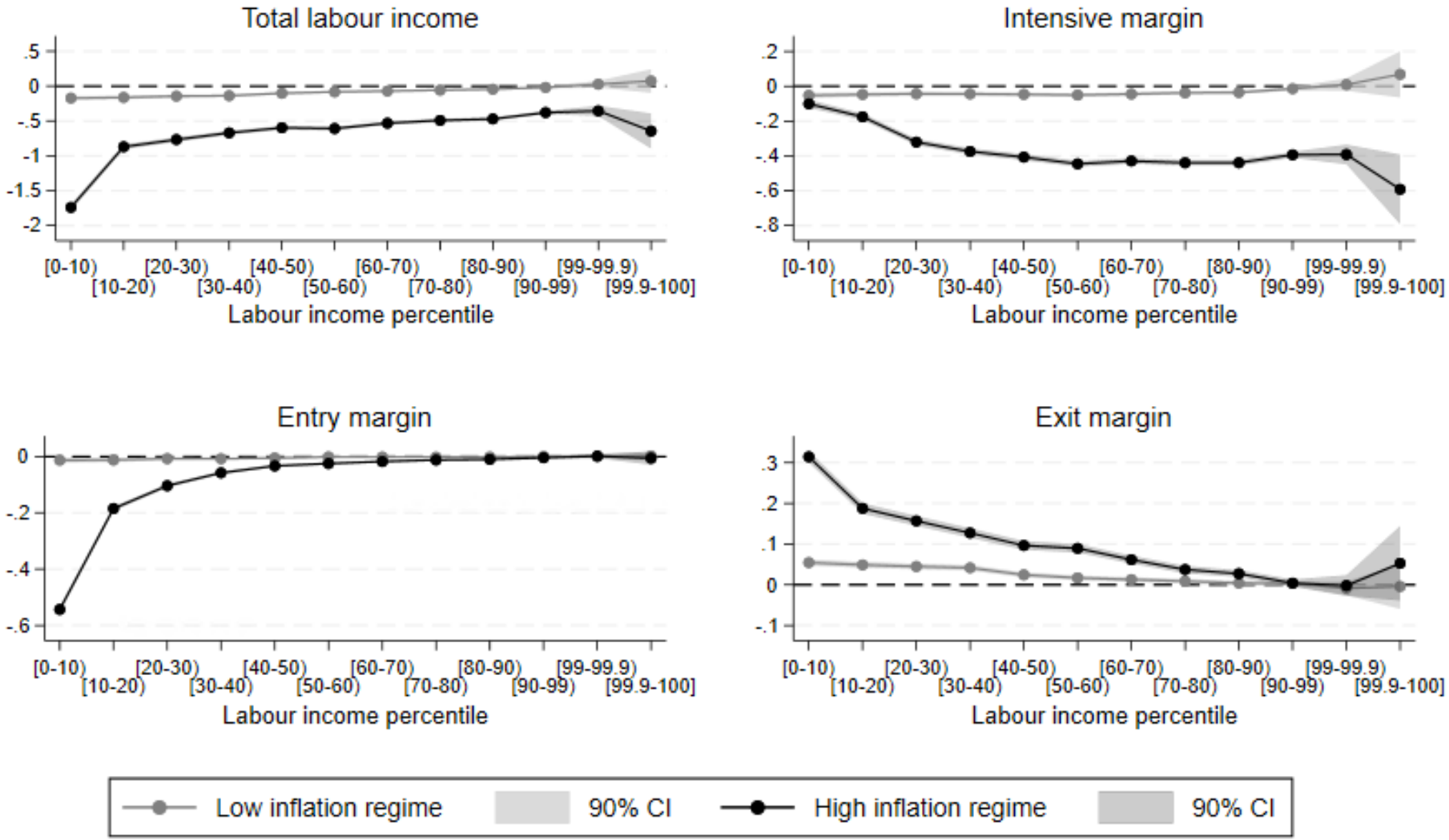
Add interaction terms of high and low inflation periods with MP and GDP

$$\Delta y_{i,t+h} = \alpha_g^h + \beta_g^{h,r} \Delta i_t \times R_{t-1} + \Gamma_g^{h,r} X_{t-1} \times R_{t-1} + \epsilon_{i,t+h}, \qquad (2)$$

where

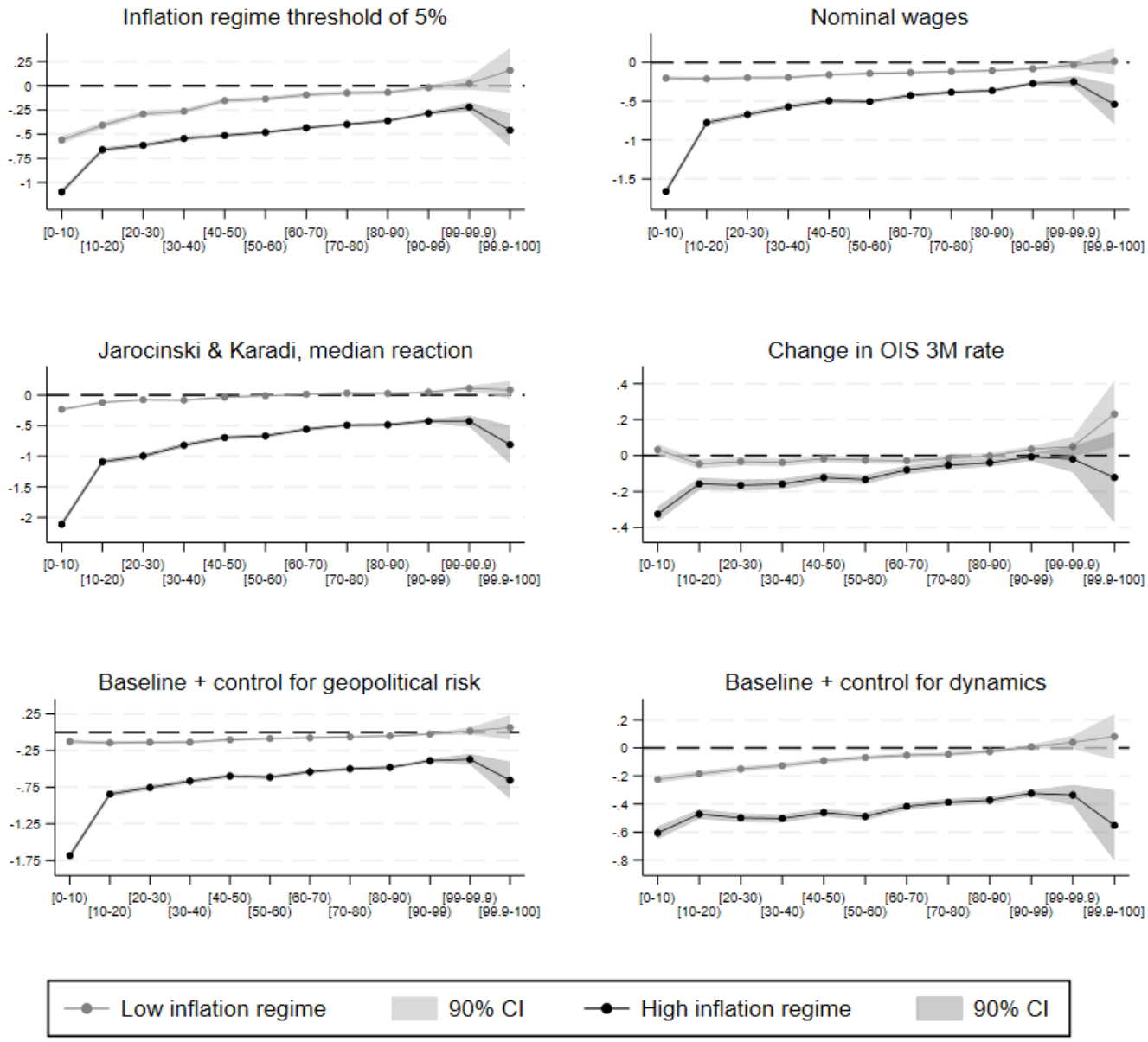
- r denotes regime, $r = L, H$; $R_t = 1$ if inflation is 7% and higher and $R_t = 0$ otherwise
- regime is defined at $t-1$, **1 month before the MP shock**
- $\beta_g^{h,L}$ captures the impact of monetary policy **in the low inflation regime** and $\beta_g^{h,L}$ **in the high inflation regime** for the income group g
- $\gamma_g^{h,L}$ control for potentially heterogeneous impact of **economic growth by the regime**

Results by inflation regime



- MP is **more powerful in the high-inflation** regime (Gargiulo et al. 2024, Tenreyro and Thwaites 2016)
- **Heterogeneity by regime**: regime *L* linear, regime *H* weak U-shape

Robustness: threshold, nominal wages, MP shock, controls



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Reaction in aggregate consumption: Matching multipliers

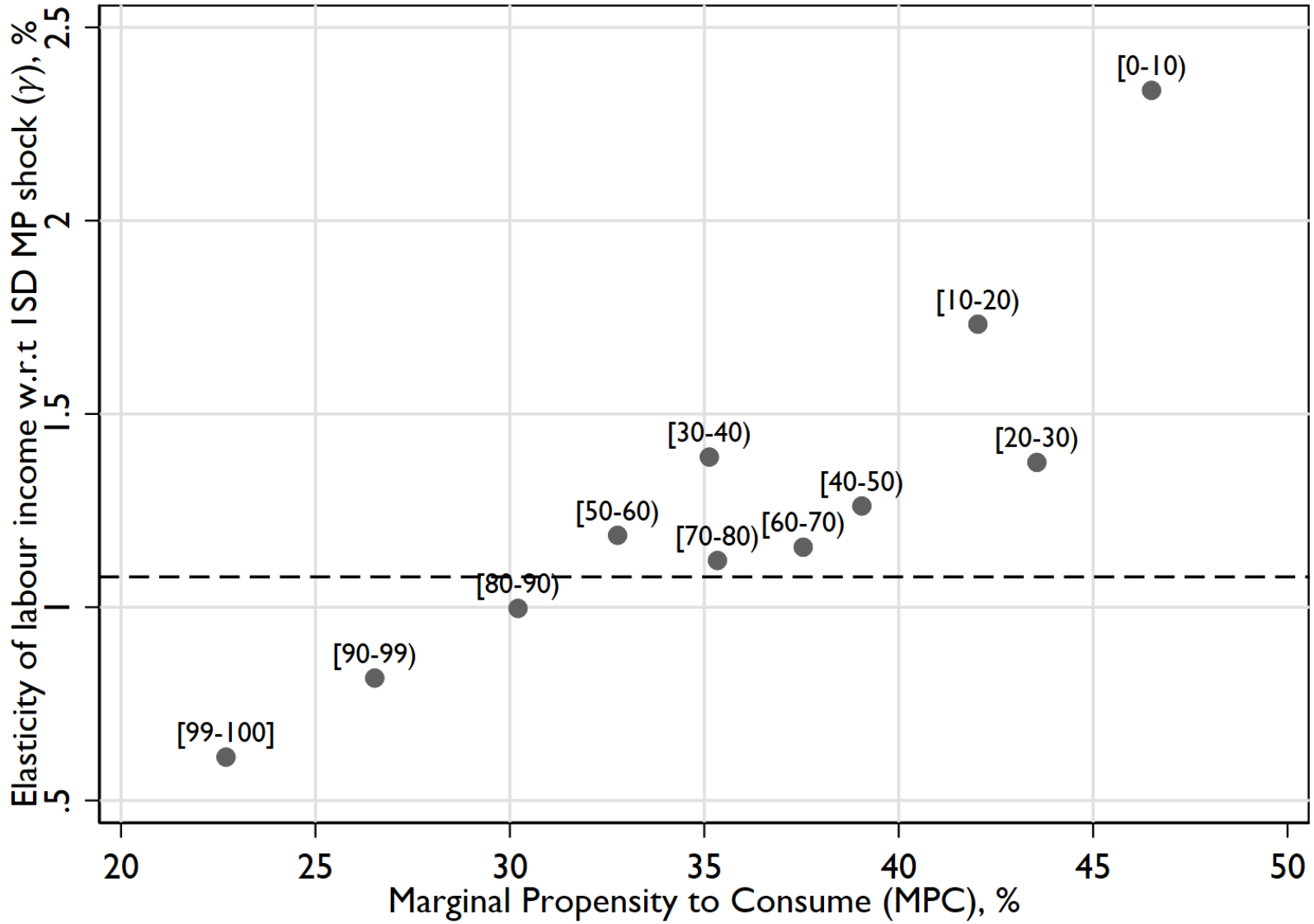
Following Patterson 2023 the **aggregate MPC** can be disentangled into **two components**, the income-weighted average MPC and the covariance between the individual-level response to aggregate shocks and MPC:

$$MPC = \sum_j \frac{dC_j}{dE_j}\frac{dE_j}{dY} = \sum_j \frac{E_j}{Y}\frac{dC_j}{dE_j} + cov(\frac{dC_j}{dE_j}, \gamma_j), \tag{3}$$

where

- MPC denotes aggregate MPC
- C_j is the consumption of household j
- E_j is the income of household j
- Y is the aggregate output
- $\frac{dC_j}{dE_j}$ is the MPC of household j, **self-reported** in Household Finance and Consumption Survey (HFCS)
- $\gamma_j = \frac{dE_j}{dY}\frac{Y}{E_j}$ is the elasticity of household j labour income to aggregate 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
Contribution of covariation			5%	11%	5%
Response of consumption to MP shock		0.49%	0.52%	0.11%	0.83%
Response of earnings Gini to MP shock		-	0.35%	0.15%	0.42%

Mechanism by THANK: heterogenous vs aggregate reaction

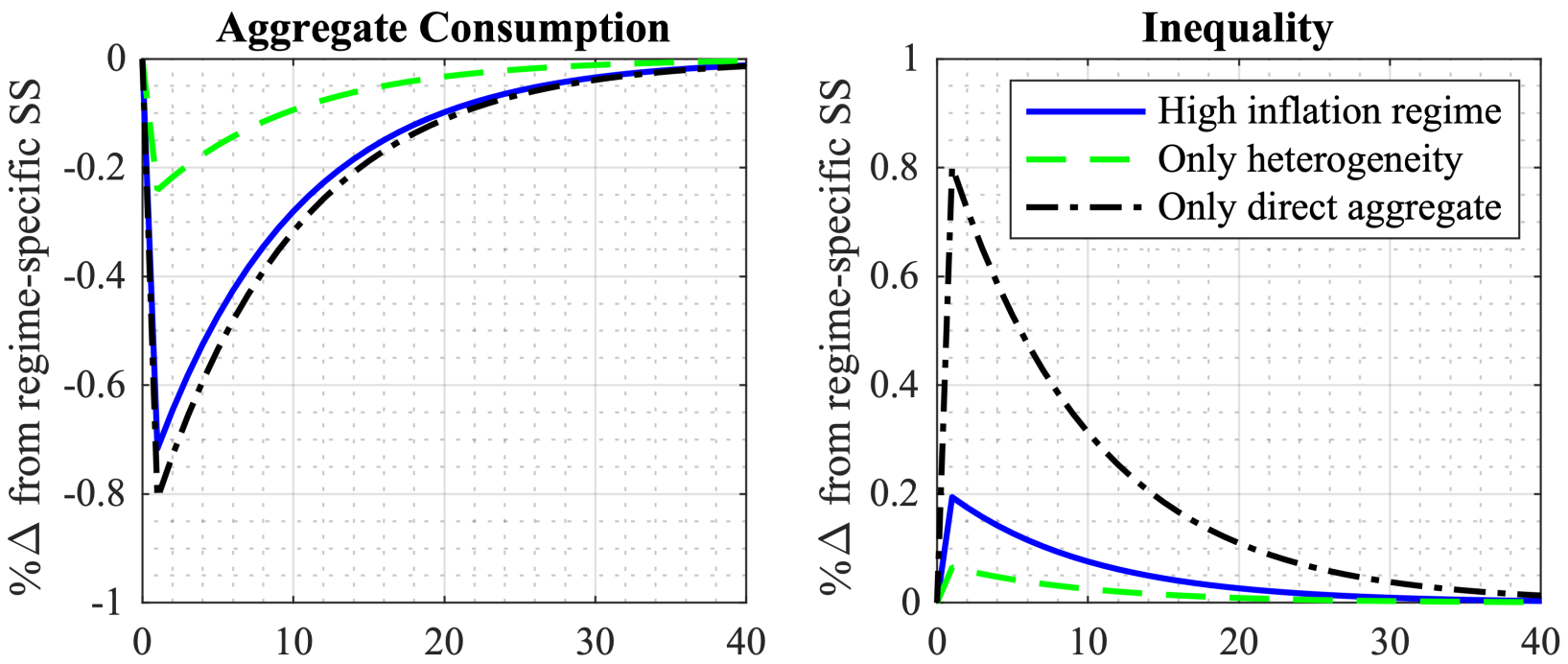


Figure: IRFs to a one-standard-deviation monetary policy shock in the high regime for different scenarios. The effect for the full model (blue solid), with only state-dependent heterogeneity (green dashed), and with only state-dependent direct aggregate amplification (black dash-dotted) are shown. The IRFS are expressed as percentage deviations from the regime-specific steady state.

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Take-aways

1. MP shock has the strongest impact on **low-wage workers**
   - Tightening increases inequality - extensive margin has a key role
2. Distributional impact depends on the **inflation regime**
   - Monetary policy affects earnings more in a high inflation period
   - The shape of the reaction over the distribution of earnings is different by regime - linearly declining in low inflation and inverted U-shaped in high inflation
3. **Distributional effects amplify the effect of monetary policy** - by around 5%
   - The amplification is weaker in a high inflation regime because of the inverted U-shape effect over the distribution

THANK YOU!

Comments and questions:

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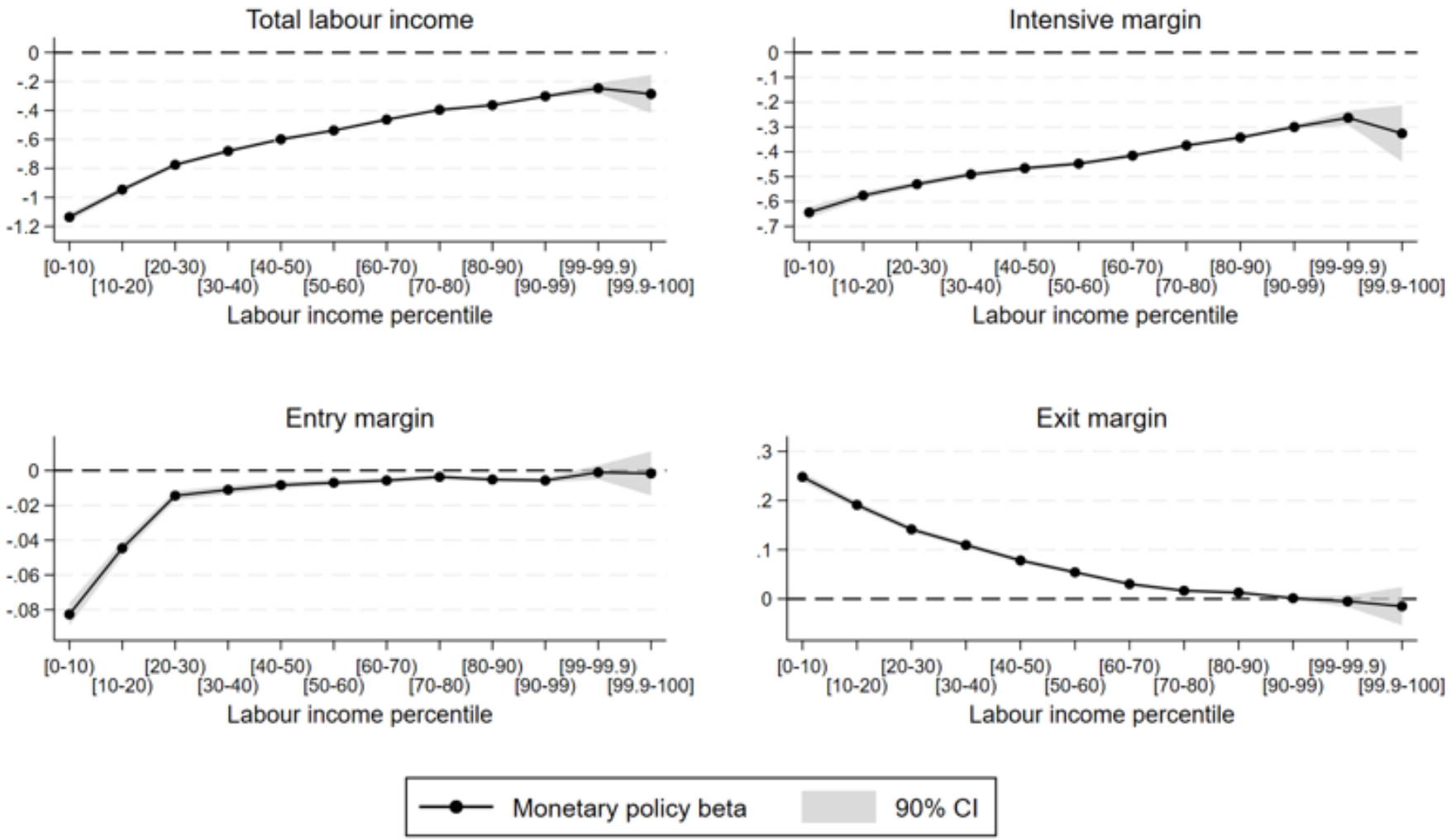
Earnings data

- 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 deflated by CPI
  - 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

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 Jarociński 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)

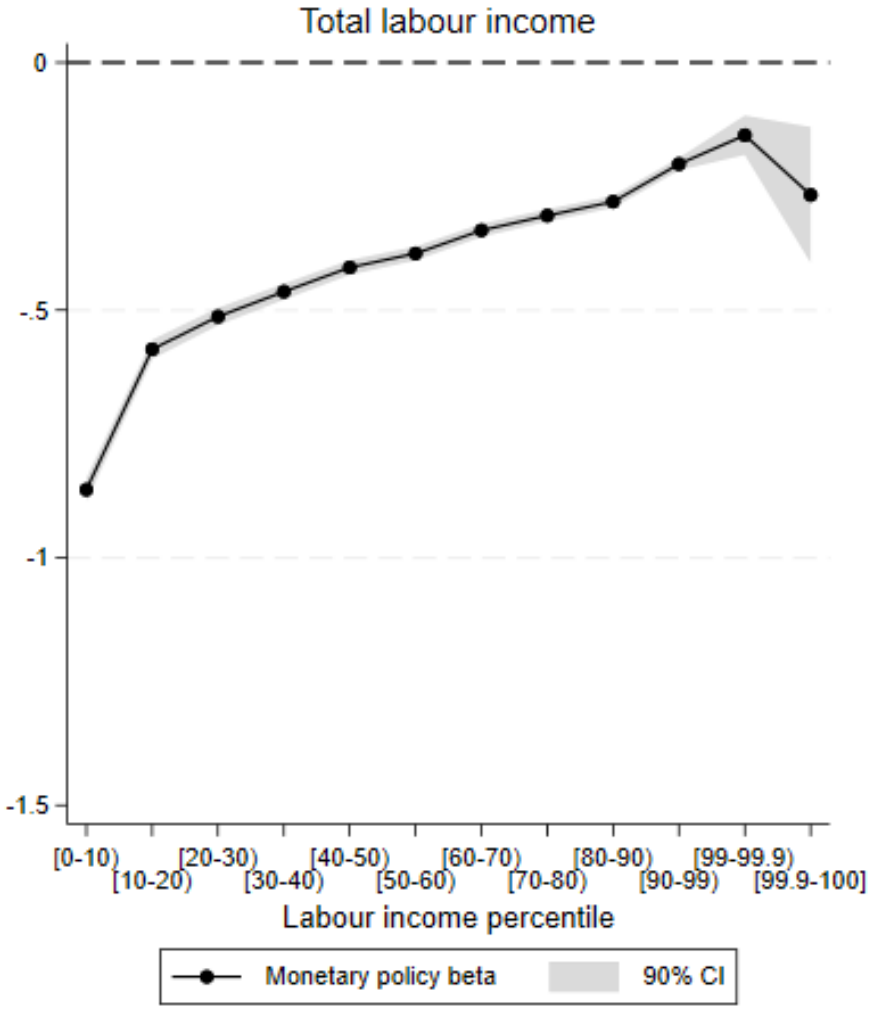
MP impact by M12: yearly data

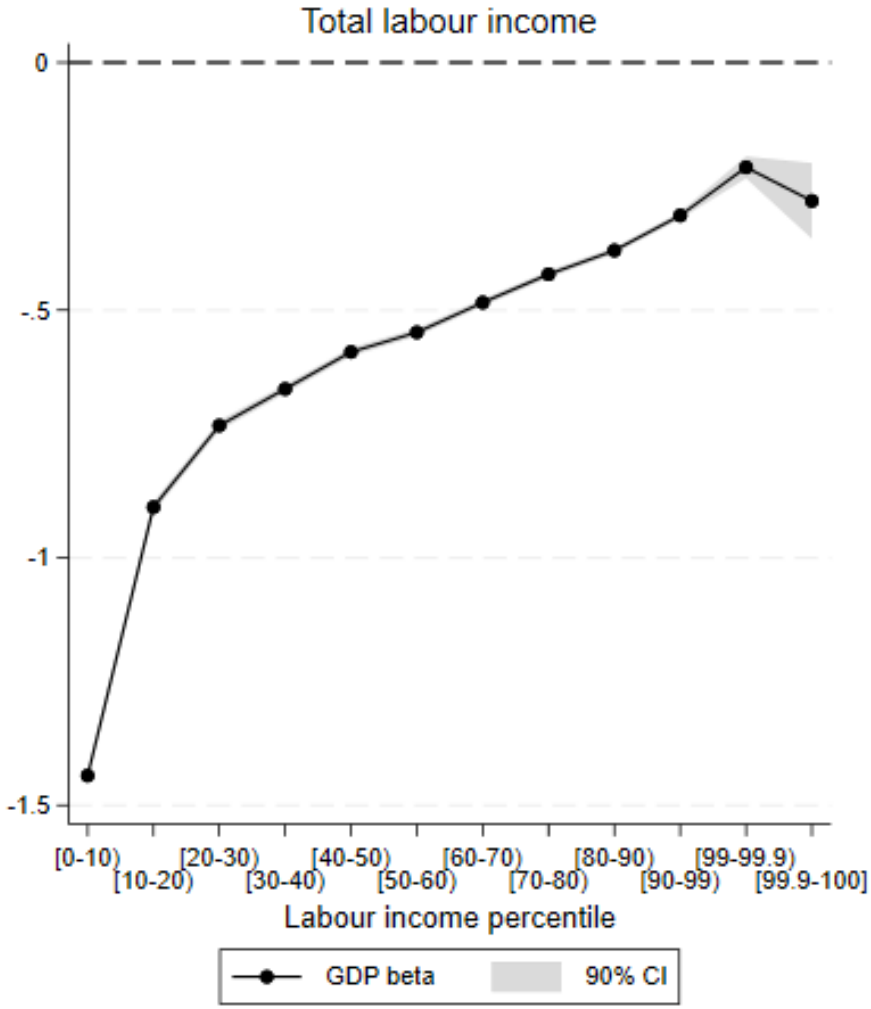


Yearly data underestimates extensive margin: 1SD MP impact by M12

	Monthly frequency 2008M1-2023M9		Yearly frequency 2008-2022	
	(1) Total labour income	(2) Contribution of intensive margin	(3) Total labour income	(4) Contribution of intensive margin
$[0-10)$	-0.027***	-0.001***	-0.108***	-0.044***
$[10-20)$	-0.018***	-0.002***	-0.090***	-0.046***
$[20-30)$	-0.016***	-0.004***	-0.074***	-0.045***
$[30-40)$	-0.015***	-0.005***	-0.065***	-0.043***
$[40-50)$	-0.013***	-0.006***	-0.057***	-0.041***
$[50-60)$	-0.012***	-0.006***	-0.051***	-0.040***
$[60-70)$	-0.011***	-0.006***	-0.044***	-0.037***
$[70-80)$	-0.010***	-0.006***	-0.038***	-0.034***
$[80-90)$	-0.009***	-0.006***	-0.035***	-0.031***
$[90-99)$	-0.006***	-0.005***	-0.029***	-0.027***
$[99-99.9)$	-0.005***	-0.004***	-0.023***	-0.024***
$[99.9-100]$	-0.008***	-0.006***	-0.027***	-0.029***
All sample	-0.015***	-0.005***	-0.057***	-0.039***

Monetary policy risk is less heterogenous than business cycle risk

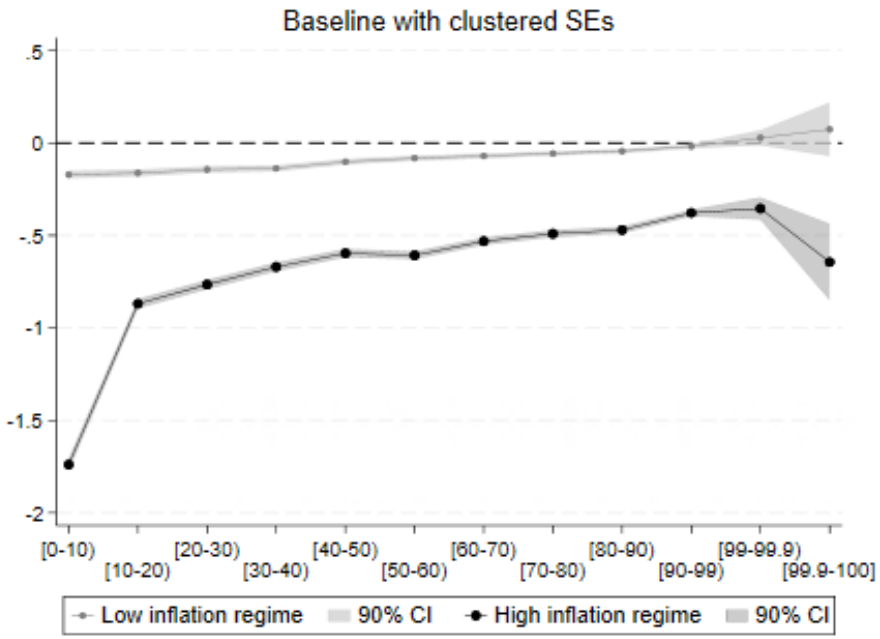


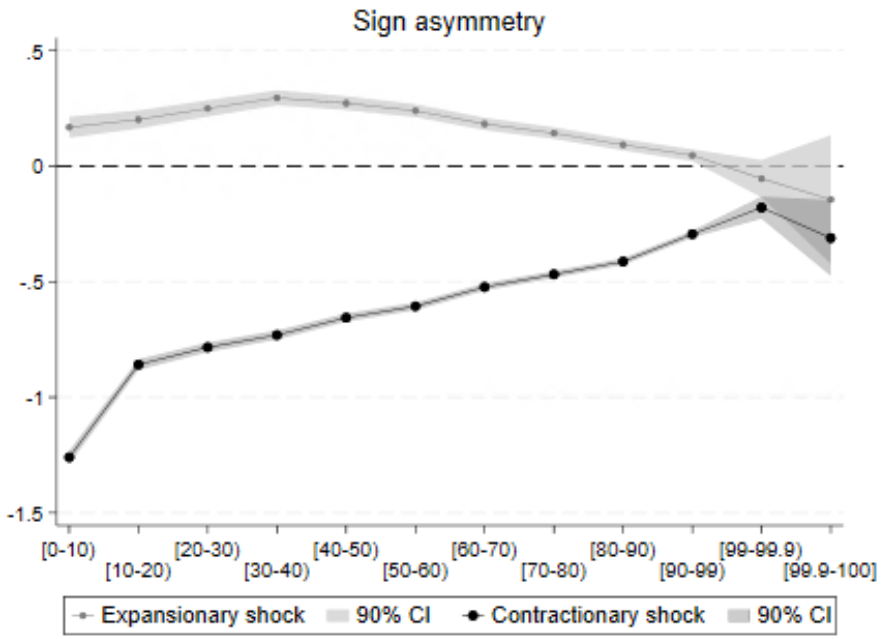


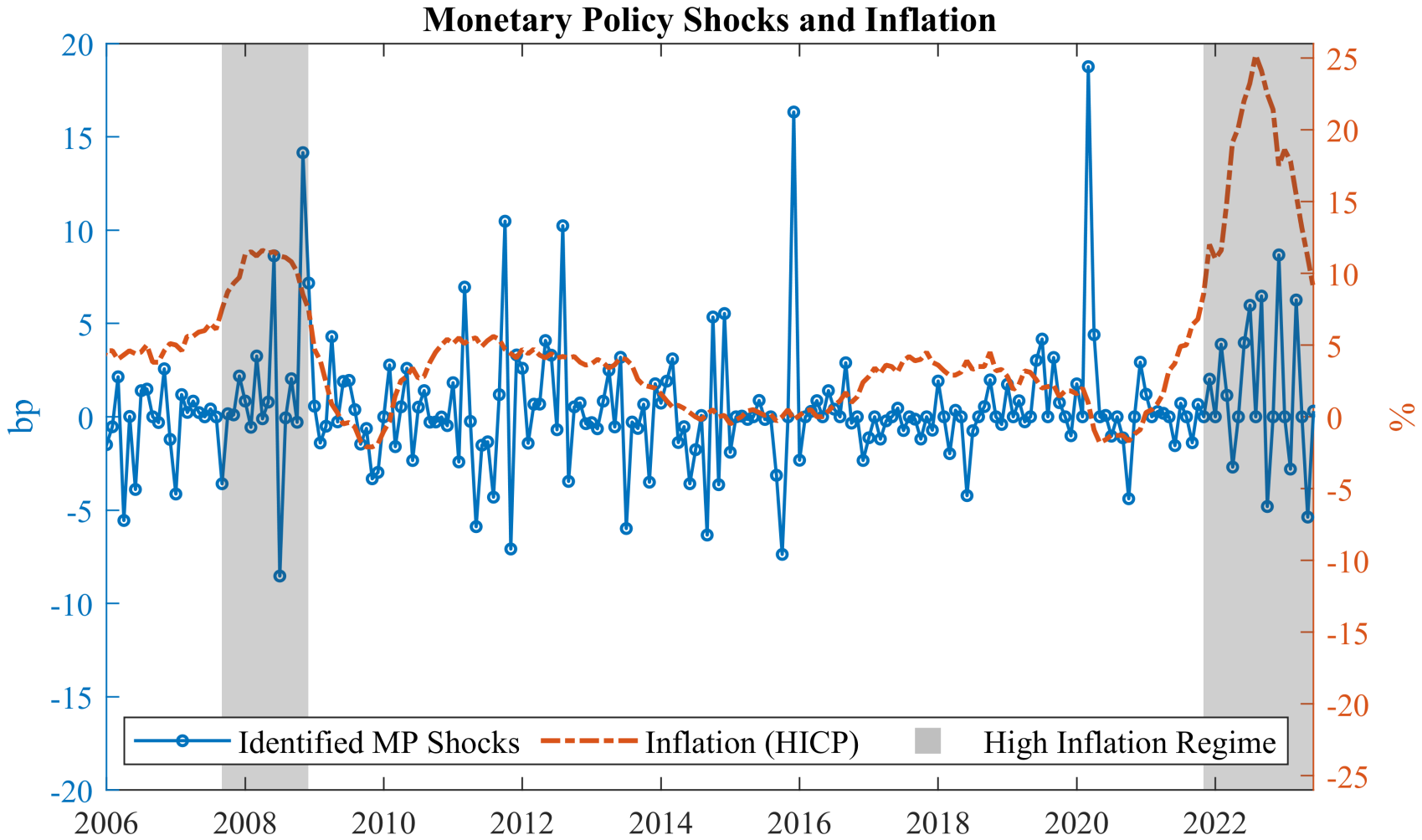
Monetary policy effect by regime, 2008M1-2023M9

	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***

100bp MP impact: by regime with clustered SEs and sign asymmetry







- Jarociński and Karadi 2020 Bayesian VAR-based median reaction

Deriving contribution of the covariation term

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

$$MPC_{iw} = \sum_j \frac{E_j}{Y} \frac{dC_j}{dE_j} = \sum_j iw_j \frac{dC_j}{dE_j}, \tag{4}$$

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:

$$MPC = \sum_j iw_j \frac{\gamma_j}{\bar{\gamma}} \frac{dC_j}{dE_j}, \tag{5}$$

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 $\bar{\gamma}$

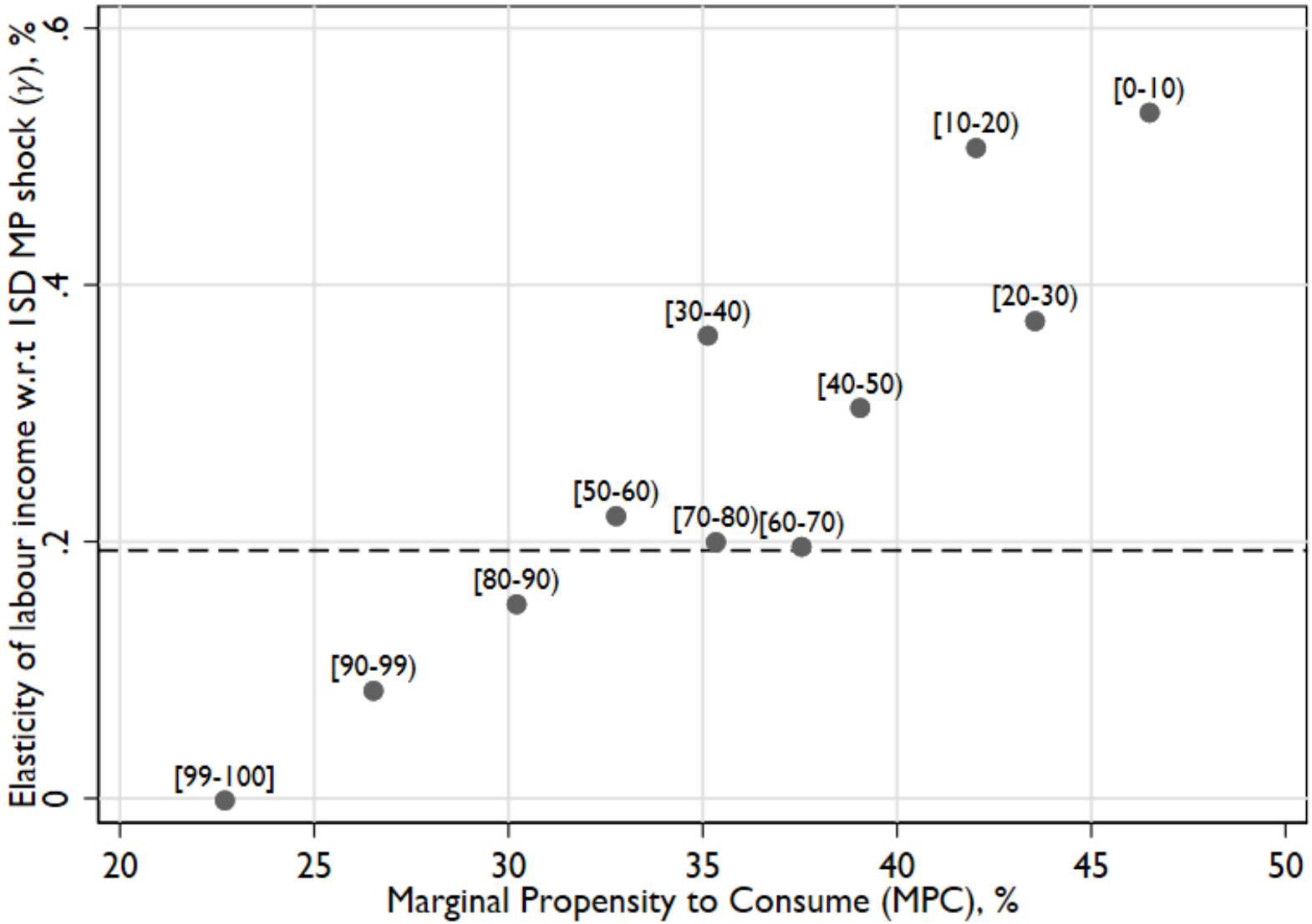
- The **contribution of the covariation term** can be found as:

$$cov(\frac{dC_j}{dE_j}, \gamma_j) = MPC - MPC_{iw}, \tag{6}$$

Matching MP reaction with MPC

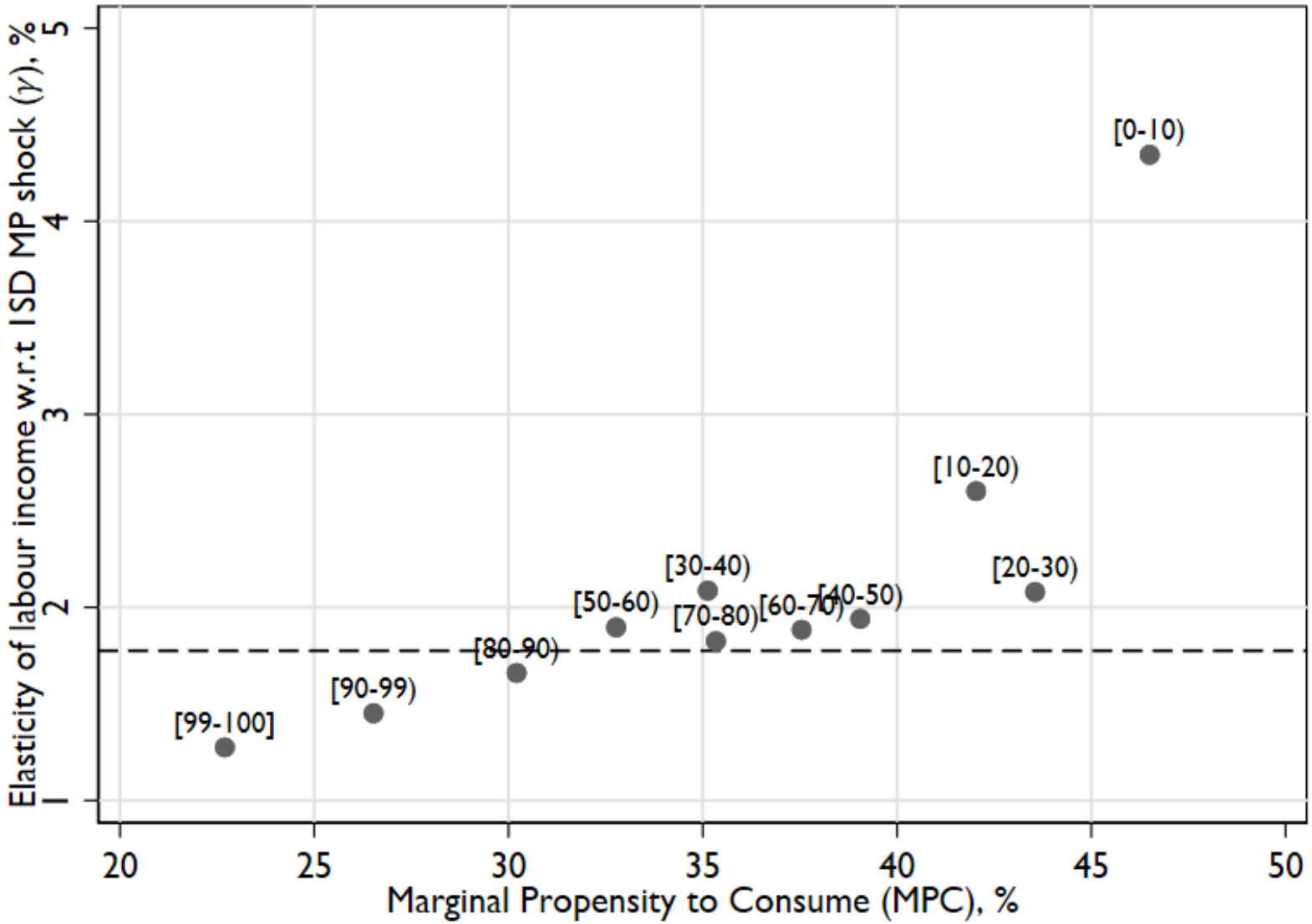
- Match our effects of MP by income distribution with household-level estimates of MPC from **the Household Finance and Consumption Survey (HFCS)** for Estonia in 2021
  - MPC in HFCS collected by self-reported windfall gain question **at the level of household**
  - $\rightarrow$ switch to the household 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 $\rightarrow$ 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: low inflation



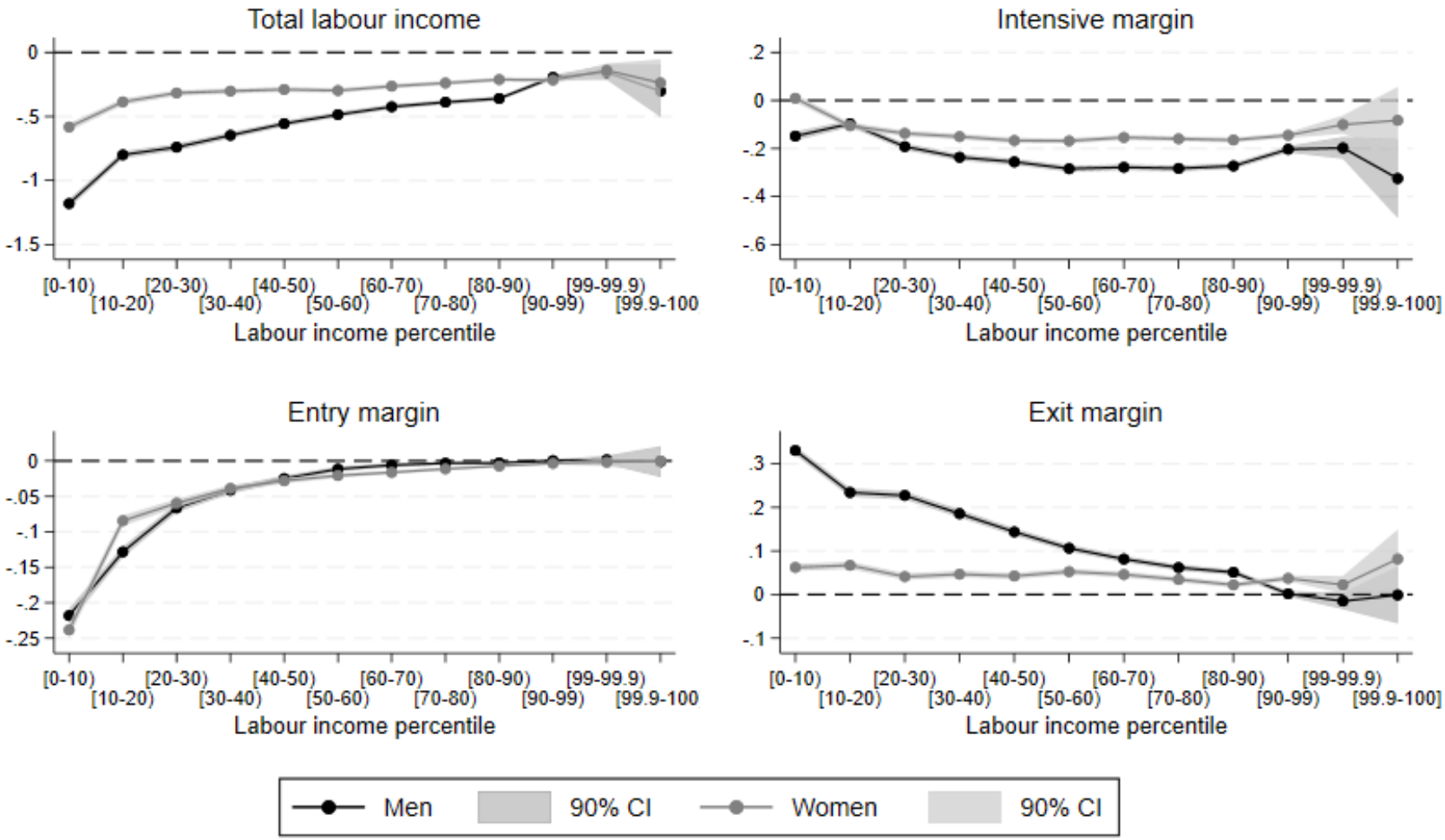
Note: Horizontal dashed line refers to the income-weighted average elasticity.

Covariation btw MP reaction and MPC: high inflation

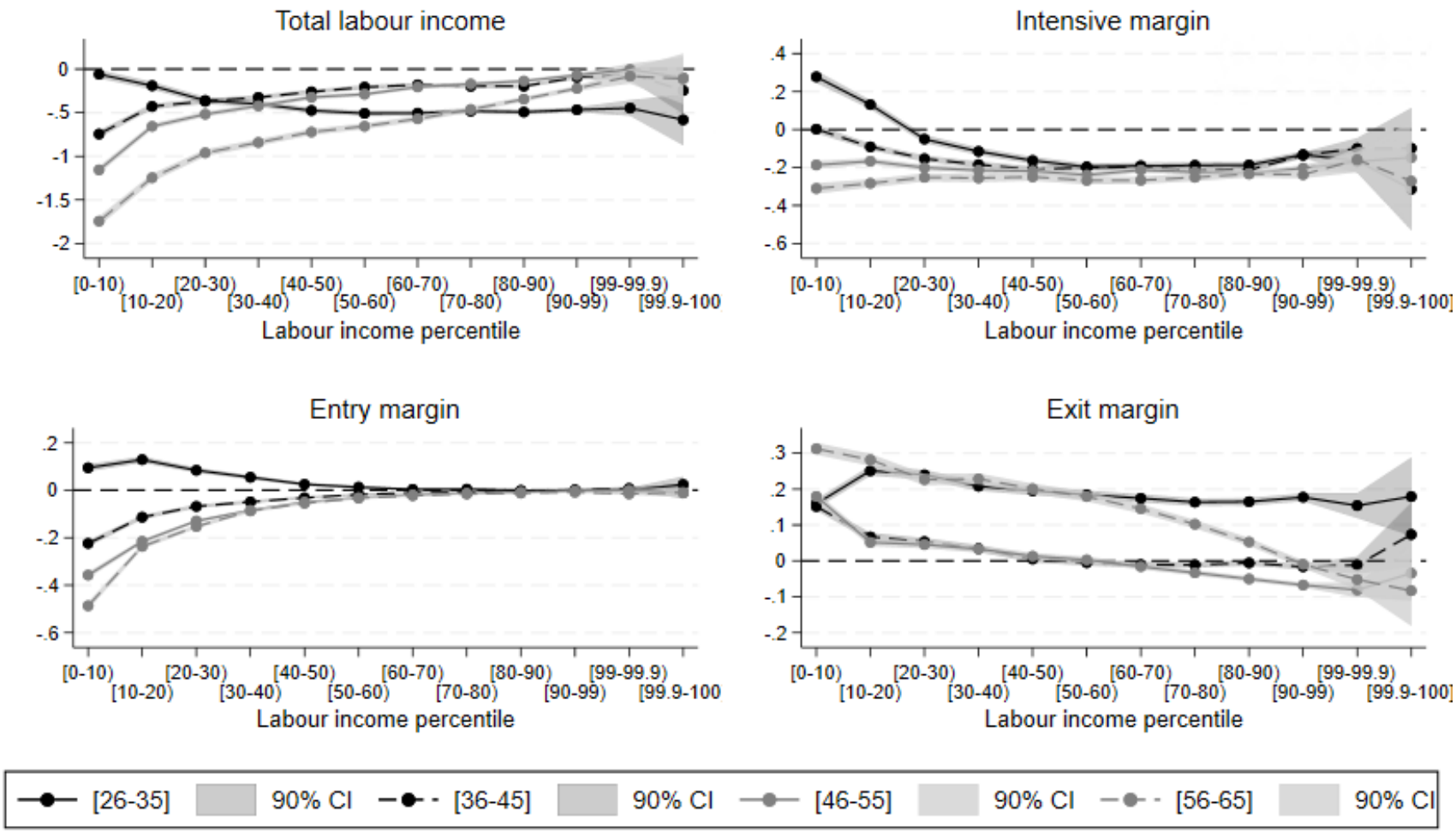


Note: Horizontal dashed line refers to the income-weighted average elasticity.

The effect of monetary policy shock by gender



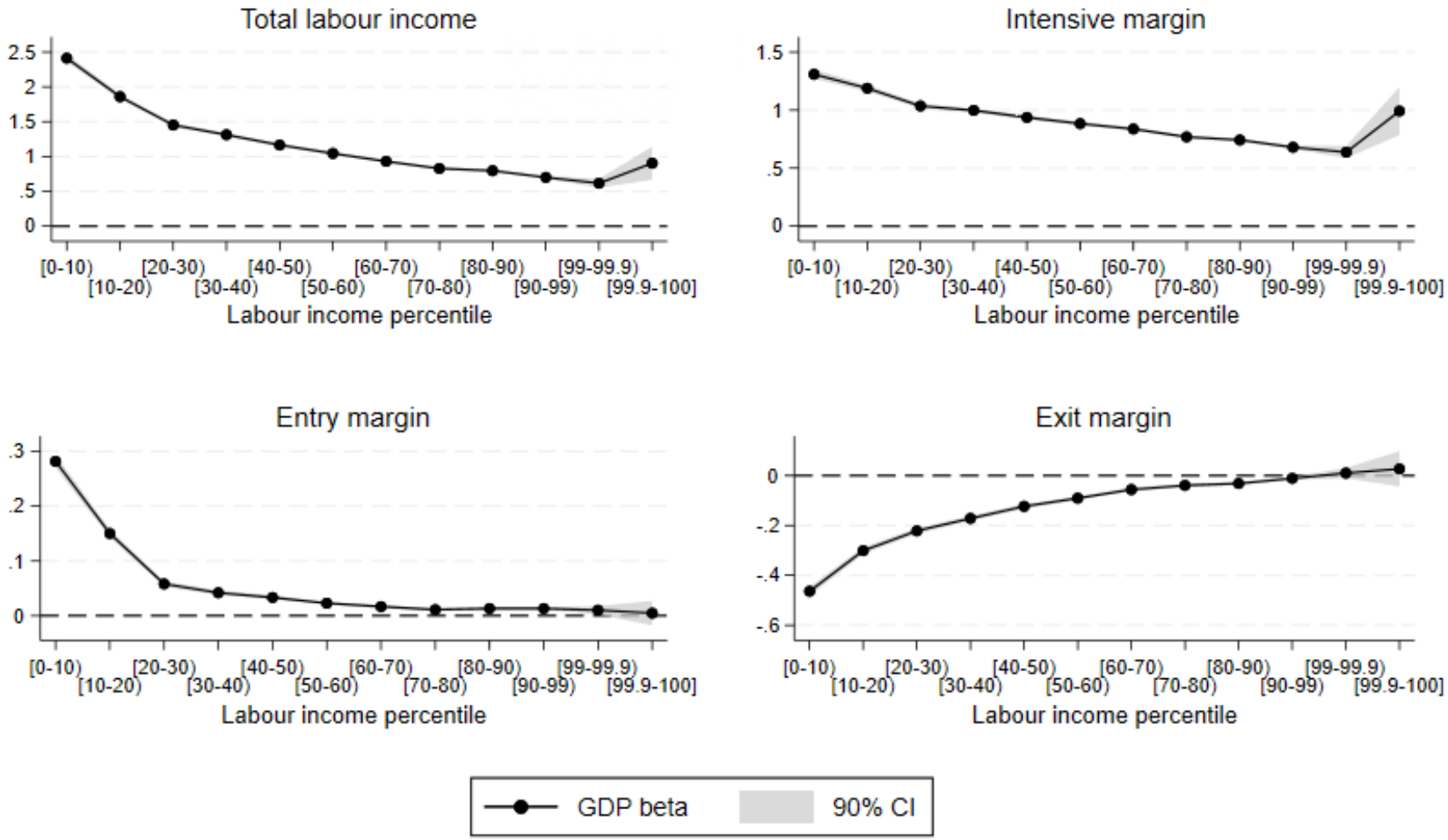
The effect of monetary policy shock by age



External validity

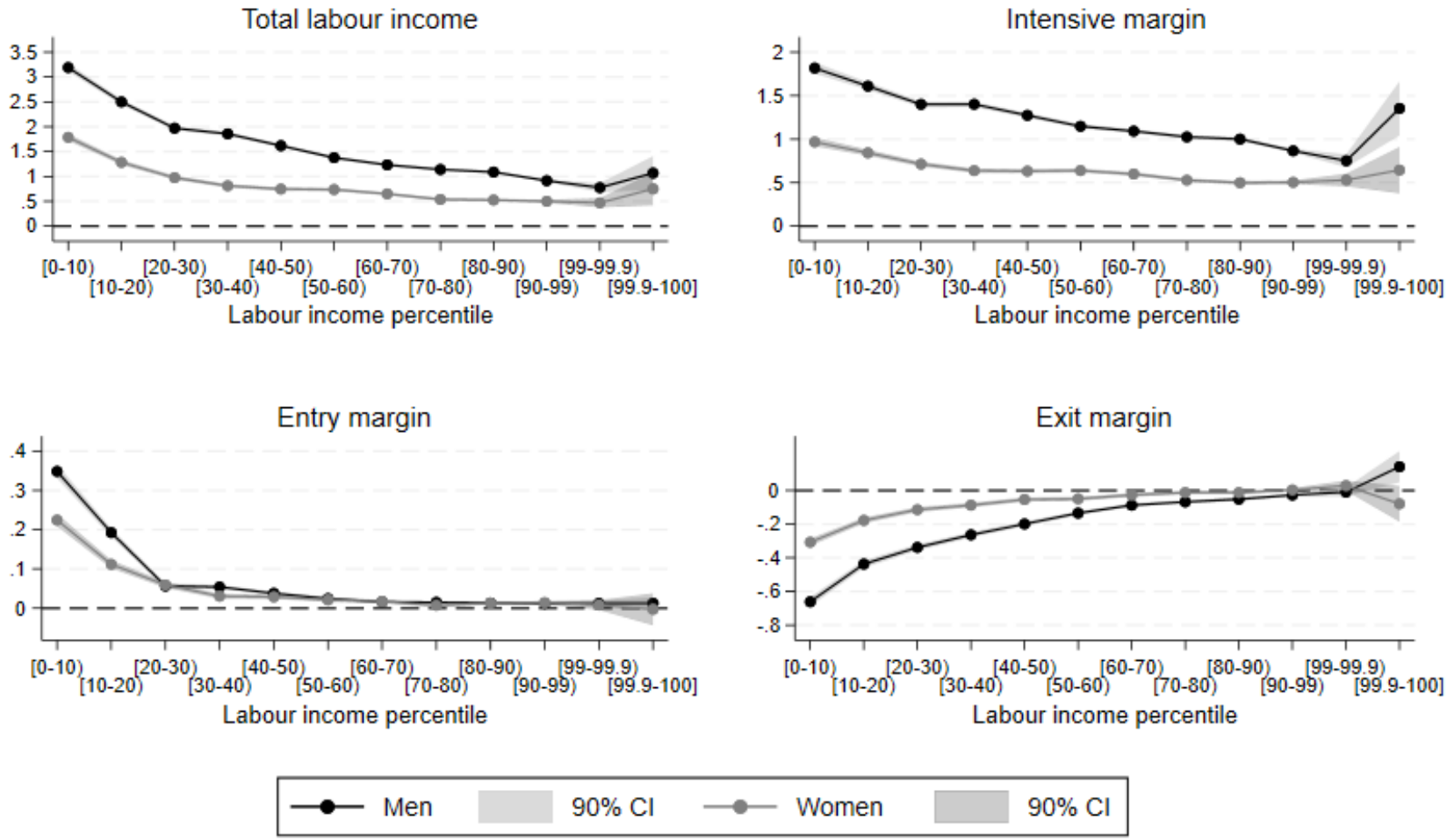
- Estonia is a member of the euro area since 2011 and imported **ECB's monetary policy** before that (Estonian crown was pegged to euro)
- Estonian **labour market has high flexibility** and is much closer to the US than the labour markets of related papers on Scandinavian or French and German data
- **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



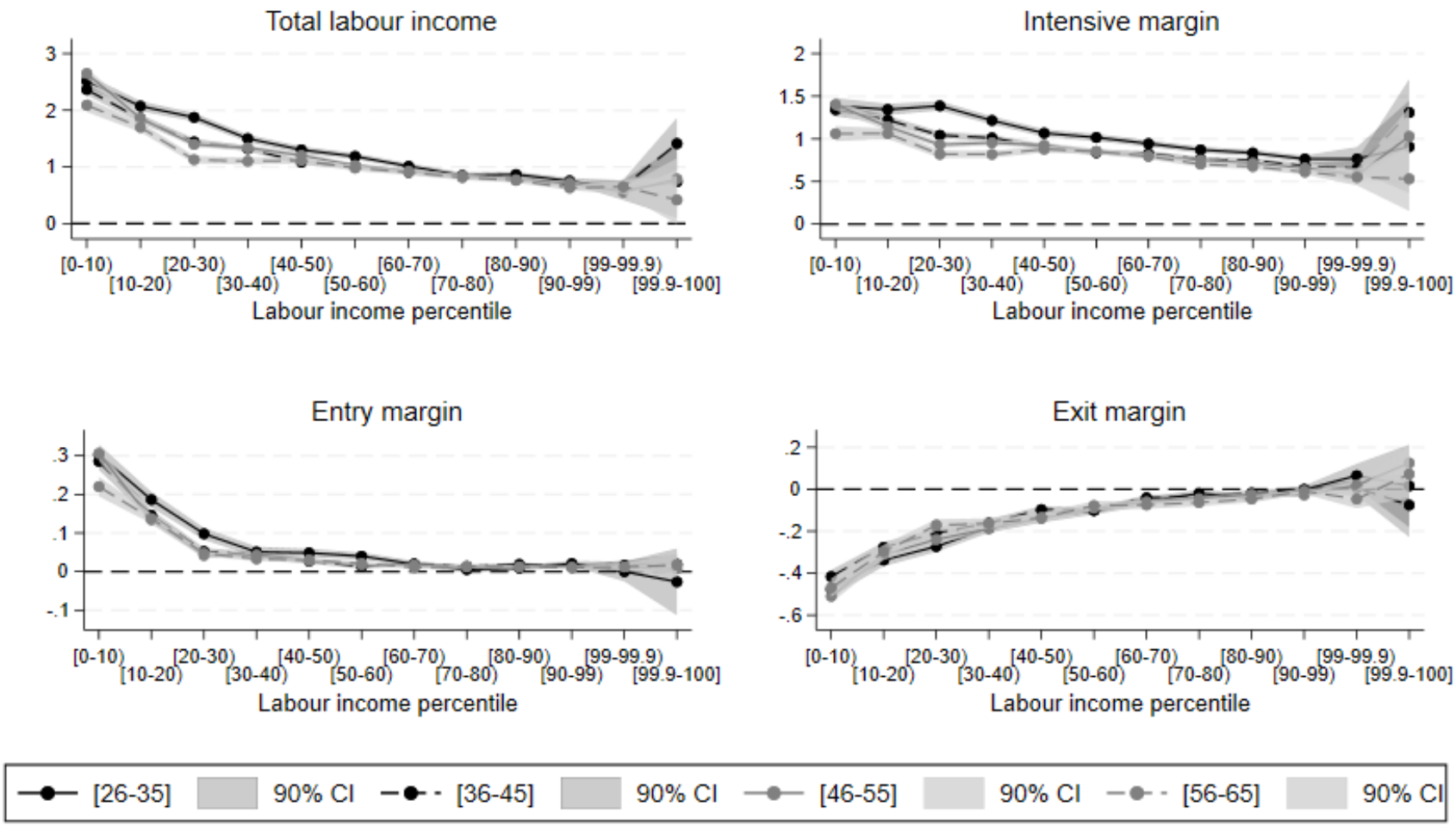
- Low-wage earners get the most out of economic growth
- Weak U-shape, the top 0.1% earners obtain increasing gains

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)

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