Monetary Policy and Earnings Inequality: Inflation Dependencies

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Aim and contribution

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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 individuals** are affected the most by monetary policy (Coibion et al. 2017 US, Lenza and Slacalek 2024 DE, FR, IT, ES) or the least (Andersen et al. 2023 DK)
- or the effect has a **weak U-shape**, low-wage earners are affected the most (Amberg et al. 2022 SE, Broer et al. 2022 DE, Hubert and Savignac 2023 FR)
  - Tighter monetary policy $\rightarrow$ higher inequality in **earnings**
  - No estimates by **inflation regimes**

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- Redistributional effects **amplify** the response of consumption, individuals more likely exposed to monetary policy have **higher MPCs** (Auclert 2019)
  - Exposure of wages taken as **homogeneous by earnings groups** (Lenza and Slacalek 2024) or exposure of unemployment heterogeneous by earnings groups, but not **monetary policy specific** (Slacalek et al. 2020)
  - No quantification of the contribution of this channel to **aggregate consumption**

Data

- 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)
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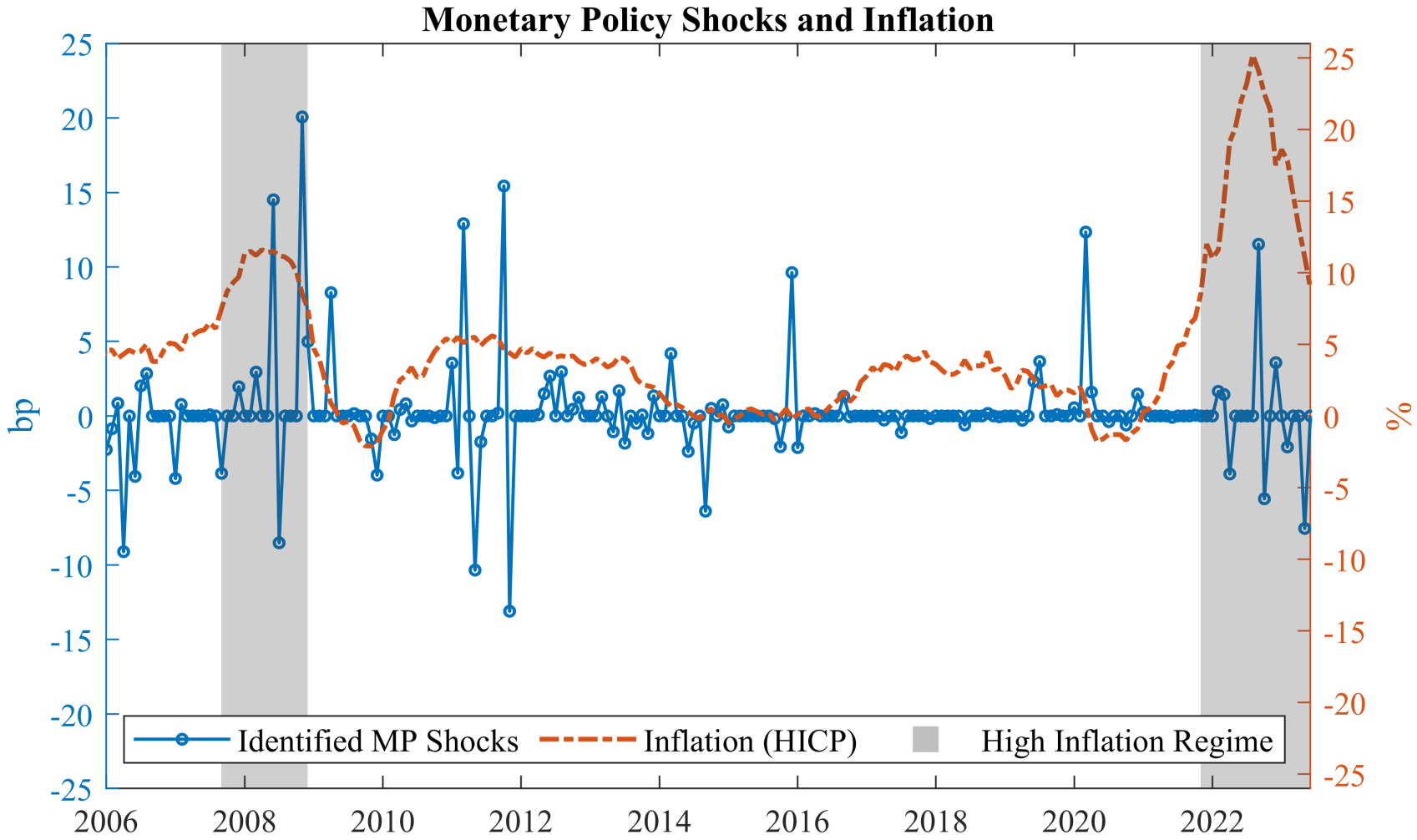
- Data from Estonia
  - High-quality **admin data on earnings at monthly frequency**
  - Part of the euro area, monetary policy has a strong effect (Almgren et al. 2022), likely due to **net interest rate exposure channel**
  - Institutional setting close to USA, flexible labour market and similar GDP 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 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:

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

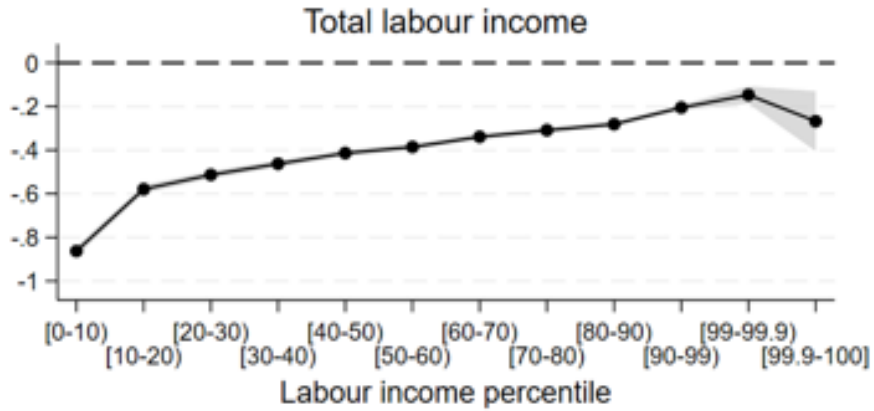
where

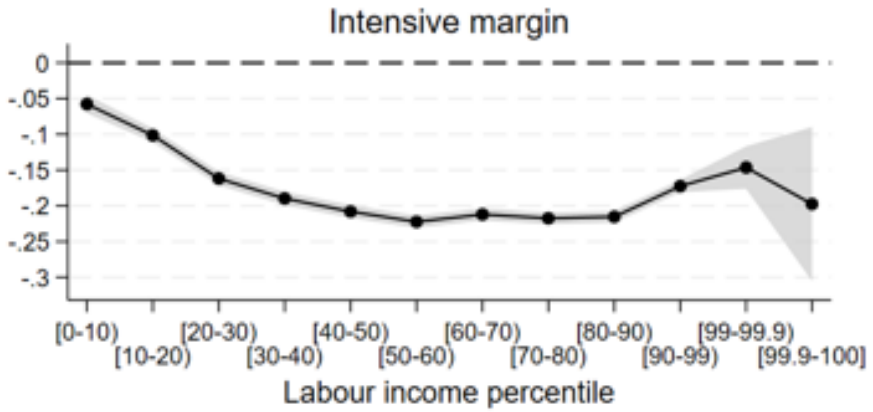
- $\Delta y_{i,t+h} = (y_{i,t+h} - y_{i,t}) / ((y_{i,t+h} + y_{i,t})/2)$ is the mid-point average growth of labour income of individual i at month $t+h$, a la Davis et al. (1996) where -2 denotes exit and 2 entry
- baseline horizon is 12 months, $h = 12$, robustness tests $h = 6, 18, 24$
- Δi_t is monetary policy shock at month t
- X_{t-1} denotes control variable y-o-y monthly GDP growth

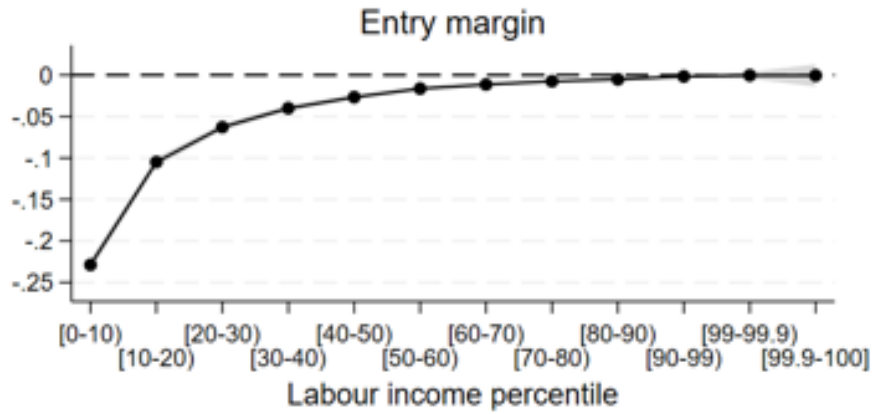
Estimate equation (1) separately for each of 12 income groups g, which are defined by **the average yearly labour income** from $t-12$ to $t-1$

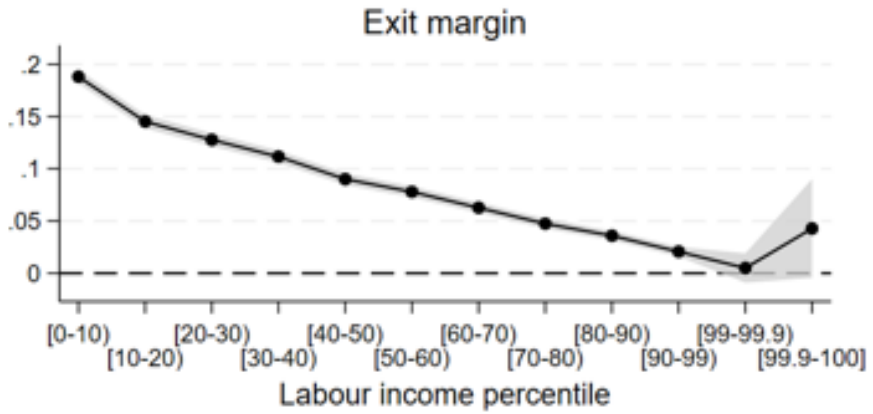
- β_g^h captures the income group-specific effect of monetary policy and
- Γ_g^h the income group-specific effect of past GDP growth on labour income

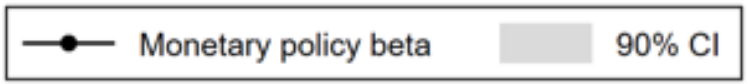
Baseline results: 100bp MP impact by M12





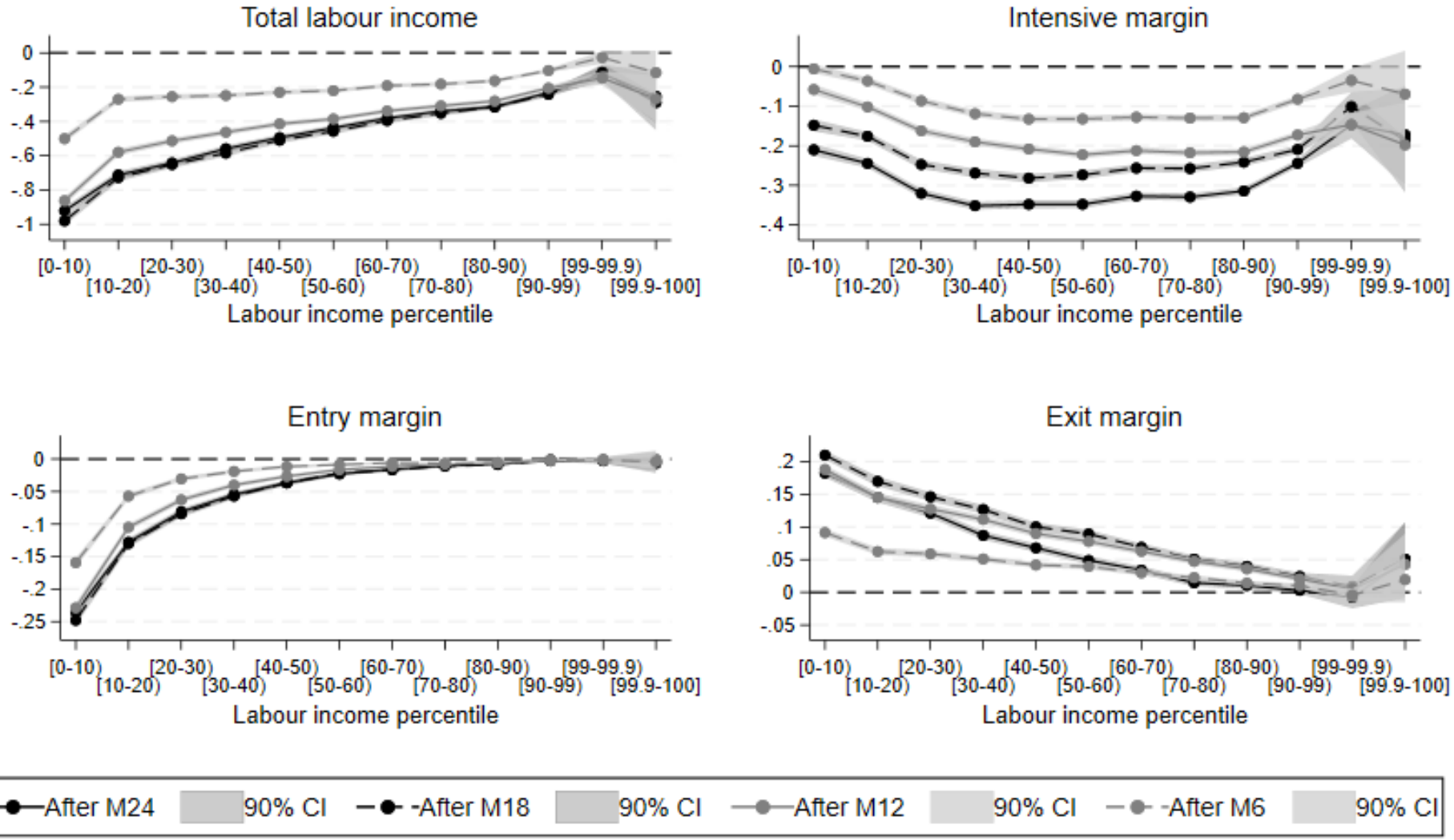






- **Low-wage earners** affected the most, small swing up at 0.01%
- **Extensive margin** more important for low-wage earners (Hubert and Savignac 2023, Broer et al. 2022)

Robustness: time horizon

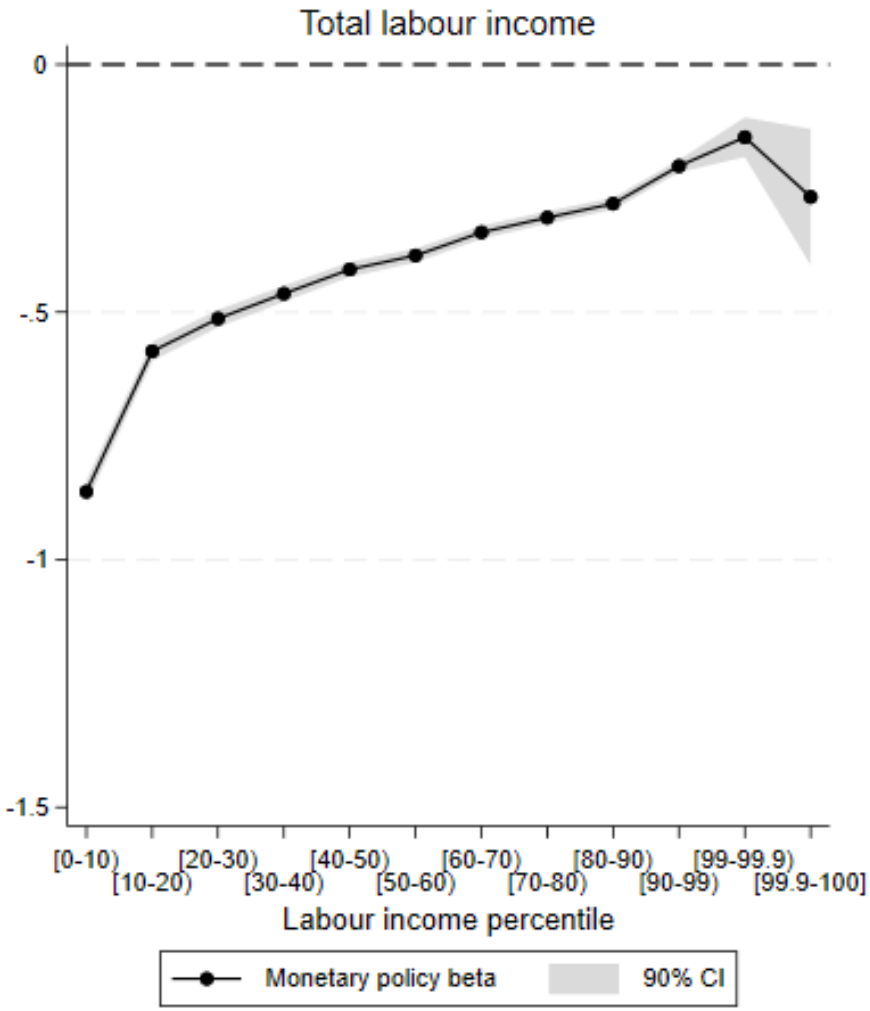


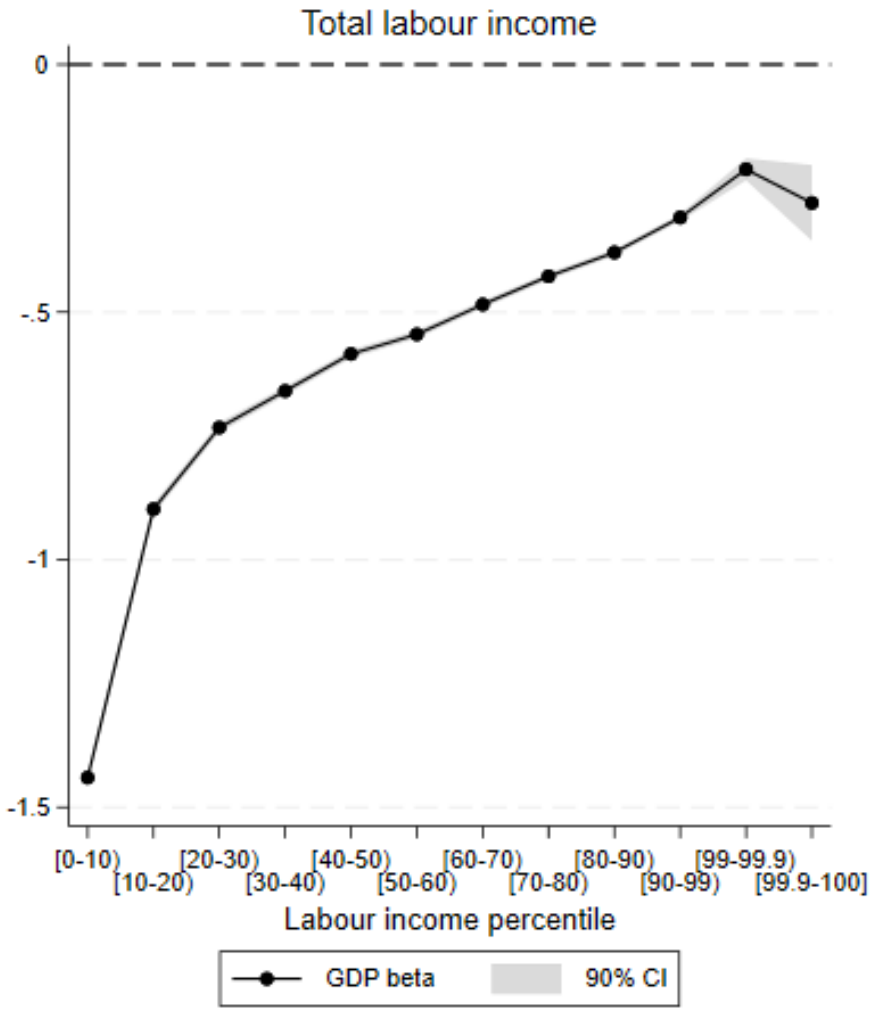
- Most of the monetary policy effect takes place **by month 12**
- **Extensive margin materialises quicker** than intensive margin

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





Empirical specification by inflation regime

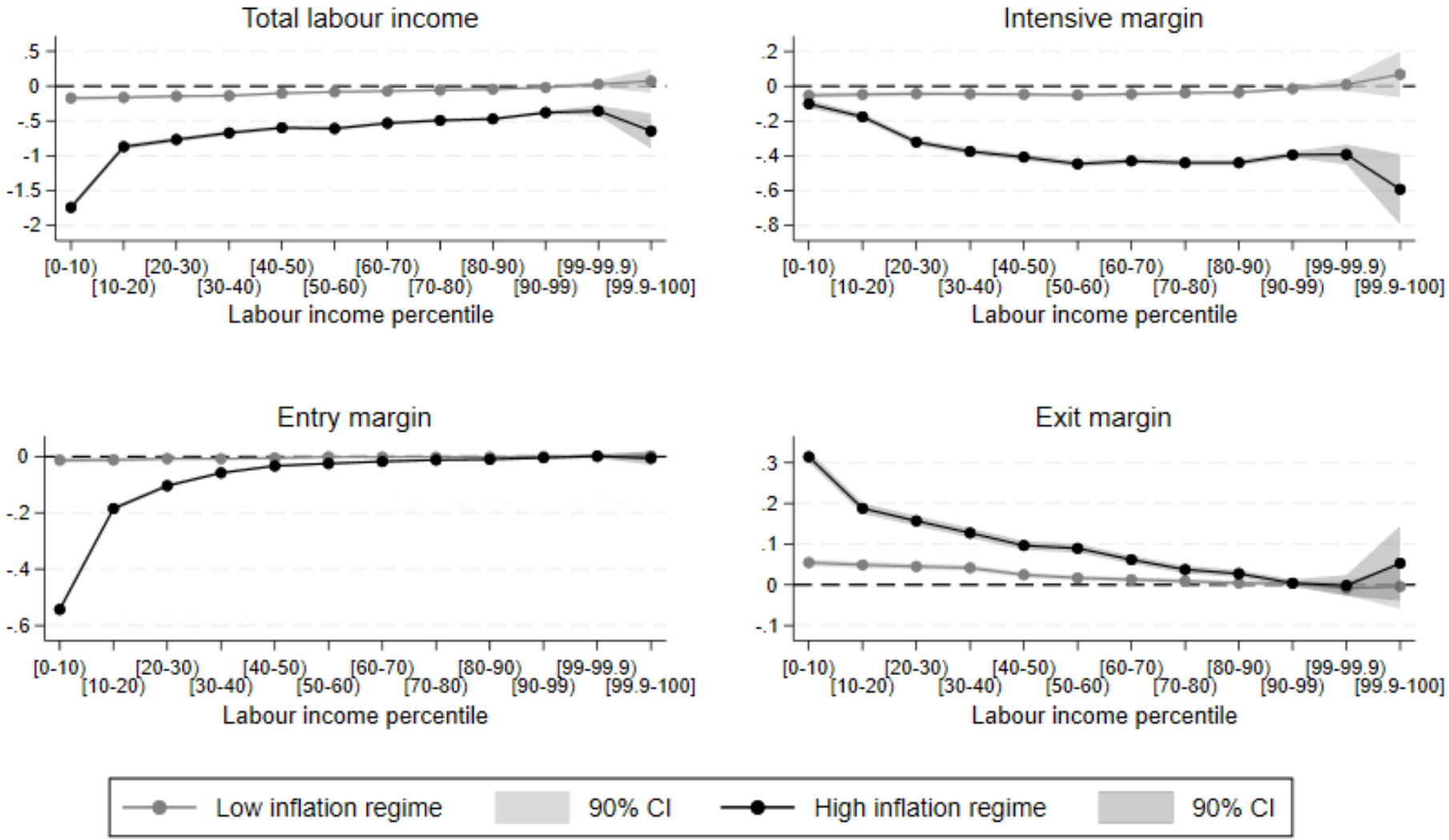
Add interaction terms of high and low inflation periods with MP and GDP

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

where

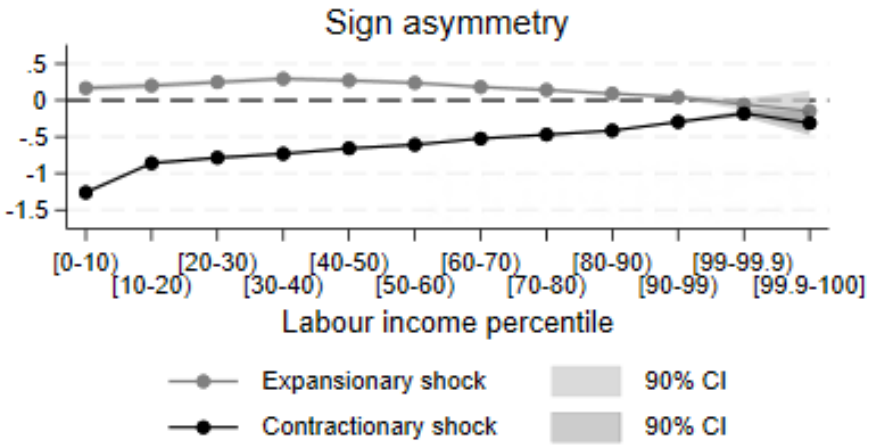
- r denotes regime, $r = L, H$; $R_t = 1$ if inflation is 7% and higher and $R_t = 0$ otherwise
- regime is defined at $t-1$, **1 month before the MP shock**
- $\beta_g^{h,L}$ captures the impact of monetary policy **in the low inflation regime** and $\beta_g^{h,L}$ **in the high inflation regime** for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

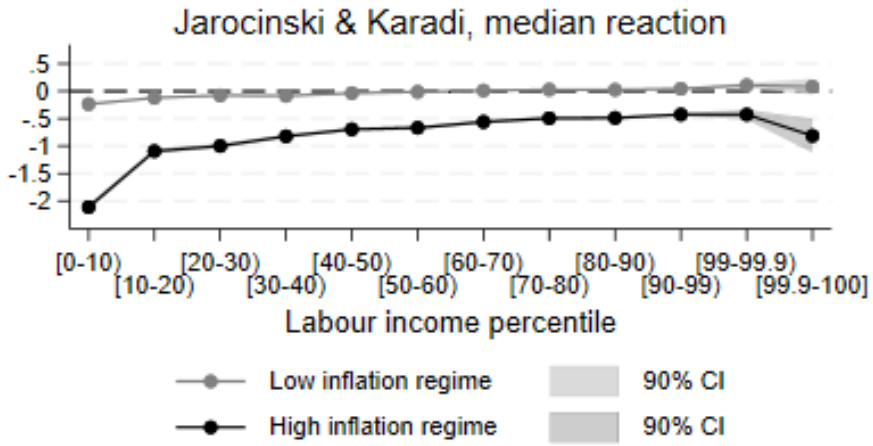
Results by inflation regime

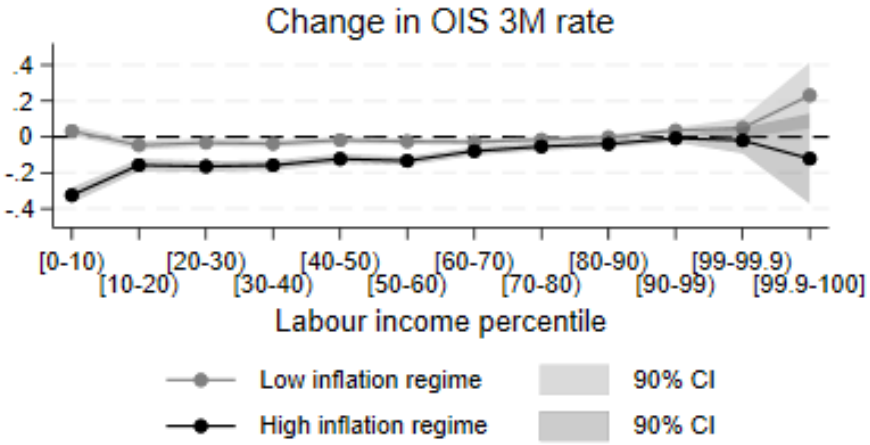


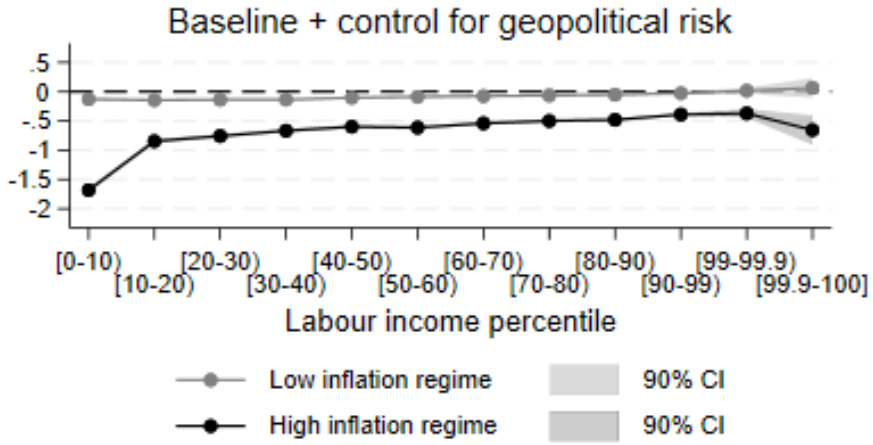
- MP is **more powerful in the high-inflation** regime (Gargiulo et al. 2024, Tenreyro and Thwaites 2016)
- **Heterogeneity by regime**: regime *L* linear, regime *H* weak U-shape

Robustness: sign asymmetry, MP shock and controls









- **Contractionary shocks** have a stronger effect (both shocks in both regimes)
- MP more powerful in **high-inflation regime** using alternative MP shocks and controlling for the 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:

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

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
- $\gamma_j = \frac{dE_j}{dY}\frac{Y}{E_j}$ 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**
  - $\rightarrow$ 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

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:

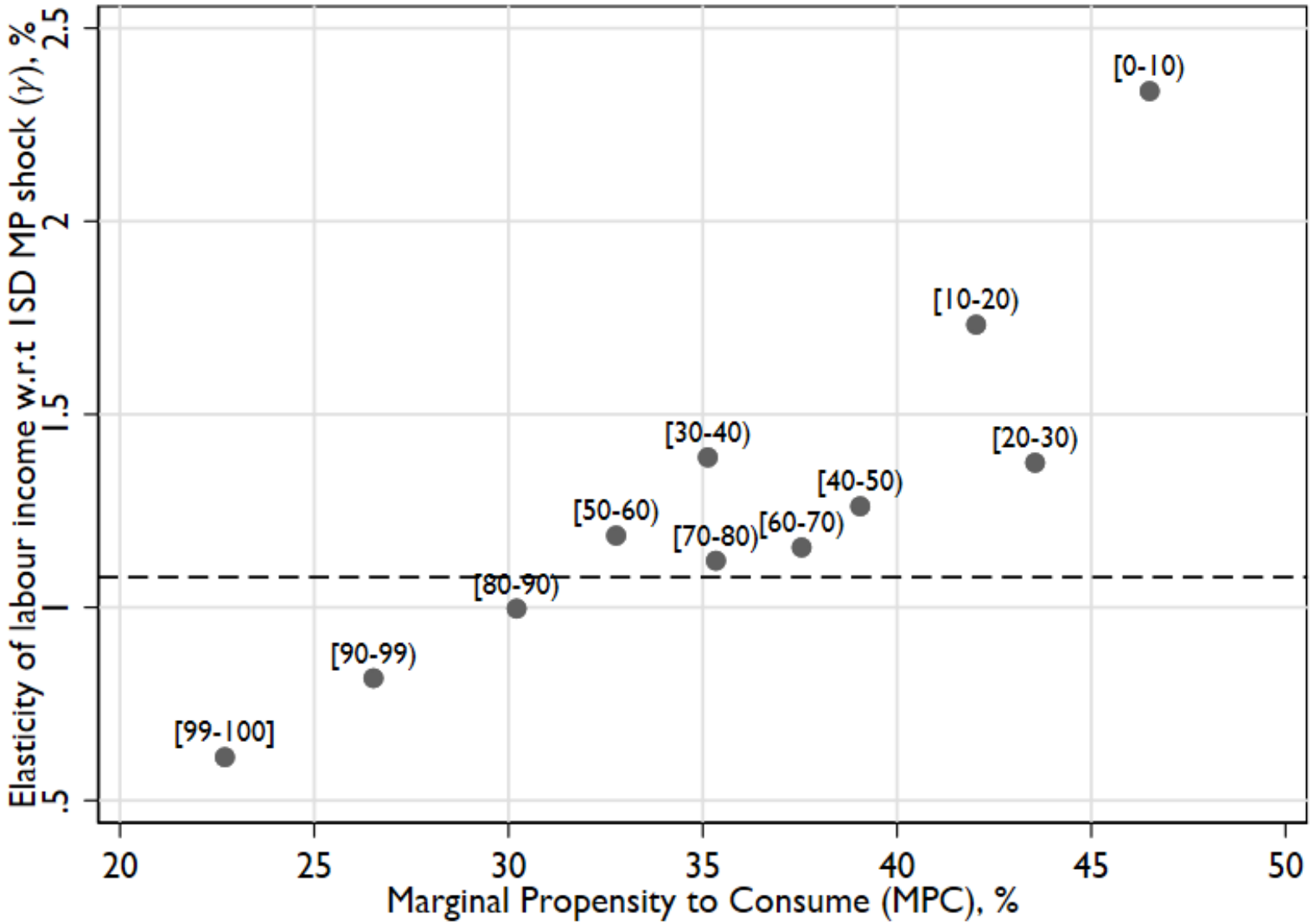
$$MPC = \sum_j iw_j \frac{\gamma_j}{\bar{\gamma}} \frac{dC_j}{dE_j}, \tag{5}$$

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:

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

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%
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. Who's earnings are affected the most by monetary policy?
   - **Low-income workers** $\rightarrow$ inequality increases with tightening and declines with expansionary policy
   - **Extensive margin** dominant for low-income workers - transitions into and out of employment

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2. In which regime is the monetary policy the most powerful?
   - In **the high inflation** regime
   - Suggests steeper Phillips curve, stronger price rigidity and increasing degree of attention during high inflation periods

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2. In which regime is the monetary policy the most powerful?
   - In **the high inflation** regime
   - Suggests steeper Phillips curve, stronger price rigidity and increasing degree of attention during high inflation periods

3. How much does the earnings heterogeneity channel matter for the transmission of MP to **aggregate consumption**?
   - On average **5%**
   - Amplification is stronger in low inflation regime, 11% vs 5%
   - ... but the effect on consumption and inequality is stronger in high inflation regime due to more powerful MP in this regime

THANK YOU!

Comments and questions:

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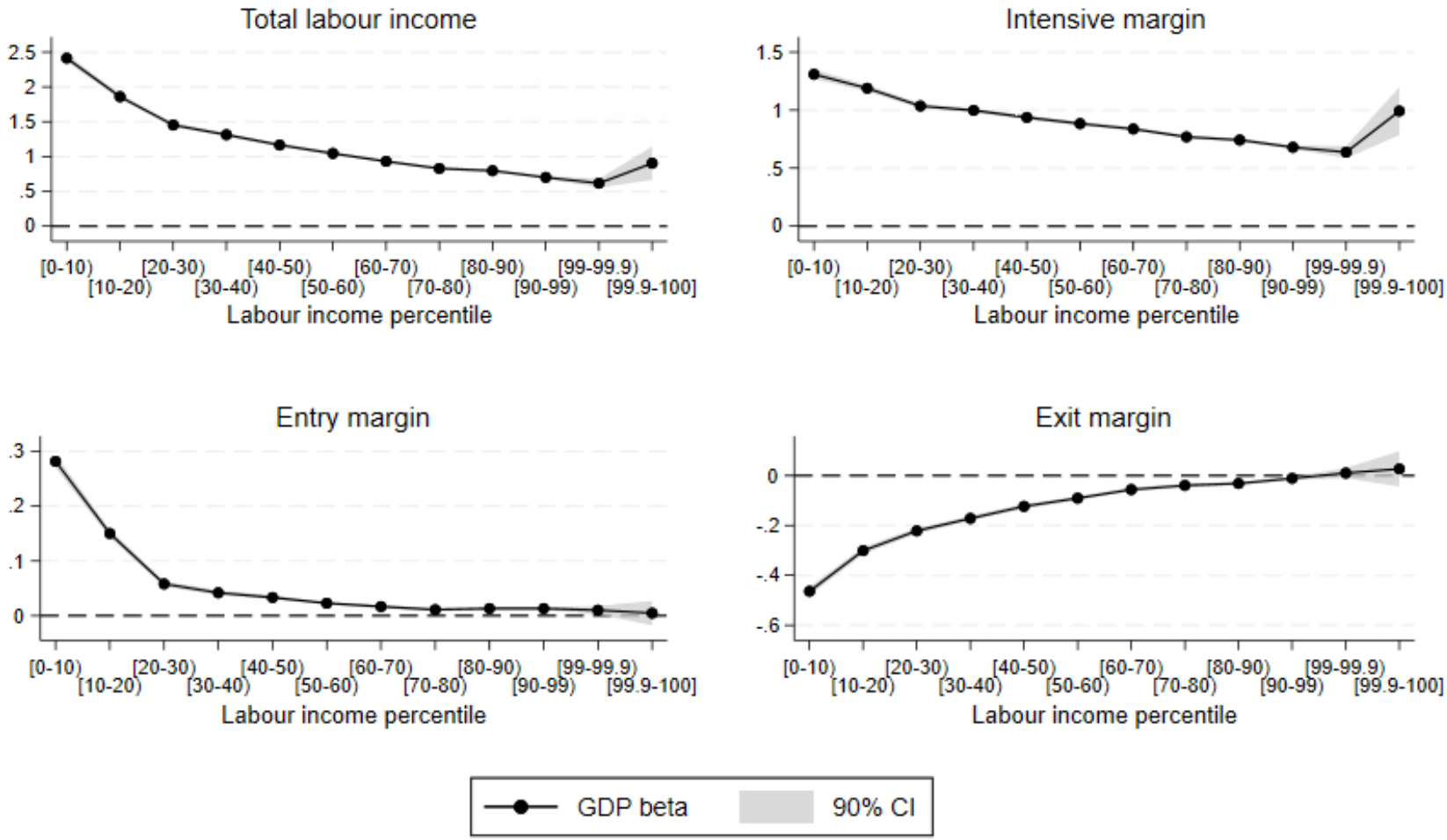
Descriptives on earnings, 2008M1-2023M9

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

External validity

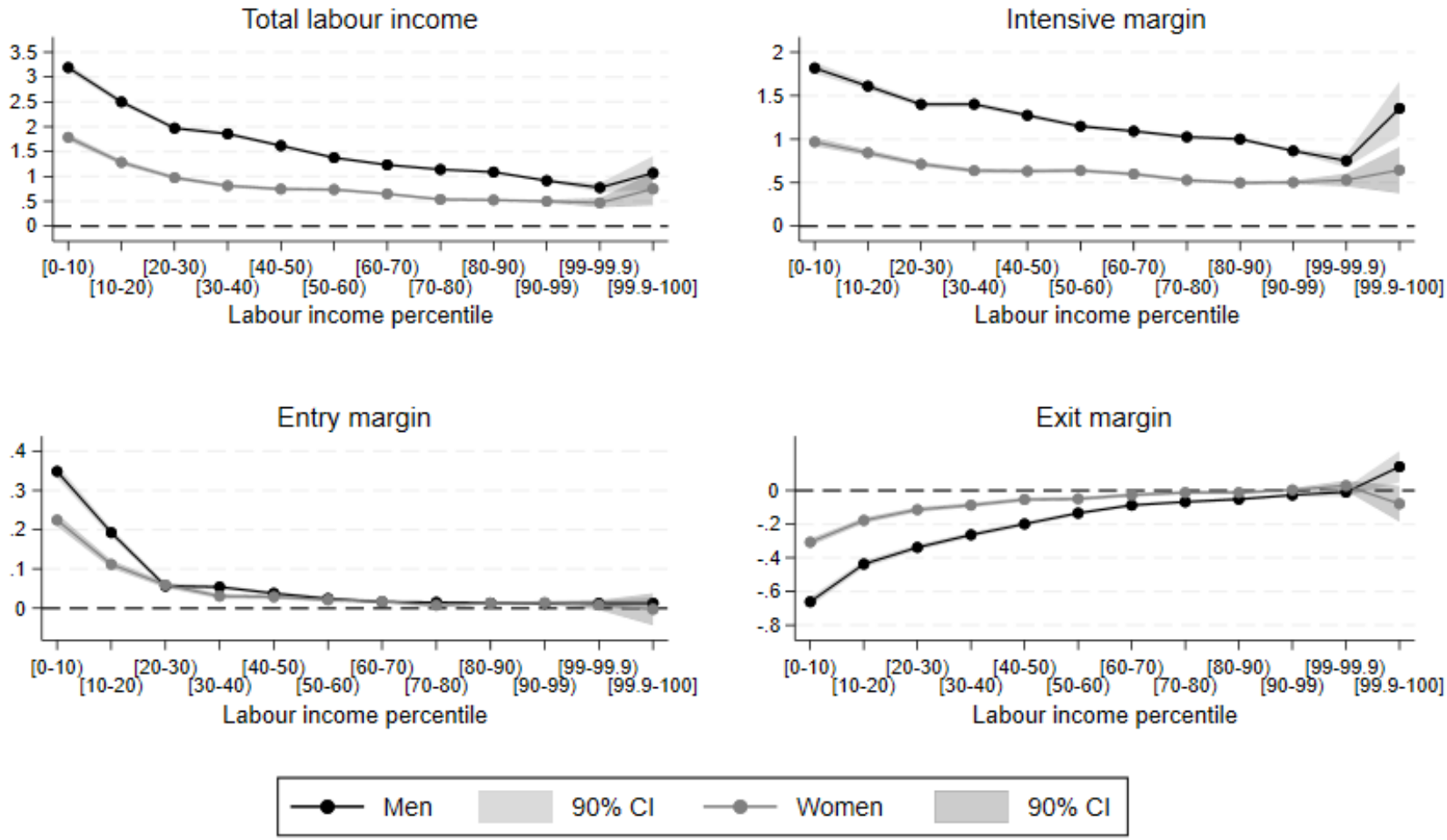
- Estonia is a member of the euro area since 2011 and imported **ECB's monetary policy** before that (Estonian crown was pegged to euro)
- Estonian **labour market has high flexibility** and is much closer to the US than the labour markets of related papers on Scandinavian or French and German data
-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



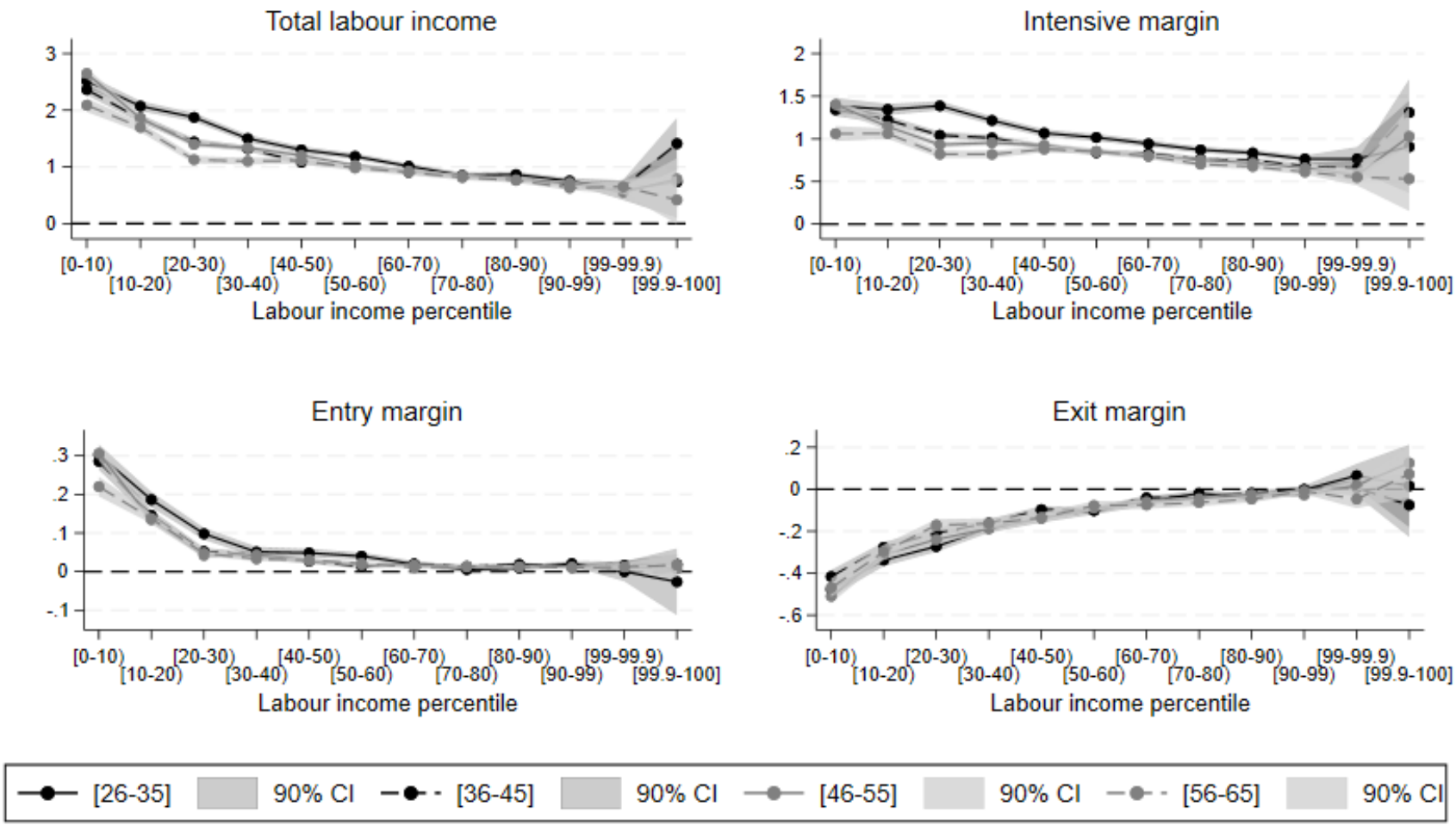
- Low-wage earners get the most out of economic growth
- Weak U-shape, the top 0.1% earners obtain increasing gains

GDP betas - men vs women



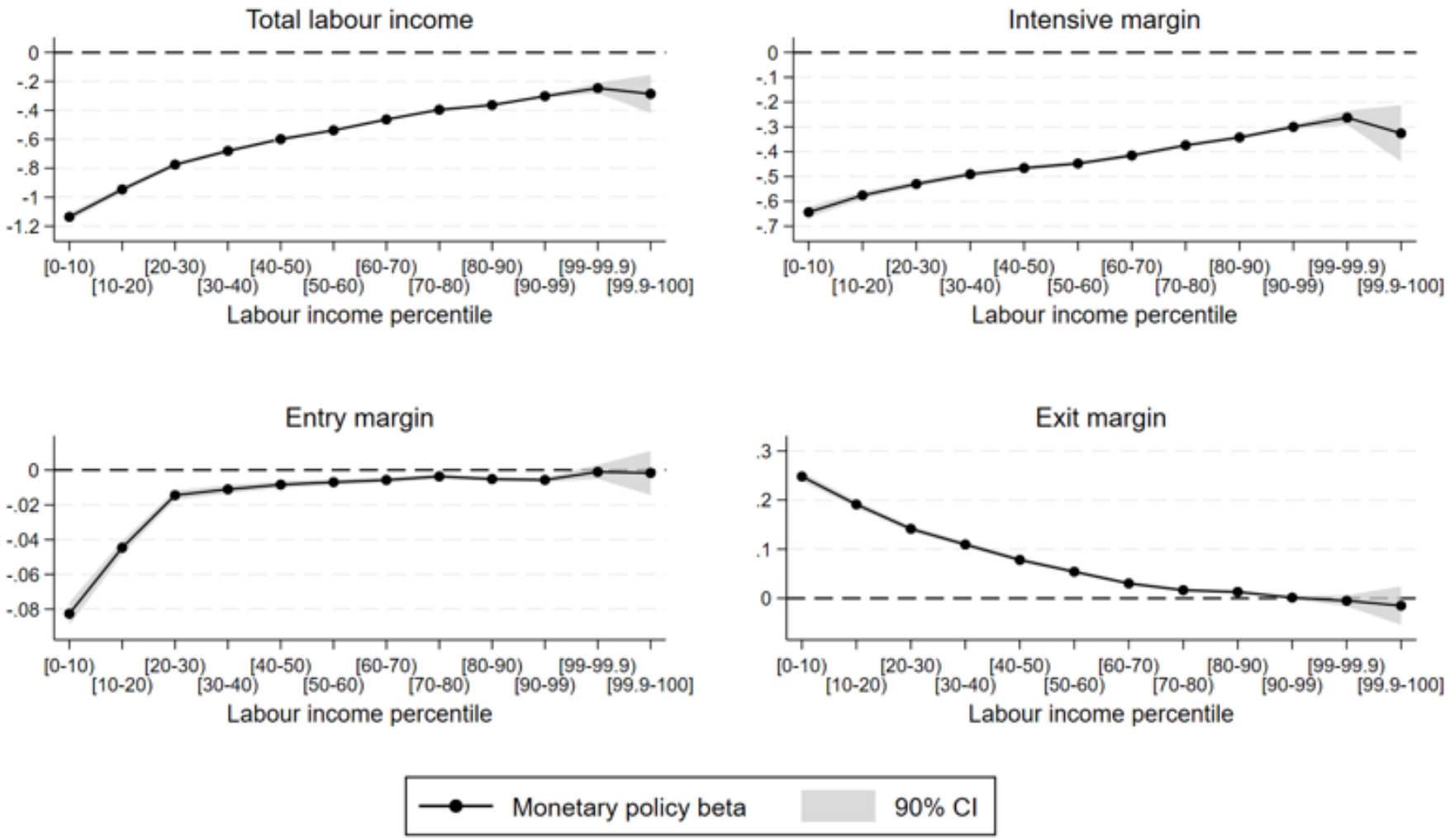
- Men gain the most, especially at the lower end
- Men's higher sensitivity to BC is similar to US (Guvenen et al. 2017)

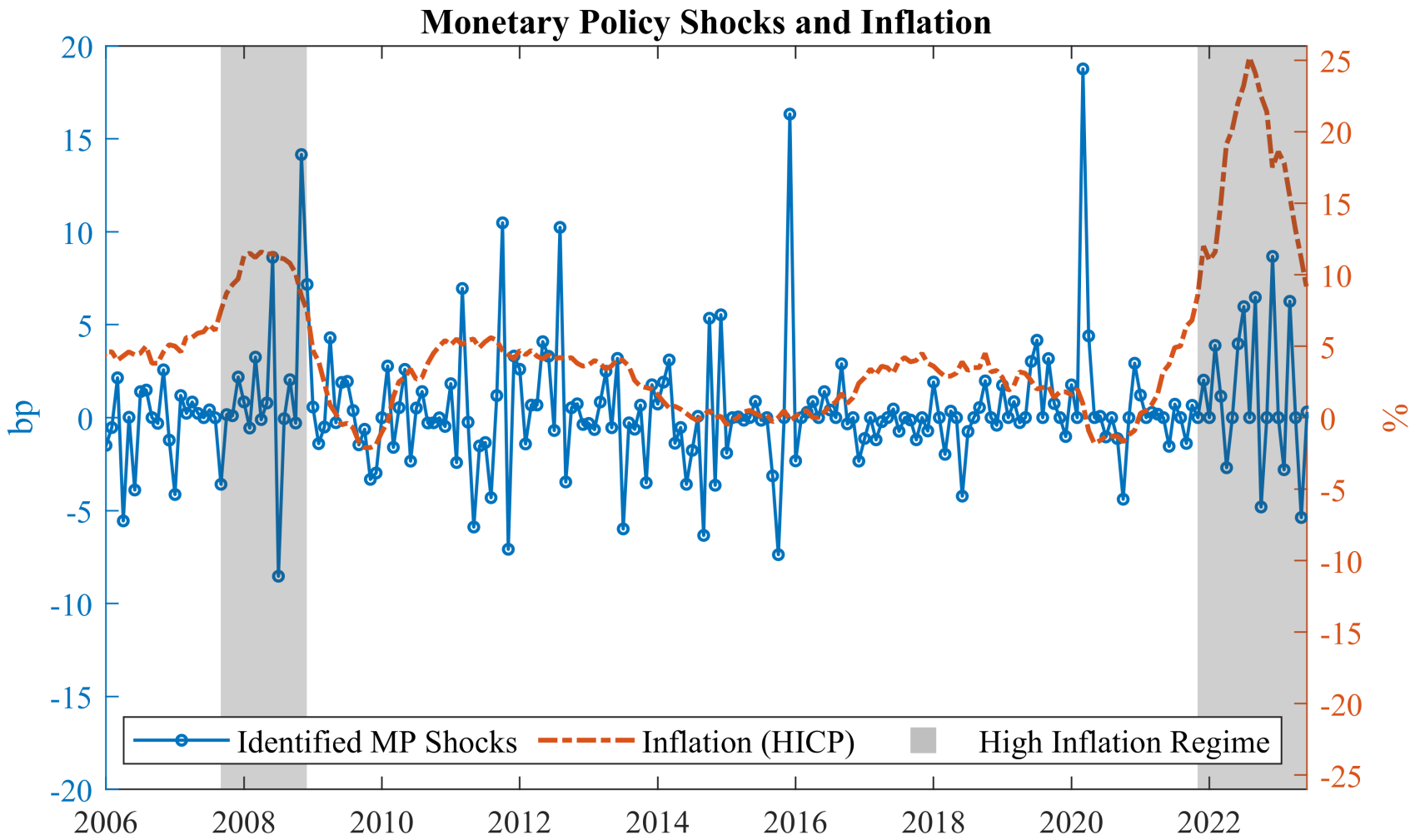
GDP betas - young vs old



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

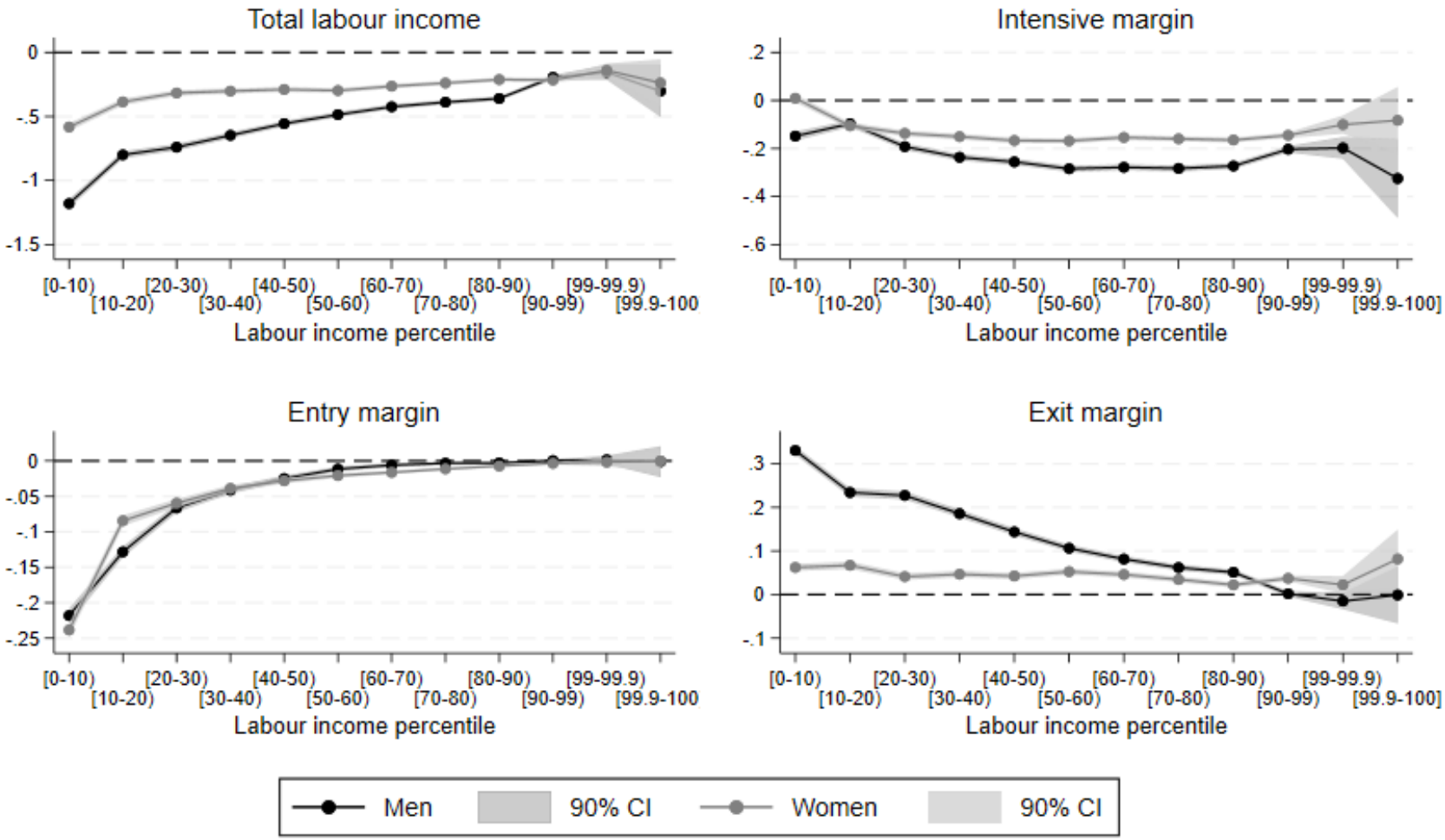
MP impact by M12: yearly data



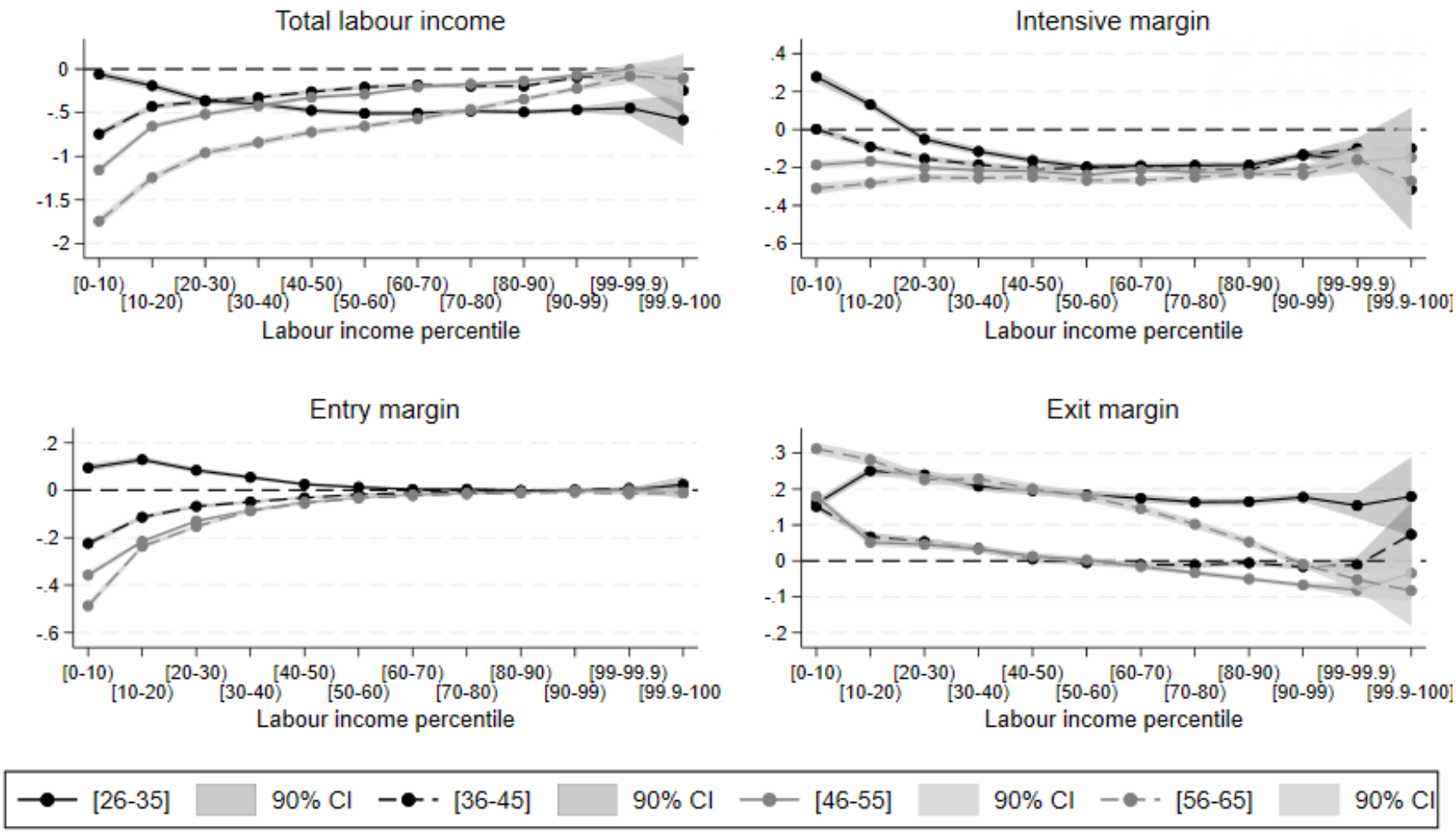


- Jarocinski and Karadi (2020) Bayesian VAR-based median reaction

The effect of monetary policy shock by gender



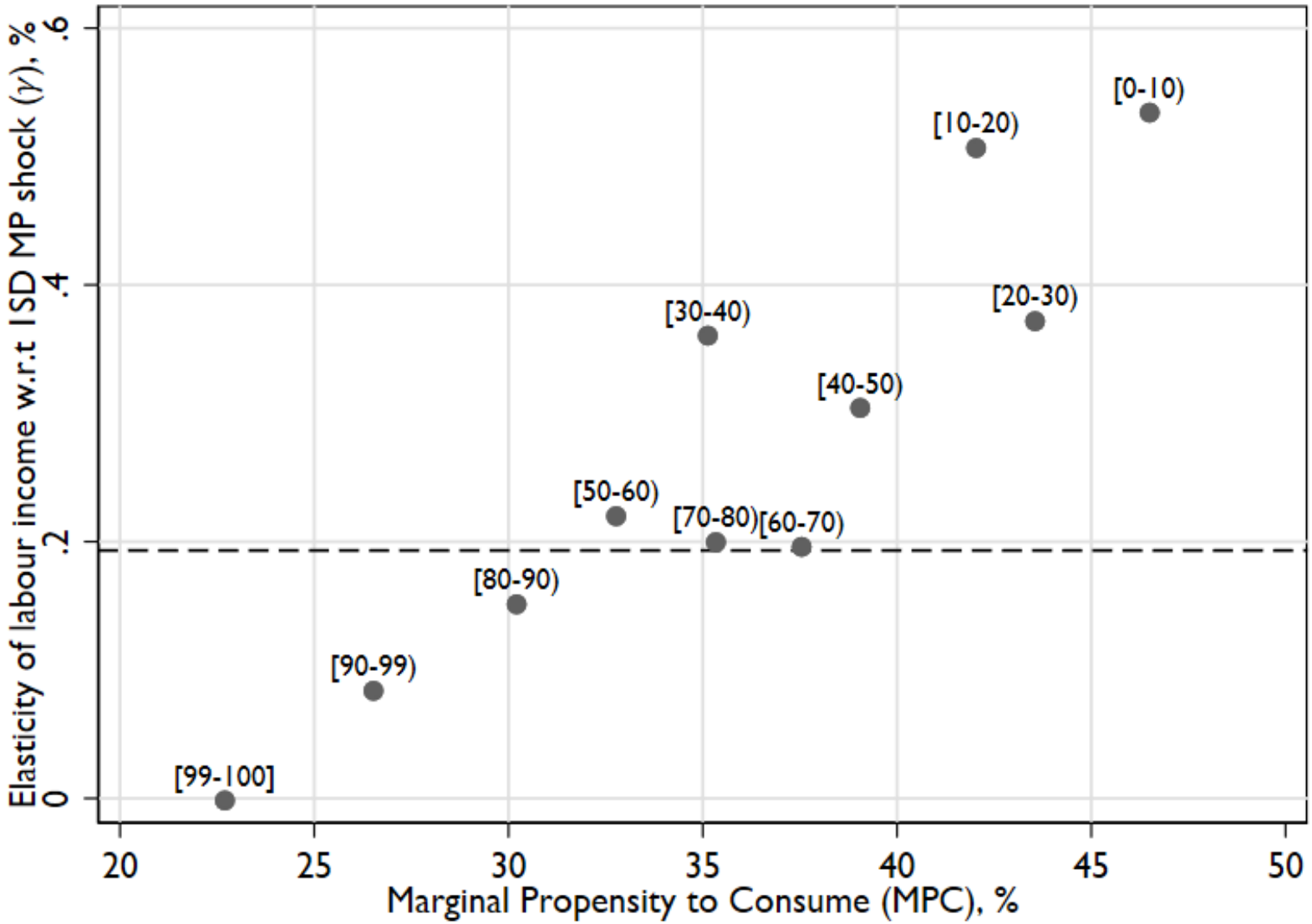
The effect of monetary policy shock by age



Monetary policy effect by regime, 2008M1-2023M9

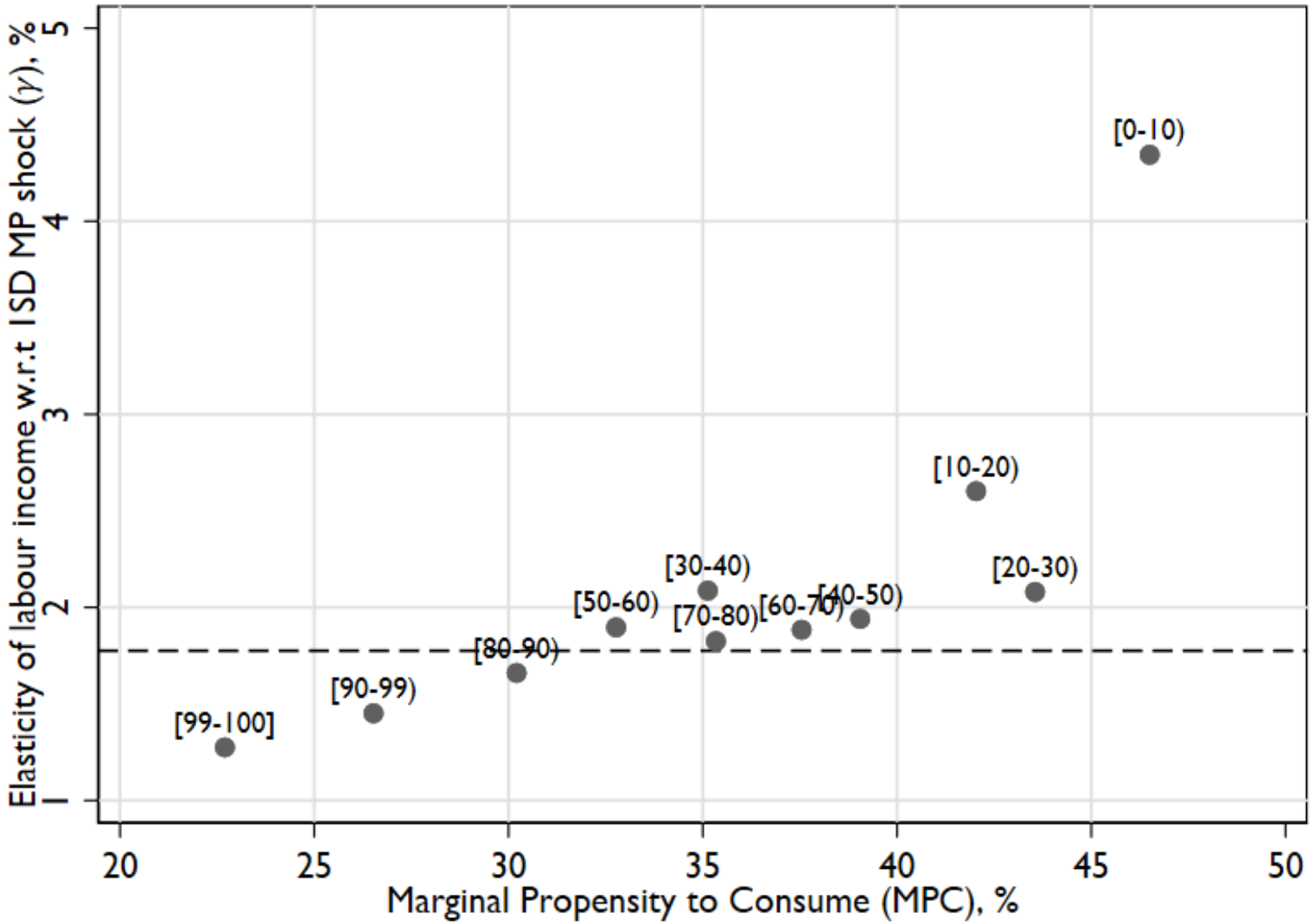
	Low inflation		High inflation	
	(1) Total labour income	(2) Intensive margin	(3) Total labour income	(4) Intensive margin
$[0-10)$	-0.005***	-0.002***	-0.055***	-0.003***
$[10-20)$	-0.005***	-0.001***	-0.028***	-0.006***
$[20-30)$	-0.005***	-0.001***	-0.024***	-0.010***
$[30-40)$	-0.004***	-0.001***	-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***

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.

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