# The Curious Incidence of Shocks along the Income Distribution

Conference on Monetary Policy Tools and Their Impact on the Macroeconomy

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# Introduction: Micro $\Longleftrightarrow$ Macro

## Broad Motivation

- What are the distributional consequences of aggregate shocks?
- Through what channels do aggregate shocks affect individuals?
- How does heterogeneity affect aggregate outcomes?

## What we do:

1. Use a large German administrative dataset to measure heterogeneous co-movement of
   - Earnings
   - Separation rates
   - Job-finding rates

   with aggregate income fluctuations
2. Measure responses to identified Monetary (and Fiscal) shocks

# Theory and evidence so far

## Heterogeneity and Monetary Policy

- Theory suggests that heterogeneity has the potential to impact the transmission of MP
- Scant empirical evidence (so far)

## (Quantitative) Theory:

- Gornemann et al (2012), McKay et al (2016), Auclert (2019), Kaplan et al (2018), Werning (2015), Ravn & Sterk (2017), Broer et al (2019), Hagedorn et al (2019a,b), Bilbiie (2018)

## Empirical evidence

- Coibion et al (2017), D'Acunto et al (2019a,b), Patterson (2018), De Giorgi & Gambetti (2017), Alves et al (2019), Almgren et al (2019)

# What we find

- Workers at the bottom of the income distribution are more exposed to aggregate earnings risk, and to monetary policy shocks
- Holds for continuously employed workers, even more for those that alternate between employment and non-employment
- Effect comes mainly from booms, less so from recessions
- Effect of shocks on job-finding and separation rates are also strongly heterogeneous along the income distribution

# Outline

1. Quick review of theory
2. Description of the data
3. Worker "$\beta$"s and decomposition
4. Responses to identified shocks
5. Conclusions

# Theory: Heterogeneity and Aggregate Demand

Focus on two channels related to earnings:

- Earnings heterogeneity channel (Auclert 2019, Patterson 2020)

$$dC = \sum \left( MPC_i \frac{dY_i}{dY} \right) dY = \underbrace{\overline{MPC} dY}_{\text{Agg. Income}} + \underbrace{Cov\left( MPC_i, \frac{dY_i}{dY} \right) dY}_{\text{Earnings Heterogeneity}}$$

- Cyclicality of income risk (Werning 2015, Ravn & Sterk 2017)

| Income Risk | | Respose of $C$ to $R$ |
|---|---|---|
| countercyclical | → | higher sensitivity |
| acyclical | → | 'As if' representative agent' |
| procyclical | → | lower sensitivity |

# Data

Two percent sample of German Labor Market Histories 1974-2014

- 1.7 million individual histories
- Labor market spells split into Episodes (~ 12 months)
- ~ 300 million month-person observations
- Labor market status, compensation, benefits

Peculiarities

- Focus on Euro-sample (2000-2014) for Monetary shocks, otherwise 1980-2014
- "Daily Wage" is average earnings during an episode

# Definitions

Labor market statuses

- Employed (E)
  - Subcategory 'Fully attached': Excluding interns, early retirees, etc
- Unemployed (U)
  - Recipients of unemployment benefits (ALG I)
- Not in the labor force (N)
  - Not in previous categories

Transitions: $t$ and $t+12$

- Job Stayer: same employer in $t$ and $t+12$, no interruptions
- Job Switcher: employed in $t$ and $t+12$, but not Stayers
- E2U: employed in $t$, unemployed in $t+12$
- E2N: employed in $t$, not in labor force in $t+12$
- N2E: not in labor force in $t$, employed in $t+12$

# Descriptive statistics

**Table 1:** Descriptive Statistics by Decile – January 2000

| | (1) | (2) | (3) | (4) | (5) | (6) | (7) | (8) | (9) | (10) |
|---|---|---|---|---|---|---|---|---|---|---|
| | mean | mean | mean | mean | mean | mean | mean | mean | mean | mean |
| Female | 0.77 | 0.73 | 0.59 | 0.50 | 0.43 | 0.36 | 0.32 | 0.30 | 0.24 | 0.13 |
| Age | 39.32 | 39.91 | 38.52 | 38.26 | 38.69 | 39.69 | 40.81 | 41.43 | 42.30 | 44.02 |
| Edu | 1.10 | 1.07 | 1.09 | 1.10 | 1.10 | 1.11 | 1.15 | 1.22 | 1.44 | 1.74 |
| Skill | 1.97 | 2.03 | 2.09 | 2.10 | 2.11 | 2.13 | 2.19 | 2.32 | 2.59 | 2.99 |
| Part time | 0.47 | 0.41 | 0.26 | 0.16 | 0.09 | 0.05 | 0.04 | 0.03 | 0.02 | 0.01 |
| Wage | 19.60 | 38.79 | 50.09 | 60.12 | 69.04 | 77.45 | 86.26 | 97.98 | 116.01 | 141.60 |
| Empl t+1 | 0.80 | 0.88 | 0.91 | 0.93 | 0.95 | 0.95 | 0.96 | 0.96 | 0.95 | 0.95 |
| Obs | 48409 | 48752 | 51788 | 44532 | 51884 | 46602 | 49641 | 47108 | 46905 | 48001 |

# Aggregate earnings "betas"

- Also include year-month fixed effects
- Group individuals into percentiles by past earnings (5 years).
- Then estimate

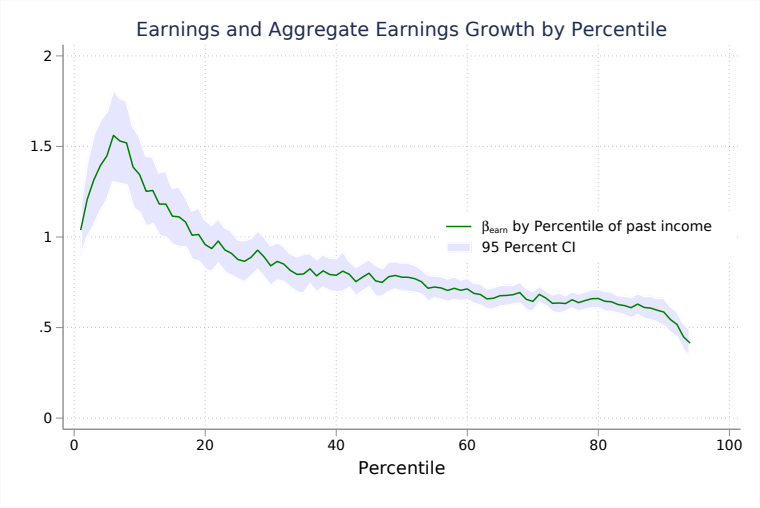
$$\Delta y_{j,t}^{p} = \alpha + \beta_{earn}^{p} \Delta Y_t + \varepsilon_{j,h}$$

for $\Delta x_t = \log(x_{t+12}) - \log(x_t)$

- Also include year-month fixed effects
- The sample starts in 1980 and excludes former East Germany.
- First: only include individuals fully attached in $t$

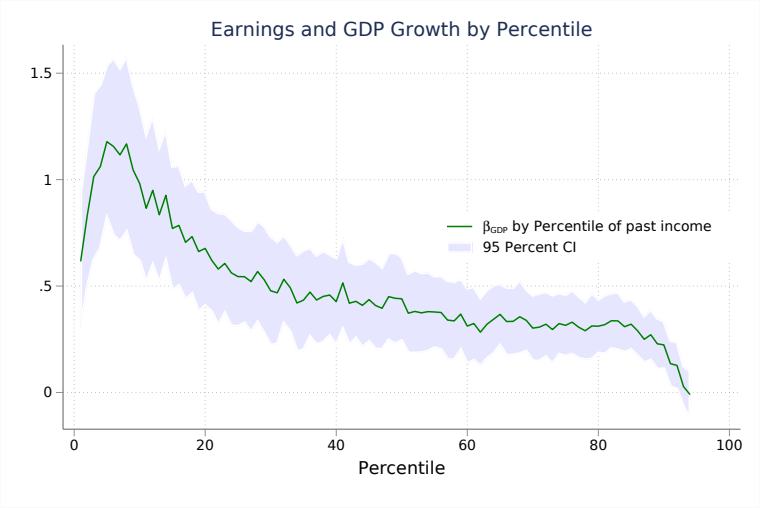
# Aggregate earnings betas

$$\Delta y_{j,t}^{p} = \alpha + \beta_{earn}^{p} \Delta Y_t + \varepsilon_{j,h}$$



# Aggregate earnings betas - GDP

$$\Delta y^p_{j,t} = \alpha + \beta^p_{GDP} \Delta GDP_t + \varepsilon_{j,h}$$



# Aggregate earnings betas – split by aggregate growth rates

$$\Delta y^{d}_{j,t} = \alpha + \gamma_{\Delta Y \lesseqgtr \overline{\Delta Y}} \beta^{p}_{earn} \Delta Y_t + \varepsilon_{j,h}$$

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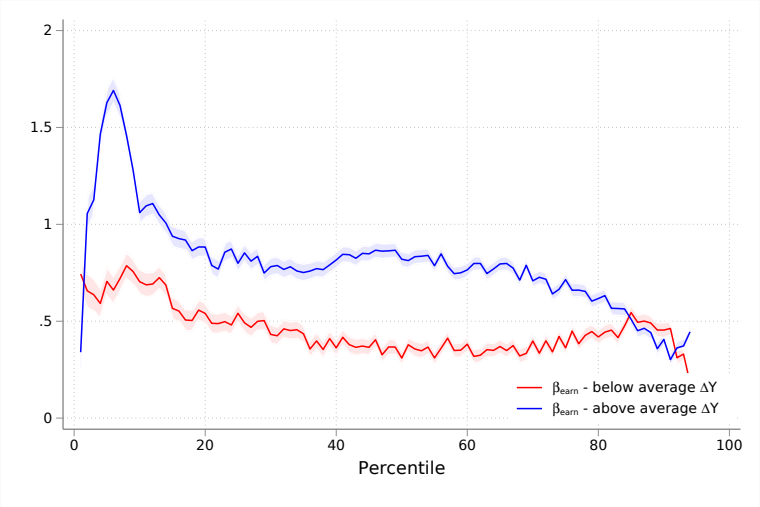

# Aggregate earnings betas - different income distributions

Split individuals by residual earnings and fixed effects.

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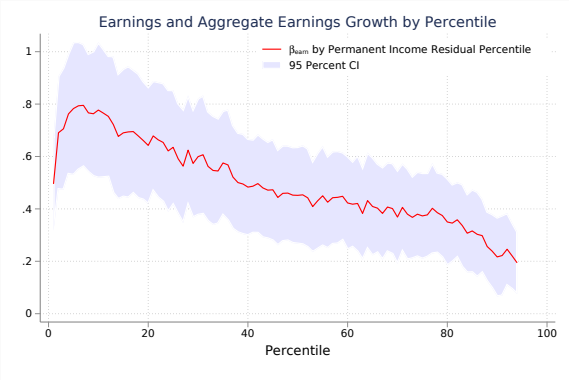
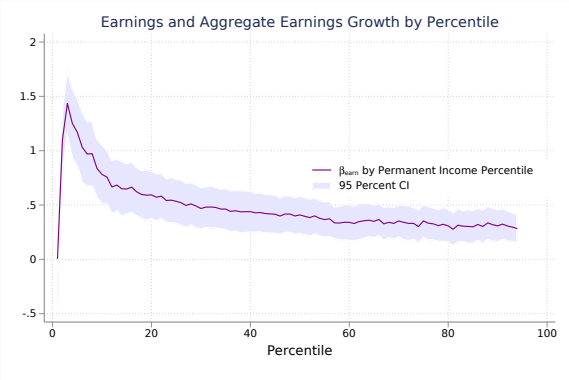


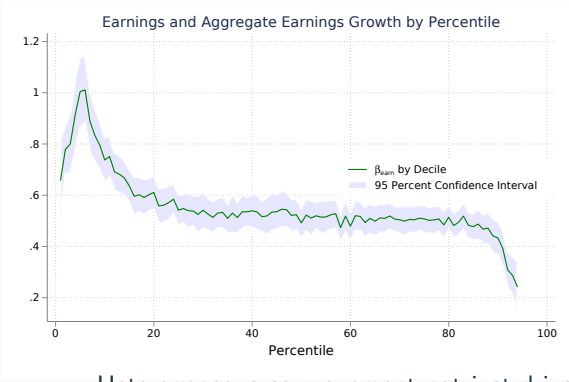




Controls used in Mincer regression: AGE, $\text{AGE}^2$, GENDER, SCHOOLING, OCCUPATION.

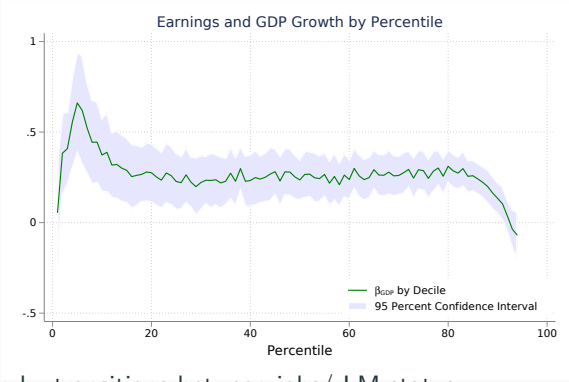
# Aggregate earnings betas - different sample

Split individuals by past earnings (5 years), only including

**(a)** Fully attached



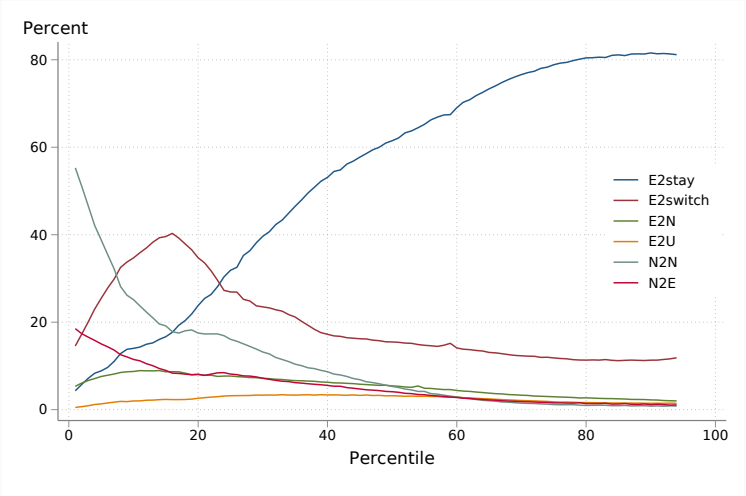

**(b)** Stayers




- Heterogeneous co-movement not just driven by transitions between jobs/ LM status
- But: Change in magnitude points to importance of changes in job/ labor market status, particularly at bottom of distribution

# Heterogeneity in 12m labor market transitions

Share of labor market transitions in total



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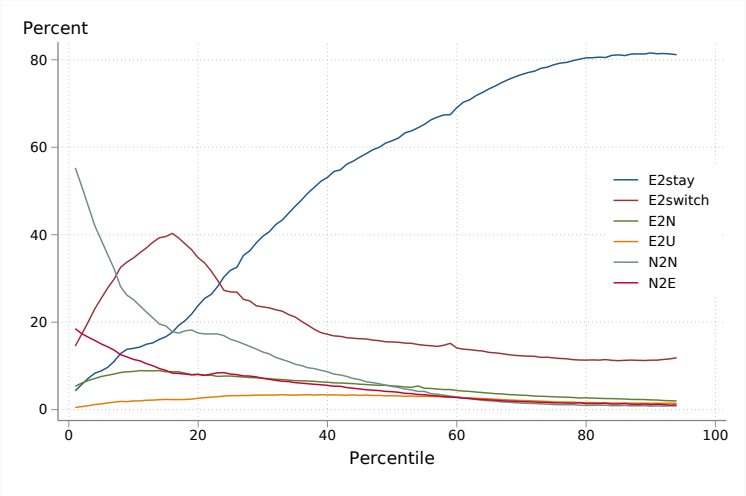

# Aggregate earnings betas – Entire sample

Include entire sample and use hyperbolic sine transform (to deal with 0s)

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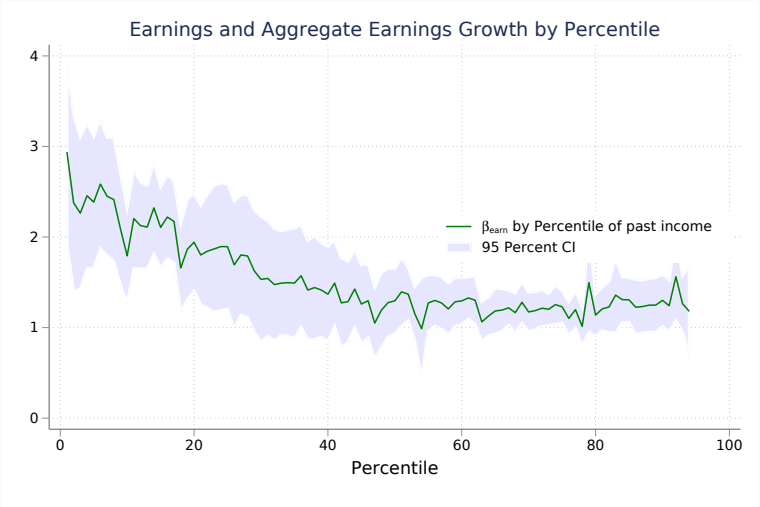

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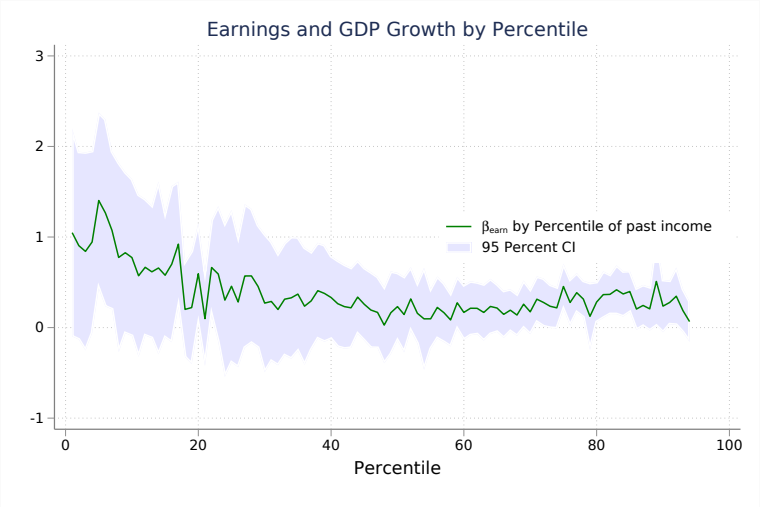


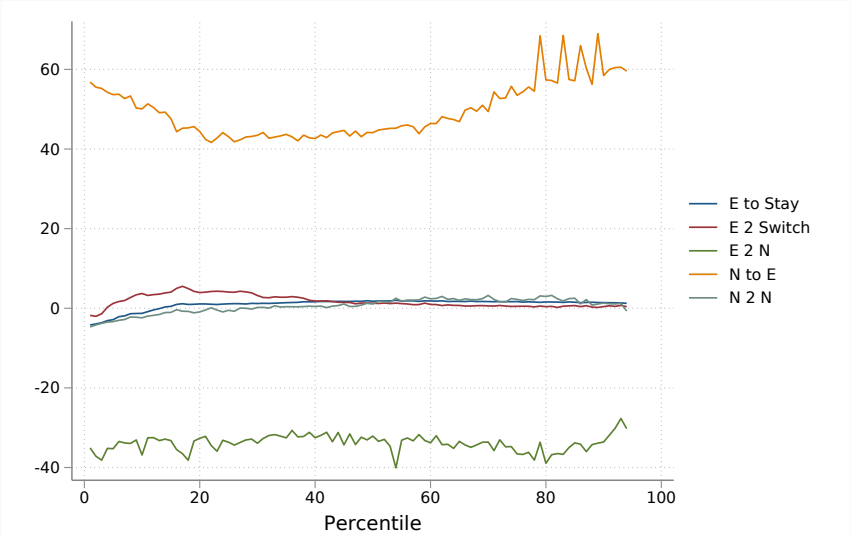
# Aggregate earnings betas – by labor market groups

$$\Delta y_{i,t}^{p} = \left[\beta_{stay}^{p} I_{stay} + \beta_{sw}^{p} I_{sw} + \beta_{E2N}^{p} I_{E2N} + \beta_{N2E}^{p} \mathcal{I}_{N2E}\right] \Delta Y_t$$

- Collapse N and U to "N"

# Aggregate earnings betas – by labor market groups

$\beta^{p}_{earn}$ for different labor market groups



# Aggregate earnings betas – Decomposition

$$\Delta y_{i,t}^{p} = \left[\beta_{stay}^{p} I_{stay} + \beta_{sw}^{p} I_{sw} + \beta_{E2N}^{p} I_{E2N} + \beta_{N2E}^{p} \mathcal{I}_{N2E}\right] \Delta Y_t$$

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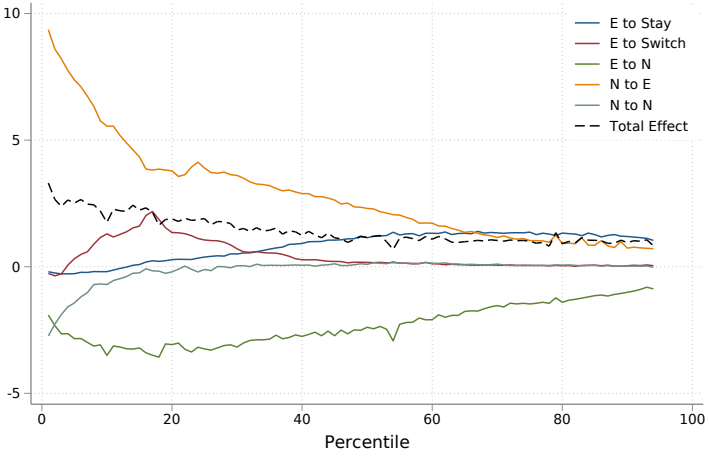
$$\Delta y^p_{i,t} = \left[\beta^p_{stay} I_{stay} + \beta^p_{sw} I_{sw} + \beta^p_{E2N} I_{E2N} + \beta^p_{N2E} \mathcal{I}_{N2E}\right] \Delta Y_t$$



# Labor market transitions and aggregate earnings

- So far: contribution of different labor market transitions to $y - Y$ comovement
- Now: Comovement of transitions with $Y$
- Again, collapse N and U to "N", and estimate

$$TR^{p}_{j,s_1,s_2|s_1} = \beta \Delta Y_t + \varepsilon_{j,t} \text{ for } s_1, s_2 = E, N$$

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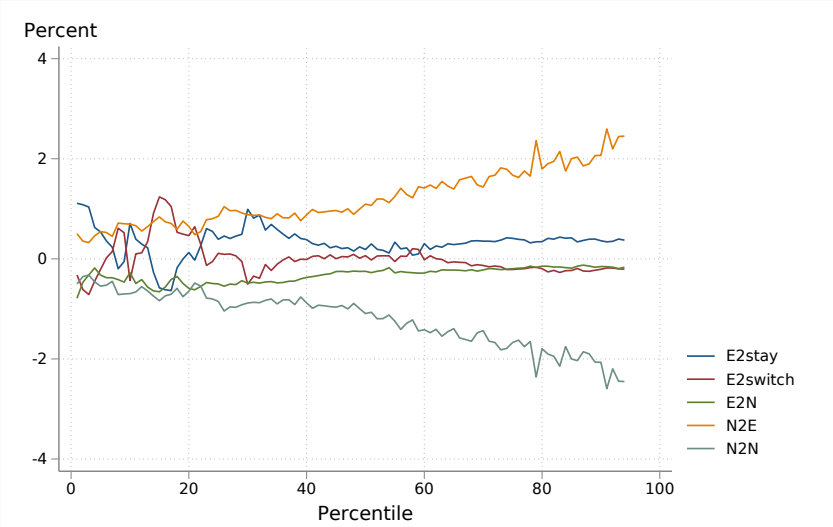


# Taking stock

- Significant heterogeneity in incidence of aggregate earnings movements:
  - Aggregate changes load more on lower part of income distribution
  - Due mostly to changing earnings in booms
  - Below the median changes driven by switchers and job-finding/losing
  - Above the median changes driven by earnings of stayers
- Potential for significant amplification of shocks if low income households have higher MPCs that high
- Next: Identified shocks and risk channel

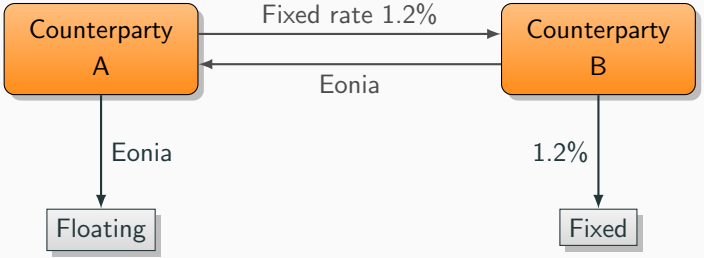
# Impact of Monetary Policy

ECB monetary policy likely endogenous - follow Almgren et al (2019) to identify shocks

- Instrument interest rate changes following Gertler & Karadi (2015)
- High frequency changes in Overnight Index Swap (OIS) rates

# Instrument – OIS

Overnight Index Swap contract

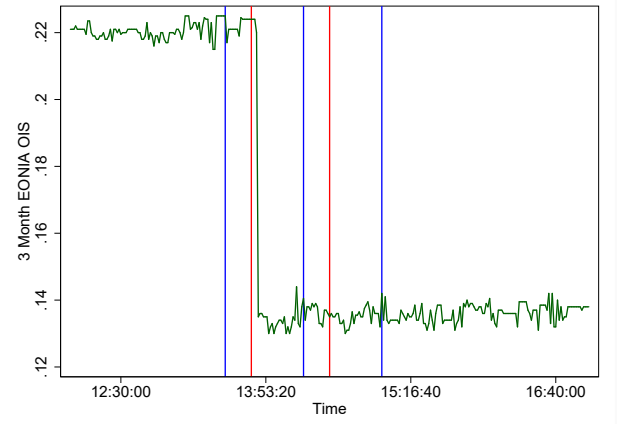



- "Risk free" $\Longrightarrow$ can be used during crisis
- Good measure of interest rate expectations
- Intra-day trading $\Longrightarrow$ narrow 45min measurement window

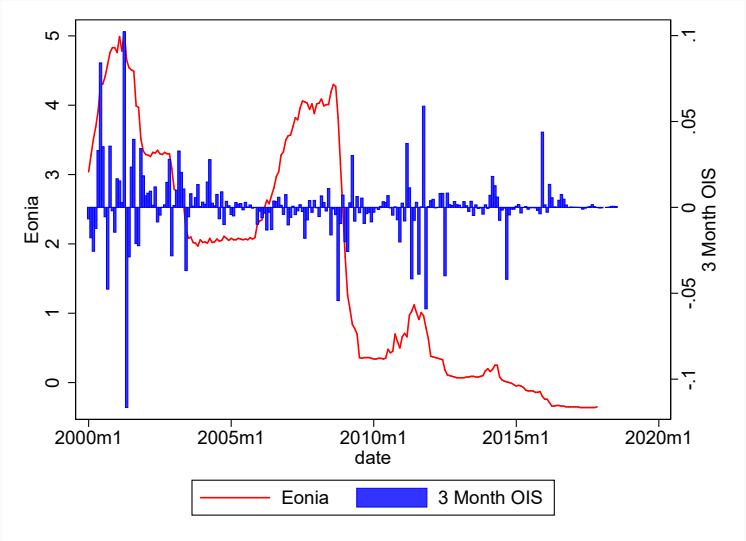
# Impact of Monetary Policy

ECB monetary policy likely endogenous - follow Almgren et al (2019) to identify shocks

- Instrument interest rate changes following Gertler & Karadi (2015)
- High frequency changes in Overnight Index Swap (OIS) rates
- Short time window around announcement (Press release + Press Conference)



# Impact of Monetary Policy



# Effects of Monetary Policy – (Monthly) Earnings

- Estimate:

$$\Delta y_j^d = \alpha + \beta_h^d \Delta i_t + \varepsilon_{j,h}$$

  for $\Delta y_j^d = y_{j,t+h}^d - y_{j,t-1}^d$

- Impulse responses to a 100 bp surprise increase in $i_t$.

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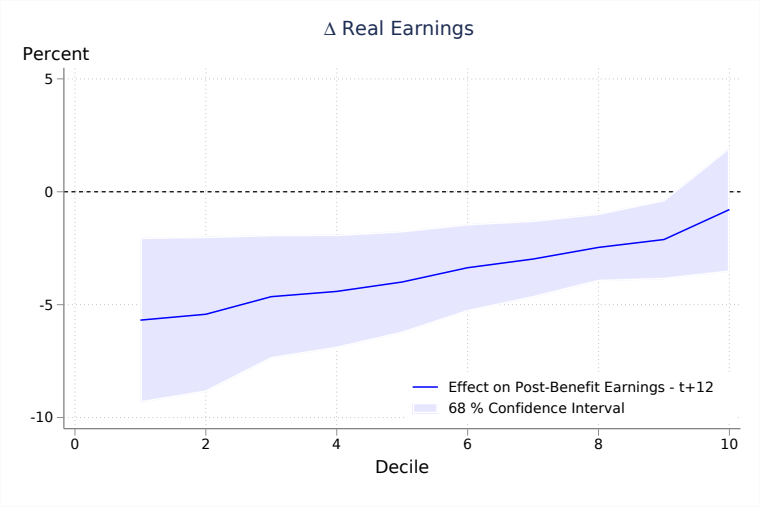
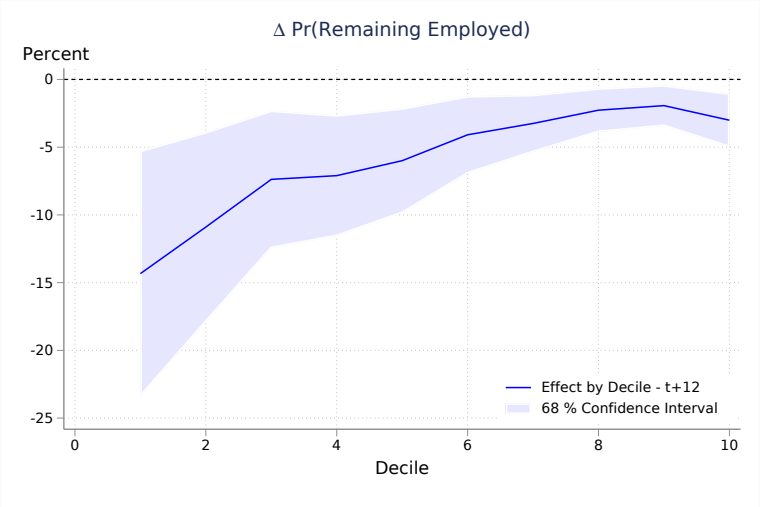


# Effects of Monetary policy – Employment transitions

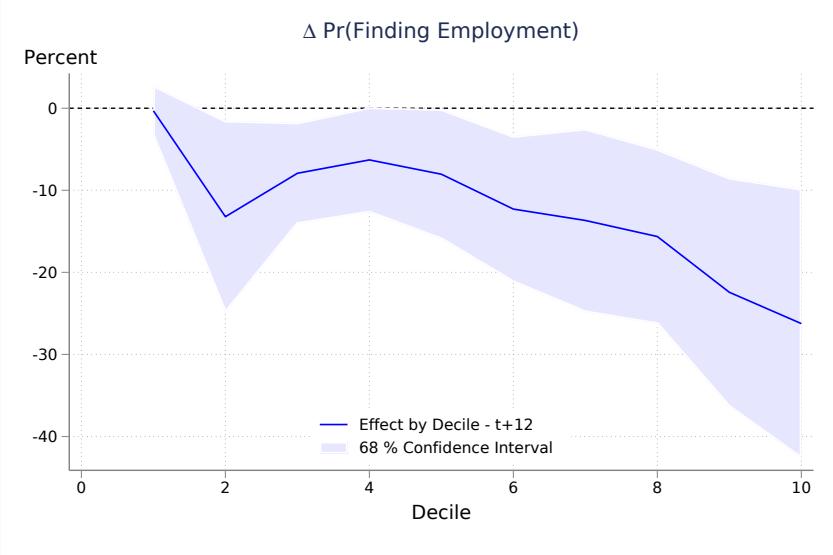
$$TR^{p}_{j,s_1,s_2|s_1} = \alpha + \beta^{d}\Delta i_t + \varepsilon_{j,h} \text{ for } s_1, s_2 = E, N$$

# Effects of Monetary policy – prob of remaining employed

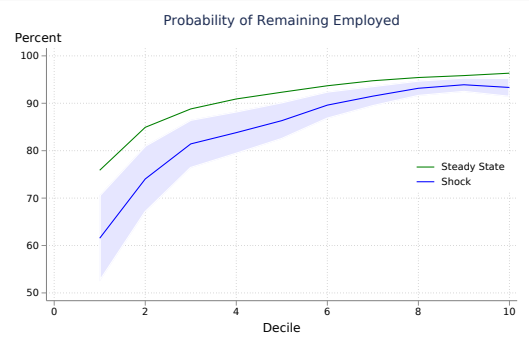
$$TR^{p}_{j,s_1,s_2|s_1} = \alpha + \beta^{d}\Delta i_t + \varepsilon_{j,h} \text{ for } s_1, s_2 = E, N$$

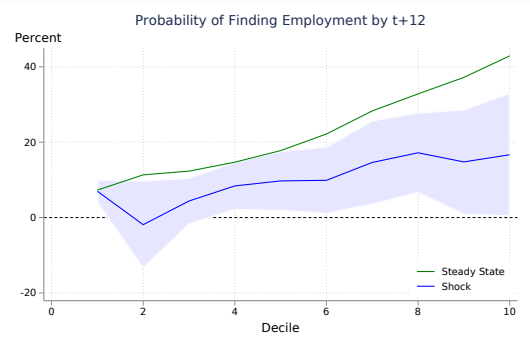


# Effects of Monetary policy – Job finding

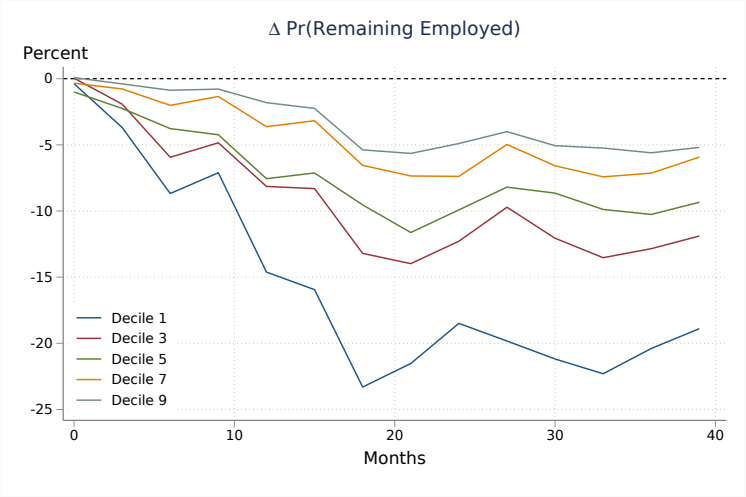


# Effects of Monetary policy – Adding steady state probabilities

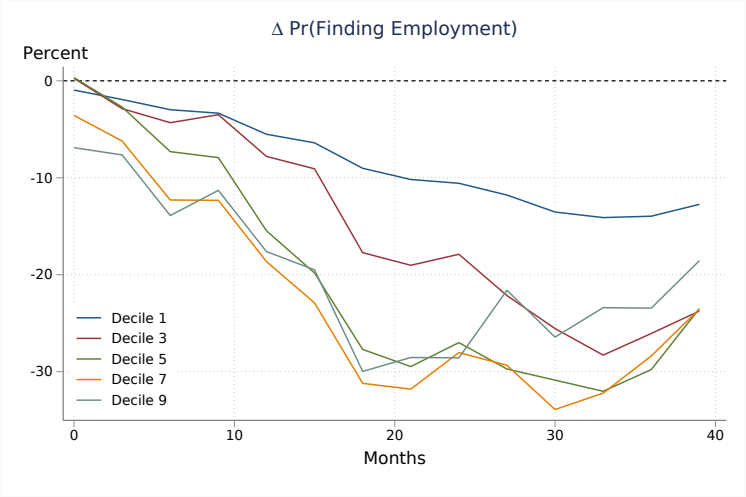


# Full impulse responses – Currently employed



# Full impulse responses – Currently non-employed



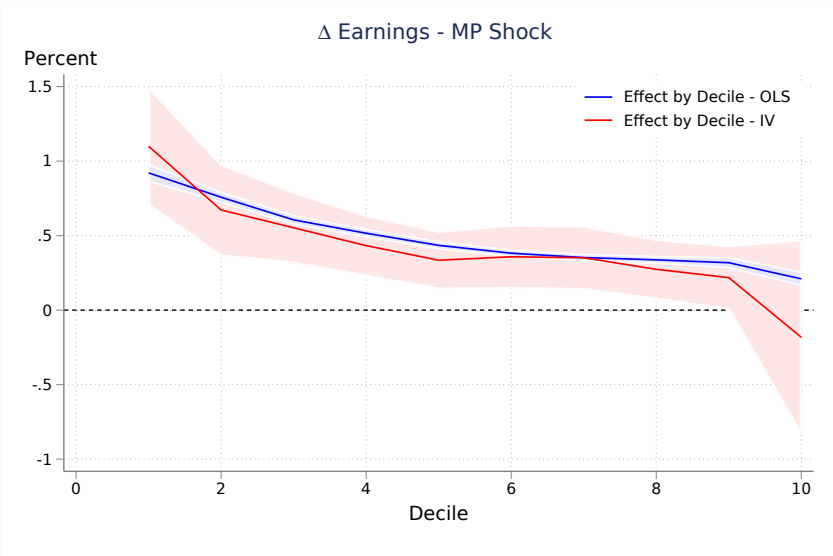
# Different shocks

How do aggregate shocks affect individuals?

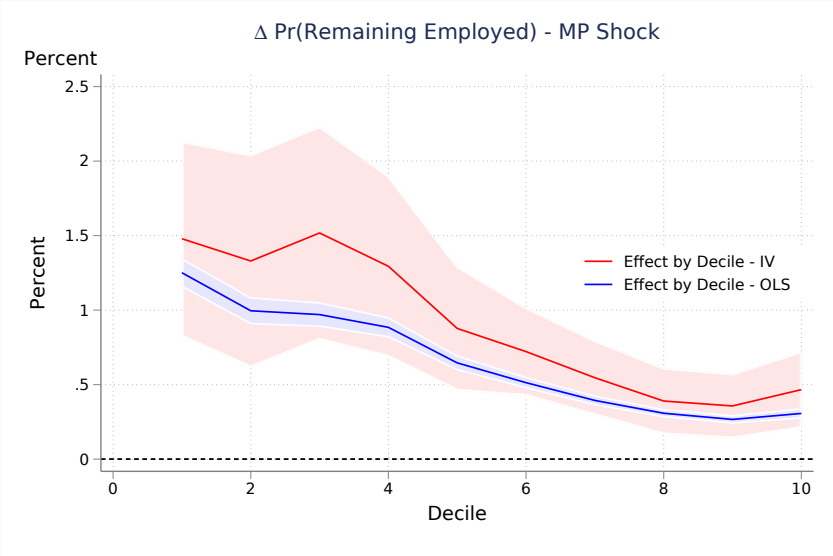

$$emp^d_{j,t+h} = \alpha + \beta^d_{earn}\Delta Y_t + \varepsilon_{j,h} \quad |emp^d_{j,t-1} = 1$$

- Instrument using high frequency movements in OIS rates
- Includes dummies for calendar months

# Monetary transmission through Aggregate – Wages



# Monetary transmission through Aggregate – Employment



# Conclusion

Transmission of aggregate shocks to individual incomes

- Earnings heterogeneity channel: Unequal incidence, lower deciles more exposed to aggregate shocks
- Cyclical risk channel: countercyclical risk, and unequal incidence of it

Going forward

- Greater focus on impact on unemployed
- More identified shocks, e.g. TFP shocks
- Tying back to theory - how heterogeneous are the MPCs?
- Use as an input into HANK model to quantify

# Descriptive statistics

**Table 2:** Descriptive Statistics by Decile – January 2000

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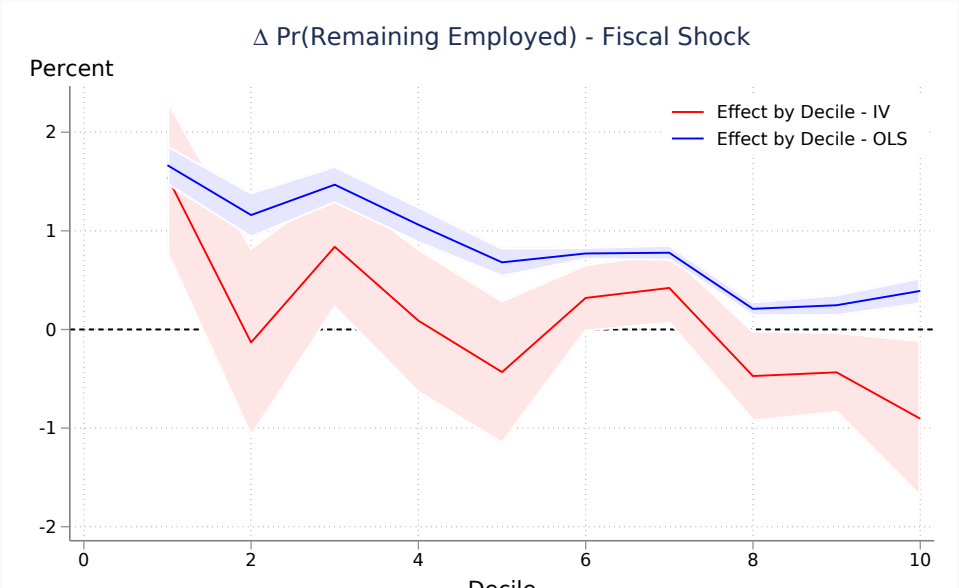
| Age | 42.05 | 41.57 | 40.76 | 40.43 | 40.90 | 41.90 | 42.91 | 43.30 | 44.18 | 45.50 |
| Education | 1.15 | 1.10 | 1.13 | 1.15 | 1.15 | 1.18 | 1.21 | 1.31 | 1.56 | 1.93 |
| Skill level | 2.01 | 2.07 | 2.13 | 2.18 | 2.17 | 2.20 | 2.24 | 2.38 | 2.65 | 3.01 |
| Part time | 0.55 | 0.43 | 0.33 | 0.24 | 0.17 | 0.12 | 0.08 | 0.06 | 0.04 | 0.02 |
| Daily wage | 21.49 | 41.35 | 53.02 | 64.46 | 76.07 | 86.88 | 98.76 | 114.33 | 139.78 | 175.88 |
| Empl next year | 0.76 | 0.86 | 0.89 | 0.90 | 0.92 | 0.93 | 0.94 | 0.95 | 0.96 | 0.95 |
| Observations | 49366 | 46212 | 45457 | 49721 | 47040 | 46003 | 44837 | 46433 | 46897 | 46417 |

# Fiscal transmission through Aggregate – Employment



# Fiscal transmission through Aggregate – Wages*