Monetary Policy and Regional Inequality

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Motivation

Economic prosperity is very unevenly distributed across space

In many economies, including the euro area, regional inequality has intensified

Rising inequality coincided with prominent role of monetary policy in macro policy mix

We study whether these two phenomena are linked

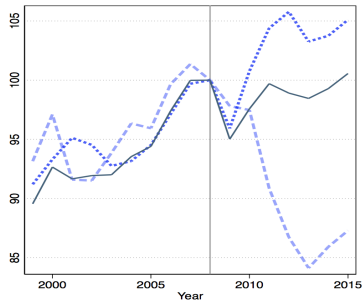GDP per capita (cities/counties in the euro area)

Chart shows real GDP per capita, normalized to 100 in 2008 at the regional level (NUTS3 in Eurostat classification); dotted (dashed) line refers to 95th (5th) percentile and solid line to the mean.

Identification

Monetary policy is by construction endogenous to economic prospects

Regionally disaggregated data offer a novel answer to this identification challenge

Regional conditions do not enter the central bank objective function

So, controlling for macro factors, variation in policy is exogenous to regional GDP

"*[The ECB's] single monetary policy will adopt a euro area-wide perspective; it will not react to specific regional or national developments*"

ECB Governing Council Press Release, 13 October 1998

Model, data and estimation

- ▶ Panel local-projections framework (Jordà 2005):

$$y_{i,t+h} = \alpha_i + \beta_1 i_{k,t} + \beta_2 \mathbf{x_{i,t}} + \beta_3 \mathbf{x_{j,t}} + \beta_4 \mathbf{x_{k,t}} + \epsilon_{i,t+h}$$

- – $y_{i,t+h}$: log GDP in region i in year $t + h$ (Source: Cambridge Econometrics and Eurostat Regio Database; NUTS3 level)
- – $i_{k,t}$: euro area short-term interest rate (AWM database)
- – controls: (i) region-specific: $\mathbf{x_{i,t}}$, (ii) country-specific: $\mathbf{x_{j,t}}$ and (iii) euro area-specific: $\mathbf{x_{k,t}}$ (AMECO)

- ▶ Sample consists of 886 regions over 17 years

- ▶ Estimations are based on:

- – Standard OLS for benchmark estimates at the mean
- – Quantile fixed-effects estimation (Machado & Silva 2019) and sub-sample regressions (Crouzet & Mehrotra 2020) for other parts of the distribution

Baseline results

- ► Sizable impact of policy rate changes on regional GDP
- ► Response stronger and more persistent in poorer regions
- ► Regions in lower parts of distribution exhibit hysteresis
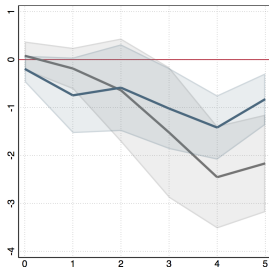- ► Policy tightening aggravates regional inequality (and *vv.*)
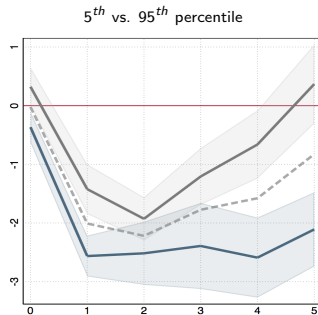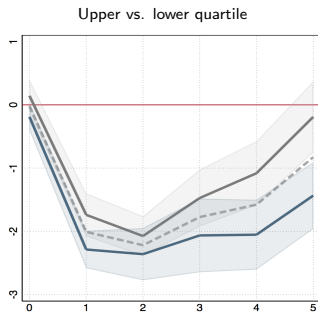
Vertical axis refers to impact of 100 basis point rate hike on regional GDP (in %). Horizontal axis refers to horizon of IRF (in years). Solid lines denote point estimates and shaded areas denote 90% confidence bands. Dashed lines refer to point estimates at the mean.

Sources of hysteresis

- ▶ Strong hysteresis in employment, with only upper parts of distribution experiencing full rebound
- ▶ Labour productivity also exhibits persistent contraction but weaker and less persistent than for employment
- ▶ Adds to growing literature that challenges notion of MP as exerting only transitory effects; *Blanchard 2018, Dupraz et al. 2019, Jordà et al. 2020*

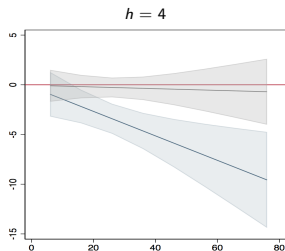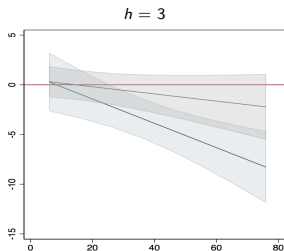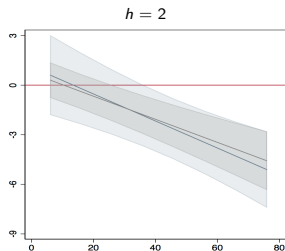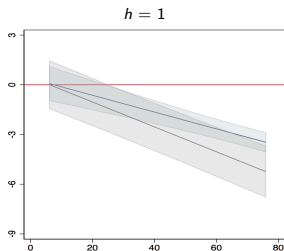Employment and productivity at the bottom decile

Employment at the mean
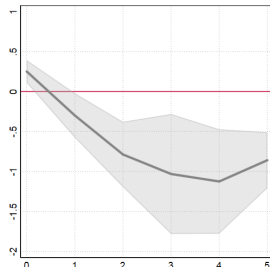
Vertical axis refers to impact of 100 basis point rate hike (in %) and horizontal axis to horizon (in years). Solid lines (shaded areas) denote point estimates (90% confidence bands).

Policy effects conditional on industry structure

Vertical axis refers to impact of 100 basis point rate hike on regional GDP (in %). Horizontal axis refers to percentage share of capital-intensive GVA relative to the sum of capital- and labour-intensive GVA. Solid lines denote point estimates and shaded areas denote 90% confidence bands for the bottom (in blue) and top ten percent (in grey) of the per-capita GDP distribution. h refers to the IRF-horizon (in years).

Key takeaways

- First paper to study the link between monetary policy and regional inequality, based on euro area data
- We find that policy tightening aggravates regional inequality and policy easing mitigates it
- The underlying mechanism consists in an uneven incidence of hysteresis (in poorer but not in richer regions)
- As such, it adds to a growing literature giving rise to *"grumblings (...) about whether potential output is really independent of monetary policy"* (*Blanchard 2018*)

Background slides

# Data

- Short-term interest rate from the AWM database
- Macro data from AMECO
- Monetary variables from ECB BSI statistics
- Regional data from Cambridge Econometrics
    - Dataset based on Eurostat's REGIO database
    - NUTS3 level of disaggregation (NUTS 2013 classification)
    - Covers the statistical territory of EU28 and Norway between 1980 and 2015
- Our sample includes EA12 NUTS3 regions, except for:
    - Luxembourg, as it consists of one NUTS3 region
   - French overseas territories (FRA10, FRA20, FRA30, FRA40 and FRA50)

Stylized facts

Table: Heterogeneity at different aggregation levels

|		Mean	St. Dev.	Min	Max	10th	Median	90th
GDP	*Country*	31273	10252	16623	51789	17017	34210	39184
	Region	26250	11929	8455	127390	14796	24491	38083
Capital-intensive GVA	*Country*	6503	2666	2096	10502	3093	7067	9356
	Region	7371	6302	819	91688	2459	6274	12138
Labor-intensive GVA	*Country*	18580	5913	10087	30807	11170	18915	24336
	Region	15457	7164	4733	70126	9449	13812	23151
Observations	*Country*	11						
	Region	886						
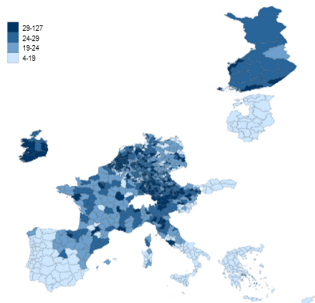
Evolution of average per capita GDP in selected percentiles
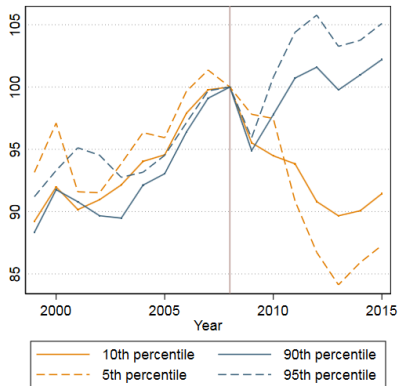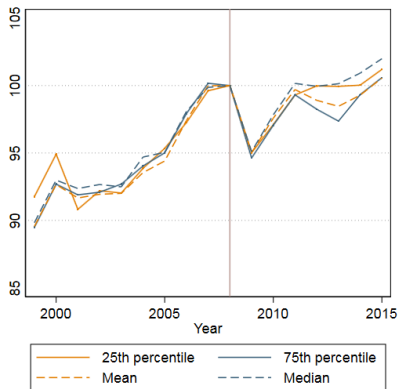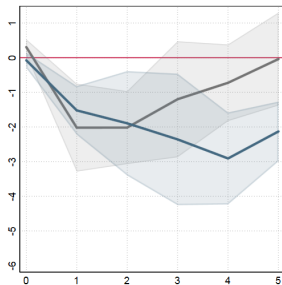

Notes: The lines show the normalized percentiles of regional GDP per capita in the total sample of EA11. The percentiles have been normalized to 100 in 2008.

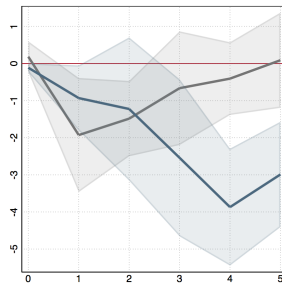# Mean and subsample analysis

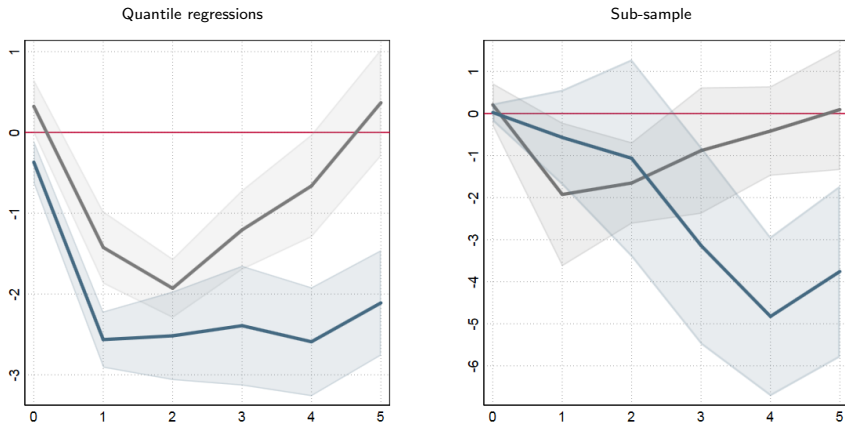Impact of monetary policy on regional output at the mean
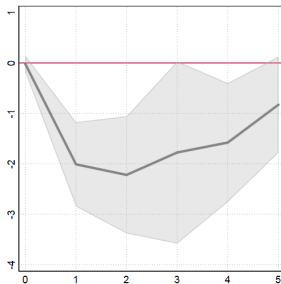
Impact of monetary policy on regional output:
upper vs. lower quartile

Impact of monetary policy on regional output:
bottom versus top decile

Impact in outer tails of the distribution

Quantile regressions   Sub-sample

Notes: Vertical axis refers to impact of 100 basis point rate hike on regional GDP (in %). Horizontal axis refers to horizon of IRF (in years). Solid lines denote point estimates and shaded areas denote 90% confidence bands. LHS-panel shows the 5th percentile (in blue) and the 95th percentile (in grey) of the baseline model estimated via quantile regressions; RHS-panel shows the corresponding average estimates from the sub-sample analysis for the bottom five percent (in blue) and top five percent (in grey) of the per-capita GDP distribution.

Impact by sub-sectors

Capital-intensive

Labor-intensive
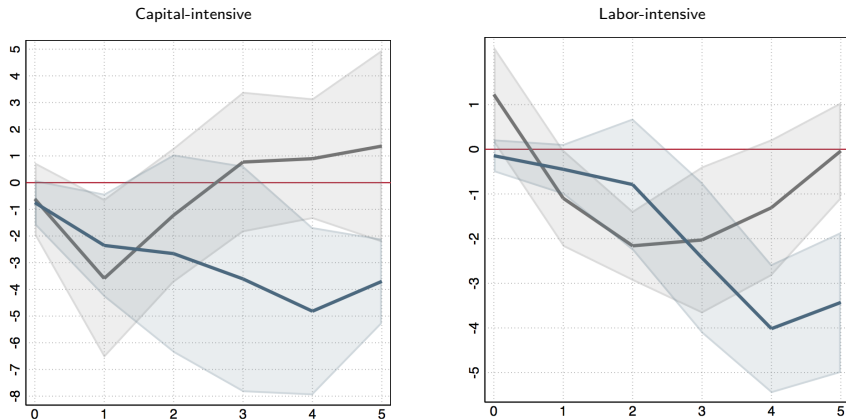
Notes: Vertical axis refers to impact of 100 basis point rate hike (in %). Horizontal axis refers to horizon of IRF (in years). Solid lines denote p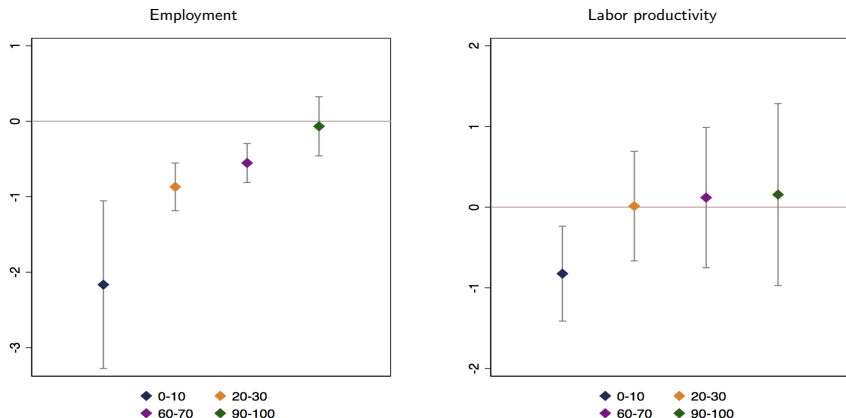oint estimates and shaded areas denote 90% confidence bands. The LHS (RHS) chart refers to the GVA of capital-intensive (labor-intensive) sub-sectors. Grey (blue) lines refer to average effects in top (bottom) deciles.

Impact at horizon $h = 5$

Notes: LHS panel shows impacts of a 100 basis point rate hike on employment at horizon $h = 5$ (in %) for the decile ranges from: 0-10; 20-30; 60-70; and 90-100 (in that order from left to right); RHS panel shows corresponding impacts on labor productivity. Diamonds indicate point estimates and bars indicate 90% confidence intervals.
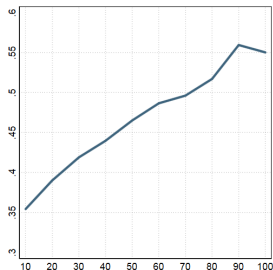
Role of industry structures

- ▶ Stronger response in capital- than in labour-intensive output
- ▶ Poorer regions tend to specialise in labour-intensive output
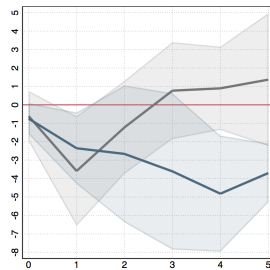- ▶ Heterogeneity of MP effects also holds within sectors

Impact of monetary policy on regional output across sectors
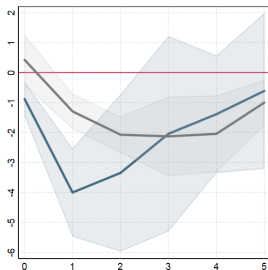
Industry structure across quantiles of per-capita GDP distribution
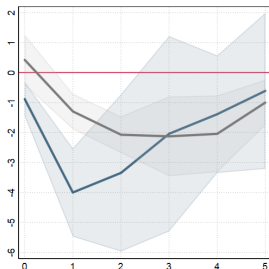
Impact of monetary policy on capital-intensive output

In LHS and RHS panels, vertical axis refers to impact of 100 basis point rate hike on regional GDP (in %). Horizontal axis refers to horizon of IRF (in years). Solid lines denote point estimates and shaded areas denote 90% confidence bands. In LHS panel, blue (grey) IRFs refer to capital- (labour-) intensive output. In RHS panel, blue (grey) IRFs refer to bottom (top) decile of per-capita GDP distribution. In the middle panel, vertical axis refers to ratio of output in capital-intensive sector over sum of output in capital- and labor-intensive sectors, averaged over the sample period; horizontal axis refers to quantiles of regional per-capita GDP distribution.
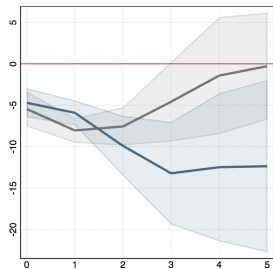
Cross-sectional variation in interest-rate sensitivity

- ▶ Sharper identification strategy exploiting cross-sectional variation in interest-rate exposure
- ▶ Narrower transmission channels working via industry structures again point to persistence only in poorer regions

Impact of MP across industries

Interaction of MP with capital intensity

In LHS panel, vertical axis refers to impact of 100 basis point rate hike on regional GDP (in %). Blue (grey) IRFs refer to capital- (labour-) intensive output. In RHS panel, vertical axis refers to coefficient on interaction between policy rate and capital intensity of regional output. Impact is calibrated on a 100 basis point rate hike and an increase in the capital-intensive share of regional GVA relative to the sum of capital- and labour-intensive GVA from 0 to 100%. Horizontal axis refers to horizon of IRF (in years). Solid lines denote point estimates and shaded areas denote 90% confidence bands for bottom (in blue) and top ten percent (in grey) of per-capita GDP distribution.

Policy effects conditional on industry structure
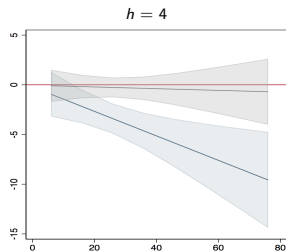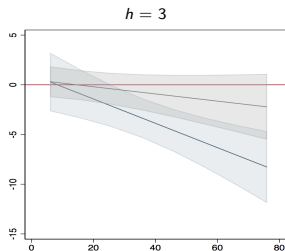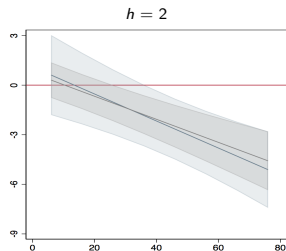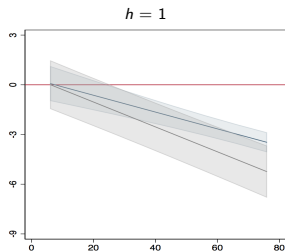
Vertical axis refers to impact of 100 basis point rate hike on regional GDP (in %). Horizontal axis refers to percentage share of capital-intensive GVA relative to the sum of capital- and labour-intensive GVA. Solid lines denote point estimates and shaded areas denote 90% confidence bands for the bottom (in blue) and top ten percent (in grey) of the per-capita GDP distribution. h refers to the IRF-horizon (in years).

Dynamic relationship: regional and national GDP

▶ Covid-19 crisis to trigger deep contraction in aggregate GDP

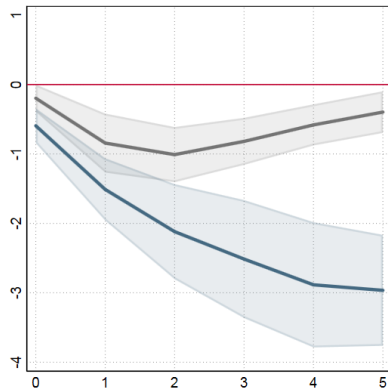▶ Poorer regions likely to be hit harder
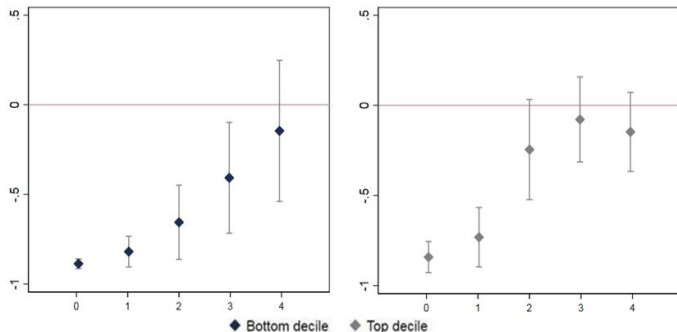
Notes: Vertical axis refers to coefficient of national GDP (scaled to a 1% contraction). Horizontal axis refers to horizon of IRF (in years). Diamonds denote point estimates and ranges denote 90% confidence bands.

Long sample results

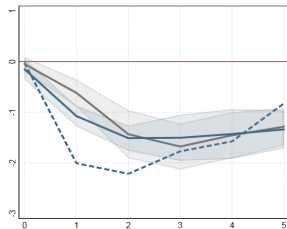Long (blue) vs. pre-crisis (grey) vs. baseline (dashed)
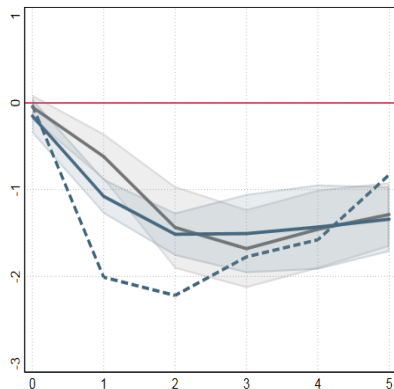
GDP: bottom vs. top decile

Vertical axis refers to impact of a 100 basis point rate hike on the respective dependent variable (in %), horizontal axis refers to horizon of IRF (in years). In LHS panel, IRFs are for GDP during the extended period 1990-2015 (in blue), the pre-crisis period 1990-2007 (in grey) and the baseline period 1999-2015 (in dashed blue); in RHS panel, IRFs are for GDP 1990-2015 at the bottom ten percent (in blue) and top ten percent (in grey) of the per-capita GDP distribution.

Long sample results

GDP impact over different sample periods
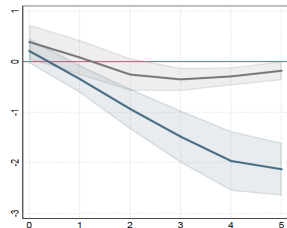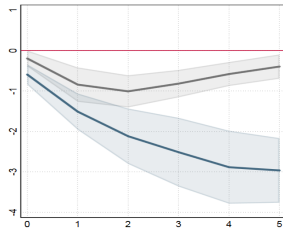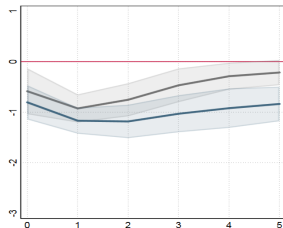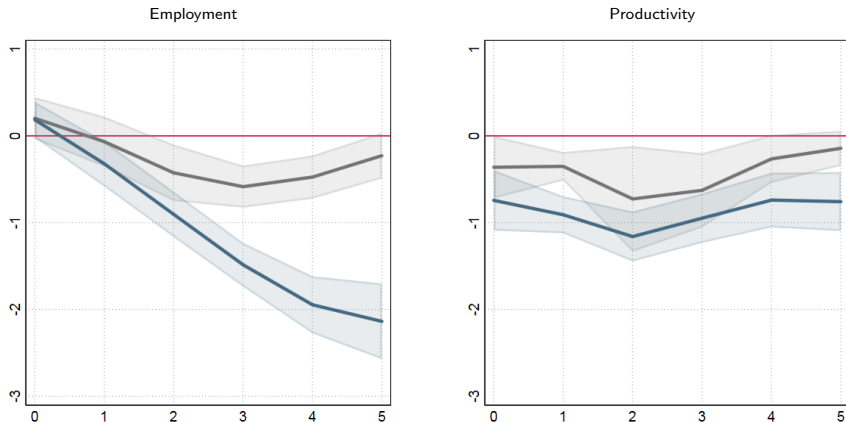
GDP

Employment

Labor productivity

Notes: Vertical axis refers to impact of a 100 basis point rate hike on the respective dependent variable (in %), horizontal axis refers to horizon of IRF (in years). In top-LHS, IRFs are for GDP during the extended period 1990-2015 (in blue), the pre-crisis period 1990-2007 (in grey) and the baseline period 1999-2015 (in dashed blue); in top-RHS, IRFs are for GDP over the period 1990-2015 in the bottom ten percent (in blue) and top ten percent (in grey) of the per-capita GDP distribution; bottom-LHS for employment and bottom-RHS for productivity. Solid lines denote point estimates and shaded areas denote 90% confidence bands.

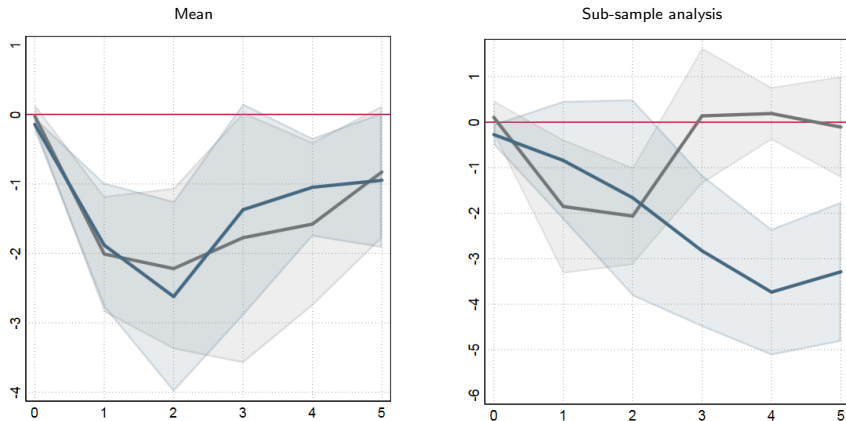# Impact of monetary policy during the pre-crisis period (1990-2007)

Employment

Productivity

Notes: Vertical axis refers to impact of 100 basis point rate hike on regional GDP (in %). Horizontal axis refers to horizon of IRF (in years). Solid lines denote point estimates and shaded areas denote 90% confidence bands. LHS-panel shows the IRFs for employment at the bottom ten percent (in blue) and top ten percent (in grey) of the per-capita GDP distribution during the period 1990-2007. RHS-panel shows the corresponding IRFs for productivity.
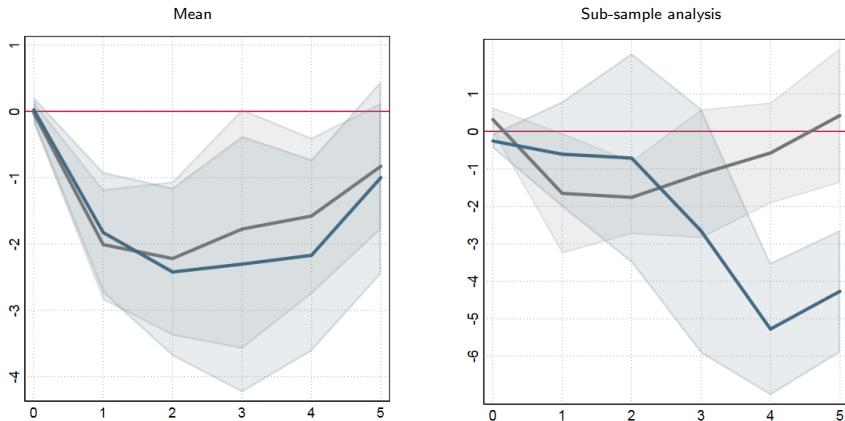
Inclusion of expected HICP and GDP

Notes: Vertical axis refers to impact of 100 basis point rate hike on regional GDP (in %). Horizontal axis refers to horizon of IRF (in years). Solid lines denote point estimates and shaded areas denote 90% confidence bands. LHS-panel shows mean estimates for the baseline (in grey) and the modified model (in blue). RHS-panel shows the corresponding average estimates from the sub-sample analysis for the bottom ten percent (in blue) and top ninety percent (in grey) of the per-capita GDP distribution.

Use of Lemke/Vladu shadow rate
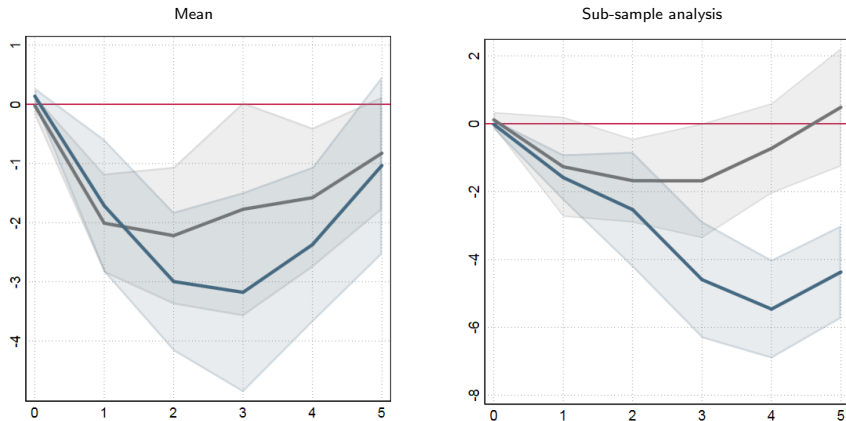

Mean

Sub-sample analysis

Notes: Vertical axis refers to impact of 100 basis point rate hike on regional GDP (in %). Horizontal axis refers to horizon of IRF (in years). Solid lines denote point estimates and shaded areas denote 90% confidence bands. LHS-panel shows mean estimates for the baseline (in grey) and the modified model (in blue). RHS-panel shows the corresponding average estimates from the sub-sample analysis for the bottom ten percent (in blue) and top ninety percent (in grey) of the per-capita GDP distribution.

Use of Krippner shadow rate
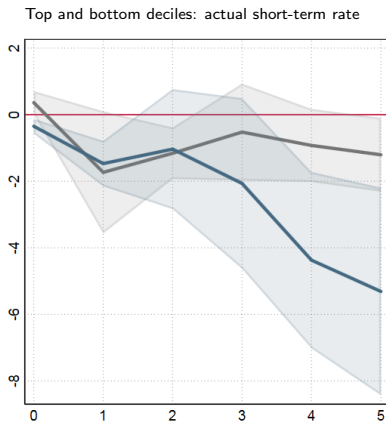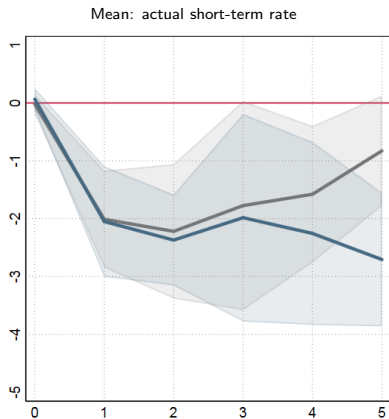

Mean

Sub-sample analysis

Notes: Vertical axis refers to impact of 100 basis point rate hike on regional GDP (in %). Horizontal axis refers to horizon of IRF (in years). Solid lines denote point estimates and shaded areas denote 90% confidence bands. LHS-panel shows mean estimates for the baseline (in grey) and the modified model (in blue). RHS-panel shows the corresponding average estimates from the sub-sample analysis for the bottom ten percent (in blue) and top ninety percent (in grey) of the per-capita GDP distribution.

Inclusion of lagged residuals

Mean: actual short-term rate

Top and bottom deciles: actual short-term rate

Notes: Vertical axis refers to impact of 100 basis point rate hike on regional GDP (in %). Horizontal axis refers to horizon of IRF (in years). Solid lines denote point estimates and shaded areas denote 90% confidence bands. LHS-panel shows mean estimates for the baseline (in grey) and the modified model (in blue). RHS-panel shows the corresponding average estimates from the sub-sample analysis for the bottom ten percent (in blue) and top ninety percent (in grey) of the per-capita GDP distribution.
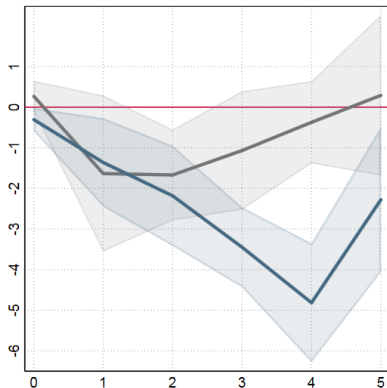
Inclusion of lagged residuals

Top and bottom deciles: Lemke/Vladu shadow rate

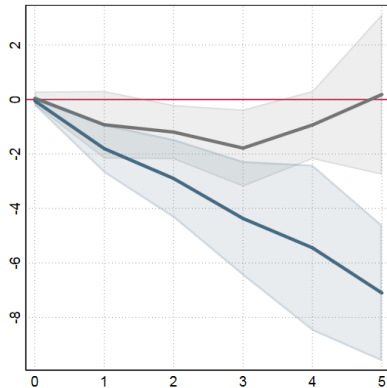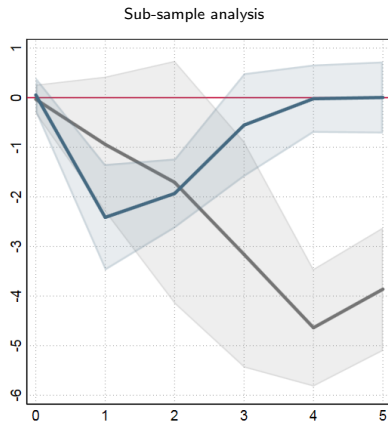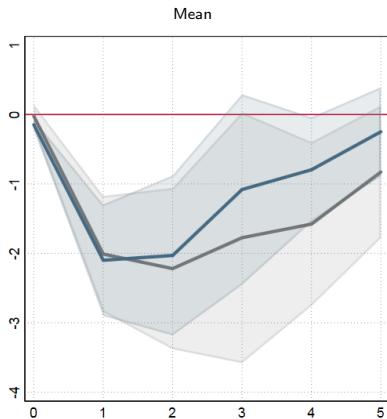Top and bottom deciles: Krippner shadow rate

Notes: Vertical axis refers to impact of 100 basis point rate hike on regional GDP (in %). Horizontal axis refers to horizon of IRF (in years). Solid lines denote point estimates and shaded areas denote 90% confidence bands. LHS-panel shows mean estimates for the baseline (in grey) and the modified model (in blue). RHS-panel shows the corresponding average estimates from the sub-sample analysis for the bottom ten percent (in blue) and top ninety percent (in grey) of the per-capita GDP distribution.

Additional covariates

Mean

Sub-sample analysis

Notes: Vertical axis refers to impact of 100 basis point rate hike on regional GDP (in %). Horizontal axis refers to horizon of IRF (in years). Solid lines denote point estimates and shaded areas denote 90% confidence bands. LHS-panel shows mean estimates for the baseline (in grey) and the modified model (in blue). RHS-panel shows the corresponding average estimates from the sub-sample analysis for the bottom ten percent (in blue) and top ninety percent (in grey) of the per-capita GDP distribution.

Links to related literature

Distributional effects of monetary policy

- ▶ So far focuses on households; *Coibion et al. 2017, Ampudia et al. 2018, Lenza & Slacalek 2018, Dossche et al. 2020*
- ▶ We broaden scope to geographical dimension

Regional impact of macro shocks

- ▶ So far focuses on other types of shocks; *Auerbach & Gorodnichenko 2012, Nakamura & Steinsson 2014, Chodorow-Reich et al. 2020*
- ▶ ... or on US-specific mortgage channel; *Di Maggio et al. 2017, Beraja et al. 2018, Eichenbaum et al. 2018*
- ▶ We model impact across entire regional GDP distribution

Long-lived effects of monetary policy

- ▶ Growing literature challenges notion of MP merely exerting transitory effects; *Blanchard 2018, Dupraz et al. 2019, Jordà et al. 2020*
- ▶ We provide evidence on incidence and sources of hysteresis