# Non-linear Macro and Distributional Effects of US Monetary Policy

## ARC 2020 LABOR MARKET AND MONETARY POLICY

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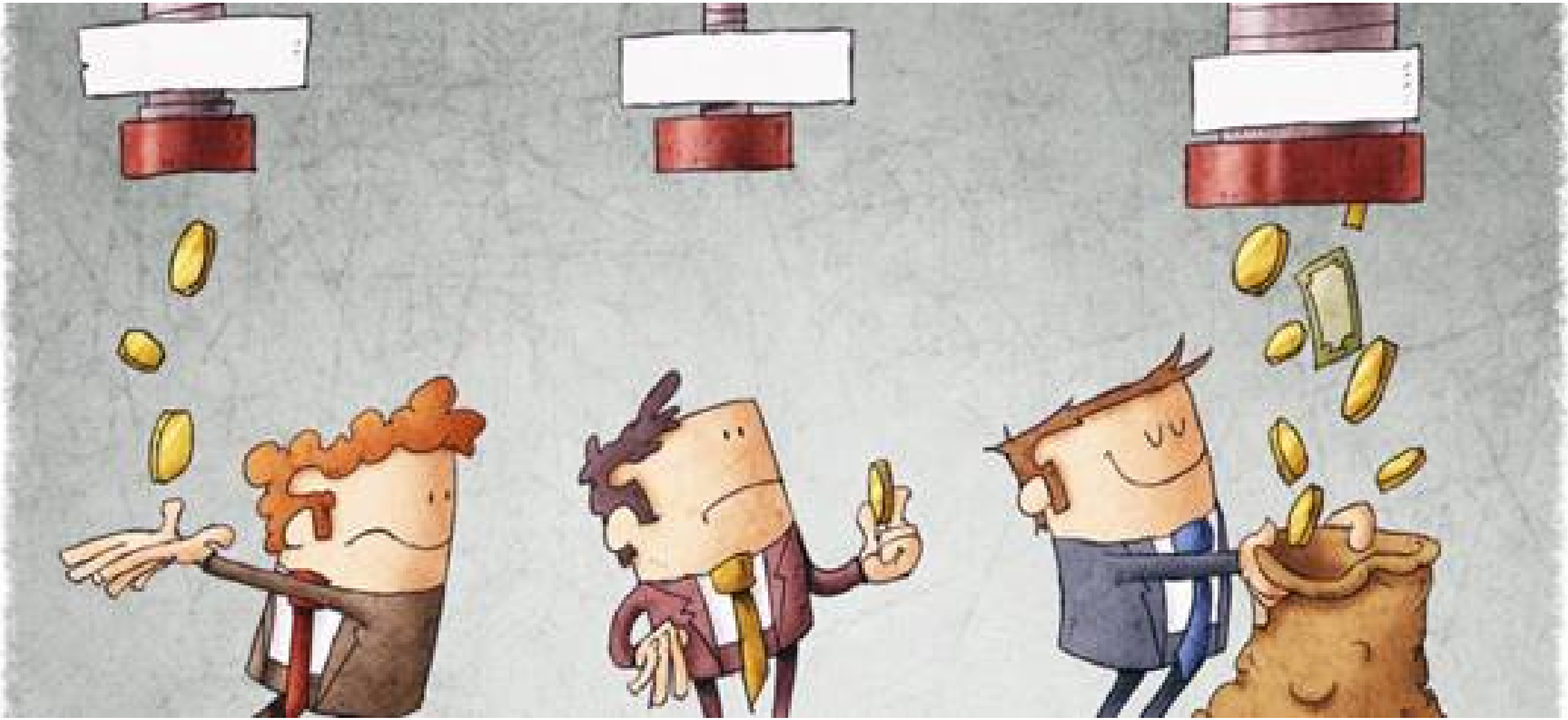
# Do conventional and unconventional monetary policies affect income inequality?



# Do conventional and unconventional monetary policies affect income inequality?

- **No consensus yet:** UMP limited impact on economic activity and negatively affected income and wealth distribution (Acemoglu and Johnson 2012; Stiglitz 2015); by supporting employment, unconventional expansionary monetary policy may in fact reduce inequality (Draghi 216).

- **Empirical evidence available mostly for conventional:** Coibion, Gorodnichenko, Kuen and Silvia (2017) find that expansionary conventional monetary policy reduces inequality in income, labor earnings, consumption and total expenditure.

- **Rapidly growth literature:** more than 50 papers in the last two years...

# Questions and contribution to the literature

**Do the macro and distributional effects depend:**

- **Business cycle (recession vs expansion):** Weise 1999; Garcia and Schaller 2002; Peersman and Smets 2001; Tenreryo and Thwaites 2016.
- **Sign of the shock (easing vs. tightening):** Cover 1992; Angrist et al. 2013; Matthes and Barnichon 2015, Tenreryo and Thwaites 2016.
- **Conventional vs. unconventional monetary policy**

# Data on inequality

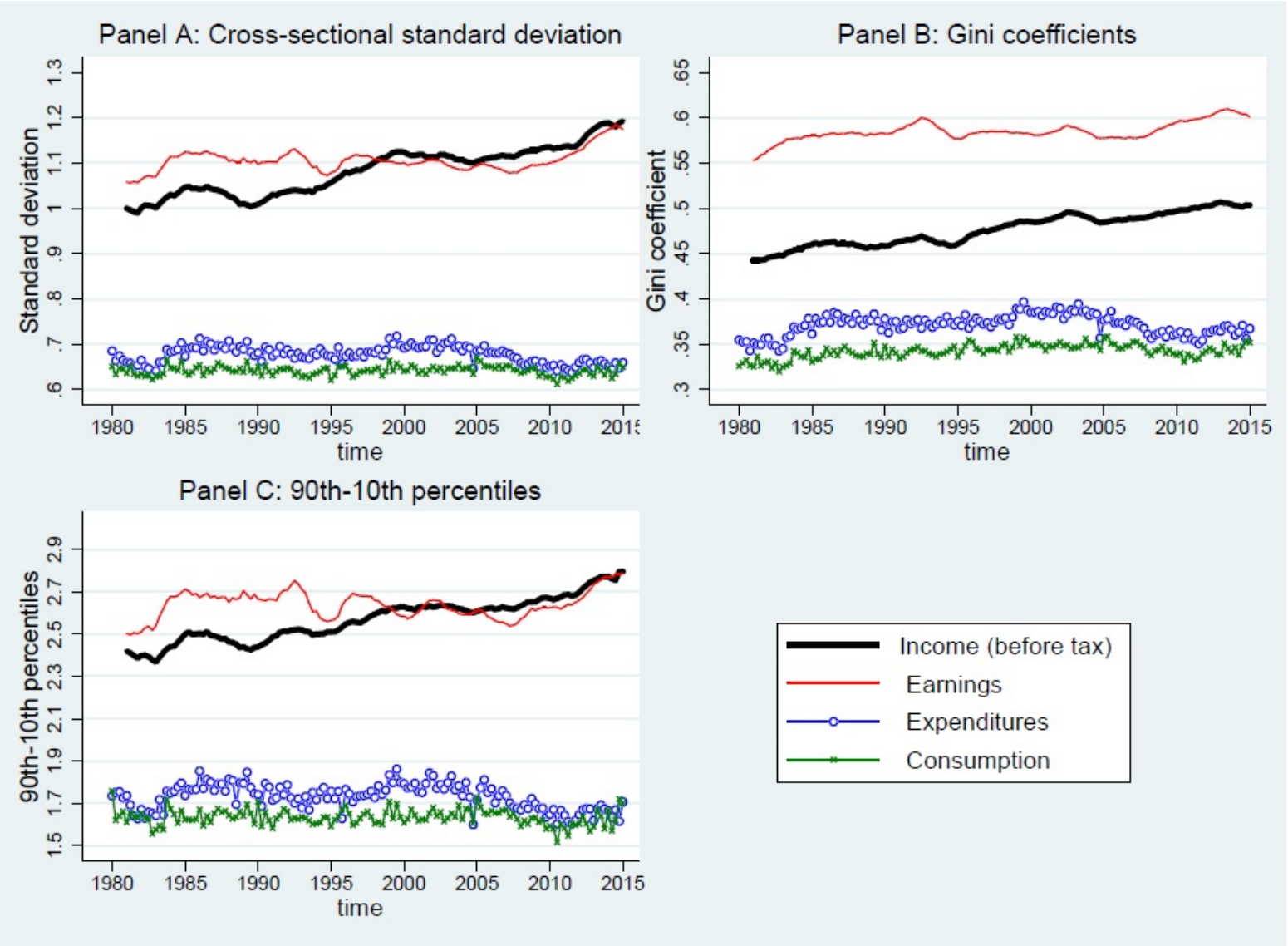
**Consumer Expenditure Survey (CEX)—the national household survey carried out by the Bureau of Labor Statistics (BLS)**

- Available at quarterly frequency but excludes top 1 percent and no information on wealth.

**Measures of inequality:**

- Income (total income and labor earnings) and expenditure (total expenditure and consumption).
- (i) the standard deviation; (ii) the 90-10 percentile difference; and (iii) the Gini index.

# Inequality trends




Note: Inequality measures are one-year moving average

# Inequality across the business cycle

**Table 1**
Correlations of inequality measures with macroeconomic variables

| | 1 | 2 | 3 |
|---|---|---|---|
| Panel A: Correlation with GDP | | | |
| | Corr (GDP,SD) | Corr(GDP,Gini) | Corr(GDP, 90th-10th) |
| Income Inequality | 0 | -0.16 | 0.06 |
| Earnings Inequality | 0.06 | -0.34 | 0.02 |
| Expenditures Inequali | 0.3 | 0.23 | 0.2 |
| Consumption Inequali | 0.26 | 0.23 | 0.21 |
| Panel B: Correlation with Unemployment rate | | | |
| | Corr (UE,SD) | Corr(UE,Gini) | Corr(UE, 90th-10th) |
| Income Inequality | -0.05 | 0.14 | -0.04 |
| Earnings Inequality | 0 | 0.36 | 0.07 |
| Expenditures Inequali | -0.25 | -0.16 | -0.18 |
| Consumption Inequali | -0.3 | -0.22 | -0.22 |

Note: Table 1 presents the correlations between inequality measures (income, earnings, expenditures and consumption) with Gross Domestic Product (Panel A; GDP) and unemployment rate (Panel B; UE). Correlations are made with respect of three different measures of inequality: standard deviation (column 1), Gini coefficient (column 2) and the log difference between the 90th and the 10th percentile of the cross sectional distirbution (column 3).
All series are HP filtered prior to the calculations of correlations.

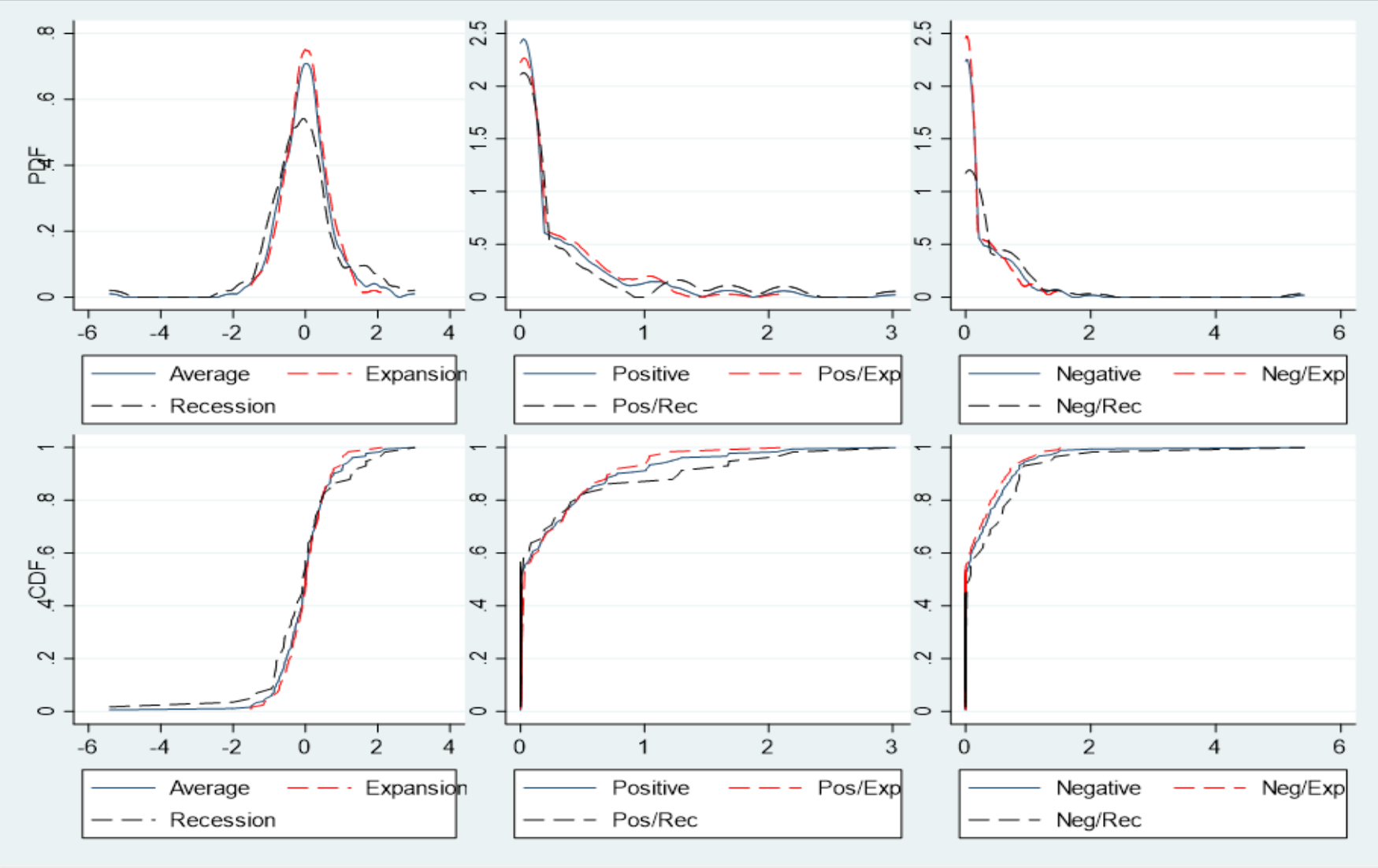
# Monetary policy shocks

- High-frequency data following Gurkaynak et al. (2005), Gertler and Karadi (2015), Nakamura, E. and J. Steinsson (2018) and Cloyne et al. (2018).

- Proxy SVAR approach (Stock and Watson 2018, Mertens and Ravn 2013), modified to account for account for the structural break in 2008m8.

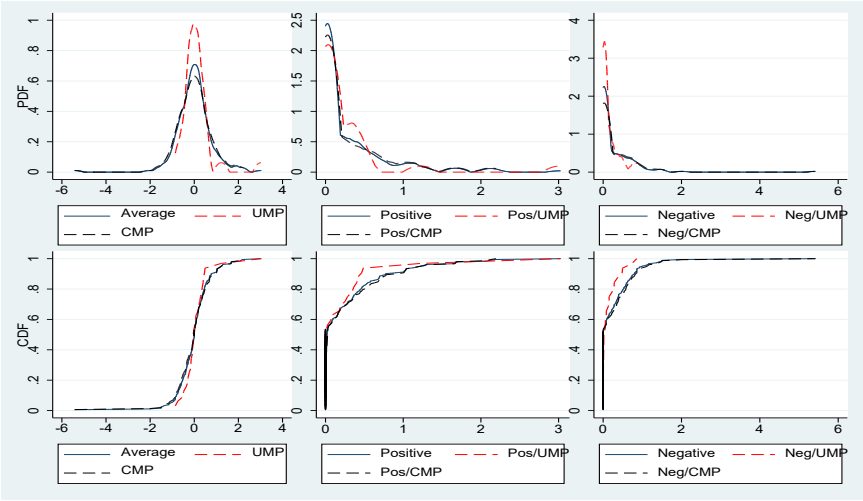
- Baseline: one-year government bond rate as the policy rate and the current month Fed funds future as the instrument.

# Shock propensity and cumulated density functions: recession versus expansions




Note: The first-row panels show the probability density distribution of the shocks according to the state of the economy (recession versus expansion) and its interaction with the sign of the shocks (expansionary monetary policy shocks (-) versus contractionary shocks (+)). The time series of the negative shocks has been multiplied by (-1) to better show the comparison with positive ones. The second-row panels show the cumulative distributions of the shocks.

# Shock propensity and cumulated density functions: conventional versus unconventional monetary policy




Note: The first-row panels show the probability density distribution of the shocks according to the momentary policy toolkit (conventional monetary policy versus unconventional) and its interaction with the sign of the shocks (expansionary monetary policy shocks (-) versus contractionary shocks (-)). The time series of the negative shocks has been multiplied by (-1) to better show the comparison with positive ones. The second-row panels show the cumulative distributions of the shocks.

# Empirical methodology

## Linear

$$x_{t+h} - x_{t-1} = c^{(h)} + \sum_{j=1}^{J} \alpha_j^{(h)} \left(x_{t-j} - x_{t-j-1}\right) + \sum_{i=1}^{I} \beta_i^{(h)} \epsilon_{t-1}^{mp} + \varepsilon_{t+h}$$

## Positive vs. negative

$$x_{t+h} - x_{t-1} = c^{(h)} + \sum_{j=1}^{J} \alpha_j^{(h)} \left(x_{t-j} - x_{t-j-1}\right) + \beta_+^h \; D_t \, \epsilon_t^{mp} + \beta_+^h \; (1 - D_t) \, \epsilon_t^{mp} + \sum_{i=1}^{J} \beta_i^{(h)} \epsilon_{t-i}^{mp} + \varepsilon_{t+h},$$

- *X*=outcome variable
- $\epsilon_{t-1}^{mp}$=monetary policy shock
- *J*=2 and *I*=3
- Newey–West (1987) standard errors.

# Empirical methodology

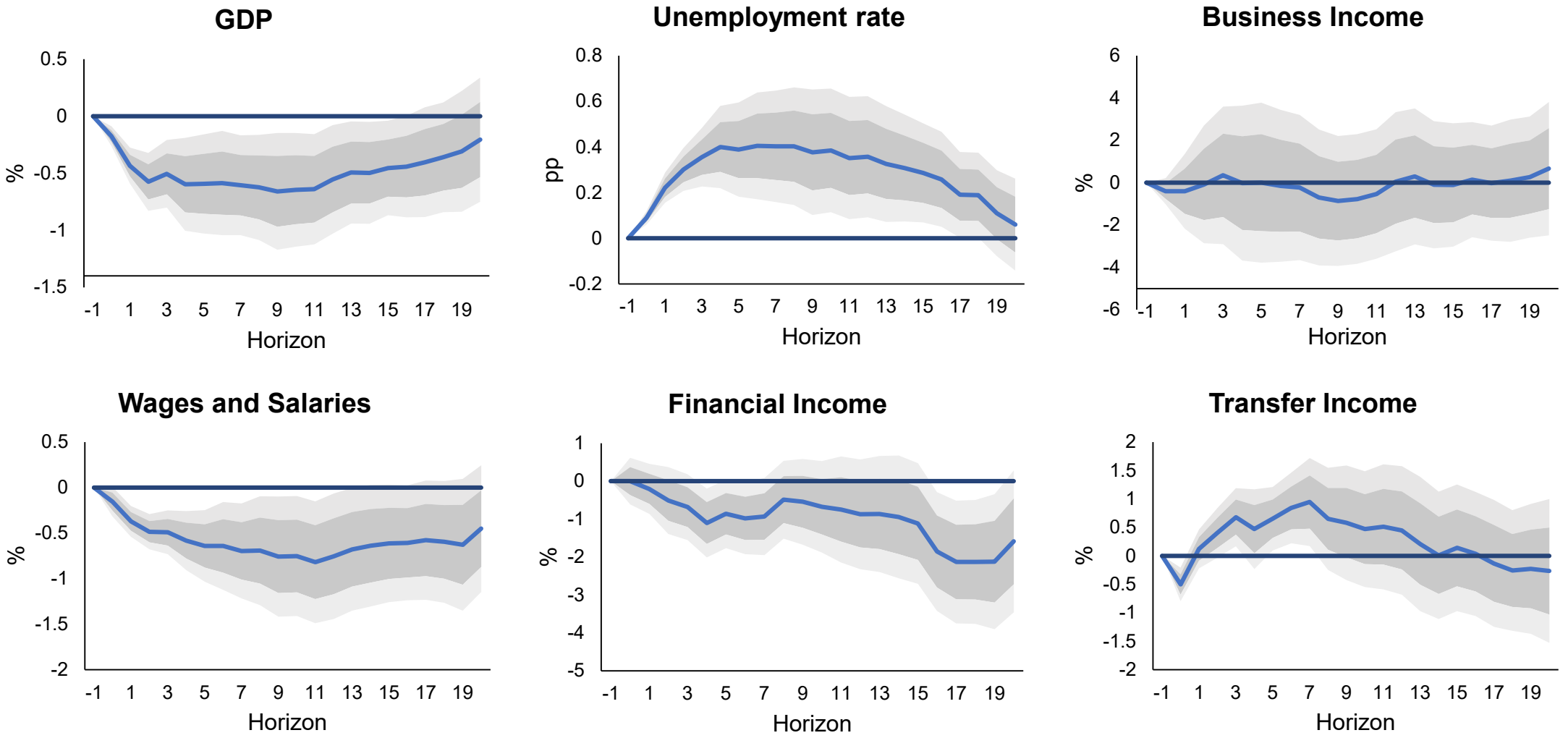
Recession vs. expansion (conventional vs. unconventional)

$$
\begin{aligned}
&x_{t+h} - x_{t-1} \\
&= I_{t-1}\left[ c^{(h)}{}_E + \sum_{j=1}^{J} \alpha_{j,E}^{(h)} \left(x_{t-j} - x_{t-j-1}\right) + \sum_{i=0}^{J} \beta_{i,E}^{(h)} \epsilon_{t-i}^{mp} \right] \\
&+ (1 - I_{t-1})\left[ c^{(h)}{}_R + \sum_{j=1}^{J} \alpha_{j,R}^{(h)} \left(x_{t-j} - x_{t-j-1}\right) + \sum_{i=0}^{J} \beta_{i,R}^{(h)} \epsilon_{t-i}^{mp} \right] + \varepsilon_{t+h},
\end{aligned}
$$

Fore recessions/expansions: $I(z_t) = \frac{exp(-\theta z_t)}{1+exp(-\theta z_t)}$ and $\theta = 3.5$; z=seven-quarter average lagged GDP growth

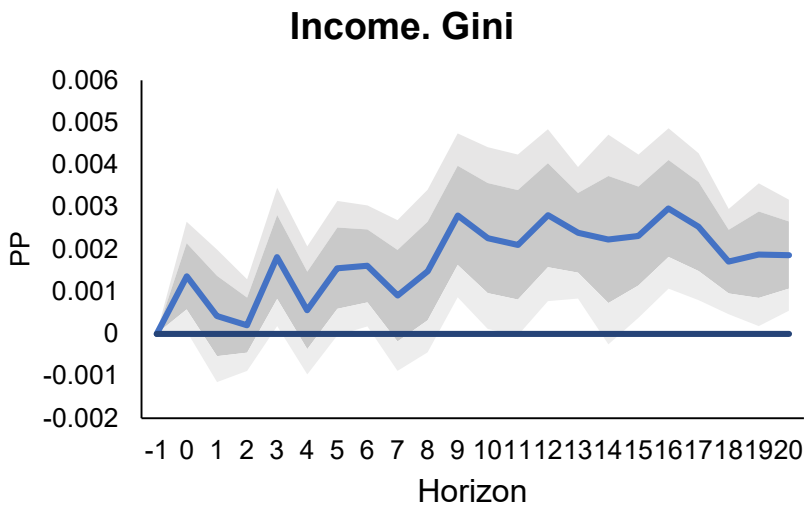
For conventional vs. unconventional: *I* equal to 1 after 2008q4, 0 otherwise.

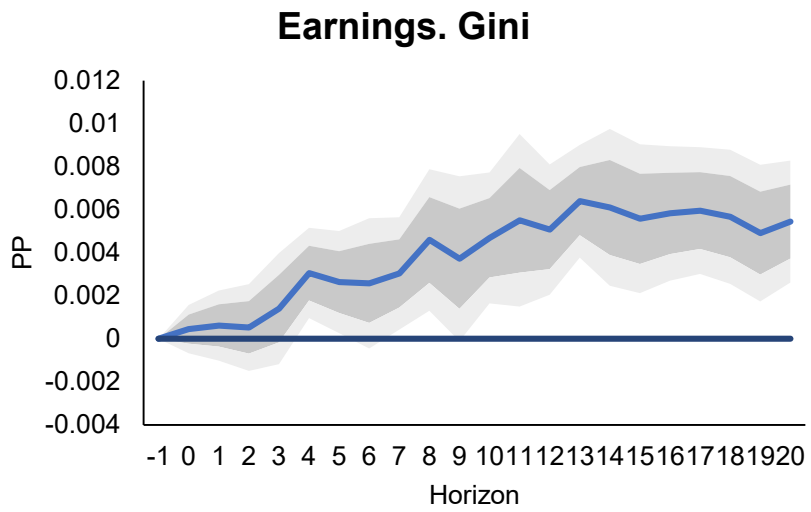
# Linear: Macro variables

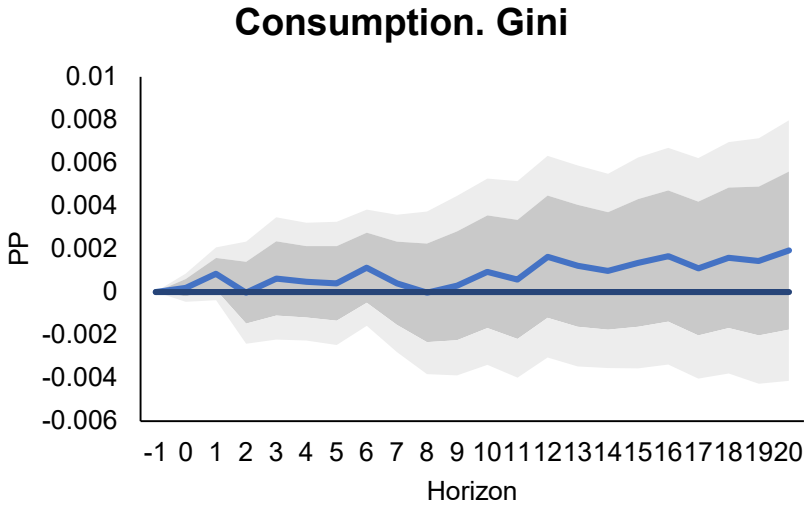


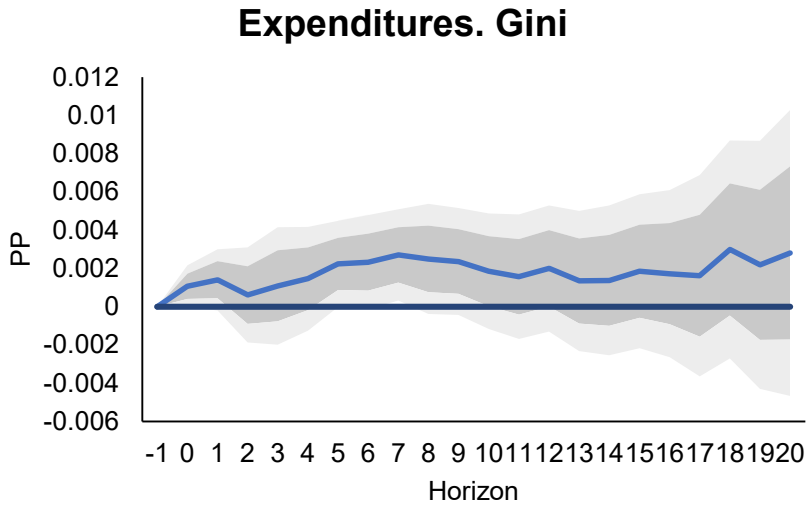

Note: The figure reports the IRFs to a 100 b.p. contractionary monetary policy shocks. The dark and light grey shaded area indicate 1 standard deviation and 1.65 sd confidence intervals respectively.

# Linear: Inequality variables

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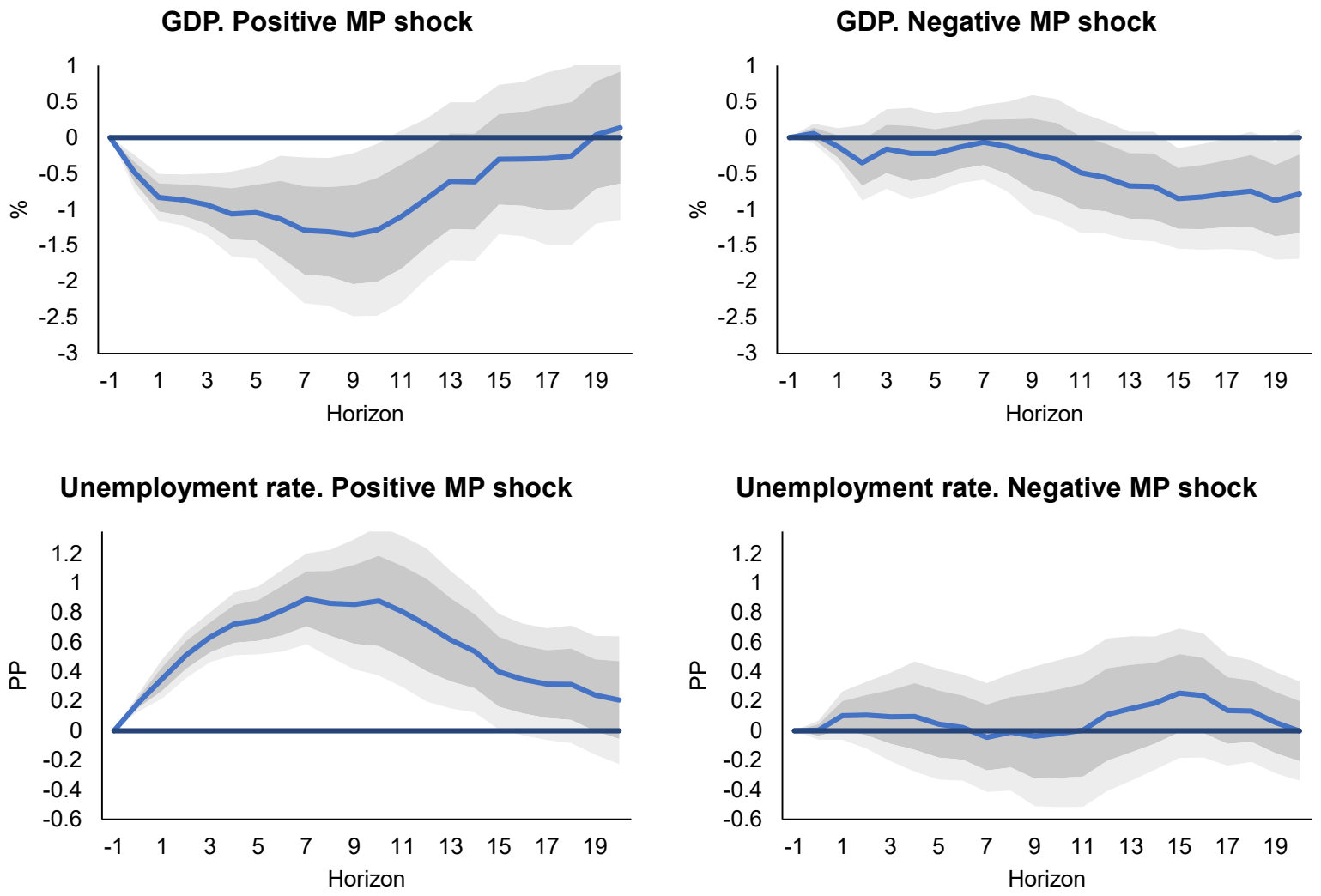
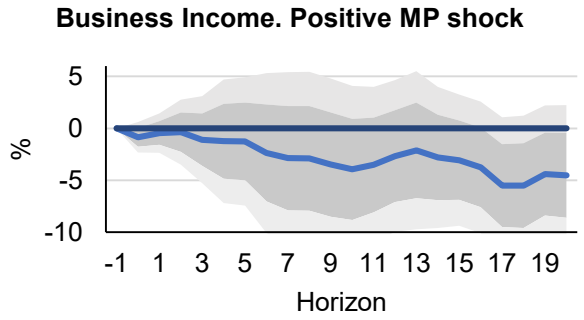
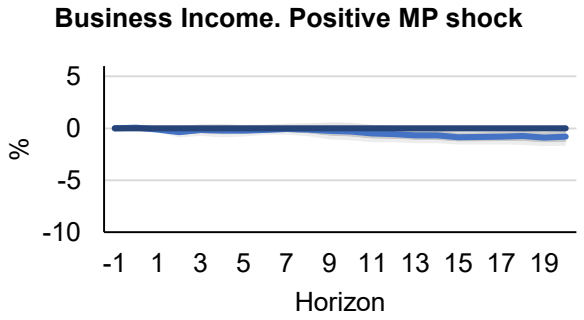
# Positive vs. negative monetary policy shocks—macro

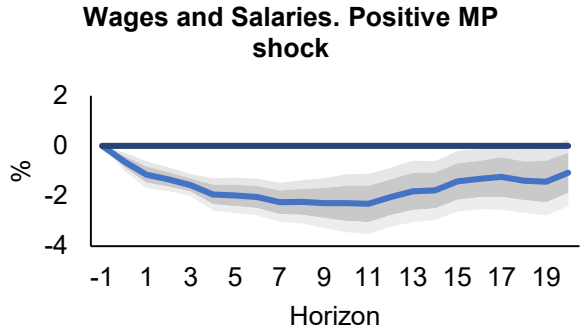


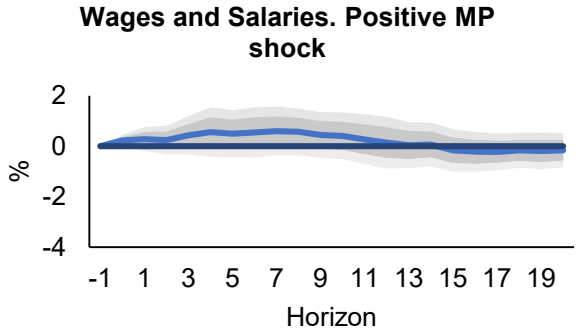

Note: The first two columns report the IRFs to a 100 b.p. contractionary positive and negative monetary policy shocks respectively. The dark and light grey shaded area indicate 1 standard deviation and 1.65 sd confidence intervals respectively. The black line in the third column indicates the correspondent p-value of the t-statistics of the null hypothesis of equality of coefficients, with the solid redline line indicating a p-value equal to 0.10.

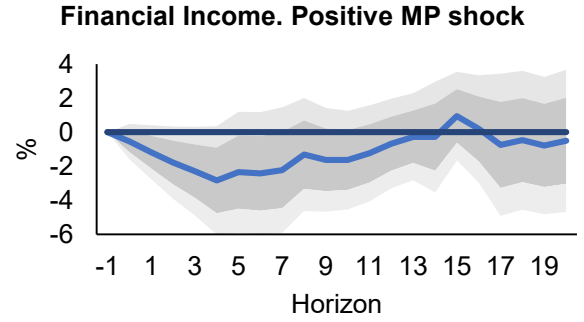
# Positive vs. negative monetary policy shocks—income

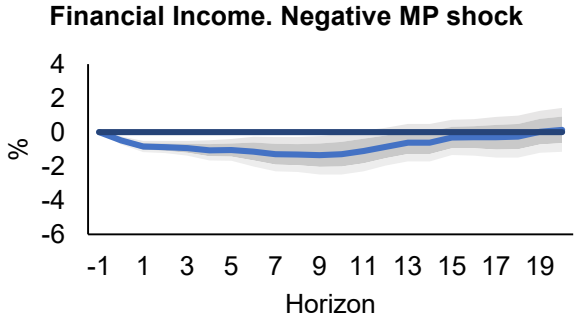
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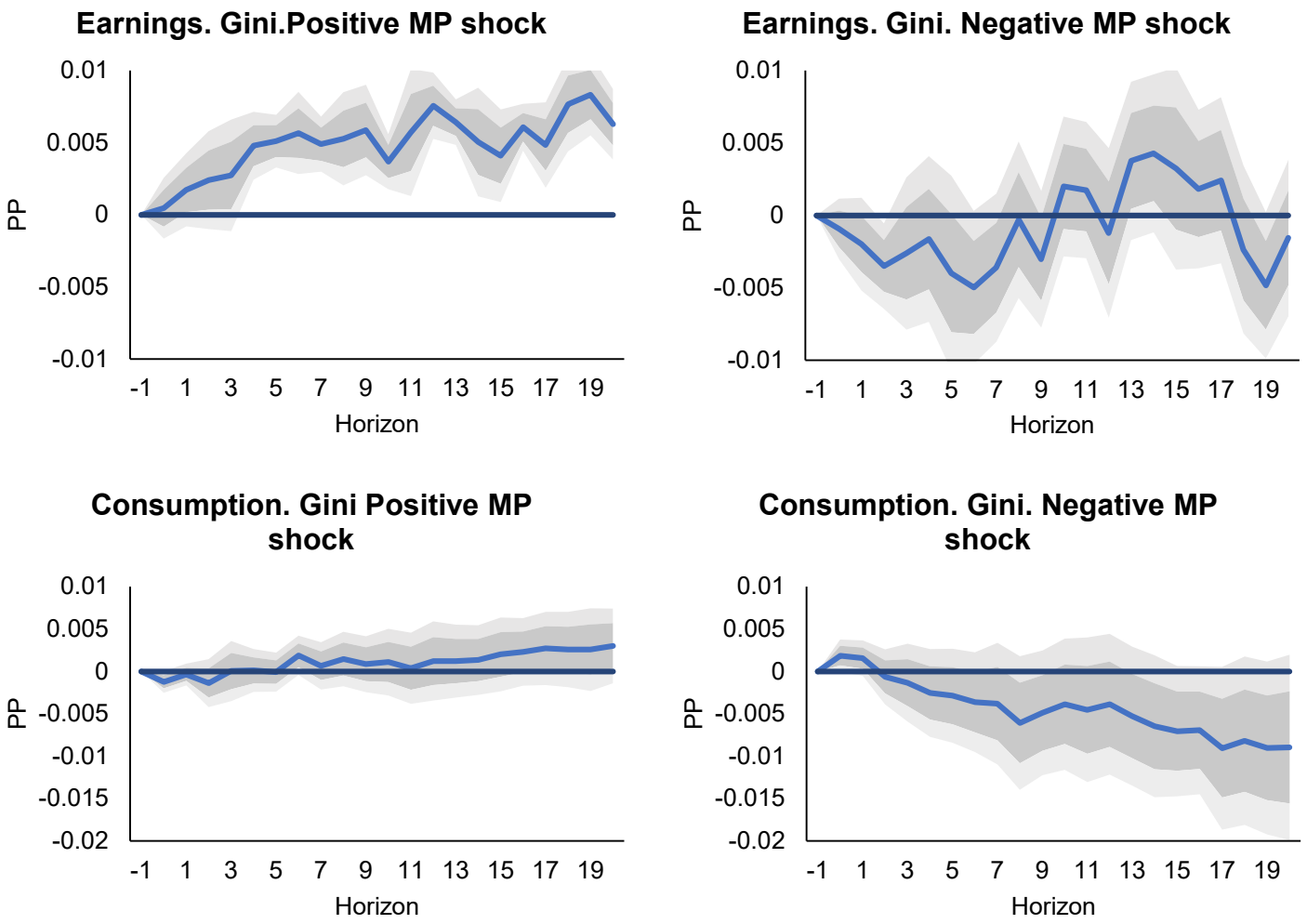
# Positive vs. negative monetary policy shock—inequality

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# Cumulative responses of macro measures to positive and negative monetary policy shocks

| | | Regime | | Significance level of difference |
|---|---|---|---|---|
| Cumulative impact on | Horizon | Positive Shocks | Negative Shocks | P test (Newey West) |
| GDP | 4 | -3.5645 | -0.8936 | 0.1026 |
| | 8 | -8.2229 | -1.8303 | 0.072 |
| | 12 | -12.2289 | -4.2173 | 0.2632 |
| | 16 | -12.5127 | -8.8735 | 0.7516 |
| Unemployment | 4 | 2.1997 | 0.3965 | 0.0348 |
| | 8 | 5.4265 | 0.4144 | 0.0018 |
| | 12 | 8.5652 | 0.4589 | 0.0034 |
| | 16 | 10.3891 | 1.2486 | 0.0333 |

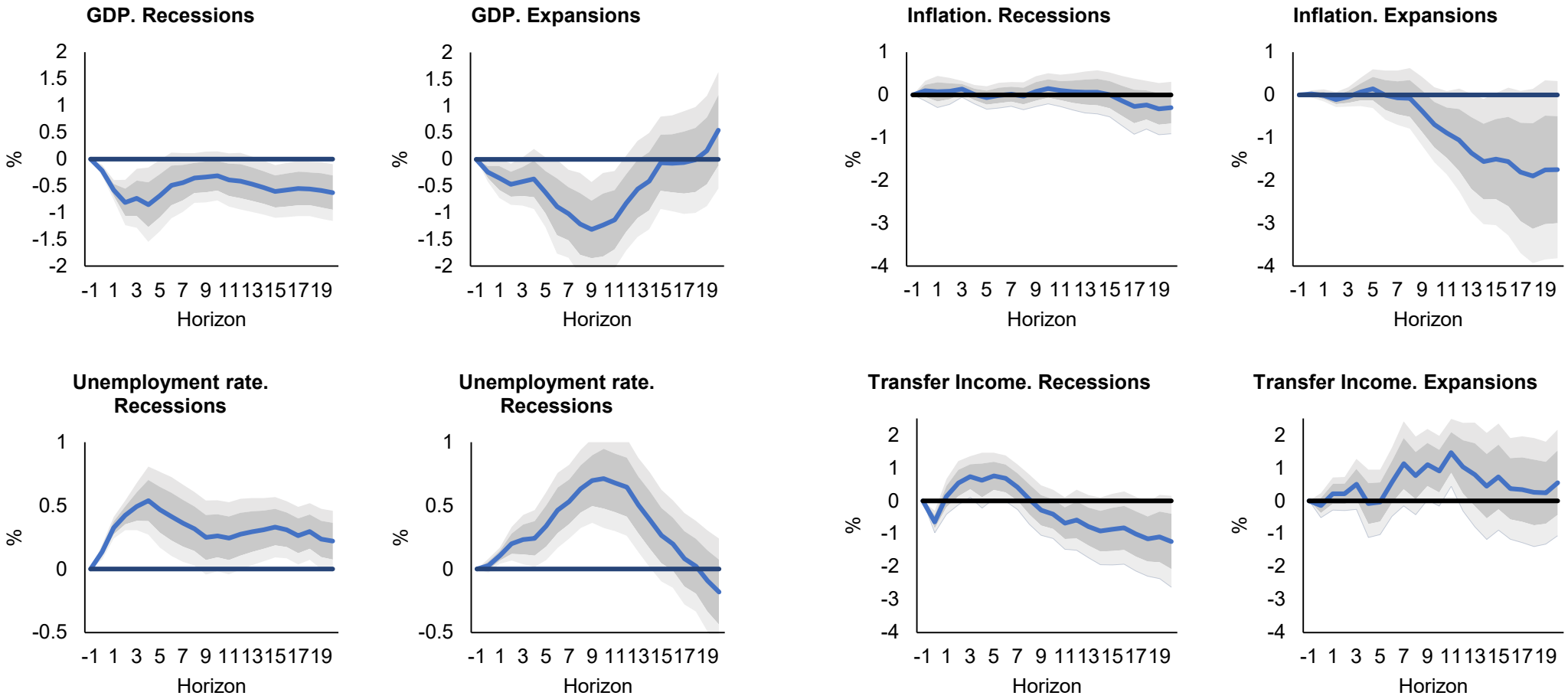
Note: Table above shows the cumulated impulse response function for GDP and unemployment in differences and a measure on how significant the difference between both estimations is. Standard errors are calculated using Newey-West estimator.

# Cumulative responses of inequality measures to positive and negative monetary policy shocks

| | | Regime | | Significance level of difference |
|---|---|---|---|---|
| Cumulative impact on | Horizon | Positive Shocks | Negative Shocks | P test (Newey West) |
| Income gini | 4 | 0.0024 | 0.0054 | 0.6376 |
| | 8 | 0.0111 | 0.0118 | 0.9529 |
| | 12 | 0.0196 | 0.0205 | 0.9647 |
| | 16 | 0.0277 | 0.0311 | 0.9127 |
| Earnings gini | 4 | 0.012 | -0.0014 | 0.2281 |
| | 8 | 0.0348 | -0.0084 | 0.0523 |
| | 12 | 0.0605 | 0.0012 | 0.0576 |
| | 16 | 0.0819 | 0.0179 | 0.152 |
| Expenditures gini | 4 | 0.0015 | 0.0048 | 0.8327 |
| | 8 | 0.0092 | 0.0076 | 0.9617 |
| | 12 | 0.016 | 0.0068 | 0.8657 |
| | 16 | 0.0253 | -0.0002 | 0.7277 |
| Consumption gini | 4 | -0.0015 | -0.0032 | 0.8277 |
| | 8 | 0.0021 | -0.0196 | 0.33 |
| | 12 | 0.0059 | -0.0374 | 0.289 |
| | 16 | 0.0123 | -0.0609 | 0.2204 |

Note: Table above shows the cumulated impulse response function for the calculated Gini coefficients for income, earnings, expenditures and consumption in differences and a measure on how significant the difference between both estimations is. Standard errors are calculated using Newey-West estimator.

# Recessions vs. expansions—macro




Note: The first two columns report the IRFs to a 100 b.p. contractionary monetary policy shocks in recession and expansion respectively. The dark and light grey shaded area indicate 1 standard deviation and 1.65 sd confidence intervals respectively. The black line in the third column indicates the correspondent p-value of the t-statistics of the null hypothesis of equality of coefficients, with the solid redline line indicating a p-value equal to 0.10.

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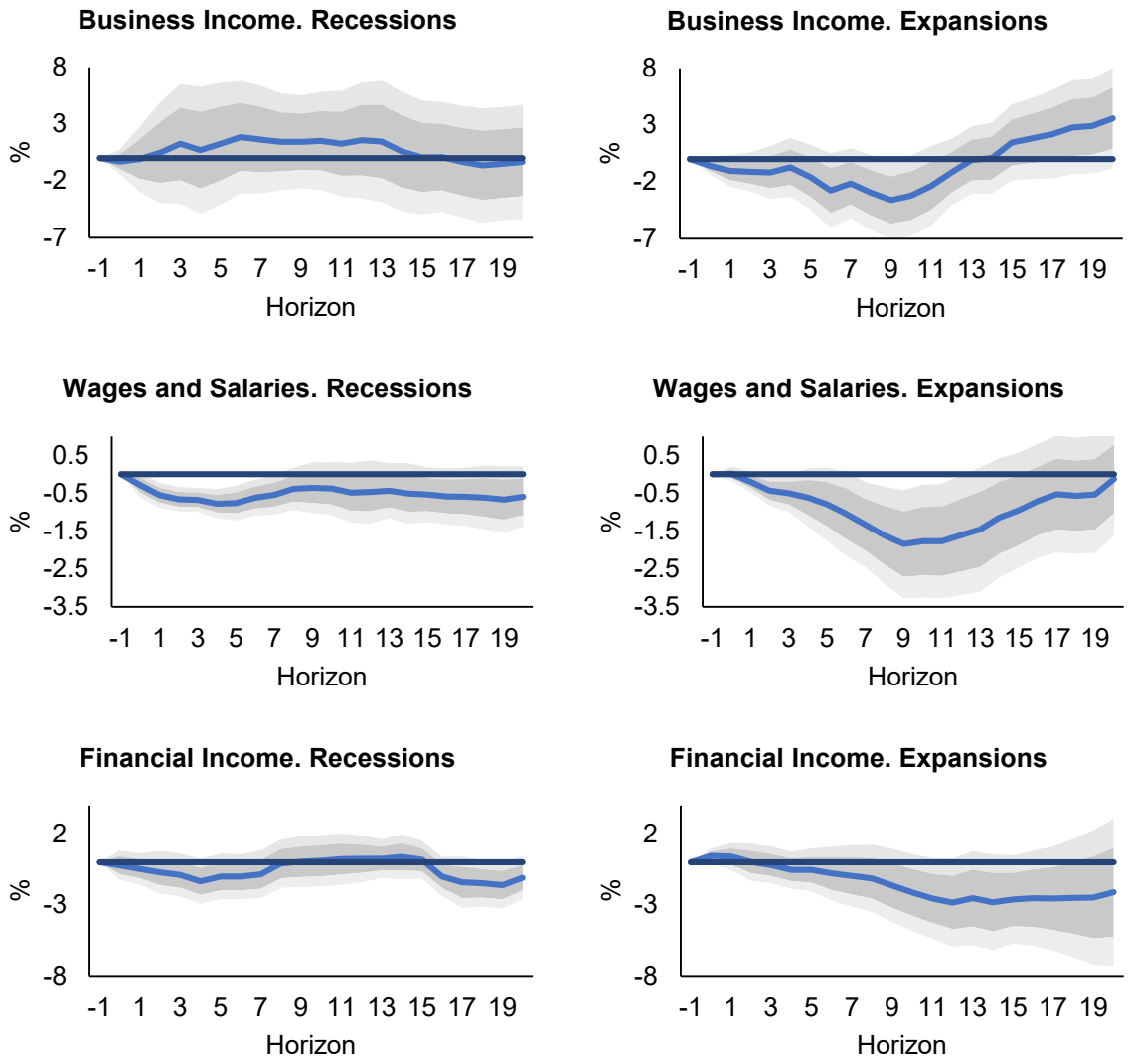


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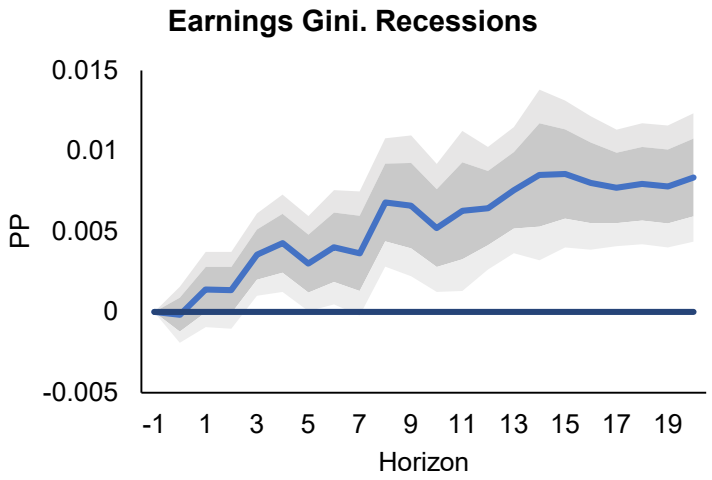
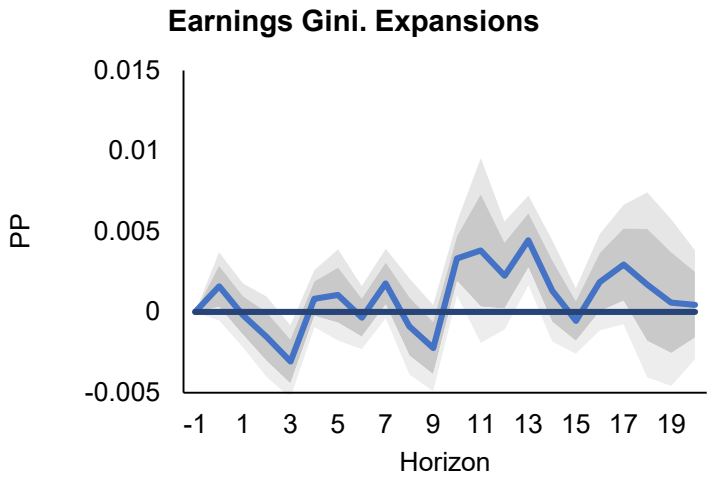
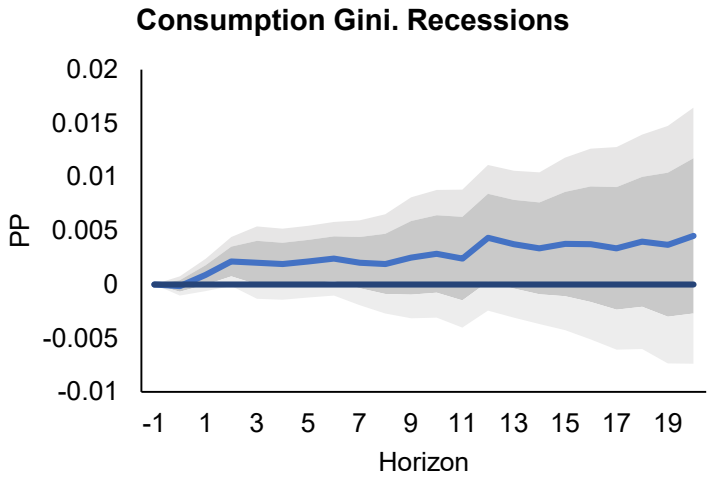
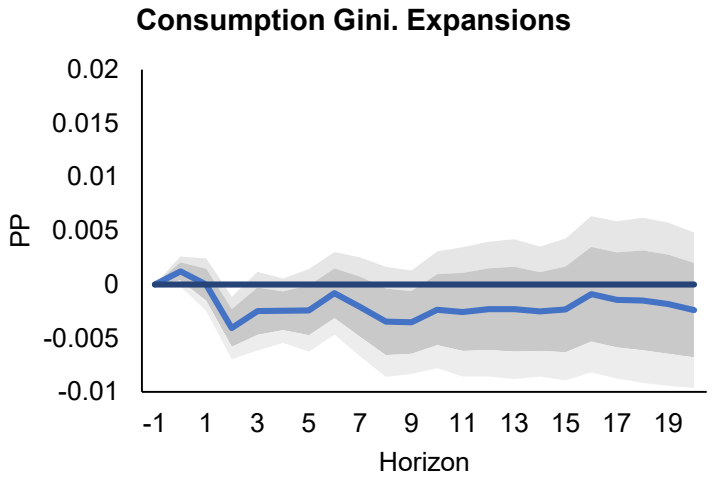
# Recessions vs. expansions—inequality

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# State-dependent cumulative responses of macro measures to monetary policy shocks in recessions and expansions

| | | Regime | | Significance level of difference |
|---|---|---|---|---|
| Cumulative impact on | Horizon | Expansion | Recession | P test (Newey West) |
| GDP | 4 | -1.6422 | -2.9279 | 0.4302 |
| | 8 | -5.8535 | -5.0116 | 0.8442 |
| | 12 | -11.2242 | -6.6217 | 0.5053 |
| | 16 | -13.8534 | -8.8704 | 0.5825 |
| Unemployment | 4 | 0.7679 | 1.7722 | 0.0522 |
| | 8 | 2.6895 | 3.3072 | 0.6839 |
| | 12 | 5.3549 | 4.2946 | 0.6645 |
| | 16 | 6.6461 | 5.4921 | 0.7179 |

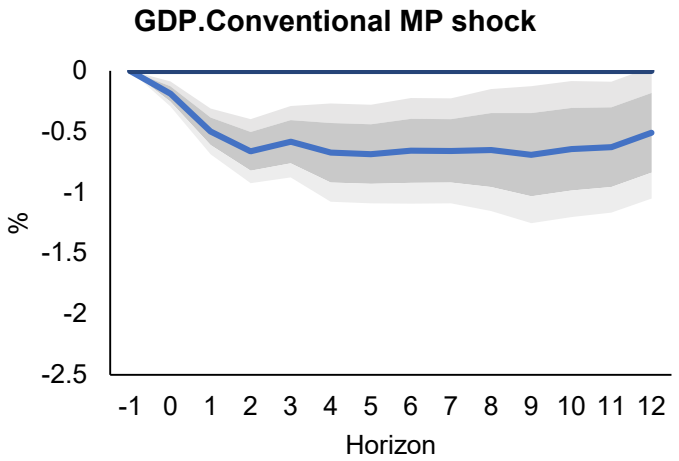
Note: Table above shows the cumulated impulse response function for GDP and unemployment in differences and a measure on how significant the difference between both estimations is. Standard errors are calculated using Newey-West estimator.

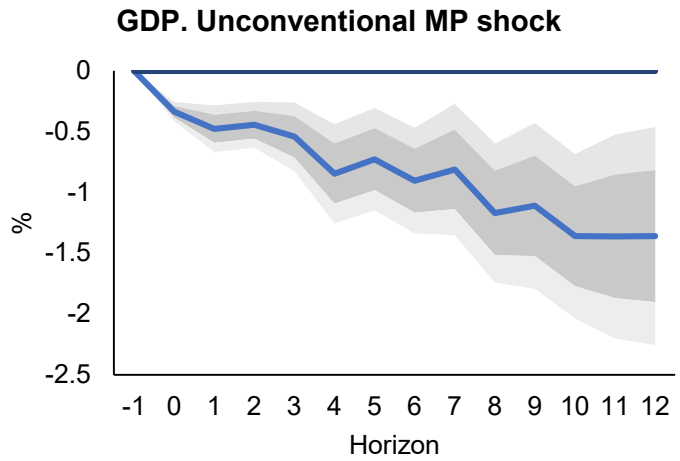
# State-dependent cumulative responses of inequality measures to monetary policy shocks in recessions and expansions

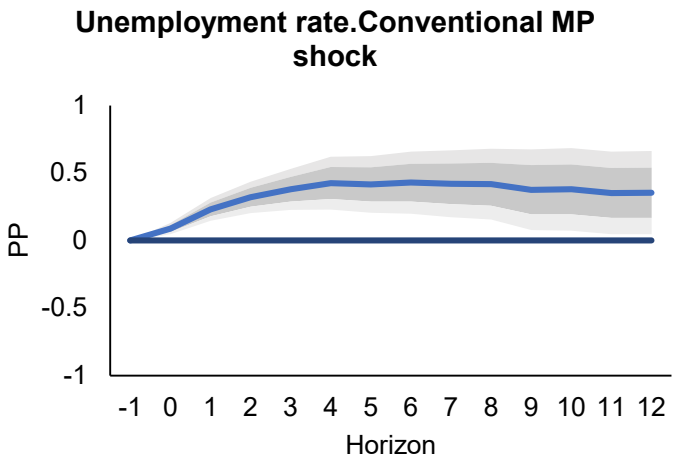
| | | Regime | | Significance level of difference |
|---|---|---|---|---|
| Cumulative impact on | Horizon | Expansion | Recession | P test (Newey West) |
| Income gini | 4 | -0.0013 | 0.0043 | 0.3906 |
| | 8 | 0.0024 | 0.0136 | 0.4313 |
| | 12 | 0.0124 | 0.0221 | 0.6414 |
| | 16 | 0.011 | 0.0385 | 0.3283 |
| Earnings gini | 4 | -0.0013 | 0.0134 | 0.0185 |
| | 8 | -0.0023 | 0.0364 | 0.0225 |
| | 12 | 0.0116 | 0.0637 | 0.0522 |
| | 16 | 0.0191 | 0.0971 | 0.0329 |
| Expenditures gini | 4 | -0.0026 | 0.0098 | 0.0337 |
| | 8 | 0.0009 | 0.0223 | 0.189 |
| | 12 | 0.0072 | 0.0318 | 0.4478 |
| | 16 | 0.0152 | 0.0426 | 0.5978 |
| Consumption gini | 4 | -0.009 | 0.0068 | 0.095 |
| | 8 | -0.0191 | 0.0151 | 0.1177 |
| | 12 | -0.0306 | 0.0266 | 0.1413 |
| | 16 | -0.0394 | 0.0409 | 0.1919 |

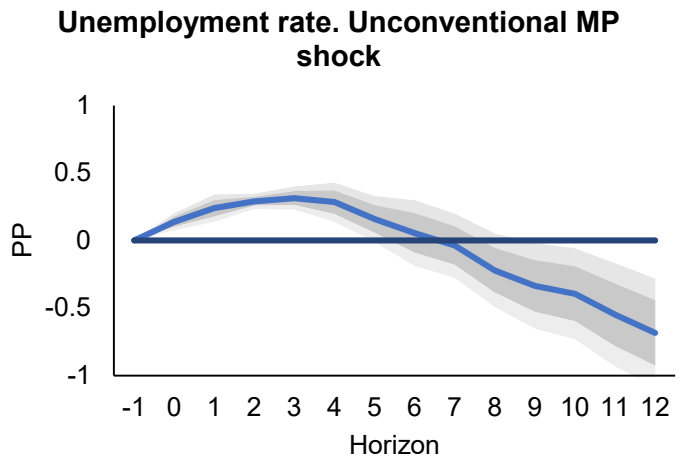
Note: Table above shows the cumulated impulse response function for the calculated Gini coefficients for income, earnings, expenditures and consumption in differences and a measure on how significant the difference between both estimations is. Standard errors are calculated using Newey-West estimator.

# Conventional vs. unconventional—macro

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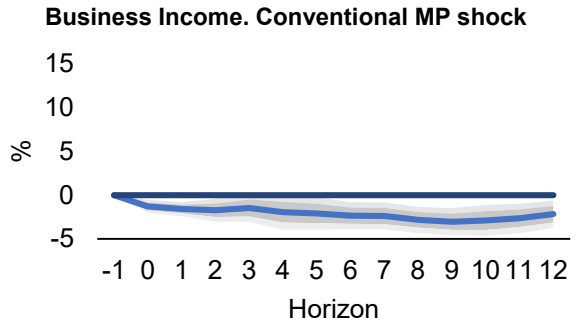
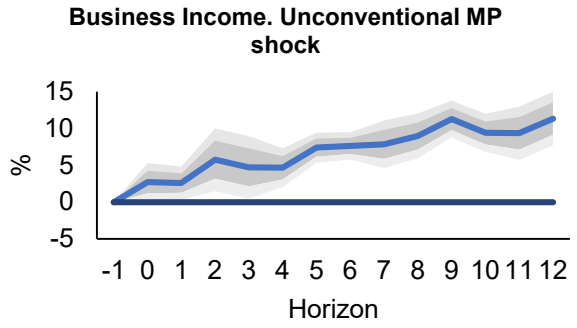
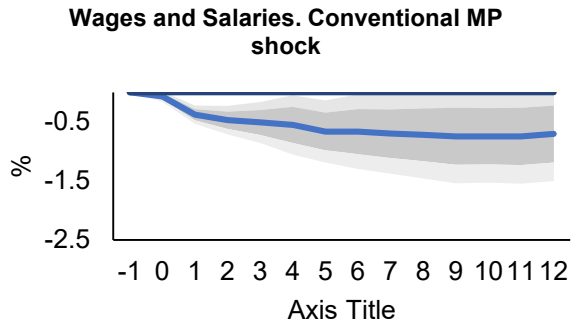
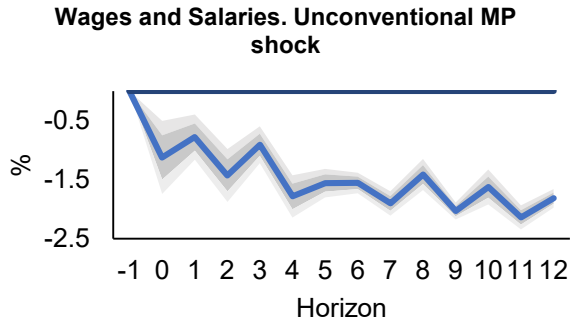
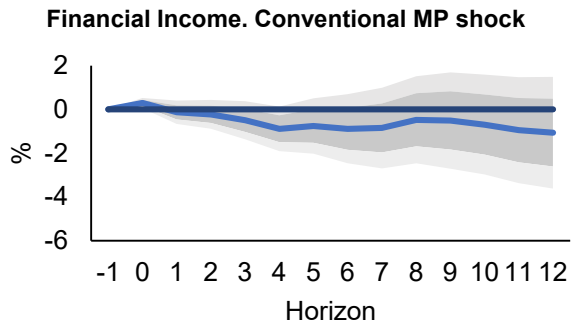
# Conventional vs. unconventional—income

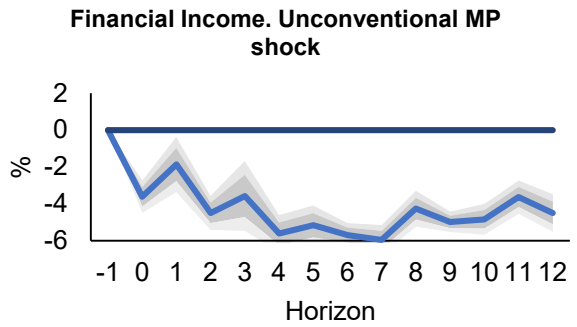


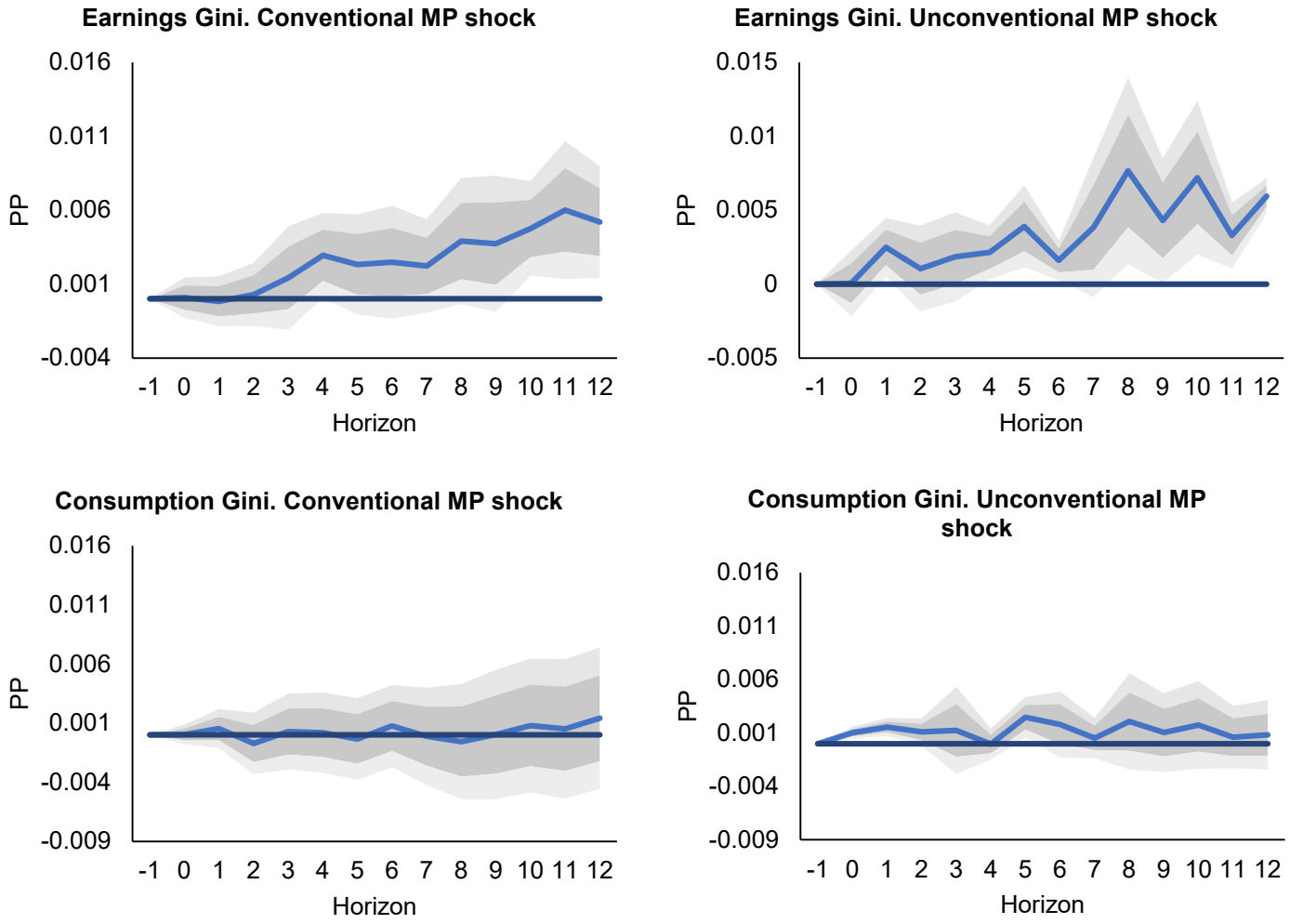




Note: The first two columns report the IRFs to a 100 b.p. contractionary conventional and unconventional monetary policy respectively. The dark and light grey shaded area indicate 1 standard deviation and 1.65 sd confidence intervals respectively. The black line in the third column indicates the correspondent p-value of the t-statistics of the null hypothesis of equality of coefficients, with the solid redline line indicating a p-value equal to 0.10.

# Conventional vs. unconventional—inequality




Note: The first two columns report the IRFs to a 100 b.p. contractionary conventional and unconventional monetary policy shocks respectively. The dark and light grey shaded area indicate 1 standard deviation and 1.65 sd confidence intervals respectively. The black line in the third column indicates the correspondent p-value of the t-statistics of the null hypothesis of equality of coefficients, with the solid redline line indicating a p-value equal to 0.10.

# State-dependent cumulative responses of macroeconomic measures to conventional and unconventional monetary policy shocks

| | | Regime | | Significance level of difference |
|---|---|---|---|---|
| Cumulative impact on | Horizon | Conventional | Unconventional | P test (Newey West) |
| GDP | 4 | -2.4209 | -2.1086 | 0.6308 |
| | 8 | -5.0801 | -6.9713 | 0.2579 |
| | 12 | -7.5891 | -14.3734 | 0.0747 |
| Unemployment | 4 | 1.3524 | 1.0372 | 0.4473 |
| | 8 | 3.03 | 1.8732 | 0.2229 |
| | 12 | 4.4875 | 2.0194 | 0.1805 |

Note: Table above shows the cumulated impulse response function for GDP and unemployment in differences and a measure on how significant the difference between both estimations is. Standard errors are calculated using Newey-West estimator.

# State-dependent cumulative responses of inequality measures to conventional and unconventional monetary policy shocks

| Cumulative impact on | Horizon | Regime | | Significance level of difference |
|---|---|---|---|---|
| | | Conventional | Unconventional | P test (Newey West) |
| Income gini | 4 | 0.0035 | 0.0115 | 0.4588 |
| | 8 | 0.0118 | 0.0257 | 0.4521 |
| | 12 | 0.0234 | 0.0291 | 0.7847 |
| Earnings gini | 4 | 0.008 | 0.0106 | 0.7151 |
| | 8 | 0.0217 | 0.0319 | 0.5281 |
| | 12 | 0.0455 | 0.054 | 0.7203 |
| Expenditures gini | 4 | 0.0073 | -0.0047 | 0.103 |
| | 8 | 0.017 | 0.0029 | 0.3404 |
| | 12 | 0.0272 | 0.0074 | 0.4701 |
| Consumption gini | 4 | 0.0001 | 0.0038 | 0.5498 |
| | 8 | -0.0011 | 0.0094 | 0.502 |
| | 12 | 0.0009 | 0.0131 | 0.6835 |

Note: Table above shows the cumulated impulse response function for the calculated Gini coefficients for income, earnings, expenditures and consumption in differences and a measure on how significant the difference between both estimations is. Standard errors are calculated using Newey-West estimator.

# Results

- Monetary policy tightening increases (reduce) inequality (output) more than a monetary expansion reduces (increase) it.

- Macro effects stronger in expansions, distributional effects in recessions (inflation channel and transfer).

- Unconventional monetary policy has been, at least, as much as effective in stabilizing output and contributing to reduce inequality as conventional monetary policy. If any, the analysis suggests that unconventional measures have a stronger impact on income variables than conventional ones.

Results robust to different shocks; state variables; lag structure.

# Implications

- Policy should be more aggressive to fight recessions than cool down the economy in expansion—no negative consequences in terms of inequality.

- Unconventional monetary policies can play a significant stabilization role.

- Call for recent HANK models to incorporate non-linearities.

# Non-linear Macro and Distributional Effects of US Monetary Policy

## ARC 2020 LABOR MARKET AND MONETARY POLICY

## KIEV-MAY 29, 2020

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