

The Effects of Monetary Policy Shocks on Inequality in Japan¹

Masayuki Inui Nao Sudo Tomoaki Yamada

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¹The views expressed are those of authors and do not necessarily reflect those of the BOJ/BIS.

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Motivation: growing interest on inequality

Impacts of monetary easing on inequality have attracted increasing attention recently

- Cohan (2014): “Mr. Bernanke’s extraordinary QE program, started in the wake of the financial crisis, has only widened the gulf between haves and have-nots.”
- Krugman (2014): “The belief that QE systematically favors the kinds of assets the wealthy own is wrong or at least overstated.”
- Bernanke (2015): “Monetary policy is a blunt tool which certainly affects the distribution of income and wealth, although whether the net effect is to increase or reduce inequality is *not clear*.”

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- Bernanke (2015): “Monetary policy is a blunt tool which certainly affects the distribution of income and wealth, although whether the net effect is to increase or reduce inequality is *not clear*.”
⇒ **Empirical issue!**

Existing empirical studies

Empirical observations are mixed

- Coibion et al. (2017): Income and consumption inequality across U.S. households respond **counter-cyclically** to monetary policy shocks
 - Interest rate \uparrow \rightarrow Income inequality \uparrow
- Mummtaz and Theophilopoulou (2016): The same result holds in the U.K.
 - Inequality declines in booms: US/UK
- Saiki and Frost (2014): The **opposite** is true using Japanese data
 - Interest rate \downarrow \rightarrow Income inequality \uparrow
- Domanski et al. (2016): Unconventional monetary policy may have widened wealth inequality, in particular through an upsurge in stock prices

Questions and Findings (1)

Question 1:

- Does a monetary policy *affects* inequalities?
⇒ Yes
 - MP shocks matter in **earnings** inequality
 - other inequality measures such as disposable income or consumption inequality does not matter
 - the direction is different from the US/UK
 - depends on the sample period ⇒ The effects **disappear recently**

Questions and Findings (2)

Question 2:

- Does the unconventional monetary policy (QE) matter for the relationship between monetary policy and inequality?
⇒ No
 - no regime switching
 - rather **continuous changes** in economic environment
 - structural changes of Japanese economy in 1981-2008

Questions and Findings (3)

Question 3:

- What kind of *transmission mechanism* works?
⇒ **Labor market flexibility** may matter on the relationship between monetary policy and inequality
 - using New Keynesian DSGE model

What we do

This paper

- Study the distributional effects of monetary policy, using the micro-level data on Japanese households.
- Draw the broad picture of the effects:
 1. focusing on inequality measures of income, consumption, and wealth based on the micro-level data
 2. using both the theoretical model and several data sets
 3. using a fairly long-span data sample: periods of **conventional** and **unconventional** monetary policy regimes

Potential transmission channels

1. Earnings heterogeneity channel ← **Japan: This paper**
 - the response of earnings to a monetary policy shock differs
2. Job creation channel
 - job creation/destruction following a MP shock
3. Income composition channel ← **US: Coibion et al. (2017)**
 - the income composition of different income types differs
4. Portfolio channel
 - the size and composite of asset portfolio differs
5. Saving redistribution channel ← **Doepke and Schneider (2006)**
 - a transfer from lenders to borrowers by a subsequent rise in inflation caused by monetary easing

I. Data & Estimation

FIES

Family Income and Expenditure Survey (FIES)

- by the ministry of internal affairs and communications
- Monthly survey on household income and expenditures
 - January 1981 – December 2008
 - The number of observations: 8,000
 - Panel data: 6 months
 - Two-or-more household members only
 - Single household and wealth info. available only after 2002
- Focus on full-time employees (household head): 25–59
 - Self-employed, retirees and **unemployed** are excluded
- Construct *quarterly series* of variables on economic inequality
 - for time series analysis

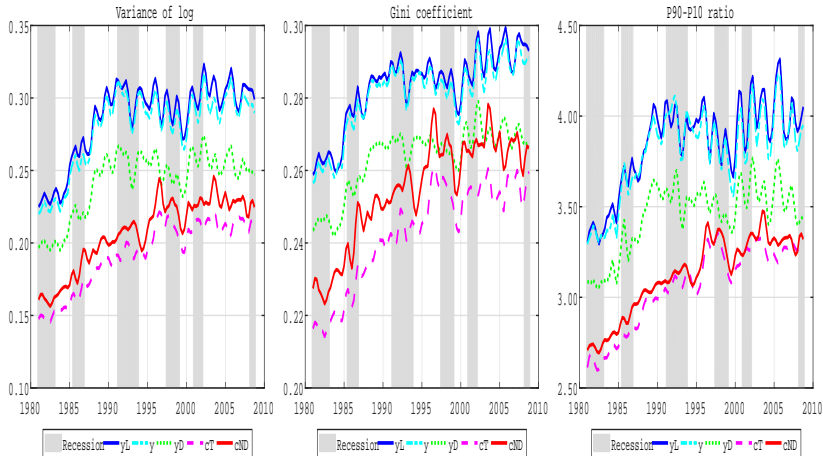
FIES (cont.)

Definition of Variables

1. Earnings y_L
 - Sum of labor income of *all* household members
2. Total income y : y_L + capital income + private transfer
3. Disposable income y_D : y + public transfers - taxes/premiums
4. Nondurable expenditures c_{ND}
 - Housing, purchasing cars and other durables are excluded
5. Total expenditure c_T : c_{ND} + durables (housing excluded)
 - Equivalized by OECD equivalent scale

▶ DETAILS

Time path of inequality measures



Estimation methodology

Estimate the impulse responses of inequality measures to a monetary policy shock, using the LLP by Jordà (2005):

$$\frac{\partial Y_{t+h}}{\partial u_t^R} \equiv \mathbb{E} \left(Y_{t+h} | u_t^R = 1; M_t \right) - \mathbb{E} \left(Y_{t+h} | u_t^R = 0; M_t \right)$$

- Y_{t+h} : inequality measure of interest such as the variance of log of earnings at period $t + h$
- u_t^R : shock to the short-term nominal interest rate at period t
- M_t : macroeconomic factors at period t
 - Table 2 in the full paper

Estimation methodology (cont.)

Estimate the impulse responses of inequality measures to a monetary policy shock, using the LLP by Jordà (2005):

$$\underbrace{Y_{t+h}}_{\text{inequality at } t+h} - Y_t = \alpha_h + \Pi_h(L)M_t + \underbrace{\varepsilon_{t+h}}_{\text{innovation}}$$

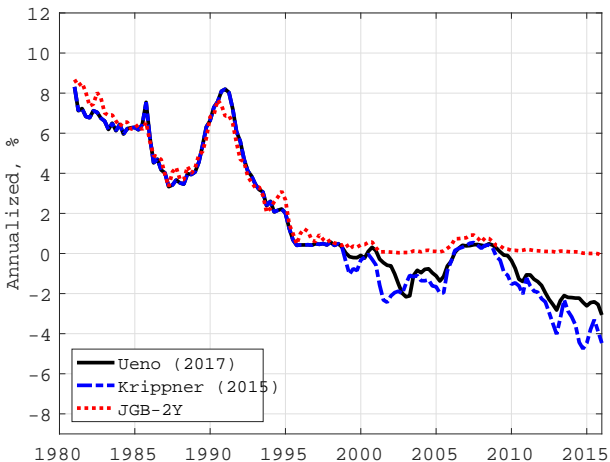
$$\Pi_h(L)X_t = \Pi_{h,0}X_t + \Pi_{h,1}X_{t-1} + \dots + \Pi_{h,d_1}X_{t-d_1}$$

$$M_t = \begin{bmatrix} \Delta TFP_t \\ Factor_t \\ \Delta R_t \end{bmatrix} \Leftarrow \text{Monetary policy variable}$$

Estimation methodology (cont.)

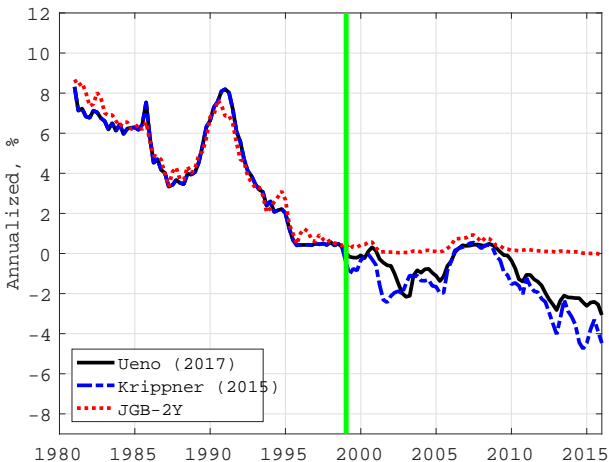
- Advantages of LLP:
 - Robustness to model misspecifications:
⇒ choice of explanatory variables and the number of lags
 - Flexibility of model specifications
 - Coibion et al. (2016) also use the LLP by Jordà (2005)

Monetary policy instrument



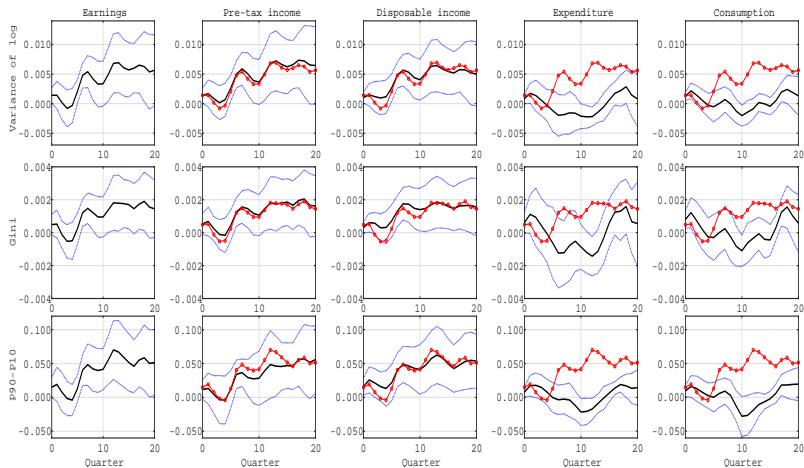
- **Baseline:** 1981Q1-1998Q4, **Shadow rate:** after 1999Q1

Monetary policy instrument



- **Baseline:** 1981Q1-1998Q4, **Shadow rate:** after 1999Q1

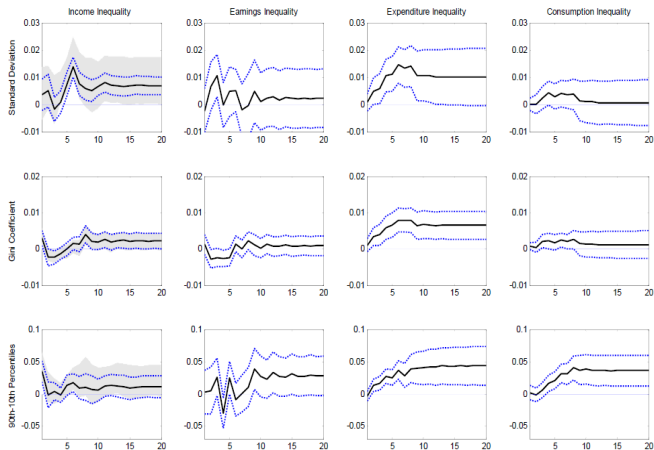
Responses of inequality measures: Baseline



- Response of economic inequality to an **expansionary** MP shock

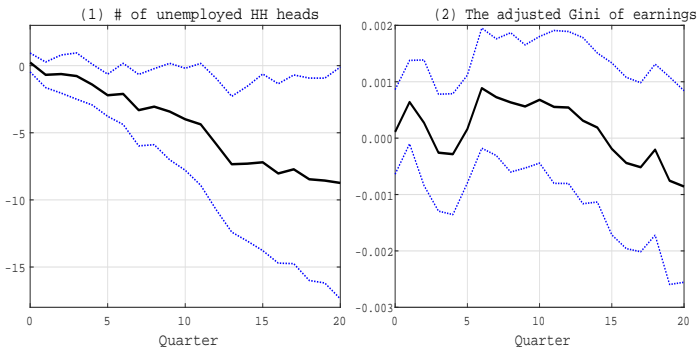
U.S. Economy

FIGURE 4: RESPONSE OF ECONOMIC INEQUALITY TO A CONTRACTIONARY MONETARY POLICY SHOCK



- Figure 4 in Coibion et al. (2017)

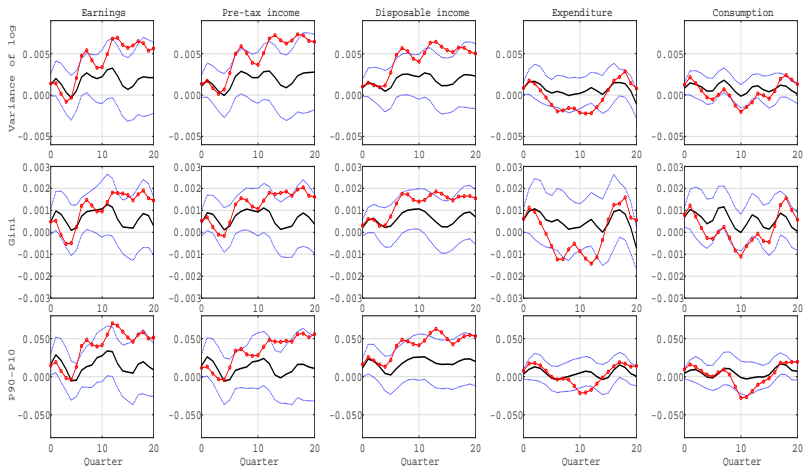
Channel through job creation



- Add unemployed using the unemployment rate: earnings of unemployed = 0

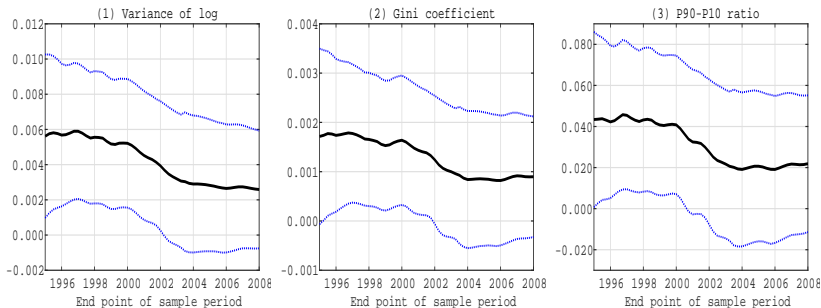
▶ Adjusted Gini

Responses of inequality: 1981-2008



- Red line: 1981-1998, Black line: 1981-2008

Changes in responses of earnings inequality over time



- How the estimated impulse response functions of earnings inequality vary with the sample period? \Rightarrow rolling estimates

Empirical observations

1. Impact of expansionary monetary policy on income inequality is *procyclical*, arises mainly from procyclical response of earnings inequality. ⇒ **Earnings heterogeneity channel matters in Japan**
2. Once-prevailing distributional effects **diminish** during 2000s
3. Possibility that a decline in earnings inequality due to job creation channel counters its rise from earnings heterogeneity channel
4. Transmission of income inequality to consumption inequality is less than one-to-one

Accounting for observations

To address to these observations, we conduct three additional analyses:

1. Two-sector DSGE model with labor market frictions
 - illustrate how the distributional effects of monetary policy change with the structure of the economy
2. Industry-level aggregate data sets
3. Micro-level data on households' financial assets and liabilities
 - check whether the model's predictions accord with the data

II. Model

(under revision)

Literature: Theory

Models of inequality:

- Monetary policy shocks:
 - Guerrieri and Lorenzoni (2012), Gornemann et al. (2016), Auclert (2019), McKay et al. (2016)
- Fiscal policy shocks:
 - Oh and Reis (2012), McKay and Reis (2015)
- ↑ Heterogeneous Agent New Keynesian (HANK) Models
- Two-agent New Keynesian model (TANK):
 - Debortoli and Gali (2016)
- Mechanism behind earnings inequality in HANK models
⇒ idiosyncratic income risks (stochastic, but **exogenous**)

Literature: Theory

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Want to explain earnings inequality

Basic Idea behind the Model

- MP shocks matter \Rightarrow nominal rigidities

Explaining earnings inequality:

- What determines labor income?
 - one sector model without any frictions in the labor market, labor income is determined from productivity of workers
 - Different wages among sectors? \Rightarrow arbitrage and equal wage in equilibrium
 - MP shocks do not matter
- \Rightarrow Multi-sector with different wage + labor market frictions

Our model

- Two production sectors (X and Z)
 - each of which has final goods firms and intermediate goods firms
 - consumption composite consists of goods X and goods Z
- Two types of households (X and Z)
 - each of which has two types of members: “father (mother)” and “son (daughter)”
 - **Attached**: father supplies its labor inputs to one of two sectors
 - **Mobile**: son can supply its labor inputs to both sectors
 - father and son live together: same budget and combined utility function

Objectives of households

- Each type of households ($s = X, Z$) maximizes:

$$U_{s,t} = \mathbb{E}_t \left[\sum_{q=0}^{\infty} \beta^q u(C_{s,t+q}, C_{s,t+q-1}, N_{s,t+q}, H_{s,t+q}) \right]$$

$$u(\cdot, \cdot, \cdot, \cdot) = \log(C_{s,t+q} - bC_{s,t+q-1}) - \theta \frac{N_{s,t+q}^{1+\eta}}{1+\eta} - \phi \frac{H_{s,t+q}^{1+\eta}}{1+\eta}$$

- N : attached labor input, H : mobile labor input
- β : discount factor, C : consumption, b : habit
- η : Frisch elasticity of labor supply
- θ, ϕ : labor disutility parameters

Budget constraint

- The budget constraint:

$$C_{s,t} + \frac{B_{s,t}}{P_t} \geq \left[\begin{aligned} & \frac{W_{s,t}}{P_t} N_{s,t} + \frac{W_t}{P_t} H_{s,t} \\ & + \left(\frac{\Pi_{X,t} + \Pi_{Z,t}}{P_t} \right) \gamma \Pi_s + \left(\frac{R_{X,t} K_X + R_{Z,t} K_Z}{P_t} \right) \gamma K_s \\ & + R_{t-1} \frac{B_{s,t-1}}{P_t} + \kappa_B \left(\frac{B_{s,t}}{P_t} \right)^2 \end{aligned} \right],$$

- P_t : price level, $B_{s,t}$: bond holdings
- $W_{s,t}$: wage of each sector, W_t : wage of mobile workers
- Π_s : profit of each sector, K_s : capital stock
- $R_{X,t}$: nominal rental costs of the capital stock
- $\gamma \Pi_s$: share of dividends, γK_s : share of capital stock
- κ_B : adjustment costs of bond holding
- Capital stock is fixed at some level

Intermediate firm's price setting

- In sector X , the intermediate firm i choose the prices to solve:

$$\max_{P_{X,t}(i)} \mathbb{E} \left[\sum_{q=0}^{\infty} \beta^{t+q} \frac{\Lambda_{t+q}}{\Lambda_t} \frac{\Pi_{t+q,X}(i)}{P_{t+q}} \right]$$

- subject to

$$\begin{aligned} \Pi_{X,t+q,X}(i) &= P_{X,t+q}(i)x_{t+q}(i) - MC_{X,t+q}(i)x_{t+q}(i) \\ &\quad - \frac{\kappa_X}{2} \left(\frac{P_{X,t+q}(i)}{P_{X,t+q-1}(i)} - 1 \right)^2 P_{X,t+q} X_{t+q}, \\ x_t(i) &= AN_{X,t}(i)^{\alpha\mu} U_{X,t}(i)^{\alpha(1-\mu)} K_{X,t}(i)^{1-\alpha} \end{aligned}$$

- $x_{t+q}(i)$: intermediate good, $MC_{X,t+q}(i)x_{t+q}(i)$: marginal costs
- Λ_t : Lagrange multiplier, κ_X : price adjustment parameter

Demand curves

- Final goods:

$$\tilde{X}_t = \left[\int_0^1 x_t(i)^{1-\varepsilon} di \right]^{\frac{\varepsilon}{\varepsilon-1}}$$

- Demand functions for the differentiated products produced by firm

$$x_t(i) = \left[\frac{P_{X,t}(i)}{P_{X,t}} \right]^{-\varepsilon} \tilde{X}_t$$

Rest of the model

- Price index of the final good:

$$P_{X,t} = \left[\int_0^1 P_{X,t}(i)^{1-\varepsilon} di \right]^{\frac{1}{1-\varepsilon}}$$

- The *aggregator* constructs the composite of consumption goods using the aggregate technology

$$C_t = X_t^\rho Z_t^{1-\rho}$$

- Demand curve:

$$X_t = \rho \left(\frac{P_t}{P_{X,t}} \right) C_t$$

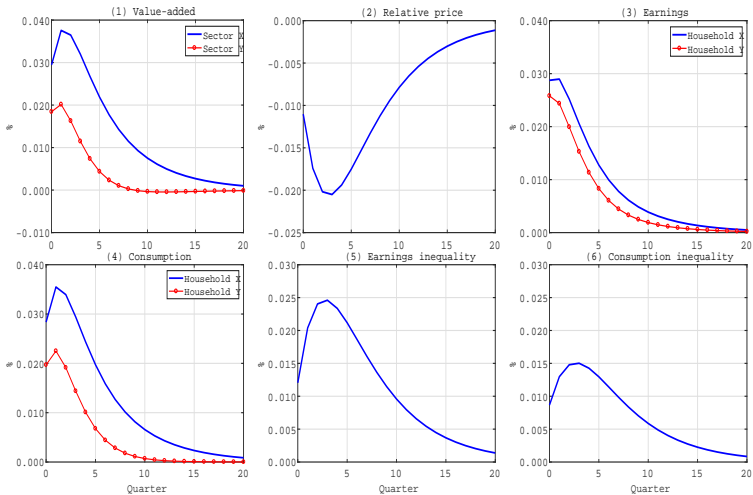
- Monetary policy:

$$\log R_t = \rho_n \log R_{t-1} + (1 - \rho_n) \varphi \log \pi_t + \epsilon_{R,t}$$

Setup

- Assumption (1): $\rho > 1 - \rho$
 - Household X enjoys a higher level of consumption than does household Z
 - X receives *higher earnings* than Z at steady state
- Assumption (2): $\kappa_X > \kappa_Z$
 - Monetary policy affects two sectors *differently* around steady state
 - the price of goods X is adjusted at a slower pace than that of goods Z in the wake of a monetary policy shock
 - goods X attract a larger demand than goods Z , because goods X becomes cheaper than goods Z
- Other parameters are symmetric
 - no wealth inequality
 - Table 1 in full paper

After an expansionary monetary policy shock



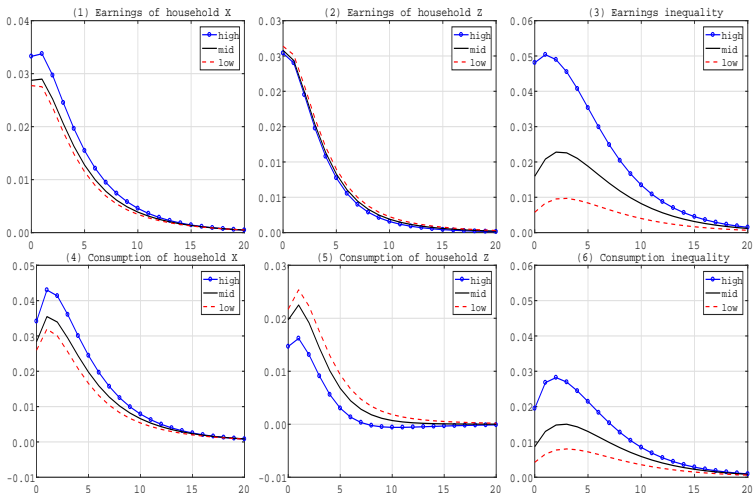
Mechanism

- The cross-sector heterogeneity arises from the difference in price stickiness between $P_{X,t}$ and $P_{Z,t}$
- Goods price of sector X becomes relatively cheaper in the short-run \Rightarrow the demand towards goods X_t becomes larger than the demand for goods Z_t

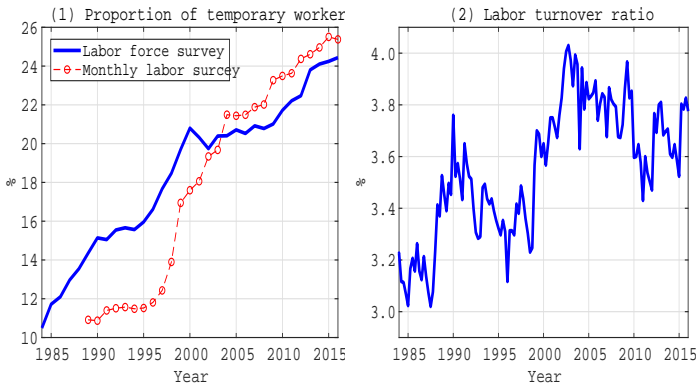
$$X_t = \rho \left(\frac{P_t}{P_{X,t}} \right) C_t$$

- Intermediate goods firm i , facing a greater demand, employs a larger amount of attached labor inputs $N_{X,t}(i) \Rightarrow$ the nominal wage for those labor inputs $W_{X,t}$ increases disproportionately compared to other wages $W_{Z,t}$ and W_t

Labor market flexibility: $\mu \in \{0.4, 0.6, 0.8\}$

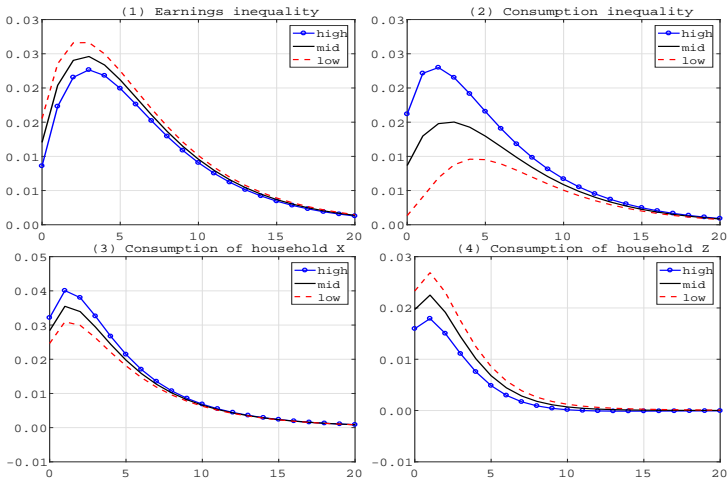


Labor market flexibility in Japan



- Source: Labor force survey and Monthly labor survey.

Distribution of financial assets matters



- $\gamma_{K_X} \in \{0.4, 0.5, 0.6\}$

Mechanism (2)

- The distribution of capital stock holding substantially affects the dynamics of both earnings and consumption inequality following monetary policy shocks
- $\gamma_{K,X} = 0.4$ (low): household X becomes less wealthy \Rightarrow supplies more labor inputs to the goods producing sectors due to the negative wealth effect
 - Opposite is true in household Z
- Boosting earnings inequality across households + less consumption inequality

Conclusion

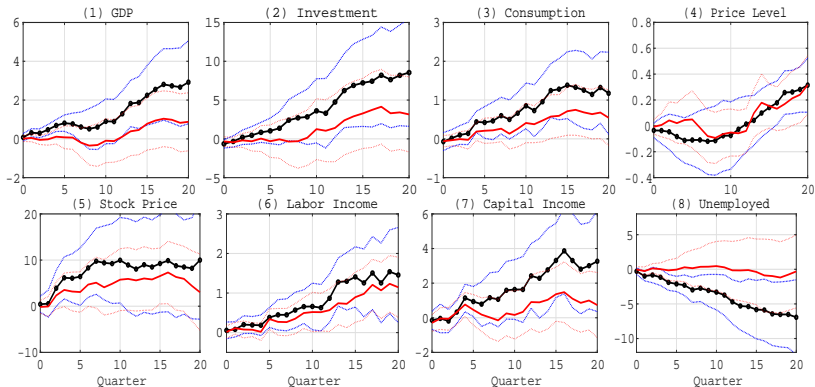
Empirically and theoretically study how monetary policy shocks are transmitted to inequality.

- Distributional effects of monetary policy were once present, but have become statistically insignificant during the 2000s
- Labor market flexibility is central to the dynamics of income inequality after the monetary policy shocks
- Transmission of income inequality to consumption inequality is minor
- Distributions of financial assets and liabilities don't play a significant role

Thank you!

Appendix Figures

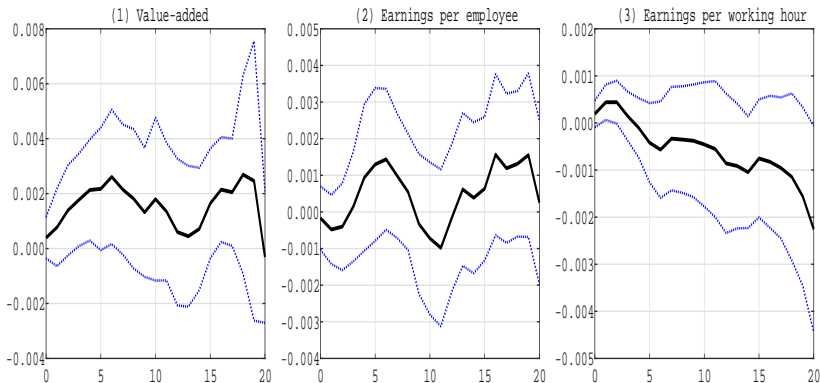
Responses of macro variables



Cross-firm heterogeneity to earnings inequality: baseline



Cross-firm heterogeneity to earnings inequality: 1981-2008



Data Details

Data Details

Definition of Variables

- Labor income y :
 - sum of monthly labor income of household members, which include household head, his/her spouse and other household members
- Nondurable expenditure c :
 - food; repair and maintenance of houses; fuel, light and water charges; domestic utensils, non-durable goods, and services; clothing and footwear; medical care; transportation and communication, excluding purchase of vehicles and bicycles; education; culture and recreation, excluding recreational durable goods; and other consumption expenditure, excluding remittance

◀ RETURN

Adjusted Gini

Adjusted Gini coefficient

$$G^* \equiv \frac{\sum_{i=1}^{\bar{N}} \sum_{j=1}^{\bar{N}} |x_i - x_j|}{2\bar{N} \sum_{i=1}^{\bar{N}} x_i} = G \frac{N}{\bar{N}} + \frac{\bar{N} - N}{\bar{N}}$$

- Assumption: earnings of unemployed = 0

◀ RETURN