Quantitative Easing and Inequality

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Disclaimer: *The views expressed in this paper are those of the author and do not necessarily reflect the position of the Federal Reserve Bank of New York, or the Federal Reserve System.*

- Debate regarding the distributional consequences of QE: positive effects on **labor market** vs **capital market**
- Existing results in the literature are **empirical** and **conflicting each other**: **Bivens (2015), Casiraghi et al. (2018), Lenza and Slascalek (2018)**, **Saki and Frost (2014), Montecino and Epstein (2015), Taghizadeh-Hesary et al. (2020)**
- This paper studies **aggregate** and **distributional consequences** of the **unconventional monetary policies** (**quantitative easing** and **forward guidance**) using **an estimated DSGE model** with **heterogeneous agents**

Research question

1. Did quantitative easing raise inequality?
2. What were the aggregate and distributional effects of forward guidance?
3. How would conventional monetary policy have been different from quantitative easing?

Relation to the literature

- Existing work in the (HANK) literature
  - **Implication of inequality on aggregate dynamics (transmission mechanisms)**: Kaplan et al. (2018), Auclert (2019), Broer et al. (2019), Bilbiie (2020), and Acharya and Dogra (2020)
  - **Distributional consequences of monetary policy (or inflation)**: Doepke and Schneider (2006) and Gornemann et al. (2021)
  - **HANK estimation**: Bayer and Luetticke (2020), Auclert et al. (2021), Liu and Plagborg-Moller (2021), and Acharya et al. (2020)

Model

- **Heterogeneous Agent New Keynesian (HANK)** model with **ELB** and **UMP**
  - **Households**: idio. income risk, unemployment risk, two assets (liquid deposit/illiquid capital)
  - **Firms**: search and matching labor market frictions with wage rigidity (ad-hoc wage function), price rigidity (Rotemberg), fixed costs, capital adjustment costs
  - **Financial institutions**: financial intermediation (take deposit/purchase capital) with agency problem - Gertler and Karadi (2011)
  - **Monetary authority**: conventional monetary policy - Taylor rule with ELB, unconventional monetary policy - QE (issue bonds/purchase capital), FG (longer expected ELB duration)

Solution method

- **Main method**: the perturbation method with state space reduction

$$A\mathbb{E}_t\left[X_{t+1}\right] + BX_t + CX_{t-1} + E\varepsilon_t = 0 \tag{1}$$

$$\Rightarrow\ X_t = PX_{t-1} + Q\varepsilon_t \tag{2}$$

X_t : endogenous variables in period t (dev. from ss) ε_t : exogenous shocks in period t

- **Quick solution update**: update parts of the Jacobian matrice (parts that do not affect the steady-state household problem) - Bayer et al. (2020)

- **ELB**: an (temporary) alternative regime $\Rightarrow$ compute a perfect foresight path out of the ELB

$$\tilde{A}\mathbb{E}_{t+T}\left[X_{t+T+1}\right] + \tilde{B}X_{t+T} + \tilde{C}X_{t+T-1} + \tilde{D} = 0\ ,\quad X_{t+T+1} = PX_{t+T}\ ,\ T\text{: expected ELB duration} \tag{3}$$

$$\cdots\ \Rightarrow\ X_t = P(T)X_{t-1} + J(T) + Q(T)\varepsilon_t \tag{4}$$

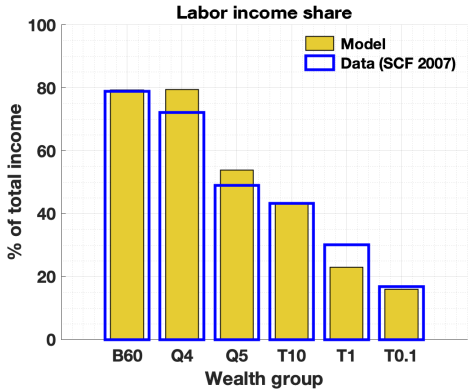
Estimation

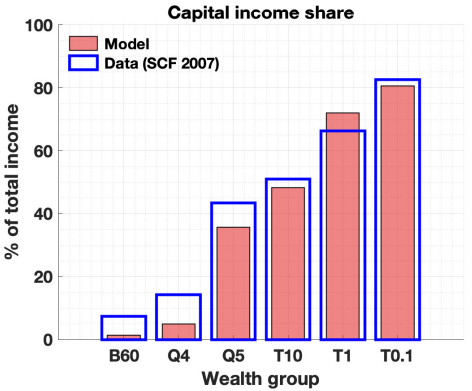
Parametrization strategy

- Fix a set of parameters
  - Internally calibrate the relevant parameters to match **households' wealth and income composition** e.g.) **income process**, **portfolio adjustment costs**, **asset returns**, **borrowing cost** dt
  - For other parameters, use standard values or values from the existing work, e.g.) **Financial institutions - Gertler and Karadi (2011)**
- Estimate parameters that matters for the dynamics, e.g.) **price and wage rigidity**, **adjustment frictions** and **policies**, and **shock processes**

Data for the calibration | Short list of parametrization | Full list of parametrization

Model fit - Households' income composition





- **Labor income**: wage and salary
- **Capital income**: business income (income from business or farm, investment income, rents, trusts, and royalties) + asset income (dividends, capital gain, fixed interest) Additional model fit Supplements

- Data: 1) **Output**, 2) **Consumption**, 3) **Investment**, 4) **Inflation rate**, 5) **Federal funds rate**, 6) **Real wage**, 7) **Unemployment rate**, 8) **Lump-sum transfer**, 9) **Profits**, and 10) **Central bank's assets** from 1992 Q1 to 2018 Q4 Observables and Shocks

$$\begin{bmatrix} \text{Output} \\ \text{Consumption} \\ \text{Investment.} \\ \text{Inflation rate} \\ \text{Federal funds rate} \\ \text{Real wage} \\ \text{Unemployment rate} \\ \text{Lump-sum transfer} \\ \text{Profits} \\ \text{CB's assets} \end{bmatrix} = \begin{bmatrix} \Delta \log Y_t \\ \Delta \log C_t \\ \Delta \log I_t \\ \log\left(\frac{\pi_t}{\pi}\right) \\ \log\left(\frac{1+i_t}{1+i}\right) \\ \Delta \log w_t \\ \log\left(\frac{u_t}{u}\right) \\ \Delta \log L_t \\ \Delta \log \Pi_t \\ \log\left(\frac{A_t^{QE}}{A^{QE}}\right) \end{bmatrix} \tag{5}$$

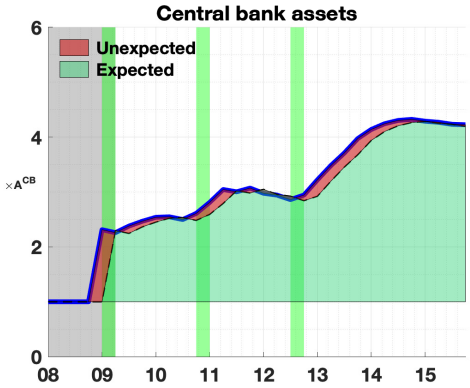
- Estimation method: **Block MCMC method** - Chib and Ramamurthy (2010), Kullish et al. (2014), Jones (2017) $\Rightarrow$ Sequentially update parameters (**Block 1** - **Exp ELB durations**, prior - NY Fed PD survey, **Block 2** - **Structural parameters**) Estimation results

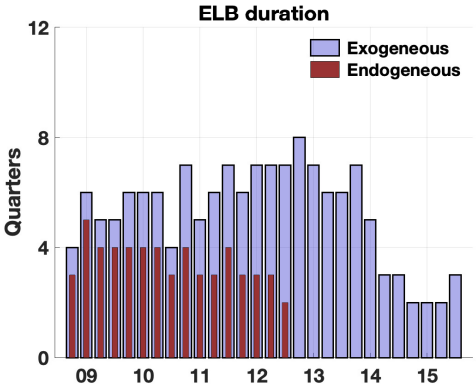
Results

1) Counterfactual analysis 1: UMP **vs** No UMP

2) Counterfactual analysis 2: UMP (QE) **vs** CMP

UMP during the ELB episode



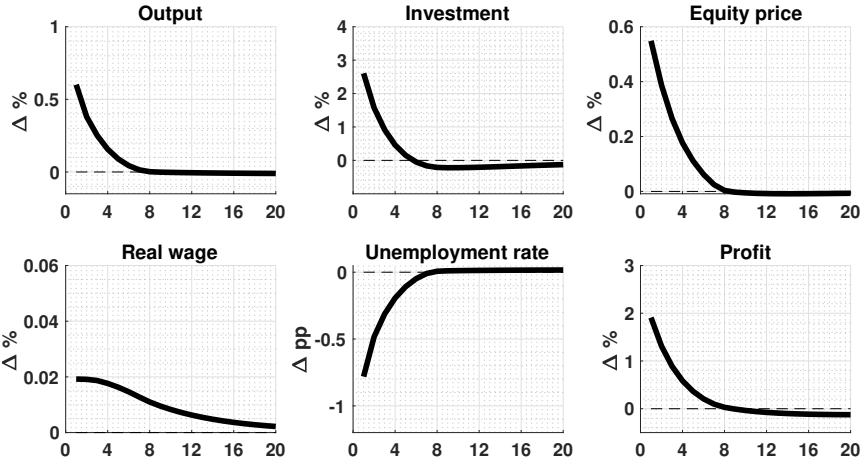


- UMP 1 (QE): CB's private asset purchases
- UMP 2 (FG): Exogenous ELB durations $\geq$ Endogenous ELB durations

Interest rates Mechanisms

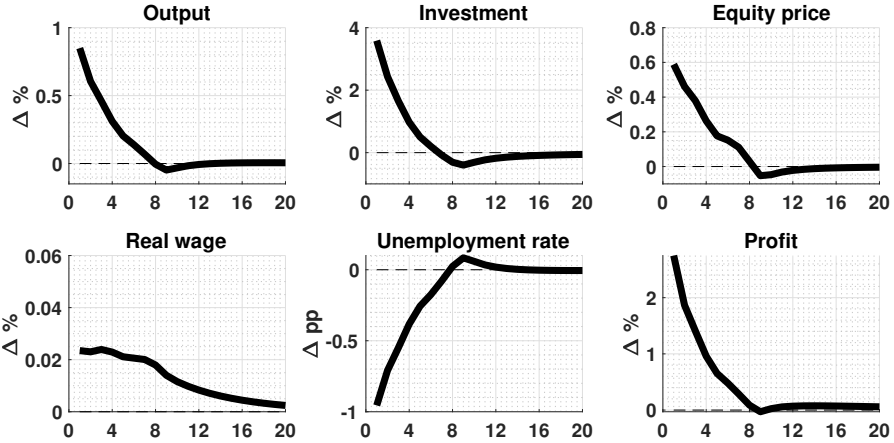
IRFs to QE shocks (average during the ELB episode, shock size = 5% of SS Y)

Additional IRFs



IRFs to FG (average during the ELB episode, additional one quarter of ELB episode)

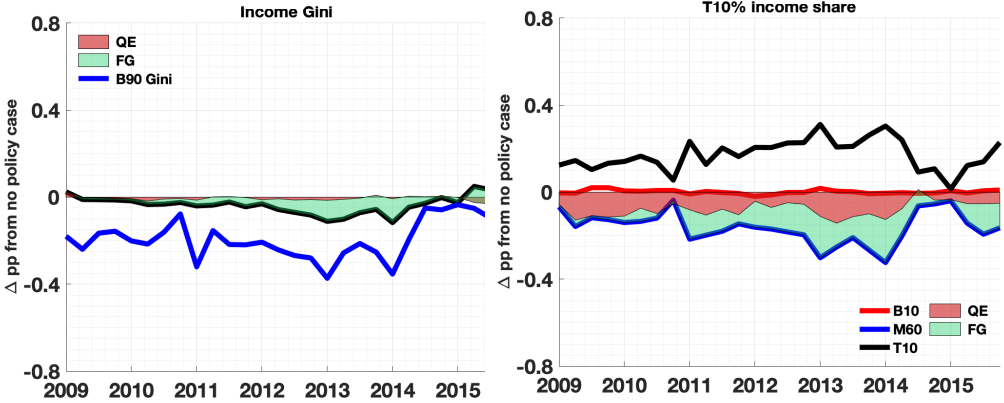
Additional IRFs



The effects of UMP - Aggregate effects

- Aggregate effects (average): output ⇑ 1.1% investment ⇑ 3.2%, unemployment rate ⇓ 1.4 **pp**, profits ⇑ 3.2%, equity prices ⇑ 0.9%, and real wage ⇑ 0.1%
- FG accounts for about 55-60% of the total effects Supplements

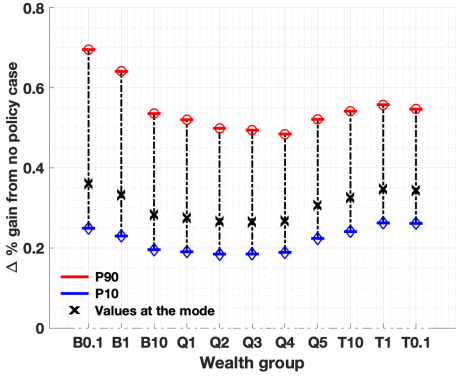
Distributional effects of UMP: Income inequality

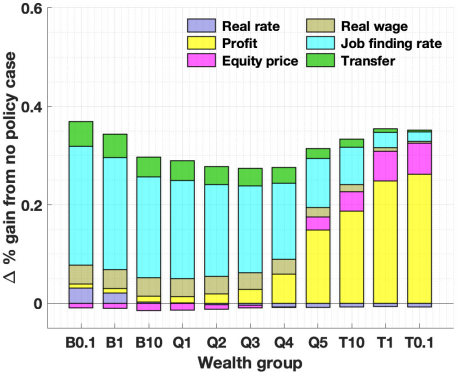


- UMP **reduced income inequality**, measured by the Gini index, especially among bottom 90% households mainly **by lowering the unemployment rate** U rates across HHs
- At the same time, **QE increased the top 10% income share by increasing profits** and **equity prices** Decomposition Supplements

Distributional effects of UMP: Welfare effects (Consumption equivalents)

CE formula



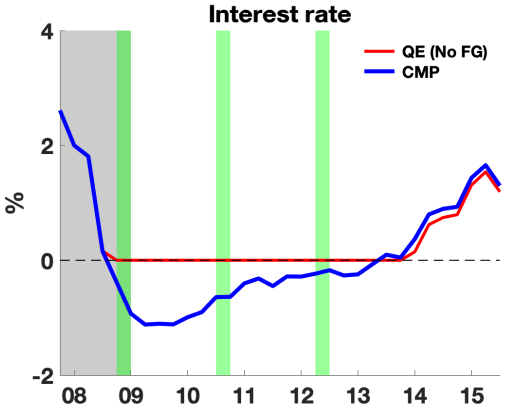


- **U-shaped welfare effects**: Both ends of the wealth distribution benefit more than the middle
- **Higher job finding rates** benefit the **bottom** disproportionately, while **higher profits** and **equity prices** disproportionately benefit the **top** disproportionately

1) Counterfactual analysis 1: UMP **vs** No UMP

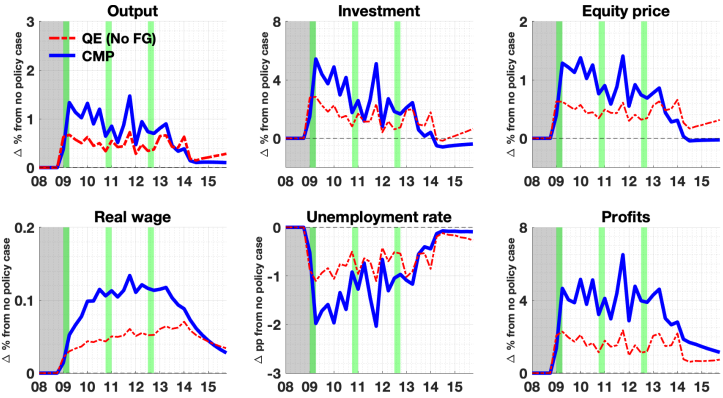
2) Counterfactual analysis 2: UMP (QE) **vs** CMP

QE vs CMP



- **Counterfactual scenario**: the policy rate is allowed to fall below zero (blue line), but there are no UMP

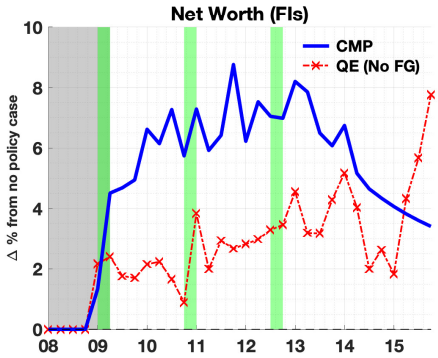
QE vs CMP - Aggregate effects



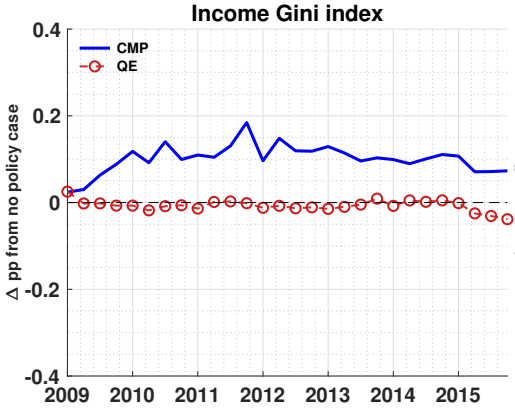
- The economy would have experienced larger stimulus if the ELB were not binding (compared to when the CB conducts QE only)

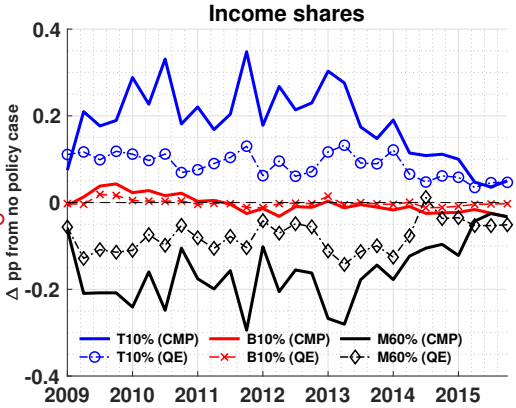
QE vs CMP - Aggregate effects

- QE **lowers the spread** between assets and liabilities of FIs $\Rightarrow$ **crowd out** FIs' investment
- CMP **increases the spread** $\Rightarrow$ **crowd in** FIs' investment
- CMP is more effective at stimulating private investment $\Rightarrow$ **overall stimulus effects and benefits for FI are larger** than those of QE

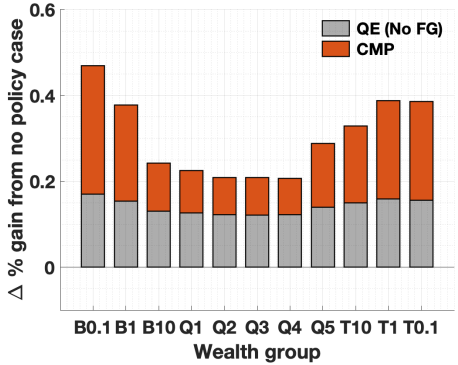


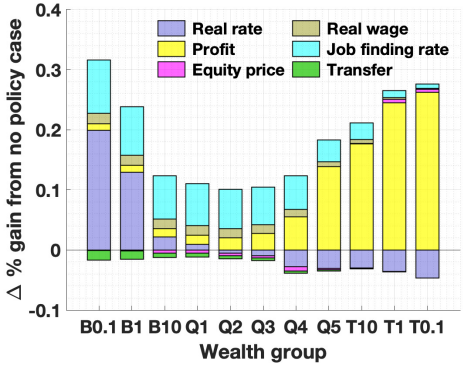
QE vs CMP - Distributional effects





QE vs CMP - Welfare effects





- CMP exacerbates a '**hollowing-out**' of the middle: ***savings redistribution*** benefits the bottom and hurts the top, but **gains of the levered investors (FIs)** benefit the top

Conclusion

Conclusion

- This paper develops and **estimates a HANK model** with **the ELB constraint** and **unconventional monetary policies (QE & FG)**
- QE, together with FG, **softened the recession** by stimulating economic activities: everyone enjoyed **positive welfare effects**
- However, UMP had **non-linear distributional effects**: both ends of the wealth distribution benefited more than the middle $\Rightarrow$ **overall income inequality, measured by the Gini index, fell**, but **the income gap between the top 10% and the rest widened**
- FG **amplified both aggregate and distributional effects** of the CB's asset purchases: **a stronger stimulus** comes at the cost of **more severe income polarization**
- CMP would have been **more effective at stimulating the economy** than QE, but **income polarization** would have been **more severe**

Thank you!