Financial Intermediation and Aggregate Demand: A Sufficient Statistics Approach

Yu-Ting Chiang [1] Piotr Zoch [2]

[1]St Louis Fed

[2]University of Warsaw and GRAPE

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Introduction

How does the financial sector transmit policies to agg. demand?

Framework: nests financial interm. models + HH heterogeneity

- Financial sector: issues liquid assets to finance illiquid capital

Sufficient statistics: elasticities of liquidity supply w.r.t. returns

Application: asset purchases vs. tax cuts (Wall Street vs. Main Street)

- Model comparison: output responses differ by orders of magnitude due to implicit assumptions about the elasticities.
- Result: given our estimates of the elasticities for the U.S, response to tax cuts is stronger.

Model

Household and Production

Households: consume and save in liquid and illiquid asset, $b_{i,t}$, $a_{i,t}$:

$$\max_{c_{i,t},b_{i,t},a_{i,t}} \mathbb{E} \sum_{t\geq 0} \beta_i^t u\left(c_{i,t}, h_{i,t}\right), s.t.$$

$$\begin{aligned} c_{i,t} + b_{i,t} + a_{i,t} + \Phi_t(a_{i,t}, a_{i,t-1}) \\ = (1 + r_t^B) b_{i,t-1} + (1 + r_t^A) a_{i,t-1} + y_{i,t} - \mathcal{T}(y_{i,t}). \end{aligned}$$

portfolio adj. costs: Φ_t, borrowing constraints: $b_{i,t} \geq \underline{b}$, $a_{i,t} \geq \underline{a}$

labor income: $y_{i,t} = \frac{W_t}{P_t} z_{i,t} h_{i,t}$, idiosyncratic shocks: $z_{i,t}$

Production: sticky wages; capital adjustment costs.

Returns on capital: r_{t+1}^K.

The Financial Sector

- A representative bank issues deposits $\tilde{d}_t$ to hold capital and liquid government debt b_t^B. Liquidity supply $d_t \coloneqq \tilde{d}_t - b_t^B$.

- The bank's problem:

$$r_{t+1}^N n_t = \max_{k_t^B, d_t} r_{t+1}^K q_t k_t^B - r_{t+1}^B d_t$$

  subject to their balance sheet and financial constraints:

$$q_t k_t^B = d_t + n_t, \quad q_t k_t^B \leq \Theta\Big(\big\{r_{s+1}^K, r_{s+1}^B\big\}_{s \geq t}\Big) n_t$$

- Net worth of banks: $n_{t+1} = (1-f)(1+r_{t+1}^N)n_t + m$.

- Illiquid assets consist of the net worth of banks and capital:

$$a_t = n_t + q_t k_t^F, \quad r_{t+1}^A = \frac{1}{a_t}(r_{t+1}^N n_t + r_{t+1}^K q_t k_t^F).$$

Government

- Government issues debt b_t^G, collects tax $T_t = \int \mathcal{T}(y_{i,t})\,di$, purchases goods g_t and illiquid assets a_t^G

$$b_t^G - (1 + r_t^B) b_{t-1}^G = g_t - T_t + a_t^G - (1 + r_t^A) a_{t-1}^G.$$

- Monetary policy sets the nominal rate to implement real liquid rate target r_t^B.
- Equilibrium: prices and allocations such that agents optimize and markets clear. In particular,

$$\text{liquid asset market}: \quad \int b_{i,t}\,di = d_t + b_t^G.$$

- Focus on an equilibrium where the financial constraint is binding.

Liquidity Supply and Aggregate Responses

Nesting Models of Financial Intermediation

Models of financial intermediation ($\mathcal{M}$)

- asset diversion (Gertler and Kiyotaki, Gertler and Karadi)
- costly state verification (Bernanke et al.)
- costly leverage (Uribe and Yue, Cúrdia and Woodford)
- collateral constraints (Bianchi and Mendoza)

Lemma

Given $\mathcal{M}$, there exists $\Theta(\cdot)$ s.t. d_t as a function of returns is identical to that in $\mathcal{M}$. Moreover, at the steady state,

$$\frac{\partial \Theta_t}{\partial r^K_{s+1}} = \gamma^{s-t}\ \bar{\Theta}_{r^K}, \quad \frac{\partial \Theta_t}{\partial r^B_{s+1}} = -\gamma^{s-t}\ \bar{\Theta}_{r^B}, \quad \forall s \geq t,$$

where $\Theta_t := \Theta(\{r^K_{s+1}, r^B_{s+1}\}_{s\geq t})$ and $\bar{\Theta}_{r^K}, \bar{\Theta}_{r^B} \geq 0, \gamma \in [0,1)$.

$\mathcal{D}_t(\{r^K_s, r^B_s\}) := d_t$ given returns; elasticities governed by $\bar{\Theta}_{r^K}, \bar{\Theta}_{r^B}, \gamma$

A Demand and Supply Representation

Approach: characterize equilibrium as an intertemporal demand and supply system.

Lemma

Given $\left\{b_s^G, T_s, g_s, r_s^B\right\}_{s=0}^{\infty}$*, the equilibrium* $\left\{y_s, r_s^K\right\}_{s=0}^{\infty}$ *solve:*

$$\mathcal{C}_t(\{y_s, r_s^A, r_s^B, T_s\}) + \mathcal{X}_t(\{y_s, r_s^K\}) + g_t = y_t,$$

$$\mathcal{B}_t(\{y_s, r_s^A, r_s^B, T_s\}) = \mathcal{D}_t(\{r_s^K, r_s^B\}) + b_t^G,$$

and

$$r_t^A = \mathcal{R}_t^A\big(\{r_s^K, r_s^B\}, \mathcal{D}_{t-1}(\{r_s^K, r_s^B\})\big),$$

where $\mathcal{C}_t, \mathcal{B}_t, \mathcal{X}_t, \mathcal{R}_t^A$ *are functions that do not depend on* Θ*.*

Implication: aggregate responses depend on financial frictions Θ *only* through the liquidity supply function $\mathcal{D}_t$.

Aggregate Output Response

Define excess liquidity and aggregate demand as

$$\boldsymbol{\epsilon}_t(\cdot) \coloneqq \mathcal{D}_t(\cdot) + b_t^G - \mathcal{B}_t(\cdot), \quad \Psi_t(\cdot) \coloneqq \mathcal{C}_t(\cdot) + \mathcal{X}_t(\cdot) + g_t,$$

Theorem

Given $\{d\boldsymbol{b}^{\boldsymbol{G}}, d\boldsymbol{T}, d\boldsymbol{g}, d\boldsymbol{r}^B\}$*, the aggregate output response is:*

$$d\boldsymbol{y} = \underbrace{\left(\mathbf{I} - \boldsymbol{\Psi}_y - \boldsymbol{\Omega}\boldsymbol{\epsilon}_y\right)^{-1}}_{\text{(iii) modified Keynesian cross}} \times \Big(\underbrace{d\boldsymbol{g} + \boldsymbol{\Psi}_T d\boldsymbol{T} + \boldsymbol{\Psi}_{r^B} d\boldsymbol{r}^B}_{\text{(i) goods market}} + \underbrace{\boldsymbol{\Omega}\big(d\boldsymbol{b}^G + \boldsymbol{\epsilon}_T d\boldsymbol{T} + \boldsymbol{\epsilon}_{r^B} d\boldsymbol{r}^{\boldsymbol{B}}\big)}_{\text{(ii) asset markets}} \Big)$$

$\boldsymbol{\Omega} \coloneqq \boldsymbol{\Psi}_{r^K} \times (-\boldsymbol{\epsilon}_{r^K}^{-1})$: how aggregate demand responds to changes in r^K due to excess liquidity .

Asset Purchases vs. Tax Cuts

Asset Purchases vs. Tax Cuts

Consider two policies with the same paths for b_t^G, r_t^B, g_t:

policy 1: asset purchases $\Delta_t := a_t^G - (1 + r_t^A) a_{t-1}^G$; tax T_t

policy 2: pays Δ_t to households; tax $T_t - \Delta_t$

Differences in output responses: $\widehat{d\boldsymbol{y}} := d\boldsymbol{y}^{\text{asset}} - d\boldsymbol{y}^{\text{tax cut}}$

$$\widehat{d\boldsymbol{y}} = \left(\mathbf{I} - \boldsymbol{\Psi}_y - \boldsymbol{\Omega}\boldsymbol{\epsilon}_y\right)^{-1}\Big(\underbrace{\boldsymbol{C}_T \boldsymbol{\Delta}}_{\text{(i) goods market}} + \underbrace{\boldsymbol{\Omega}\,(-\boldsymbol{B}_T)\boldsymbol{\Delta}}_{\text{(ii) asset markets}} \Big)$$

(i): tax cuts $\rightarrow$ stronger direct consumption response

(ii): asset purchases create more excess liquidity
$\rightarrow$ affects AD via asset markets, strength depends on Ω

Model Comparison

Exercise: keep households and steady state the same; vary the financial sector's liquidity supply elasticities

Empirical elasticities:

$$\underbrace{d\Theta_t}_{\text{(i)}} = \sum_{h\geq 1} \gamma^{h-1}\Big(\bar{\Theta}_{r^K}\, \underbrace{\mathbb{E}_t[dr^K_{t+h}]}_{\text{(ii)}} - \bar{\Theta}_{r^B}\, \underbrace{\mathbb{E}_t[dr^B_{t+h}]}_{\text{(iii)}}\Big) + \upsilon_t$$

(i) bank market leverage (ii) corp bond yields (iii) treasury yields

Our estimates: $\bar{\Theta}_{r^K} = 25,\ \bar{\Theta}_{r^B} = 27,\ \gamma = 0.96$

Implicit assumptions of standard models:

1. GKK-implied elasticities: $\bar{\Theta}_{r^K} = 11,\ \bar{\Theta}_{r^B} = 12,\ \gamma = 0.99$
2. Perfectly elastic (Auclert et al. (2023)): $\bar{\Theta}_{r^K}, \bar{\Theta}_{r^B} \to \infty$
3. Perfectly inelastic (Kaplan et al. (2018)): $\mathcal{D}_{r^K} = \mathcal{D}_{r^B} = \mathbf{0}$

Policy Experiments

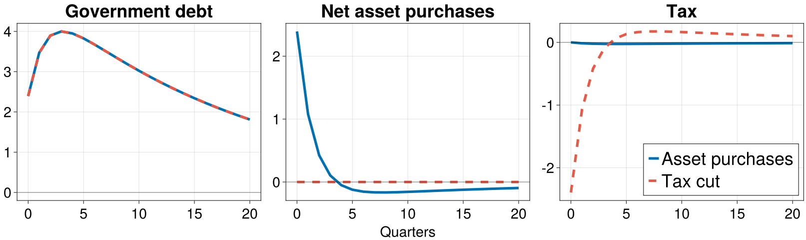


Figure 1: Government debt, net asset purchases, and taxes; y-axis: % of steady-state GDP. We keep g_t and r_t^B constant at steady-state levels.

Aggregate Output Responses

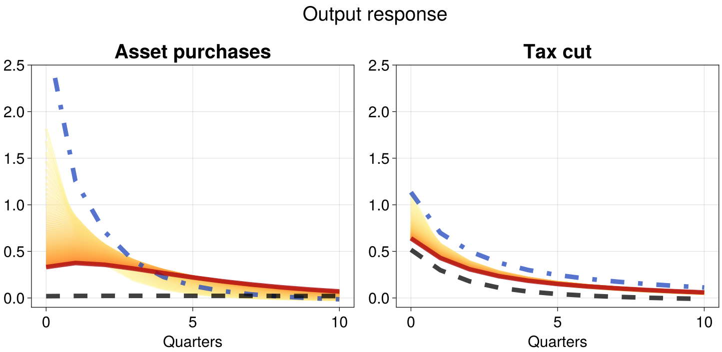
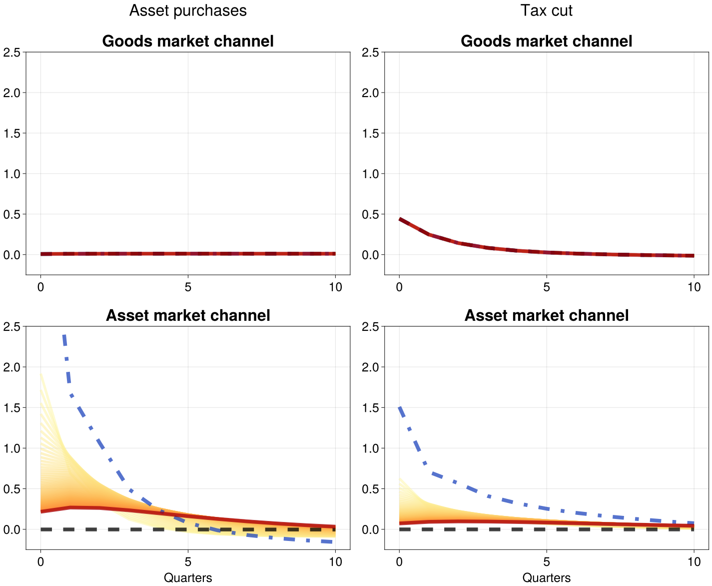


Figure 2: y-axis: % of steady state GDP; blue: perfectly inelastic; yellow to red: $\bar{\Theta}_{r^K}$ from GKK to our estimate; black: perfectly elastic.

Decomposition of Aggregate Output Responses



Relative Effectiveness of Asset Purchases v.s. Tax Cuts

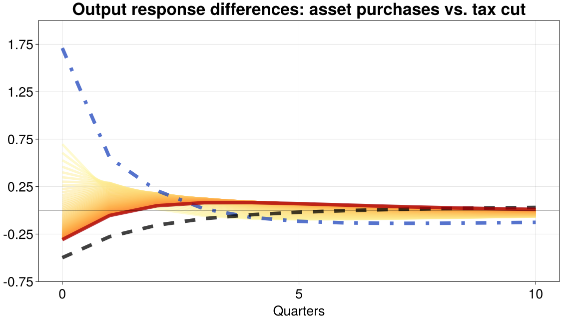


Figure 3: y-axis: % of steady state GDP; blue: perfectly inelastic; yellow to red: $\bar{\Theta}_{r^K}$ from GKK to our estimate; black: perfectly elastic.

$$\widehat{d\boldsymbol{y}} = \left(\mathbf{I} - \boldsymbol{\Psi}_y - \boldsymbol{\Omega}\boldsymbol{\epsilon}_y\right)^{-1}\left(\boldsymbol{C}_T\boldsymbol{\Delta} + \boldsymbol{\Omega}\,(-\boldsymbol{B}_T)\boldsymbol{\Delta}\right)$$

Conclusion

- A framework to study how the financial sector affects macroeconomic policies
- Key: elasticities of liquidity supply w.r.t returns
- Application: effectiveness of asset purchases vs. tax cuts
- Output responses differ by orders of magnitude due to implicit assumptions about these elasticities
- Our estimates: modest asset market channel, targeting households is relatively more effective