Monetary Policy and Redistributional Channel

Adrien Auclert

Presented By Ding Dong
Department of Economics, HKUST

HKUST Macro Group

MP Transmission Mechanisms [2]

Classics Channels of MP:

- Interest Rate Channel
  $i \downarrow \Rightarrow r \downarrow$ (with sticky price) $\Rightarrow c \uparrow$ (*Euler Equation*)
- Exchange Rate Channel
  $i \downarrow \Rightarrow \varepsilon \downarrow \Rightarrow NX \uparrow \Rightarrow Y \uparrow \Rightarrow C \uparrow$
- Asset Price Channel[1] (*q-theory & life-cycle theory*)
  $i \downarrow \Rightarrow$ equity $>$ debt $\Rightarrow$ equity price $\uparrow \Rightarrow$ wealth $\uparrow \Rightarrow c \uparrow$
- Credit Channel
  - Bank Lending Channels
    $i \downarrow \Rightarrow$ bank's lending$\Rightarrow$ firm's borrowing
  - Balance Sheet Channels (BG, 1995)
    $i \downarrow \Rightarrow$ balance sheet improves $\Rightarrow$ cost of borrowing $\downarrow$

[1]Iacaviello (2005) etc. also explore the real estate price channel.
[2]Ireland, 2005. *The New Palgrave Dictionary of Economics, Second Edition*

Highlight of This Paper

Monetary expansions:

- increase real income (from labor/capital)
- raise inflation
- lower real interest rates

NOT everyone is equally affected by these changes.

- working hours and capital ownership is unlikely to be equal
- unexpected inflation revalues nominal balance sheets.
  $\rightarrow$ *nominal* creditors lose and *nominal* debtors gain.
- lower R doesn't necessarily benefit asset holders
  $\rightarrow$ *duration* and *measurement* of assets and liabilities matter

Highlight of This Paper

Channels of MP on consumption:

- Interest Rate Channel*
  un-hedged interest rate exposure, URE
- Earning Heterogeneity Channel*
- Fisher Channel*
  net nominal position, NNP
- Income Channel
- Substitution Channel
- Exchange Rate Channel
  closed economy
- Asset Price Channel
  secondary effect through dY, dP and dR

*redistribution channels of mp

Outline

- Introduction
  - Conventional transmission channels of MP
  - Highlight of this paper
- Partial Equilibrium Models
  - PE 1: Complete Market, Perfect Foresight
  - PE 2: Incomplete Market, Uninsured Idiosyncratic Risk
- General Equilibrium Model
  - Aggregation Results
  - Re-distributional Channels
- Sufficient stats: Redistribution elasticity of consumption
- Conclusion

PE Model 1

- Complete Market
- No Uncertainty
- Separable preference over c and n
- Perfect foresight over P and W

UMP of Agent (1) with No Financial Asset

$$\max \quad \sum_t \beta^t \{u(c_t) - v(n_t)\}$$

$$s.t. \quad P_t c_t = P_t y_t + W_t n_t$$

where Py is endowed income, aka claimed profit;
Wn is wage income.

UMP of Agent (1) with No Financial Asset

At period 0,

$$max \quad \sum_t \beta^t \{u(c_t) - v(n_t)\}$$

$$s.t. \quad \sum_{t \geqslant 0} c_t = \sum_{t \geqslant 0} (y_t + w_t n_t)$$

where w=W/P is real wage rate.

UMP of Agent (2) with Real Bond

$$max \quad \sum_t \beta^t \{u(c_t) - v(n_t)\}$$

$$s.t. \quad P_t c_t + \sum_{s \geqslant 1} {}_t q_{t+s} ({}_t b_{t+s}) P_{t+s} = P_t y_t + W_t n_t +$$

$$({}_{t-1} b_t) P_t + \sum_{s \geqslant 1} {}_t q_{t+s} ({}_{t-1} b_{t+s}) P_{t+s}$$

where ${}_t q_{t+s}$ is time-t (real) price of real zero coupon bonds that mature at time t+s,
and ${}_t b_{t+s}$ is the quantity purchased.
Define ${}_0 q_t \equiv q_t$

UMP of Agent (2) with Real Bond

At period 0,

$$max \quad \sum_t \beta^t \{u(c_t) - v(n_t)\}$$

$$s.t. \quad \sum_{t\geqslant 0} q_t c_t = \sum_{t\geqslant 0} q_t(y_t + w_t n_t) + \sum_{t\geqslant 0} q_t({}_{-1} b_t)$$

UMP of Agent (3) with with Real and Nominal Bond

$$max \quad \sum_t \beta^t \{u(c_t) - v(n_t)\}$$

$$s.t. \quad P_t c_t + \sum_{s\geqslant 1} {}_tQ_{t+s} \; {}_tB_{t+s} + \sum_{s\geqslant 1} {}_tq_{t+s} \; {}_tb_{t+s} \, P_{t+s} = P_t y_t + W_t n_t +$$

$$({}_{t-1}B_t) + \sum_{s\geqslant 1} {}_tQ_{t+s} \; {}_{t-1}B_{t+s} + ({}_{t-1}b_t)P_t + \sum_{s\geqslant 1} {}_tq_{t+s} \; {}_{t-1}b_{t+s} \, P_{t+s} \tag{1}$$

where ${}_tQ_{t+s}$ is time-t price of nominal zero coupon bonds that mature at time t+s,
and ${}_tB_{t+s}$ is the quantity purchased.

Aside: No Arbitrage Condition

At period t, with 1 dollar:
The nominal return to nominal bonds that mature at period t+s:

$$\frac{1}{{}_tQ_{t+s}}$$

The nominal return to real bonds that mature at period t+s:

$$\frac{1}{{}_tq_{t+s}\,P_t}P_{t+s}$$

No Arbitrage Condition (Fisher Equation):

$$ {}_tQ_{t+s} = ({}_tq_{t+s})\frac{P_t}{P_{t+s}} \tag{2}$$

Aside: Real Flow Budget Constraint

Nominal (Q replaced by q):

$$P_t c_t + \sum_{s\geqslant 1} \left({}_t q_{t+s} \right) \frac{P_t}{P_{t+s}} \, {}_t B_{t+s} + \sum_{s\geqslant 1} \, {}_t q_{t+s} \, {}_t b_{t+s} \, P_{t+s} = P_t y_t + W_t n_t +$$

$$\left({}_{t-1} B_t \right) + \sum_{s\geqslant 1} \left({}_t q_{t+s} \right) \frac{P_t}{P_{t+s}} \, {}_{t-1} B_{t+s} + \left({}_{t-1} b_t \right) P_t + \sum_{s\geqslant 1} \, {}_t q_{t+s} \, {}_{t-1} b_{t+s} \, P_{t+s}$$

Real:

$$c_t + \sum_{s\geqslant 1} \left({}_t q_{t+s} \right) \frac{1}{P_{t+s}} \, {}_t B_{t+s} + \sum_{s\geqslant 1} \, {}_t q_{t+s} \, {}_t b_{t+s} \, \frac{P_{t+s}}{P_t} = y_t + w_t n_t +$$

$$\frac{{}_{t-1} B_t}{P_t} + \sum_{s\geqslant 1} \left({}_t q_{t+s} \right) \frac{1}{P_{t+s}} \, {}_{t-1} B_{t+s} + \left({}_{t-1} b_t \right) + \sum_{s\geqslant 1} \, {}_t q_{t+s} \, {}_{t-1} b_{t+s} \, \frac{P_{t+s}}{P_t}$$

UMP of Agent (3) with with Real and Nominal Bond

At period 0,

$$max \quad \sum_t \beta^t \{u(c_t) - v(n_t)\}$$

$$s.t. \quad \sum_{t \geqslant 0} q_t c_t = \underbrace{\sum_{t \geqslant 0} q_t [y_t + w_t n_t]}_{\omega^H:\ \text{human wealth}} + \underbrace{\sum_{t \geqslant 0} q_t [(\,_{-1}b_t) + (\frac{_{-1}B_t}{P_t})]}_{\omega^F:\ \text{financial wealth}} \equiv \omega \tag{3}$$

- Message: Financial assets with same financial wealth deliver same solution to UMP.
  $\Rightarrow$ The composition of balance sheet is irrelevant.
- Question: Is the composition relevant after a shock?

Aside: MP Shock in NK Models

A stylized NK model with no uncertainty and investment features:

$$log(\frac{c_t}{\bar{c}}) = log(\frac{c_{t+1}}{\bar{c}}) - \sigma(i_t - log(\frac{P_{t+1}}{P_t}) - \varrho) \tag{4}$$

$$log(\frac{P_t}{P_{t-1}}) = \beta log(\frac{P_{t+1}}{P_t)} + \kappa log(\frac{c_t}{\bar{c}}) \tag{5}$$

$$i_t = \varrho + \phi_\pi log(\frac{c_t}{\bar{c}}) + \varepsilon_t \tag{6}$$

Now consider a one-time monetary shock:

$$\varepsilon_0 < 0; \quad and \quad \varepsilon_t = 0 \quad \forall t \neq 0 \tag{7}$$

where $\bar{x}$ is steady state value of x; $\varrho = 1/\beta - 1$ is steady state real interest rate; σ is the elasticity of substitution; κ is f(parameter).

Aside: MP Shock in NK Models

The solution features:

$$i_t = \varrho; \quad P_t = P_{t-1} \quad c_t = \bar{t} \quad \forall t \geqslant 1$$

solving it backward, impact on i and c is one-shot ($i_0 \downarrow$, $c_0 \uparrow$);

$$i_0 = \varrho + \frac{1}{1 + \kappa\sigma\phi_\pi}\varepsilon_0$$

$$log(\frac{c_0}{\bar{c}}) = -\frac{\sigma}{1 + \kappa\sigma\phi_\pi}\varepsilon_0$$

Impact on P is immediate and permanent ($P_t \uparrow$):

$$log(\frac{P_0}{\bar{P}}) = -\frac{\kappa\sigma}{1 + \kappa\sigma\phi_\pi}\varepsilon_0$$

Aside: MP Shock in NK Models

Given that wage

$$w_t = \frac{v'(c_t^{1/1-\alpha})}{u'(c_t)}$$

$\rightarrow$ The impact on *wage* is one-shot ($w_0 \uparrow$).

Given that capital rent

$$\rho_t = \frac{\alpha}{1-\alpha} w_t c_t^{1/1-\alpha} = \frac{\alpha}{1-\alpha} \frac{v'(c_t^{1/1-\alpha})}{u'(c_t)} c_t^{1/1-\alpha}$$

$\rightarrow$ The impact on *capital return* is one-shot ($\rho_0 \uparrow$).

Given that claimed profit

$$\pi_t = c_t - w_t n_t - \rho_t k = c_t \left(1 - \frac{\alpha}{1-\alpha} \frac{v'(c_t^{1/1-\alpha})}{u'(c_t)} c_t^{1/1-\alpha}\right)$$

$\rightarrow$ The impact on *claimed profit* is one-shot ($\pi_0 \uparrow$).

Aside: MP Shock in NK Models

Given that $q_0 = Q_0 = 1$, and $P_t = P_0$ for $t \geqslant 1$,

$$q_t = Q_t = \Pi_{s=0}^{t-1} {}_sQ_t = \frac{1}{1+i_0}\beta^{t-1}$$

where the first equation utilizes no arbitrage condition that

$$Q_t = q_t \frac{P_0}{P_t}$$

Define R=1+i, we have that for $t \geqslant 1$.

$$\frac{dq_t}{q_t} = \frac{dQ_t}{Q_t} = -\frac{dR_0}{R_0},$$

$\rightarrow$ The impact on *nominal and real state prices* is permanent, starting from t=1.

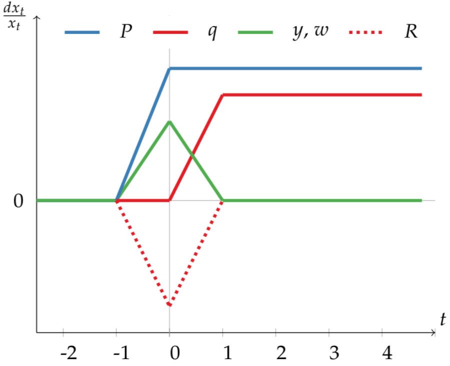
A Transitory Monetary Shock

Keep balance sheet fixed at $\{{}_{-1}B_t\}_{t\geqslant 0}$, $\{{}_{-1}b_t\}_{t\geqslant 0}$,
A stylized transitory monetary policy shock at period 0 in New Keynesian models features:

- Nominal price rises in proportion after period 0; $\frac{dP_t}{P_t} = \frac{dP}{P}$, for $t \geqslant 0$.
- Present-value discount rate rises in proportion after period 1; $\frac{dq_t}{q_t} = -\frac{dR}{R}$, for $t \geqslant 1$.
- Fisher equation holds again after period 1; $\frac{dQ_t}{Q_t} = -\frac{dR}{R}$, for $t \geqslant 1$.
- Endowed income and real wage rise at period 0 only.
- Impact on consumption and interest rate at period 0 only.

A Transitory Monetary Shock

A stylized transitory monetary policy shock at period 0 in New Keynesian models features:



Theorem 1

This paper is interested in the first-order change in initial consumption ($dc = dc_0$), labor supply ($dn = dn_0$) and welfare (dU) after the monetary policy shock.

Theorem 1

$$dc = MPC(d\Omega + \psi n dw) - \sigma c MPS \frac{dR}{R} \tag{8}$$

$$dn = MPN(d\Omega + \psi n dw) + \psi n MPS \frac{dR}{R} + \psi n \frac{dw}{w} \tag{9}$$

$$dU = u'(c) d\Omega \tag{10}$$

where $d\Omega$ is *net-of-consumption wealth change*.
$MPC = \partial c_0 / \partial y_0$; $MPN = \partial n_0 / \partial y_0$; $MPS = 1 - MPC + w_0 MPN$;

Wealth Effect

We start by unpacking net wealth revaluation $d\Omega$

Theorem 1

$$dc = MPC(d\Omega + \psi n dw) - \sigma c MPS \frac{dR}{R} \tag{11}$$

$$dn = MPN(d\Omega + \psi n dw) + \psi n MPS \frac{dR}{R} + \psi n \frac{dw}{w} \tag{12}$$

$$dU = u'(c) d\Omega \tag{13}$$

$d\Omega$ aggregates net-of-consumption wealth change (*wealth effects*).

Unpacking Wealth Effect: $d\Omega$

$$d\Omega =$$

$$\underbrace{dy + ndw}_{Earning} - \underbrace{\sum_{t \geqslant 0} Q_t \left(\frac{{}_{-1}B_t}{P_0}\right)\frac{dP}{P}}_{Fisher} + \underbrace{\left(y + wn + \left(\frac{{}_{-1}B_t}{P_0}\right) + \left({}_{-1}b_t\right) - c\right)\frac{dR}{R}}_{URE}$$

Unpacking Wealth Effect: $d\Omega$

$$\underbrace{dy + ndw}_{Earning} - \underbrace{\sum_{t\geqslant 0} Q_t(\frac{{}_{-1}B_t}{P_0})\frac{dP}{P}}_{Fisher} + \underbrace{(y + wn + (\frac{{}_{-1}B_t}{P_0}) + ({}_{-1}b_t) - c)\frac{dR}{R}}_{URE}$$

Earning Channel: Monetary policy affects present value of income, a sum of endowed income and wage income. Working hours, n, measures exposure of workers to wage change, i.e., the more he works, the more he benefits.

Unpacking Wealth Effect: $d\Omega$

$$\underbrace{dy + ndw}_{Earning} - \underbrace{\sum_{t\geqslant 0} Q_t(\frac{{}_{-1}B_t}{P_0})\frac{dP}{P}}_{Fisher} + \underbrace{(y + wn + (\frac{{}_{-1}B_t}{P_0}) + ({}_{-1}b_t) - c)\frac{dR}{R}}_{URE}$$

Fisher Channel: Monetary policy affects nominal price level (immediately and permanently), generating nominal denomination of assets and liabilities.
Net Nominal Position (**NNP**): Present value of *nominal* assets.

$$dy + ndw - \underbrace{\sum_{t\geqslant 0} Q_t(\frac{{}_{-1}B_t}{P_0})}_{NNP}\frac{dP}{P} + (y + wn + (\frac{{}_{-1}B_t}{P_0}) + ({}_{-1}b_t) - c)\frac{dR}{R}$$

Unpacking Wealth Effect: $d\Omega$

$$\underbrace{dy + ndw}_{Earning} - \underbrace{\sum_{t \geqslant 0} Q_t(\frac{{}_{-1}B_t}{P_0})\frac{dP}{P}}_{Fisher} + \underbrace{(y + wn + (\frac{{}_{-1}B_t}{P_0}) + ({}_{-1}b_t) - c)\frac{dR}{R}}_{URE \quad Channel}$$

Interest Rate Exposure Channel: Monetary policy affects real interest rate.
Unhedged Interest Rate Exposure (**URE**): The difference between all maturing assets(including income) and liabilities (including planned consumption) at time 0.

$$dy + ndw - \sum_{t \geqslant 0} Q_t(\frac{{}_{-1}B_t}{P_0})\frac{dP}{P} + \underbrace{(y + wn + (\frac{{}_{-1}B_t}{P_0}) + ({}_{-1}b_t) - c)}_{URE}\frac{dR}{R}$$

Aside: URE

Suppose that $dR < 0 \Leftrightarrow$ a *decline* in the discount rate:

$\Rightarrow$ Present value of *future* assets $\uparrow$ (*traditional capital gain view*)

$\Rightarrow$ Present value of *future* liabilities $\uparrow$

$\Leftrightarrow$ net wealth gain iff *future* assets $>$ *future* liabilities

$$\sum_{t\geqslant 1} q_t[y_t + w_t n_t] + \sum_{t\geqslant 1} q_t[({}_{-1}b_t) + (\frac{{}_{-1}B_t}{P_t})] > \sum_{t\geqslant 1} q_t c_t$$

Given that *lifetime* assets $=$ *lifetime* liability

$$\sum_{t\geqslant 0} q_t[y_t + w_t n_t] + \sum_{t\geqslant 0} q_t[({}_{-1}b_t) + (\frac{{}_{-1}B_t}{P_t})] = \sum_{t\geqslant 0} q_t c_t$$

$\Leftrightarrow$ net wealth gain iff *current* assets $<$ *current* liability, aka:

$$URE = y + wn + (\frac{{}_{-1}B_t}{P_0}) + ({}_{-1}b_t) - c < 0$$

Aside: URE

Implication: Duration of asset plan matters after interest rate shock

- Fixed-Rate Mortgage holders/ Annuitized Retirees:
  $URE = 0 \Rightarrow$ income and outlays roughly balanced
- Adjustable-Rate Mortgage Holders:
  $URE < 0 \Rightarrow$ *gain* from temporary interest rate decline
- Savers with large amount of short-duration wealth:
  $URE > 0 \Rightarrow$ *lose* from temporary interest rate decline

Summarize net of consumption wealth change $d\Omega$ as:

$$d\Omega = dy + ndw - NNP\frac{dP}{P} + URE\frac{dR}{R} \tag{14}$$

Discussion: Monetary Policy and Household Welfare

- Popular discussion: Asset value affects welfare of holders.
  $\Rightarrow$ mp $\rightarrow$ i $\downarrow$ $\rightarrow$ bond price $\uparrow$ $\rightarrow$ bond holders benefit
- *Our model:* mp does *not* affect asset values directly
  Monetary policy influence asset values through three channels: a risk-free real discount rate effect (dR), an inflation effect (dP), and an effect on dividends (dy).

$$dU = u'(c)d\Omega = u'(c)(dy + ndw - NNP\frac{dP}{P} + URE\frac{dR}{R}) \quad (15)$$

- Benefit long-term bond holders with short-term consumption
- Hurt short-term bond holders with long-term consumption
  i.e., by lowering return to re-investment of wealth.

Revisit Theorem 1: Interest Rate

Theorem 1: $dc = MPC(d\Omega + \psi ndw) - \sigma cMPS\frac{dR}{R}$

$$dc = MPC(dy + ndw - NNP\frac{dP}{P} + URE\frac{dR}{R} + \psi ndw) - \sigma cMPS\frac{dR}{R}$$

$$dc = MPC(dy + ndw - NNP\frac{dP}{P} + \psi ndw) + (MPC * URE - \sigma cMPS)\frac{dR}{R}$$

$\Rightarrow$ A decline in interest rate increases consumption iff

$$\sigma cMPS > MPC * URE$$

$\Leftrightarrow$ substitution effect $>$ income effect
now define dY as *overall* change in income:

$$dY = dy + ndw + wdn$$

Overall Response of Consumption

Corollary 1

$$dc = \hat{MPC}\left(dY - NNP\frac{dP}{P} + URE\frac{dR}{R}\right) - \sigma c(1 - \hat{MPC})\frac{dR}{R} \quad (16)$$

where $\hat{MPC} = \frac{MPC}{MPC+MPS} = \frac{MPC}{1+wMPN} \geqslant MPC$.

$$dc = \underbrace{\hat{MPC} * dY}_{\text{aggregate income}} - \underbrace{\hat{MPC} * NNP\frac{dP}{P}}_{Fisher} + \underbrace{\hat{MPC} * URE\frac{dR}{R}}_{URE} - \underbrace{\sigma c \hat{MPS}\frac{dR}{R}}_{Substitution}$$

where $\hat{MPS} = 1 - \hat{MPC} = \frac{MPS}{MPC+MPS}$.

Extensions

- utility function: separable ⇒ general
- consumption goods: non-durable ⇒ non-durable and durable
- complete market ⇒ incomplete market with uninsured risk

PE Model 2

- Incomplete Market
  - set of assets can be traded
  - borrowing constraint
- Can trade in N stocks:
  a. real price $S_t = (S_{1t}, S_{2t}, ...S_{Nt})$
  b. pay real dividends $d_t = (d_{1t}, d_{2t}, ...d_{Nt})$
  c. portfolio of share: $\theta_t = (\theta_{1t}, \theta_{2t}, ...\theta_{Nt})$
- Can trade in long-term bond:
  a. nominal price Q_t at time t
  b. pay declining nominal coupon $(1, \delta, \delta^2 ...)$ from period t+1
  c. current bond portfolio Λ_t at time t
- Idiosyncratic income uncertainty
- Separable preference over c and n

UMP of Agent

$$max \quad E[\sum_t \beta^t \{u(c_t) - v(n_t)\}]$$

s.t. budget constraint:

$$P_t c_t + Q_t(\Lambda_{t+1} - \delta\Lambda_t) + \theta_{t+1} P_t S_t =$$

$$P_t y_t + P_t w_t n_t + \Lambda_t + \theta_t(P_t S_t + P_t d_t) \tag{17}$$

borrowing constraint:

$$\frac{Q_t\Lambda_t + \theta_{t+1} P_t S_t}{P_t} \geqslant -\frac{\bar{D}}{R_t} \tag{18}$$

(end of period wealth cannot be too negative)

NNP and URE

Net Nominal Position:

$$NNP_t \equiv \underbrace{\frac{\Lambda_t}{P_t}}_{\text{current}} + \underbrace{Q_t \delta \frac{\Lambda_t}{P_t}}_{\text{PV of future}}$$

Un-hedged Interest Rate Exposure:

$$URE_t \equiv \underbrace{y_y + w_t n_t + \frac{\Lambda_t}{P_t} + \theta_t d_t}_{\text{maturing assets}} - \underbrace{c_t}_{liabilities}$$

Theorem 2

Theorem 2

Assume that the consumers is

(i) *at interior optimum*, or

(ii)*at a binding borrowing constraint*, or

(iii) *unable to access financial market*,

$$dc = MPC(d\Omega + \psi n dw) - \sigma c MPS \frac{dR}{R} \tag{19}$$

$$dc = \hat{MPC}(dY - NNP\frac{dP}{P} + URE\frac{dR}{R}) - \sigma c(1 - \hat{MPC})\frac{dR}{R} \tag{20}$$

$$dn = MPN(d\Omega + \psi n dw) + \psi n MPS \frac{dR}{R} + \psi n \frac{dw}{w} \tag{21}$$

Theorem 2

- When *at interior optimum*
  $\Rightarrow \sim$ Theorem 1
- When *at a binding borrowing constraint*
  $\Rightarrow$ change in borrowing capacity$= -NNP\frac{dP}{P} + URE\frac{dR}{R}$
  $\Rightarrow \hat{MPC} = 1; \hat{MPS} = 0$
  $\Rightarrow$ dc & dn $\sim -NNP\frac{dP}{P} + URE\frac{dR}{R}$
  $\Rightarrow$ pure wealth effect
- When *unable to access financial market*
  $\Rightarrow$ NNP=URE=0 (hand-to-mouth, $\hat{MPC} = 1$)
  $\Rightarrow$ pure wealth effect
- $\Rightarrow$ empirical works

Aggregation

GE model features

- closed economy
- I heterogeneous types of agents
  - β_i
  - u_i
  - v_i
  - each type has a mass 1 of individuals
- idiosyncratic state: $s_{it} \in S_i$
- idiosyncratic income change: dY_i
- gross income change: dY
- for any variable z, we denote $E_I[z_{it}]$ as cross sectional average.

Theorem 3

Theorem 3
To the first order, in response to dY_i, dY, dP and dR, aggregate consumption changes by dC=

$$\underbrace{E_I[\frac{Y_i}{Y}\hat{MPC}_i]dY}_{\text{Agr-income channel}} + \underbrace{Cov_I(\hat{MPC}_i, dY_i - Y_i\frac{dY}{Y})}_{\text{Earning hetero channel}} - \underbrace{Cov_I(\hat{MPC}_i, NNP_i)\frac{dP}{P}}_{\text{Fisher channel}}$$

$$+(\underbrace{Cov_I(\hat{MPC}_i, URE_i)}_{\text{URE channel}} - \underbrace{E_I[\sigma_i(1-\hat{MPC}_i)c_i]}_{\text{Substitution channel}})\frac{dR}{R} \qquad (22)$$

⇒ Macroeconomic response captured by a small set of household-level micro data. (*sufficient statistics*)
⇒ Can be applied in mp, fp or even open economy analysis.

Theorem 3 (Cont'd)

RA model

To the first order, in response to $dY_i = dY$, dY, dP and dR, aggregate consumption changes by

$$dC = E_I[\frac{Y_i}{Y}\hat{MPC}_i]dY - E_I[\sigma_i(1-\hat{MPC}_i)c_i]\frac{dR}{R}$$

or equivalently,

$$dC = \underbrace{\hat{MPC}dY}_{\text{Income channel}} \underbrace{-\sigma(1-\hat{MPC})C\frac{dR}{R}}_{\text{Substitution channel}}$$

$$\Rightarrow \quad \frac{dC}{C} = -\sigma\frac{dR}{R}$$

Question: Do re-distributional channels amplify mp shocks?

Theorem 3 (Cont'd)

Rewrite equation as
dC=

$$E_I[\frac{Y_i}{Y}\hat{MPC}_i]dY + \gamma Cov_I(\hat{MPC}_i, \frac{Y_i}{Y})dY - Cov_I(\hat{MPC}_i, NNP_i)\frac{dP}{P}$$

$$+(Cov_I(\hat{MPC}_i, URE_i) - E_I[\sigma_i(1-\hat{MPC}_i)c_i])\frac{dR}{R} \qquad (23)$$

where γ measures the elasticity of agent i's relative income to aggregate income. The effect of mp on γ is negative in literature.
Question: Do re-distributional channels amplify mp shocks?
$\Leftrightarrow$: Are the *Cov* terms positive or negative?
Answer: Negative. Re-distributional channels amplify mp shocks.

Theorem 3 (Cont'd)

$$Cov_I(\hat{MPC}_i, \frac{Y_i}{Y}) < 0$$

Low-income agents have high MPCs.

MP accommodation $\Rightarrow$ income inequality $\downarrow$ $\Rightarrow$ Aggregate consumption $\uparrow$

$\Rightarrow$ MP accommodation *increases* aggregate consumption through income heterogeneity channel.

Theorem 3 (Cont'd)

$$Cov_I(\hat{MPC}_i, NNP_i) < 0$$

Net nominal *borrowers* have higher MPC than Net nominal *lenders*.
MP accommodation $\Rightarrow$ price $\uparrow$ $\Rightarrow$ benefit borrowers $\Rightarrow$ aggregate consumption $\uparrow$
$\Rightarrow$ MP accommodation *increases* aggregate consumption through Fisher channel.

Theorem 3 (Cont'd)

$$Cov_I(\hat{MPC}_i, URE_i) < 0$$

Agents with unhedged *borrowing* exposure ($URE < 0$) have higher MPC than agents with unhedged *saving* exposure ($URE > 0$).
$\Rightarrow$ MP accommodation *increases* aggregate consumption through interest rate exposure channel.

Related Literature

- Hetero effects of mp (data)
  - Inflation: Doepke and Schneider (06)
  - Earnings: Coibion, Gorodnichenko, Kueng, Silvia (12)
  - Consumption effects: Di Maggio et al (17), Wong (16)
- mp shocks and transmission mechanisms
  - BG (95), Ireland (05), CEE (99, 05) etc.
  - Role of mortgage structure: Calza, Monacelli, Stracca (13), Rubio (11), Garriga, Kydland and Sustek (13)
  - **HANK models**: Gornemann, Kuester and Nakajima (14), McKay, Nakamura and Steinsson (16), KMV (16)
- MPC heterogeneity
  - Aggregate demand effects: Eggertsson-Krugman (12), Farhi-Werning (13)
  - Role of incomplete markets: Guerrieri-Lorenzoni (15), Oh-Reis (13), Sheedy (14), McKay-Reis (14), Werning (15)
  - Measurement: Mian, Rao, Sufi (13), Baker (13)

Conclusion

- Decomposition of mp channels on consumption
- Re-distributional channels
  - Earning heterogeneity channel
  - Fisher channel (NNP)
  - Interest rate exposure channel (URE)
- All amplify mp shocks
- Future work
  - measurement of NNP/URE
  - variable capital
  - persistence of mp shocks
  - interaction b/w household and other sectors
  - open economy