Open Market Operations

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Introduction

- New Monetarist model with money and bonds, A_m and A_b
  - study two policies: LR inflation and a one-time OMO
  - assets can differ in acceptability or pledgeability
  - these differences are microfounded in information theory
  - with random or directed search, and bargaining, price taking or posting
- Results:
  - negative nominal rate, liquidity trap, sluggish prices, multiplicity
  - OMO's work, unless liquidity is not scarce or if the economy is in a trap, *but what matters is* ΔA_b *and not* ΔA_m

Related Literature

- NM surveys:
  - Williamson & Wright (2010), Nosal & Rocheteau (2011), Lagos et al (2014)
- Related monetary policy analyses:
  - Williamson (2012,2013), Rocheteau & Rodriguez-Lopez (2013), Dong & Xiao (2014), Han (2014)
- McAndrews (May 8 speech):

The Swiss National Bank, the European Central Bank, Danmarks Nationalbank, and Swedish Riksbank recently have pushed short-term interest rates below zero. This is ... unprecedented.

Environment

- Each period in discrete time has two subperiods:
  - in DM, sellers produce q; buyers consume q
  - in CM, all agents work ℓ, consume x and adjust portfolios
- Period payoffs for buyers and sellers:

$$\begin{aligned} \mathcal{U}^b(x,\ell,q) &= U(x) - \ell + u(q) \\ \mathcal{U}^s(x,\ell,q) &= U(x) - \ell - c(q) \end{aligned}$$

- NB: the buyers can be households, firms or financial institutions.

Assets

- A_m and A_b can be used as payment instruments (Kiyotaki-Wright), collateral for loans (Kiyotaki-Moore) or repos (combination).
  - asset prices: ϕ_m and ϕ_b
  - pledgeability parameters: χ_m and χ_b
- Nominal returns:
  - real liquid bonds: $1+\rho = (1+\pi)/\phi_b$
  - nominal liquid bonds: $1+\nu = \phi_m/\phi_b$
  - nominal illiquid bonds: $1+\iota = (1+\pi)(1+r)$

Acceptability

- 3 types of DM meetings or trading needs/opportunities:
  - $\alpha_m = prob$(type-m mtg): seller accepts only money
  - $\alpha_b = prob$(type-b mtg): seller accepts only bonds
  - $\alpha_2 = prob$(type-2 mtg): seller accepts both
- Special cases:
  - $\alpha_b = 0$: no one takes only bonds
  - $\alpha_b = \alpha_2 = 0$: no one takes bonds
  - $\alpha_b = \alpha_m = 0$: perfect subs

Policy

- Policy instruments:
  - money growth rate = inflation rate: π
  - liquid real bond supply: A_b
  - nominal bonds: omitted for talk but results (in paper) are similar
  - tax: T adjusts to satisfy GBC after Δ monetary policy
- NB: trading A_b for $A_m \Leftrightarrow$ changing A_b with A_m fixed
  - due to the 'radical' assumption that prices clear markets
  - classical neutrality holds, but OMO's can still matter
- NB: A_b can be used to target ρ within bdds $[\underline{\rho}, \iota]$

CM problem

Let $z_m = \phi_m a_m$ and $z_b = a_b$. Then

$$\begin{aligned} W(z_m + z_b) &= \max\{U(x) - \ell + \beta V(\hat{z}_m, \hat{z}_b)\} \\ \text{st } x + T &= z_m + z_b + \ell - (1+\pi)\hat{z}_m - \phi_b \hat{z}_b \end{aligned}$$

- Lemma (history independence): $(\hat{z}_m, \hat{z}_b) \perp (z_m, z_b)$
- Lemma (linear CM value function): $W'(\cdot) = 1$

DM problem

Let the terms of trade be given by $p = v(q)$ where v is a mechanism (e.g., Walras, Nash, Kalai...). Then

$$\begin{aligned} V(z_m, z_b) &= W(z_m + z_b) + \alpha_m [u(q_m) - p_m] \\ &\quad + \alpha_b [u(q_b) - p_b] + \alpha_2 [u(q_2) - p_2] \end{aligned}$$

Liquidity constraint: $p_j \leq \bar{p}_j$, where

$$\bar{p}_m = \chi_m z_m,\ \bar{p}_b = \chi_b z_b \text{ and } \bar{p}_2 = \chi_m z_m + \chi_b z_b$$

Types of equilibria

Lemma: We always have $p_m = \bar{p}_m$ but we can have either

1. $p_2 = \bar{p}_2$, $p_b = \bar{p}_b$ (constraint binds in all mtgs)
2. $p_2 < \bar{p}_2$, $p_b = \bar{p}_b$ (constraint slack in type-2 mtgs)
3. $p_2 < \bar{p}_2$, $p_b < \bar{p}_b$ (constraint slack in type-2 & type-b mtgs)

Consider Case 1, where

$$v(q_m) = \chi_m z_m,\ v(q_b) = \chi_b z_b \text{ and } v(q_2) = \chi_m z_m + \chi_b z_b$$

Case 1 (bonds are scarce)

- Euler equations,

$$\iota = \alpha_m \chi_m \lambda(q_m) + \alpha_2 \chi_m \lambda(q_2)$$
$$s = \alpha_b \chi_b \lambda(q_b) + \alpha_2 \chi_b \lambda(q_2),$$

- where
  - $\iota =$ nominal rate on an illiquid bond
  - $s =$ spread between yields on illiquid and liquid bonds
  - $\lambda(q_j) =$ Lagrange multiplier on $p_j \leq \bar{p}_j$

Nominal yield on liquid bond

- Standard accounting yields

$$\rho = \frac{\alpha_m \chi_m \lambda(q_m) - \alpha_b \chi_b \lambda(q_b) + (\chi_m - \chi_b)\alpha_2 \lambda(q_2)}{1 + \alpha_b \chi_b \lambda(q_b) + \alpha_2 \chi_b \lambda(q_2)}$$

- While $\iota > 0$ is impossible, $\rho < 0$ is possible when, e.g.,
  - $\chi_m = \chi_b$ and $\alpha_m \lambda(q_m) < \alpha_b \lambda(q_b)$ (A_b has higher liquidity premium)
  - or $\alpha_m \lambda(q_m) = \alpha_b \lambda(q_b)$ and $\chi_m < \chi_b$ (A_b is more pledgeable).

Negative rates in practice

- Not all Treasury securities are equal; some are more attractive for repo financing than others... Those desirable Treasuries can be hard to find: some short-term debt can trade on a negative yield because they are so sought after. *The Economist*

- Interest rates on Swiss government bonds have been negative for a while. These bonds can be used as collateral in some markets outside of Switzerland where the Swiss franc cannot. *Aleks Berentsen*

Case 1 policy results

- Effects of LR inflation: $\Delta\pi > 0 \Rightarrow$ no effect on q_b and

$$z_m \searrow q_m \searrow q_2 \searrow s \nearrow \phi_b \nearrow \text{ and } \rho \rightsquigarrow \text{ (Fisher vs Mundell)}$$

- Effects of one-time OMO: $\Delta A_b > 0 \Rightarrow$

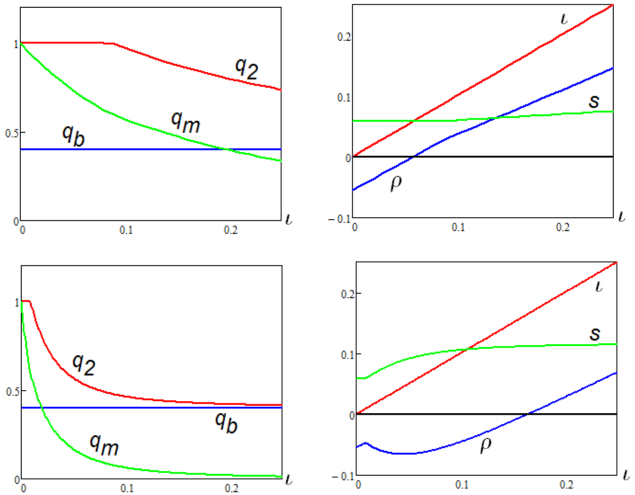
$$z_m \searrow q_m \searrow q_2 \nearrow q_b \nearrow s \searrow \phi_b \nearrow \text{ and } \rho \nearrow$$

- Sluggish prices: $\Delta A_m > 0$ and $\Delta A_b < 0 \Rightarrow \Delta z_m > 0 \Rightarrow P$ goes up by less than A_m (quantity eqn fails for OMO)

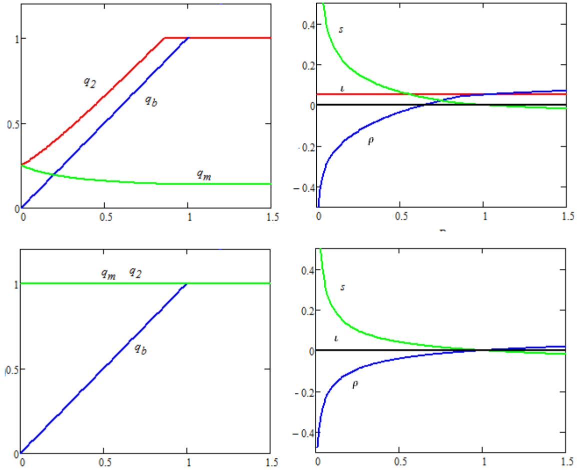
Other cases

- Case 2: $p_2 < \bar{p}_2$ and $p_b = \bar{p}_b$
  - $\Delta\pi > 0 \Rightarrow z_m \searrow q_m \searrow s \nearrow$ and no effect on q_b or q_2
  - $\Delta A_b > 0 \Rightarrow q_b \nearrow s \searrow$ and no effects on z_m, q_m or q_2
- Case 3: $p_2 < \bar{p}_2$ and $p_b < \bar{p}_b$
  - $\Delta\pi > 0 \Rightarrow z_m \searrow q_m \searrow$ but no other effects
  - $\Delta A_b > 0 \Rightarrow$ no effect on anything (Ricardian equivalence)
- Cases 1, 2 or 3 obtain when A_b is low, medium or high, resp.

Effects of inflation



Effects of OMO's



Variations

- Nominal bonds:
  - A_b and A_m grow at rate π and OMO is a one-time change in levels
  - Results are the same except $\partial q_b / \partial \pi < 0$ in Case 1
- Long-term bonds:
  - imply multiplier effects, but not big enough to generate multiple equilibria
  - still, $\partial z_m / \partial A_b$ is bigger, so prices look even more sluggish after injections of cash by OMO

Liquidity trap

- Injections of cash... by a central bank fail to decrease interest rates and hence make monetary policy ineffective." *Wikipedia*
- After the rate of interest has fallen to a certain level, liquidity-preference may become virtually absolute in the sense that almost everyone prefers cash to holding a debt which yields so low a rate of interest. In this event the monetary authority would have lost effective control over the rate of interest." *Keynes*

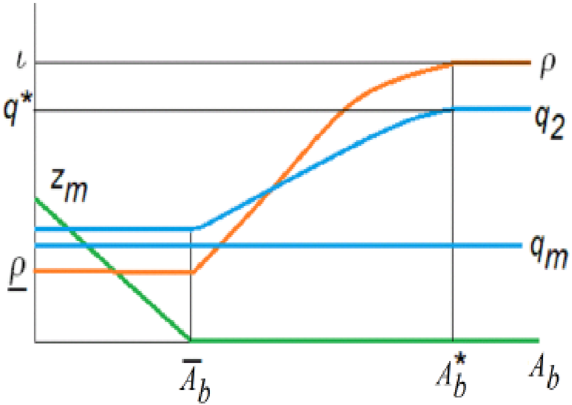
Liquidity trap with heterogeneous buyers

- Type-i buyers have $\alpha_j^i = prob(\text{type-}j \text{ mtg})$
- For some type-i (e.g., banks) $\alpha_2^i > 0 = \alpha_m^i = \alpha_b^i$
- They hold bonds and hold money iff $A_b < \bar{A}_b$
  - $A_m, A_b > 0 \Rightarrow$ they must have same return adjusted for χ's
  - Hence, $\forall A_b < \bar{A}_b$ we get the lower bdd

$$\underline{\rho} \equiv \frac{(\chi_m - \chi_b)\iota}{\iota + \chi_b}$$

- NB: In this economy $\underline{\rho} = 0$ iff $\chi_m = \chi_b$ or $\iota = 0$ (Friedman rule).

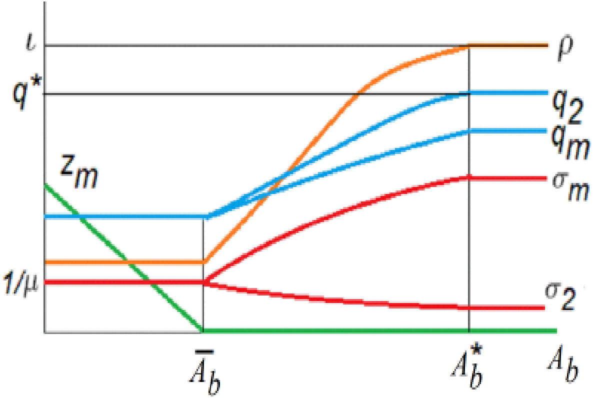
Liquidity trap with random search: Example



Directed search with heterogeneous sellers

- Type-m and type-2 sellers sort into segmented submarkets
- Buyers can go to any submarket and are indifferent if both open
- We consider bargaining and posting terms of trade
- Generates a liquidity trap but now buyers *choose* their types
- Arrival rates are endogenous fns of submarket seller/buyer ratio σ
  - $\Rightarrow$ policy affects output on extensive and intensive margins
  - $\Rightarrow$ effect of money injection on $\mathbb{E}q$ is ambiguous

Liquidity trap with directed search: Example



Endogenous acceptability

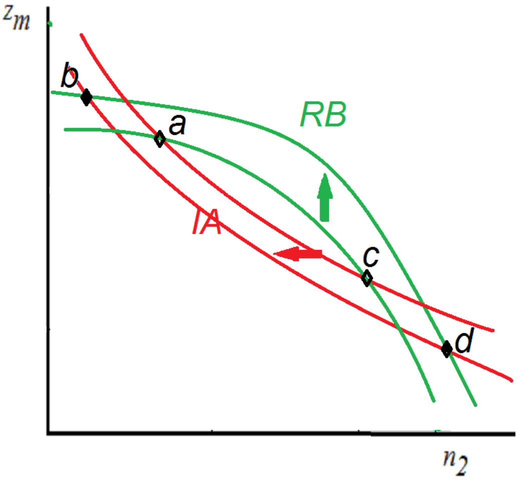
- As in LPW, set $\chi_j = 1$ and let buyers produce bad assets at 0 cost
  - all sellers recognize A_m (for simplicity)
  - but have cost κ to recognize A_b, where κ differs by seller
- Sellers' benefit of being informed is $\Delta = \Delta(z_m)$
- If $\alpha = prob$ (seller mtg) and $\theta =$ buyers' bargaining power, e.g.,

$$\Delta(z_m) = \frac{\alpha(1-\theta)}{\theta}\left[u \circ q_2(z_m) - u \circ q_m(z_m) - z_b\right].$$

Equilibrium acceptability

- Measure of informed sellers $n_2 = F \circ \Delta(z_m) = N(z_m)$ defines IA curve
- Euler eqn for buyers defines RB curve $z_m = Z(n_2)$
- Both slope down $\Rightarrow$ multiplicity
  - higher $z_m \Rightarrow$ fewer sellers invest in information
  - higher $n_2 \Rightarrow$ buyers hold less real money balances
- Paper derives clean comparative statics despite multiple equil and endogenous α's

OMO money injection w/ endog acceptability



Endogenous pledgeability

- As in LRW, buyers in CM can produce bad assets at costs $\beta\gamma_m z_m$ and $\beta\gamma_b z_b$
- Set $\alpha_2 > 0 = \alpha_m = \alpha_b$ (for now) and $\theta = 1$ as in std signalling theory
- Let p_m and p_b be real money and bond payments
- IC for money:

$$\overbrace{\iota z_m + \alpha_2 p_m}^{\text{cost of legit cash}} \leq \overbrace{\gamma_m z_m}^{\text{cost of counterfeit}}$$

- IC for bonds is similar

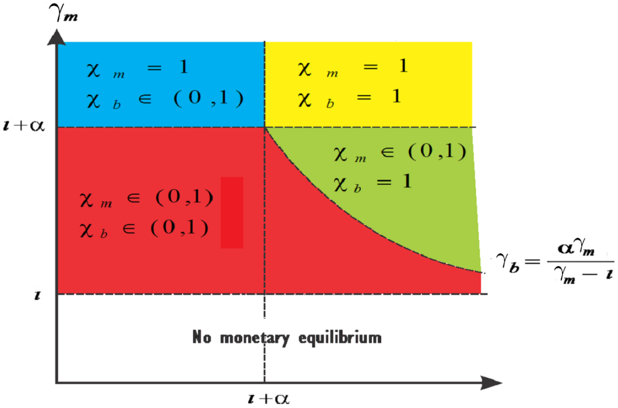
Pledgeability constraints

- Sellers' IR constraint at equality: $c(q) = p_m + p_b$
- Buyers' feasibility constraints: $p_m \leq z_m$ and $p_b \leq z_b$
- Buyers' IC: $p_m \leq \chi_m z_m$ and $p_b \leq \chi_b z_b$ where:

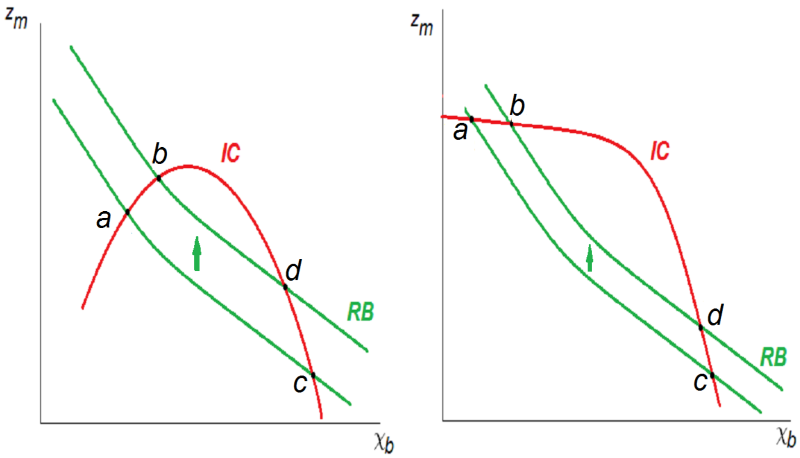
$$\chi_m = \frac{\gamma_m - \iota}{\alpha} \text{ and } \chi_b = \frac{\gamma_b - s}{\alpha}$$

- NB: χ_j depends on cost γ_j, policy ι and market spread s
- Paper delivers clean comparative statics despite multiple equil and endogenous χ's

Types of equilibria in an example



OMO money injection w/ endog pledgeability



Conclusion: I

- New Monetarist theory used to analyze monetary policy:
  - money and bonds differing in liquidity, grounded in information theory
  - robust across environments
- The model can generate negative nominal interest, liquidity traps, sluggish prices and multiplicity
- Take Away: printing money and buying T-bills is a bad idea
- It's probably worse with LR bonds (Quantitative Easing)

Conclusion: II

- Bonds either have or do not have liquidity value:
  - if they don't then OMO's (and QE) are irrelevant
  - if they do then the Fed has it all wrong
- What is the effect on M on P? Ill posed.
  - Quantity eqn holds for transfers but not OMO's
- What is the effect of π on the nominal rate? Ill posed.
  - Fisher eqn holds for ι but not ρ.
- It is not so easy to check Quantity and Fisher eqns in the data!