CONVENTIONAL AND UNCONVENTIONAL MONETARY POLICY WITH FRICTIONS

Aloisio Araujo[a], Susan Schommer[b] and Michael Woodford[c]

[a] IMPA and EPGE/FGV
[b] UERJ
[c] Columbia University

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- It is often the case that this is also not desirable economically.
- In fact, the main effect of such may be indistinguishable a simple restrictions on trade which prevent efficient risk sharing.

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- Whether better results may be obtained by a purely endogenous approach or by one involving government regulation, is often a **quantitative** issue.
- **Numerical investigation**, even of simplified models, may give us a better understanding of what to expect, and hope for, in actual economies.

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- An important example is given by **mortgages**, when residential homes serve as collateral for loans to households.
- Similarly, corporate bounds are often backed by equipment and plants.
- In financial markets, investors can borrow money to establish a position in stocks, using these as collateral.

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- It describes a two-period economy where **collateral** constitutes the only enforcement mechanism.
- Individuals have to put up durable goods as collateral when they want to take short positions in financial markets.
- Agents are allowed to default on their promises without any punishment (in particular no reputation effects), but in the case of default, the collateral is seized and distributed among creditors.

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- If the durable good is **plentiful**, the model is equivalent to a standard **Arrow-Debreu** model (and competitive equilibrium allocations are Pareto-optimal).
- If, on the other hand, the collateralizable durable good is **scarce**, most assets are not traded in equilibrium and markets appear to be **incomplete**.

Features of Our Monetary Model

- **Dimensions** of monetary policy as in **Araujo, Schommer, Woodford; AEJ: Macro (2015)**
  - CB can control riskless nominal interest rate (by varying interest paid on reserves), subject to ZLB
  - CB can also purchase risky assets, financed by issuing riskless nominal liabilities (reserves)
- In **ASW (2015)** prices are flexible, so the interest rate is neutral
- We have to include some kind of **friction** in the economy in order to analyze the conventional monetary policy
- In our recent work we consider an extension of the model in **ASW (2015)** with an endogenous supply of goods in period 0 and sticky wages or prices.

The Model

- Two periods $(0, 1)$, S states $(s = 1, ..., S)$ at date 1

  – alternative interest-rate and asset-purchase policies at 0

- Two goods, non-durable and durable, at each date

  – durable good the only form of collateral for private borrowing

- Households $h = 1, ..., H$ have preferences represented by $u^h(x^h)$, an increasing, quasi-concave function of

$$x^h = (x^h, x_1^h, ..., x_S^h), \quad x_s^h = (x_{s1}^h, x_{s2}^h)$$

  – good 1 = non-durable; good 2 = service flow from durable

The Model

- Assets:
  - durable good (yields one unit of services at each date and in each possible state; can be rented)
  - money (liability of CB, pays riskless nominal rate i)
  - privately issued financial claims: promise fixed nominal amount at date 1, backed by durable as collateral (multiple types, with different degrees of collateralization, may coexist)

- Notation for quantities:
  - x_3^h = holdings of durable period 0 (may be rented in period 0)
  - μ^h = nominal money balances
  - ψ_j^h = holdings of private debt of type j
  - φ_j^h = issuance of debt of type j

The Model

- Prices (in units of money):
  - consumption goods: (p_1, p_2) at 0, (p_{s1}, p_{s2}) in state s at 1
  - durable good: p_3 at 0, p_{s3} in state s at 1
  - private debt: q_j at 0 for debt of type j (face value of 1 unit of money, C_j units of collateral)
- Endowments of household h:
  - non-durable good: e^h_{s1} at date 1
  - durable good: e^h_3 at data 0
  - money: m^h
- $\sigma^h \in \mathbb{R}_+$ is the fraction of the demand for non-durable goods; $\sigma^h \geq 0$ for each h, and $\sum_h \sigma^h = 1$;
- $u^h(x^h) - v^h(\sigma^h y)$ is the utility function, where $y \geq 0$ is the aggregate demand for the non-durable good in the period 0.

The Central Bank

- CB balance sheet:
  - hhold initial money endowments: CB liabilities backed by CB holdings of riskless nominal gov't debt
  - purchases x_3^{CB} units of durable in period 0
  - issues reserves in quantity $(p_3 - p_2)x_3^{CB}$ to finance purchases
  - hence total money supply

$$M = \sum_h m^h + (p_3 - p_2)x_3^{CB}$$

The Central Bank

- Conventional monetary policy:
  - CB free to set i (interest on reserves) (subject to $i \geq 0$)
  - this also determines the equilibrium interest rate on any other riskless gov't debt, or riskless (fully backed) private debt (given $M > 0$)
- CB also determines value of money in terminal period: p_{s1} an independent choice for each possible state s
  - in an infinite-horizon model, could simply have interest-rate policy each period (and each state)
  - here instead: CB assumed to redeem the money for non-durable goods at date 1, at specified parity

The Central Bank

- Net tax collections necessary by CB and/or gov't at date 1 in aggregate amount

$$(1+i)M - p_{s2}x_3^{CB}$$

  - obligation divided (lump-sum) among households according to tax shares θ^h ($\theta^h \geq 0, \sum_h \theta^h = 1$), specified as part of fiscal policy

Financial Markets

- Borrowing:
  - only enforceable debt contracts only allow lender to seize collateral backing the loan if not paid
  - debt can be discharged either by delivering specified amount of money, or specified amount of durable good (collateral) (at option of borrower)
    - – each amount specified independently of state s
  - w.l.o.g., assume contract j promises 1 unit of money, or C_j units of durable

Problem of household in sticky price model

Problem of household h: choose plan $(x^h, x_3^h, \psi^h, \varphi^h, \mu^h)$ to maximize $U^h(x^h)$ subject to constraints:

$$p_1(x_1^h - \sigma^h y) + p_2(x_2^h - x_3^h) + p_3(x_3^h - e_3^h) + q \cdot (\psi^h - \varphi^h) + (\mu^h - m^h) \leq 0;$$

$$p_{s1}(x_{s1}^h - e_{s1}^h) + p_{s2}(x_{s2}^h - x_3^h) - \sum_{j=1}^S (\psi_j^h - \varphi_j^h) \min\{1, p_{s2}C_j\} + \theta^h[(1+i)M - p_{s2}x_3^{CB}] - (1+i)\mu^h \leq 0; \quad \forall s \in \mathcal{S}$$

$$x_3^h - \sum_{j=1}^S \varphi_j^h C_j \geq 0$$

Extended model with an endogenous supply of good

- It may be considered undesirable to specify the predetermined price level p_1 and the supply commitments $\{\sigma^h\}$
- We have N different possible states of the world in period 0 with ex-ante probabilities $\pi_n > 0$ such that $\sum_n \pi_n = 1$.
- The values of p_1 and the $\{\sigma^h\}$ (endogenous) are chosen prior to the realization of the state n [independent of n].
- Each agent h chooses a value of σ^h and a plan $(\mu_n, x_n, \psi_n, \varphi_n)$ for each of the states n, to maximize:

$$\sum_n \pi_n [u^h(x_n^h) - v^h(\sigma^h y_n)]$$

subject to the same set of constraints as above for each of the states n.

Equilibrium

An equilibrium for policy $(i_n, x_{n3}^{CB}, \{p_{ns1}\}_{s=1}^{S})$ is a collection of vectors (p_1, σ) and $[(\overline{x}_n, \overline{\psi}_n, \overline{\varphi}_n, \overline{\mu}_n); (\overline{p}_n, \overline{q}_n); \overline{y}_n)]$ and collateral requirements$\{C_j\}_{j=1}^{S}$ such that:

(i) for each h, σ^h and the plans $(\overline{x}_n^h, \overline{\psi}_n^h, \overline{\varphi}_n^h, \overline{\mu}_n^h)$ solves utility max problem

(ii) $\sum_{h=1}^{H} \overline{x}_{n1}^h - \overline{y}_n = 0$

(iii) $\sum_{h=1}^{H} (\overline{x}_{n2}^h - e_{n3}^h) = 0$

(iv) $\sum_{h=1}^{H} (\overline{x}_{n3}^h - e_{n3}^h) - x_3^{CB} = 0$

(v) $\sum_{h=1}^{H} (\overline{x}_{ns1}^h - e_{ns1}^h) = 0$

(vi) $\sum_{h=1}^{H} (\overline{x}_{ns2}^h - e_{ns3}^h) = 0$

(vii) $\sum_{h=1}^{H} (\overline{x}_{ns3}^h - e_{ns3}^h) = 0$

(viii) $\sum_{h=1}^{H} (\overline{\psi}_n^h - \overline{\varphi}_n^h) = 0$

(ix) $\sum_{h=1}^{H} \overline{\mu}_n^h - M_n - (p_{n3} - p_{n2}) x_3^{CB} = 0$

(x) $\sum_{h=1}^{H} \sigma^h - 1 = 0$

Some cases to consider in the extended model

An example in which:

- **State 1** [high-probability, “normal” state] is a state in which conventional monetary policy (appropriate setting of i alone) will suffice to achieve a desirable allocation of resources, while central-bank purchases of the durable will not accomplish anything (because no collateral constraints bind);
- **State 2** [low-probability, “crisis” state] is one in which conventional monetary policy is constrained by the zero lower bound, and also one in which some collateral constraint binds, so that the allocation of resources can be affected by central-bank purchases of the durable.

Normal State

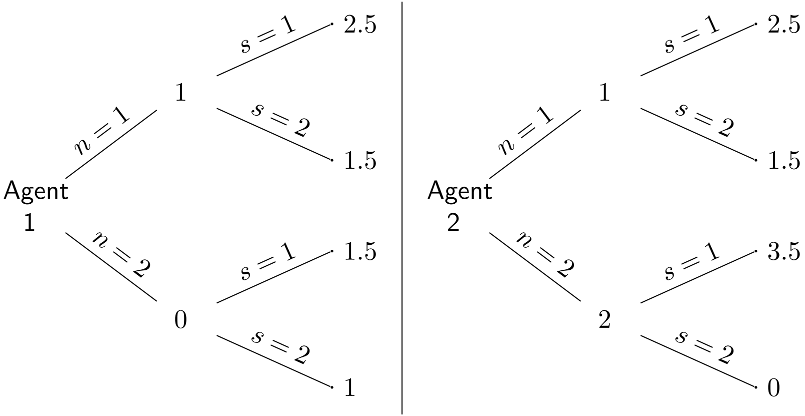
- An economy in which there is an AD equilibrium with no purchases of the durable by the central bank and **real rate of interest** $p_1(1+i)/p > 1$.
- In the (flexible-price) endowment economy, changing i has no consequences for the allocation of resources.
- One value of i would achieve $p_1 = p$, and under the assumption made above, this requires $i > 0$, so that the policy is feasible.
- Thus conventional monetary policy suffices to achieve both (a) the AD allocation, and (b) the price-level target p in both periods.

Crisis State

- An economy in which the best equilibrium that involves no central-bank purchases involves $p_1(1+i)/p < 1$, so that with $p_1 = p$, it will not be possible to implement this equilibrium using conventional monetary policy [as this would require $i < 0$]
- We could then obtain an economy in which the zero lower bound constrains interest-rate policy, and in which central-bank purchases affect the allocation of resources, and probably can improve welfare.

Numerical example

- We analyze an example with two states of nature: $n = 1$ represents "normal" state and $n = 2$ represents "crisis" state
- The **endowments** are:



Conventional monetary policy

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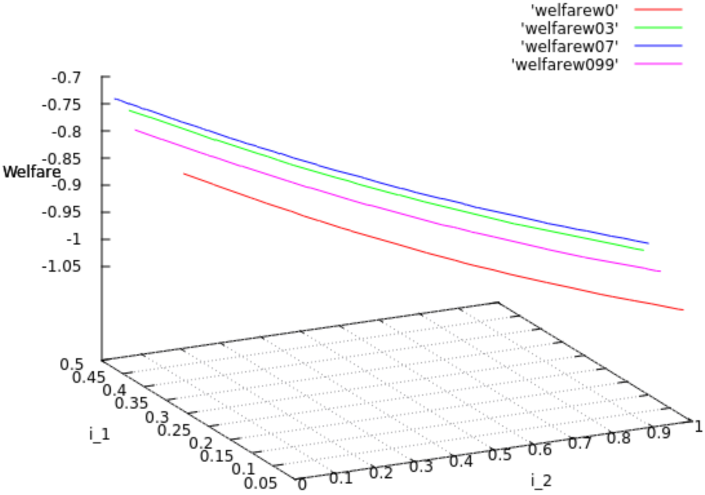

Table: Welfare

	$\omega_2 = 0$	$\omega_2 = 0.3$	$\omega_2 = 0.7$	$\omega_2 = 0.99$
i_1	0.3087	0.4445	0.4774	0.4272
i_2	0	0	0	0
U^1	-1,6944	-1,6247	-1,6203	-1,7490
U^2	0,1219	0,1530	0,1600	0,2230
welfare	-0,7862	-0,7358	-0,7301	-0,7629