On the (Dynamic) Money Creation Approach

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Outline

Introduction and Motivation

Approach and Model

Equilibria with Banks: Flexible Prices

Equilibria with Banks: Frictions

Conclusion and Extensions
Motivation: Current Monetary Architecture (1/4)

- Money (e.g. $M_1$) is mainly in the form of bank deposits:
  - In Switzerland, $M_1 = 655$ billions CHF, deposits = 570 billions CHF = 87% of $M_1$ (08/2018)
  - In Germany, $M_1 = 2'376$ billions EUR, deposits = 2’119 billions EUR = 89% of $M_1$ (08/2018)
  - In the US, $M_1 = 3’701$ billions USD, deposits = 2’102 billions USD = 57% of $M_1$ (08/2018)

- Broader Aggregates: $M_2$, $M_3$
The creation of money is organised hierarchically. The central bank issues banknotes and coins (physical central bank money) which serve as legal tender.

- Commercial banks have the right to issue deposits when they grant loans and purchase assets.
- Deposits themselves are claims on banknotes.
- Commercial banks face a set of rules such as capital requirements or deposit insurance schemes.
Motivation: Current Monetary Architecture (2/4)

• However, they are not (or only to a small extent) required to hold central bank money as reserves for their deposits.

• Interbank liabilities - for example, created through the millions of payments in the economy - are usually settled with reserves (electronic central bank money). Only commercial banks have access to reserves.
Motivation: Current Monetary Architecture (4/4)

Source: Cukierman (2017)
Motivation: Loanable Funds vs. Money Creation

- Most models of banking, banking regulation, and monetary policy are based on the loanable-funds approach:

  **Savings → Lending**

  (Holmström and Tirole 1997, also Gersbach and Rochet (2015) and (2017)).

- The monetary architecture is different:

  **Lending / Money Creation → Savings**

- Hierarchical monetary architecture

- What additional insights can we obtain from this perspective?
Motivation: Research Questions

• Does it make a difference?

• What is the role of capital requirements with regard to money creation?

• Do we find new or alternative foundations for regulation and policies in the true architecture?

• Do we obtain new insights on the role of quantitative easing or on limits to arbitrage?

• Which mechanisms ensure that money creation by private banks is controlled and steered towards a desirable level?
Motivation: Literature

- Gurley and Shaw (1960), Tobin (1963)
  - Debate on natural economic limits to assets and liabilities creation by the commercial banking industry

- More recently: McLeay et al. (2014) and other central banks
  - Reserve requirements have lost their significance.
  - Exceptional times (central banks purchase large amount of securities or lend to banks at low interest rates):
    Do such policies trigger money creation and foster investment?
Relation to the Literature (1/3)

Fiat money (banknotes) can have a **positive value** in a finite-horizon model, when there are

- sufficiently large penalties for unpaid debt to governments (e.g. tax liabilities),
- sufficiently large gains from using and trading money, and
- a cash-in-advance constraint.

(Shubik and Wilson (1977), Shubik and Tsomocos (1992), Dubey and Geanakoplos (1992), Dubey and Geanakoplos (2003a), and Dubey and Geanakoplos (2003b))
Relation to the Literature (2/3)

In our setting, money (bank deposits) has a positive value, because there are

- sufficiently large penalties for defaulting against the central bank and
- gains from using and trading money, since it allows financing of firms that need banks.

Moreover, we assume

- competitive money creation by banks and
- a two-tier structure of publicly and privately created monies (but no banknotes).

Remark: A deposit-in-advance constraint is redundant, since deposits are interest-bearing.
Relation to the Literature (3/3)

• Independent paper: Jakab and Kumhof (2017)
  – Using DSGE models and calibrations, they suggest that the impact of shocks on bank lending and the real economy is (considerably) larger with private money creation than in a loanable-funds model.

• We investigate the properties of static and dynamic general equilibrium models
  – with private money creation and payment processes,
  – with individual versus collective incentives to create money, and
  – in the absence as well as in the presence of frictions.

• Applications:
  – Alternative monetary architectures
  – Unconventional monetary policy

• Alternative approach: search theory of money (Monnet et al.)
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Conclusion and Extensions
Approach

• Neoclassical growth model
• Discrete time
• One physical commodity for investment and consumption
• Standard preferences of representative household
Entrepreneurs

- $K_F$ in FT technology $\rightarrow f(K_F)$
  - Direct financing by households
  - Production function: Concave, Inada conditions and risk-free

- $K_M$ in MT technology $\rightarrow K_M R_{M}^{s,t}$ ($0 < R_{M}^{l,t} < R_{M}^{h,t}$)
  - Financing by banks
  - Production function: Linear and risky ($s = l, h$)
Banks and Public Authorities

- **Banks**
  - Continuum of identical banks in $[0, 1]$  
  - Monitoring and lending to MT
- **The central bank (CB)**
  - allows banks to refinance themselves or to deposit reserves, both at the policy rate $(R_{CB}^s)_{s=I,H}$.
- **Government authorities**
  - Heavy penalties for defaulting against CB,
  - Lump-sum taxation for bank bailout.
- **Fully-specified sequential process of**
  - bank foundation
  - lending and deposit creation with
  - markets for investment and consumption goods and
  - interbank market including all payment processes
Institutional Set-up: Monies (1/2)

- Private deposits (claims on banknotes)
  - are created by commercial banks through loans to firms (in MT),
  - are destroyed through the purchase of (new) bank equity and the repayment of loans,
  - are held by households or firms in the form of deposits at banks,
  - are used to buy goods,
  - have positive value since they are essential to overcome the impossibility to finance firms in MT directly and large penalties for default against CB.
  - Payment process: transfer of deposit of amount $X$ from bank A to bank B creates automatically an interbank liability $X$ of bank A to bank B.
Institutional Set-up: Monies (2/2)

• CB deposits
  – are created by the CB through loans to banks, and
  – are held by banks in the form of deposits at the CB.

• CB deposit constraint
  – Interbank liabilities are repaid with CB deposits.
Households

• Owner of
  – initial capital stock $K_0$
  – both technologies

• Choice of a portfolio of
  – bank deposits
  – bank equity
  – investments via bonds in FT
Period $t$ - Stage 1

Banks grant loans to firms in MT.
Period $t$ - Stage 2

Firms in MT buy an amount of the investment good.
Period $t$- Stage 3

Households invest in bank equity, deposits, and bonds.
Period $t$ - Stage 4

Households buy goods from firms.
Period $t$ - Stage 5

Firms in MT repay their bank loans.
Definition of Equilibrium

Given the central bank policy \(((R_{CB}^{s,t})_{s=l,h})_{t=1}^{\infty}\), an equilibrium with banks is defined as a tuple

\[(R_{D}^{s,t}, R_{F}^{t}, R_{L}^{s,t}, R_{E}^{s,t}, q^{s,t}, p^{s,t}, L_{M}^{t}, S_{F}^{t}, D_{H}^{t}, E_{B}^{t}, K_{M}^{t}, K_{F}^{t})_{t=1}^{\infty}\]

such that firms and banks maximize profits, households maximize expected utility and market for bonds and goods clear. All actors are price takers.
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Derivation of Equilibria

- **Banks’ behavior** ($I_M^b$) only depends on
  - the average money created $\overline{I}_M$,
  - the intermediation margin $(R^s_L - R^s_{CB})_{s=l,h}$, and
  - the capital structure $\varphi$.

- **Banks’ maximization problem**

  $$\max_{I_M^b \in [0, +\infty)} \mathbb{E}[\max(I_M^b(R^s_L - R^s_{CB}) + \overline{I}_M(R^s_{CB} - R^s_D) + e_B R^s_D, 0)]$$

- **Intuition**
  - $I_M^b$ deposits move to other banks through payment system
  - $\overline{I}_M$ deposits are obtained
  - $e_B R^s_D$ need not be paid
The First Welfare Theorem of Money Creation

Given a CB policy \( ((R_{CB}^{s,t})_{s=1,h})_{t=1}^{\infty} \), there is a unique symmetric competitive equilibrium regarding bank lending and direct financing. The resulting allocation is first-best.

Remarks:

• The price of the good in \( t = 1 \) and the financing structure of banks are the indeterminate variables in this equilibrium.

• First-best allocation: standard neoclassical growth model
Consequences

- There is no bank default in any competitive equilibrium.
- No accumulation of electronic central bank money.
- Without loss of generality, we can normalize $p^{s,0}$ (e.g. $p^{s,0} = 1$).
- Given $p^{s,0} = 1$, $((R_{CB}^{s,t})_{s=l,h})_{t=1}^{\infty}$ and $(\varphi_t)_{t=1}^{\infty}$, all equilibrium values are uniquely determined.
- Equivalence: Loanable Funds Approach to Money Creation Approach
Further Equivalence Results

Sovereign money architecture: Only electronic central bank money can be lent by commercial banks.

- Equivalent to money creation equilibria

- Intuition: If the central bank only uses the interest rate as a policy instrument, it does not matter whether a bank creates loans and deposits and later refines its interbank liabilities – created in the payment process – at the central bank, or directly borrows central bank money in a sovereign money architecture and lends this money to the private sector.
Inefficient Asymmetric Equilibria

Proposition

Given a CB policy \( ((R_{s,t}^{s,t})_{s=1,h} \infty, t=1) \), there exist inefficient asymmetric competitive equilibria.

Intuition: Some banks create a large amount of money (and credit) and default in the bad state. Other banks create a small (or zero) amount of money (and credit), obtain deposits and central bank reserves from other banks, and do not default.

Asymmetric equilibria can be avoided through sufficiently high bank equity capital requirements.
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Equilibrium Breakdowns and Inefficiencies with Price Rigidities

Equilibrium breakdowns

- Money creation and lending are zero.
- Money creation explodes and the monetary system collapses.

⇒ Only investment in Sector FT occurs.

Inefficient allocations in equilibrium

- Distorted investment mix of bank lending and direct financing.
Price Rigidity – No Capital Requirements

- Extreme case: \( q^{s,t} = p^{s,t} = 1 \) and \( R^{s,t}_M = R^{s,t}_L \) for all states and periods.

- Equilibria are only possible if \( R^{s,t}_{CB} = R^{s,t}_M \).

- If \( R^{s,t}_{CB} \neq R^{s,t}_M \) in one state and some period \( t \),
  - either money creation is zero or it explodes, and
  - all investments are channeled to Sector FT.

- Intuition: Let \( R^{l,t}_{CB} = R^{l,t}_M, R^{h,t}_M > R^{h,t}_{CB} \)
  - “slightly” larger money creation than other banks is profitable
    (no default risk against households or CB).
  - “slightly” larger money creation than average by all banks is in contradiction with finite money creation.
Foundation of Capital Requirements

Proposition

Money explosion can be avoided by capital requirements. Suitable (minimal) capital requirements lead to finite money creation and efficient (or inefficient) allocations.
Price Rigidity and the Zero Lower Bound

\[ \mathbb{E}[R_{M}^{s,t}] < 1, \quad R_{CB}^{s,t} \geq 1: \]

- \( R_{M}^{l,t} < 1 < R_{M}^{h,t} \): Equilibrium with banks restored with policy.
  - \( R_{CB}^{l,t} = R_{CB}^{h,t} = 1. \)
  - \( \varphi_{t}^{reg} = \frac{\sigma(R_{M}^{h,t} - 1)}{1 - \sigma}. \)

- \( R_{M}^{l,t} < R_{M}^{h,t} \leq 1 \): Depressed economy.
  - No investment in MT (even at \( R_{CB}^{l,t} = R_{CB}^{d,t} = 1 \)).
  - Bond purchase by CB does not help.
Financial Frictions – Setup

• Financial frictions are introduced at banker level.
  – Asset diversion
    (Gertler and Karadi (2011) and Gertler and Kiyotaki (2011))
  – Moral hazard
    (Holmström and Tirole (1997))
  – Inalienability of human capital
    (Hart and Moore (1994) and Diamond and Rajan (2001))

• Bankers need to be paid the amount $\theta l^b_M R^{h,t}_L$ ($0 < \theta < 1$)
  – to ensure that they monitor entrepreneurs and do not divert assets, for instance.

• Bankers maximize their expected consumption,
  – which is proportional to their bank’s balance sheet.
Financial Frictions – Results and Intuition

Results

• No equilibrium with banks exists for any intermediation margin and equity ratio.

• Existence of equilibria with banks can be restored by capital regulation, as it limits money creation.

Intuition: Profitable upward deviation from average lending

• Increase in a banker’s expected consumption.

• Deviation prevented by appropriate capital requirements.
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Conclusion and Extensions
Conclusion

- **Baseline model**
  - First-best allocation in symmetric equilibria, regardless of central bank policies (First Welfare Theorem).
  - Equivalence Theorems (loanable funds, sovereign money).
  - Inefficient asymmetric equilibria.

- **Price rigidities**
  - No equilibrium with banks may exist.
  - Under normal economic conditions,
    - joint monetary policy and capital requirements can restore the existence and, in some cases, the efficiency of equilibria.
  - In a depressed economy,
    - joint monetary policy and capital requirements are not effective.
    - Quantitative Easing is not effective

- **Financial Frictions**
  - No equilibrium with banks exists.
  - Joint monetary policy and capital requirements are effective.
Extensions

- Very simple model!
- Simple extensions:
  - non-contingent deposit contracts, multiple states, costs of equity issuance, costs of monitoring.
- Substantial extensions (new papers):
  - banknotes,
  - adding money creation through purchase of securities,
  - haircuts in Central Bank lending to banks, and
  - Production cycles, maturity structures, accumulation of reserves

⇒ Examine differences between loanable funds and money creation approach and possibly set new foundations for regulation and central bank policies.