On the stability of money demand

Robert E. Lucas, Jr. and Juan Pablo Nicolini

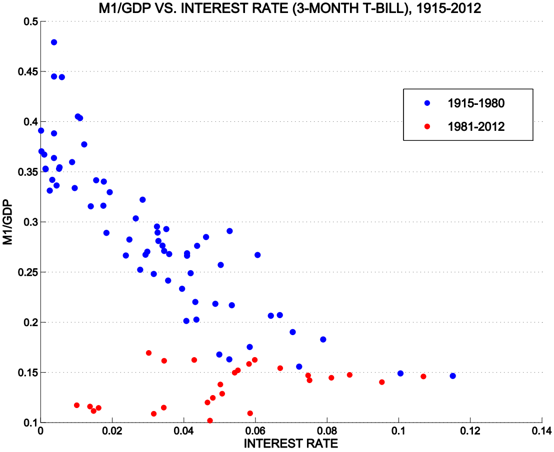
discussion by Francesco Lippi (EIEF)

The 8th Bank of Portugal monetary conference on monetary economics

Lisbon , June 2015

Fact: the relation between $M1/GDP$ and r changes after the 80s

breakdown mostly due to deposit (not currency)



reserves and M1 central to policy yet absent in standard macro models

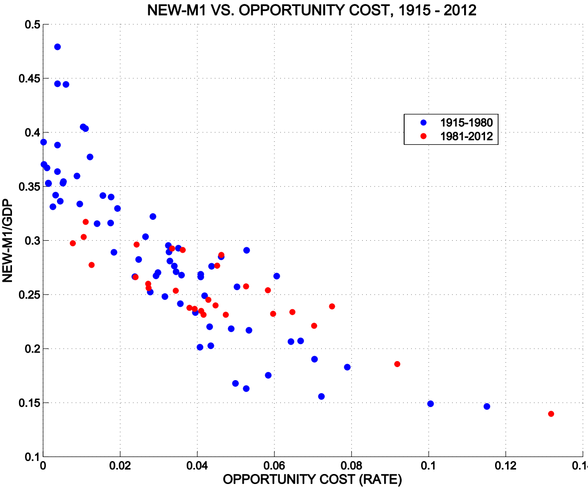
Money: difficult to analyze both in theory and in data

- what assets serve as money in practice?
  regulation and technical change matter

- in particular: NOW and MMDA (interest paying deposits) in early 1980s
  - MMDA allowed for limited checking but no limits on ATM withdrawals
  - MMDA close substitute to deposit but included in M2 (not in M1)

- relevance: e.g. M, P, Y, r relationship (and welfare)

Empirical contribution: new measure of M1

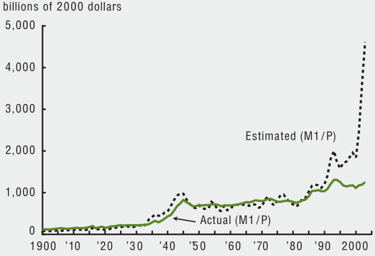


Essentially $M1_{new} = M1 + MMDA$

Related empirical analysis in Teles and Zhou (2005)

FIGURE 2

Actual and estimated real balances M1/P, 1900–2003 (interest elasticity of 0.5)

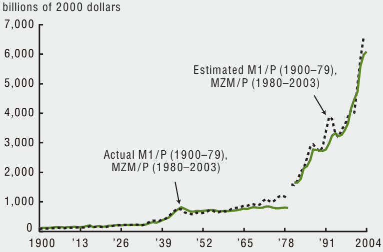


Notes: Restricting the interest elasticity to be .5, the estimated real balances are $\left(\frac{M_1}{P}\right)_t = 0.05 Y_t i_t^{-0.5}$.

Source: Authors' calculations and Lucas (2000).

FIGURE 8

Actual and estimated real balances, M1/P (1900–79) and MZM/P (1980–2003) (common interest elasticity of 0.24)



Notes: Estimated 1900–79: $\left(\frac{M_1}{P}\right)_t = 0.13 Y_t i_t^{-0.24}$.

Estimated 1980–2003: $\left(\frac{MZM}{PY}\right)_t = 0.17 Y_t \left(i_t - i_t^m\right)^{-0.24}$.

MZM = M1+ MMMF + MMDA

Model competing means of payments / deposits

$$\max_{n,\gamma,\delta,x,c,d,a} \sum_{t=0}^{\infty} \beta^t U(x_t) \quad \text{subject to} \quad m \geq c\theta^c + d\theta^d + a\theta^a \tag{3}$$

$$nc \geq px\Omega(\gamma), \tag{4}$$

$$nd \geq px\left[\Omega(\delta) - \Omega(\gamma)\right], \tag{5}$$

$$na \geq px\left[1 - \Omega(\delta)\right]. \tag{6}$$

The law of motion for money balances is

$$m' = \frac{m + T + py(1-\phi n) - px\left(k^d\left(F(\delta) - F(\gamma)\right) + k^a\left(1 - F(\delta)\right) + 1\right) - (\theta^c - 1)c}{1+\pi}$$

– Key choices: $0 < \gamma < \delta$, and # transactions n (m unit elasticity w.r.t. y)

Model competing means of payments / deposits

$$\max_{n,\gamma,\delta,x,c,d,a} \sum_{t=0}^{\infty} \beta^t U(x_t) \quad \text{subject to} \quad m \geq c\theta^c + d\theta^d + a\theta^a \tag{3}$$

$$nc \geq px\Omega(\gamma), \tag{4}$$

$$nd \geq px\left[\Omega(\delta) - \Omega(\gamma)\right], \tag{5}$$

$$na \geq px\left[1 - \Omega(\delta)\right]. \tag{6}$$

The law of motion for money balances is

$$m' = \frac{m + T + py(1-\phi n) - px\left(k^d\left(F(\delta) - F(\gamma)\right) + k^a\left(1 - F(\delta)\right) + 1\right) - (\theta^c - 1)c}{1+\pi}$$

– Key choices: $0 < \gamma < \delta$, and # transactions n (m unit elasticity w.r.t. y)

– Costs: ϕn, Fixed cost: $k^d < k^a$, "reserve requirements" $\theta^c, \theta^d, \theta^a$

– "Opportunity cost" of $m = c + d + a$ is $\lambda_m = V'(m)\frac{r}{1+r}$ with $\lambda_m'(r) > 0$

Tradeoffs

A unit of consumption x made of purchases of different size z:

$$1 = \int_0^\infty f(z)\frac{z}{\nu}dz$$

– checks have fixed cost per-purchase $\rightarrow$ convenient for large purchase

– pin down γ (cash-good threshold), n # transactions

$$\gamma \frac{1}{\nu} \frac{\left[(\theta^c - 1) + r\left(\theta^c - \theta^d\right)\right]}{n} = k^d \quad (11)$$

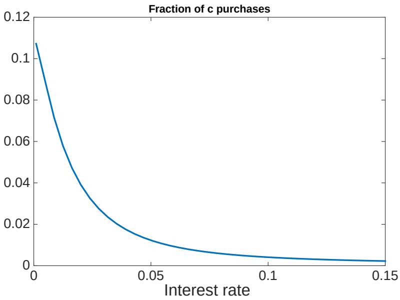
$$\frac{n^2\phi}{(1-\phi n)} = \frac{r\theta^a + \left[(\theta^c - 1) + r\left(\theta^c - \theta^d\right)\right]\Omega(\gamma) + r(\theta^d - \theta^a)\Omega(h(r)\gamma)}{\left[1 + k^d\left(F(h(r)\gamma) - F(\gamma)\right) + k^a\left(1 - F(h(r)\gamma)\right)\right]} \quad (12)$$

resources spent on "trips" to the bank: ϕn

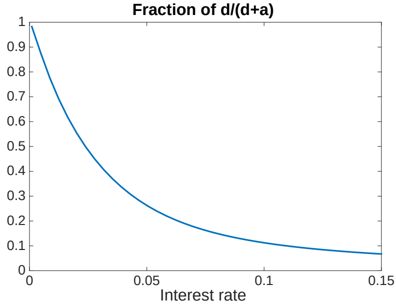
resources spent on banking services $k^d(F(\delta) - F(\gamma))$, $k^d(1 - F(\delta))$

Novelty is the multiplicity of bank liabilities

cash $c/(c+d+a) = \Omega(\gamma)$



deposits $d/(d+a)$

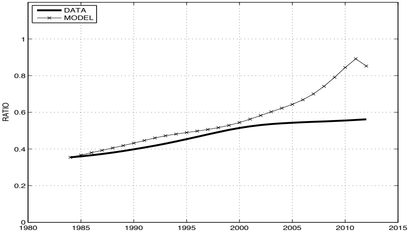


- both cash and deposits are used even at $r = 0$ if $\theta^c > 1$
- No demand for MMDA at $r = 0$

Main results from calibration (match 1984 values)

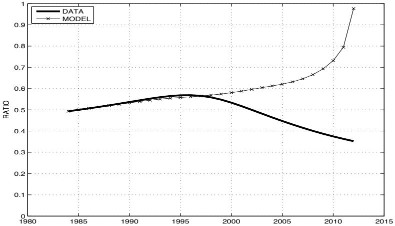
$c/(c+d+a)$

Figure 5b: Currency / Demand Deposits - trend component , 1984 - 2012



$d/(d+a)$

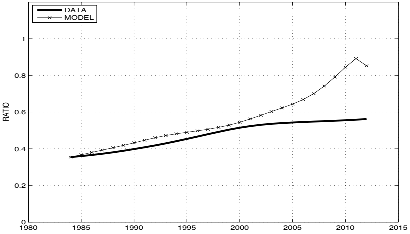
Figure 5d: Demand Deposits / (Demand Deposits+MMDAs) - trend component, 1984 - 2012



Main results from calibration (match 1984 values)

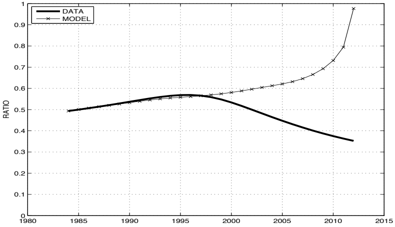
$c/(c+d+a)$

Figure 5b: Currency / Demand Deposits - trend component , 1984 - 2012

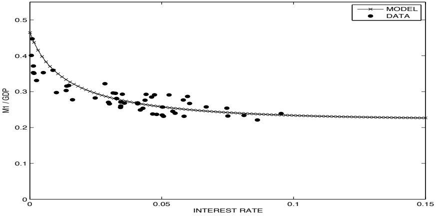


$d/(d+a)$

Figure 5d: Demand Deposits / (Demand Deposits+MMDAs) - trend component, 1984 - 2012



gure 6: M1/GDP vs. Interest Rate (3-Month T-Bill), 1915 - 1935 & 1983 - 2012



$$\frac{M}{GDP} = A^{\frac{1+(\theta^c-1)\Omega(\gamma)}{n(r)}} \cong \frac{A}{n(r)}$$

Comments

1. some details (on interest elasticity, multipliers & transaction-costs specification)

2. on modeling M1: beyond households?

3. what did we learn?

Non-monotone $M(r)$ when both γ and n endogenous

$n(r)$ has a 1/2 elasticity w.r.t. r for given γ and $\theta^c = 1$, like BT model

Non-monotone $M(r)$ when both γ and n endogenous

$n(r)$ has a 1/2 elasticity w.r.t. r for given γ and $\theta^c = 1$, like BT model

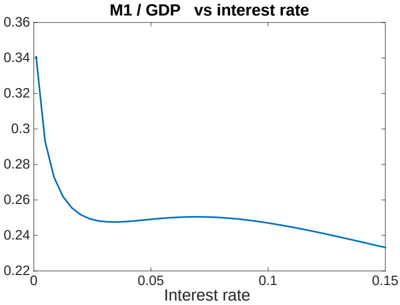
but $n(r)$ is a non-monotone function of r when $\gamma = \gamma(r, \theta^i, k^i)$
and for $\theta^c > 1$ model has satiation at $r = 0$

Non-monotone $M(r)$ when both γ and n endogenous

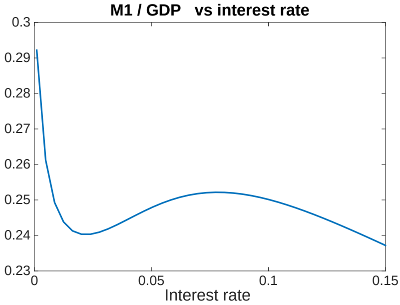
$n(r)$ has a 1/2 elasticity w.r.t. r for given γ and $\theta^c = 1$, like BT model

but $n(r)$ is a non-monotone function of r when $\gamma = \gamma(r, \theta^i, k^i)$
and for $\theta^c > 1$ model has satiation at $r = 0$

$\theta_c = 1.01$

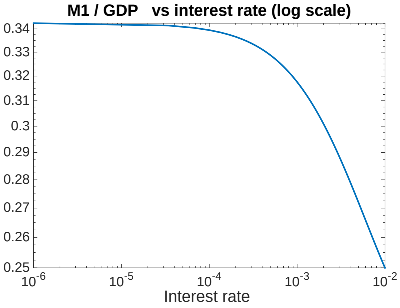


$\theta_c = 1.005$

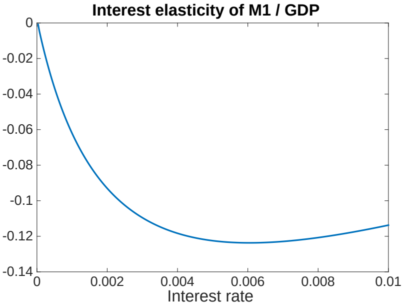


Interest elasticity of M1 at low interest $r < 0.01$

Satiation of money balances



Interest elasticity is small



M1 and Multipliers

Let $M = a + b + c$ and remember $m = c(r, ...)\theta^c + d(r, ...)\theta^d + a(r, ...)\theta^a$

- model features a money multiplier :

$$M = \mu(\theta^i, k^i, r)\ m$$

  - look at the empirical performance of the multiplier !

M1 and Multipliers

Let $M = a + b + c$ and remember $m = c(r, ...)\theta^c + d(r, ...)\theta^d + a(r, ...)\theta^a$

- model features a money multiplier :

$$M = \mu(\theta^i, k^i, r)\ m$$

- look at the empirical performance of the multiplier !

- Money M to GDP in model is

$$\frac{M}{p\ y(1 - \phi n)}$$

M1 and Multipliers

Let $M = a + b + c$ and remember $m = c(r, ...)\theta^c + d(r, ...)\theta^d + a(r, ...)\theta^a$

- model features a money multiplier :

$$M = \mu(\theta^i, k^i, r)\ m$$

- look at the empirical performance of the multiplier !

- Money M to GDP in model is

$$\frac{M}{p\,y(1-\phi n)} = \underbrace{\frac{M}{px}}_{eq.\ 13}\ \ \frac{x}{p\,y(1-\phi n)}$$

M1 and Multipliers

Let $M = a + b + c$ and remember $m = c(r, ...)\theta^c + d(r, ...)\theta^d + a(r, ...)\theta^a$

- model features a money multiplier :

$$M = \mu(\theta^i, k^i, r)\ m$$

- look at the empirical performance of the multiplier !

- Money M to GDP in model is

$$\frac{M}{p\ y(1-\phi n)} = \underbrace{\frac{M}{px}}_{eq.\ 13} \ \frac{x}{p\ y(1-\phi n)} = \frac{M}{px}\ (1 - transaction\ service)$$

Dissociated transaction costs: $\phi_i \rightarrow n_i$?

model assumes once ϕ is "paid" c, d, a are rebalanced

hence n the same for all instruments

Dissociated transaction costs: $\phi_i \rightarrow n_i$?

model assumes once ϕ is "paid" c, d, a are rebalanced

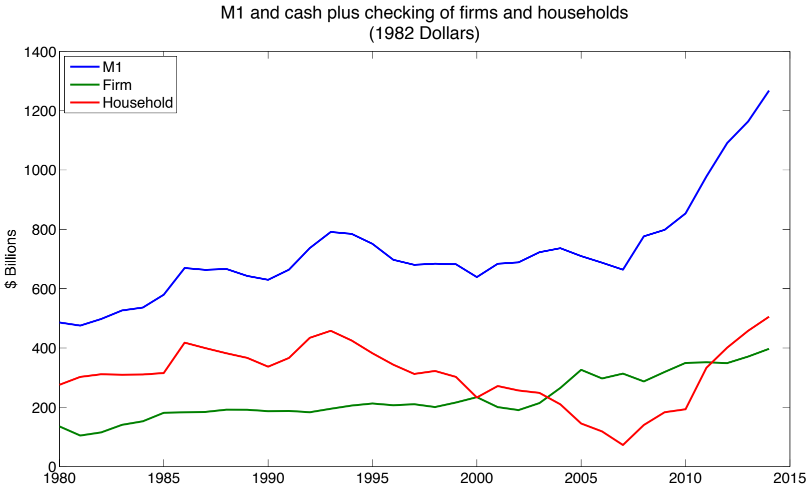
hence n the same for all instruments

In data (Italy, 2002) transaction frequency varies across assets:

	mean	median
# currency transactions (from d to c)	22 (60 w. ATM)	12 (48 w. ATM)
# deposits transactions (from *Wealth* to d)	14 (+12 Auto)	2 (+12 Auto)

Source Italian households survey data (Bank of Italy)

Sectoral breakdown of *M*1: HH and (non-fin) Firms



Notes: M1 is from the Federal Reserve Board of Governors Release H.6 at the end of the period. Firm cash+checking is from the Flow of Funds L.102(A): Nonfinancial business; checkable deposits and currency; asset. Household cash+checking is from the Flow of Funds L.101(A): Households and nonprofit organizations; checkable deposits and currency; asset. All data is not seasonally adjusted and deflated using CPI (CPIAUCNS) from the BLS.

Why do we care about a “stable” $M/P = L(r, y)$?

- “*Giving colorful names to statistical relationships*
  is not a substitute for economic theory”

Why do we care about a "stable" $M/P = L(r, y)$?

- "*Giving colorful names to statistical relationships is not a substitute for economic theory*"

  - theory of $L(r, y)$ is key to quantify costs of anticipated inflation

Why do we care about a "stable" $M/P = L(r, y)$?

- "*Giving colorful names to statistical relationships is not a substitute for economic theory*"

- theory of $L(r, y)$ is key to quantify costs of anticipated inflation
- Lucas-Nicolini might serve that role (cost: GDP wasted in cash management)

.... all the ingredients for coherent welfare analysis are there . . . use them?

Why do we care about a "stable" $M/P = L(r, y)$?

- "*Giving colorful names to statistical relationships*
  is not a substitute for economic theory"
  - theory of $L(r, y)$ is key to quantify costs of anticipated inflation
  - Lucas-Nicolini might serve that role (cost: GDP wasted in cash management)

  .... all the ingredients for coherent welfare analysis are there . . . use them?

- A test of our ability to understand (account for) data we observe
  - My work with Alvarez on BT data + model

Why do we care about a "stable" $M/P = L(r, y)$?

- "*Giving colorful names to statistical relationships is not a substitute for economic theory*"
  - theory of $L(r, y)$ is key to quantify costs of anticipated inflation
  - Lucas-Nicolini might serve that role (cost: GDP wasted in cash management)

  .... all the ingredients for coherent welfare analysis are there . . . use them?

- A test of our ability to understand (account for) data we observe
  - My work with Alvarez on BT data + model

- fine tuning control of reserves, M, P, y, r?
  - Great motivation but not fully developed

Conclusions

Very useful measurement

Simple clean theoretical model to think through data

Several implications can be expanded and refined . . . . . I look forward to it!