Liquid Accounts as a Store of Value

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Introduction

- Main functions of money: Store of Value, Medium of exchange
- Here money as a store of value (transactions also with credit)
  - Explains neglected facts about liquid assets
  - Interpretation of Financial Crisis alternative to credit crunch

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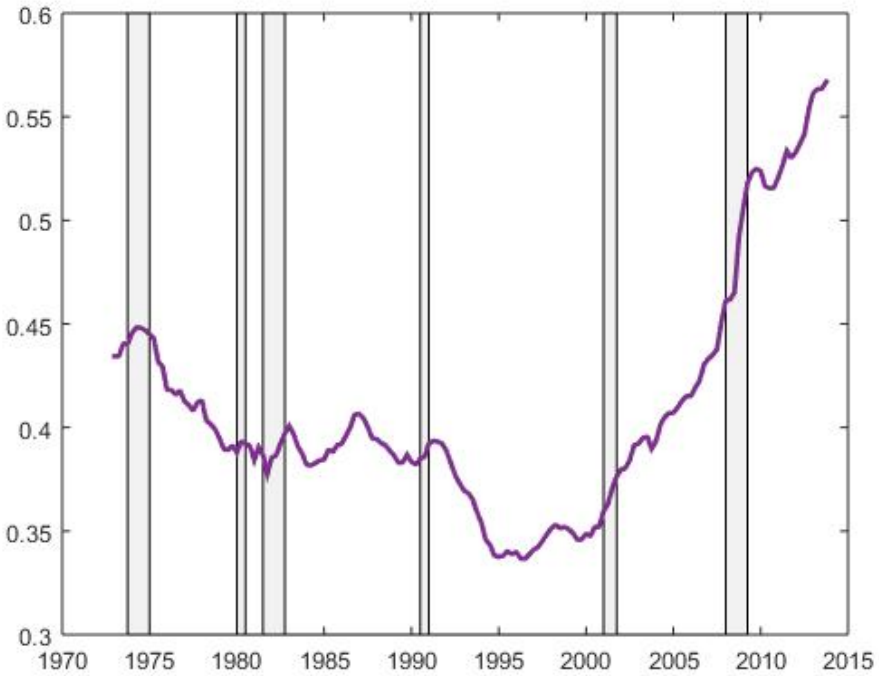
Why liquidity as a store of value?

- Deposits in all U.S. commercial banks over GDP

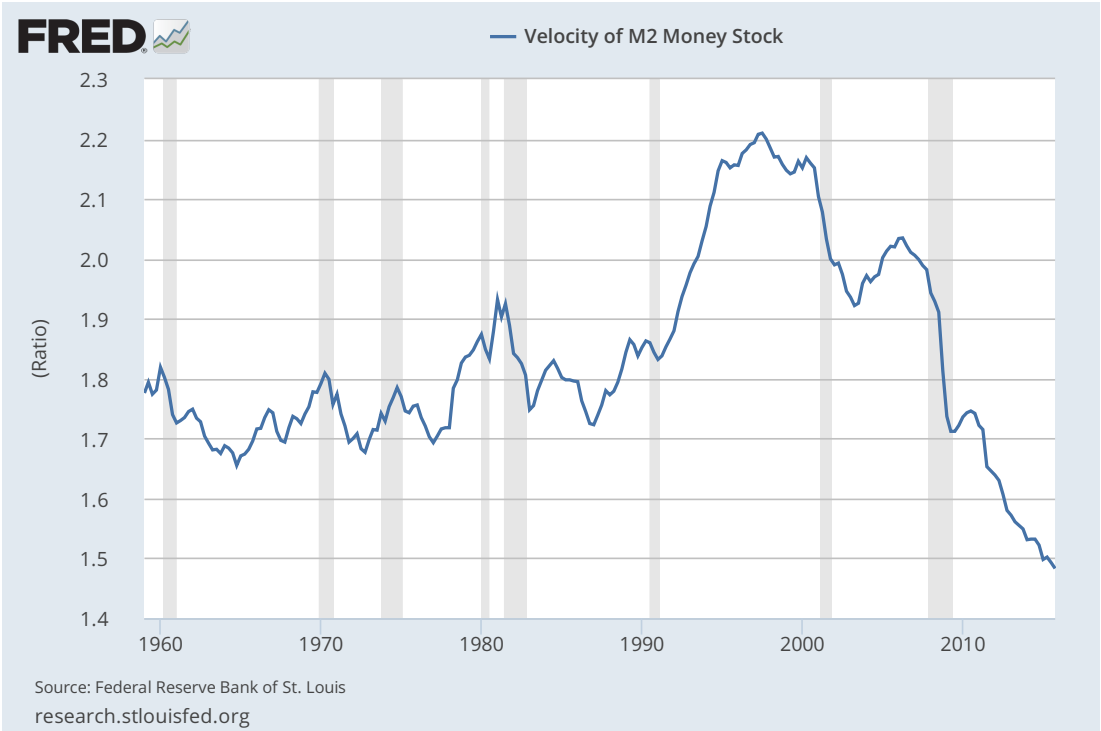


Source: Board of Governors of the Federal Reserve System. Release: H.8 Assets and Liabilities of Commercial Banks in the United States

- Similar figures for other aggregates of liquid savings

Data Motivation

- V=PY/M



- Volatile and drops in most recessions
- Why do we need so much liquidity?
- Why liquidity surge during recessions?

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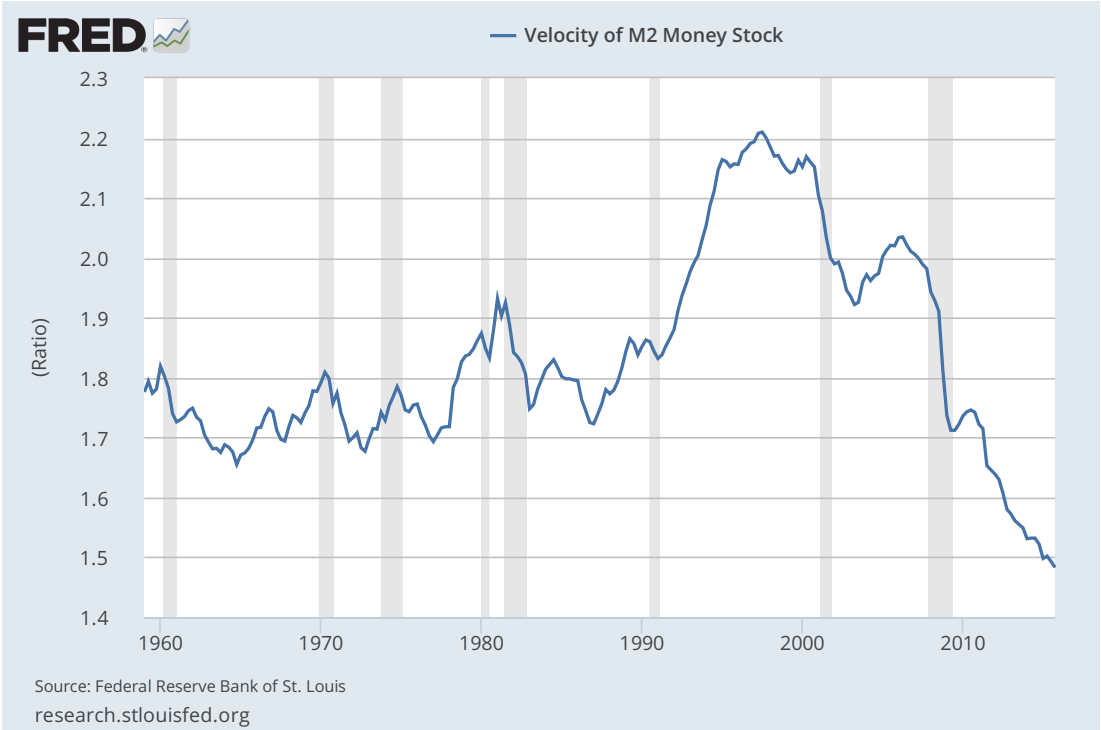

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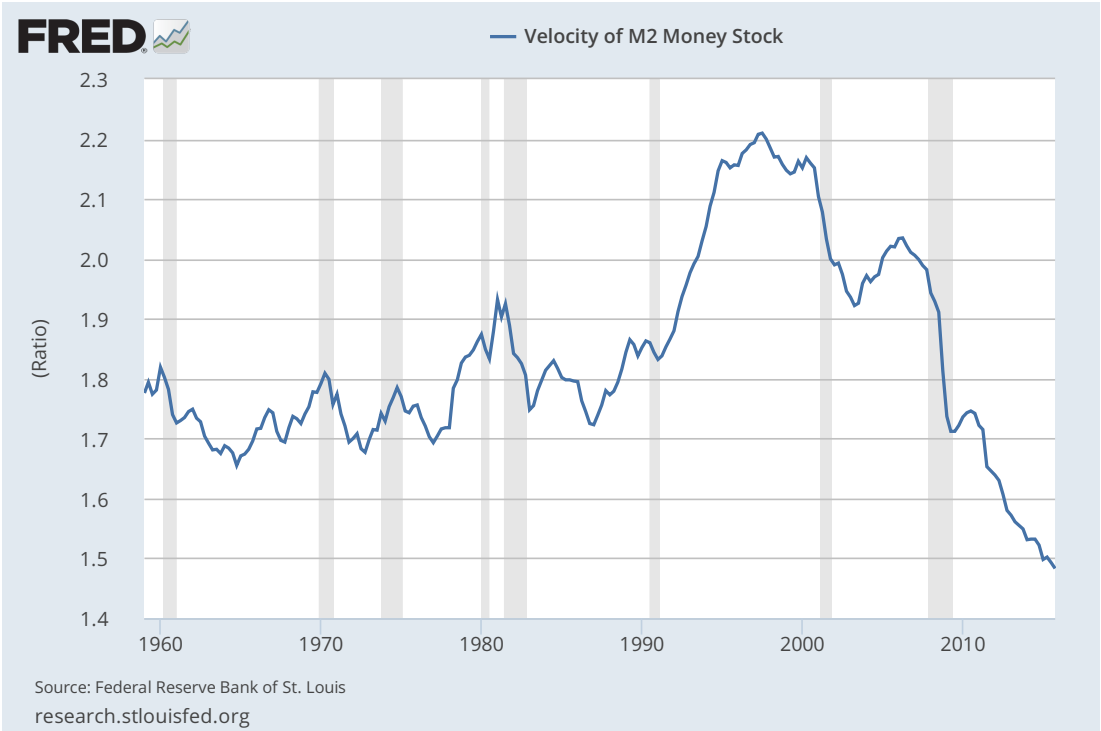

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Questions

1. Why do we need so much liquidity?
   - Because consumption and capital goods are hard to find (due to search friction)

   $\Downarrow$

   - Demand for intrinsically useless commodity to store residual wealth not matched with goods
   - Welfare implication: money makes agents less preoccupied about not finding goods, but look for better trading opportunities which improves firms' productivity
2. Why these liquid assets often surge during recessions?
   - Search friction shock: Liquidity surge when firms cannot sell their entire production capacity $\Leftrightarrow$ buyers don't spend all funds

John Stuart Mill (1829) "It must, undoubtedly, be admitted that there cannot be an excess of all other commodities, and an excess of money at the same time."

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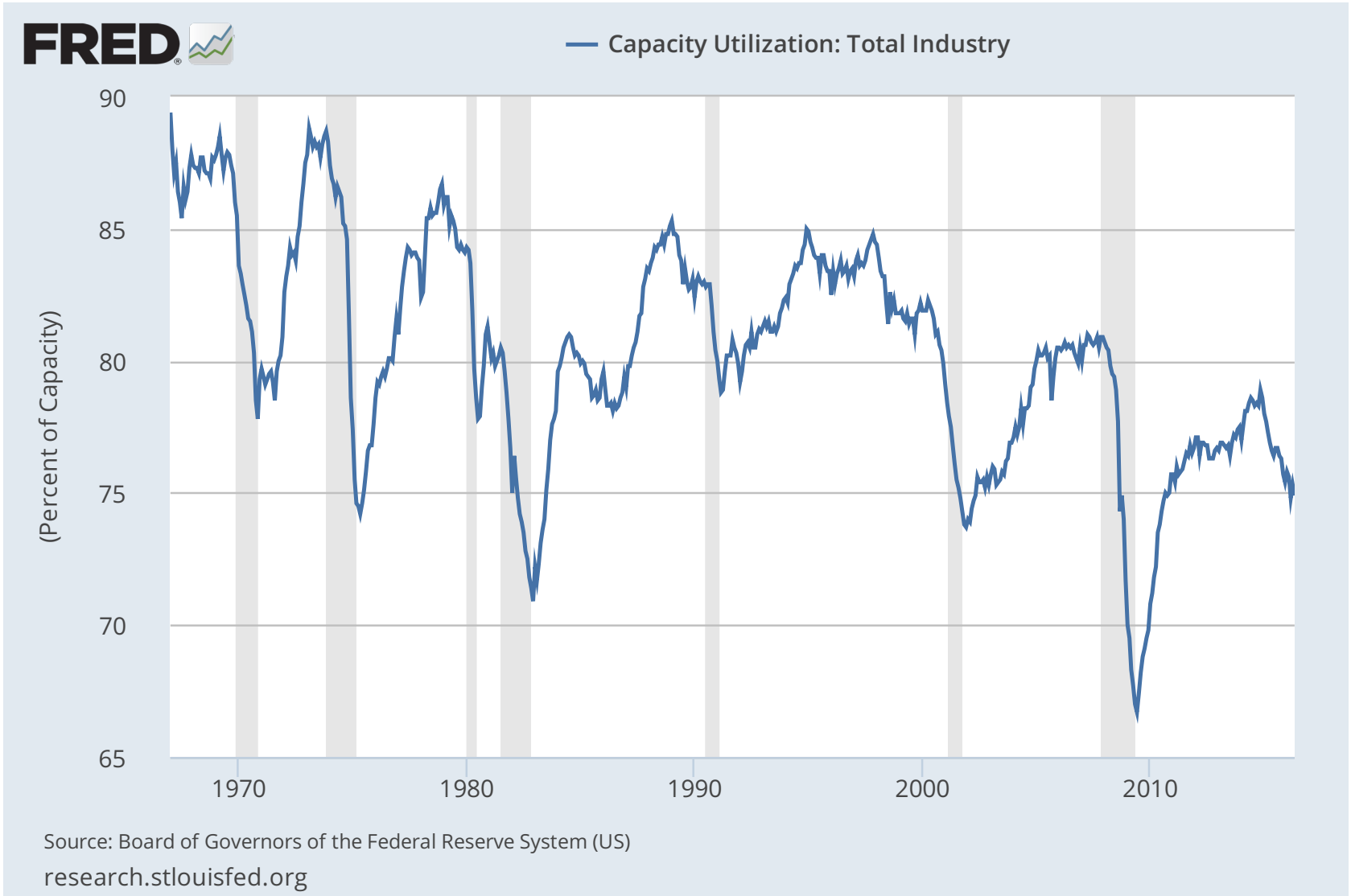
FRED
Capacity Utilization: Total Industry
(Percent of Capacity)
90
85
80
75
70
65
1970
1980
1990
2000
2010
Source: Board of Governors of the Federal Reserve System (US)
research.stlouisfed.org

Literature

- Money and Search: Kiyotaki-Wright (1989), Shi (1997), Lagos-Wright (2005) etc.
  - Lack of double coincidence of wants + quid pro quo trades $\Rightarrow$ money as a medium of exchange.
- Money arises for different reason here
- To make this clear, money not the only means of payment (credit)
- Other assets are not as easy to buy because of the search friction
- Money residual store of value

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- Here they demand money because they didn't make transactions
- Not rivals:
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Literature continued

- Liquidity motive: Bewley(1980), Imrohoroglu (1992), Wen (2015)
  - Idiosyncratic shock after labour supply and investment in illiquid asset and M only short-run payment

    $\Downarrow$

  - Precautionary liquidity in excess of expected consumption
- Both theories induce end of period residual liquidity but for different reasons
- Different implications

Literature continued

- Baumol-Tobin (BT) transaction cost in heterogeneous agents model. There too money is primarily a store of value
- Microfoundation based on search frictions has the following to offer:
  1. Cost of holding money varies over B.C. $\Rightarrow$ predicts when money is procyclical and when is countercyclical, and relates this to aggregate productivity
  2. With search friction, possible to assume search effort costs similar to exogenous BT costs. But these costs do not bare entire responsibility for M holdings as M demanded even without the BT cost (because of search friction). Furthermore, financial innovation (lower effort costs) does not necessarily decrease level of money demand

Literature continued

- Papers on Velocity: Hodrick-Kocherlakota-Lucas 1991, Wang-Shi 2006, Telyukovay-Visschers 2013,
- Relative to these papers, I exploit V decline in recessions to construct a theory of money and b.c.

Literature continued

- Search friction in the goods market
  - Bai, Rios-Rull, Storesletten (2012), Huo and Rios-Rull (2013),Petrosky-Nadeau, Wasmer (2014), Den Haan (2014), Duras (2015)
  - I use similar framework to build a theory of liquidity

Literature continued

- Asset market liquidity
  - Kiyotaki and Moore (2012), Jermann and Quadrini (2012), Shi (2012), Cui-Radde (2013), Christiano, Motto and Rostagno (2014)
  - Liquidity as a credit constraint
    - Firms want to produce more but they are constrained
  - No credit constraints here. Focus on liquidity as consequence of inability to buy and sell goods
    - Firms do not *wish* to produce more because inability to sell
  - Different perspective: in this lit HH's resources don't reach firms at beginning of production process (to finance input). In mine, HH's resources don't reach firms in the form of sales
  - Policy implication: injecting liquidity less effective (?)

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Literature continued

- Like New Keynesian framework study monetary policy
- No cash-less limit
- Woodford: side show. But
  - Renewed attention to quantities (e.g. QE)
  - To know whether they matter, we have to understand them
  - Here M quantities identifies a new source of the B.C. (matching shock)

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Road map

- Introduce the model
- Derive some theoretical results that highlight private and social role of money
- Estimation and interpretation of the financial crisis

Set-up

- Neoclassical model
- Intrinsically useless storable asset
- Search friction: CRS matching function $\mu(f, h)$. In a market with tightness $\theta = \frac{f}{h}$, buyer finds a trading post with probability $\psi(\theta)$ and a trading post is matched with a buyer with probability $\phi(\theta)$

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Households

HH enters submarket (p, q) s.t. $pq \leq p_m m + wn + kr$.
With probability $\psi(\theta(p, q))$

$$\begin{cases} c + k' - k(1-\delta) = q, & k' \geq 0 \\ p_m m' = p_m m + wn + kr - pq \end{cases}$$

With probability $1 - \psi(\theta(x, q))$

$$\begin{cases} c + k' - k(1-\delta) = 0, & k' \geq 0 \\ p_m m' = p_m m + wn + kr. \end{cases}$$

Heterogeneity in assets holdings.
For tractability lit assumes big family (Shi-97), or Lagos-Wright trick. Here no need to assume anonymity to rule out credit $\Rightarrow$ perfect insurance for all households.
Note: $wn + kr$ not in cash but used for transactions (no CIA)

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Timing

- Labour and capital inputs markets clear at the beginning but payment from firms to households deferred to the end after sales
- HH and firms make transactions. HH pay with money or with IOU on end of period income
- Firms pay income through revenues, which take the form of money and IOU's issued by households. In equilibrium the net position of all IOU's is zero, so they all clear out
- Alternative decentralization with banks that accept deposits of initial money holdings and issue loans. $\Rightarrow$ Banking frictions possible extension

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Household

- Wakes up with capital k and liquid goods m, and solves the following problem:

$$V(k,m,\Omega) = \max_{\{c,k',n,m'\geq 0, q,p\geq 0, d,\hat{m}\geq 0\}} u(c,n,d) + \beta EV(k',m',\Omega')$$

$$s.t. \quad p_m\hat{m} + pq \leq wn + kr + p_m m,$$

$$c + k' - k(1-\delta) = \psi(\theta(p,q))q,$$

$$p_m m' \leq pq\left(1 - \psi(\theta(p,q))\right) + p_m\hat{m},$$

$$q \leq A_d d,$$

- if $\psi = \min(1,\theta)$ boils down to P.C. money looses value

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Why money has value?

- It can be used for transactions but also IOU on income can (no special medium of exchange / no cash-in-advance)
- But it is easier to "buy" than investment

$$\Downarrow$$

- Residual savings used to "buy" m' even though lower dividend than k
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Firms

- A trading post in submarket (p, q) gives profits

$$\pi(p, q) = \max_{k_d, n_d} \phi(\theta(p, q))pq - wn_d - rk_d$$

s.t.

$$q \leq Ak_d^{\alpha} n_d^{1-\alpha}$$

- free entry implies

$$\phi(\theta(p, q))p = \xi,$$

This implies function $\theta(p, q)$ that households take into account in choosing their market

Market clearing conditions

$$\psi(\theta)q = \phi(\theta)fq$$

with $\theta = \frac{f}{h}$, with $h = 1$.

$$m' = m + dm,$$

$$k = fk_d.$$

$$n = fn_d.$$

Money is neutral, but not superneutral

- money or p_m appear in the following conditions

$$p_m \hat{m} + pq \leq p_m m + wn + kr,$$

$$p_m m' = pq\left(1 - \psi(\theta)\right) + p_m \hat{m}.$$

$$\lambda_4 = \beta E\left(\lambda_1' \frac{p_m'}{p_m}\right)$$

$$p_m(\lambda_1 - \lambda_4) = \lambda_{\hat{m}}$$

- Neutrality: increase constant money stock and decrease prices so that $p_m m$ remains constant.
- Superneutrality: changing money growth M'/M affects $\frac{p_m'}{p_m}$.

Planner Problem

Definition

An allocation $\{c, n, d, q, k', f\}$ is said to be efficient if it solves the following planner problem:

$$\widetilde{V}(k) = \max_{\{d,q,c,n,k',f\}\geq 0} u(c, n, d) + \beta E\widetilde{V}(k') \tag{1}$$

s.t.

$$\theta q \leq Ak^{\alpha}n^{(1-\alpha)} \tag{2}$$

$$q \leq A_d d \tag{3}$$

$$c + k' - k(1 - \delta) \leq \phi(\theta)\theta q \tag{4}$$

$$\theta = f/H \tag{5}$$

The Friedman rule and the value of money

- In ss, the Friedman rule $\frac{p'_m}{p_m}$ is optimal.
  (I don't know how result hinges on price mechanism being efficient. With comp. search, only θ distorted by inflation, not d. Perhaps with other bargaining protocol d distorted and inflation helps.)

More on the FR

Non monetary equilibrium

- What if expectations of future $p'_m = p''_m = ... = 0$?
- If nobody demands money today and $p_m = 0$ then hh choose $\psi = 1$ and $\theta = \infty$, but then $\phi = 0$.
- Since production is bounded, firms would not sell any goods, $c =$ negative investment until $k' = 0$.
- It is possible that hh choose $\psi < 1$ and $\theta < \infty$ even if money useless, but still very inefficient.

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More Credit

- Money inessential if agents that get matched spend all existing funds, including those of the unmatched $\Rightarrow$ no residual wealth to be stored in money
- Decentralization with match-contingent intratemporal bond
- Money looses value at the max feasible credit (replaced by *inside* money but always a need for inside and/or outside liquid assets)

More Credit

$$p_m\hat{m}(e) + v_1\hat{b}(e) + pq \leq wn + rk + p_m(m + b), \tag{6}$$

$$p_m\hat{m}(u) + v_1\hat{b}(u) \leq wn + rk + p_m(m + b), \tag{7}$$

$$p_m m'(e) + v_2 b'(e) \leq p_m(\hat{m}(e) + \hat{b}(e)) + pq(1 - \psi(p, q)), \tag{8}$$

$$p_m m'(u) + v_2 b'(u) \leq p_m(\hat{m}(u) + \hat{b}(u)) - pq\psi(p, q). \tag{9}$$

Quantitative Exercise

Matching function

- $$\mu = z_m^{1/\rho} \left(\alpha_m f^\rho + (1-\alpha_m) h^\rho\right)^{1/\rho}$$
- Probabilities:

$$\psi(\theta) = \frac{\mu}{h} = z_m \left(\alpha_m \theta^\rho + (1-\alpha_m)\right)^{1/\rho},$$

$$\phi(\theta) = \frac{\mu}{f} = \frac{\psi(\theta)}{\theta}.$$

- if $\rho = -\infty \Rightarrow$ perfect competition!

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Quantitative Exercise

Reinterpreting Matching as Function of Aggr. Demand and Supply

- $$q\mu = z_m^{1/\rho} \left(\alpha_m (qf)^\rho + (1-\alpha_m)(qh)^\rho\right)^{1/\rho}$$
- $$y = z_m^{1/\rho} \left(\alpha_m {y_s}^\rho + (1-\alpha_m){y_d}^\rho\right)^{1/\rho}$$
- Probabilities:

$$\theta = \frac{fq}{hq} \equiv \frac{y_s}{y_d},$$

$$\psi(\theta) = \frac{q\mu}{qh} = \frac{y}{y_d}$$

$$\phi(\theta) = \frac{q\mu}{qf} = \frac{y}{y_s}$$

- Need to construct y_s and y_d.

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Quantitative Exercise

Construct Aggr. Demand and Supply

- Data on $_{TCU}$ = percentage of total available capacity being used to produce demanded finished products (FRB).
  - $y = ({}_{TCU}k)^{\alpha}n^{1-\alpha} \Rightarrow y_s = (1k)^{\alpha}n^{1-\alpha}$, $\phi = \frac{y}{y_s} = {}_{TCU}{}^{\alpha}$
- $y_d = wn + rk + p_m m \Rightarrow \psi = \frac{y}{y_d}$, $\theta = \frac{y_s}{y_d}$.

Quantitative Exercise

Construct Aggr. Demand and Supply

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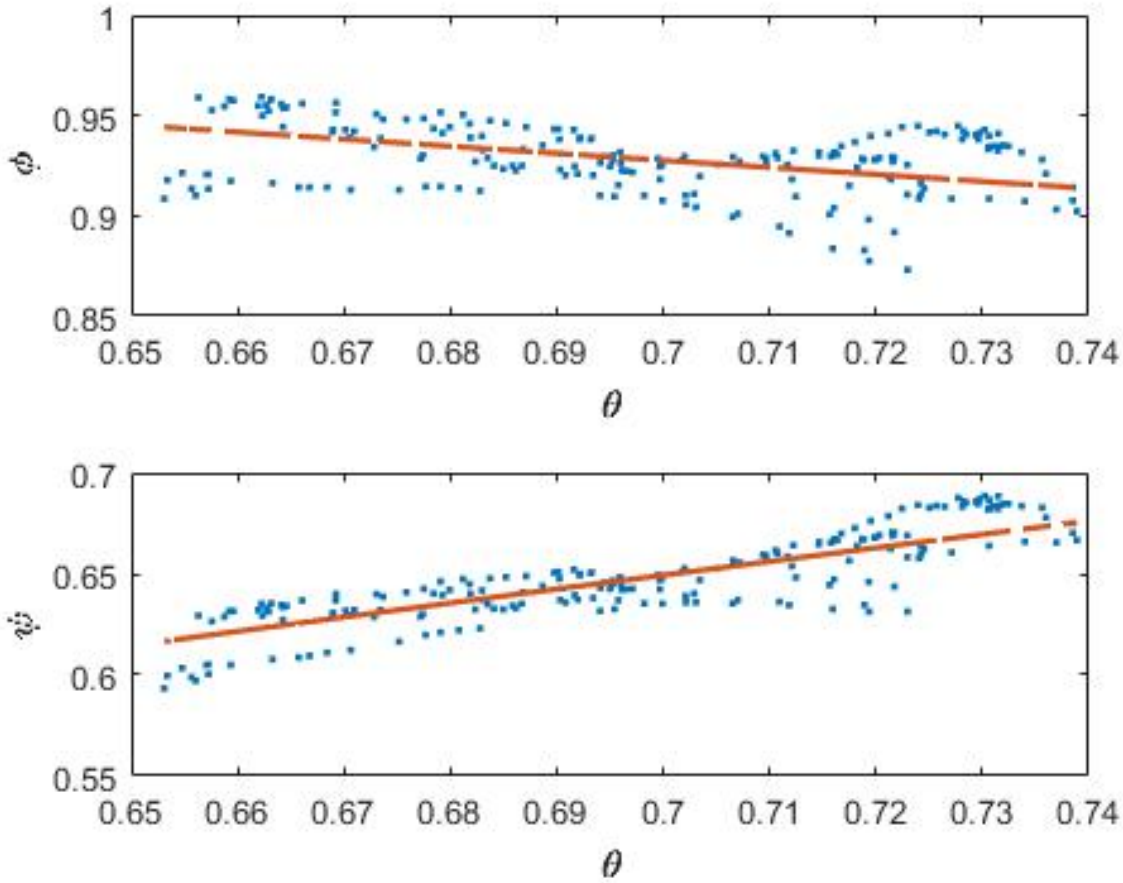
Test matching theory



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- Not obvious: if $|dy| < |dy_d| < |dy_s|$ and correl $\Rightarrow \frac{\partial \psi}{\partial \theta} < 0$

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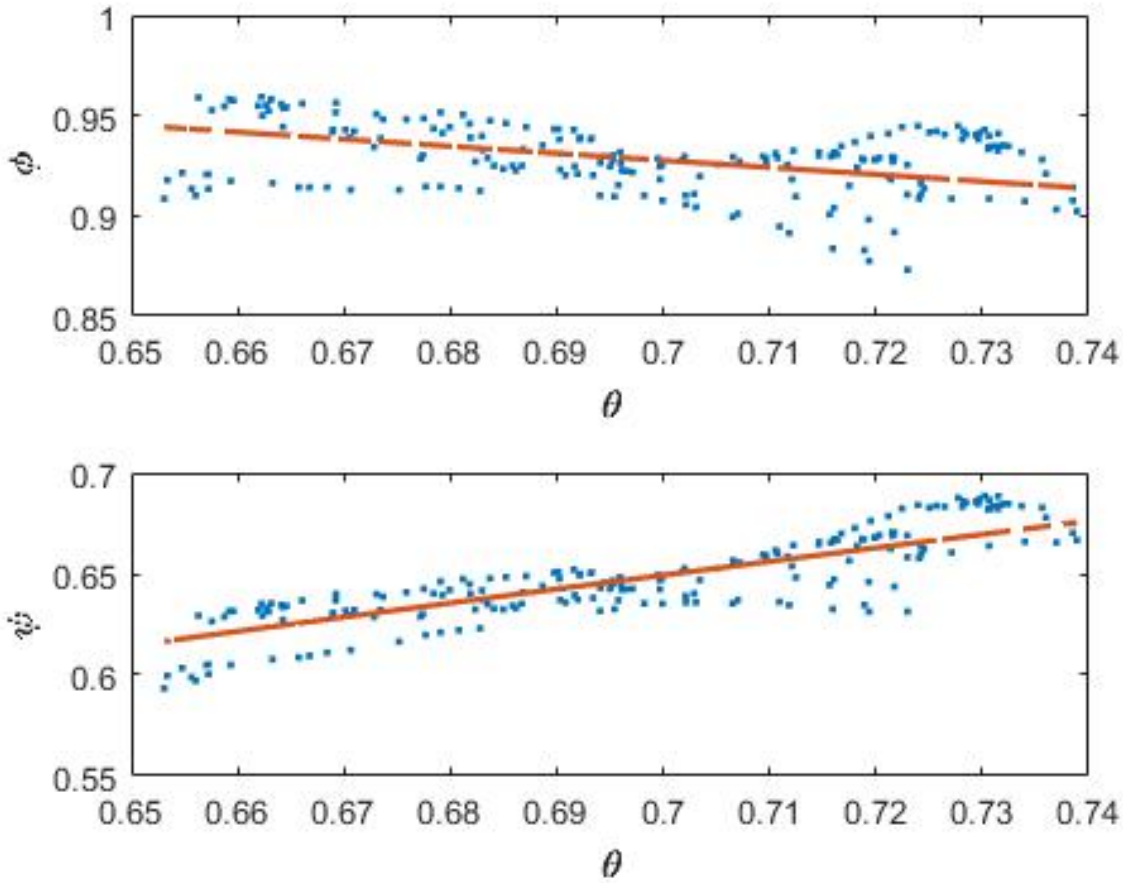

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Bayesian Estimation

- $$u = log(c) - \chi_n \frac{n^{1+1/\nu_n}}{1+1/\nu_n} - \chi_d \frac{n_d^{1+1/\nu_d}}{1+1/\nu_d}.$$
- Obs=$\{GDP, C, H, TCU, M2\}$
- AR1 shocks: $A, \beta, \chi_n, z_m, A_d$
- Parameters to estimate: ρ, ν_n, ν_d and shock processes.

Bayesian Estimation

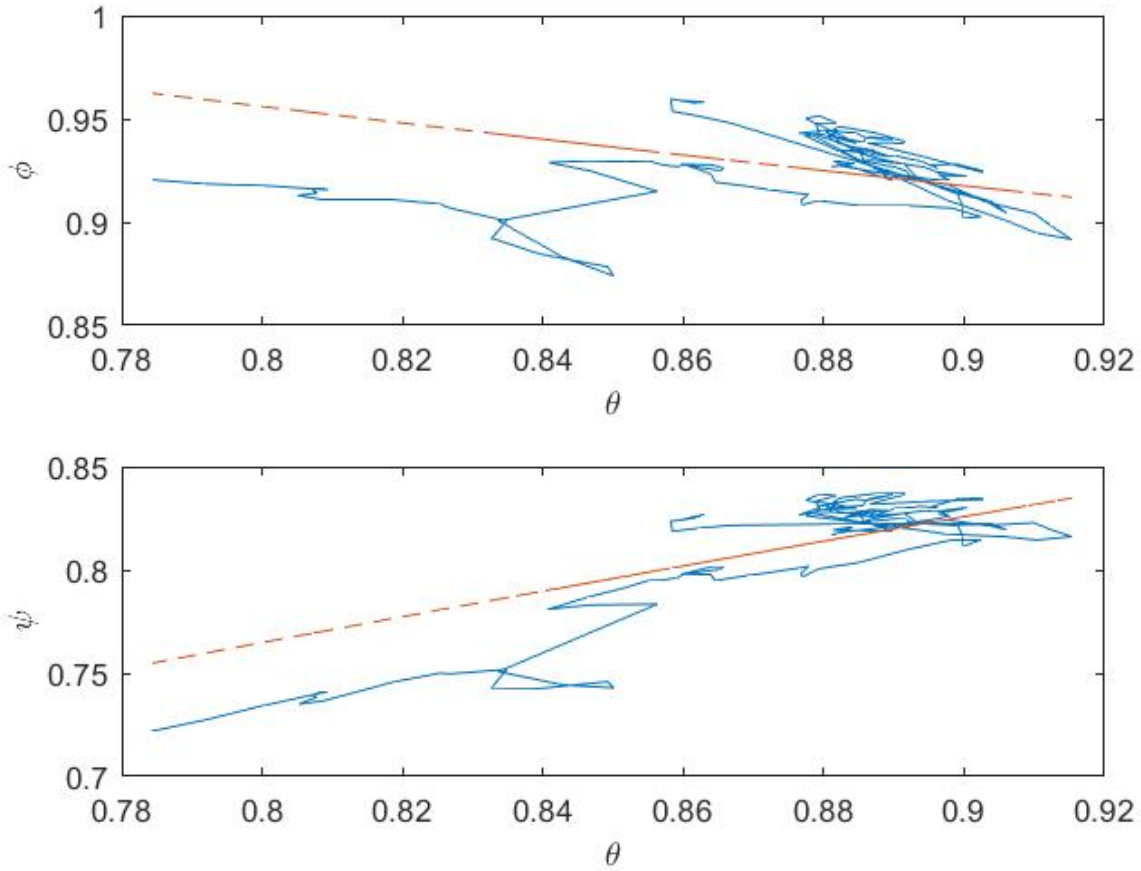
Table 1: Summary of Parametrization

		Prior			Posterior				
Name	Description	Density	Para(1)	Para(2)	Mode	Median	Std	[5 ,	95]
α	Capital income share	fixed	0.34						
δ	Capital depreciation	fixed	0.026						
β	Discount factor	fixed	0.99						
γ_a	TFP growth	fixed	1.0023						
ν	Inverse Frisch labour	G	0.7	1	0.201	0.017	0.07	0.01	0.21
ν_d	Inverse Frisch effort	G	0.7	0.1	0.97	0.99	0.11	0.857	1.204
$-\rho$	Matching Compl.	G	0.7	0.5	2.731	2.635	0.073	2.735	2.546
			Persistence of shocks						
ρ_a	TFP	U	0	0.999	0.985	0.985	0.007	0.971	0.995
ρ_β	β	U	0	0.999	0.998	0.989	0.010	0.969	0.999
ρ_n	Labour supply	U	0	0.999	1.000	1.000	0.000	0.999	1.000
ρ_d	Effort productivity	U	0	0.999	1.000	0.998	0.001	0.997	0.999
ρ_{z_m}	Matching	U	0	0.999	0.977	0.978	0.010	0.959	0.991
			Std of shocks						
σ_a	TFP	IG	0.08	2	0.66	0.66	0.04	0.60	0.73
σ_β	β	IG	0.06	2	0.02	0.03	0.00	0.02	0.03
σ_n	Labour supply	IG	0.09	2	1.34	1.33	0.11	1.18	1.53
σ_d	Effort product.	IG	0.31	2	0.77	0.73	0.05	0.66	0.83
σ_{z_m}	Matching	IG	0.17	2	1.30	1.27	0.08	1.14	1.41
			Std of measurement error						
σ_c	Consumption	IG	0.1 std(c)	0.01 std(c)	0.66	0.66	0.04	0.60	0.73
σ_n	Labour	IG	0.1 std(n)	0.01 std(n)	0.02	0.03	0.00	0.02	0.03
σ_y	GDP	IG	0.1 std(y)	0.01 std(y)	1.34	1.33	0.11	1.18	1.53
σ_θ	θ	IG	0.1 std(θ)	0.01 std(θ)	0.77	0.73	0.05	0.66	0.83
σ_ϕ	ϕ	IG	0.1 std(ϕ)	0.01 std(ϕ)	1.30	1.27	0.08	1.14	1.41

Notes: Para (1) and Para (2) list the means and the standard deviations for Beta, Gamma, and Normal distributions; the upper and lower bound of the support for the Uniform distribution. Para (1) indicates the value of the calibrated parameters.

Prior

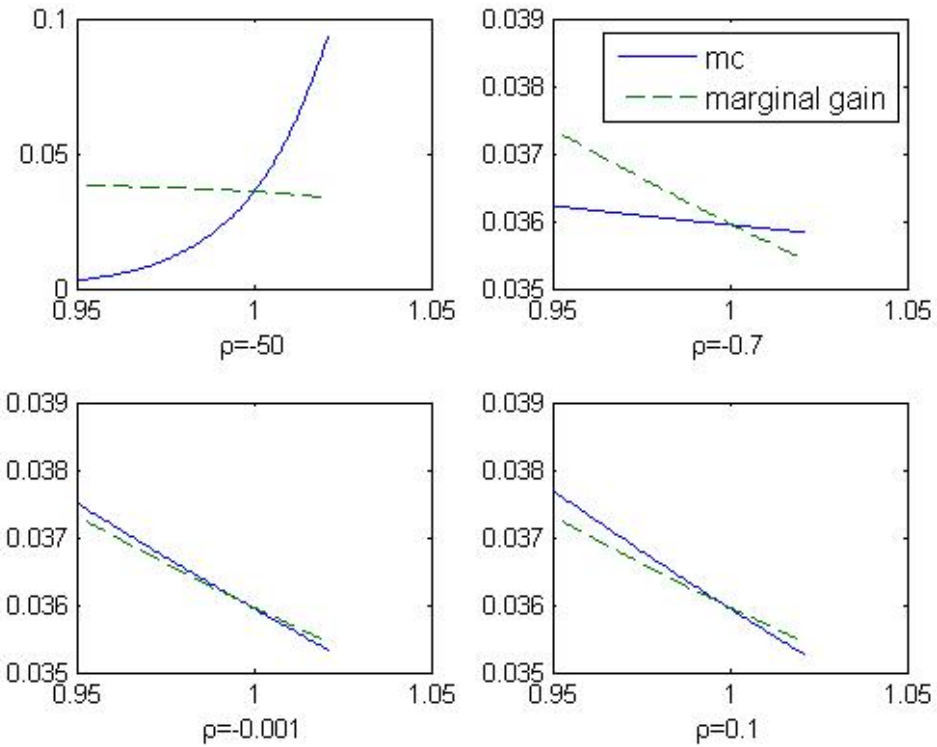
Prior for ρ



Prior

Elasticity of Matching Function $\rho = -1$

- $\rho < 0.05$ (about CD) to make problem concave.



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- Small changes in ρ similar impulse responses but different importance of TFP and Labour wedge.

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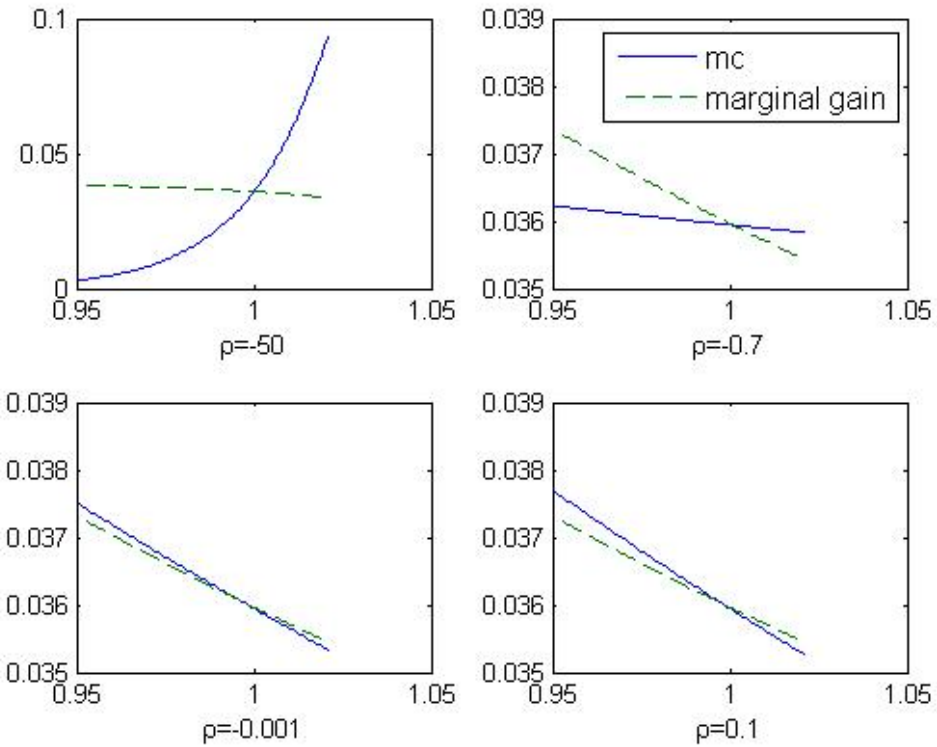

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Variance Decomposition

Table: Variance decomposition

	GDP	C	N	ϕ	Y_d	Y_s	Velocity
z_m	0.3693	0.1460	0.0538	0.6837	0.0264	0.0188	0.5049
A_d	0.2013	0.0466	0.1622	0.1523	0.7989	0.0592	0.2495
A	0.2797	0.2956	0.0057	0.1098	0.0830	0.6351	0.1799
β	0.0439	0.3194	0.1391	0.0011	0.0642	0.0507	0.0019
n	0.0956	0.1827	0.6315	0.0471	0.0213	0.2314	0.0772

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Why labour volatile despite low Frisch elasticity?

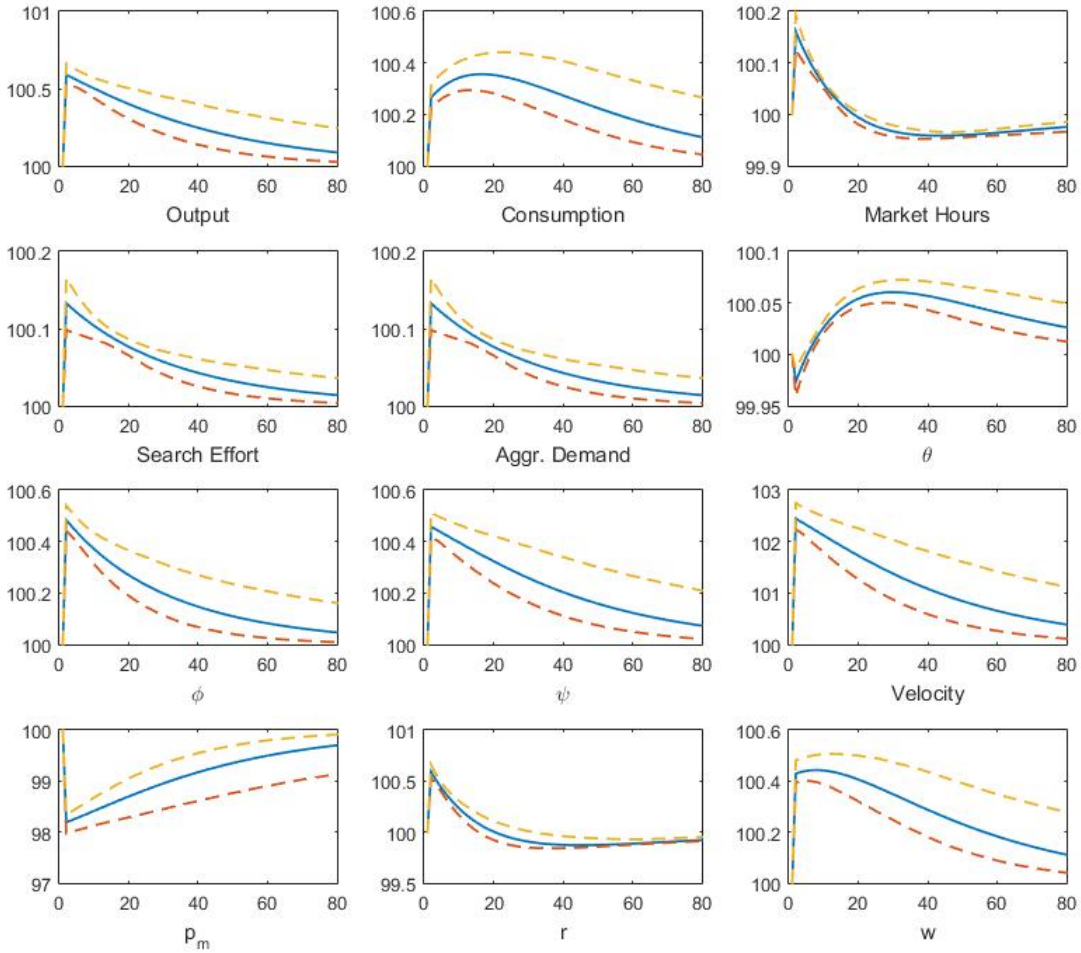
- Frictions induce wedge in labor supply condition

$$-u_n = u_c w + \left(\frac{u_d}{A_d} \frac{1}{\psi} - \lambda_{\hat{m}} \frac{1-\psi}{\psi} \right) w, \tag{10}$$

- Frictions reduce the marginal gain of working: with an extra unit of income you can do less cause it is costly to find goods

- Wedge worsens during recessions consistently with Chari et al. (2007) $\Rightarrow$ more hours volatility

IRF z_m


Output
Consumption
Market Hours
Search Effort
Aggr. Demand
θ
ϕ
ψ
Velocity
p_m
r
w

Mechanism after drop in z_m

- Drop in $z_m \Rightarrow$ drops in ψ ϕ
- $\phi \downarrow$ (similar to negative TFP shock) $\Rightarrow n$, c, y, k', w, $r \downarrow$
- $\psi \downarrow \Rightarrow p_m m \uparrow$ ($1/p_m$ procyclical)
- What z_m represents?
- Black box for cautious behaviour due to e.g. Information, screening, monitoring, agency and retail costs

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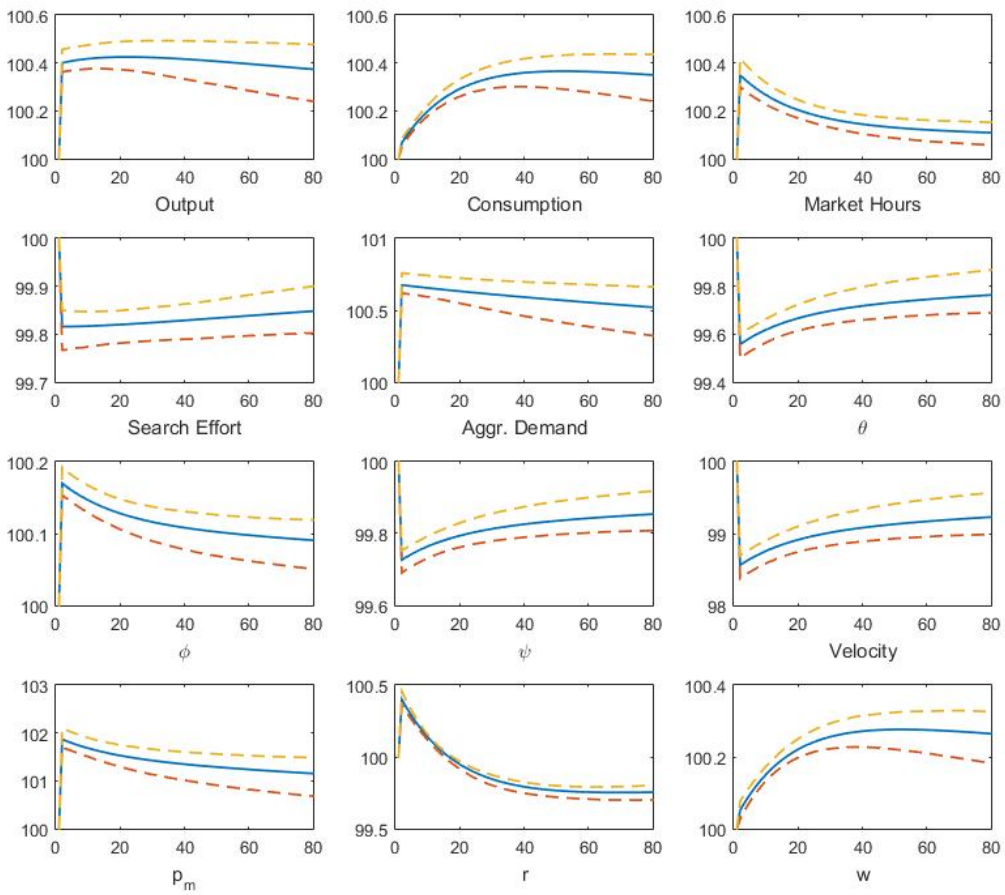
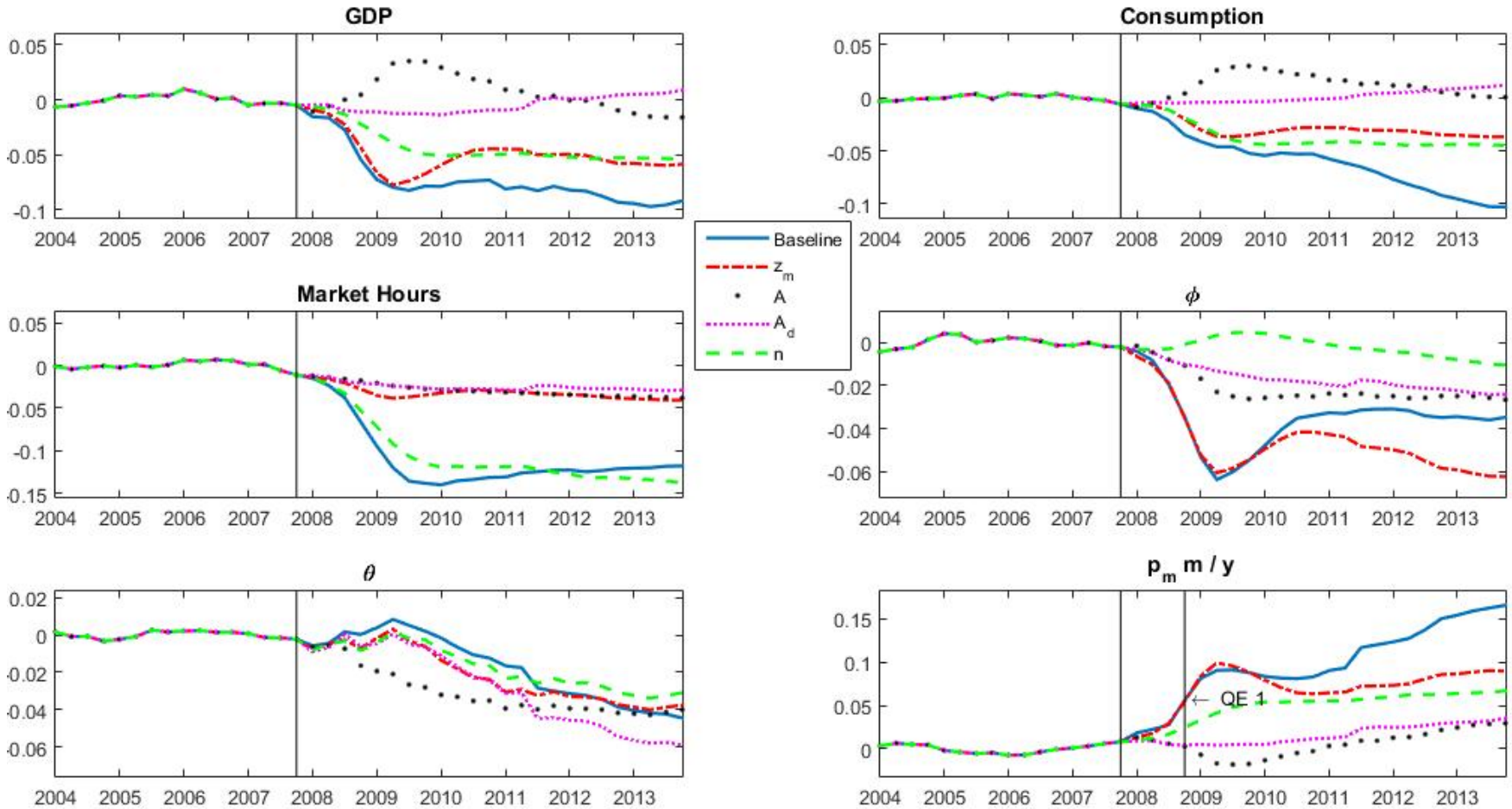


- ψ p_m and Velocity move in the wrong direction $\Rightarrow$ data call for z_m shocks

What accounts for the Great Recession?

One shock at the time from 2007.IV onward



Previous Recessions?

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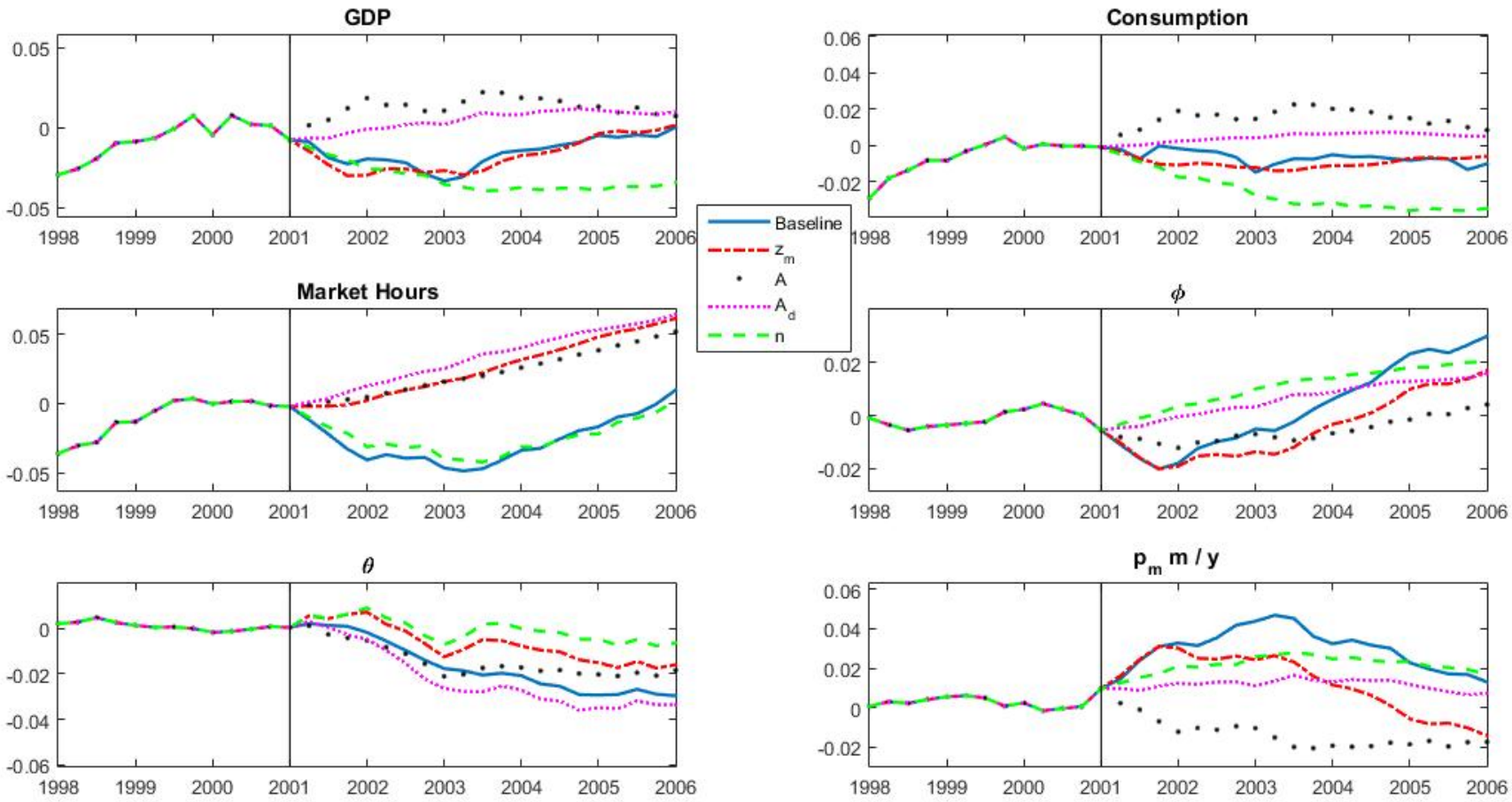

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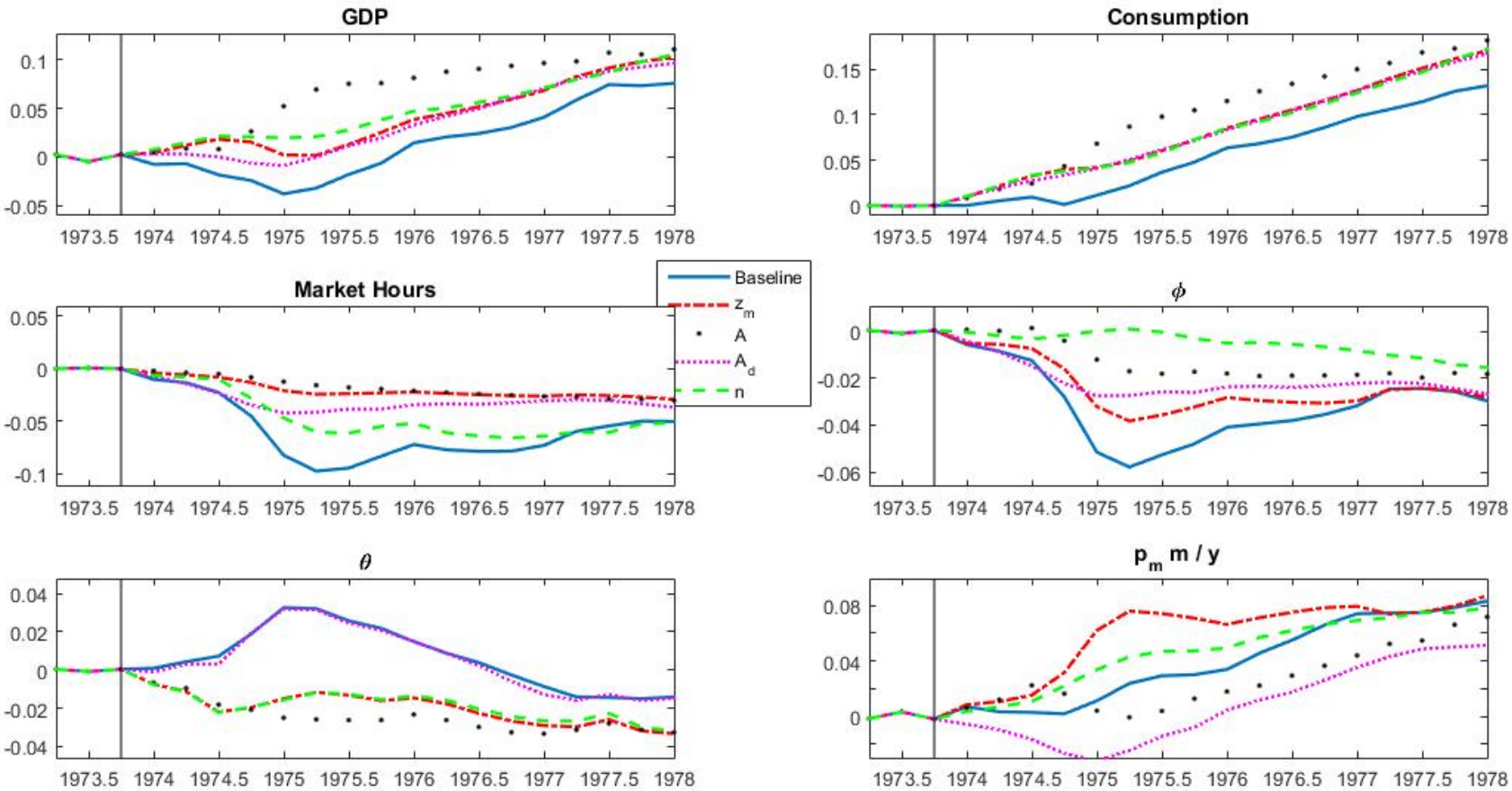

Conclusion

- Observed amounts of money holdings and credit call for theory of money as a store of value
- Money solves need to carry value when goods are "hard to find"
- Link between excess supply of goods and liquid assets

- Matching wedge important for the B.C. and money aggregates

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$$\Downarrow$$

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Simple theory that could be extended with

- DSGE frictions and QE
- Different layers of liquid assets (money, bonds, stock market, capital, housing ...)
- Bank frictions
  - Real effects of a gov. debt crisis

Simple theory that can be extended in many ways

- Model Banks
- Predict long run trend in deposits given drop in inflation?
- What is z_m?
- Estimation within DSGE (QE with sticky prices ?)
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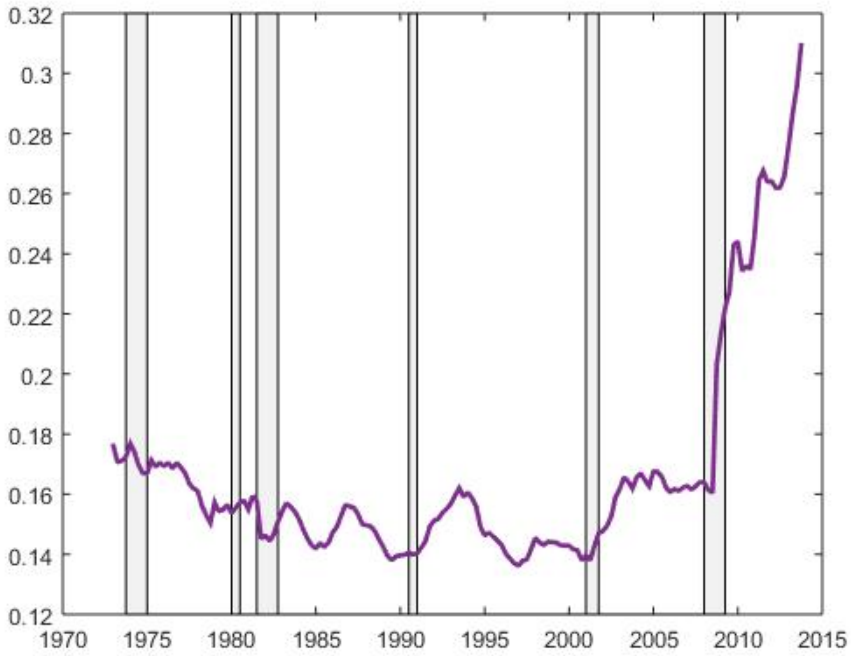
Measure of bank assets not reintroduced in real economy

- Cash and liquid securities of all U.S. commercial banks over GDP
  - Measure of savings channeled through banks not reintroduced in the real economy through loans



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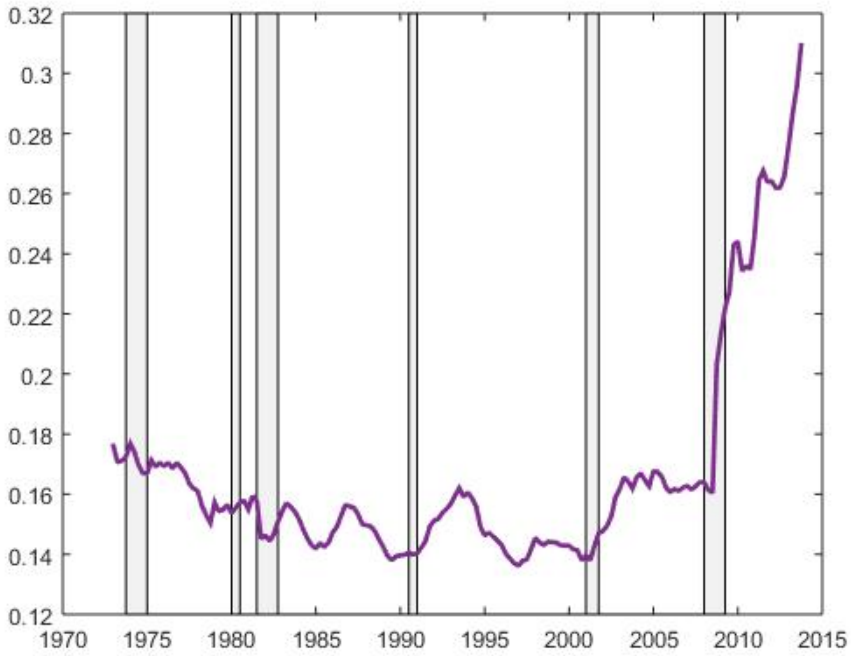

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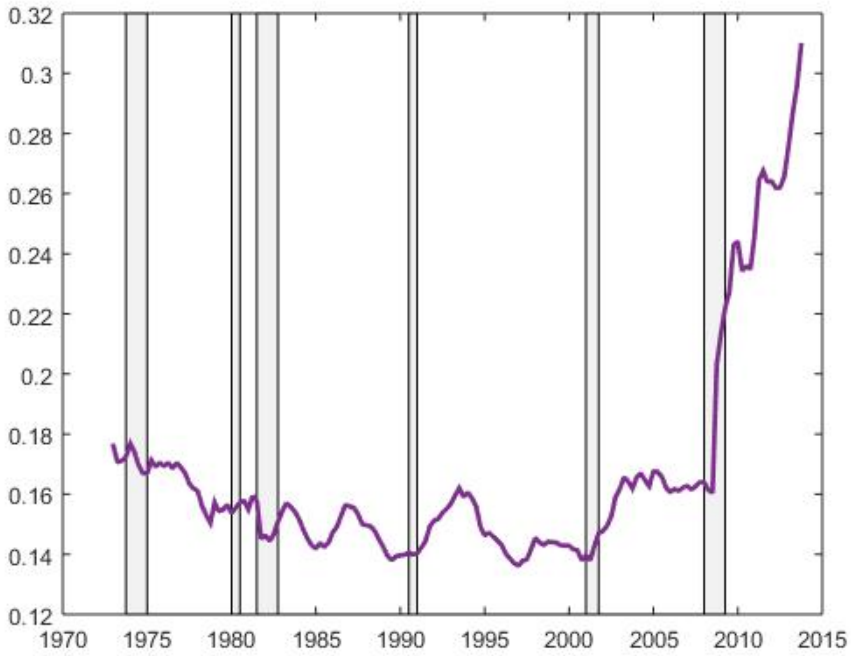

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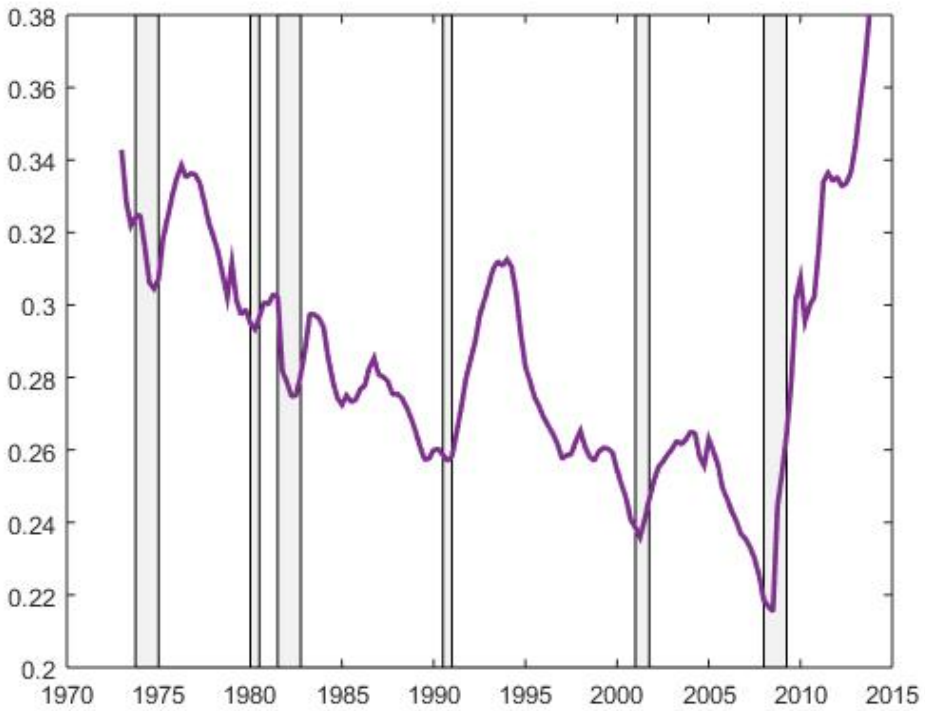
- Cash and liquid securities over total assets of all U.S. commercial banks



QE still in there

But notice that it increased during other recessions too

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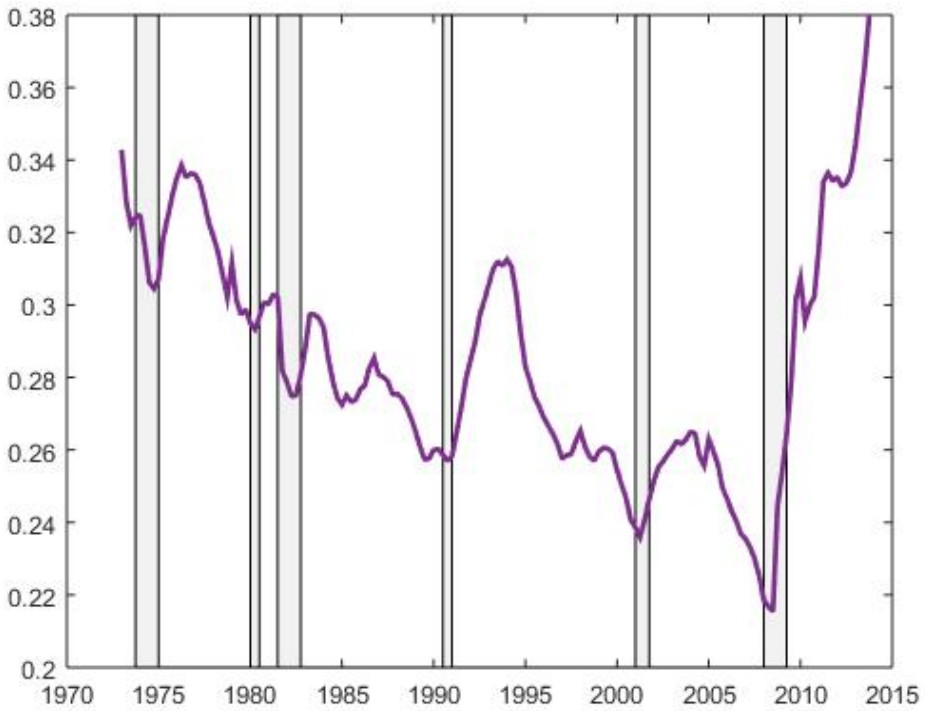

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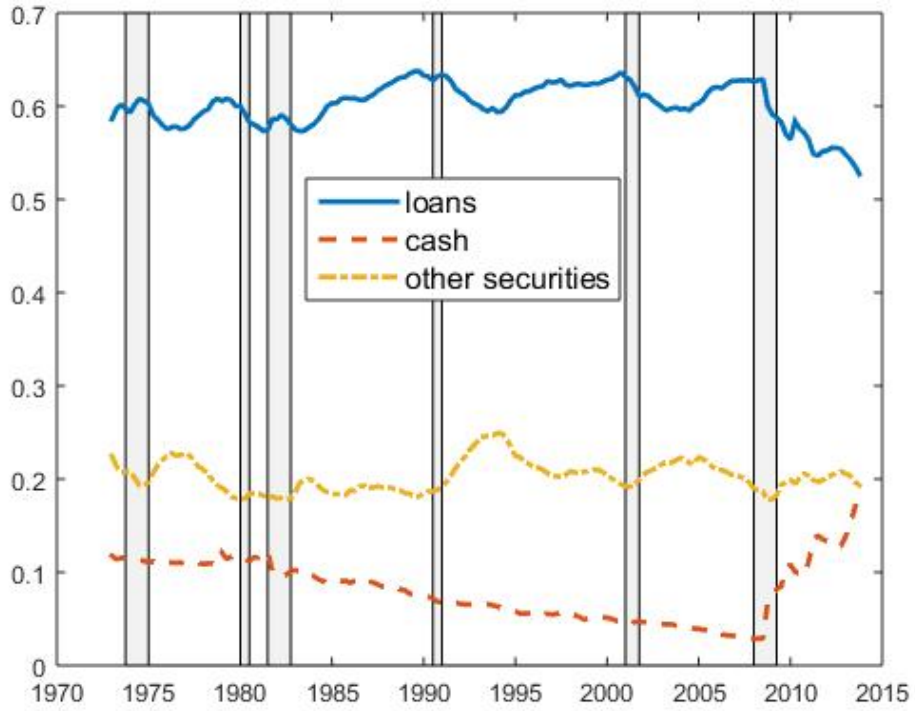
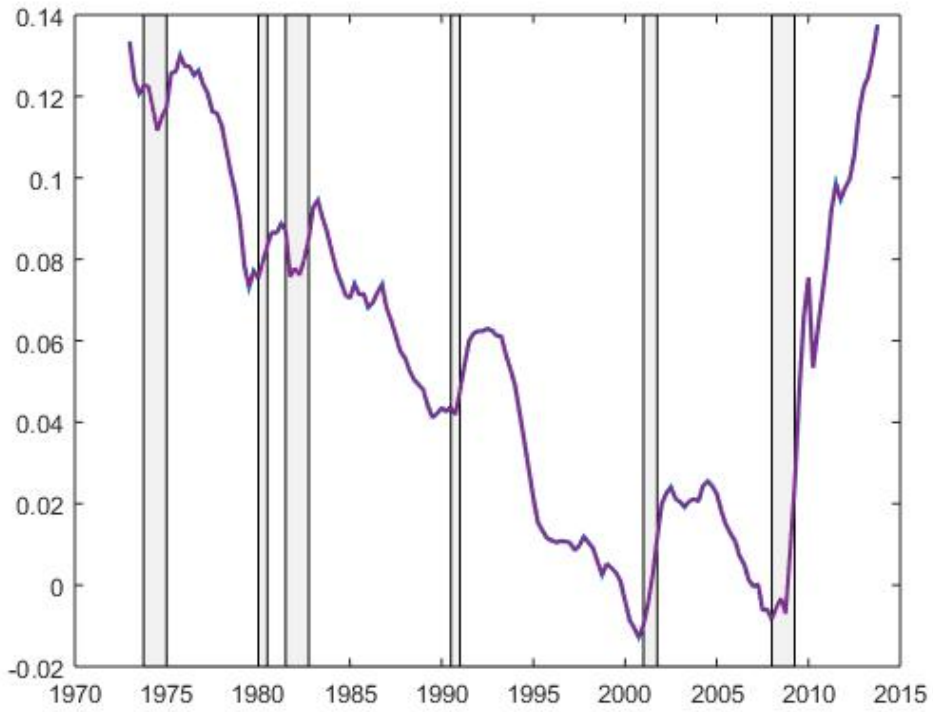
- Assets composition all U.S. commercial banks



- Liquidity increased more than QE: total assets did not increase as much as cash (otherwise loans would not have dropped)

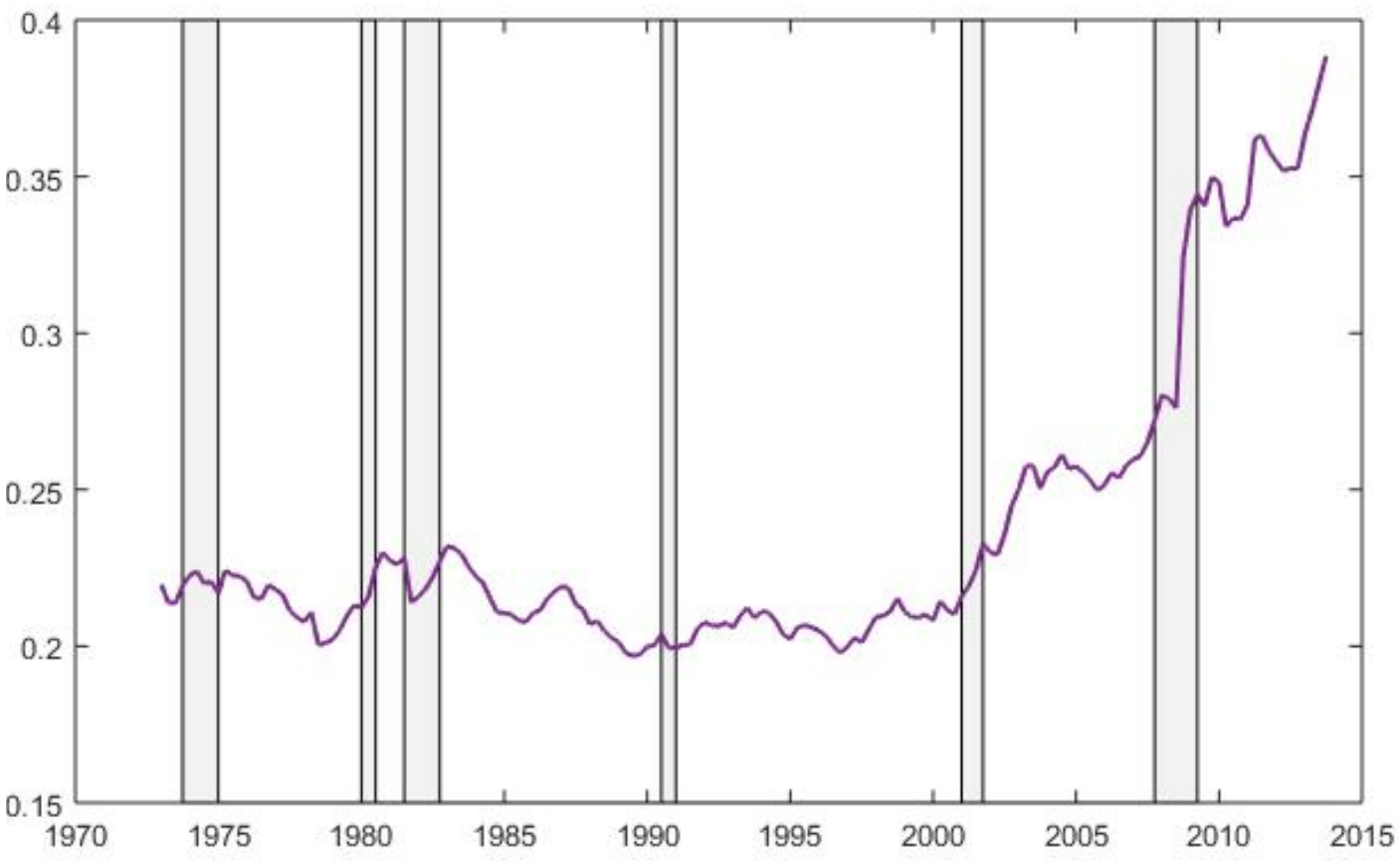
- Deposits minus Loans all U.S. commercial banks over GDP



- Intro
- Liquidity shock

Liquidity

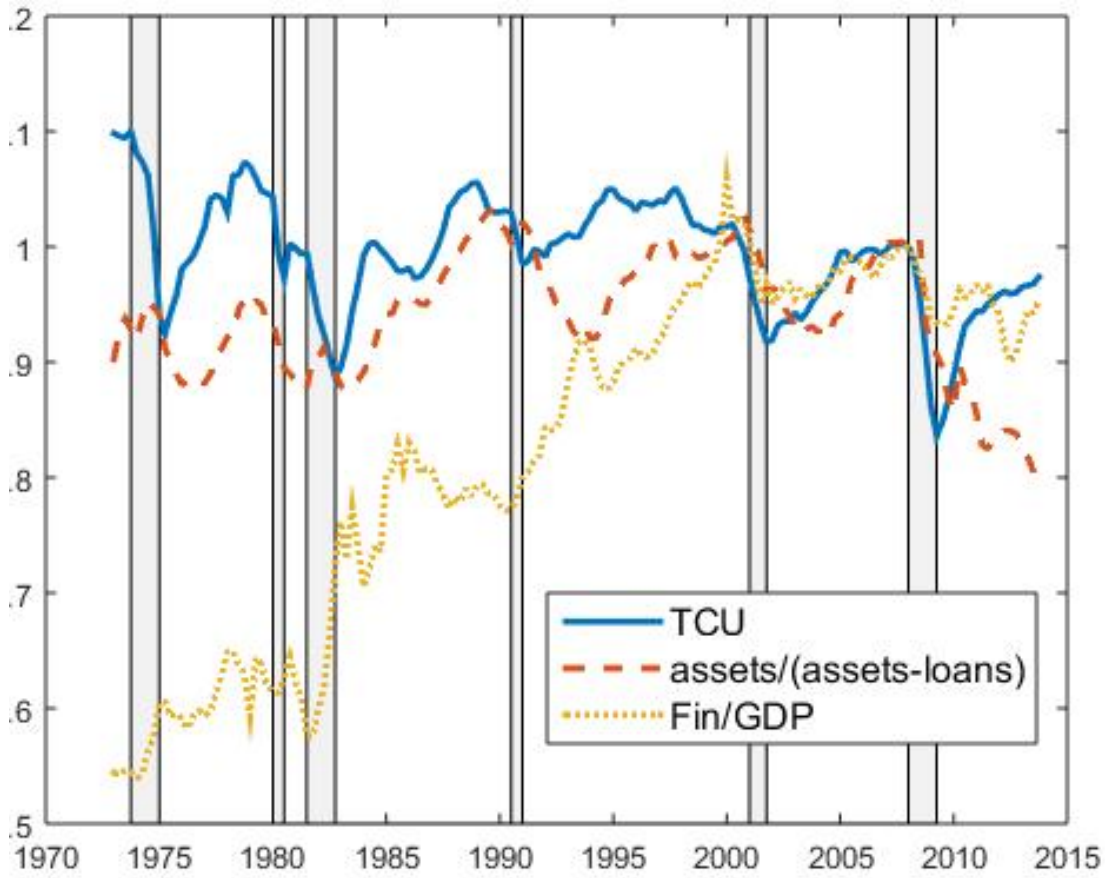
- Assets-Loans of all U.S. commercial banks over GDP



- Liquidity shock

Liquidity

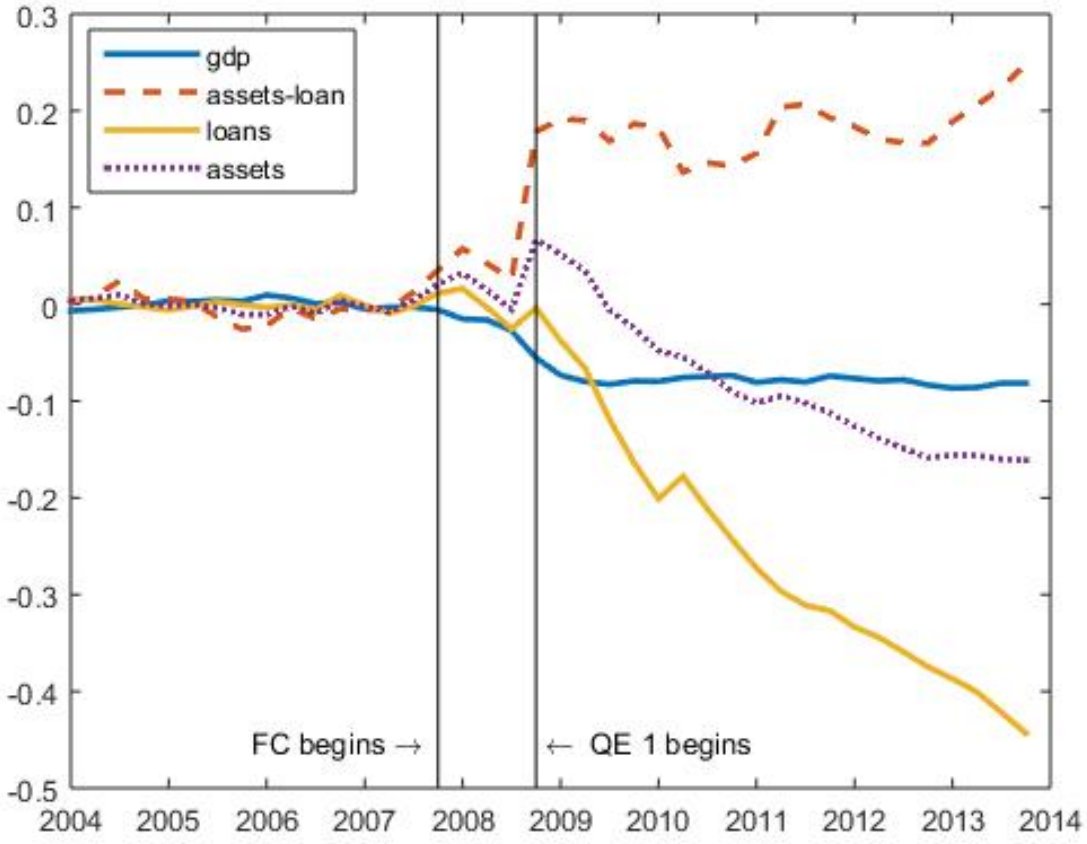
- TCU vs inverse of (Assets-Loans) /Assets



- Liquidity shock

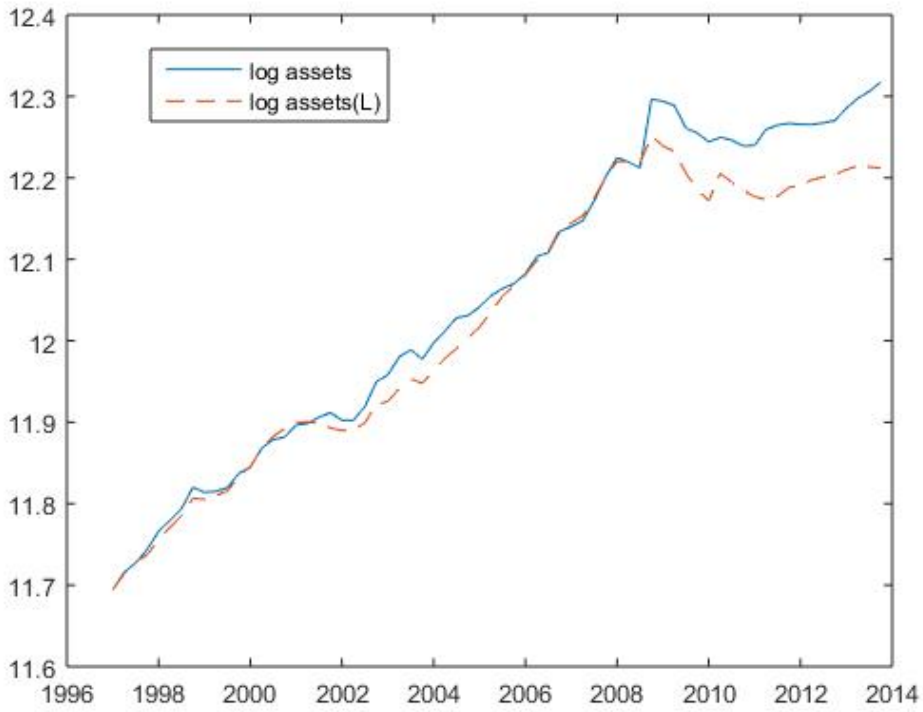
Financial Crisis zoom

- Linearly de-trended logs



- Liquidity shock

- $dlog(A) = \beta_0 + \beta_1 dlog(L)$



- difference after 2008 is QE
- increase in (A-L)/GDP from 2008-2009.II = 21%. Without QE = 8%
- Liquidity shock

What I don't do

- Not interested in modeling banks but in capturing aggregate liquidity. Banks are consolidated in the rap agent decisions
- Not a deep theory of why liquidity surge happened. Here modeled as a shock to the willingness/ability to buy goods that leads to cash hoarding. I study its consequences

Board of Governors of the Federal Reserve System. Release: H.8 Assets and Liabilities of Commercial Banks in the United States

- Assets=Cash assets, Loans and leases,Securities, trading assets, Other assets
- Securities=Treasury securities inclusing Mortgage-backed securities, Other securities including MBS
- Loans=Commercial and industrial loans, Real estate loans, Consumer loans, Other loans and leases
- Cash=Includes vault cash, cash items in process of collection, balances due from depository institutions, and balances due from Federal Reserve Banks
- Deposits include time deposits

Let ψ be probability

- with probability ψ and full payment py_d

$$c + k' - k(1-\delta) = y_d,$$

$$p_m m' = 0.$$

- with probability $1-\psi$ or if no full payment

$$c + k' - k(1-\delta) = 0,$$

$$p_m m' = wn + kr + p_m m.$$

- Not rational to misreport $y_d(\theta)$ s.t.

$$p(\theta) y_d(\theta) > wn + kr + p_m m$$

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Trick to Kill Heterogeneity

- Insurers have aggregation technology $Y = \int_0^1 \psi_i y_{d,i} di$ and collects all money
- Perfect insurance across all hh's who did not misreport: each receive $y_i = \psi_i y_{d,i}$ and money $p_m m_i' = p_i(1 - \psi_i) y_{d,i}$
- HH

Household with bond

- Wakes up with capital k and liquid goods m and b, and solves the following problem:

$$V(k,m,b,\Omega) = \max_{\{c,k',n,m' \geq 0, y_d \geq 0, \theta \geq 0\}} u(c,n) + \beta EV(k',m',b',\Omega')$$

$$s.t. \quad b' + p(\theta) y_d(\theta) \leq wn + kr + b(1+i) + p_m m,$$

$$c + k' - k(1-\delta) = \psi(\theta) y_d,$$

$$p_m m' = p(\theta) y_d(\theta) \left(1 - \psi(\theta)\right).$$

- HP: bonds can't be sold to firms, it cannot be bought at end of period (just like Bewley)
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- Alternative: bonds bought with small search friction
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- HP: bonds can't be sold to firms, it cannot be bought at end of period (just like Bewley)
- not CIA because you pay with IOY (so no need m' for future transactions)
- Alternative: bonds bought with small search friction
- HH

Household with credit card

$$V(k, m, cc, \Omega) = \max_{\{c,k',n,n_d,m' \geq 0, y_d, \theta \geq 0, \hat{cc}\}} u(c, n, n_d) + \beta EV(k', m', cc', \Omega')$$

$$s.t. \quad p(\theta) y_d(\theta) \leq wn + kr + p_m m + cc(1+i),$$
$$c + k' - k(1-\delta) = \psi(\theta)(y_d(\theta) + \hat{cc}),$$
$$y_d(\theta) + \hat{cc} \leq A_d n_d,$$
$$b = p(\theta) y_d(\theta) - p(\theta)\psi(\theta)\left(y_d(\theta) + \hat{cc}\right)$$

- if $b < 0 \Rightarrow cc' = b$
- if $b > 0 \Rightarrow p_m m' = b$
- Note :cc' is credit in excess of $wn + rk + p_m m + cc(1+i)$
- Stock of credit card loans 2000-2013.IV $= 5.8\%$ of deposits $\Rightarrow cc' = 0$
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Household with search bond

- Wakes up with capital k and liquid goods m and b, and solves the following problem:

$$V(k,m,b,\Omega) = \max_{\{c,k',n,m'\geq 0, y_d \geq 0, \theta \geq 0\}} u(c,n) + \beta EV(k',m',b',\Omega')$$

$$s.t. \quad q(\theta_b)\psi_b(\theta_b)b' + p(\theta)y_d(\theta) \leq wn + kr + b + p_m m,$$

$$c + k' - k(1-\delta) = \psi(\theta)y_d,$$

$$p_m m' = p(\theta)y_d(\theta)\left(1 - \psi(\theta)\right).$$

with ψ you actually borrow b' with $1-\psi$ you don't.

- Implicit HP: bond can't be sold to firms it cannot be bought at end of period (just like Bewley)
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Household with credit card 2

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$$s.t. \quad p(\theta)y_d(\theta) \leq wn + kr + b + p_m m - \widehat{b},$$

$$c + k' - k(1-\delta) = \psi(\theta)y_d,$$

$$balance = p(\theta)y_d(\theta)\left(1 - \psi(\theta)\right) + \widehat{b}$$

- if $balance < 0 \Rightarrow b' = balance$
- if $balance > 0 \Rightarrow p_m m' = balance$
- HH

Matching story

- Same as labor market where y_d is vacancies and y_s unemployment. e.g.
- Goods come in several varieties. Each hh puts an order of quantity y_d of a specific one. In each market, Y_d contains all varieties demanded and Y_s all supplied. Assume they are representative of population of varieties. Then if θ low some hh's will remain unmatched $\Rightarrow \psi$ low. matching function det matches and probabilities given θ

The Friedman rule and the value of money

To gain intuition, useful to focus on the case with no effort costs: $U_d = 0$.

- $\theta = 0$, $\phi = 1$ and $d = \infty$ is optimal. U_d like vacancy cost in MP: without vacancy costs infinite vacancies and full employment! Role of demand: benefit to make households search in crowded markets
- If inflation is above the Friedman rule, then $\theta > 0$ and $\phi < 1$ in steady state (inefficient)
- In a deterministic steady state with positive output, the value of money is infinity at the Friedman rule and bounded when inflation is above the Friedman rule
- Social role of money: it makes HH not worry about not finding goods

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Intuition

- Private benefit from lowering θ: $p \downarrow$, $q \uparrow$.
- Private cost:$\psi \downarrow$ and more savings in m' rather than k'.
- If money is dominated in return, optimal $\theta > 0$, so $p_m m'$ bounded.
- At the Friedman rule money gives same return as capital $\Rightarrow$ not private cost.

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- $\theta = 0$, and $p_m m'$ are at infinity.
- Note: they search infinitely hard to find goods. With search effort, $\theta > 0$.

Back to FR

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