Pledgability and liquidity: a New-Monetarist model of financial and macroeconomic activity

Venky Venkateswaran (NYU Stern)
Randall Wright (Wisconsin, FRB-Mpls)

Aug 2013
motivation

Implications of imperfect credit and asset liquidity in a standard macro model with money, investment, housing, taxes...
motivation

Implications of imperfect credit and asset liquidity in a standard macro model with money, investment, housing, taxes...

Qualitative and quantitative results on the long run effects of monetary policy, financial innovation...
key results

Higher inflation

- Lowers real returns on assets, depending on their pledgability
- Raises investment in liquid assets
- Can raise or lower employment
**key results**

Higher inflation

- Lowers real returns on assets, depending on their pledgability
- Raises investment in liquid assets
- Can raise or lower employment

A model calibrated to post-war US data

- Matches observed long-run relationship of inflation with aggregates
- Generates large differences in asset returns
- Implies an ‘optimal’ inflation of about 3 percent
environment

A New Monetarist framework

Infinite horizon, discrete time

Sequential trade in 2 markets at each date

- **KM**: Subject to frictions, as in Kiyotaki-Moore
- **AD**: Frictionless, as in Arrow-Debreu

Preferences

<table>
<thead>
<tr>
<th></th>
<th></th>
<th>$t - 1$</th>
<th></th>
<th></th>
<th>$t$</th>
<th></th>
<th></th>
<th>$t + 1$</th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td>KM</td>
<td>AD</td>
<td>KM</td>
<td>AD</td>
<td>KM</td>
<td>AD</td>
<td>KM</td>
<td>AD</td>
</tr>
<tr>
<td>$\sigma u(q)$</td>
<td>$\sigma c(q)$</td>
<td>$U(x, h, \ell)$</td>
<td>$f(k, \ell)$</td>
<td>$\sigma u(q)$</td>
<td>$\sigma c(q)$</td>
<td>$U(x, h, \ell)$</td>
<td>$f(k, \ell)$</td>
<td>$\sigma u(q)$</td>
<td>$\sigma c(q)$</td>
</tr>
</tbody>
</table>
the KM market

A fraction \( \sigma \) of agents ('buyers') trade in bilateral meetings with 'sellers'

- Payoffs \( u(q) \) and \( c(q) \) respectively
A fraction $\sigma$ of agents ('buyers') trade in bilateral meetings with 'sellers'

- Payoffs $u(q)$ and $c(q)$ respectively

Lack of commitment and record-keeping

- $\rightarrow$ Assets as **collateral** for promises to repay in following AD
the KM market: pledgability limits

To get $q$, a buyer must promise utility of $z(q)$ to the seller

$$z(q) = (1 - \theta) u(q) + \theta c(q)$$
To get $q$, a buyer must promise utility of $z(q)$ to the seller

$$z(q) = (1 - \theta) u(q) + \theta c(q)$$

Promises subject to a pledgability limit

$$z(q) = \frac{1}{\omega'} d \leq \frac{1}{\omega'} \bar{D}(a) = \frac{1}{\omega'} \sum_j \phi_j a_j \mu_j$$

- Penalty for default is the loss of assets, up to a fraction $\mu_j \in [0, 1]$
- No default in equilibrium, but the possibility of default limits credit
- Possible to add unsecured debt (as in Kehoe-Levine)
the AD market

Preferences and Technology

- Utility: $U(x, h, \ell) = U(x, h) - \ell$
- Production: $X = f(k, \ell)$, operated by a representative firm

Assets

- Neoclassical capital $k$ (depreciation $\delta_k$)
- Housing $h$ (Supply $H$, fixed/endogenous, depreciation $\delta_h$)
- Money $m$ (Supply $M$, determined by policy)

Prices

- Asset prices: $\phi = (\phi_k, \phi_h, \phi_m)$
- Factor prices: $(\rho, \omega)$
the portfolio problem

\[
\max_{\hat{a}, q, d} -\phi \hat{a}/\omega + \beta W[y(\hat{a}, 0), h] + \beta \sigma [u(q) - z(q)] + \sigma [\tilde{d}/\omega' - c(\tilde{q})]...
\]
the portfolio problem

\[
\max_{\hat{a}, q, d} \quad -\phi \hat{a}/\omega + \beta W \left[ y(\hat{a}, 0), h \right] + \beta \sigma \left[ u(q) - z(q) \right] + \sigma [\tilde{d}/\omega' - c(\tilde{q})] \ldots,
\]

subject to

\[
z(q) = \frac{d}{\omega'}
\]

\[
d \leq \bar{D}(\hat{a})
\]

\((q, d) \equiv \text{Terms of trade when a buyer, depends on } \hat{a}\)

\((\tilde{q}, \tilde{d}) \equiv \text{Terms of trade when a seller, does not depend on } \hat{a}\)
Case I: Liquid

- Capital, housing etc. provide ‘sufficient’ liquidity
- All assets priced at fundamental value

\[
\phi_h = \beta [\omega U_h + (1 - \delta_h)\phi_h]
\]

\[
1 = \beta (\rho + 1 - \delta_k)
\]

\[
\phi_m = 0
\]

- Rates of return equalized across assets

\[
1 + r_j = \frac{1}{\beta}
\]
stationary equilibrium

Case II: Illiquid Nonmonetary

- Pledgable assets command a **liquidity premium**

\[ \phi_h = \beta [\omega U_h + (1 - \delta_h)\phi_h (1 + \Lambda \mu_h)] \]

\[ 1 = \beta(\rho + 1 - \delta_k)(1 + \Lambda \mu_k). \]

where

\[ \Lambda = \sigma \left[ \frac{u'(q) - z'(q)}{z'(q)} \right] \]

- **Liquidity-adjusted** rates of return equalized across assets

\[ (1 + r_j)(1 + \Lambda \mu_j) = \frac{1}{\beta} \]

- Effect on prices or quantities, depending on reproducibility
stationary equilibrium

Case III: Monetary

- Inflation $\rightarrow$ value of liquidity $\rightarrow$ asset prices/quantities

$$\phi_m = \beta \phi'_m (1 + \Lambda) \quad \Rightarrow \quad \Lambda = \frac{\phi_m}{\beta \phi'_m} = 1 + i$$
stationary equilibrium

Case III: Monetary

- Inflation → value of liquidity → asset prices/quantities

\[ \phi_m = \beta \phi'_m (1 + \Lambda) \quad \Rightarrow \quad \Lambda = \frac{\phi_m}{\beta \phi'_m} = 1 + i \]

\[ \phi_h = \beta [\omega U_h + (1 - \delta_h) \phi_h (1 + i \mu_h)] \]
\[ 1 = \beta (\rho + 1 - \delta_k) (1 + i \mu_k) \]

- Higher inflation/pledgability \quad \Rightarrow \quad Lower accounting returns

\[ (1 + r_j) (1 + i \mu_j) = \frac{1}{\beta} \]
monetary policy I: the Fisher theory

Inflation and asset returns

Result

Higher $\pi$ reduces real rates of return on liquid assets.

Intuition: Inflation increases liquidity premia
monetary policy II: the Tobin effect

Inflation and capital accumulation

Result

If $\mu_k > 0$, capital accumulation increases with inflation.

Intuition: Inflation increases demand for liquid assets
monetary policy III: the Phillips curve

Inflation and AD employment

Opposing wealth and substitution effects → overall effect ambiguous:

\[
\frac{\partial \ell}{\partial \pi} = -\Delta_3^{-1} \Lambda'_k (f_k + 1 - \delta_k) \left\{ f_k \ell U_x + (f_k - \delta_k) f\ell U_{xx} \right\} > 0
\]

Result

Suppose \( U(x,h) = x^{1-\eta} - \eta + v(h) \) and \( f(k,\ell) = k^\alpha \ell^{1-\alpha} \). Then, AD employment increases with \( \pi \) iff \( \eta \leq \eta^* \).

Intuition: Strength of the substitution effect decreases with curvature.
monetary policy III: the Phillips curve

Inflation and AD employment

Opposing wealth and substitution effects $\rightarrow$ overall effect ambiguous:

$$\frac{\partial \ell}{\partial \pi} = -\Delta_3^{-1} \Lambda'_k (f_k + 1 - \delta_k) \begin{cases} >0 & \text{if } f_k \ell U_x + (f_k - \delta_k) \ell U_{xx} > 0 \\ ? & \text{otherwise} \end{cases}$$

Result

Suppose $U(x, h) = \frac{x^{1-\eta}}{1-\eta} + v(h)$ and $f(k, \ell) = k^\alpha \ell^{1-\alpha}$. Then, AD employment increases with $\pi$ iff $\eta \leq \eta^*$. 

Intuition: Strength of the substitution effect decreases with curvature
numerical analysis

The AD Market

- Taxes on labor ($\tau_\ell$) and asset returns ($\tau_a$)
- Government bonds (pledgability $\mu_b$)
- Preferences and technology

\[ U(x, h, \ell) = \log x + \psi \log h - \zeta \ell \quad f(k, l) = k^\alpha l^{1-\alpha} \]

Housing cost: \[ g(I_h) = \frac{I_h^{1+\xi}}{1 + \xi} \]

The KM Market

- Preferences and technology

\[ u(q) = \nu \frac{q^{1-\eta}}{1 - \eta} \quad c(q) = q \]
<table>
<thead>
<tr>
<th>Parameter</th>
<th>Description</th>
<th>Baseline</th>
<th>Identified by</th>
</tr>
</thead>
<tbody>
<tr>
<td>$\beta$</td>
<td>Discount factor</td>
<td>0.95</td>
<td>Set directly</td>
</tr>
<tr>
<td>$\alpha$</td>
<td>Capital share</td>
<td>0.33</td>
<td>&quot;</td>
</tr>
<tr>
<td>$\pi$</td>
<td>Inflation</td>
<td>0.037</td>
<td>&quot;</td>
</tr>
<tr>
<td>$\delta_h$</td>
<td>Depreciation of housing</td>
<td>0.10</td>
<td>&quot;</td>
</tr>
<tr>
<td>$\delta_k$</td>
<td>Depreciation of capital</td>
<td>0.10</td>
<td>&quot;</td>
</tr>
<tr>
<td>$\tau_\ell$</td>
<td>Labor-income tax</td>
<td>0.30</td>
<td>&quot;</td>
</tr>
<tr>
<td>$\tau_a$</td>
<td>Asset-income tax</td>
<td>0.40</td>
<td>&quot;</td>
</tr>
<tr>
<td>$\psi$</td>
<td>Coefficient on $h$ in $U$</td>
<td>0.86</td>
<td>Housing/GDP</td>
</tr>
<tr>
<td>$\xi$</td>
<td>Curvature of $h$ cost fn</td>
<td>0.30</td>
<td>Housing investment/GDP</td>
</tr>
<tr>
<td>$\zeta$</td>
<td>Coefficient on $\ell$ in $U$</td>
<td>0.38</td>
<td>Hours worked</td>
</tr>
<tr>
<td>$\mu_b$</td>
<td>Pledgability of bonds</td>
<td>0.45</td>
<td>Real return on bonds</td>
</tr>
<tr>
<td>$\mu_k$</td>
<td>Pledgability of capital</td>
<td>0.17</td>
<td>Capital/GDP</td>
</tr>
<tr>
<td>$\mu_h$</td>
<td>Pledgability of housing</td>
<td>0.06</td>
<td>Home equity loans/housing</td>
</tr>
<tr>
<td>$B$</td>
<td>Bond supply</td>
<td>0.08</td>
<td>T-bills/GDP</td>
</tr>
<tr>
<td>$\theta$</td>
<td>Bargaining power</td>
<td>0.86</td>
<td>Retail markup</td>
</tr>
<tr>
<td>$\eta$</td>
<td>Curvature of $u(q)$</td>
<td>0.63</td>
<td>$M/PY$ and $Y$ vs inflation</td>
</tr>
<tr>
<td>$\nu$</td>
<td>Constant in $u(q)$</td>
<td>1.39</td>
<td>&quot;</td>
</tr>
<tr>
<td>$\sigma$</td>
<td>Fraction of KM buyers</td>
<td>0.67</td>
<td>&quot;</td>
</tr>
</tbody>
</table>

Alternative Calibration
effect of \( \pi \)
model vs. data
model vs. data: labor
model vs data: empirical studies

Permanent increases in inflation/money growth

Ahmed and Rogers (2000): US time series
- Positive effects on consumption, investment, and output

Madsen (2003): A panel of OECD countries
- Negative effect on investment

Bullard (1999)
- Positive effect on output in low inflation countries, but mixed evidence overall
the welfare costs of inflation
monetary policy: effect of $\pi$
monetary policy: effect of $\pi$
other results

- Endogenous pledgability

- Immediate versus deferred settlement

- Risk

- Financial development (increases in pledgability)
financial development I: effect of $\mu_h$
financial development II: effect of $\mu_k$
final remarks

- A flexible and tractable theory of the role of assets in the exchange process

- A unified analysis of macro aggregates, money, asset and credit markets

- Next steps: short run implications (transitions, business cycles)
Assets as media of exchange
- Kiyotaki and Wright (1989, 1993),...

Assets as collateral
- Kiyotaki and Moore (1997, 2005),...

Limits to pledgability
- Holmstrom and Tirole (2011),...

Effects of inflation
- Fisher, Mundell-Tobin, Friedman, Phillips...
an alternative calibration

<table>
<thead>
<tr>
<th>Parameter</th>
<th>Description</th>
<th>Baseline</th>
<th>Alternate</th>
<th>Identified by</th>
</tr>
</thead>
<tbody>
<tr>
<td>$\beta$</td>
<td>Discount factor</td>
<td>0.95</td>
<td>0.95</td>
<td>Set directly</td>
</tr>
<tr>
<td>$\alpha$</td>
<td>Capital’s Share</td>
<td>0.33</td>
<td>0.33</td>
<td>&quot;</td>
</tr>
<tr>
<td>$\pi$</td>
<td>Inflation</td>
<td>0.037</td>
<td>0.037</td>
<td>&quot;</td>
</tr>
<tr>
<td>$\delta_h$</td>
<td>Depreciation of housing</td>
<td>0.10</td>
<td>0.10</td>
<td>&quot;</td>
</tr>
<tr>
<td>$\delta_k$</td>
<td>Depreciation of capital</td>
<td>0.10</td>
<td>0.10</td>
<td>&quot;</td>
</tr>
<tr>
<td>$\tau_\ell$</td>
<td>Labor-income tax</td>
<td>0.30</td>
<td>0.30</td>
<td>&quot;</td>
</tr>
<tr>
<td>$\tau_a$</td>
<td>Asset-income tax</td>
<td>0.40</td>
<td>0.40</td>
<td>&quot;</td>
</tr>
<tr>
<td>$\psi$</td>
<td>Coefficient on $h$ in $U$</td>
<td>0.86</td>
<td>0.73</td>
<td>Housing/GDP</td>
</tr>
<tr>
<td>$\xi$</td>
<td>Curvature of $h$ cost fn</td>
<td>0.30</td>
<td>0.30</td>
<td>Housing investment/GDP</td>
</tr>
<tr>
<td>$\zeta$</td>
<td>Coefficient on $\ell$ in $U$</td>
<td>0.38</td>
<td>0.41</td>
<td>Hours worked</td>
</tr>
<tr>
<td>$\mu_b$</td>
<td>Pledgability of bonds</td>
<td>0.45</td>
<td>0.45</td>
<td>Real return on bonds</td>
</tr>
<tr>
<td>$\mu_k$</td>
<td>Pledgability of capital</td>
<td>0.17</td>
<td>0.06</td>
<td>Capital/GDP</td>
</tr>
<tr>
<td>$\mu_h$</td>
<td>Pledgability of housing</td>
<td>0.06</td>
<td>0.04</td>
<td>Home equity loans/housing</td>
</tr>
<tr>
<td>$B$</td>
<td>Bond supply</td>
<td>0.08</td>
<td>0.07</td>
<td>T-bills/GDP</td>
</tr>
<tr>
<td>$\theta$</td>
<td>Bargaining power</td>
<td>0.86</td>
<td>0.68</td>
<td>Retail markup</td>
</tr>
<tr>
<td>$\eta$</td>
<td>Curvature of $u(q)$</td>
<td>0.63</td>
<td>0.39</td>
<td>$M/PY$ and $Y$ vs inflation</td>
</tr>
<tr>
<td>$\nu$</td>
<td>Constant in $u(q)$</td>
<td>1.39</td>
<td>1.11</td>
<td>&quot;</td>
</tr>
<tr>
<td>$\sigma$</td>
<td>Fraction of KM buyers</td>
<td>0.67</td>
<td>0.75</td>
<td>&quot;</td>
</tr>
</tbody>
</table>
model vs. data: alternative calibration
monetary policy: alternative calibration
monetary policy: alternative calibration

Return on bonds, $r_b(\pi)$

Return on capital, $r_k(\pi)$

Return on housing, $r_h(\pi)$

Real balances, $\phi_m M(\pi)$

Liquidity, $D(\pi)$

Welfare gains, $\Delta x(\pi)$
Two assets

- Riskless bonds with $\mu_b = 1$
- Equity in a Lucas tree with risky dividends and $\mu_e < 1$
  - Dividend realization known at the beginning of the KM market

Return differential

$$r^e - r^b = \frac{(1 + r)i}{1 + i} \frac{1 - \mu_e}{1 + i\mu_e} - \frac{\mu_e \text{cov} (\Lambda, \gamma e / \phi_e)}{1 + i\mu_e}.$$
immediate vs. deferred settlement

Timing of payment/settlement

- Immediate: Kiyotaki-Wright
- Deferred: Kiyotaki-Moore, this paper

Key issue: Effect on pledgability
- Immediate: Limits to transferability
- Deferred: Limits to pledgability

Example 1: Risk of diversion
- Immediate settlement provides more liquidity if it reduces divertible fraction
Immediate vs. deferred settlement

Timing of payment/settlement

- Immediate: Kiyotaki-Wright
- Deferred: Kiyotaki-Moore, this paper

Key issue: Effect on pledgability

- Immediate: Limits to transferability
- Deferred: Limits to pledgability


immediate vs. deferred settlement

Timing of payment/settlement

- Immediate: Kiyotaki-Wright
- Deferred: Kiyotaki-Moore, this paper

Key issue: Effect on pledgability

- Immediate: Limits to transferability
- Deferred: Limits to pledgability

Example 1: Risk of diversion

- Immediate settlement provides more liquidity if it reduces divertible fraction
Immediate vs. deferred settlement

Example 2: Housing

- Fully pledgable, i.e. \( \mu_h = 1 \)

- Case 2a: Nontradable housing services
  
  ▶ \( U(x, h) \) depends on beginning-of-period \( h \)
  
  ▶ → Preference for collateralized debt
Example 2: Housing

- Fully pledgable, i.e. $\mu_h = 1$

- Case 2a: Nontradable housing services
  - $U(x, h)$ depends on beginning-of-period $h$
  - → Preference for collateralized debt

- Case 2b: Tradable services
  - $U(x, h)$ depends on net position in $h$ (after trading)
  - → Immediate and deferred settlement equivalent
Lucas trees require maintenance to retain value

- After trading, but before the start of the next period
- Agents cannot commit to maintaining assets in their possession

Level of maintenance $n \in [0, 1]$

- Preserves a fraction $n$ of the value of the asset
- Utility cost of maintenance $\chi n$

\[ \Rightarrow \quad D_e \leq \mu_e e \quad \text{where} \quad \mu_e = 1 - \frac{\omega' \chi}{\phi_e' + \gamma} \]
immediate vs. deferred settlement

Case I: Observable heterogeneity

- E.g. Buyer (seller) commonly known to have a lower maintenance cost
- ⇒ Preference for collateralized borrowing (immediate transfer)
immediate vs. deferred settlement

Case I: Observable heterogeneity

- E.g. Buyer (seller) commonly known to have a lower maintenance cost
- ⇒ Preference for collateralized borrowing (immediate transfer)

Case II: Ex-post heterogeneity

- Maintenance cost realized - and privately observed - after trading
- ⇒ Preference for immediate transfer