# Aggregate Unemployment and Household Unsecured Credit

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Conference in honor of Tom Cooley
*October 4-5, 2013*

# What this paper is about

Broad Question:

How do credit frictions influence the aggregate labor market?

- Empirical evidence that credit to households matters for employment changes, through consumer spending.

- Household unsecured credit
  - tripled from 1978 to 2008 (10% of annual consumption)

# What we do

Objective:

1. Provide a model that links:
    - labor market
    - goods market
    - household unsecured credit

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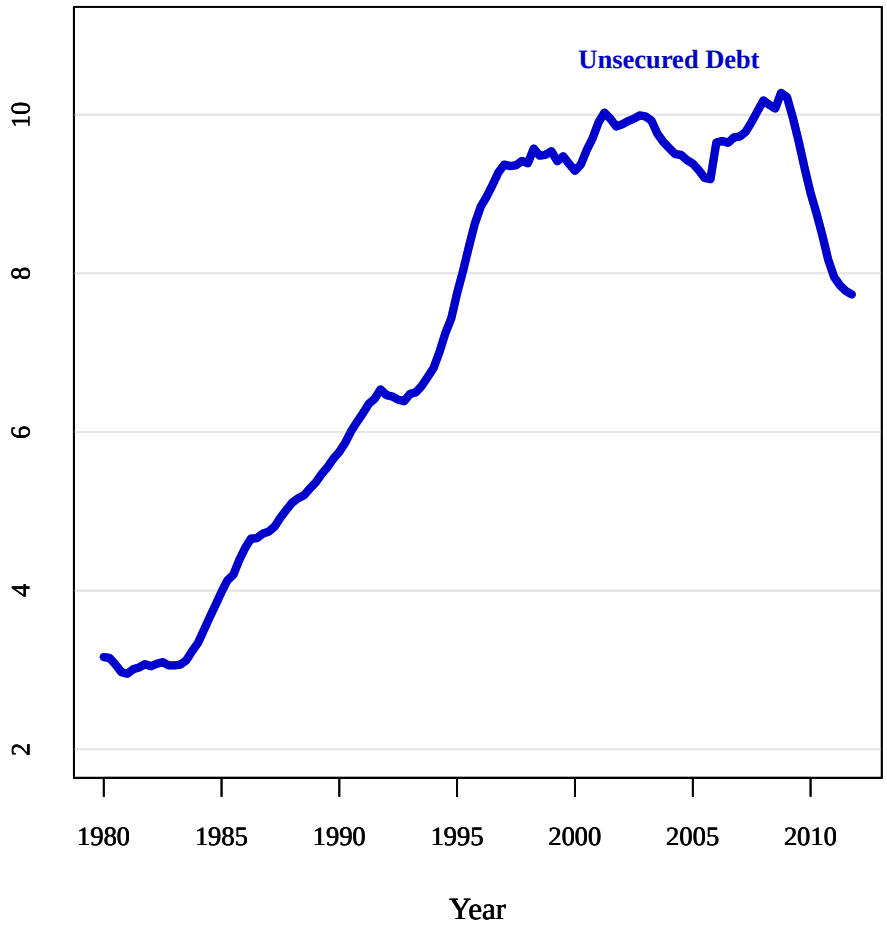
   - labor market: Mortensen-Pissarides
   - goods market: Shi (1995), Trejos-Wright (1995)
   - household unsecured credit: Kehoe-Levine (1993)

# What we do

## Objective:

2. Calibrate: How much of the decline in unemployment can be accounted for by the expansion of unsecured debt?




- Unsecured debt = revolving debt outstanding / consumption

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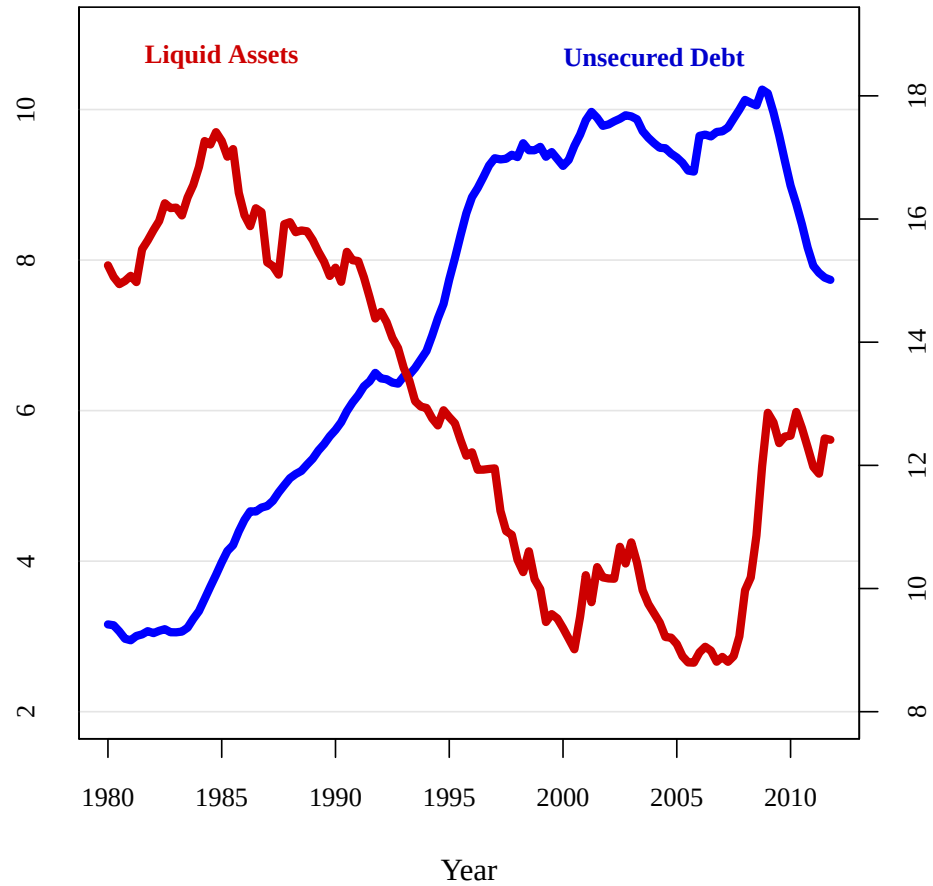


- Unsecured debt = revolving debt outstanding / consumption
- Liquid assets = M2 + treasuries / total assets

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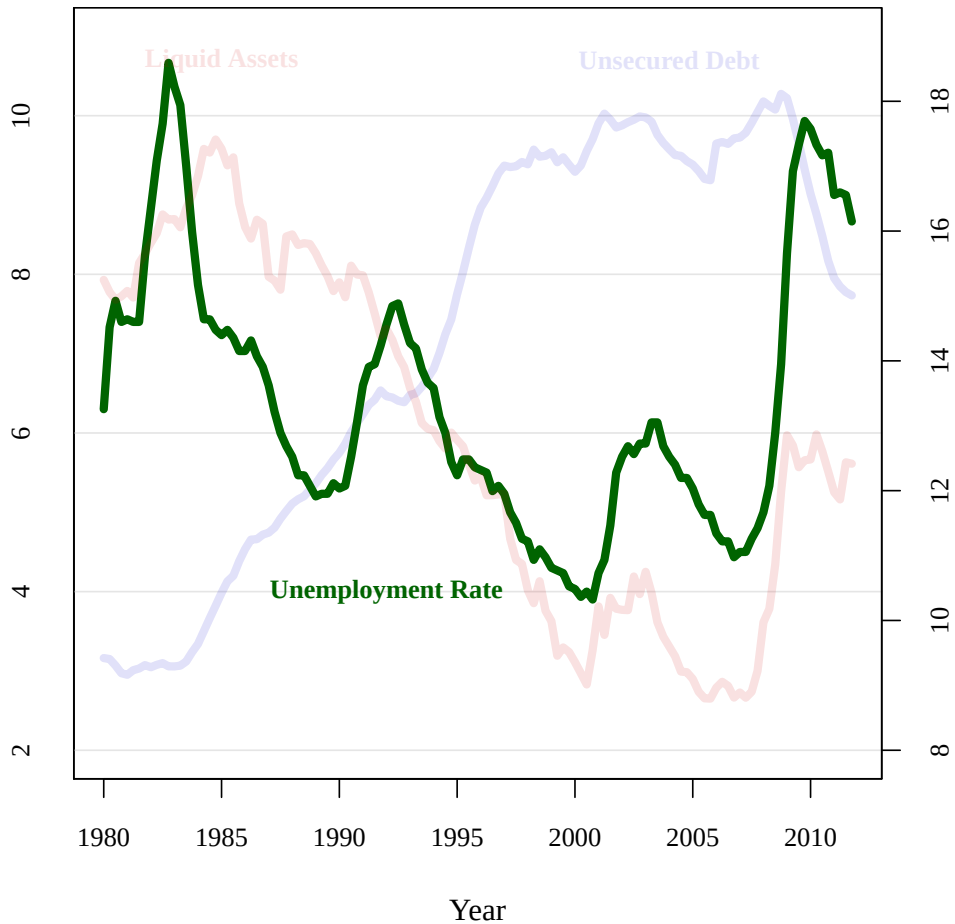


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# Key Mechanism

1. Credit affects job creation through firm productivity
   - higher credit limits and more borrowing increase firm's expected revenue from trade in the goods market

2. (Aggregate) unemployment affects credit limit through incentive constraints
   - low unemployment leads to more sellers in the goods market, more costly for the household to default

# Literature

**Unemployment & Money**

- Shi (1998), Berensten, Menzio, Wright (2011), Rocheteau, Rupert, Wright (2007)

**Unemployment & Firm Financial Frictions**

- Wasmer & Weil (2004), Petrosky-Nadeau & Wasmer (2012), Petrosky-Nadeau (2012)

**Credit, Limited Commitment & Incentive Constrained Debt**

- Diamond (1982, 1987, 1990), Kehoe & Levine (1993, 2001), Telyukova & Wright (2007), Sanches & Williamson (2010), Gu, Mattesini, Monnet, Wright (2012)

What's new:

1. consider labor, credit, and goods markets together.
2. credit is to households; limited commitment
3. punishment from default is not autarky, can still use liquid assets

# Environment

- Discrete time, infinite horizon, $\beta = \frac{1}{1+r}$
- Agents
  - Unit measure of households
  - Large measure of firms
- Each period is divided into 3 sub-periods
  1. Frictional Labor Market (**LM**)
     - matching of workers and firms
  2. Decentralized Retail Market (**DM**)
     - households and firms meet, trade $y_t$ for assets or debt
  3. Centralized Settlement (**CM**)
     - consume/produce general good $c_t$, pay back debt

# Households

- Quasi-linear Utility

$$\mathbb{E}\sum_{t=0}^{\infty}\beta^t[\ell(1-e_t)+\upsilon(y_t)+c_t]$$

  - LM value of leisure, $\ell$; employment status: $e_t \in \{0,1\}$
  - DM consumption good: $y_t$
  - CM consumption good: $c_t$

- Assets (numeraire) are storable: $a_t$
  - storage technology, $Ra_t$, with $R < 1+r$
  - fraction $\nu$ can be used for payment in DM (partially liquid)

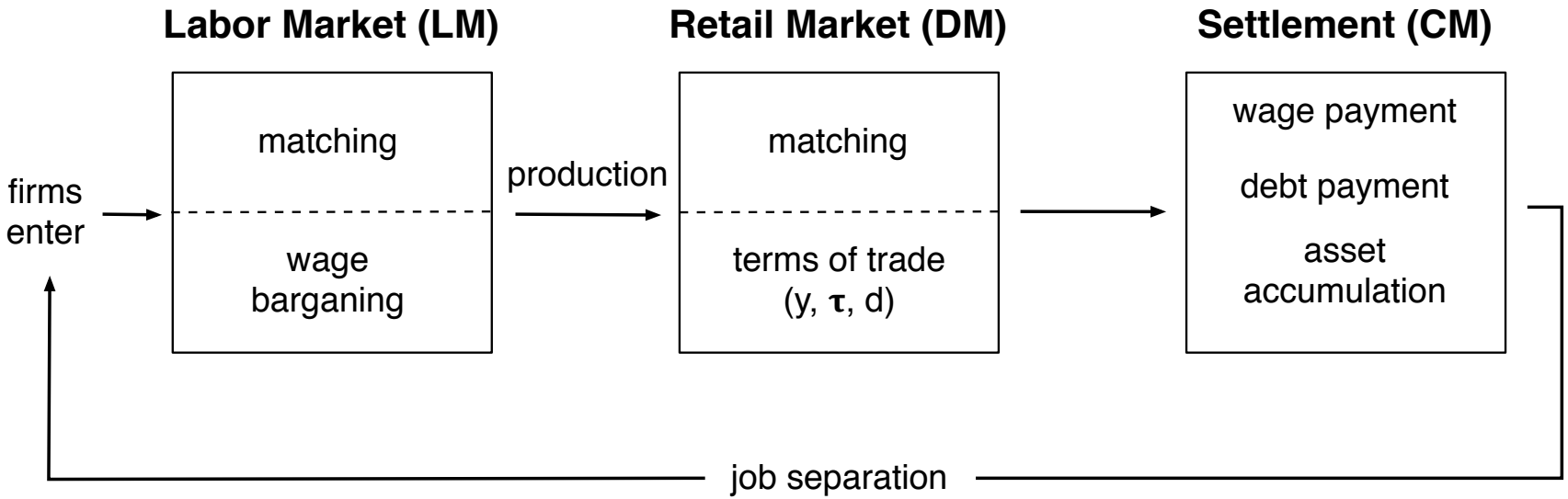
# Firms

- Firms enter labor market at cost: $k$
- Production of firm/worker match: $\bar{z}$
  - firm sell $y_t \in [0, \bar{z}]$ in DM
  - inventories $x_t = \bar{z} - y_t$ in CM
- Exogenous separation rate: $\delta$

# Frictions

- Labor market
  - matching rate of workers and job openings: $m(u_t, o_t)$
  - labor market tightness: $\theta_t = o_t/u_t$
- DM Goods Market
  - all households search
  - sellers are the measure of filled (productive) firms: $n_t = 1 - u_t$
  - matching: $\alpha(n_t)$
- Lack of commitment to repay debt in CM
  - Incentive constrained debt (no equilibrium default)
  - Monitoring technology
    - $\omega$ fraction of households monitored
    - $\rho$ probability that default is recorded publicly

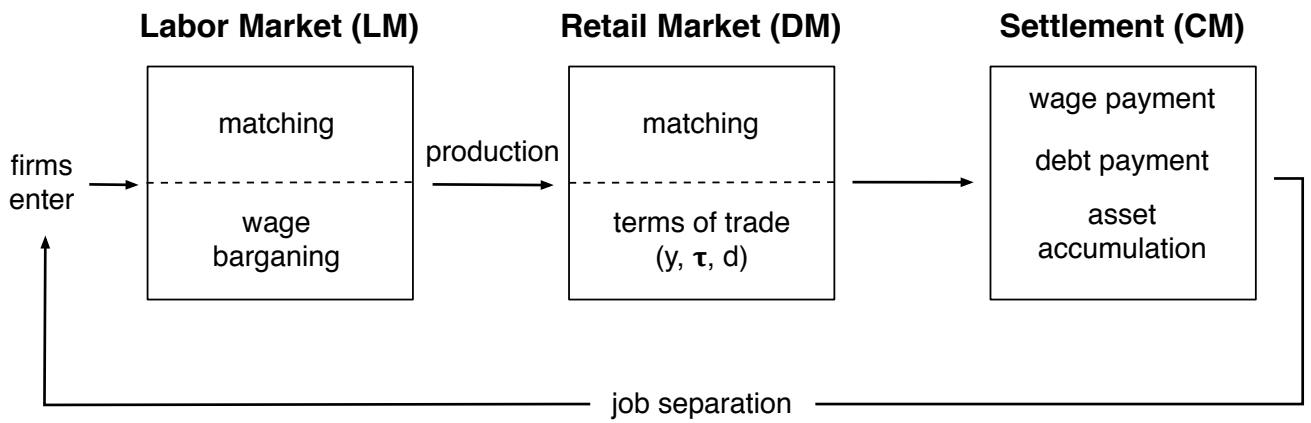
# Timing


Labor Market (LM)
Retail Market (DM)
Settlement (CM)
matching
wage
barganing
production
matching
terms of trade
(y, τ, d)
wage payment
debt payment
asset
accumulation
firms
enter
job separation

# Equilibrium

- Focus on steady state equilibria
- Upon a recorded default, household loses access to credit

- Solution approach: solve backward
  1. CM problem
  2. Trade in DM
  3. Labor market outcomes



# CM Decision Problem

- Household with debt $d$, assets $a$, and no default record

$$W_e(d,a) = \max_{c,a' \geq 0} \{c + (1-e)\ell + \beta U_e(a')\}$$

$$\text{s.t.} \quad c + d + a' = ew + (1-e)b + Ra + \Delta$$

# CM Decision Problem

- Household with debt $d$, assets $a$, and no default record

$$W_e(d,a) = \underbrace{Ra - d + ew + (1-e)(\ell + b) + \Delta}_{\text{linear in wealth}} + \underbrace{\max_{a' \geq 0} [-a' + \beta U_e(a')]}_{\text{independent of current assets}}$$

# CM Decision Problem

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- those with no access to credit

$$\tilde{W}_e(a) = Ra + ew + (1-e)(\ell + b) + \Delta + \max_{a' \geq 0} \left\{ -a' + \beta \tilde{U}_e(a') \right\}$$

# CM Decision Problem

- Household with debt $d$, assets $a$, and no default record

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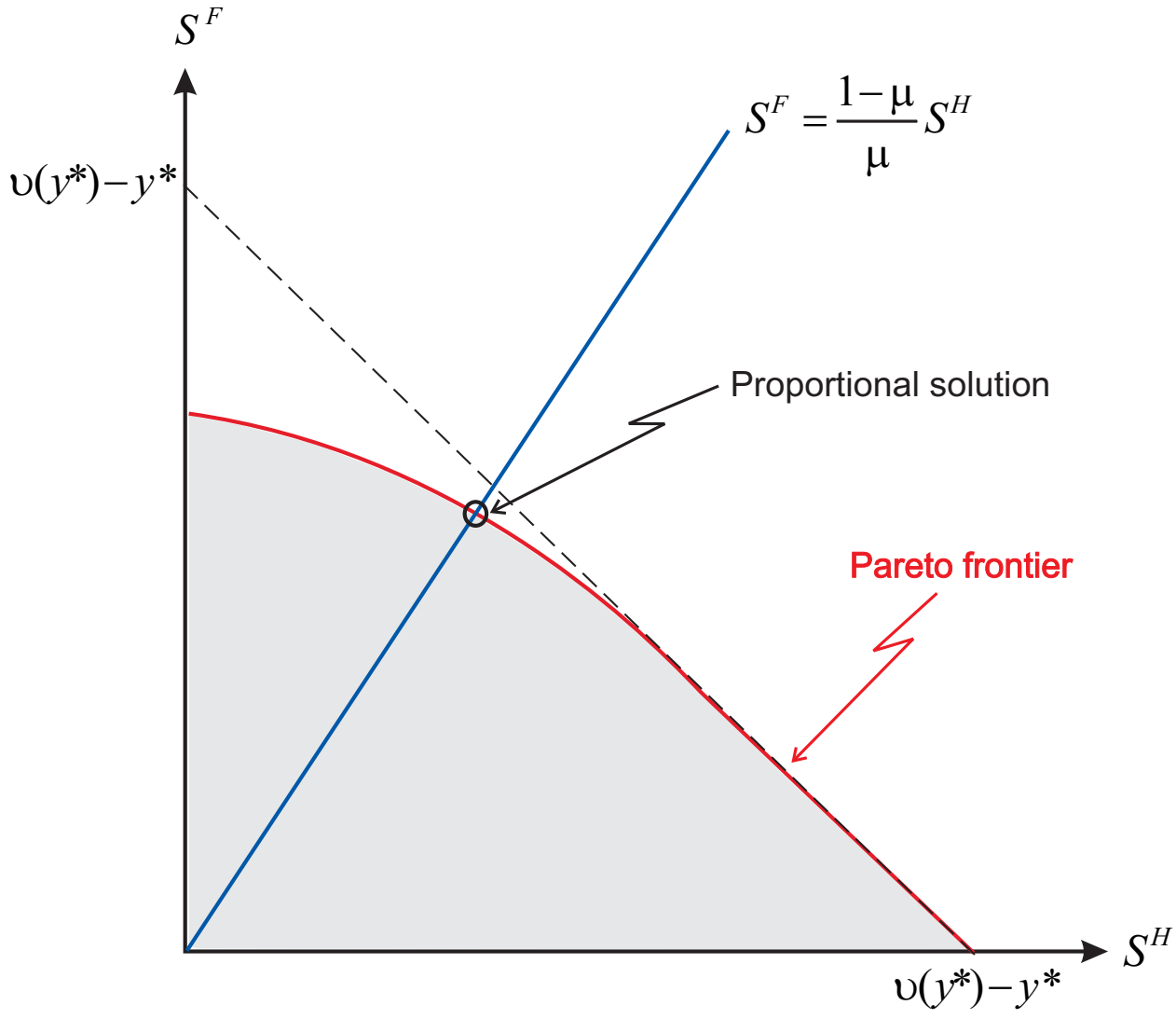
- Firm with $x$ inventories, $d$ units of debt, $a$ assets, and $w$ wage promises

$$\Pi(x,d,a,w) = \underbrace{x + d + Ra}_{\text{total revenue}} - \underbrace{w}_{\text{wages}} + \underbrace{\beta(1-\delta)J}_{\text{value next LM}}$$

# Terms of trade in DM

- Contract is a triple $(y, \tau, d)$
  - $y$: DM output transferred to household
  - $\tau$: transfer of liquid assets to firm
  - $d$: unsecured credit
- Proportional bargaining solution (Kalai)
  - $\mu$: household's share
- Feasibility
  - $d \leq \bar{d}$
  - $\tau \leq \nu a$
- $y$ is a function of household's total payment capacity $\bar{d} + R\nu a$

# Trade depends on household's total payment capacity



# DM output depends on total payment capacity

- $y$ only depends on payment capacity $y(\bar{d} + R\nu a)$
- If payment capacity is high enough, trade $y = y^*$
- Otherwise, trade is constrained

$$(1-\mu)\upsilon(y) + \mu y = \bar{d} + R\nu a$$

- note: The price of one unit of DM output is

$$1 + \underbrace{(1-\mu)\left[\upsilon(y) - y\right]/y}_{\text{average markup}}$$

# Labor Market - Households

- Household with no default record, employment status $e \in \{0, 1\}$, assets $a$

$$U_1(a) = \overbrace{\alpha(n)\mu[v(y) - y]}^{\text{expected surplus in DM}} + (1 - \delta)W_1(0, a) + \delta W_0(0, a)$$

$$U_0(a) = \alpha(n)\mu[v(y) - y] + pW_1(0, a) + (1 - p)W_0(0, a)$$

# Job Creation - Firms

- Value of a filled job in DM

$$J = \frac{z - w}{1 - \beta(1 - \delta)}$$

- Productivity depends endogenously on credit limit through $y$

$$z = \bar{z} + \frac{\alpha(n)}{n}(1 - \mu)\left\{\omega\left[\upsilon\left(y\right) - y\right] + (1 - \omega)\left[\upsilon\left(\tilde{y}\right) - \tilde{y}\right]\right\}$$

- Rest is as in Mortensen-Pissarides
  - free entry $\Rightarrow k = \beta f J$
  - wages are determined by Nash Bargaining

# Credit affects unemployment through firm productivity

- Beveridge Curve

$$u = \frac{\delta}{m(1,\theta) + \delta}$$

- Job creation condition

$$\frac{(r+\delta)k}{m(\frac{1}{\theta},1)} + \beta\lambda\theta k = (1-\lambda)\Big\{z - \ell - b\Big\}$$

- Unemployment $u$ is decreasing in trade $y(\bar{d}, a)$ and $\tilde{y}(\tilde{a})$ through productivity.

# Need to determine payment capacity

- Asset accumulation
- Debt constraint

# Asset accumulation

- Given $y(\bar{d} + R\nu a)$, households solve

$$\max_{a \geq 0} \quad \underbrace{\alpha(n)\mu[\upsilon(y) - y]}_{\text{expected surplus}} - \underbrace{(1 + r - R)a}_{\text{cost of holding } a}$$

# Asset accumulation

- Given $y(\bar{d} + R\nu a)$, households solve

$$\max_{a \geq 0} \quad \underbrace{\alpha(n)\mu[v(y) - y]}_{\text{expected surplus}} - \underbrace{(1 + r - R)a}_{\text{cost of holding } a}$$

- FOC

$$\underbrace{\alpha(n)\mu\nu R\left[\frac{v'(y) - 1}{(1 - \mu)v'(y) + \mu}\right]}_{\text{liquidity premium}} - \underbrace{(1 + r - R)}_{\text{mc of holding a}} \leq 0$$

- Asset choice depends on $\bar{d}$ through $y$

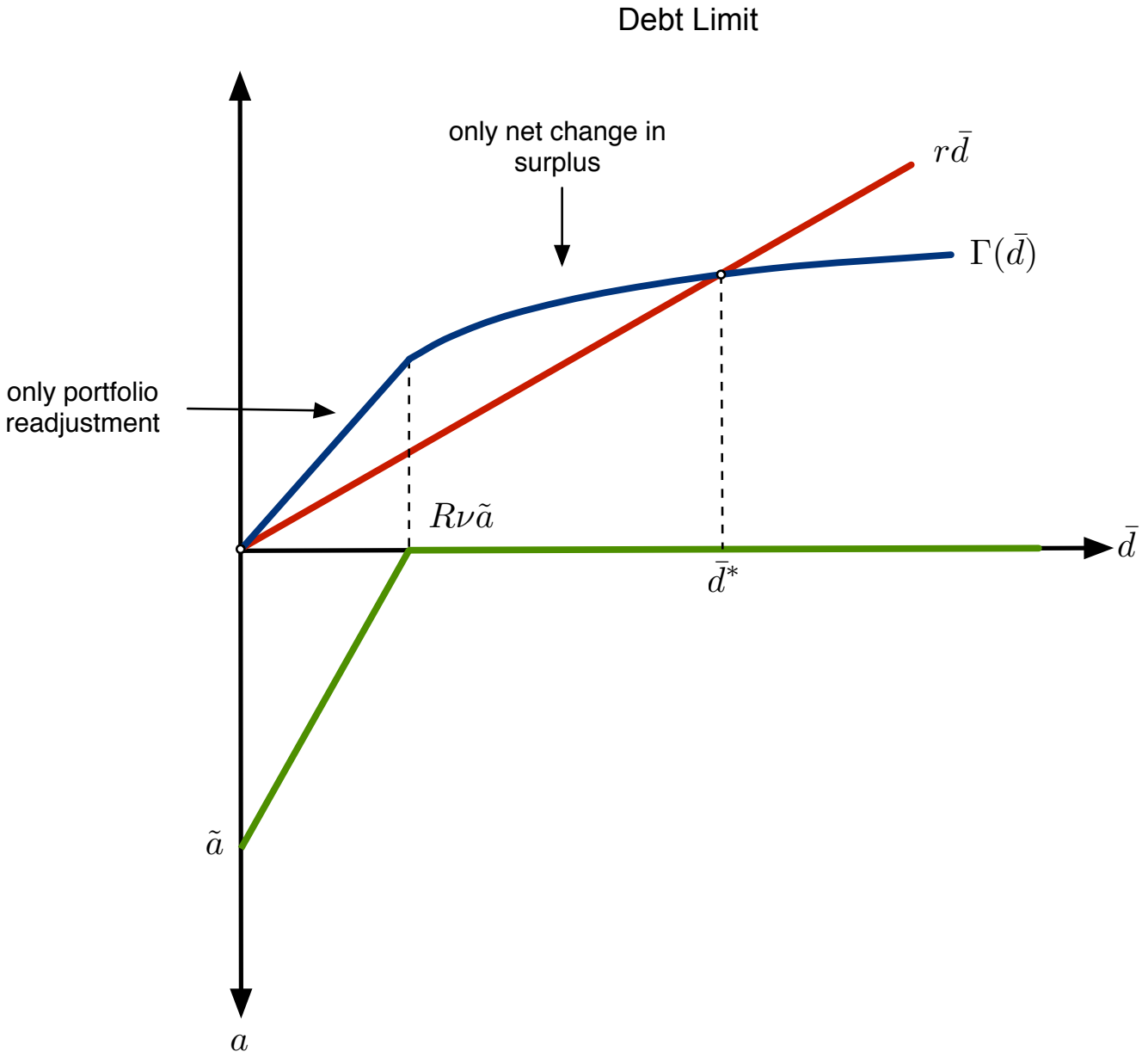
# Debt Limit

- Debt limit = lifetime cost of losing access to credit
- Two components

$$\bar{d} = \frac{\rho}{r}\Big\{ \underbrace{\alpha(n)\mu\Big[[\upsilon(y) - y] - [\upsilon(\tilde{y}) - \tilde{y}]\Big]}_{\text{net change in surplus}} + \underbrace{(1 + r - R)(\tilde{a} - a)}_{\text{portfolio adjustment cost}} \Big\} = \Gamma(\bar{d})$$

- Cost of losing access to credit is increasing in debt limit $\bar{d}$
- Forms a fixed point problem

# If there is a positive debt limit, HH hold no assets



# Credit and liquid assets depend positively on employment

As employment $n$ increases:

- Liquidity premium rises $\Rightarrow$ $\tilde{a}$ increases
- Cost of default rises $\Rightarrow$ $\bar{d}$ increases

# GE: Multiple Steady States

- Debt limit is decreasing with unemployment
- Unemployment decreasing with debt limit
- Strategic complementarity leads to multiple equilibria
    - credit and unemployment are negatively correlated across equilibria

# Calibration

# Calibration

- Model period is one month, $\beta = 0.997$
- Benchmark: US 2000-2008
- Experiment: Consider an exogenous change in financial technology
  - change $(\omega, \rho)$ to match unsecured debt outstanding in:

1. 1978-1986
2. 2011

- Compare steady state unemployment

# Labor Market

- Match labor flows, unemployment, vacancy rate

| Description | Value | Source/Target |
|---|---|---|
| **Labor Market** | | |
| *Directly* Match | | |
| Unemployment benefits, $b$ | 0.53 | $b = .5w$ |
| Value of leisure, $\ell$ | 0.48 | $b + \ell = .95w$, Hagedorn & Manovskii (2008) |
| Elasticity of LM matching, $\eta$ | 0.50 | Petrolongo & Pissarides (2001) |
| *Jointly* Match | | |
| LM matching efficiency, $A$ | 0.50 | Vacancy rate, JOLTS |
| LM bargaining, $\lambda$ | 0.50 | Hosios condition |
| Job destruction rate, $\delta$ | 0.019 | Unemployment rate, CPS |
| Vacancy cost, $k$ | 0.10 | Job finding probability, CPS |

# Credit and Goods Market

- Survey of Consumer Finance (SCF): credit & charge cards

| Description | Value | Source/Target |
|---|---|---|
| **Credit & Goods Market** | | |
| *Directly* Match | | |
| DM production, $\bar{z}$ | 1 | Normalization |
| Access to unsecured credit, $\omega$ | 0.74 | % with at least 1 cc (SCF) |
| Elasticity of DM matching function, $\psi$ | 0.50 | Equal contribution in matching |
| Return on Liquid Assets, $R$ | 1.0025 | Real user cost of M2 (SL Fed.) |
| *Jointly* Match | | |
| Detection Rate, $\rho$ | 0.30 | Debt financed consumption |
| DM matching efficiency, $\epsilon$ | 0.24 | Average cc utilization rate |
| DM bargaining, $\mu$ | 0.13 | Retail Markup 30% |
| Utility level parameter, $\upsilon_0$ | 1.42 | M2 to consumption |
| Utility elasticity, $\gamma$ | 0.03 | Elasticity of M2 to cost (0.17) |
| Liquidity measure, $\nu$ | 0.05 | Middle range for coexistence |

# Experiment: Tighten Credit

- Consider exogenous changes in financial technology
  1. Access to unsecured credit $\omega$
  2. Monitoring technology $\rho$

- **1978-1986**
  - Change $\omega$ from 73% to 65%
  - Adjust $\rho$ to match fall in unsecured credit of 16 percentage points

- **2011**
  - Change $\omega$ from 73% to 68%
  - Adjust $\rho$ to match fall in unsecured credit of 5 percentage points

- Compare steady state unemployment

# Unemployment and Credit, 1978-1986

| | Bench. 2000-2008 | Exp. | Diff. | Data 1978-1986 |
|---|---|---|---|---|
| **Credit & Goods Market** | | | | |
| Credit to Con., $\alpha(n)\omega\bar{d}/C$ | 0.23 | 0.07 | -0.16 | -0.16 |
| M2 to Cons., $(1-\omega)R\tilde{a}/C$ | 0.74 | 0.93 | 0.19 | 0.14 |
| Agg. productivity, $z$ | 1.07 | 1.06 | -4.45% | - |
| **Labor Market** | | | | |
| Unemployment rate (%) | 5.13 | 6.82 | 1.69 | 2.39 |

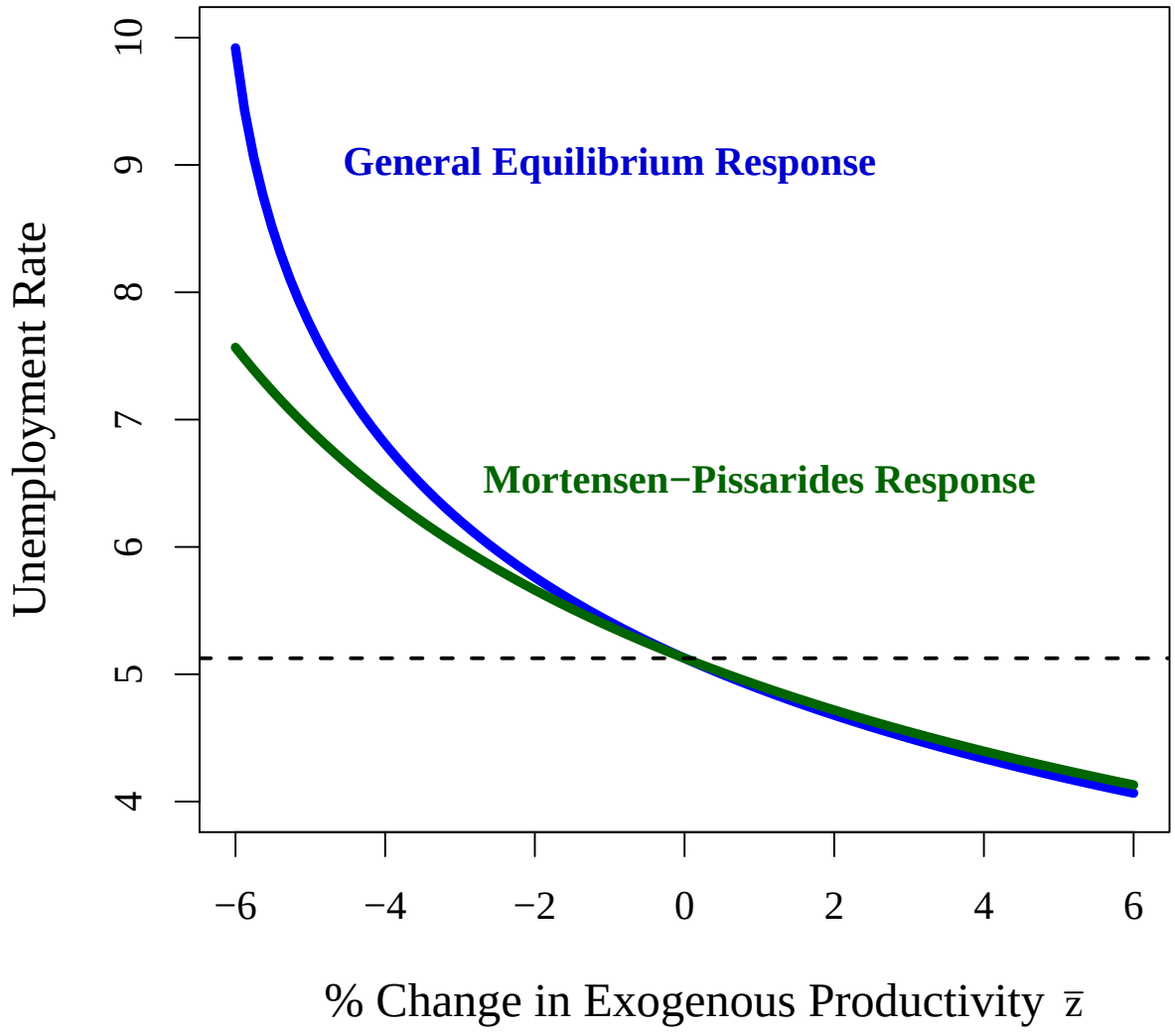
# Unemployment and Credit, 2011

| | Bench. 2000-2008 | Exp. | Diff. | Data 2011 |
|---|---|---|---|---|
| **Credit & Goods Market** | | | | |
| Credit to Con., $\alpha(n)\omega\bar{d}/C$ | 0.23 | 0.18 | -0.05 | -0.05 |
| M2 to Cons., $(1-\omega)R\tilde{a}/C$ | 0.74 | 0.92 | 0.18 | 0.08 |
| Agg. productivity, $z$ | 1.07 | 1.06 | -1.44% | - |
| **Labor Market** | | | | |
| Unemployment rate (%) | 5.13 | 5.53 | 0.40 | 3.80 |

# Credit - Amplification Channel

- Change exogenous component of productivity, $\bar{z}$
- Decompose changes in unemployment into
  - Mortensen-Pissarides channel
  - Credit & goods market channel

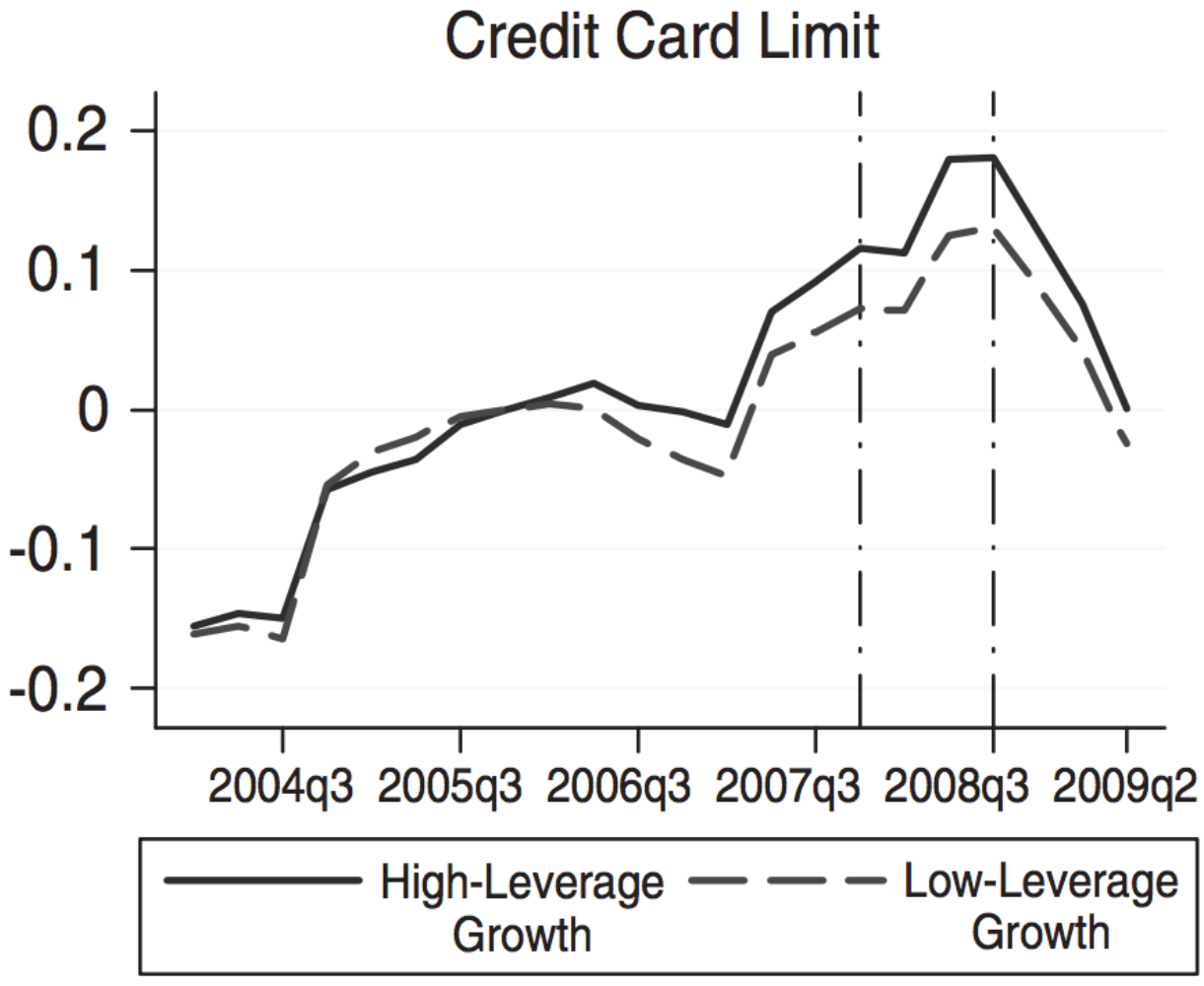
# Credit amplifies exogenous productivity changes



# Conclusion

- Tractable model linking labor and household credit markets.
- Complementarities between job creation and credit limits.
- Coexistence of liquid assets and unsecured debt
- Calibrated the model to asses the effect of a credit crunch: potentially large, but mitigated by the availability of liquidity.
- More work to do: dynamics.

# Credit Card Limits




Source: Mian and Sufi (2012)

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