Collateral and Capital Reallocation

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Role of Collateral in Macro Finance

- **Macro finance**
  - Interaction between finance and macro economy
  - Needed: Tractable dynamic microfounded model of financing

- **Collateral**
  - **(1)** Model of collateralized finance based on limited enforcement
    - Insight: Fixed (esp. tangible) assets determine capital structure
  - **(2)** Collateral assets key for secured and unsecured debt
    - Insight: Unsecured debt claim on unencumbered assets
  - **(3)** Durability of collateral assets affects ability to finance
    - Insight: More durable (and new) assets harder to finance

- **Capital reallocation**
  - **(4)** Reallocation of less durable, old assets to more constrained firms
    - Insight: Distributive effects of collateral price exceed collateral effects

Papers on Collateral and Capital Reallocation

- **Collateral**
  - **(1)** Model of collateralized finance based on limited enforcement
    - Rampini/Viswanathan (2013) Collateral and capital structure
  - **(2)** Collateral assets key for secured and unsecured debt
    - Rampini/Viswanathan (2022) Collateral and secured debt
  - **(3)** Durability of collateral assets affects ability to finance
    - Rampini (2019) Financing durable assets
- **Capital reallocation**
  - **(4)** Reallocation of less durable, old assets to more constrained firms
    - Lanteri/Rampini (2023) Constrained-efficient capital reallocation
- **More related (and selected) literature**
  - Collateral: Rampini/Viswanathan (2019, 2022b), Lanteri/Rampini (2023b)
  - Capital reallocation: Eisfeldt/Rampini (2006, 2007)

(1) Model of Dynamic Collateralized Finance

- **Model** (essentially stochastic growth model)
  - Environment: discrete time; infinite horizon: $t = 0, 1, \ldots$
  - Preferences: linear; discount factor $\beta \in (0, 1)$; limited liability
  - Endowment: w_0 at time 0
  - Technology:
    - Production function $f(k)$ with decreasing returns, Inada condition
    - Capital k depreciates at geometric rate $\delta \in (0, 1)$
- **Limited enforcement** – Rampini/Viswanathan (2010, 2013)
  - Limited enforcement without exclusion implies collateral constraints
  - Firms can abscond with
    - all cash flows and fraction $1 - \theta$ of (depreciated) assets (distinction!)
  - No exclusion from future borrowing – unlike Kehoe/Levine (1993)
  - Implication: Optimal long-term contract can be implemented with
    - one-period ahead borrowing subject to collateral constraint
- Nature of assets matters – (in)tangibility; durability; repossessability

Dynamic Collateralized Firm Financing

- **Firm's** (recursive) **problem:** Given w and interest rate R, solve

$$v(w) \equiv \max_{\{d,k,b,w'\} \in \mathbb{R}^2_+ \times \mathbb{R}^2} d + \beta v(w')$$

subject to budget constraints

$$\begin{aligned} w + b &\geq d + k \\ f(k) + k(1-\delta) &\geq Rb + w' \end{aligned}$$

and collateral constraint

$$\theta k(1-\delta) \geq Rb$$

- **Tractability:** One-period ahead claims are sufficient
  - Extends to stochastic case – one-period ahead Arrow securities
- Similar: Kiyotaki/Moore (1997)

Collateral vs. Net Worth

- **State variable is net worth** $w' = f(k) + k(1-\delta) - Rb$
  - Assets (incl. current cash flow) minus liabilities
  - Net worth matters *because* of collateral constraints
- **Collateral is endogenous**
  - Inside collateral: assets acquired for use in production
  - *Not:* Outside collateral: additional pledgeable assets ($\approx$ net worth)
  - See, e.g., Bernanke/Gertler
    - Agency costs, ~~collateral~~, and business fluctuations (1986)
    - Agency costs, net worth, and business fluctuations (*AER* 1989)
- Related: Scheinkman/Weiss (1986)

Investment with Collateral Constraints

- **Investment Euler equation**

$$1 \geq \beta \frac{\mu'}{\mu} \frac{f_k(k) + (1-\theta)q(1-\delta)}{\wp}$$

  and $v_w(w) = \mu$ (using Benveniste/Scheinkman (1979))

- **Down payment**

$$\wp = 1 - R^{-1}\theta(1-\delta) \quad [= \underbrace{R^{-1}(r+\delta)}_{\text{user cost } u} + R^{-1}(1-\theta)(1-\delta)]$$

  - Internal funds required per unit of capital
  - Debt per unit of capital $R^{-1}\theta(1-\delta)$
  - Investment of constrained firm: $k = \frac{1}{\wp} w$
  - Nature of assets determines collateralizability θ

- Stochastic version of model quantitatively plausible
  - Li/Whited/Wu (2016)

- Dynamic model allows analysis of
  - risk management; insurance; intermediation; rental markets/leasing

(2) Collateral vs. Secured Debt

- So far: **No distinction between secured and unsecured debt**

- **Recent puzzles on secured debt**
  - Secured debt acyclical/countercyclical – Azariadis/Kass/Wen (2016)
  - Limited use of secured debt by large firms – Lian/Ma (2021)
  - Secular decline in secured debt – Benmelech/Kumar/Rajan (2022)
  - Need to consider other cash-flow or earnings based constraints?

- **Terminology**
  - **Collateral (law):** Assets pledged to secure loan
  - **Collateral (economics):** Assets that facilitate enforcement

- Insight: **Collateral restricts both secured and unsecured debt**
  - Unsecured debt backed by unencumbered assets
  - Collateral essential to understanding firm financing

Trade-off between Secured and Unsecured Debt

- Model as before but distinction between secured and unsecured debt
- Capital can be financed with secured and unsecured debt
  - Encumbered capital k_s explicitly pledged to secured lender
  - Unencumbered capital $k_u = k - k_s$ backs unsecured debt
- **Benefits of secured debt – enforcement of payment** $\theta_s > \theta_u$
  - Pledging assets explicitly facilitates enforcement
    - *"increases the lender's ability to collect the debt forcibly through liquidation of the collateral"* – Mann (1997)
- **Costs of secured debt – (direct) cost** $\kappa > 0$
  - Alternative: indirect cost – operating flexibility
    - Encumbered capital less efficient: $k = k_u + \phi k_s$ with $\phi < 1$
    - *"you just don't have the same flexibility of dealing with your properties as if you owned them unencumbered"* – Mann (1997)
- Trade-off: cost of encumbering assets vs. ability to lever

Firm Financing with Secured and Unsecured Debt

- Firm's problem

$$v(w) = \max_{\{d,k_s,k_u,w',b_s,b_u\} \in \mathbb{R}^4_+ \times \mathbb{R}^2} d + \beta v(w')$$

subject to budget constraints for current and next period

$$\begin{aligned} w + \sum_{j \in \mathcal{J}} b_j &\geq d + \sum_{j \in \mathcal{J}} k_j + \kappa k_s \\ f(k) + \sum_{j \in \mathcal{J}} k_j (1 - \delta) &\geq R \sum_{j \in \mathcal{J}} b_j + w' \end{aligned}$$

collateral constraints on secured and unsecured borrowing

$$\theta_j k_j (1 - \delta) \geq R b_j, \qquad \forall j \in \mathcal{J},$$

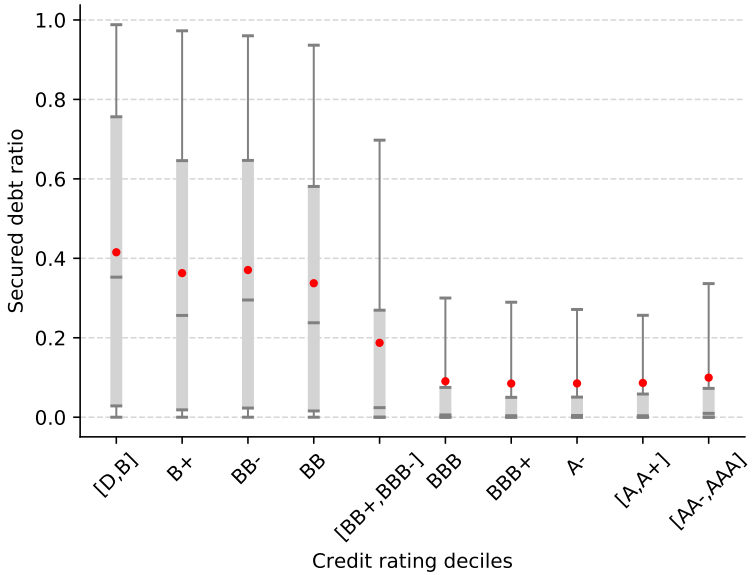
where $k = \sum_{j \in \mathcal{J}} k_j$ and $\mathcal{J} \equiv \{s, u\}$.

- Borrower incurs cost of secured debt; not reflected in interest rate

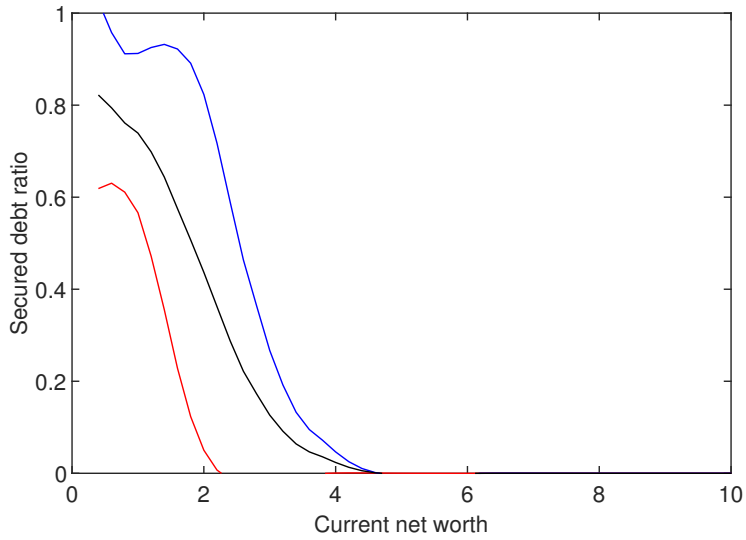
Choice between Secured and Unsecured Debt

- **Constrained firms use secured debt**

Panel A: Secured debt/Total debt – Data



Panel B: Secured debt/Total debt – Model



- Unconstrained firms have unsecured debt in model and data
  - but nevertheless face collateral constraints
  - as unencumbered assets back unsecured debt

(3) Effect of Durability of Assets

- Nature of assets matters – one aspect: **durability**
  - New assets have longer useful life than old assets
  - ~~Alternative: different quality assets depreciate at different rates~~

- **New and old capital**
  - Suppose capital lasts for two periods (one-horse shay depreciation)
  - **New, durable assets** k_N last two periods; price $q_N \equiv 1$ (exogenous)
  - **Old, non-durable assets** k_O one period of useful life left; price q_O
  - Perfect substitutes in production: $k \equiv k_N + k_O$
  - Price of old capital $q_O \equiv q$ determined in (stationary) equilibrium

- Otherwise economy as before but OLG with two-period lived firms
  - For simplicity; more generally stochastic over-lapping generations
  - Firms born with stochastic net worth w

Firm's Problem with Two-Period Assets

- Given net worth w, entrepreneur solves

$$v(w) \equiv \max_{\{d,k_N,k_O,b,w'\} \in \mathbb{R}^3_+ \times \mathbb{R}^2} d + \beta w'$$

subject to budget constraints for current and next period

$$\begin{aligned} w + b &\geq d + k_N + q k_O \\ f(k) + q k_N &\geq Rb + w' \end{aligned}$$

and the collateral constraint

$$\theta q k_N \geq Rb$$

and $k \equiv k_N + k_O$

- Note: only new assets can serve as collateral

Choice between New and Old Capital

- User cost of new and old assets for unconstrained firms

$$\begin{aligned} u_N &\equiv 1 - R^{-1}q \qquad [= R^{-1}(r + (1-q))] \\ u_O &\equiv q \qquad\qquad\qquad [= R^{-1}q(r+1)] \end{aligned}$$

- Down payment on new and old assets

$$\begin{aligned} \wp_N &\equiv 1 - R^{-1}\theta q \quad [= u_N + R^{-1}(1-\theta)q > u_N] \\ \wp_O &\equiv q \end{aligned}$$

- Investment Euler equation (multiplier on collateral constraint λ')

$$u_j + \lambda' \wp_j \geq \beta f_k(k)$$

- Basic trade-off: In equilibrium,
  - $\wp_N > \wp_O$ – new assets require higher down payment
  - $u_N \leq u_O$ – new assets have lower user cost

- **(Un)constrained firms buy old (new) assets**

(4) Capital Reallocation and Efficiency

- **Constrained-efficient allocation?**
  - Related: Lorenzoni (2008), Davila/Korinek (2018)

- **Model**
  - Economy as before
  - Stochastic firm net worth w with distribution $\pi(w)$
  - Firms can pay negative dividends to raise funds at cost

$$d_0 - \phi(-d_0) + \beta d_1$$

    where cost of equity issuance $\phi(-d)$, increasing and convex for $d < 0$

- **Planner**
  - Choose allocation and prices subject to same constraints as firms
  - Note: no redistribution except through induced price of old assets

Constrained-Efficient Price

- First-order condition w.r.t. price q (in current period)

$$\int k_O(w)\left(1+\phi_d(w)\right)d\pi(w) = \int k_N^-(w)\left(1+\theta\lambda^-(w)\right)d\pi(w)$$

or

$$\int k_O(w)\left(1+\phi_d(w)\right)d\pi(w) - \int k_N^-(w)d\pi(w)$$
$$= \int \theta k_N^-(w)\lambda^-(w)d\pi(w)$$

- Using market clearing for capital goods ($\int k_O d\pi = \int k_N^- d\pi$)

$$\int \underbrace{k_O(w)\phi_d(w)d\pi(w)}_{\text{distributive externality}} = \int \underbrace{\theta k_N^-(w)\lambda^-(w)d\pi(w)}_{\text{collateral externality}}$$

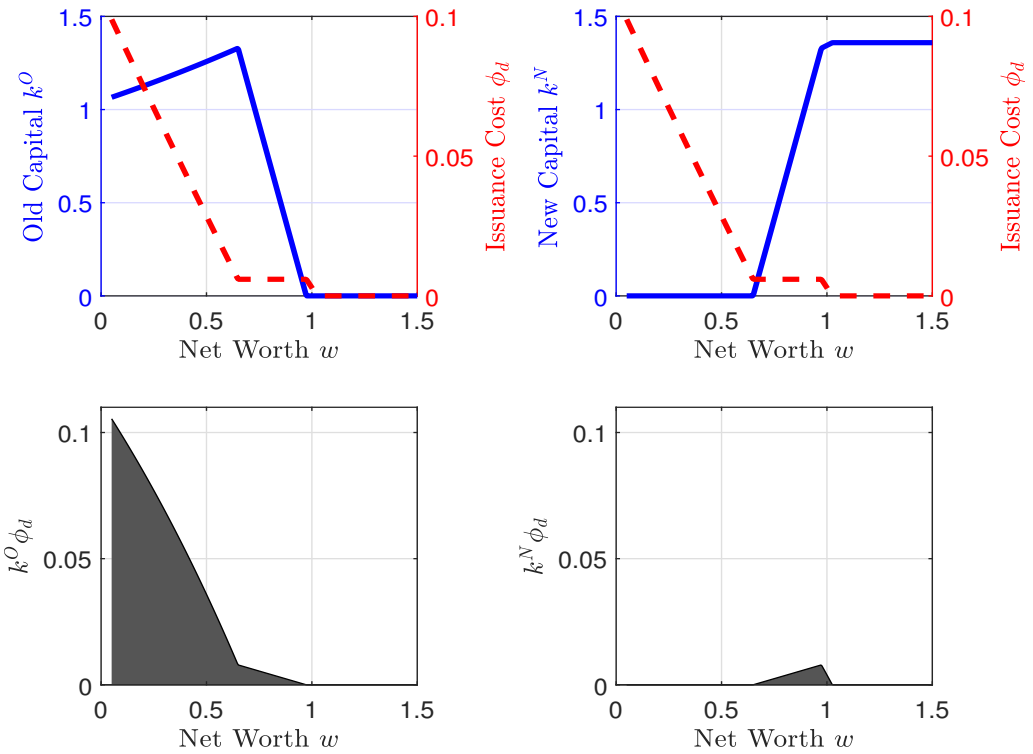
and note that $\phi_d(w) = \lambda(w)$

Externalities at Competitive Equilibrium

- At stationary competitive equilibrium
  - Distributive externality is larger than collateral externality

$$\int k_O(w)\phi_d(w)d\pi(w) > \theta \int k_N(w)\phi_d(w)d\pi(w)$$

  - CE price of old capital is **higher** than constrained-efficient one
- Intuition: constrained firms are net buyers of old capital



Essential Role of Heterogeneity and Reallocation

- **Distributive externality hinges on reallocation in equilibrium**
  - Stationary equilibrium with reallocation

- Representative entrepreneur in steady state – Kiyotaki/Moore (1997)
  - Assets in fixed supply (land)
  - Entrepreneur has constant amount of land in steady state
  - Misallocation, but no reallocation
  - Change in price of land has no effect on budget constraints
  - Only collateral externality

- **Result obtains with assets in fixed supply and OLG firms**
  - Heterogeneity between young and old firms
  - Reallocation of land from old to young firms
  - Distributive externality dominates collateral externality

(5) Financing Adoption of Clean Technology

- New paper: Lanteri/Rampini (2023b)

- **Choice between clean and dirty technologies**
  - Capital requires energy to operate

$$x_j \equiv \min\left\{\frac{e_j}{\gamma_j}, k_j\right\}$$

    where e_j is energy input for type j capital
  - Two types of capital: clean and dirty $\gamma_C < \gamma_D$
  - Production $f(x)$ where $x = \sum_{j \in \mathcal{J}} x_j$

- **Insight: (Un)constrained firms adopt dirty (clean) technologies**
  - Clean capital is expensive reflecting lower energy costs
  - Key: collateral only partially pledgeable

Conclusion

- **Collateral central to finance and hence macro finance**
  - Collateralizable assets matter for financing, not just secured debt
  - Focus on firms but also applies to households
- **Useful laboratory for macro finance**
  - Models as laboratories – Lucas
  - Model is quantitatively and empirically plausible
  - Strength: tractability
- **Applications** (today)
  - Choice between new (durable) vs. old (less durable) capital
  - Choice between clean vs. dirty technologies