Asset Collateralizability and the Cross-Section of Expected Returns

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Introduction

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  - Theory: Agency costs force firms to use collateral to borrow capital
  - Implications: Financial accelerator effect, affect aggregate asset market

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- This paper: are there cross-sectional implications?
  - Theory: Countercylical tightness of the collateral constraint
  - Prediction: Collateralizable asset hedges for aggregate shocks
- Overview of the paper:
  - Theory: a canonical GE model of collateral constraint
  - Quantify the asset pricing implications in the cross-section
  - Supporting evidence: high collateralizability $\Rightarrow$ lower return

Related Literature

- Macroeconomic effects of financial frictions
  - Bernanke and Gertler (1989), Kiyotaki and Moore (1997), Calstrom and Fuerst (1997)
  - This paper: Quantitative asset pricing implications
- The effect of financial frictions on aggregate stock market
  - He and Krishnamurthy (2013), Brunnermeier and Sannikov (2014), Li (2017)
  - This paper: Focus on the cross section
- Literature on whether financial constraints risk is priced: weak evidence
  - Lamount et. al. (2001), Gomes et. al. (2004), Whited and Wu (2006)
  - This paper: Business cycle fluctuations of collateral constraint
  - Asset collateralizability channel, interact with financial constraint

Overview

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- This paper: Quantify the asset pricing implications in the cross section.

Overview

- A canonical GE model of financial frictions
- This paper: Quantify the asset pricing implications in the cross section.
- Household: Two members, worker and entrepreneur
  - Worker
    - Consume, work and save
    - Can only save through a risk-free account with entrepreneur
  - Entrepreneur
    - Borrow from worker, and acquire capital and run a neoclassical firm
    - Face a collateral constraint (micro-funded by limited enforcement)
- Neoclassical non-financial firm

Worker and Non-financial Firm

- Worker's consumption and saving problem:

$$
\begin{aligned}
\max_{C_t, B_t, L_t} U_t &= \left\{ (1-\beta) C_t^{1-\frac{1}{\psi}} + \beta \left(E_t [U_{t+1}^{1-\gamma}] \right)^{\frac{1-\frac{1}{\psi}}{1-\gamma}} \right\}^{\frac{1}{1-\frac{1}{\psi}}} \\
\text{s.t.} \quad C_t + B_t &= R_{t-1}^f B_{t-1} + W_t L_t + \Pi_t
\end{aligned}
$$

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- Non-financial firm
  - Cobb-Douglas production function:

$$Y_t = A_t (K_t^{\phi} H_t^{1-\phi})^{\alpha} L_t^{1-\alpha}$$

  - K_t is collateralizable asset, H_t is non-collateralizable asset
  - A_t is the exogenous aggregate productivity.

Entrepreneurs

- The entrepreneurs come in overlapping generations.
- Each period t, a (1-λ) fraction of entrepreneurs forced to liquidate, and their net worth paid off to household as dividend.
- The measure of new entrepreneurs will come at time t, with initial wealth provided by household.
- Standard assumption for agency frictions in persist in the long run.

Entrepreneurs

- Optimization problem of a typical generation-0 entrepreneur:

$$V_0 = \max_{\{N_{t+1}, K_{t+1}, H_{t+1}, B_t\}_{t=0}^{\infty}} E_0 \left[\sum_{t=1}^{\infty} M_{0,t} \lambda^{t-1} (1-\lambda) N_t \right]$$

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$$N_{t+1} = R_{t+1}^K q_t K_{t+1} + R_{t+1}^H p_t H_{t+1} - R_t^f B_t, t \geq 0$$

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- The stochastic discount factor is MRS from worker's problem.

Asset Markets

- Assets:
  - R^K_{t+1}: Return on collateralizable asset
  - R^H_{t+1}: Return on non-collateralizable asset
  - R^f_t: Risk-free rate for household loan
  - R^l_t: (Shadow) interest rate among entrepreneurs

Asset Markets

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  - R^l_t: (Shadow) interest rate among entrepreneurs
- Recursive form of entrepreneurs' problem

$$\begin{aligned} V(N_t) &= \max_{K_{t+1},H_{t+1},B_t,B^l_t,N_{t+1}} E_t M_{t+1}\left[\lambda V(N_{t+1}) + (1-\lambda) N_{t+1}\right] \\ \text{s.t.} \quad N_t &= q_t K_{t+1} + p_t H_{t+1} - B_t - B^l_t \\ N_{t+1} &= R^K_{t+1} q_t K_{t+1} + R^H_{t+1} p_t H_{t+1} - R^f_t B_t - R^l_t B^l_t \\ B_t &\leq \zeta q_t K_{t+1} \end{aligned}$$

Augmented SDF

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- Augmented SDF for entrepreneurs:

$$\widetilde{M}_{t+1} = M_{t+1} \frac{\lambda \mu_{t+1} + (1-\lambda)}{\mu_t}$$

  - $\lambda \mu_{t+1} + (1-\lambda)$: weighted average of marginal value of net worth
  - The augmented SDF prices R^K_{t+1}, R^H_{t+1} and R^l_t
  - The worker's SDF prices R^f_t

Interest Rates

- Equilibrium conditions for R^f and R^l:

$$\begin{aligned} 1 &= E_t\left[\widetilde{M}_{t+1}\right] R_t^f + \eta_t \\ 1 &= E_t\left[\widetilde{M}_{t+1}\right] R_t^l \end{aligned}$$

  - η_t Lagrangian multiplier of the collateral constraint

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  - η_t Lagrangian multiplier of the collateral constraint

- The interest rate spread

$$R_t^l - R_t^f = \eta_t R_t^l$$

  - Limits to arbitrage: $R_t^l - R_t^f > 0$ when constraint is binding, $\eta_t > 0$
  - The spread disciplines the calibrated tightness of financial constraints

Capital Returns

- Equilibrium conditions for R^K and R^H:

$$\begin{aligned} 1 &= E_t\left[\widetilde{M}_{t+1} R^H_{t+1}\right] \\ 1 &= E_t\left[\widetilde{M}_{t+1} R^K_{t+1}\right] + \zeta \eta_t \end{aligned}$$

- Return on non-collateralizable asset

$$R^H_{t+1} = \frac{\overbrace{MPK^H_{t+1} + p_{t+1}(1-\delta_H)}^{Y^H_{t+1}}}{p_t}$$

- Return on collateralizable asset

$$R^K_{t+1} = \frac{\overbrace{MPK^K_{t+1} + q_{t+1}(1-\delta_K)}^{Y^K_{t+1}}}{q_t}$$

Capital Returns

- Valuation for non-collateralizable asset:

$$p_t = \underbrace{\frac{E_t(Y^H_{t+1})}{R^I_t}}_{\text{time discount}} + \underbrace{Cov_t\left[\widetilde{M}_{t+1}, Y^H_{t+1}\right]}_{\text{discount for risk}}$$

- Valuation for collateralizable asset:

$$q_t = \frac{E_t(Y^K_{t+1})}{R^I_t} + Cov_t\left[\widetilde{M}_{t+1}, Y^K_{t+1}\right] + \underbrace{\frac{\zeta\eta_t}{1-\zeta\eta_t} E_t\left[\widetilde{M}_{t+1} Y^K_{t+1}\right]}_{\text{marginal value of relaxing the constraint}}$$

- Hedging: countercyclical $\eta_t \Rightarrow$ countercyclical marginal value of relaxing constraint

Decomposition of Expected Return Spread

- Expected return spread

$$E_t[\widetilde{M}_{t+1}(R^H_{t+1} - R^K_{t+1})] = \zeta \eta_t$$

- Decomposition

$$E_t[R^H_{t+1} - R^K_{t+1}] = \underbrace{\frac{\zeta(R^l_t - R^f_t)}{E_t[\widetilde{M}_{t+1}]}}_{\text{liquidity premium}} \underbrace{-R^l_t Cov_t(\widetilde{M}_{t+1}, R^H_{t+1} - R^K_{t+1})}_{\text{risk premium}}$$

- Testable implication: TED predicts expected return spread.

Impulse Responses of Negative TFP shock

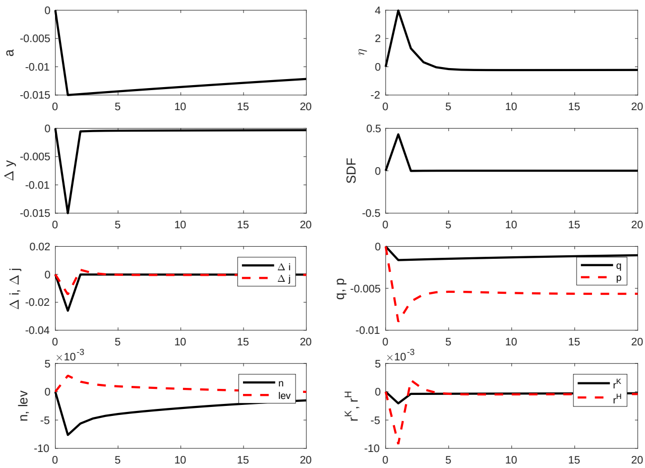

Figure : Impulse Responses of Negative TFP shock

Empirical Targets

- Measure Firm Collateralizability
- Sort portfolio on collateralizability
  - Finding: Firms with high proportion of collateralizable assets earn lower return.
- Interact portfolio sorting with financial constraint measure
  - Finding: The effect more pronounced among constrained firms.
- Conditional AP test
  - Finding: The effect more pronounced under tight aggregate liquidity condition.

Collateralizability Measure

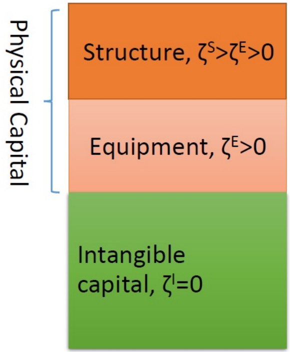

Figure : Collateralizability Measurement Framework

Collateralizability Measure

- The collateral constraint:

$$B \leq \zeta_S S + \zeta_E E$$

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- Empirical implementation: Focus on a subset of financing constrained firms:

$$\frac{B_{i,t}}{AT_{i,t}} = \zeta_S \theta^S_{i,t} + \zeta_E \theta^E_{i,t}.$$

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- $\theta^S_{i,t}$ and $\theta^E_{i,t}$: the share of structure and equipment in book asset, $AT_{i,t}$.

$$\theta^s_{i,t} = \frac{S_{j,t}}{FA_{j,t}} \times \frac{PPENT_{i,t}}{AT_{i,t}},$$

$$\theta^E_{i,t} = \frac{E_{j,t}}{FA_{j,t}} \times \frac{PPENT_{i,t}}{AT_{i,t}},$$

  - $\frac{S_{j,t}}{FA_{j,t}}$ and $\frac{E_{j,t}}{FA_{j,t}}$: industry specific ratio of structure and equipment w.r.t. total fixed asset, from BEA fixed asset table.

Collateralizability Measure

- Book leverage regression:

$$\frac{B_{i,t}}{AT_{i,t}} = const + \zeta_S \theta^S_{i,t} + \zeta_E \theta^E_{i,t} + \gamma X_{it} + \sum_j Industry_j + \sum_t Year + \varepsilon_{i,t},$$

where X_{it} are controls including profitability, Q, earnings volatility, marginal tax rate and the rating dummy.

Collateralizability Measure

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  where X_{it} are controls including profitability, Q, earnings volatility, marginal tax rate and the rating dummy.

- The collateralizability measure:

$$\frac{\left(\widehat{\zeta}_S \theta^S_{i,t} + \widehat{\zeta}_E \theta^E_{i,t}\right) AT_{i,t}}{PPENT_{i,t} + In\tan_{i,t}}.$$

- It measures the proportion of firms collateralizable assets with respect to the firm's total physical plus intangible asset.
- Intangible capital measure: Peters and Taylor (2016)

Capital Structure Regression

Table : Capital Structure Regressions (Book Leverage)

	Whole sample	Dividend		SA index		WW Index	
		uncons.	cons.	uncons.	cons.	uncons.	cons.
ζ_S	0.110***	0.0849***	0.142***	0.0952***	0.0799***	0.0982***	0.0774***
	(15.29)	(9.81)	(11.47)	(11.15)	(5.83)	(11.46)	(5.96)
ζ_E	0.0330***	0.0101	0.0672***	0.00959	0.0399***	0.0104	0.0257**
	(5.41)	(1.42)	(6.19)	(1.34)	(3.39)	(1.44)	(2.34)
Obs	73614	34753	38779	42934	29735	37994	35157
r2	0.277	0.285	0.288	0.280	0.304	0.289	0.292

t statistics in parentheses
* $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$

Univariate Portfolio Sorting

Table : **Univariate Portfolio Sorting on Asset Collateralizability, Equal Weighted**

	1	2	3	4	5	1-5
	Financially constrained firms, SA index					
$R^e(\%)$	1.60	1.33	1.21	1.03	0.89	0.71
(t)	4.26	4.35	4.25	3.80	3.19	3.04
$\sigma(\%)$	8.17	6.66	6.18	5.90	6.09	5.05
	Financially unconstrained firms, SA index					
$R^e(\%)$	1.14	1.00	0.94	0.85	0.77	0.37
(t)	4.55	3.99	3.64	3.36	2.94	2.87
$\sigma(\%)$	5.47	5.48	5.61	5.47	5.69	2.84
	Whole sample					
$R^e(\%)$	1.49	1.21	1.03	0.96	0.81	0.67
(t)	4.42	4.41	3.98	3.67	3.00	3.72
$\sigma(\%)$	7.32	5.98	5.63	5.67	5.92	3.93

Univariate Portfolio Sorting

Table : **Univariate Portfolio Sorting on Asset Collateralizability, Value Weighted**

	1	2	3	4	5	1-5
	Financially constrained firms, SA index					
$R^e(\%)$	0.90	0.83	0.86	0.66	0.37	0.54
(t)	2.54	2.39	2.76	2.36	1.23	2.21
$\sigma(\%)$	7.77	7.58	6.80	6.09	6.49	5.28
	Financially unconstrained firms, SA index					
$R^e(\%)$	0.76	0.59	0.64	0.63	0.53	0.23
(t)	3.60	2.60	2.79	3.03	2.44	1.39
$\sigma(\%)$	4.58	4.98	4.99	4.57	4.69	3.64
	Whole sample					
$R^e(\%)$	0.77	0.62	0.55	0.60	0.48	0.29
(t)	3.62	2.75	2.56	2.77	1.81	1.55
$\sigma(\%)$	4.61	4.93	4.67	4.69	5.74	4.05

Univariate Portfolio Sorting

Table : **Univariate Portfolio Sorting, Other Financial Constraints Measure**

	SA index		Dividend		WW Index	
	uncons.	cons.	uncons.	cons.	uncons.	cons.
	Value Weighted Portfolios					
(1)-(5)	0.23	0.54	0.09	0.40	0.19	0.43
t-stat	1.39	2.21	0.53	2.22	1.23	1.94
	Equal Weighted Portfolios					
(1)-(5)	0.37	0.70	0.39	0.65	0.42	0.70
t-stat	2.87	3.04	3.02	3.32	4.23	3.37

Table : **Asset Pricing Tests (sort on collateralizability)**

Panel A: Carhart Four-Factor Model

	1	2	3	4	5	1-5
	Financially constrained firms, SA index					
α	0.28	0.20	0.23	-0.03	-0.40	0.68
(t)	1.92	1.51	2.05	-0.31	-2.65	3.05
	Financially unconstrained firms, SA index					
α	0.30	0.10	0.15	0.08	-0.12	0.42
(t)	3.49	1.19	2.24	1.03	-1.11	2.55
	Whole sample					
α	0.31	0.08	0.05	0.03	-0.20	0.50
(t)	3.29	0.95	0.75	0.41	-1.58	2.97

Panel B: Fama-French Five-Factor Model

	1	2	3	4	5	1-5
	Financially constrained firms, SA index					
α	0.51	0.38	0.28	-0.07	-0.56	1.07
(t)	3.12	2.86	2.42	-0.81	-3.08	4.08
	Financially unconstrained firms, SA index					
α	0.23	-0.01	0.12	-0.05	-0.26	0.49
(t)	2.62	-0.12	1.69	-0.56	-2.28	2.73
	Whole sample					
α	0.25	0.10	-0.01	-0.07	-0.28	0.53
(t)	2.75	1.20	-0.09	-1.08	-1.64	2.53

Conditional Moments

- TED spread: LIBOR minus Tbill, aggregate funding liquidity measure
- Predictive regression: TED predicts 1-month ahead excess return spread.

Table : **Predictive Regression by TED**

	Whole Sample	SA index		Dividend		WW Index	
		uncons.	cons.	uncons.	cons.	uncons.	cons.
TED(-1)	0.063	0.087*	0.203***	0.016	0.107**	0.095*	0.106*
	(0.057)	(0.051)	(0.074)	(0.060)	(0.052)	(0.056)	(0.064)
const	0.088	-0.194	-0.410	-0.023	0.067	-0.273	-0.020
	(0.383)	(0.305)	(0.436)	(0.356)	(0.304)	(0.290)	(0.365)
N	359	359	359	359	359	359	359

Summary

- This paper: cross-sectional implications of collateral constraint
  - Theory: Countercylical tightness of the collateral constraint
  - Prediction: Collateralizable asset hedges for aggregate shocks
- Overview of the paper:
  - Theory: a canonical GE model of collateral constraint
  - Quantify the asset pricing implications in the cross-section
  - Compelling evidence: high collateralizability $\Rightarrow$ lower return

Appendix: Firm Characteristics

Table : **Firm Characteristics on Collateralizability Sorted Portfolios**

	1	2	3	4	5
Collateralizability	0.029	0.049	0.066	0.087	0.130
Collateralizable/AT	0.041	0.047	0.051	0.063	0.071
Book leverage	0.090	0.173	0.197	0.214	0.209
Market leverage	0.049	0.135	0.181	0.205	0.198
BM	0.432	0.568	0.637	0.658	0.649
log(ME)	4.270	5.034	5.145	5.196	5.156
KZ	-3.503	-1.678	-1.043	-0.240	-0.435
WW	-0.186	-0.247	-0.267	-0.275	-0.272
SA	-2.518	-2.967	-3.090	-3.119	-3.118
Dividend Paying (%)	31.90	44.11	51.57	53.16	49.76