Asset Specificity of Non-Financial Firms

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Motivation

- Specificity is a fundamental feature of production assets in practice.
  - Assets are heterogeneous and specialized, rather than homogeneous.

- Asset specificity key to many economic issues:
  1. Investment irreversibility, impact of uncertainty
  2. Contracting: debt, firm organization
  3. Productivity/misallocation
  4. Returns to scale, concentration...

- But challenging to measure.
  - How do we know if one asset is more specific than another?
  - What are determinants of asset specificity?

- Poses obstacles for empirical and quantitative analyses.

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Overview

1. **Systematic measures** of asset specificity across industries
   - For plant, property, equipment; inventory; receivable; intangibles...
     - ★ Detailed analyses in US bankruptcy filings
     - ★ Recovery rate: liquidation value/book value (cost net of depreciation)

2. **Determinants** of asset specificity
   - **Physical attributes** that make some assets more specific than others
     - ★ Physical foundations of economic properties
   - **Macroeconomic and industry conditions** may also matter
     - ★ More for non-firm specific assets

3. **Implications**
   - Traditional investment theory
     - ★ **Investment irreversibility**: investment & pricing behavior
   - "New economy" and **rising intangibles**
     - ★ Physical of non-financial firms already highly specific
     - ★ Intangibles may not affect firms' liquidation values by much

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Asset Specificity

$$\underbrace{\frac{\text{Value in alternative use}}{\text{Cost (book value)}}}_{\text{Our Data: Recovery Rate}}$$

Models of investment irreversibility:

- When firms disinvest, they receive only λI.
- Ramey-Shapiro 01: $\lambda \approx 0.28$.
  Bloom 09: $\lambda \approx 0.66$. Lanteri 18: $\lambda \approx 0.93$.

Models of traditional collateral constraints:

- Firms can pledge physical assets and borrow λK.
- Moll 14: $\lambda = 0.17$ (baseline), 0.76 (US). Midrigan-Xu 14: $\lambda = 0.86$.
  Catherine-Chaney-Huang-Sraer-Thesmar 18: $\lambda \approx 0.15$.

Asset Specificity

$$\underbrace{\frac{\text{Value in alternative use}}{\text{Cost (book value)}}}_{\text{Our Data: Recovery Rate}} \times \frac{\text{Cost}}{\text{Value in current use}} = \frac{\text{Value in alternative use}}{\text{Value in current use}}$$

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   - Data
   - Asset-Level Specificity
   - Firm-Level Specificity
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   - Macro and Industry Conditions
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   - Traditional Investment Theories
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   - A Short Note on Debt

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Data Source

- Hand collect liquidation recovery rates across asset types & industries
  - From liquidation analysis in Ch11 cases
  - Reports value of each type of asset if the firm gets liquidated
  - Asset types: plant, property, equipment (PPE); inventory; receivables...
  - Case coverage: 2000–2016
  - Liquidation recovery rate: liquidation value/book value (cost)
- Liquidation: Ch 7 —cease operations and sell off individual assets
  - Liquidation value estimates commonly derive from specialist appraisals: on-site field examinations, simulate live liquidations
- Industry average liquidation recovery rate λ_{ij}:
  - λ_{ij}: average liquidation recovery rate of asset type j in industry i
- Data covers $\sim$50 industries and all major asset categories

Data: Asset Specificity

Raw Data: Liquidation Analysis Example from Bankruptcy Filings

Liquidation Analysis Example: LyondellBasell

Obligor Debtors
Liquidation Analysis

Exhibi

(MILLIONS)	NBV	Low	High	Midpoint
Cash & Equivalents & Short Term Investments	$238.1	$238.1	$238.1	$238.1
Trade Accounts Receivable	1,248.1	748.9	873.7	811.3
Other Receivables	268.1	8.4	57.0	32.7
Intercompany Receivables	30,474.1	0.0	0.0	0.0
Inventory	1,872.5	1,295.9	1,511.0	1,403.5
Prepaids and Other Current Assets	305.4	0.0	0.0	0.0
Property, Plant & Equipment, net	9,366.5	1,577.4	1,577.4	1,577.4
Investments and Long-Term Receivables	27.5	0.2	1.8	1.0
Intercompany Investments	43,823.1	336.1	373.1	354.6
Intangible Assets, net	1,254.1	427.6	427.6	427.6
Insurance Proceeds	0.0	0.0	229.6	114.8
Other Long-Term Assets	72.2	61.6	63.6	62.6
Gross Proceeds	$88,949.4	$4,694.2	$5,352.9	$5,023.5
Costs Associated with Liquidation:				
Payroll/Overhead		(93.9)	(107.1)	(100.5)
Liquidation Costs of PP&E		(157.7)	(157.7)	(157.7)
Chapter 7 Trustee Fees		(140.8)	(160.6)	(150.7)
Chapter 7 Professional Fees		(70.4)	(80.3)	(75.4)
Net Estimated Proceeds before EAI Assets		$4,231.3	$4,847.2	$4,539.2

detail

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Asset-Level Recovery Rates

By SIC2 Industry

Average liquidation recovery rates by industry & asset type ($\lambda_{i,j}$)

- Plant, Property, and Equipment (PPE)
  - Mean: **0.33**; 75th: 0.43; 25th: 0.24
  - High: Transportation (0.69), Lumber (0.58), Wholesale (0.57)
  - Low: Personal services (0.08), Educational services (0.15)
- Inventory
  - Mean: **0.44**; 75th: 0.56; 25th: 0.32
  - High: Auto dealers (0.88), Apparel stores (0.75), Supermarkets (0.75)
  - Low: Restaurants (0.14), Special construction (0.2), Telecom (0.26)

Checks for Data Informativeness

1. Auction recovery rate of equipment in aerospace manufacturing
   - **28%** in Ramey-Shapiro 01 ; **32%** in our data
2. Total liquidation proceeds in Chapter 7
   - Chapter 7 reports total receipts by trustee (not by asset category)
   - Also need to impute value of "abandoned" assets
3. Liquidation value benchmarks used by lenders
   - PPE: lend **20% to 30%** of book value for avg non-financial firm
4. Recovery rate implied by PPE sales of Compustat firms
   - Sale proceeds: SPPE. Calculate implied net book value of PPE sold.
   - Levels match. 0.4 correlated across industries.

Consistent w/ market-based transactions & firms in general

- Asset specificity shaped by physical attributes of assets in an industry

check2 check3 check4

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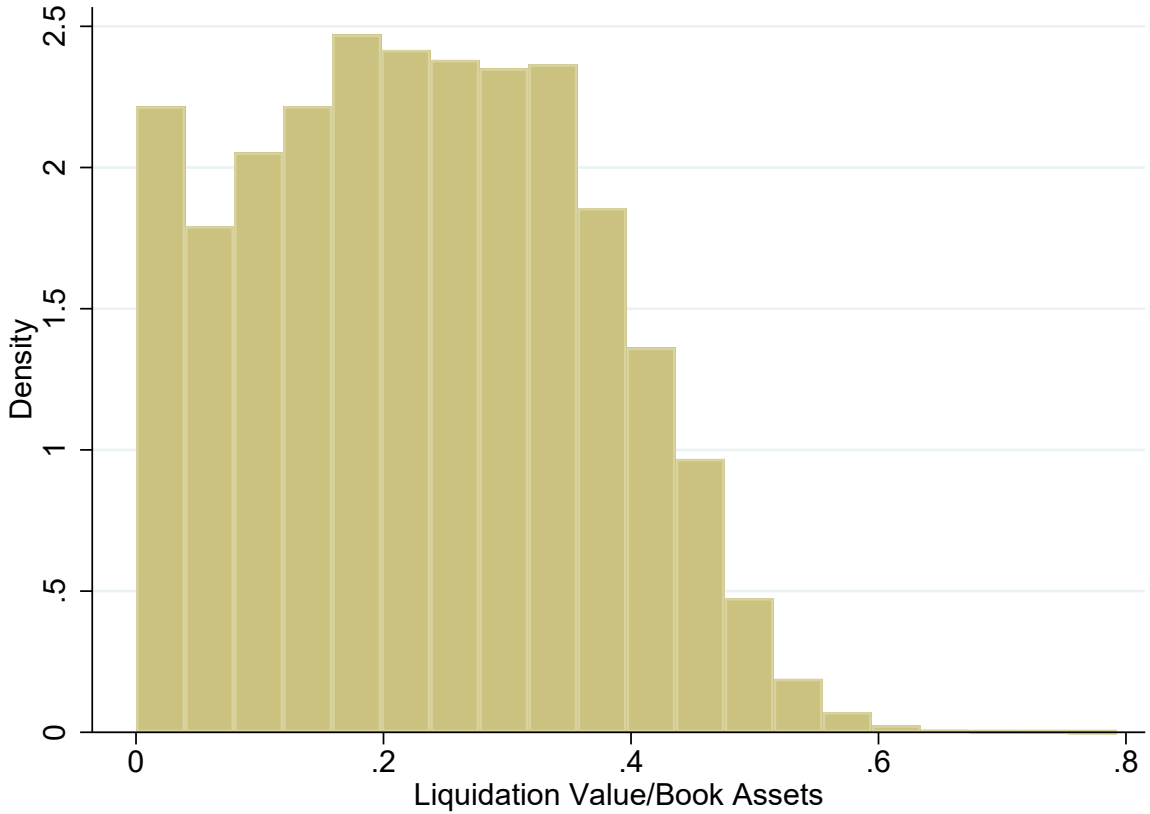
Firm-Level Liquidation Values

- Firm-level liquidation value: $Liq_t^k = \sum_j \lambda_{ij} NBV_{jt}^k$
  - λ_{ij}: liquidation recovery rate of asset j in industry i
  - NBV_{jt}^k: net book value of asset type j in year t for firm k
  - Liq_t^k can be calculated for Compustat firms
- Assumption: firms in a given industry use similar assets
  - E.g., steel mills use similar equipment
  - Later connect λ_{ij} to physical attributes of assets in industry
- Industry-average liquidation value: mean of Liq_t^k in industry i

lease

Firm-Level Liquidation Values

Firm-Level Liquidation Value (PPE + Working Capital)/Book Assets



Mean: 0.23; 75th: 0.33; 25th: 0.12

comp tev

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Determinants of Asset Specificity: Physical Attributes

A. Overview

- Mobility
  - Some assets very mobile (e.g., aircraft, vehicle)
  - Some assets location specific (e.g., heating system, shelf)
- Durability
  - Some assets perishable (e.g., fresh food)
  - Some assets last long (e.g., buildings)
- Standardization/customization
  - Some assets highly customized (e.g., optical lenses)
  - Some assets relatively standardized (e.g., trucks)

framework

Determinants of Asset Specificity: Physical Attributes

B. Assessing Physical Attributes of Assets

How to measure physical determinants of asset specificity?

1. Capital stock composition in each industry
   - BEA Fixed Asset Table: 71 types of equipment & structures
2. Attribute of each type of asset
   - Mobility: transportation cost (BEA I-O)
   - Durability: depreciation rate (BEA/Compustat)
   - Standardization: design cost/total production cost of asset (BEA I-O)
3. Industry's overall asset attribute
   - Weighted average using capital stock composition

Use 1997 BEA tables

detail

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Determinants of Asset Specificity: Physical Attributes

B. Assessing Physical Attributes of Assets

Mobility (transportation cost/production cost of asset)

- Low mobility: nuclear fuel, furniture
  High mobility: ships, aircraft, electronics

Durability (depreciation rate of asset)

- Low durability: office equipment
  High durability: railroad, pipeline, sewage system

Standardization/customization (design cost/production cost of asset)

- Low standardization: telecom, special ind machinery, fabricated metal
  High standardization: vehicles, mining equipment, nuclear fuel

sumstat

Determinants of Asset Specificity: Physical Attributes

C. Impact of Physical Attributes

Industry-level PPE Recovery Rate		
	Industry Classification	
	2-digit SIC	BEA sectors
Transportation cost	-0.47***	-0.48***
	(0.12)	(0.12)
Depreciation rate	-0.55***	-0.56***
	(0.19)	(0.19)
Design cost share	-1.70**	-1.85**
	(0.83)	(0.86)
Industry size (sales share)		0.41
		(0.58)
Industry size (value-added share)		
Constant	1.00***	1.03***
	(0.21)	(0.22)
Obs	48	48
R^2	0.39	0.39

Determinants of Asset Specificity: Physical Attributes

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Depreciation rate	-0.55***	-0.56***	-1.62**	-1.83**
	(0.19)	(0.19)	(0.73)	(0.76)
Design cost share	-1.70**	-1.85**	-2.47**	-2.49**
	(0.83)	(0.86)	(0.95)	(0.94)
Industry size (sales share)		0.41		
		(0.58)		
Industry size (value-added share)				1.48
				(1.12)
Constant	1.00***	1.03***	1.13***	1.16***
	(0.21)	(0.22)	(0.19)	(0.19)
Obs	48	48	45	45
R^2	0.39	0.39	0.29	0.33

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Impact of Macro and Industry Conditions

Industry-specific: few industries use the asset.

- Compute HHI for each type of asset. Take assets in top tercile.

Firm-specific: customized to the firm.

- Compute design share in total cost. Take assets in top tercile.

Impact of Macro and Industry Conditions

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For each asset, assign to 4 types. For an ind, calculate % of each type.

1. Not industry-specific & not firm-specific.
   - vehicles
2. Industry-specific & not firm-specific.
   - aircraft, ships, railroad equipment, oil & gas equipment, nuclear fuel
3. Not industry-specific & firm-specific.
   - fabricated metal products, electronic devices
4. Industry-specific & firm-specific.
   - communications structures & equipment

Impact of Macro and Industry Conditions

	Case-level PPE Recovery Rate			
	(1)	(2)	(3)	(4)
GDP gr	0.28	-2.05		
	(0.58)	(3.56)		
GDP gr × % non-ind spec, non-firm spec		8.46**		
		(3.80)		
GDP gr × % ind spec, non-firm spec		3.15		
		(3.19)		
GDP gr × % non-ind spec, firm spec		-7.77		
		(5.15)		
Industry lev			-0.25	0.70
			(0.20)	(0.96)
Industry lev × % non-ind spec, non-firm spec				-1.23
				(1.19)
Industry lev × % ind spec, non-firm spec				-2.52***
				(0.58)
Industry lev × % non-ind spec, firm spec				0.60
				(2.41)
Fixed effect			Industry	

Impact of Macro and Industry Conditions

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Impact of Macro and Industry Conditions

How much industry conditions need to change to bring
PPE recovery rate from highest industries (e.g., transportation ∼69%)
to median (e.g., manufacturing ∼33%)?

To induce a change in PPE recovery rate of ∼35pp—

- For typical industry:
  industry leverage needs to increase by 140 percentage points.
- If industry has 100% industry-specific but not firm-specific assets:
  industry leverage needs to increase by 19 percentage points.

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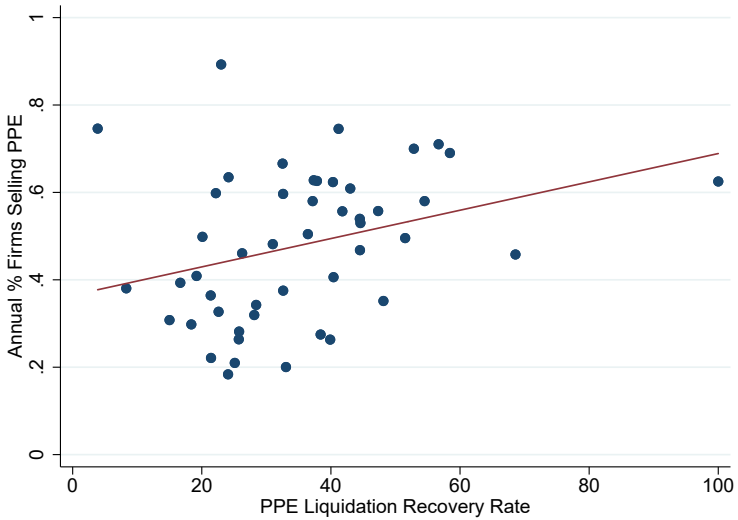
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Impact of Investment Irreversibility

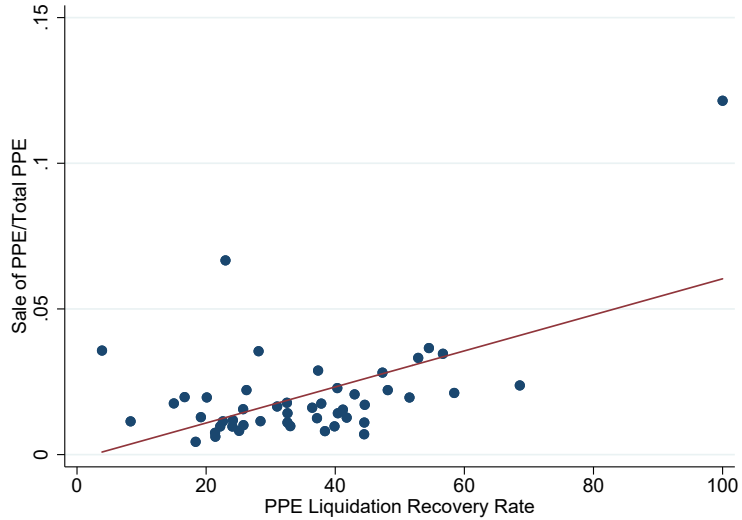
A. Prevalence of Disinvesting

- Higher irreversibility$\rightarrow$ less disinvestment

PPE Sales and PPE Liquidation Recovery Rate



Frequency of PPE Sales



PPE Sold/Net Book PPE

iv table

Impact of Investment Irreversibility

B. Investment Response to Uncertainty

- Higher irreversibility$\rightarrow$ more responsive to uncertainty shocks
  - When investment irreversible, $\exists$ option value for wait and see
  - $I_{i,t+1} = \alpha_i + \eta_{j,t} + \beta\sigma_{i,t} + \phi\lambda_i \times \sigma_{i,t} + \gamma X_{i,t} + \epsilon_{i,t}$

	PPE Invest Rate			Inventory Invest Rate		
	(1)	(2)	(3)	(4)	(5)	(6)
Vol	-3.09***	-5.13***	-3.71***	-4.23***	-4.41***	-3.84***
	(0.40)	(0.82)	(0.46)	(0.55)	(0.94)	(0.83)
Vol $\times$ PPE recovery rate	3.11***	9.32***	2.89**			-1.29
	(1.08)	(2.34)	(1.10)			(1.70)
Vol $\times$ Inventory recovery rate			1.67*	3.85***	4.30*	3.94***
			(0.88)	(1.21)	(2.19)	(1.19)
IV	N	Y	N	N	Y	N
Fixed effect	Firm. Industry-Year.					

determinants

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			(0.88)	(1.21)	(2.19)	(1.19)
IV	N	Y	N	N	Y	N
Fixed effect	Firm. Industry-Year.					

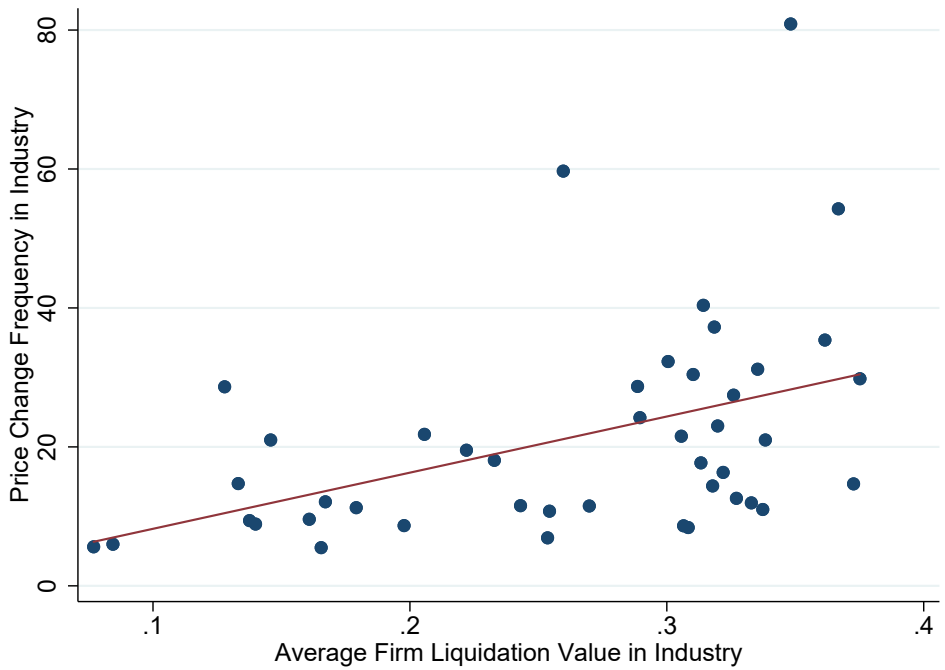
determinants

Impact of Investment Irreversibility

C. Firm-Specific Capital and Price Rigidity

- Firm-specific capital can induce higher price rigidity
  - Sbordone 02, Woodford 05, Altig-Christiano-Eichenbaum-Linde 11
  - More cautious to raise prices in response to positive demand shock
  - If raise price and have excess capacity, cannot reduce capital easily

Asset Specificity and Frequency of Price Change (Nakamura-Steinsson)



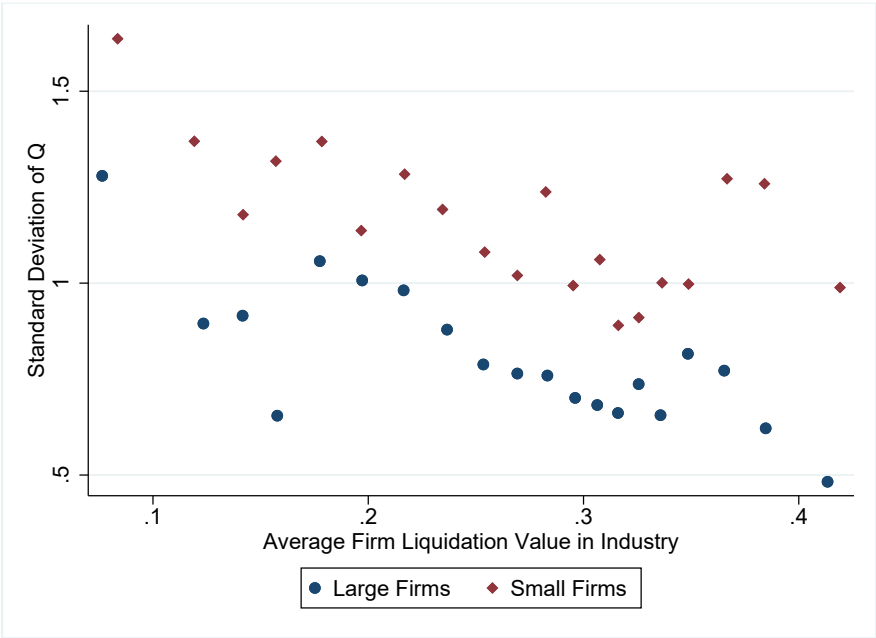
table

Impact of Investment Irreversibility

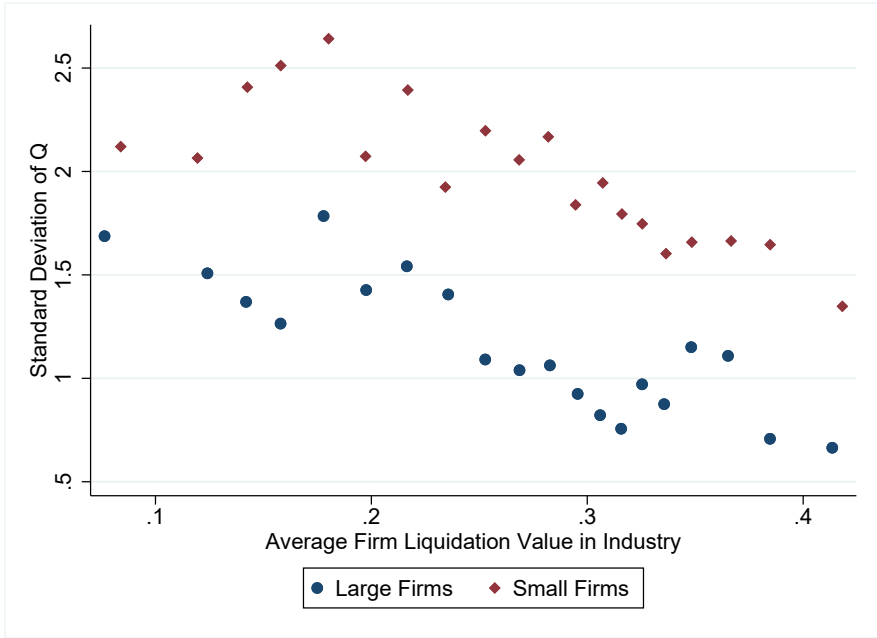
D. Dispersion in Q

- High asset specificity $\rightarrow$ more productivity dispersion
  - More frictions in capital reallocation (Eisfeldt-Rampini 06, Lanteri 18)

Standard Deviation of Q



Regular Q



Q w/ Intangibles

theory table

Outline

1. Overview
2. Asset Specificity of Non-Financial Firms
   - Data
   - Asset-Level Specificity
   - Firm-Level Specificity
3. Determinants of Asset Specificity
   - Physical Attributes
   - Macro and Industry Conditions
4. Implications
   - Traditional Investment Theories
   - The "New Economy" and Rising Intangibles
   - A Short Note on Debt

The "New Economy" and Rising Intangibles

Recent research highlights **rise of intangible assets**

- Intangibles relative to fixed assets rose substantially by all measures Corrado-Hulten-Sichel 05, Haskel-Westlake 18, Crouzet-Eberly 19

Intangibles: production assets without physical presence

Identifiable intangibles:

- Data/software, usage rights/licenses, patent/trademark...
- Sometimes on balance sheet: if purchased from outside.

Non-separable intangibles:

- Organizational capital, "economic competencies"
- Mostly off balance sheet. Sometimes part of goodwill.

The "New Economy" and Rising Intangibles

How does rising intangibles affect firms' asset specificity?

- Common concern: Liquidation value $\downarrow$, tighten borrowing constraints
  - Caggese & Perez-Orive 18, Li 19, Falato et al 20

The "New Economy" and Rising Intangibles

How does rising intangibles affect firms' asset specificity?

- Common concern: Liquidation value $\downarrow$, tighten borrowing constraints
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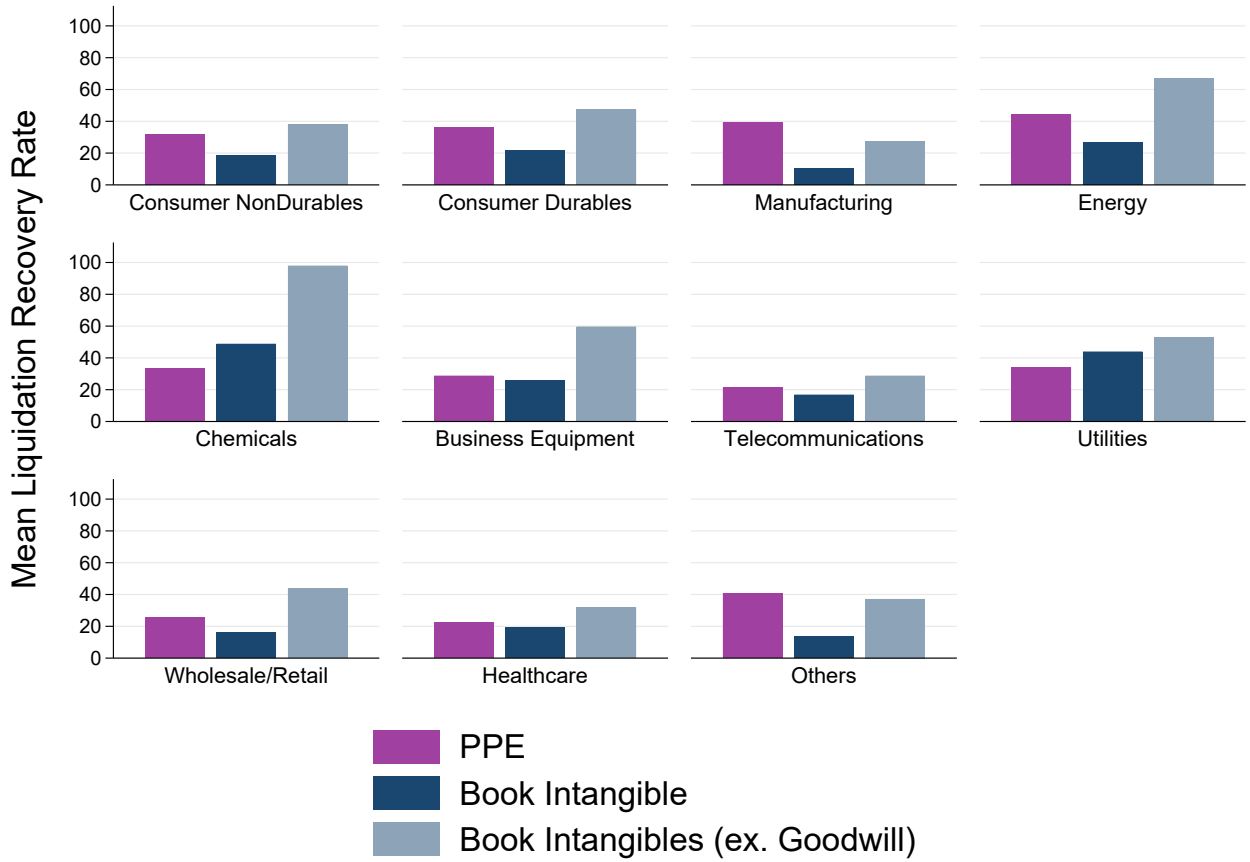
Data: Rising intangibles may not change liquidation values by much

1. Physical assets highly specific in the first place
2. Identifiable intangibles not necessarily more specific
3. Rising intangibles strong in industries w/ specialized physical assets

Rising Intangibles and Liquidation Values

A. Identifiable intangibles not much more specific than PPE

Average Liquidation Recovery Rate: PPE vs. Book Intangibles



Book intangibles: Mean: 16%; IQR: 2% to 25%.

Non-goodwill book intangibles: Mean: 35%; IQR: 4% to 59%.

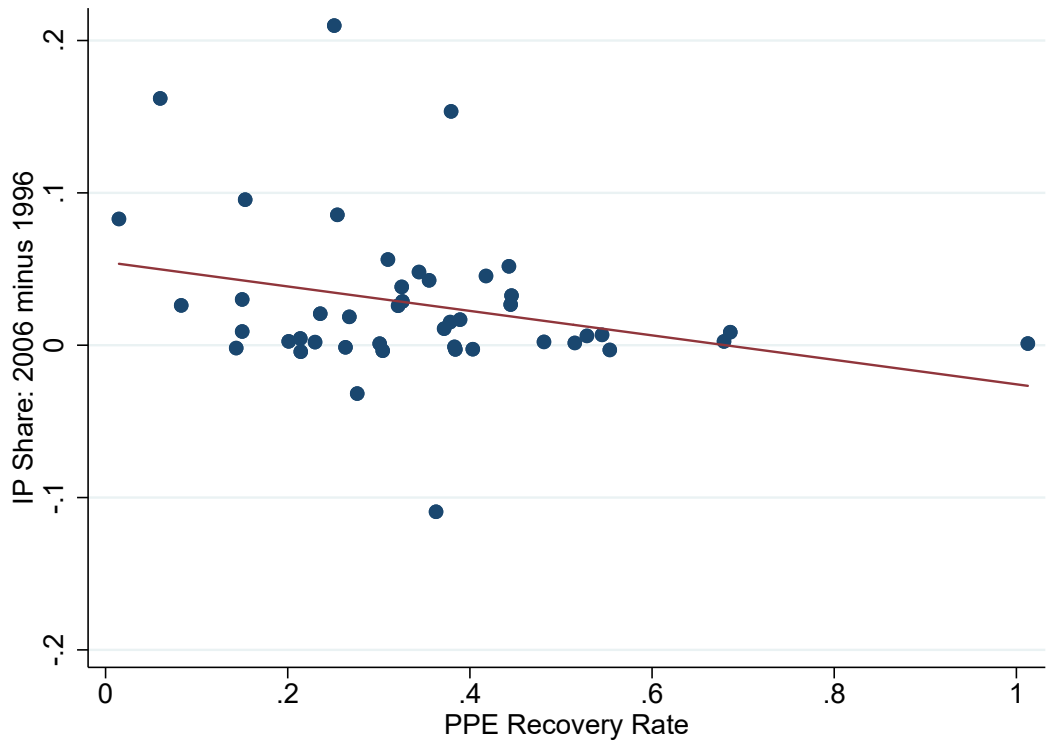
back

Rising Intangibles and Liquidation Values

B. Intangibles rose more in industries w/ higher PPE specificity

BEA industry-level intangible stock: primarily intellectual property

IP/(IP+Fixed Asset): **2016 minus 1996**



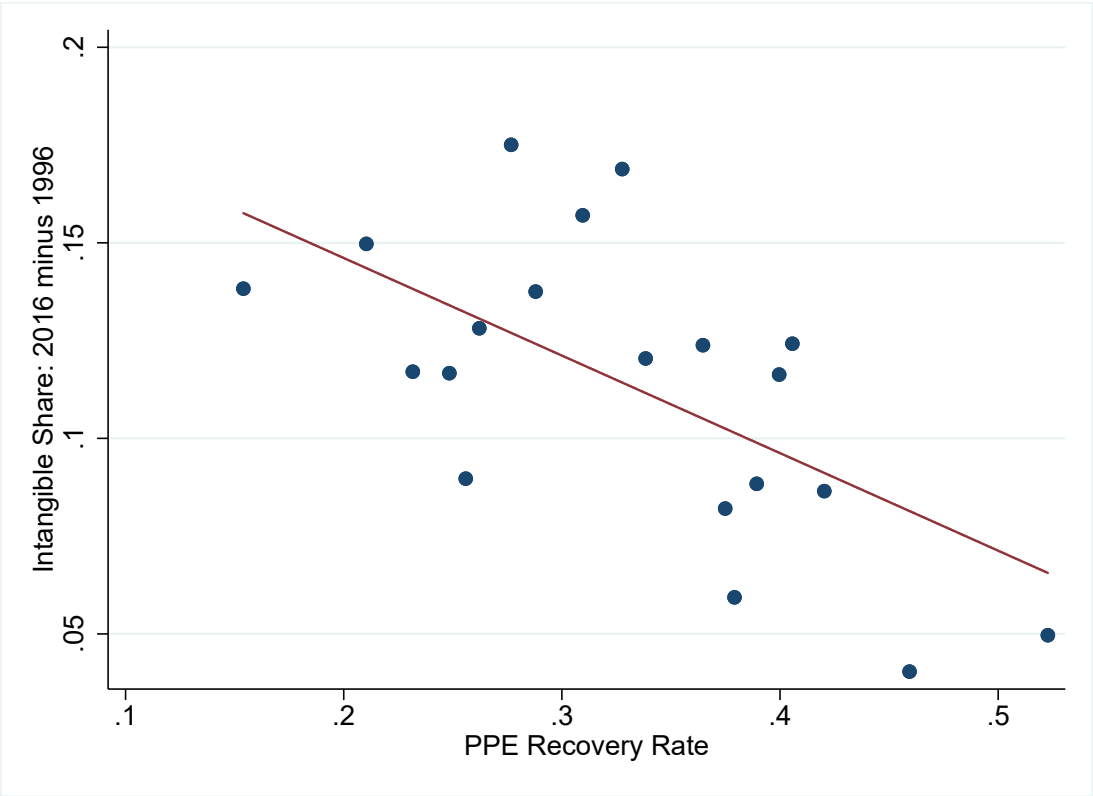
Rising Intangibles and Liquidation Values

B. Intangibles rose more in industries w/ higher PPE specificity

Compustat firm-level intangible stock from Peters-Taylor 17

- Book intangibles + capitalize R&D, 30% of SG&A

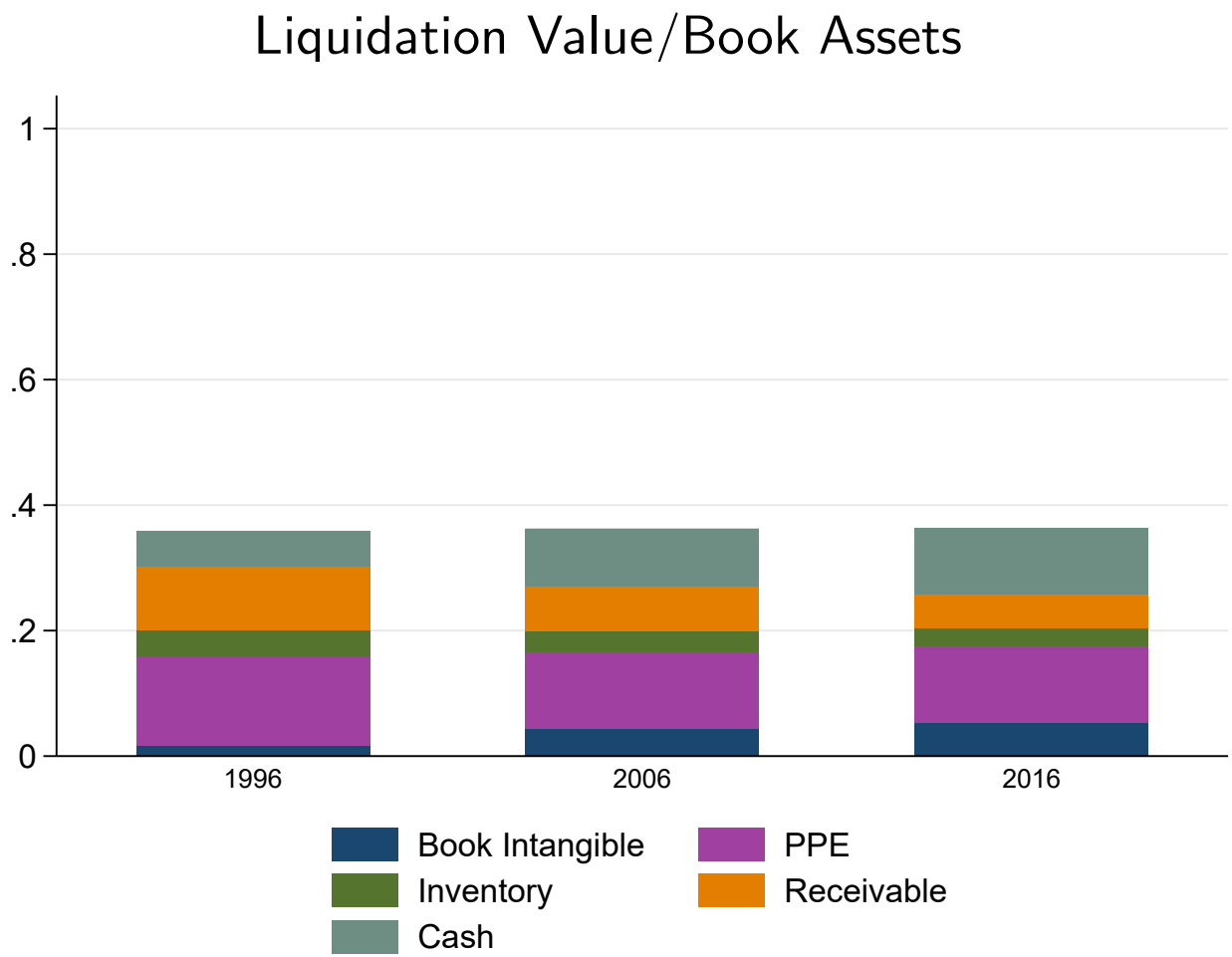
Intangibles/(Intangibles+PPE): **2016 minus 1996**



table

Rising Intangibles and Liquidation Values

C. Estimated firm liquidation value has not changed much



more

What is Different about Intangibles?

- Growth accounting, nature of investment
  - Corrado-Hulten-Sichel 05, Crouzet-Eberly 19
- Economy of scale
  - Crouzet-Eberly 19, Hsieh & Rossi-Hansberg 19

Much to be understood about the nature and impact of intangibles

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Nature of Debt

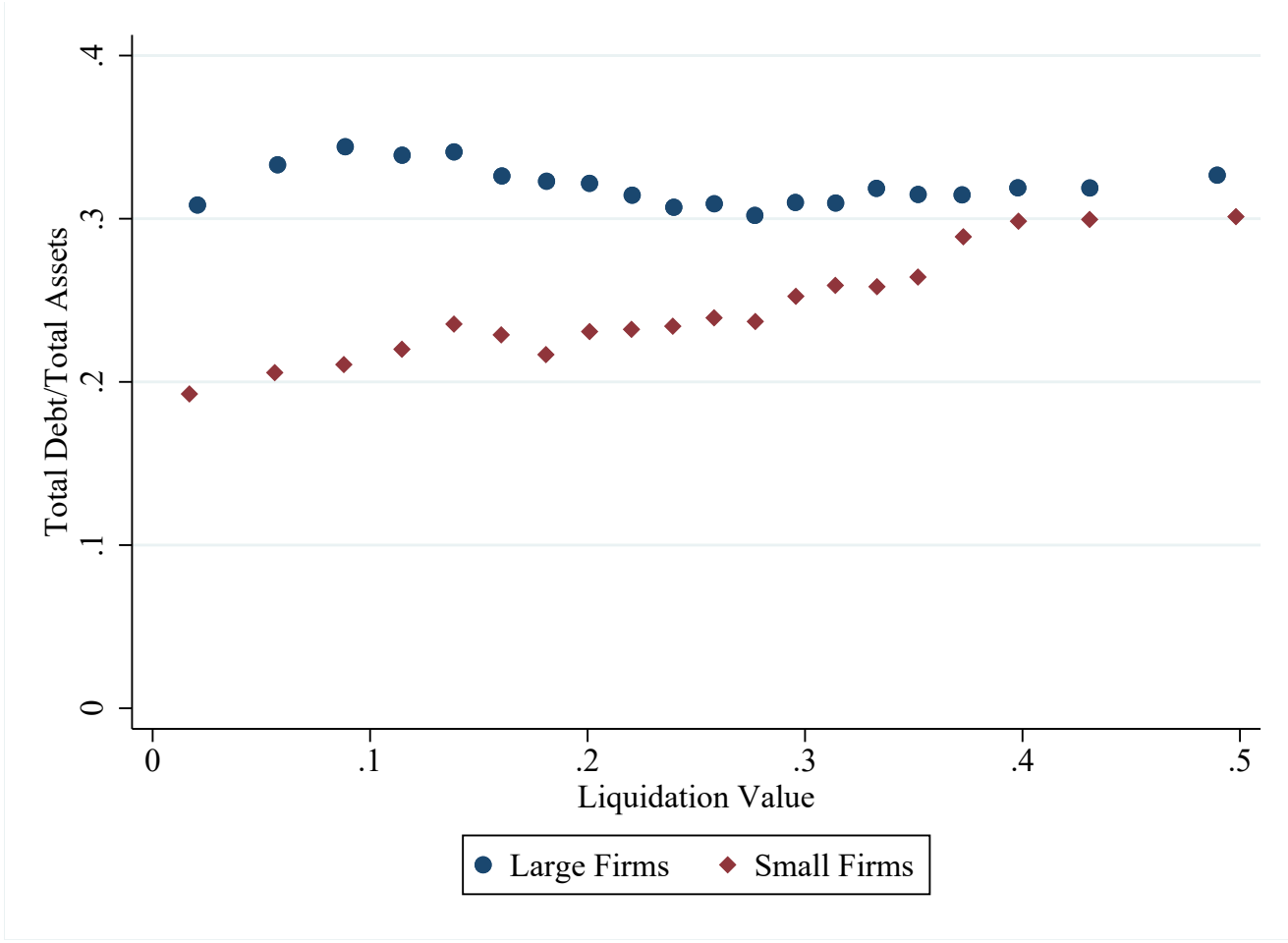
Companion paper on debt contracting (Kermani-Ma 20)

- Large firms, firms with positive earnings:
  - Total borrowing not sensitive to liquidation value
- Small firms, firms with negative earnings:
  - Total borrowing is sensitive to liquidation value
- Liquidation values affect debt composition & contract features

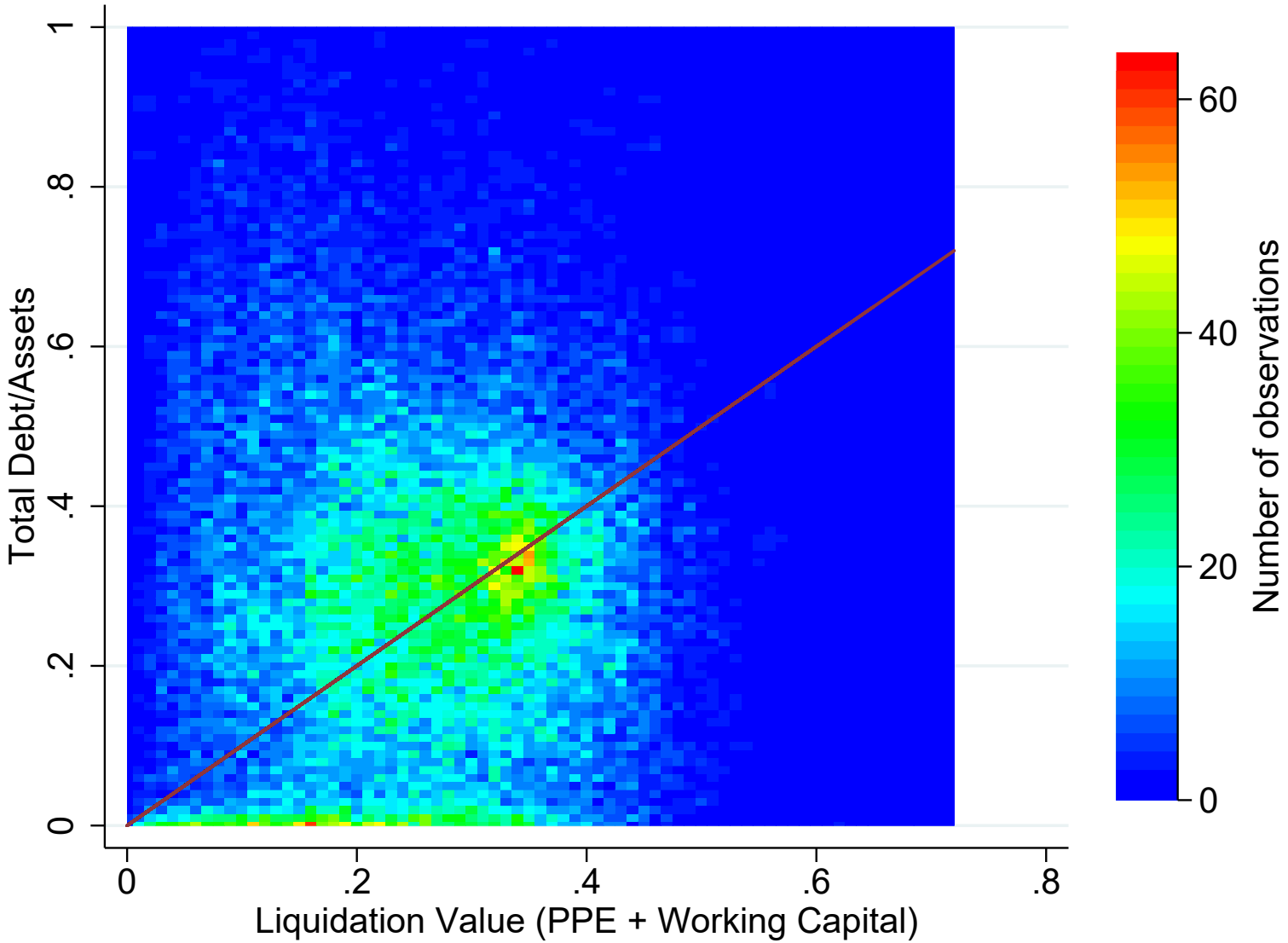
  Not always total debt capacity
  - Many firms borrow based on earnings/cash flow value (Lian-Ma 20)

Borrowing and Liquidation Value

Total Book Leverage (Debt/Assets) and Liquidation Value

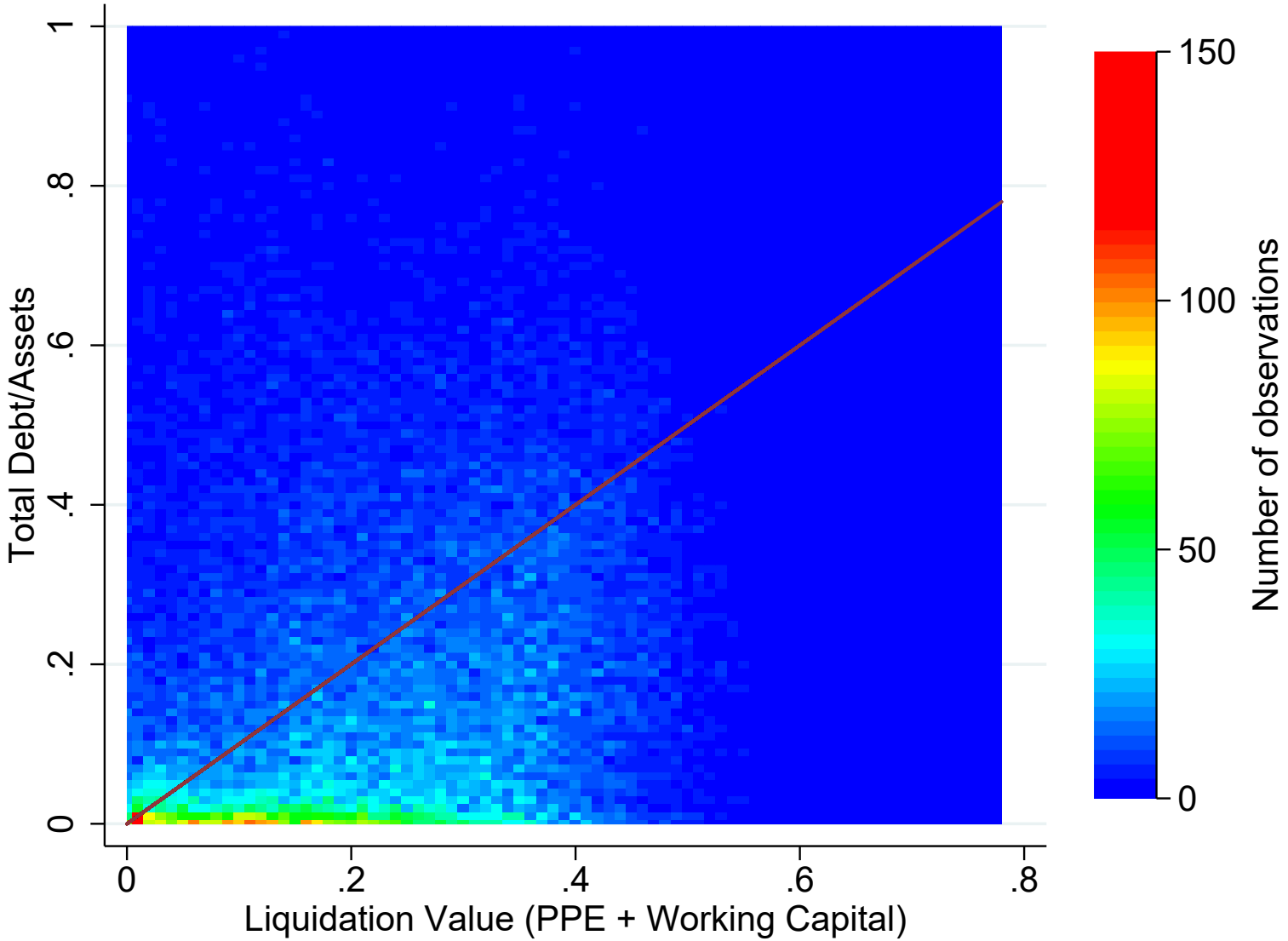


Borrowing and Liquidation Value: Large Firms



more

Borrowing and Liquidation Value: Small Firms



Summary

Comprehensive data on asset specificity across industries and categories

1. Non-financial firms' assets often highly specific (not just "tech firms")
2. Physical bases of economic properties & cross-industry variations
3. Implications for a number of macro-finance issues
   - Investment irreversibility, uncertainty shocks
   - Impact of rising intangibles

Ongoing effort to understand the nature of firms & their assets

- Hope new micro data facilitates a wide range of analyses