”Leverage-based Asset Pricing”

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Swedish House of Finance Conference on
Financial Markets and Corporate Decisions
August 19-20, 2019

Leverage-based Asset Pricing

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Context

Leverage-based asset pricing: extract information about asset prices from the debt side of firms' balance sheets

- information can be encoded in firm characteristics such leverage ratios, debt structures, corporate bond prices, loan prices etc.

Application

Apply 'Leverage-based asset pricing' to the valuation of **private firms**

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Q: Can we use 'credit market equivalent' (CME) valuation to value private firms?

Credit Market Equivalents and the Valuation of Private Firms

Niklas Huether[1] Lukas Schmid [2] Roberto Steri[3]

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- it tells us the value of a payoff to an investor in a particular state in the future (here at horizon j)
    - if times are good at time $t + j$, payoffs are less valuable ($\mathcal{M}_{t+j}$ lower)
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- an asset pricing model is a specification of an SDF
  - under some assumptions it exists and is unique (for example, no arbitrage)

Asset Pricing in Theory 101 and 1/2

If the payoff $X_{t+j} = D_{t+j} + P_{t+j}$, an SDF gives

$$P_t = E_t[\mathcal{M}_{t+j} D_{t+j} + P_{t+j}]$$

and so, for any return $R_{t+j} = \frac{D_{t+j}+P_{t+j}}{P_t}$

$$1 = E_t[\mathcal{M}_{t+j} R_{t+j}]$$

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- if all assets satisfy the equation, they are priced consistently from investors' persepctive
- if the equation is violated for an asset, it may be a good idea to invest in the asset

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Applications:

- $R \rightarrow \mathcal{M}$
  if we observe returns, we can figure out what $\mathcal{M}$ makes the equation hold
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  - what should be the $\mathcal{M}$ for an investor in PE?

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$$\mathcal{M}_{t+1} = \exp(-R_{m,t+1})$$

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- Korteweg and Nagel (2016) propose to value PE investments through

$$\mathcal{M}_{t+1} = \exp(a - bR_{m,t+1})$$

  - this generalized public market equivalent (GPME) valuation is based on the SDF of an investor who is invested in the public stock market *and a risk free asset*
  - Q: would investing in PE improve the investor's risk-return relation?

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In practice, we replace returns on the stock market portfolio $R_{m,t+1}$ with returns on a number j of credit market instruments, $R_{cj,t+1}$

Our stochastic discount factor therefore takes the form

$$\mathcal{M}_{t+1} = \exp(a - \sum_j b_j R_{cj,t+1})$$

Q: would investing in PE improve the risk-return relation of an investor already invested in private firms' debt instruments?

This question makes sense if equity and debt markets are not entirely segmented

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- We build portfolios of debt returns sorted on portfolio company characteristics and ask what factors $R_{cj,t+1}$ help best explain the cross-section of debt returns on PE portfolio companies in our sample
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  - we use LASSO variable selection techniques to identify our factors $R_{cj,t+1}$
- This standard asset pricing procedure yields our SDF

$$\mathcal{M}_{CME,t+1} = \exp(a - \sum_j b_j R_{cj,t+1})$$

  - we use it to compute CME valuations of PE firms' cash flows and compare them to PME and GPME

What We Find

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- Credit-market equivalents of momentum, volatility, value, and liquidity price the cross-section of PE debt market returns
- CME valuation of private equity funds paints a more positive picture of PE performance than PME/GPME valuation in our sample
  - significant underperformance under PME/GPME turns positive or insignificant under CME
  - suggestive of significant exposure of buyout performance to credit factors unrelated to public stock market activity

Data

- PE data: cash flow and valuation data from 121 funds with about 2,400 unique sample portfolio companies with vintage years 1996-2013
  - some portfolio companies exhibit unrealized returns and latest valuations are self-reported
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  - provides bid and ask quotes averaged across all dealers, type of facility (term versus revolver), merged with DealScan providing original amount, currency, country of origination, seniority condition, loan secured, loan base rate, and spread
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- Merged data: Loan pricing data for about eighty percent of the funds
  - funds in merged are slightly smaller than benchmark Preqin sample
  - caveats:..... many!

Result #1: Debt Valuations predict PE performance

	All PE deals		
	Exit uc	log(VM)	Holding R_E
	(1)	(2)	(3)
Distress loan	0.514***		
	(0.078)		
Log average bid price		3.824***	
		(0.614)	
Holding loan return (in %)			1.182*
(holding time as equity)			(0.632)
Loan maturity (yrs)	-0.004	-0.155*	11.019*
	(0.013)	(0.077)	(5.431)
# of quotes	-0.021	0.262***	11.656
	(0.020)	(0.090)	(15.875)
Fund size (m)	0.000	-0.000	0.003
	(0.000)	(0.000)	(0.003)
Equity investment year FE	Yes	Yes	Yes
Industry FE	Yes	Yes	Yes
Observations	299	299	82
Adj. R^2	0.272	0.231	0.213

Estimates of linear probability model of **exit equity performance**

- debt performance predicts predict exit equity performance

Result #1: Debt Valuations predict PE performance

	(1)	(2)	(3)
			with distressed loan
Distress loan	1.335*		
	(0.229)		
Loan maturity (yrs) (t-1)	0.451***	0.451***	0.556***
	(0.044)	(0.043)	(0.106)
# of quotes (t-1)	0.922**	0.923**	0.936
	(0.036)	(0.037)	(0.081)
Log average bid price (t-1)		0.987***	0.980***
		(0.003)	(0.005)
Number of fund-deal-quarters	5,856	5,856	1,753

Estimates of **hazard ratios** associated with GPs' decision to sell/hold portfolio investments

- debt performance predicts exit hazard rates

Result #1: Debt Valuations predict PE performance

	(1)	(2)	(3)	(4)
Taken private	-7.110**	-6.007**	-13.601*	-9.853
	(2.913)	(2.569)	(7.014)	(5.911)
Leverage		-3.936*		-5.251*
		(2.301)		(3.109)
	(2.913)	(2.569)	(7.014)	(5.911)
Growth			2.389***	2.256***
			(0.810)	(0.739)
Stock return			10.545***	10.023***
			(2.511)	(2.140)
Loan maturity (yrs)			-0.910*	-0.829*
			(0.465)	(0.467)
# of quotes			1.347	1.128
			(1.219)	(1.155)
Fund size (m)			-0.000	-0.000
			(0.000)	(0.000)
Inv Qtr-Year FE	Yes	Yes	Yes	Yes
Qtr-Year FE	Yes	Yes	Yes	Yes
Industry FE	Yes	Yes	Yes	Yes
Adj. R^2	0.352	0.362	0.102	0.122
Observations	1,020	1,020	728	728

Regression estimates of avg bid loan prices one quarter after the company is taken private by a private equity firm

- being taken private significantly predicts loan prices *negatively*

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We consider the following characteristics

- spread-to-maturity ('credit spread')
- momentum
- price as a percentage par value ('market-to-book')
- market capitalization ('size')
- volatility
- # of quotes
- bid-ask spreads ('liquidity')
- accruals
- profitability

We find significant return spreads (around 1 to 2 percent annually) associated with these characteristics

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We then follow the standard two-stage regression approach

- run time series regressions of portfolio returns on factors to get exposure ($'\beta'$)
- check whether average portfolio returns line up with exposures in a cross-sectional regression to get risk price ($'\lambda'$)
- $E[R_{c,t+1} - r_f] = \sum_j \beta_{c,j}\lambda_{c,j}$?

We use to LASSO variable selection techniques to identify the relevant factors

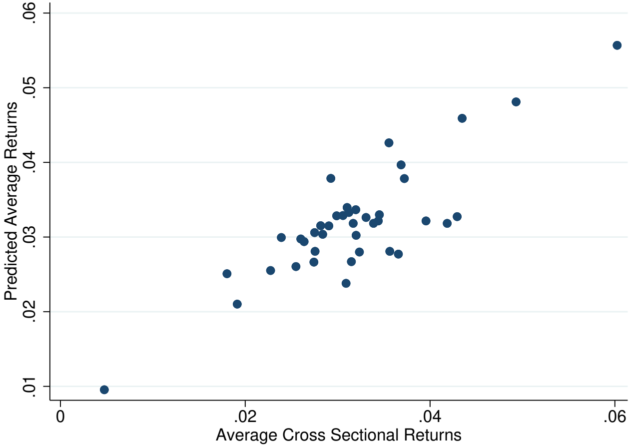
Result #2: Credit Factors price Debt Returns

	(1) rmrf β / SE
Q5mQ1_mom	0.018***
	(0.004)
Q5mQ1_vola	0.017***
	(0.004)
Q5mQ1_price	-0.014***
	(0.003)
Q5mQ1_MV	-0.014***
	(0.003)
Q5mQ1_BA	0.014***
	(0.003)
Adj. R^2	0.596

Results from the second stage regression suggest a five-factor model for debt returns

- momentum, volatility, price ('market-to-book'), market cap ('size'), bid-ask ('liquidity') are significant debt return predictors

Result #2: Credit Factors price Debt Returns



The five-factor model prices quintile portfolios sorted on characteristics well

Result #3: Valuing PE

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Our SDF becomes

$$\mathcal{M}_{t+1} = \exp(a - \sum_j b_j R_{cj,t+1})$$

with

$$R_{c,t+1} = \begin{bmatrix} \text{Q5mQ1mom}_{t+1} \\ \text{Q5mQ1vola}_{t+1} \\ \text{Q5mQ1price}_{t+1} \\ \text{Q5mQ1MV}_{t+1} \\ \text{Q5mQ1BA}_{t+1} \end{bmatrix}$$

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We can use this SDF to price PE cash flows!

This can make sense because debt and equity markets are not entirely segmented, as suggested previously

Result #3: Valuing PE Fund Portfolios

		All Deals	Realized Deals
CME		0.335 (0.357)	-0.013 (0.007)
	$H_0 : CME = 0$	$t = 0.830$ (0.400)	$t = -1.405$ (0.160)
GPME		-0.105 (0.029)	-0.001 (0.002)
	$H_0 : GPME = 0$	$t = -3.610$ (0.001)	$t = -0.460$ (0.650)
PME		-0.115 (0.025)	-0.017 (0.002)
	$H_0 : PME = 0$	$t = -4.590$ (0.000)	$t = -8.690$ (0.000)

- relative to PME and GPME PE deals underperform on average, and mostly significantly so
- performance looks brigher in light of credit market performance through the lens of CME
  - underperformance may reflect credit market exposure
  - account for such exposure in PE performance evaluation

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A: Debt price data help predict PE performance

Q: Can we use 'credit market equivalent' (CME) valuation to value private firms?

A: Accounting for credit market exposure helps understanding PE valuations