Lecture Notes

Livdan, Sapriza, and Zhang (2009, Journal of Finance): Financially Constrained Stock Returns

Lu Zhang[1]

[1]The Ohio State University
and NBER

BUSFIN 8250: Advanced Asset Pricing
Ohio State

Theme

A dynamic investment-based asset pricing model with debt dynamics in the form of collateral constraints

Outline

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Economic Question

In search for a deep integration between investment-based asset pricing and (dynamic) corporate finance

Specifically, how financial constraints affect risk and expected returns?

Outline

Operating profits for firm j with capital k_{jt} and fixed costs f:

$$\pi(k_{jt}, z_{jt}, x_t) = e^{x_t + z_{jt}} k_{jt}^{\alpha} - f$$

in which the aggregate productivity follows:

$$x_{t+1} = \bar{x}(1 - \rho_x) + \rho_x x_t + \sigma_x \, \epsilon_{t+1}^{x}$$

and the firm-specific productivity follows:

$$z_{jt+1} = \rho_z z_{jt} + \sigma_z \, \epsilon_{jt+1}^{z}$$

with all shocks independent of each other

Specify the stochastic discount factor exogenously:

$$\begin{aligned} \log m_{t+1} &= \log \eta + \gamma_t (x_t - x_{t+1}) \\ \gamma_t &= \gamma_0 + \gamma_1 (x_t - \bar{x}) \end{aligned}$$

with $0 < \eta < 1, \gamma_0 > 0, \gamma_1 < 0$

Capital accumulates according to:

$$k_{jt+1} = (1-\delta)k_{jt} + i_{jt}$$

Total investment cost function:

$$\phi(i_{jt}, k_{jt}) \equiv i_{jt} + \begin{cases} \frac{a_P}{2}\left(\frac{i_{jt}}{k_{jt}}\right)^2 k_{jt} & \text{for} \quad i_{jt} \geq 0 \\ \frac{a_N}{2}\left(\frac{i_{jt}}{k_{jt}}\right)^2 k_{jt} & \text{for} \quad i_{jt} < 0 \end{cases}$$

with $a_N > a_P > 0$

Let b_{jt+1} be the face value of one-period debt at the beginning of period t with payment due at the beginning of $t+1$

Collateral constraint:

$$b_{jt+1} \geq s_0(1-\delta)k_{jt+1}$$

in which $0 < s_0 < 1$

An alternative formulation with countercyclical liquidation costs:

$$b_{jt+1} \geq s_0 e^{(x_t - \bar{x})s_1}(1-\delta)k_{jt+1}$$

with $s_1 > 0$

The saving rate is strictly less than the borrowing rate:

$$r_{st} = r_{ft} - \kappa$$

with $\kappa > 0$

The interest rate applicable to firm j:

$$\iota_{jt} \equiv \begin{cases} r_{ft} & \text{for} \quad b_{jt+1} \geq 0 \\ r_{st} & \text{for} \quad b_{jt+1} < 0 \end{cases}$$

New equity:

$$e_{jt} \equiv \max\left(0, \phi(i_{jt}, k_{jt}) + b_{jt} - \pi(k_{jt}, z_{jt}, x_t) - \frac{b_{jt+1}}{\iota_{jt}}\right)$$

Equity flotation costs:

$$\lambda(e_{jt}, k_{jt}) \equiv \begin{cases} \lambda_0 + \frac{\lambda_1}{2}\left(\frac{e_{jt}}{k_{jt}}\right)^2 k_{jt} & \text{for} \quad e_{jt} > 0 \\ 0 & \text{for} \quad e_{jt} \leq 0 \end{cases}$$

Also, countercyclical equity flotation costs ($\lambda_2 > 0$):

$$\lambda(e_{jt}, k_{jt}) \equiv \begin{cases} \lambda_0 + \frac{\lambda_1 e^{-(x_t - \bar{x})\lambda_2}}{2}\left(\frac{e_{jt}}{k_{jt}}\right)^2 k_{jt} & \text{for} \quad e_{jt} > 0 \\ 0 & \text{for} \quad e_{jt} \leq 0 \end{cases}$$

Net payout:

$$o_{jt} \equiv \pi(k_{jt}, z_{jt}, x_t) - \phi(i_{jt}, k_{jt}) + \frac{b_{jt+1}}{\iota_{jt}} - b_{jt} - \lambda(e_{jt}, k_{jt})$$

The market value of equity:

$$v(k_{jt}, b_{jt}, z_{jt}, x_t) = \max_{\{i_{jt}, b_{jt+1}\}} o_{jt} + E_t[m_{t+1} v(k_{jt+1}, b_{jt+1}, z_{jt+1}, x_{t+1})]$$

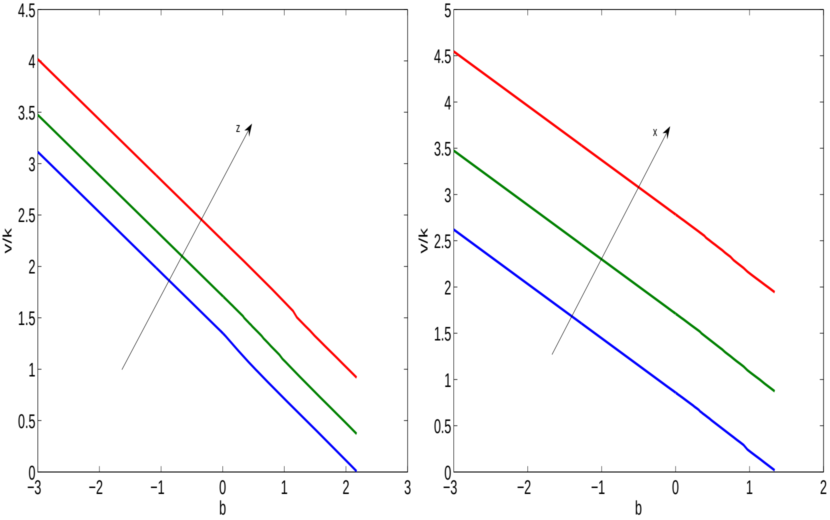
Outline

Parameter	Value	Description
α	0.65	Curvature in the production function
δ	0.01	Monthly rate of capital depreciation
ρ_x	$0.95^{1/3}$	Persistence coefficient of aggregate productivity
σ_x	0.007/3	Conditional volatility of aggregate productivity
η	0.994	Time-preference coefficient
γ_0	50	Constant price of risk parameter
γ_1	-1000	Time-varying price of risk parameter
a_P	15	Adjustment cost parameter when investment is positive
a_N	150	Adjustment cost parameter when investment is negative

Parameter	Value	Description
ρ_z	0.96	Persistence coefficient of firm-specific productivity
σ_z	0.10	Conditional volatility of firm-specific productivity
f	0.015	Fixed costs of production
s_0	0.85	Liquation value per unit of capital net of (acyclical) bankruptcy cost
s_1	0	Countercyclical liquation cost parameter
λ_0	0.08	Fixed flotation cost parameter
λ_1	0.025	Convex (acyclical) flotation cost parameter
λ_2	0	Countercyclical flotation cost parameter
κ	0.50%/12	Monthly wedge between the borrowing and saving rates of interest

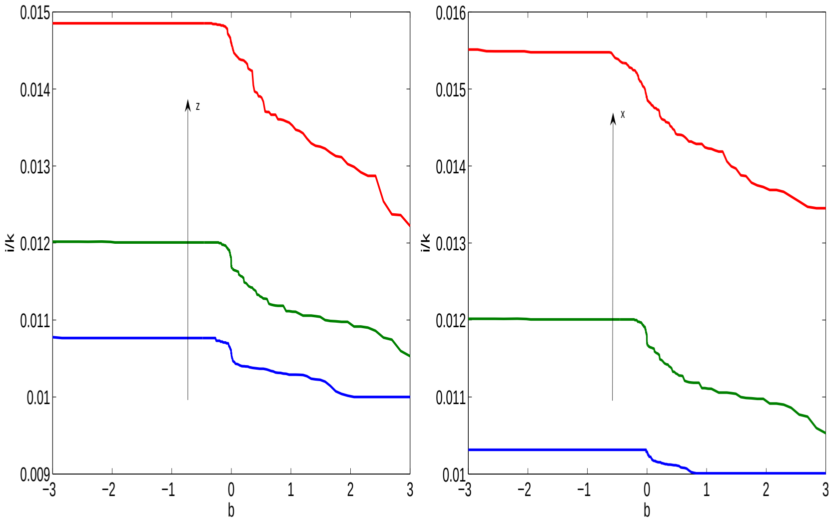
Qualitative Analysis

v_{jt}/k_{jt} conditional on $k_{jt} = \bar{k}$: $x_t = \bar{x}$ versus $z_{jt} = \bar{z}_j$



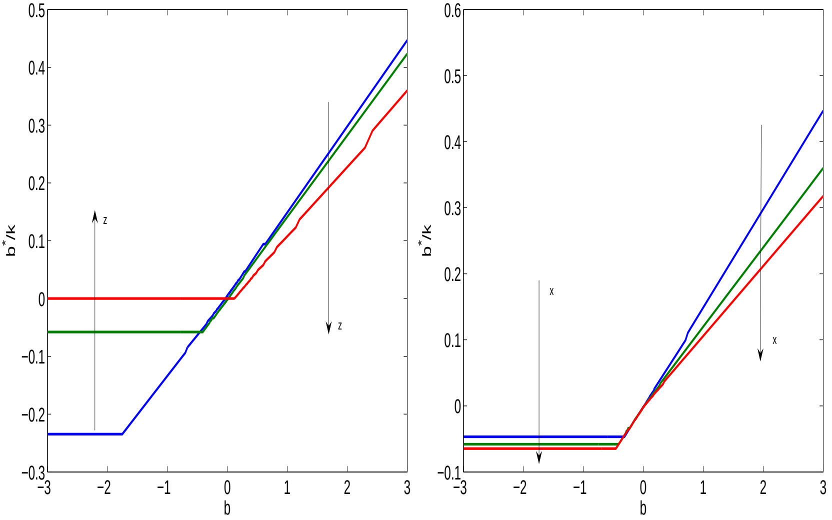
Qualitative Analysis

i_{jt}/k_{jt} conditional on $k_{jt} = \bar{k}$: $x_t = \bar{x}$ versus $z_{jt} = \bar{z}_j$



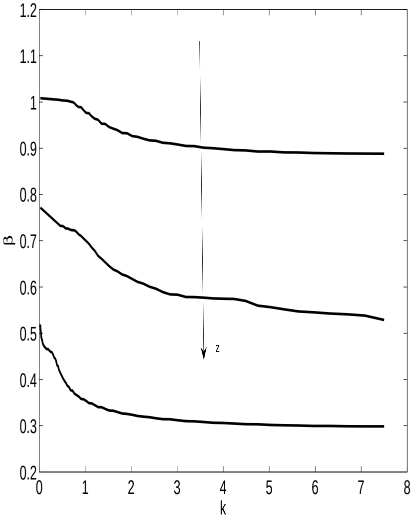
Qualitative Analysis

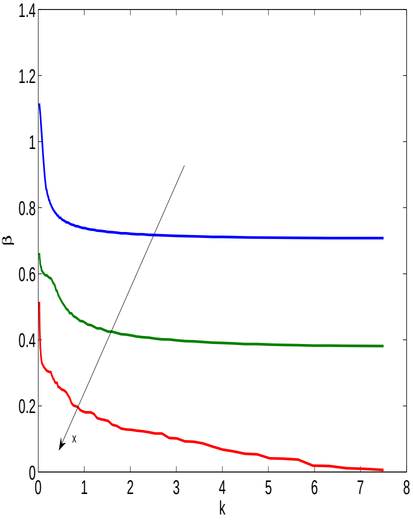
b_{jt+1}/k_{jt} conditional on $k_{jt} = \bar{k}$: $x_t = \bar{x}$ versus $z_{jt} = \bar{z}_j$



Qualitative Analysis

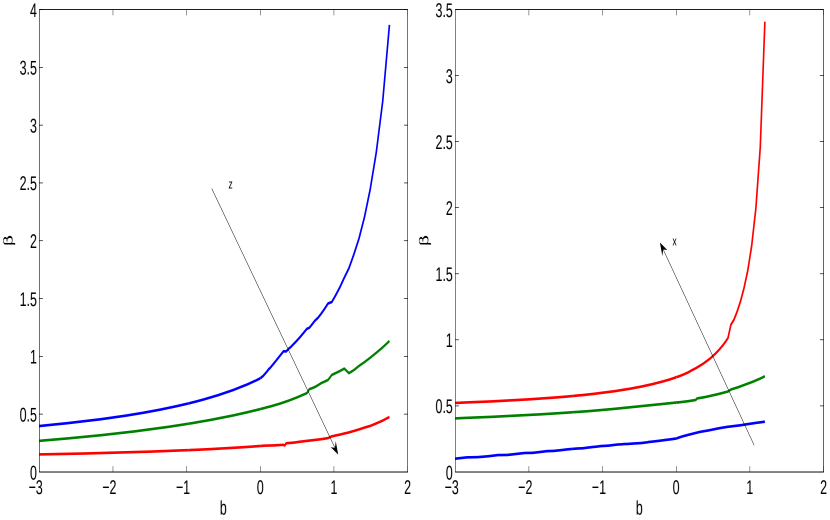
β_{jt} conditional on $b_{jt} = \bar{b}$: $x_t = \bar{x}$ versus $z_{jt} = \bar{z}_j$





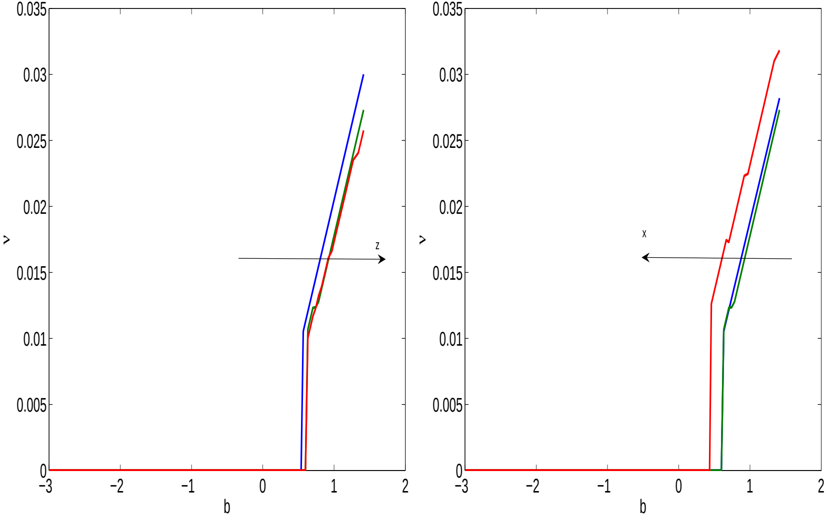
Qualitative Analysis

β_{jt} conditional on $k_{jt} = \bar{k}$: $x_t = \bar{x}$ versus $z_{jt} = \bar{z}_j$



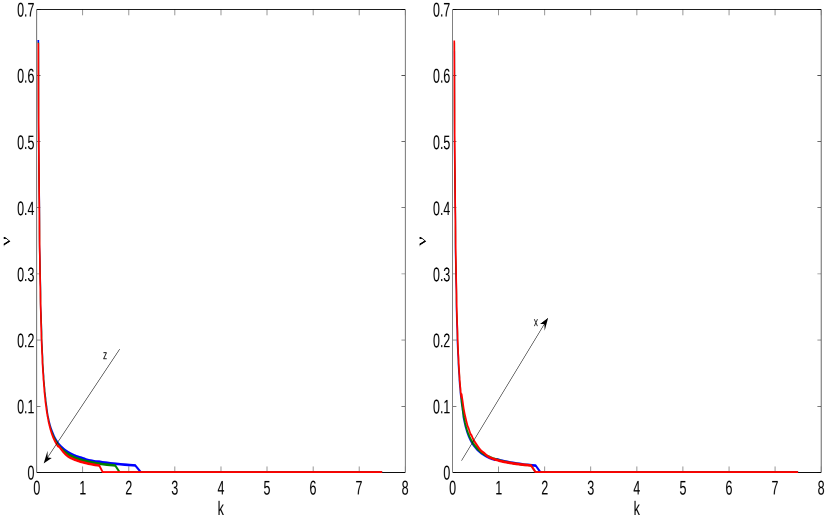
Qualitative Analysis

The shadow price of net debt, ν_{jt}, conditional on $k_{jt} = \bar{k}$: $x_t = \bar{x}$ versus $z_{jt} = \bar{z}_j$



Qualitative Analysis

The shadow price of net debt, ν_{jt}, conditional on $b_{jt} = \bar{b}$:
$x_t = \bar{x}$ versus $z_{jt} = \bar{z}_j$



Outline

1. Economic Question
2. Model
3. Qualitative Analysis
4. Quantitative Results

Quantitative Results

Univariate sorts on the shadow price of new debt in simulations

Low	2	3	4	5	6	7	8	9	High	FC	t_{FC}
Panel A: Benchmark parametrization											
0.33	0.37	0.43	0.44	0.46	0.50	0.54	0.57	0.61	0.67	0.34	3.54
Panel B: High liquidation costs, $s_0 = 0.70$											
0.14	0.14	0.15	0.15	0.16	0.16	0.18	0.18	0.18	0.19	0.05	2.23
Panel C: Low equity flotation costs, $\lambda_0 = 0.02$											
0.37	0.40	0.45	0.50	0.52	0.53	0.58	0.61	0.62	0.62	0.25	4.63
Panel D: Countercyclical liquidation costs, $s_1 > 0$											
0.11	0.12	0.14	0.15	0.16	0.16	0.17	0.18	0.18	0.20	0.09	2.70
Panel E: Countercyclical equity flotation costs, $\lambda_2 > 0$											
0.34	0.40	0.44	0.49	0.53	0.60	0.63	0.70	0.75	0.79	0.45	4.53

Quantitative Results

Double sorts on the shadow price of new debt and market cap

		Benchmark	$s_0 = 0.70$	$\lambda_0 = 0.02$	$s_1 > 0$	$\lambda_2 > 0$	LPS	WW
Low *FC*	*SL*	0.61	0.25	0.68	0.28	0.68	0.45	0.89
Middle *FC*	*SM*	0.64	0.31	0.75	0.34	0.84	0.67	0.66
High *FC*	*SH*	0.75	0.40	0.88	0.38	0.91	0.38	0.83
Low *FC*	*ML*	0.45	0.14	0.56	0.16	0.56	0.37	0.65
Middle *FC*	*MM*	0.50	0.16	0.60	0.21	0.74	0.56	0.81
High *FC*	*MH*	0.59	0.16	0.65	0.25	0.84	0.26	0.74
Low *FC*	*BL*	0.21	0.11	0.37	0.14	0.42	0.47	0.71
Middle *FC*	*BM*	0.30	0.08	0.41	0.15	0.51	0.53	0.96
High *FC*	*BH*	0.37	0.09	0.50	0.18	0.59	0.25	1.23
HIGHFC		0.51	0.22	0.63	0.26	0.74	0.30	0.93
LOWFC		0.39	0.06	0.51	0.16	0.67	0.43	0.75
FC		0.12	0.16	0.12	0.10	0.07	−0.13	0.18
t_{FC}		1.11	0.56	0.98	0.89	0.63	−1.17	0.95

Quantitative Results

Cross-sectional regressions in simulations

Benchmark			$s_0 = 0.70$					
ν_{jt}	ln(ME)	ln(B/M)	ν_{jt}	ln(ME)	ln(B/M)			
1.69			1.17					
(3.47)			(2.10)					
2.52	−1.96	3.67	0.63	−3.01	2.03			
(0.79)	(−2.55)	(3.07)	(1.59)	(−2.26)	(1.03)			
$\lambda_0 = 0.02$			$s_1 > 0$			$\lambda_2 > 0$		
ν_{jt}	ln(ME)	ln(B/M)	ν_{jt}	ln(ME)	ln(B/M)	ν_{jt}	ln(ME)	ln(B/M)
3.97			1.17			1.86		
(2.12)			(2.65)			(3.07)		
−1.96	−3.31	4.01	−0.76	−3.08	2.70	−1.25	−1.22	2.56
(−0.11)	(−4.72)	(3.07)	(−0.53)	(−2.46)	(2.62)	(−1.07)	(−4.78)	(2.64)

Cross-sectional determinants of the shadow price of new debt

The Whited and Wu (2006) variables

	CF		*TLTD*		*LNTA*
Data	Benchmark	Data	Benchmark	Data	Benchmark
−0.09	−0.25	0.02	0.14	−0.04	−0.11
(−2.94)	(−10.24)	(1.91)	(4.59)	(−1.91)	(−10.53)
	SG		*DIVPOS*		
Data	Benchmark	Data	Benchmark		
−0.04	−0.02	−0.06	−0.37		
(−1.52)	(−5.88)	(−2.14)	(−3.67)		

Quantitative Results

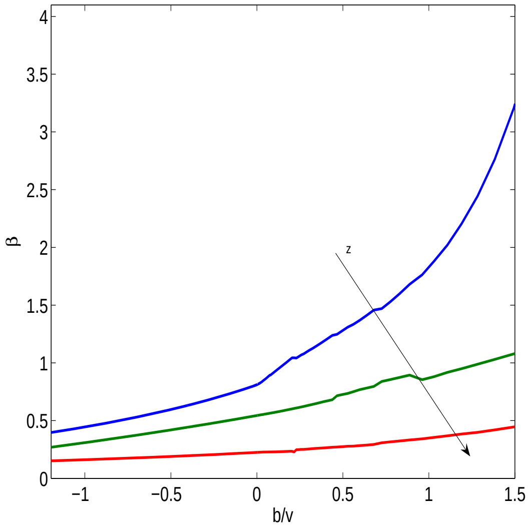
Cross-sectional determinants of the shadow price of new debt

The Kaplan and Zingales (1997) variables

CF		*TLTD*		*TDIV*	
Data	Benchmark	Data	Benchmark	Data	Benchmark
−1.00	−2.50	3.14	1.78	−39.37	−3.61
(−4.28)	(−5.60)	(6.99)	(9.23)	(−6.46)	(−9.95)
CASH		***Q***			
Data	Benchmark	Data	Benchmark		
−1.32	−0.10	0.28	0.20		
(−4.55)	(−7.30)	(3.63)	(7.47)		

Quantitative Results

The leverage-expected return relation



Quantitative Results

Cross-sectional regressions of returns on market leverage with and without asset beta

Panel A: Benchmark parametrization				
b_{jt}/v_{jt}	R^2	b_{jt}/v_{jt}	β^A_{jt}	R^2
1.093	0.28	1.051	0.0049	0.39
(5.15)		(1.26)	(3.31)	
Panel B: High liquidation costs, $s_0 = 0.70$				
b_{jt}/v_{jt}	R^2	b_{jt}/v_{jt}	β^A_{jt}	R^2
3.617	0.14	2.456	0.0048	0.15
(7.22)		(0.46)	(10.29)	
Panel C: Low fixed flotation costs, $\lambda_2 = 0.02$				
b_{jt}/v_{jt}	R^2	b_{jt}/v_{jt}	β^A_{jt}	R^2
3.490	0.09	3.083	0.0062	0.12
(4.37)		(0.82)	(10.40)	

Conclusion

A dynamic investment-based asset pricing model a la Zhang (2005) augmented with debt dynamics a la Hennessy and Whited (2005)