

# The Evolution and Distribution of the Capital Structure of Entrepreneurial Firms

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# Theories of Capital Structure

## ❑ The Irrelevance Theorem

- Modigliani and Miller (1958), Miller (1977)
- Initiated the literature on the role of financing.

## ❑ Static Tradeoff Theory

- Modigliani and Miller (1963), Bradley, Jarrell and Kim (1984)
- Debt level is too high compared to theoretical predictions. What about retained earnings and mean reversion?

## ❑ Pecking Order Theory

- Myers (1984), Jensen and Meckling (1976)
- Firms issue too much equity compared to theoretical predictions. What is the right debt capacity?

## ❑ Dynamic Target Adjustment Theory

- Brennan and Schwartz (1984), Fischer, Heinkel, Zechner (1989), Goldstein, Ju, and Leland (2001), Strebulaev (2007)
- Account for many stylized facts of observed capital structure.

# Evidence on the Capital Structure of Entrepreneurial Firms

- ❑ Carpenter and Peterson (2002)
  - Using a sample of small high-tech firms going public, argue that these firms use significantly lower debt compared to large high-tech firms.
- ❑ Berger & Udell (1998), Ueda (2004), Winton & Yerramilli (2008)
  - Explore the differences between bank and VC financing.
- ❑ Cole (2008), Cosh et al. (2009)
  - Find that nascent high-tech firms face greater market imperfections, compared to non-high-tech firms.
- ❑ Berger and Udell (1998), Haynes and Brown (2009), Robb and Robinson (2010)
  - Show the extent to which small businesses rely on debt versus equity.

# Evidence on the Capital Structure of Entrepreneurial Firms

- ❑ Beck et al. (2008), Robb and Robinson (2008)
  - Consider capital structure decisions in the context of the traditional pecking order theory.
- ❑ Ballou et al. (2008), Shane (2008)
  - Describe sources and types of financial capital for start-ups.

# Evidence on the Capital Structure of Public Firms

## □ Leary and Roberts (2005)

- Firms actively rebalance their leverage within an optimal range.
- Persistence in capital structure is due to adjustment costs.

## □ Lemmon, Roberts, and Zender (2008)

- Capital structures are stable over a long period of time.
- Have persistence and convergence of leverage.
- Firm fixed effects explain 60% of variation, while traditional factors (profitability, tangibility, size, market to book, etc.) explain 30%.

# Research Questions

- ❑ What are the determinants and evolution of the capital structure of entrepreneurial firms?
  - ❑ How much does capital structure depend on initial conditions, i.e., is there persistence?
  - ❑ How much does capital structure evolve over time cross-sectionally, i.e., is there convergence ?
  
- ❑ What is the impact of the financial crisis on the capital structure of entrepreneurial firms?

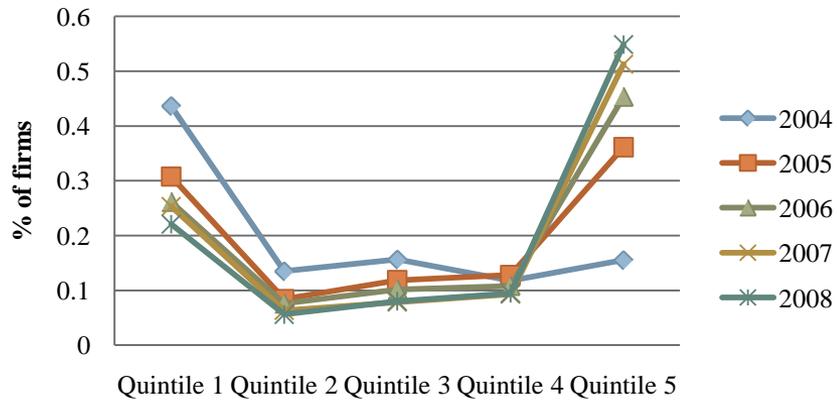
# Data and Variables

- ❑ Kauffman Firm Survey (KFS): a panel of 4,928 businesses founded in 2004 and surveyed every year up to 2008.
  
- ❑ Most papers using KFS focus on the impact of owner characteristics on performance and initial capital structure.
  
- ❑ Key capital structure variables
  - ❑ Book leverage =  $\text{total debt} / (\text{total debt} + \text{equity})$
  - ❑ Inside leverage =  $\text{inside debt} / (\text{total debt} + \text{equity})$ 
    - ❑ Insiders = owners, families, employees
  - ❑ Outside leverage =  $\text{outside debt} / (\text{total debt} + \text{equity})$ 
    - ❑ Outsiders = non-insiders, e.g. banks

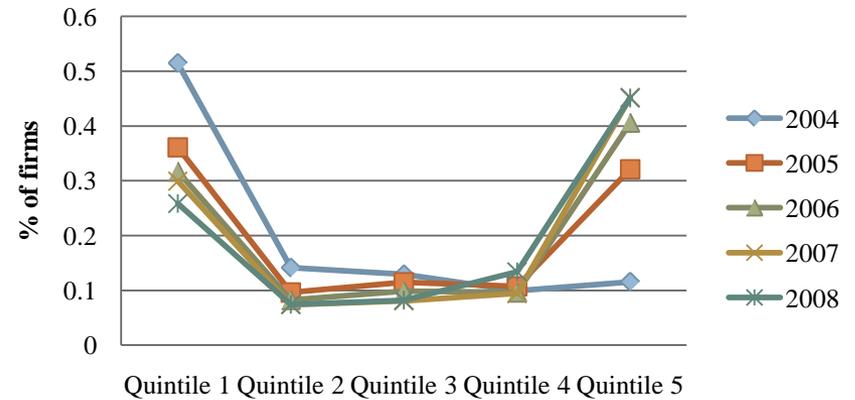
# The Distribution of Capital Structure

- Examine industry-adjusted leverage.
- Industries: 17 total, consisting of 1- and 2-digit NAICS.
- Plot histograms of the quintiles for each year.
- Compare the distribution of capital structure to that of credit risk.

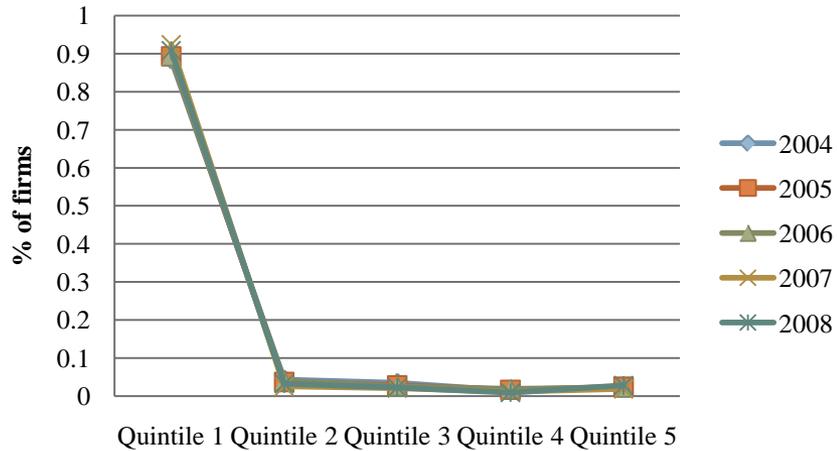
## Book Leverage



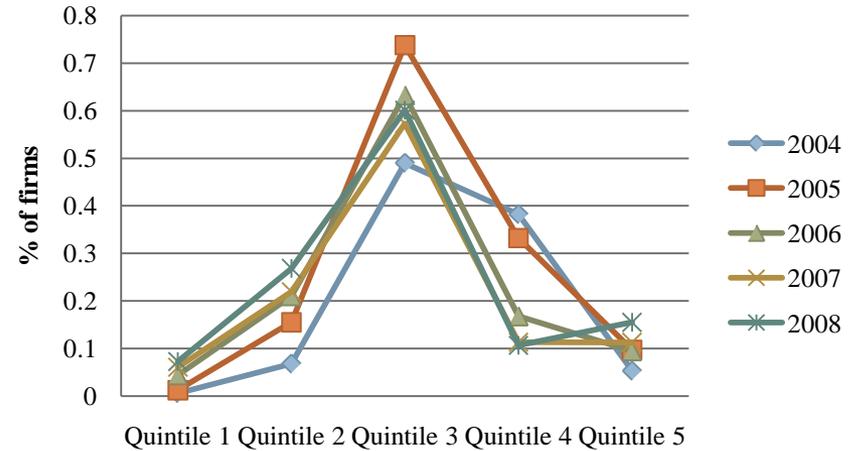
## Outside Leverage



## Inside Leverage



## Credit Risk



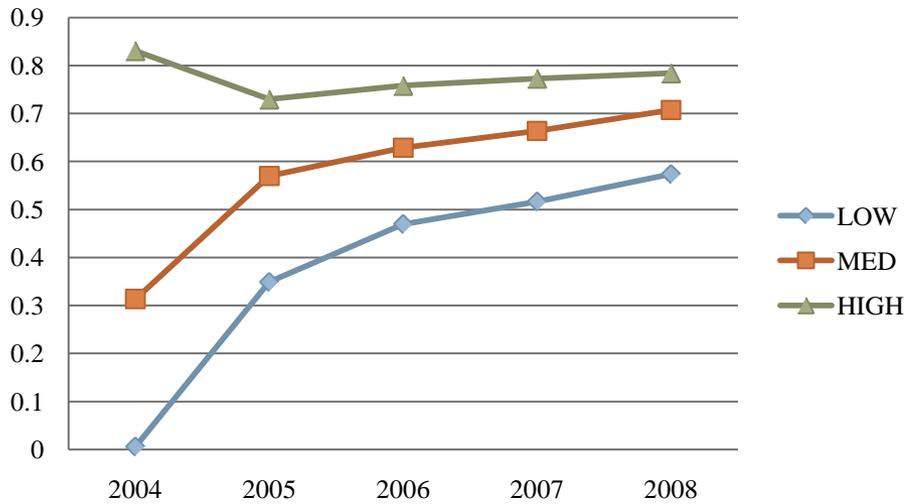
# The Distribution of Capital Structure

- ❑ The cross-sectional distribution of initial book leverage ratio is an inverted bell curve on  $[0, 1]$ .
  - This is true through the 5 years since the founding year.
  - This questions the validity of conducting OLS regressions of the leverage ratio.
  - This inverted bell shape originates from the distribution of outside leverage rather than inside leverage.
- ❑ By contrast, credit risk appears normally distributed.

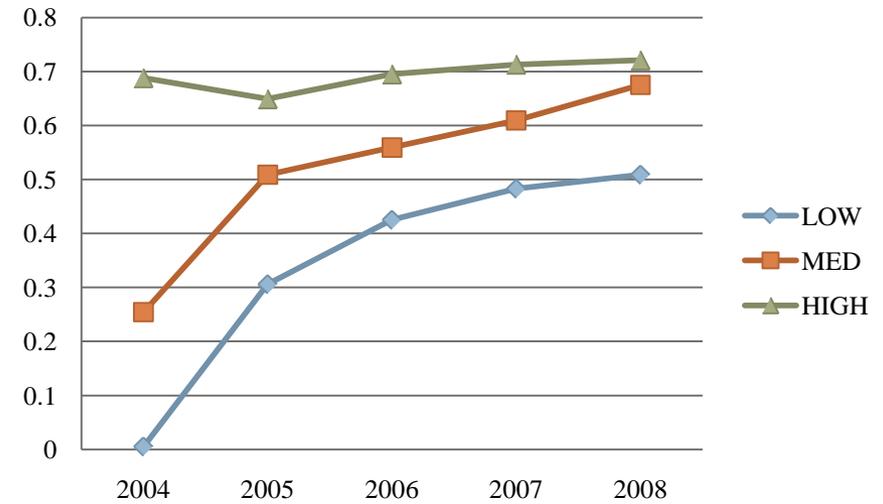
# The Evolution of Capital Structure and the Financial Crisis

- Based on firms' initial industry-adjusted book leverage in 2004, we sort firms into three groups: HIGH, MED and LOW.
- We track these three groups over time.

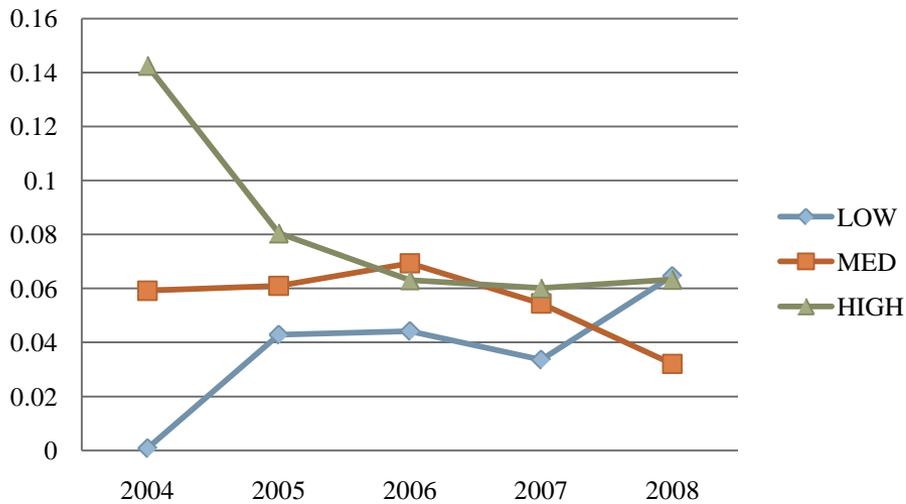
### Book Leverage



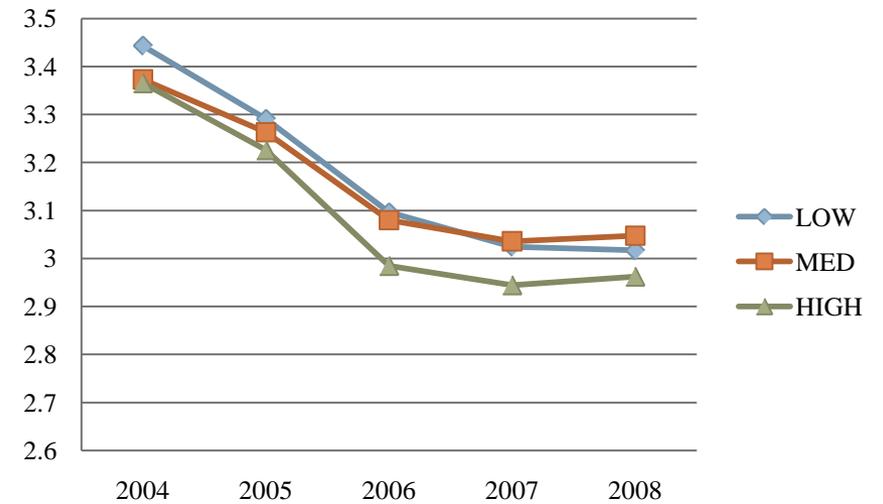
### Outside Leverage



### Inside Leverage



### Credit Risk



# The Evolution of Capital Structure and the Financial Crisis

- ❑ Leverage appears to be persistent over time.
  - The persistent effect mostly comes from outside debt, rather than inside debt.
  - More on persistence later...
- ❑ The largest leverage adjustment occurs in the first year.
  - The first year adjustment suggests firms don't achieve their target capital structure at the founding time, and changing it subsequently within a year is not costly.
- ❑ The financial crisis seems to have had no effect on the trends of capital structure for the three groups.

# Determinants of Initial Capital Structure

- We run a multinomial Logit regression to explain 2004 book leverage due to the high frequency of extreme values around 0 and 1 for book leverage.
- Also run OLS to compare ourselves to the literature.

# Multinomial Logit Regression

Initial Leverage(2004)	MED vs LOW		HIGH vs LOW	
	Coefficient	P>t	Coefficient	P>t
Female	0.024	0.848	-0.084	0.492
White	-0.132	0.343	0.208	0.135
Log (hours)	0.388***	0.000	0.307***	0.000
Age	-0.049	0.131	0.015	0.650
Age^2	0.000	0.108	-0.000	0.645
Work experience (years)	-0.016***	0.008	-0.018***	0.002
Same business	0.029	0.847	0.061	0.676
Multiple ownership	-0.007	0.951	0.074	0.515
Credit risk	-0.146*	0.055	-0.138*	0.054
Home_based	-0.390***	0.000	-0.512***	0.000
Intellectual Property	-0.020**	0.033	-0.012*	0.056
Comparative Advantage	0.174	0.147	-0.023	0.838
Sells Products	0.045	0.695	0.177	0.103
PP&E Ratio	0.174	0.254	0.720***	0.000
Observations	2,835			
Population Size	43,747			
F-Statistics	4.85			

# OLS Regression

Initial Leverage (Outside debt)	Our Regression		Robb and Robinson (2009 WP)	
	Coefficient	Standard Error	Coefficient	Standard Error
Female	-0.0050	0.0186	-0.0616***	0.0211
White	0.051**	0.0199	N.A.	N.A.
Black	N.A.	N.A.	-0.0749**	0.0317
Log (hours)	0.034***	0.0113	0.027***	0.0004
Age	0.006	0.0046	0.0152**	0.0059
Age^2	-0.000	0.0001	-0.0001**	0.0001
Work experience	-0.003***	0.0009	-0.0043***	0.0009
Same business	0.015	0.0225	0.0062	0.0193
Multiple ownership	0.011	0.0173	0.0521***	0.0201
Credit risk (Credit Score)	-0.017	0.0109	0.0023***	0.0004
Home_based	-0.067***	0.0172	-0.0848***	0.0202
Intellectual Property	-0.002*	0.0009	-0.0087	0.0238
Comparative Advantage	-0.022	0.0177	0.0360*	0.0197
Sells Products	0.012	0.0166	0.0629*	0.0324
Sells Products & Services	N.A.	N.A.	-0.0256	0.0300
PP&E Ratio	0.111***	0.0222	N.A.	N.A.
Observations	2,835		3,934	
R-Square	0.036			

# Determinants of Initial Capital Structure

- ❑ Multinomial Logit regression reveals that firms have higher initial book leverage when
  - ❑ The primary owner works longer working hours and has less working experience.
  - ❑ The business has less credit risk, more asset tangibility (i.e., less IP), and is not home-based.
- ❑ OLS regression yields similar results, but shows that cross-sectional variation in initial leverage can hardly be explained by owner- and firm- characteristics.
  - ❑ R-square is only around 3.60% (Lemmon et al., 2008).
  - ❑ There is a large unexplained part of initial leverage.

# The Persistence of Capital Structure

- Perform panel regressions of 2005-8 leverage.
- Include 2004 leverage to test for persistence: if the coefficient is positive, then have persistence.
- If leverage is determined by firm and owner characteristics, and these characteristics are persistent, then by construction initial book leverage is able to predict future leverage.
- We address this concern by constructing a residual leverage measure that is unrelated to those characteristics. This measure is the residual of a first step regression with the initial leverage being explained by firm and owner characteristics.

# Panel Multinomial Regression

Leverage	MED vs LOW		HIGH vs LOW		MED vs LOW		HIGH vs LOW	
	(1)				(2)			
	Coef.	P>z	Coef.	P>z	Coef.	P>z	Coef.	P>z
Initial Leverage(2004)	1.687***	0.000	2.518***	0.000				
Residual, Initial Leverage(2004)					1.663***	0.000	2.504***	0.000
Female	-0.063	0.592	-0.217	0.254	-0.047	0.701	-0.206	0.283
White	0.165	0.210	0.690***	0.003	0.220	0.109	0.784***	0.001
Log(hours)	0.290***	0.000	0.267**	0.021	0.341***	0.000	0.351***	0.002
Age	0.024	0.405	0.136**	0.014	0.044	0.133	0.152***	0.006
Age^2	-0.000	0.378	-0.002**	0.010	-0.000	0.124	-0.002***	0.004
Work experience (years)	-0.001	0.880	-0.013	0.147	-0.007	0.229	-0.021**	0.020
Same business	-0.065	0.601	-0.023	0.920	-0.063	0.624	0.001	0.995
Multiple ownership	0.017	0.875	0.123	0.496	0.021	0.853	0.135	0.458
Credit risk	-0.143***	0.008	-0.267**	0.014	-0.152***	0.007	-0.284***	0.009
Home based	-0.189*	0.074	-0.193	0.285	-0.347***	0.002	-0.387**	0.035
Intellectual Property	-0.001	0.720	-0.009	0.468	-0.004	0.267	-0.014	0.306
Comparative Advantage	-0.041	0.671	0.121	0.480	-0.054	0.585	-0.062	0.719
Sells Products	-0.045	0.660	-0.264	0.152	-0.012	0.910	-0.213	0.269
PP&E Ratio	-0.145	0.265	-0.468**	0.044	0.038	0.777	-0.213	0.356
Year & Industry Fixed Effect	YES				YES			
Observations	11,052				10,821			
F-Statistics	3,895.74				3,074.53			

# The Persistence of Capital Structure

- ❑ Panel multinomial Logit regression confirms that leverage is persistent over time.
  - Coefficients of initial book leverage are significantly positive at the 1% level.
  - Use of residual leverage measure in place of initial book leverage confirms persistence.
- ❑ Significant explanatory variables are similar, but not identical, to those for initial leverage (hours, credit risk, home-based), reflecting persistence.
- ❑ Credit risk is significantly negative in all specifications.
  - Firms' ability to borrow is closely related to their creditworthiness across time.

# The Convergence of Capital Structure and the Financial Crisis

- Regress change in leverage on last year's leverage.
- Run pooled OLS and year-by-year regressions.
- Pooled OLS restricts coefficients on past leverage to be the same across years.
- If the coefficient on past leverage is negative, then have convergence.

# OLS Regressions

	Pooled OLS		Lev2005-Lev2004		Lev2006-Lev2005		Lev2007-Lev2006		Lev2008-Lev2007	
	(1)		(2)		(3)		(4)		(5)	
	Coef.	P>t	Coef.	P>t	Coef.	P>t	Coef.	P>t	Coef.	P>t
Lagged Book Leverage	-0.540***	0.000	-0.601***	0.000	-0.514***	0.000	-0.555***	0.000	-0.458***	0.000
Female	-0.009	0.459	-0.006	0.787	-0.049**	0.019	0.004	0.895	0.037	0.114
White	0.031**	0.017	0.080***	0.001	0.001	0.947	0.022	0.440	-0.002	0.957
Log(hours)	0.030***	0.000	0.044***	0.003	0.032***	0.006	0.032**	0.033	0.010	0.425
Age	0.008**	0.014	0.008	0.174	0.008	0.146	0.012*	0.080	-0.000	0.972
Age^2	-0.000***	0.008	-0.000	0.132	-0.000	0.138	-0.000*	0.072	-0.000	0.869
Work experience	-0.000	0.399	-0.001	0.296	0.001	0.564	-0.002	0.182	0.001	0.570
Same business	-0.013	0.325	-0.015	0.541	-0.033	0.147	0.011	0.698	-0.013	0.636
Multiple ownership	0.018	0.068	0.014	0.478	0.021	0.250	0.004	0.838	0.038*	0.070
Credit risk	-0.022***	0.000	-0.025*	0.050	-0.011	0.347	-0.036***	0.003	-0.008	0.483
Home_based	-0.025**	0.016	0.007	0.715	-0.032*	0.080	-0.041*	0.072	-0.050**	0.023
Intellectual Property	-0.000	0.228	-0.001	0.346	-0.001	0.171	-0.000	0.369	0.000	0.481
Comparative Advantage	0.009	0.406	0.010	0.633	0.027	0.159	0.014	0.561	-0.027	0.211
Sells Products	-0.054***	0.001	-0.073**	0.010	0.005	0.850	-0.104***	0.002	-0.040	0.190
PP&E Ratio	-0.019	0.182	-0.018	0.513	-0.024	0.331	-0.025	0.423	-0.005	0.880
Observations	5555		1715		1660		1174		1006	
Robust R-square	0.2704		0.2546		0.2710		0.2735		0.2416	

# The Convergence of Capital Structure and the Financial Crisis

- ❑ Pooled OLS and year-by-year regressions reveal that the change in leverage is negatively related to last year's leverage → convergence.
- ❑ Year-by-year convergence effect is largest in 2004-5, and smallest in 2007-8, possibly indicating difficulty in adjusting leverage due to the financial crisis.

# Conclusion

- ❑ Most firms when founded choose either no leverage or very high leverage.
  - ❑ Driven by outside, rather than inside, leverage.
  - ❑ By contrast, credit risk appears normally distributed.
- ❑ Leverage is persistent over time.
  - ❑ Driven by persistence of outside leverage.
  - ❑ Largest adjustment to leverage occurs the first year.
  - ❑ The financial crisis did not change the trend.
- ❑ Owner and firm characteristics explain very little of initial leverage.
  - ❑ As with public firms, have large unexplained component.
- ❑ There is convergence in leverage, the effect being weaker during the financial crisis.