

Lemmon, Roberts and Zender (2008, JF)

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Abstract

- Leverages are heterogeneous but time-invariant
 - Cross-sectional variation $>$ time-series variation
- Firm effect outperforms than other leverage determinants
- (Trade-off story $>$ Pecking Order story)

ABSTRACT

We find that the majority of variation in leverage ratios is driven by an unobserved time-invariant effect that generates surprisingly stable capital structures: **High (low) levered firms tend to remain as such for over two decades.** This feature of leverage is largely unexplained by previously identified determinants, is robust to firm exit, and is present prior to the IPO, suggesting that **variation in capital structures is primarily determined by factors that remain stable for long periods of time.** We then show that these results have important implications for empirical analysis attempting to understand capital structure heterogeneity.

I. Data and Sample Selection

- Annual Compustat, 1965–2003
- Survivor subsample: At least 20 years of non-missing data
 - Size ↑
 - Profitability ↑
 - Growth opportunity (B/M) ↓
 - Tangibility ↑
 - Leverage ↑

Table I: All Firms vs. Survivors

Variable	All Firms		Survivors	
	Mean [Median]	(SD)	Mean [Median]	(SD)
Book leverage	0.27 [0.24]	(0.21)	0.27 [0.26]	(0.18)
Market leverage	0.28 [0.23]	(0.26)	0.32 [0.28]	(0.25)
Log(Sales)	4.43 [4.54]	(2.52)	5.49 [5.59]	(2.25)
Market-to-book	1.59 [1.00]	(1.87)	1.23 [0.89]	(1.19)
Profitability	0.05 [0.12]	(0.26)	0.12 [0.13]	(0.13)
Tangibility	0.34 [0.28]	(0.25)	0.39 [0.33]	(0.25)
Cash flow vol.	0.10 [0.06]	(0.14)	0.07 [0.05]	(0.08)
Median industry book leverage	0.24 [0.24]	(0.13)	0.26 [0.25]	(0.12)
Dividend payer	0.39 [0.00]	(0.49)	0.63 [1.00]	(0.48)
Intangible assets	0.05 [0.00]	(0.10)	0.04 [0.00]	(0.08)
Obs.	225,839		92,306	

II. The Evolution of Leverage

- Quartile portfolios
 - Leverage-sorted (Figure 1), unexpected leverage-sorted (Figure 2)
 - Regress on 1-year lagged factors
 - Firm size, profitability, tangibility, M/B and industry indicator
 - Equal-weighted (except exiting firms)
 - Track their leverages over 20 years
- Figure 1, Figure 2: Leverages are mean-reverting over time (transitory), but speeds are too slow (permanent)

Figure 1: Leverages Are Gradually Mean-Reverting

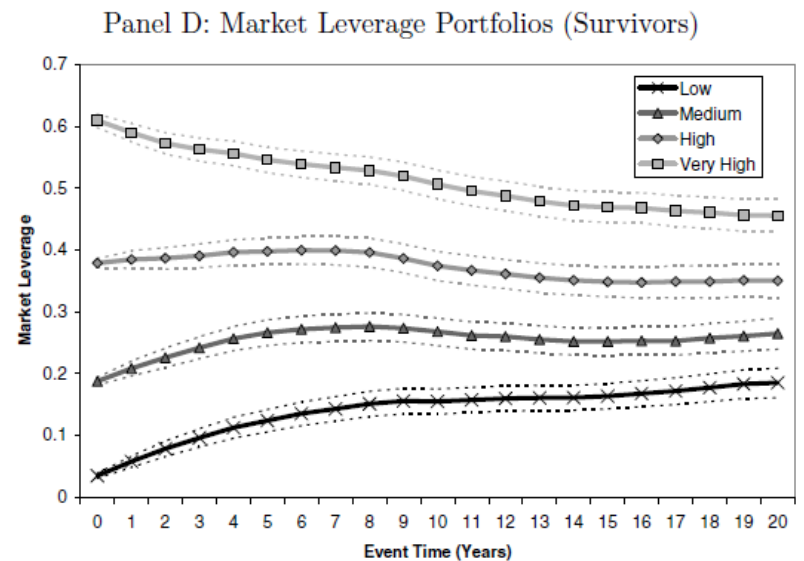
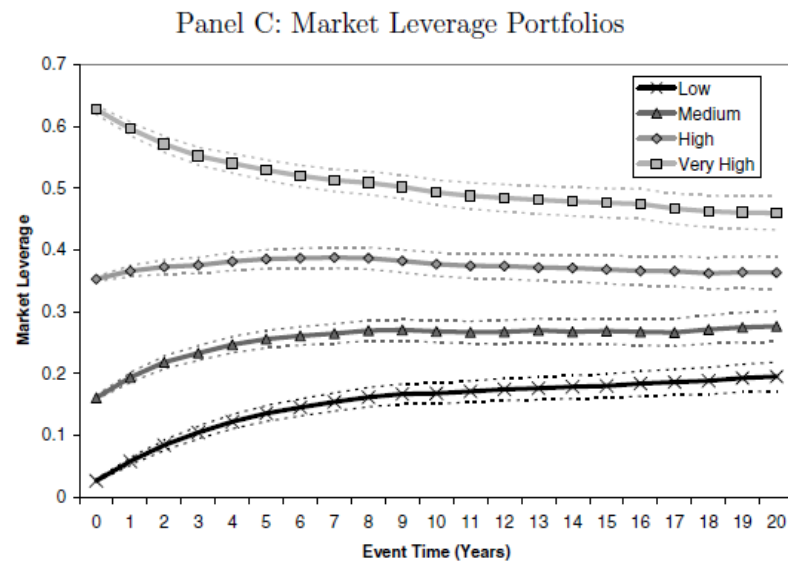
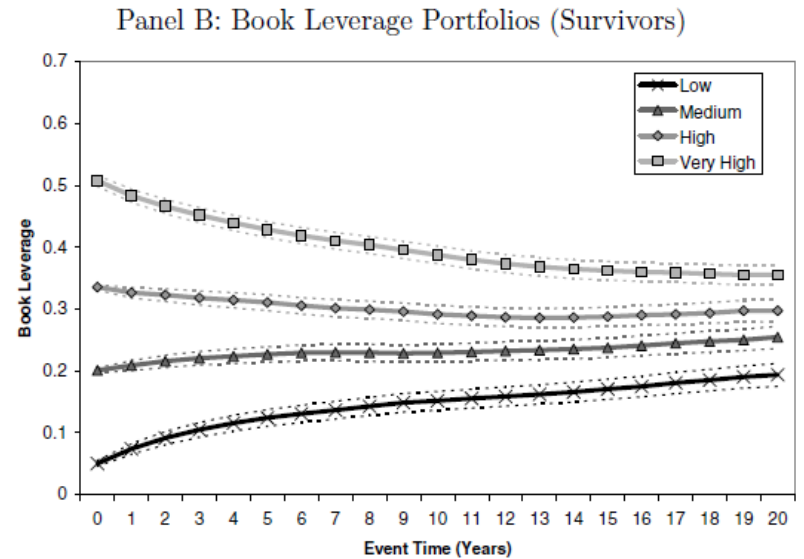
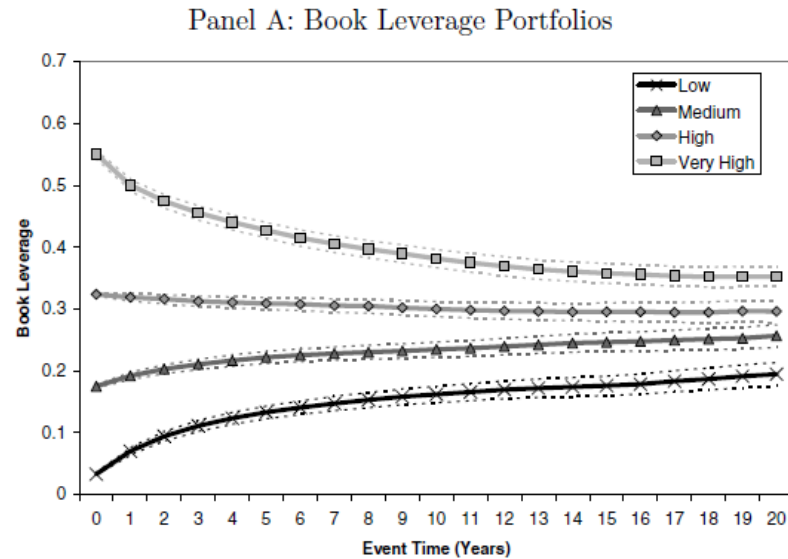
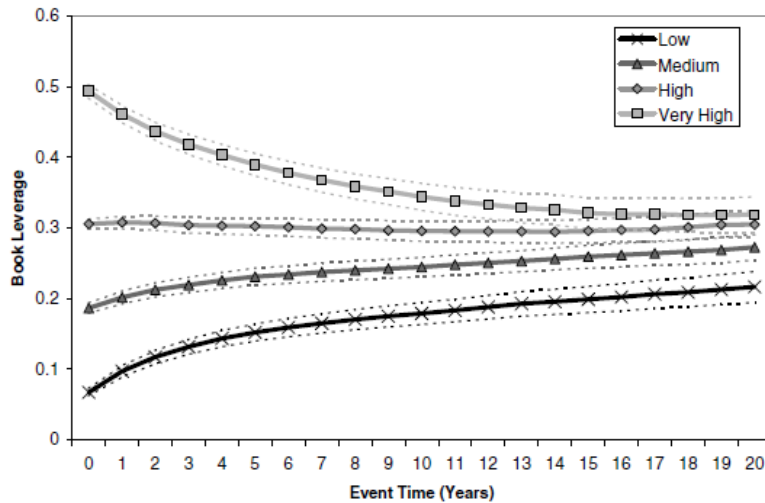
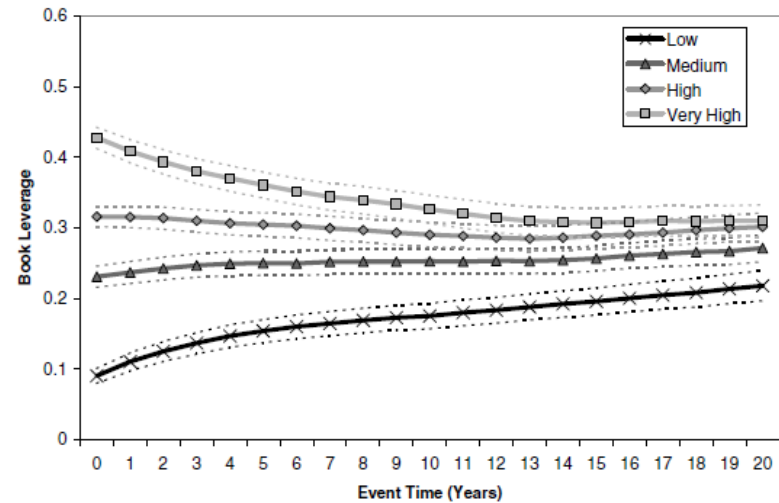


Figure 2: Similar After Controlling Determinants

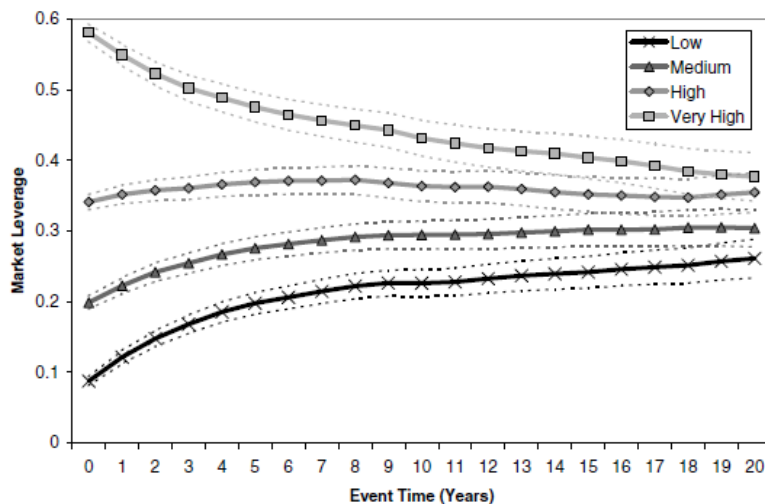
Panel A: Unexpected Book Leverage Portfolios



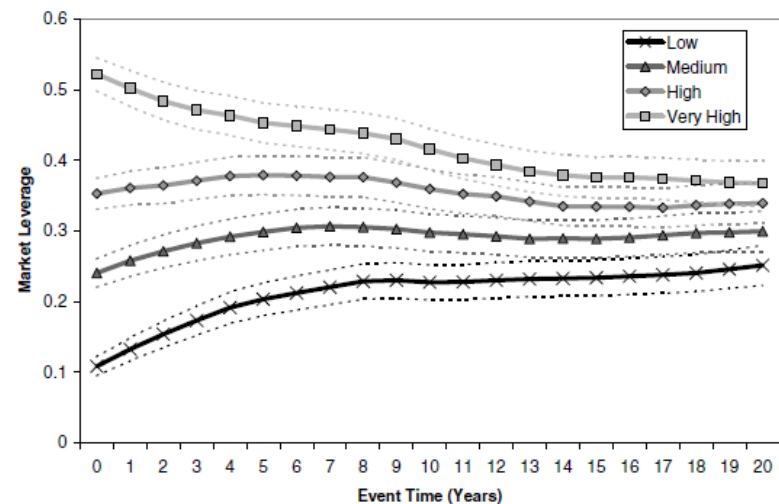
Panel B: Unexpected Book Leverage Portfolios (Survivors)



Panel C: Unexpected Market Leverage Portfolios



Panel D: Unexpected Market Leverage Portfolios (Survivors)



III. The Economic Importance of Persistence in Capital Structure

- Equation (1)

$$Leverage_{it} = \alpha + \beta X_{it-1} + \gamma Leverage_{i0} + v_t + \varepsilon_{it}$$

- $Leverage_{i0}$: Initial leverage
 - Firm-clustered error
 - All firms (Panel A) and survivors (B)
 - Regression coefficients scaled by the standard deviation of the corresponding variable
- Table II: $Leverage_{i0}$ is significant with the first-order importance (adj. $R^2 = .13$ in Panel A and $.20$ in B)

Table II: Initial Leverage Determines a Lot

Panel A: All Firms						
Variable	Book Leverage			Market Leverage		
Initial leverage	0.07 (41.57)	0.06 (38.1)	0.04 (28.63)	0.11 (52.27)	0.09 (43.16)	0.07 (33.15)
Log(Sales)		0.02 (11.58)	0.03 (16.89)		0.02 (13.73)	0.03 (18.09)
Market-to-book		-0.02 (-20.31)	-0.01 (-12.11)		-0.06 (-40.49)	-0.04 (-35.68)
Profitability		-0.03 (-22.88)	-0.03 (-23.78)		-0.05 (-30.89)	-0.04 (-30.03)
Tangibility		0.04 (27.7)	0.03 (17.94)		0.04 (24.55)	0.03 (15.92)
Industry median lev.			0.06 (42.63)			0.08 (46.27)
Cash flow vol.			0.00 (-1.81)			0.00 (-3.35)
Dividend payer			-0.03 (-24.16)			-0.05 (-29.82)
Year fixed effects	No	Yes	Yes	No	Yes	Yes
Adj. R^2	0.13	0.21	0.30	0.20	0.34	0.42
Obs.	117,914	117,914	117,914	117,300	117,300	117,300

Table II (cont'd): Survivors

Panel B: Survivors						
Variable	Book Leverage			Market Leverage		
Initial leverage	0.07 (28.56)	0.05 (24.13)	0.04 (18.55)	0.10 (30.86)	0.07 (25.25)	0.05 (19.19)
Log(Sales)		0.02 (9.13)	0.02 (11.45)		0.03 (11.78)	0.03 (12.47)
Market-to-book		-0.02 (-10.75)	-0.01 (-6.21)		-0.06 (-26.22)	-0.04 (-22.83)
Profitability		-0.03 (-14.91)	-0.03 (-15.64)		-0.06 (-19.8)	-0.05 (-20.12)
Tangibility		0.03 (17.3)	0.02 (10.59)		0.05 (18.86)	0.02 (10.65)
Industry median lev.			0.05 (26.52)			0.08 (32.65)
Cash flow vol.			-0.01 (-3.34)			-0.01 (-3.75)
Dividend payer			-0.03 (-15.53)			-0.04 (-18.84)
Year fixed effects	No	Yes	Yes	No	Yes	Yes
Adj. R^2	0.15	0.23	0.32	0.17	0.37	0.45
Obs.	68,736	68,736	68,736	68,224	68,224	68,224

Variance Decomposition

- Equation (2): $Leverage_{it} = \alpha + \beta X_{it-1} + \eta_i + v_t + \varepsilon_{it}$
- Table III: Explanatory power of Firm FE dominates all others
 - R^2 : .60 (firm FE only) vs. .65 (kitchen-sink)

Variable	Book Leverage							Market Leverage						
	(a)	(b)	(c)	(d)	(e)	(f)	(g)	(a)	(b)	(c)	(d)	(e)	(f)	(g)
Firm FE	1.00	.	0.98	.	0.95	.	0.92	1.00	.	0.94	.	0.89	.	0.85
Year FE	.	1.00	0.02	0.11	0.01	0.05	0.01	.	1.00	0.06	0.21	0.06	0.12	0.05
Log(Sales)	.	.	.	0.04	0.01	0.07	0.02	.	.	.	0.02	0.02	0.04	0.03
Market-to-book	.	.	.	0.09	0.00	0.03	0.00	.	.	.	0.31	0.01	0.19	0.01
Profitability	.	.	.	0.11	0.01	0.06	0.01	.	.	.	0.08	0.01	0.05	0.01
Tangibility	.	.	.	0.27	0.01	0.08	0.01	.	.	.	0.09	0.01	0.03	0.01
Industry med lev	0.46	0.02	.	.	.	.	.	0.35	0.03
Cash flow vol	0.00	0.00	.	.	.	.	.	0.01	0.00
Dividend payer	0.16	0.01	.	.	.	.	.	0.13	0.01
Industry FE	.	.	.	0.38	.	0.09	.	.	.	.	0.29	.	0.08	.
Adj. R^2	0.60	0.01	0.61	0.18	0.63	0.29	0.65	0.61	0.06	0.65	0.31	0.68	0.41	0.70

Table IV: Similar for Long-Run Specifications

Variable	Book Leverage		Market Leverage	
	Short Run	Long Run	Short Run	Long Run
Initial leverage	0.03 (12.92)		0.04 (14)	
Log(Sales)	0.04 (4.74)	0.02 (9.3)	0.04 (4.47)	0.03 (9.3)
Market-to-book	0.00 (−3.81)	−0.01 (−5.44)	−0.03 (−17.92)	−0.06 (−20.05)
Profitability	−0.02 (−10.98)	−0.05 (−15.46)	−0.03 (−14.84)	−0.08 (−21.71)
Tangibility	0.04 (10.19)	0.02 (8.59)	0.04 (11.11)	0.03 (10.39)
Industry median lev.	0.04 (21.41)	0.06 (22.01)	0.07 (29.65)	0.08 (23.48)
Cash flow vol.	−0.03 (−2.77)	−0.01 (−6.09)	−0.09 (−7.54)	−0.02 (−6.36)
Dividend payer	−0.03 (−14.71)	−0.03 (−11.12)	−0.04 (−18.37)	−0.04 (−14.21)
Year fixed effects	Yes		Yes	
Adj. R^2	0.29		0.43	
Obs.	55,355		54,963	

IV. Implications for Empirical Studies of Capital Structure

- Equation (3): Distributed lag model

$$Leverage_{it} = \alpha + \sum_{s=1}^n \beta_s X_{it-s} + \gamma Leverage_{i0} + v_t + \varepsilon_{it}$$

- Equation (4): Firm FE + AR(1) residual

$$Leverage_{it} = \alpha + \beta X_{it-1} + \eta_i + v_t + u_{it}$$
$$u_{it} = \rho u_{it-1} + \omega_{it}$$

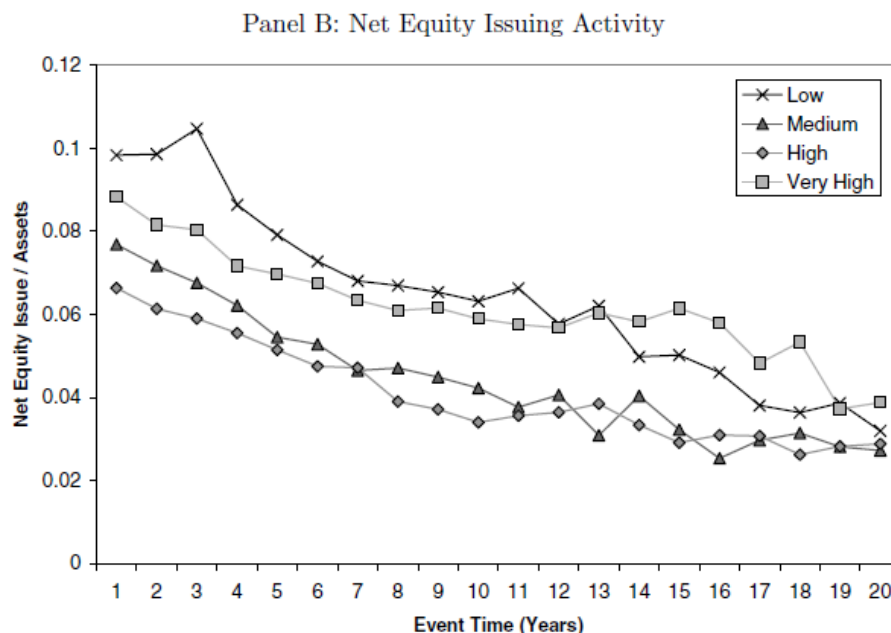
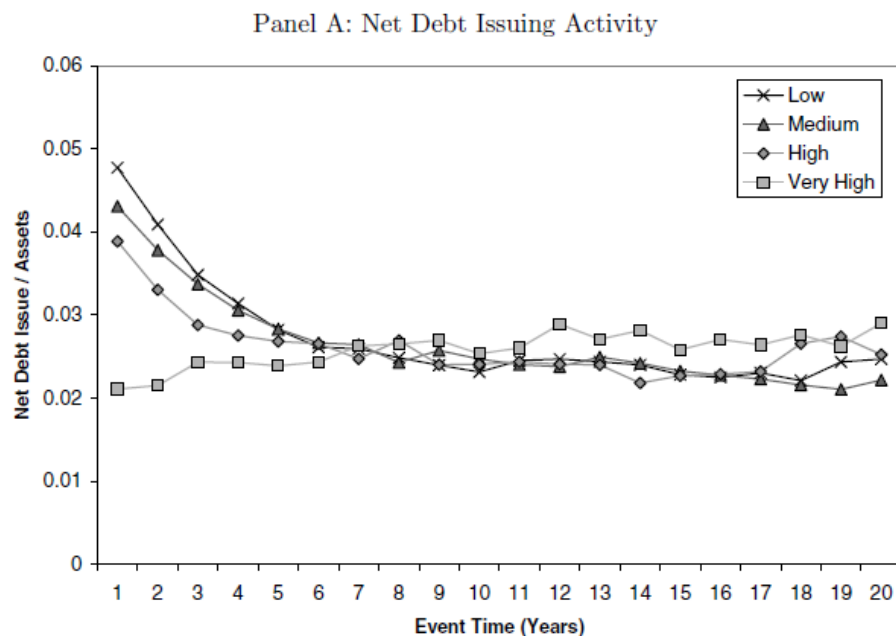
- Table V: Existing variables and models are inappropriate
 - Coefficients are by and large attenuated

Table V: Lowered Coefficients Under Firm FE

Variable	Book Leverage			Market Leverage		
	Pooled OLS	Firm FE	% Change	Pooled OLS	Firm FE	% Change
Log(Sales)	0.013 (16.96)	0.008 (8.37)	−41%	0.016 (16.86)	0.024 (21.17)	52%
Market-to-book	−0.010 (−14.01)	−0.003 (−7.14)	−74%	−0.039 (−36.16)	−0.001 (−3.23)	−96%
Profitability	−0.159 (−23.93)	−0.032 (−10.41)	−80%	−0.232 (−30.38)	−0.053 (−14.13)	−77%
Tangibility	0.160 (20.05)	0.076 (15.07)	−52%	0.156 (16.7)	0.099 (15.76)	−36%
Industry median lev.	0.569 (48.31)	0.046 (8.05)	−92%	0.544 (52.53)	0.065 (12.59)	−88%
Cash flow vol.	−0.031 (−2.71)	0.020 (1.11)	−163%	−0.099 (−8.14)	0.010 (0.48)	−110%
Dividend payer	−0.084 (−28.22)	0.000 (0.02)	−100%	−0.111 (−31.42)	0.002 (0.98)	−102%
Year fixed effects	Yes	Yes		Yes	Yes	
Adj. R^2	0.262			0.376		
AR(1)		0.660			0.653	
Obs.	106,097	106,097		105,532	105,532	

V. What Lies behind the Transitory Component?

- Figure 3 Panel A: Firms with low leverage tend to more issue debt than high-levered firms
 - Panel B: Low-levered firms issue equity (no change in leverage) and high-levered firms issue equity as well (rebalancing)



Speed of Adjustment

- Equation (5)

$$\Delta \text{Leverage}_{it} = \alpha_0 + \lambda(\mu_{it}^* - \text{Leverage}_{it-1}) + \varepsilon_{it}$$

$$\mu_{it}^* = \beta X_{it-1} + \eta_i + v_t$$

- Noise target \Rightarrow slow adjustment
- GMM: Circumvent possible underestimation (pooled OLS) and overestimation (firm FE)
- Table VI: Initial leverage seems to be another “target”
 - $.15 + .25$ in (b) $\approx .36$ in (d), $.17 + .17$ in (c) $\approx .39$ in (e)
 - Significant adjustment
 - Supports Trade-off story
 - Contradicts Pecking Order story: Shyam-Sunder and Myers (1999, JFE)
 - Rejects time-varying target: Hovakimian, Opler and Titman (2001, JFQA)

Table VI: Firms Adjust Leverage_{it} Using Leverage_{i0}

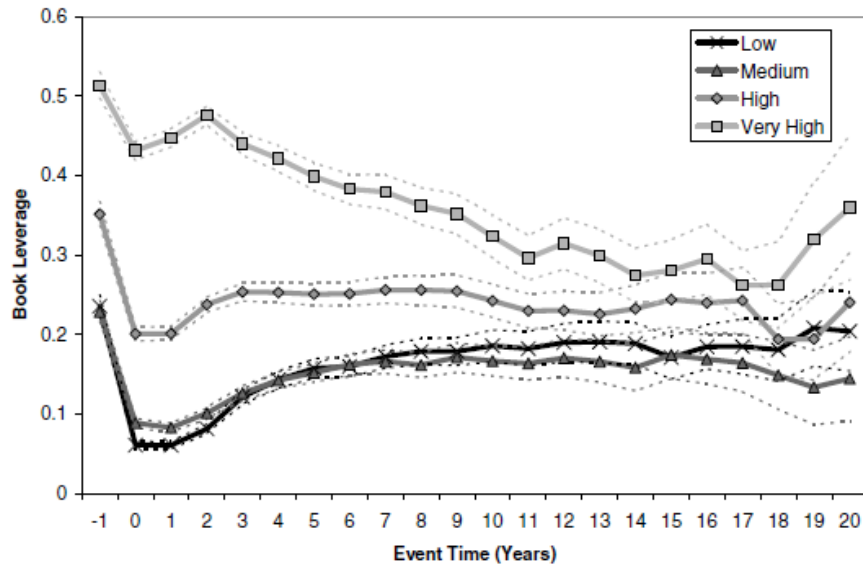
Variable	Pooled OLS			Firm Fixed Effects		GMM	
	(a)	(b)	(c)	(d)	(e)	(f)	(g)
SOA	0.13 (63.8)	0.15 (63.31)	0.17 (62.92)	0.36 (80.05)	0.39 (79.19)	0.22 (27.44)	0.25 (29.36)
Initial leverage		0.25 (23.97)	0.17 (18.34)				
Log(Sales)			0.00 (−2.6)		0.01 (5.98)		0.00 (−4.87)
Market-to-book			−0.01 (−4.89)		0.00 (−4.47)		−0.01 (−6.02)
Profitability			−0.18 (−11.97)		−0.10 (−9.19)		0.01 (0.63)
Tangibility			0.09 (10.05)		0.11 (8.81)		0.10 (12.36)
Industry median lev.			0.42 (24.11)		0.13 (9.01)		0.32 (18.79)
Half-life	4.96 (59.45)	4.35 (58.4)	3.62 (57.09)	1.53 (63.32)	1.42 (61.42)	2.82 (24.2)	2.41 (25.34)
Year fixed effects	No	No	Yes	No	Yes	No	Yes
R ²	0.72	0.72	0.72	0.72	0.71	.	.
Obs.	145,726	145,726	145,726	145,726	145,726	145,726	145,726

VI. What Lies behind the Permanent Component?

- Figure 4: Leverage is somewhat innate; i.e. previous tendencies are consistent in the sample around IPOs as well
 - No significant difference between pre- and post-IPO leverages: The capital structure decision of a firm is unchanged after listing
- Figure 5: UK firms show similar propensities
 - The methodology is identical to that of Figure 2
 - FAME database from Bureau van Dijk

Figure 4: The Persistency of Leverages Around IPOs

Panel A: Unexpected Book Leverage Portfolios (IPO Firms)



Panel B: Unexpected Market Leverage Portfolios (IPO Firms)

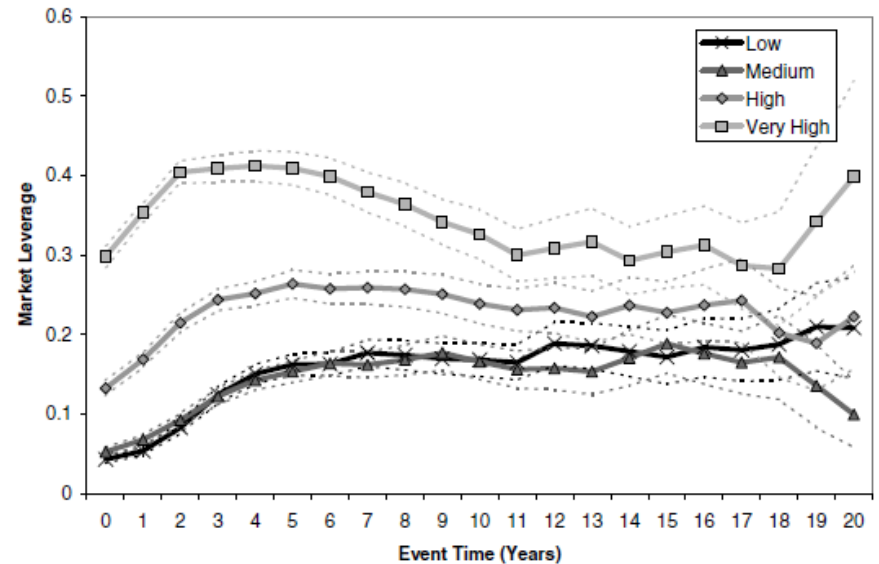
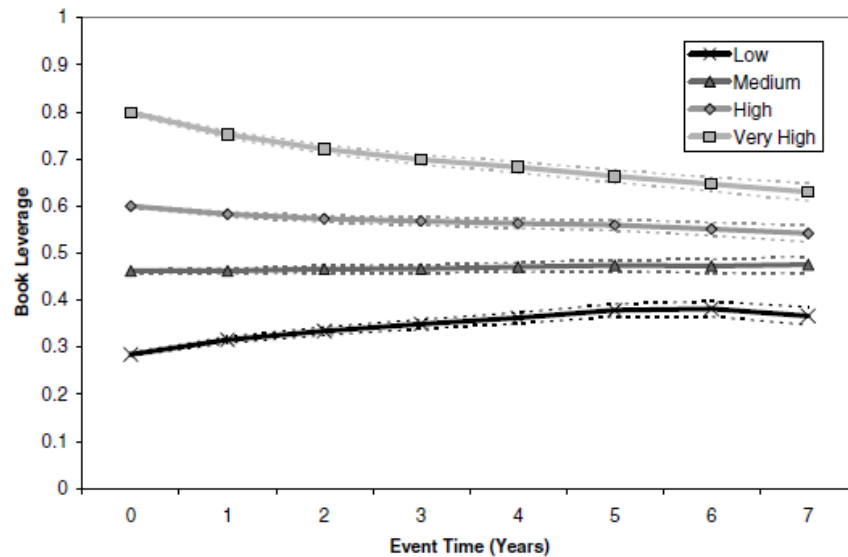
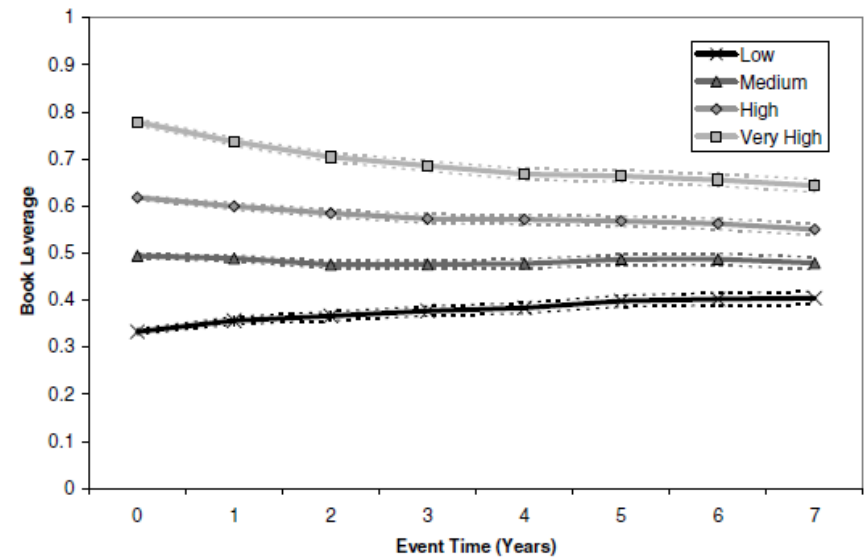


Figure 5: UK Firms Are Showing Similar Tendencies

Panel A: Unexpected Book Leverage Portfolios (All Firms)



Panel B: Unexpected Book Leverage Portfolios (Survivor Firms)



VII. Conclusion

- Capital structures are transitory but stable over time
- Empirically, existing models and variables (time-varying) are not explaining the capital structures (time-invariant) well
 - Even IPO does not change this tendency significantly
- Instead of pooled OLS, one should implement finer identification approaches to reflect that unobservable firm-specific non-fluctuating component
 - Fixed effect
 - Natural experiment
 - IV
 - Structural estimation