A Gap-Filling Theory of Corporate Debt Maturity Choice

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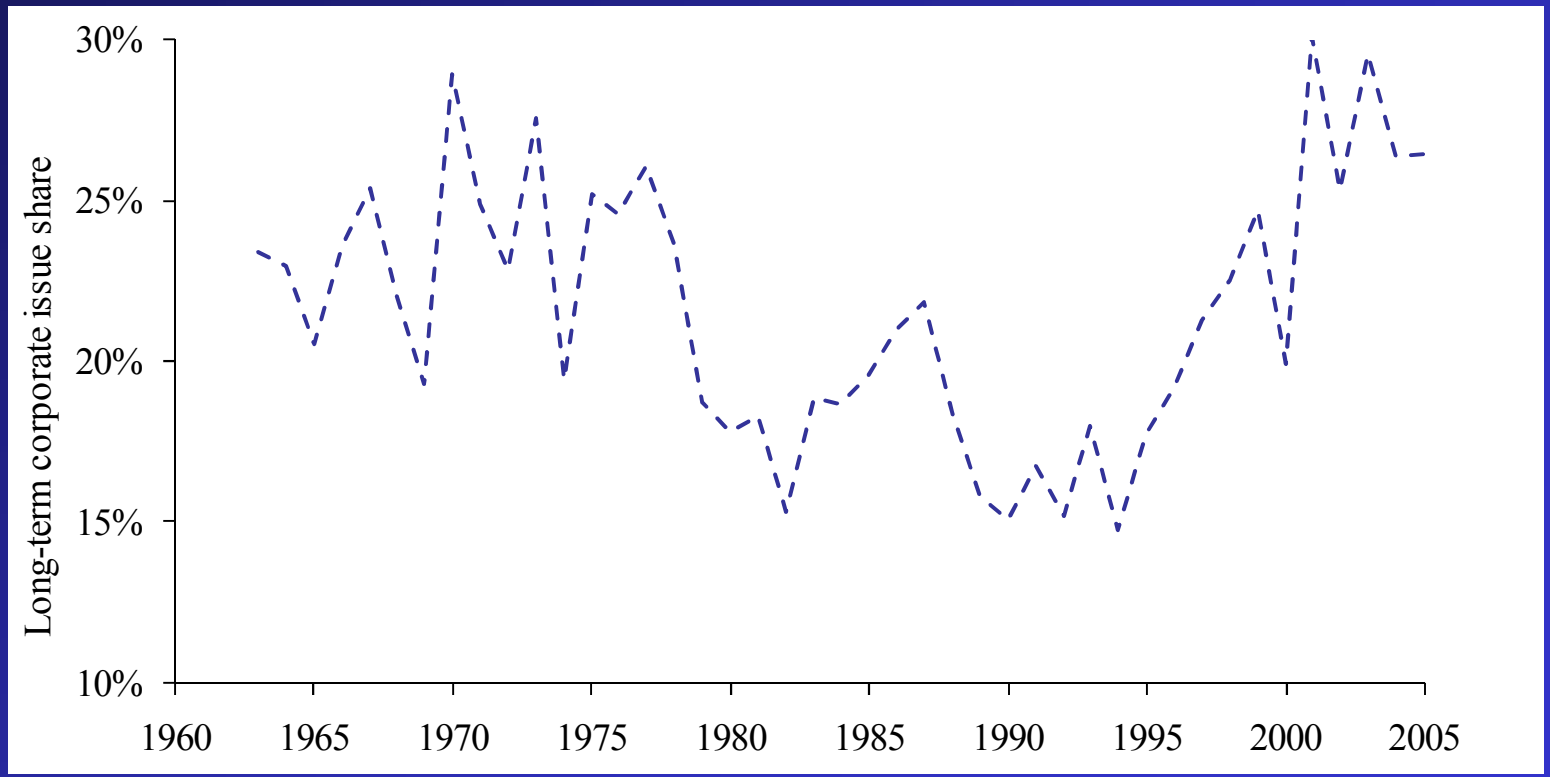
Corporate Debt Maturity

- Why does the average maturity of corporate debt vary so much over time?



Theories of Debt Maturity

- Many theories speak to the cross-section.
- Match maturities of assets and liabilities.
  - Myers (1977), Hart and Moore (1995).
- Signaling
  - Flannery (1986), Diamond (1991).
- But these theories are less well-suited to making time-series predictions.

"Market Conditions" Matter for Debt Maturity

- General level of interest rates, slope of yield curve.
  - Bosworth (1971), Taggart (1977), Marsh (1982).
- Why do market conditions matter? Managers say they want to borrow "cheap": Graham and Harvey (2001).
- Could reflect earnings-management considerations.
  - Stein (1989), Faulkender (2005), Chernenko and Faulkender (2007).
- Or efforts to exploit predictability of bond returns.
  - Baker, Greenwood and Wurgler (2003).

Questions for BGW (2003)

- What are root sources of bond-market predictability?
- Why do managers of nonfinancial firms have a comparative advantage in responding to mispricings?
  - Is it a forecasting/informational advantage?
- Butler et al (2006): “while it is provocative to think that managers may be better able to predict interest rate movements…most purchasers of corporate debt are sophisticated investors…”
- So what’s the story?

A Gap-Filling Theory of Debt Maturity

- Firms have no informational or forecasting advantage.
- Rather, act as macro liquidity providers:
  - Bond market is segmented: Modigliani and Sutch (1966), Vayanos and Vila (2007), Greenwood and Vayanos (2008).
  - Some investors have preference for specific maturities.
  - Government shocks to supply of long- and short-term bonds.
  - Arbitrageurs with limited capital.
  - Firms must raise debt financing, but can deviate from target maturity mix.
- If world is close to M-M (costs of deviating from target are small), firms will fill gaps in supply created by gov't shocks.

Testable Implications

- Corporate debt maturity moves inversely with government debt maturity.
- When government share of total debt is large, movements in corporate maturity are bigger.
- Firms with more flexible balance sheets are more aggressive gap fillers.
- Government debt maturity is a latent variable that explains apparent corporate timing ability.

Preview of Results

- Construct proxies for maturity of corporate and government debt, 1963-2005.
- Strong negative correlation between government and corporate debt maturity – “gap filling”.
- When government share of total debt is larger, firm debt maturity responds more elastically.
- Firms with more flexible balance sheets are biggest gap fillers.
- Including government debt maturity in forecasting regression reduces ability of corporate maturity to predict excess bond returns.

Model

- Three dates: 0, 1, 2.
- Short-term rates exogenous:
  - r_1 is known at time 0; r_2, is random as of time 0 with mean $E[r_2]$ and variance $Var[r_2]$.
- Four types of actors:
  - Government: exogenous supply G.
  - Pension funds: exogenous long-term demand L.
    - Can keep track of net supply $g = G-L$
  - Risk averse arbitrageurs with zero wealth
    - Mean-variance optimizers; buy long-term bonds of value h, financed with short-term borrowing. (Note: h can be positive or negative.)
  - Firms
    - Need to borrow total dollar amount C

Equilibrium Without Firms

- Market clearing sets arb demand equal to net supply *g*. Solve for *P**, price of long-term bond.
- This implies:

$$P^{*-1} - (1 + r_1)(1 + E[r_2]) = \frac{(1 + r_1)^2 \, Var[r_2]}{\gamma} g$$

- Expectations hypothesis holds if:
  - g=0: no net supply shock.
  - $Var[r_2] = 0$: no interest rate risk.
  - γ is infinite: arbs are risk-neutral.

Reality Check: Are Gov't Supply Shocks Large Relative to Arbitrage Capital?

- 2005 stock of gov't debt = $4.7 trillion.
- One standard-deviation annual shock to long-term gov't share = 9%, or $423 billion.
- A fully offsetting arbitrage position that finances $423 B of long-term bonds at the short-term rate has a (one percent) VaR of approx $98 B.
- Compare to 2005 total assets of macro and fixed-income-arbitrage hedge funds: $118 B and $28 B.

Firms

- Borrow dollar amount *C*.
- Fraction *f* comes from long-term debt.
- Target maturity structure: fraction *z* of long-term debt.
- If stray from target, firms incur dollar costs $\theta C(f - z)^2/2$.
- Firms minimize total expected financing costs:

$$\min_f \left[C\left((1 - f)(1 + r_1)(1 + E(r_2)) + \frac{f}{P} + \theta \frac{(f - z)^2}{2} \right) \right]$$

- Solution:

$$f^*(P) = z - \frac{P^{-1} - (1 + r_1)(1 + E[r_2])}{\theta}$$

Equilibrium

- Market clearing for long-term bonds implies equilibrium prices:

$$P^{*-1} - (1+r_1)(1+E[r_2]) = \left[\frac{\theta(1+r_1)^2 Var[r_2]}{\gamma\theta + C(1+r_1)^2 Var[r_2]}\right](g+Cz)$$

- and equilibrium fraction of long-term corporate debt:

$$f^* = z - \left[\frac{(1+r_1)^2 Var[r_2]}{\gamma\theta + C(1+r_1)^2 Var[r_2]}\right](g+Cz)$$

Comparative Statics

- Proposition 1: $\partial f^* / \partial g < 0$

  When gov't issues more long-term debt, firms tilt issuance toward short-term debt, and vice-versa.

- Proposition 2: $\partial^2 f^* / \partial g \partial C > 0$

  Gap-filling behavior is more pronounced when the stock of government debt is large relative to the stock of corporate debt.

Comparative Statics

- Proposition 3: $\partial^2 f^* / \partial g \partial \theta > 0$

  Firms with lower costs of straying from target maturity mix are more aggressive gap fillers.

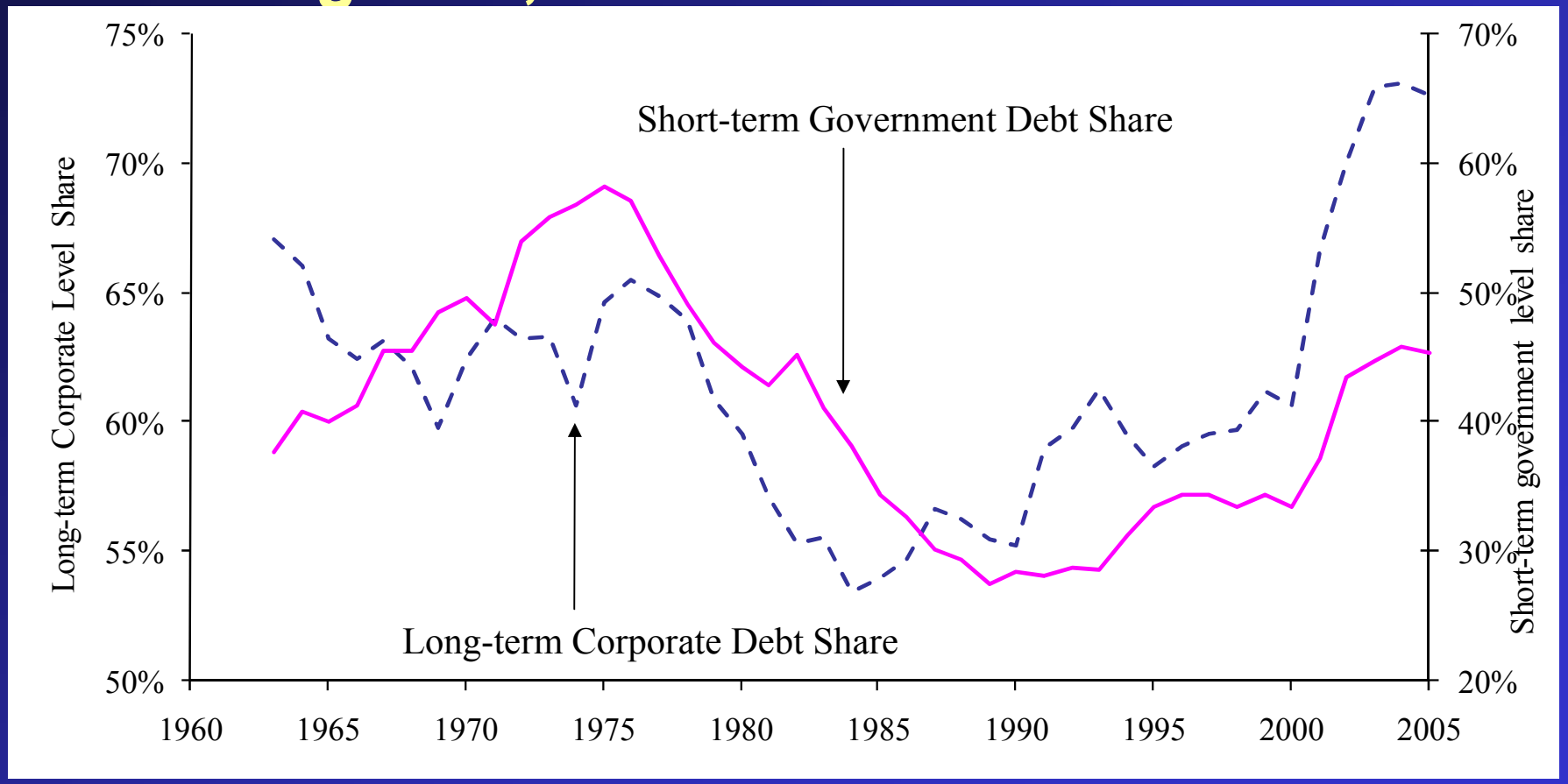
- Proposition 4: Bond-return predictability

  The ability of f^* to forecast bond returns arises because f^* responds to changes in the supply g of long-term government bonds, with g being the exogenous factor that drives variation in expected returns.

Data

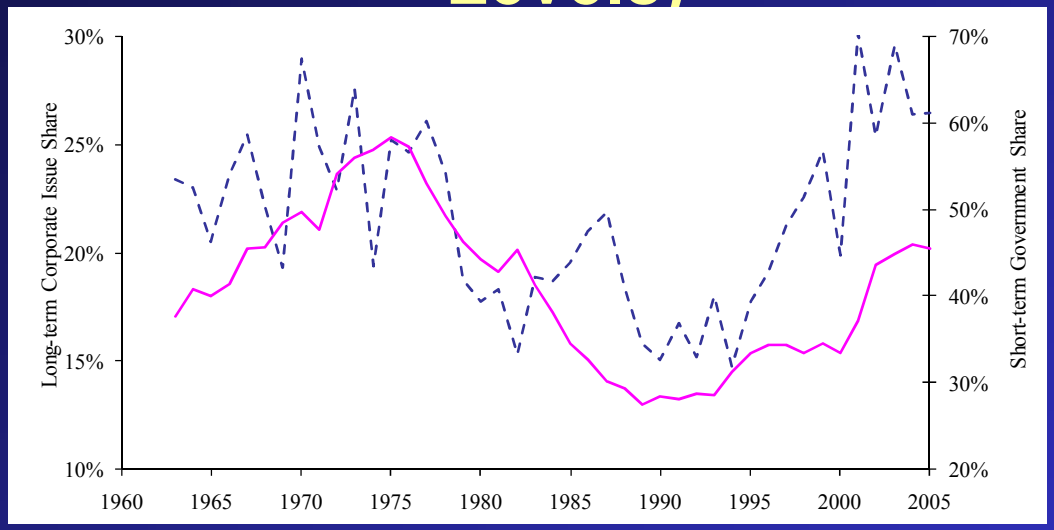
- Corporate debt maturity: “long-term” is debt with maturity > 1 year. We have three measures.
  - *Flow of Funds* nonfinancial sector: compute both long-term level share and long-term issue share.
  - Issue share assumes that one tenth of long-term debt retires every period.
  - Compustat nonfinancial firms: compute only level share. (Compositional effects make measuring issues problematic.)
- Government debt maturity from CRSP bond database.
  - Compute both long-term level share (fraction of payments due in more than one year), and weighted average maturity.

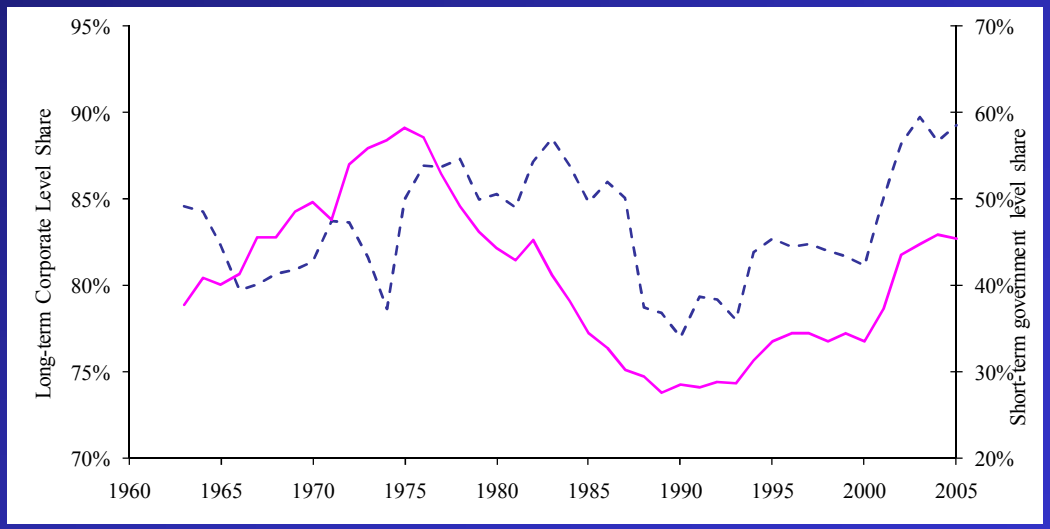
Prediction 1: Gap Filling
Figure 1, Panel A: FOF Levels



D_f^G / D^G

Figure 1, Panels B (FOF Issues) and C (Compustat Levels)





D_t^G / D^G

Table 2: Univariate Regressions of Corporate Maturity vs. Government Maturity

	FOF: Levels		FOF: Issues		Compustat: Levels	
D_L^G / D^G	-0.262		-0.249		-0.147	
	[-3.64]		[-4.21]		[-1.83]	
M		-1.804		-1.949		-1.272
		[-2.64]		[-2.85]		[-1.67]
R^2	0.22	0.11	0.29	0.18	0.15	0.12

Table 3: Include Controls

	FOF: Levels			
	(1)	(2)	(3)	(4)
D_L^G / D^G	-0.296	-0.387		
	[-5.14]	[-5.45]		
M			-2.540	-3.488
			[-4.31]	[-4.03]
y_{St}	-1.214	-1.263	-1.317	-1.404
	[-2.93]	[-3.55]	[-2.87]	[-3.43]
$y_{Lt} - y_{St}$	-0.613	-1.257	-0.781	-1.436
	[-1.11]	[-2.72]	[-1.30]	[-2.94]
Trend		0.160		0.154
		[2.26]		[1.78]
R^2	0.63	0.73	0.55	0.64

Controls Strengthen the Results

- Interpretation: both firms and the government respond in the same way to some observable factors.
  - E.g., both shift to shorter-term debt when yield curve is steeply upwards-sloping.
  - Perhaps to reduce measured borrowing costs.
- This element of positive correlation obscures the negative relationship from our model. So controls help.
- What about unobservable factors and the endogeneity of government debt maturity?
  - Return to this momentarily.

Economic Magnitudes

- Average ratio of corporate to government debt during sample period is 1.09.
- Coefficient of -0.387 from FOF levels spec with full set of controls implies that firms fill 42% of the dollar gap created by variation in gov't debt maturity.
  - 42% = 0.387x1.09.
- FOF issues measure suggests similar magnitudes.

Table 4: Robustness

- Subperiods.
- Longer sample for FOF-based measures: 1953-2005.
- Control for business cycles.
- Longer-dated proxy for government debt.

What About Endogeneity of Government Maturity?

- Can instrument for gov't maturity with ratio of gov't debt to GDP.
  - Two variables are highly correlated: univariate R-squared = 0.74.
  - Debt/GDP a proxy for stance of fiscal policy, arguably exogenous with respect to unobserved market conditions that might influence firm maturity decisions.
- IV results are precisely estimated, almost identical to OLS results.

Differenced and GLS Specifications

- Concern that measures of debt maturity are persistent.
- Standard fixes: estimate in differences, or use GLS.
- But be mindful of over-differencing: with adjustment costs, corporate maturity may not respond immediately to changes in government maturity.
  - So regressions with annual changes should not reveal the full effect.

Table 5: Differenced Regressions

$$d^C_{L,t} / d^C_t = a + b \cdot \Delta_k \left(D^G_{L,t} / D^G_t \right) + u_t$$

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	FOF Issues			Changes in FOF Levels		
	b	**[t]**	**R^2**	**b**	**[t]**	**R^2**
k=1 lag	-0.309	[-1.30]	0.04	-0.179	[-1.23]	0.06
k=2 lags	-0.331	[-2.26]	0.12	-0.265	[-1.64]	0.13
k=3 lags	-0.287	[-2.72]	0.16	-0.282	[-1.71]	0.16
k=4 lags	-0.285	[-3.86]	0.25	-0.308	[-2.07]	0.21
k=5 lags	-0.289	[-4.63]	0.33	-0.325	[-2.18]	0.24

D^G_t / D^G

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Takes a few years for firms to respond...

D^G_t / D^G

Table 6: GLS Regressions

	FOF: Levels			FOF: Issues		
D_L^G / D^G	-0.187	-0.130	-0.130	-0.238	-0.276	-0.316
	[-1.44]	[-1.20]	[-1.21]	[-2.60]	[-4.70]	[-6.16]
y_{St}		-0.290	-0.300		-0.780	-0.826
		[-1.14]	[-1.15]		[-3.78]	[-4.60]
$y_{Lt} - y_{St}$		0.299	0.284		-0.100	-0.437
		[0.79]	[0.73]		[-0.21]	[-1.02]
Trend			0.101			0.066
			[0.65]			[1.95]
R^2	0.62	0.66	0.73	0.25	0.53	0.59
ρ	0.96	0.97	0.96	0.43	0.16	0.05

Consistent with differenced specifications….

Interpretation of GLS Results

- With FOF issues, ρ is modest; GLS yields very strong results—similar to OLS.
- With FOF levels, ρ is almost one; GLS amounts to first differencing, and yields much weaker results.
- With Compustat levels, ρ is roughly 0.80; results are again similar to OLS.
- Overall conclusion: because FOF issues series is not very persistent, simple OLS approach with this measure is on firm ground.

Prediction 2: Time Variation in Gap Filling

- When we observe high values of (gov't debt)/GDP, or (gov't debt)/(total debt), firms should be more responsive in their gap filling.
- Empirical implementation:

$$d_{L,t}^{C} / d_{t}^{C} = a + b \cdot \left(D_{L,t}^{G} / D_{t}^{G} \right) + c \cdot Scale_{t} + d \cdot \left(Scale_{t} \times D_{L,t}^{G} / D_{t}^{G} \right)$$
$$+ e \cdot time + f \cdot \left(time \times D_{L,t}^{G} / D_{t}^{G} \right) + u_{tt}$$

D^G / D^G

Table 7

	Dependent Variable = Corporate Long-term issue share	
	S = gov't debt to GDP	*S = gov't debt to total debt*
D_L^G / D^G	0.640	1.188
	[2.79]	[2.44]
S	2.906	4.795
	[4.41]	[2.95]
$S \times \left(D_L^G / D^G \right)$	-4.400	-7.622
	[-4.49]	[-3.03]

…Firms more active at filling gap when Gov share is high

Prediction 3: The Cross-Section of Gap Filling

- Firms with stronger balance sheets should be more aggressive gap fillers—lower costs of deviating from target maturity mix.
- Empirical implementation: use Compustat data.
  - Proxies for balance sheet strength:
    - Market capitalization (bigger is stronger).
    - KZ index components
      - Dividend payers versus non payers (payers = stronger).
      - Cashflow/Assets (high = stronger).
      - Cash/Assets (high = stronger).
      - Tobin's Q (high = costlier to forego investment = weaker).
      - Leverage (high = weaker).

Figure 3: Gap Filling by Large and Small Firms

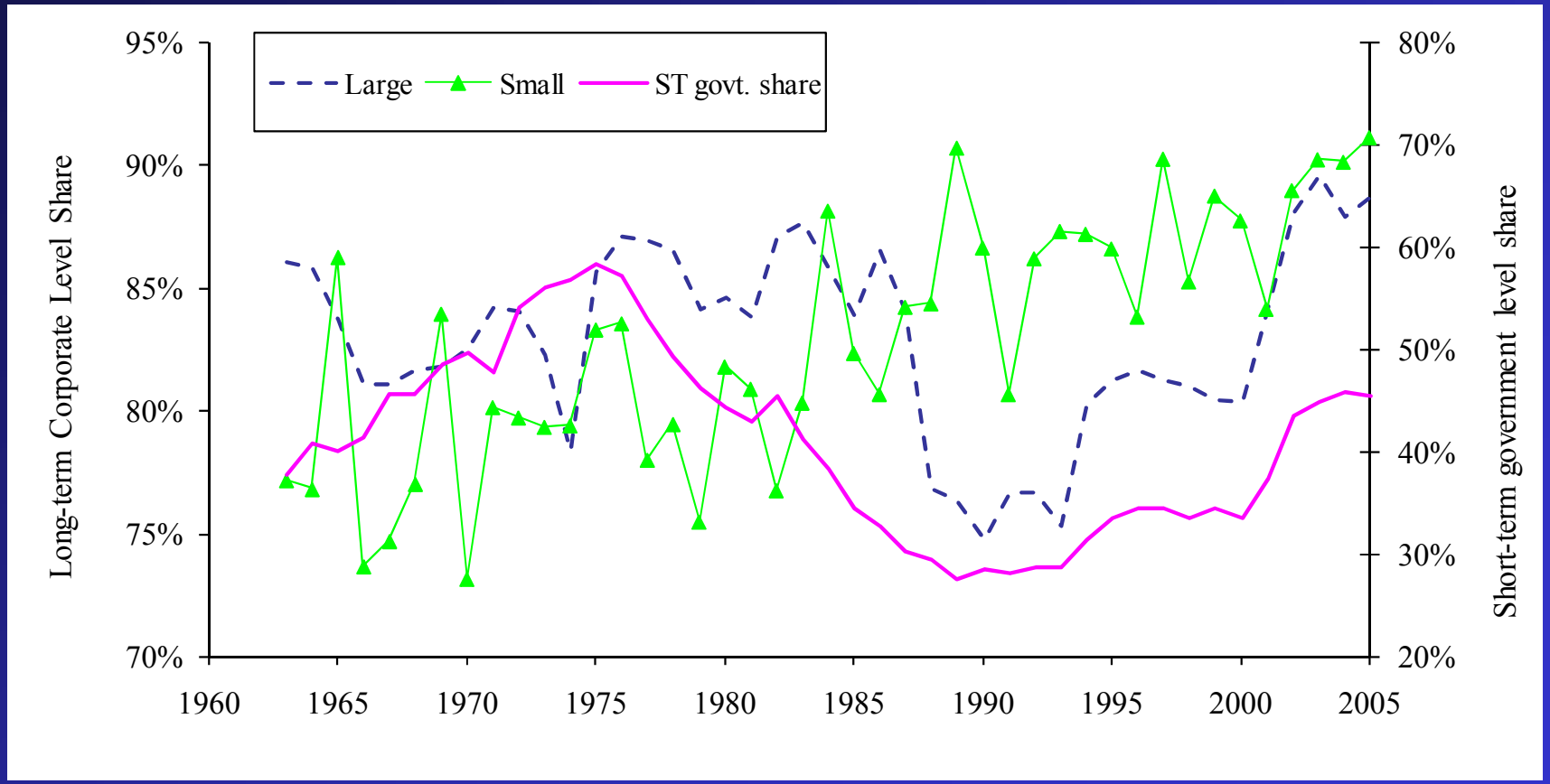

Table 8: Results Disaggregated by Firm Type

	Low		High		High – Low	
	b	**[t]**	**b**	**[t]**	$\mathbf{b^{High} - b^{Low}}$	**[t]**
All Compustat Nonfinancial	-0.228	[-2.33]				
Market Capitalization	0.024	[0.43]	-0.286	[-2.50]	-0.310	[-2.18]
Non-payers ("low"); Payers ("high")	-0.043	[-0.83]	-0.263	[-2.30]	-0.220	[-1.91]
Cash Flow/Assets	0.073	[1.35]	-0.125	[-1.42]	-0.198	[-1.94]
Cash/Assets	-0.059	[-0.39]	-0.215	[-2.53]	-0.156	[-1.07]
Tobin's Q	-0.318	[-3.09]	-0.063	[-0.69]	0.255	[1.97]
Leverage	-0.375	[-3.19]	-0.367	[-2.88]	0.008	[0.06]

Prediction 4: Forecasting Bond-Market Returns

- Adding government maturity should reduce the predictive power of corporate debt maturity for future excess bond returns.

	3-year ahead excess returns (%)				
$D^G_{L,t} / D^G_t$	0.824		0.580		0.576
	[3.22]		[1.83]		[2.00]
$d^C_{L,t} / d^C_t$		-1.588	-1.045		
		[-2.64]	[-1.52]		
$D^C_{L,t} / D^C_t$				-1.408	-1.034
				[-3.05]	[1.95]
R^2	0.19	0.17	0.25	0.20	0.28

D^G_t / D^G

Conclusions

- Firms are unlikely to have a forecasting/informational edge over, e.g., hedge funds. But can have an advantage in macro liquidity provision.
  - Follows from logic of M-M theorem: small costs of adjusting debt maturity to absorb large supply shocks.
  - Contrast with hedge funds who must worry about VaR and for whom betting the yield curve is an undiversifiable risk.
- Similar logic may explain other forms of macro timing.
  - Baker and Wurgler (2000) on the equity share and stock-market returns.
  - Large volume of repurchases after 1987 market crash.