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Revealed Preferences
for Corporate Leverage

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I consider a simple model of dynamic capital structure with adjustment costs, and I show how financial decisions reveal firms' preferences for leverage. I show that the most commonly used empirical models of capital structure (the partial adjustment model, e.g. Fama and French (2000) and the financial deficit model, e.g. Shyam-Sunder and Myers (1999)) are mis-specified. Estimating a correctly specified model yields new insights and solves spurious puzzles: The expected future financial deficit is a significant determinant of the current choice of debt versus equity, and profitable firms have a higher target leverage. However, while the value functions that I estimate display qualitatively sensible properties, they also appear extremely flat for moderate values of leverage, which is inconsistent with tax-based theories. The methodology that I propose can be readily extended to test the importance of other determinants of capital structure decisions. As an application, I show that CEO tenure flattens the left part of the estimated value function, which is consistent with agency theories.

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Abstract

I consider a simple model of dynamic capital structure with adjustment costs, and I show how financial decisions reveal firms' preferences for leverage. I show that the most commonly used empirical models of capital structure (the partial adjustment model, e.g. Fama and French (2000) and the financial deficit model, e.g. Shyam-Sunder and Myers (1999)) are mis-specified. Estimating a correctly specified model yields new insights and solves spurious puzzles: The expected future financial deficit is a significant determinant of the current choice of debt versus equity, and profitable firms have a higher target leverage. However, while the value functions that I estimate display qualitatively sensible properties, they also appear extremely flat for moderate values of leverage, which is inconsistent with tax-based theories. The methodology that I propose can be readily extended to test the importance of other determinants of capital structure decisions. As an application, I show that CEO tenure flattens the left part of the estimated value function, which is consistent with agency theories.

Corporate finance textbooks summarize the static trade-off model of capital structure with a simple picture of the value of the firm as a function of its leverage, as shown on Figure 1. In fact, other theories can be represented by an objective function, together with a pair of adjustment cost functions for debt and equity. In the cumulative pecking order theory, the objective function is flat and the adjustment costs are much higher for equity issues than for debt issues. The agency view is that the objective function represents managerial preferences, as opposed to the value of the firm for its claim holders. My contribution in this paper is to estimate the objective function "revealed" by actual firms' decisions. I use the simplest theoretical framework to derive an empirically estimable equation. Despite its simplicity, this equation offers new insight into capital structure dynamics: As predicted by the theory, the expected future financial deficit is a significant determinant of current decisions to issue debt or equity. I also find that profitable firms have a higher target leverage ratio, and that adjustment costs for debt are smaller than for equity. However, while the objective functions that I estimate display qualitatively sensible properties, they also appear extremely flat for moderate values of leverage, which is inconsistent with tax-based theories. The methodology that I propose can be readily extended to test the importance
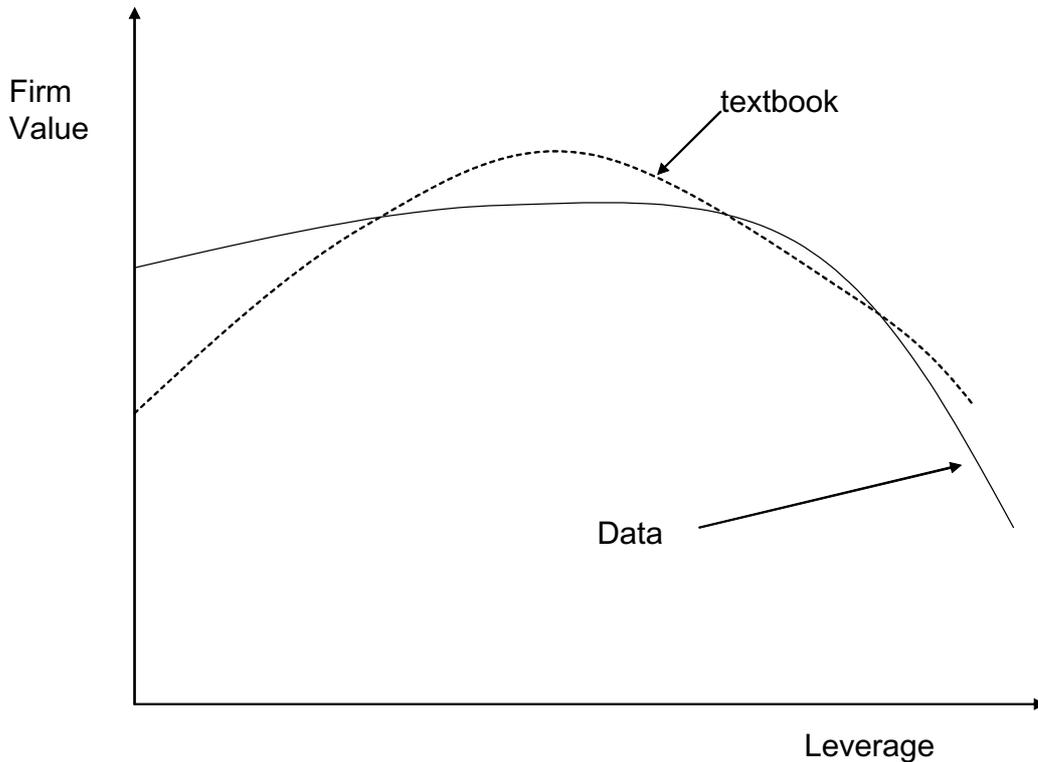

Figure 1: The "textbook" value function and the objective function "revealed" by firms'
actions.

of other determinants of capital structure decisions. As an application, I show that CEO
tenure flattens the left part of the estimated value function, which is consistent with agency
theories.

Empirical papers on capital structure fall into two categories: reduced form and struc-
tural. Most papers are reduced forms. They provide multivariate correlations and descrip-
tive statistics but they are not grounded in a rigorous framework and they estimate ad-hoc
equations. Perhaps for that reason, they typically use different and somewhat contradictory
specifications, and not surprisingly, they reach conflicting results. Fama and French (2000)
consider the dynamics of dividends and book leverage: They find that small, low leverage,
growth firms issue equity, that leverage and profitability are negatively correlated and that
mean reversion in leverage is quite slow. Another group of papers focuses on how firms
finance their investment expenditures: These papers take the financing deficit as an exoge-
nous driving process and simply regress debt issues on the financial deficit. Shyam-Sunder
and Myers (1999) find that most external finance is raised via debt issues. Frank and Goyal
(2003) show that this is true only for firms that are continuously present in Compustat
from 1971 to 1999, i.e. large, stable, old firms. For the others, net equity issues track the
financing deficit more closely than do net debt issues. Other papers depart from the usual
pecking order versus trade-off debate: Baker and Wurgler (2002) argue that book leverage

is the cumulative outcome of past attempts to time the equity market, while Welch (2004) claims that market leverage dynamics are entirely driven by stock price changes. Leary and Roberts (2003) argue that Baker and Wurgler (2002) and Welch (2004) do not correctly capture the dynamics of debt and equity issues: Leary and Roberts (2003) find that, while firms issue equity when their stock prices are high, they respond by subsequently increasing their leverage. Overall, there is little or no agreement, not only about the results, but also about the methodology: Some papers focus on book leverage and some on market leverage, some papers use the financial deficit, and some do not.

There are a few structural papers. These papers specify a full model and estimate it[1]. The structural papers typically impose many restrictions on the data. Fisher, Heinkel, and Zechner (1989) assume that debt recapitalization follow an (s, S) rule and calibrate the recapitalization bands. Hennessy and Whited (2003) is an ambitious paper that models simultaneously the investment and capital structure decisions.

Finally, some papers provide actual estimates of the costs and benefits involved in capital structure decisions. Graham (2000) estimates that the tax benefits of debt are large: the typical firm could obtain additional gross tax benefits of 15% of firm value by levering up. The perceived costs of financial distress needed to rationalize this observation seem too large, especially compared to the estimates of Andrade and Kaplan (1998). Altinkilic and Hansen (2000) estimate the magnitudes and shapes of cost functions associated with actual issues of stocks and bonds.

I borrow from both the fully structural and fully reduced form approaches. I assume the existence of a value function that depends on leverage and firms characteristics ($R\&D, ..$) but instead of estimating an ad-hoc specification, I estimate the first order condition that characterizes the optimal capital structure decision, given the value function. I then use the estimated parameters to reconstruct the shape of the value function. Section 1 describes the data in a non structural way and section 2 lays down the model and describe the estimation process.

1   Non structural description and sample selection

Throughout the paper, I use the Compustat annual files from 1971 to 2002. I include only firms with more than 25 millions of 1996 dollars in sales and total assets, and I require two lags of sales, assets, market value of equity, retained earnings, operating income, total liabilities and debt (short and long term), as well as the future value of assets, retained earnings and liabilities[2]. I also require at least 3 observations per firm. The final sample includes 4, 181 different firms and 56, 926 firm-year observations.

This sample is similar to the one that has been used in recent empirical studies (see for instance Fama and French (2000), Shyam-Sunder and Myers (1999) and Frank and Goyal (2003)). The typical results of the literature are reproduced in Tables 1a and 1b. The

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[1] Most models are reviewed in Harris and Raviv (1991)

[2] The exact definitions of all variables in terms of their data numbers in Compustat annual files are in the appendix. All the variables are winsorized at 1% and 99% to remove the influence of outliers. Altinkilic and Hansen (2000) estimate that the fixed component of issuing costs is roughly $250,000. I chose the $25 millions cutoffs so that these fixed costs are less that 1 percent of sales and assets, because my model does not allow for non-convex adjustment costs.

financial deficit, DEF_{it}, is defined as change in total assets, A_{it}, minus change in retained earnings ,RE_{it}, over lagged total assets, A_{it-1}. I include preferred stocks ,PS_{it}, in liabilities ,L_{it}. Table 1a show the results of the OLS regression

$$\frac{\Delta L_{it}}{A_{it-1}} = \alpha + \beta \times DEF_{it} + \varepsilon_{it} \tag{1}$$

I estimate $\hat{\beta} = 0.72$, while Shyam-Sunder and Myers (1999) obtained 0.76. Table 1b considers the conventional determinants of book leverage: size (lagged assets), profitability (operating income, OI_{it}, over lagged assets), R&D expenditures[3], $R\&D_{it}$, over sales, S_{it-1}, and Tobin's Q. Let $l_{it} = \frac{L_{it}}{A_{it}}$ denote book leverage. I run

$$l_{it} = \alpha \log{(A_{it-1})} + \beta \frac{R\&D_{it-1}}{S_{it-1}} + \gamma \frac{OI_{it-1}}{A_{it-1}} + \psi Q_{it-1} + u_{it} \tag{2}$$

Table 1b shows that leverage is negatively related to R&D intensity and Tobin's Q, and positively related to size, as predicted by standard theories. However, the negative relation between profitability and leverage has been considered a puzzle for the trade-off theory (Fama and French (2000)). In the next section, I will argue that equations (1) and (2) are mis-specified.

Before turning to the model, it is useful to look somewhat informally at the data. Figure 2 shows how firms use equity to rebalance their capital structure, while figure 3 shows how they use debt. The figures are constructed as follows. For equity, I consider the change in the book value of equity that is not due to changes in retained earnings. Let BE_{it} be the book value of equity, PS_{it} be the book value of preferred stocks and RE_{it} be retained earnings. Define

$$y_{it}^E = \frac{\Delta BE_{it} - \Delta PS_{it} - \Delta RE_{it}}{A_{it-1}}$$

I also look at the actual sales EI_{it} (Compustat data item 108) and purchases EP_{it} (#115) of common and preferred stocks

$$y_{it}^{NEI} = \frac{EI_{it} - EP_{it} - \Delta PS_{it}}{A_{it-1}}$$

For liabilities, I consider the change in book liabilities, L_{it}, (I have included preferred stocks as liabilities)

$$y_{it}^L = \frac{\Delta L_{it}}{A_{it-1}}$$

I also look at the debt, BD_{it}, component of liabilities [4]

$$y_{it}^D = \frac{\Delta BD_{it}}{A_{it-1}}$$

My goal is to construct the pictures for the "typical" firm in a way that is consistent with the regressions of the next section: I therefore use only manufacturing firms and I exclude

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[3] I set R&D expenditures to 0 when they are missing.

[4] Actual debt issues are only available for long term debt.

the bottom and top 10% of the distributions of size (lagged assets), profitability (operating income over lagged assets), R&D intensity (R&D expenditures over sales) and financial deficit (change in book assets minus change in retained earnings, over lagged assets). The variables $(y_{it}^E, y_{it}^{NEI}, y_{it}^L, y_{it}^D)$ are then adjusted for year effects: $\hat{y}_{it} = y_{it} - mean_j(y_{jt})$. Finally, the figures show $\hat{y}$ as a function of book leverage B:

$$\hat{y}(B) = mean_{it}(\hat{y}_{it} | B_{it-1} \in [B - .05; B + .05])$$

Figure 2 and 3 show that firms rebalance their capital structure, but that the speed seems to decline for low values of leverage. I will incorporate this potential non linearity in the model.

2 A simple model of capital structure dynamics

I now introduce a simple model of capital structure dynamics. The model focuses on capital structure decisions and does not attempt to solve for the investment decisions of the firms. I do however recognize the endogeneity issue and adjust the econometric procedure accordingly.

Let $l_{t-1} = \frac{L_{t-1}}{A_{t-1}}$ be book leverage at the beginning of period t, A_{t-1} be total assets, L_{t-1} be liabilities and E_{t-1} be book equity minus retained earnings. I assume that it is costly to change either E_t or L_t and that these costs are additively separable. Leverage has both costs and benefits, captured by the flow value function $\pi_t(l_{t-1})$. This function can depend on a vector of firm characteristics[5], Z_t. The program of the firms is therefore:

$$\tilde{V}_t(l_{t-1}, A_{t-1}) = \max_{\{D_t\}(E_t)} \left\{ A_{t-1} \left(\pi_t(l_{t-1}) - F\left(\frac{L_t - L_{t-1}}{A_{t-1}}\right) - G\left(\frac{E_t - E_{t-1}}{A_{t-1}}\right) \right) + \beta E_t \left[\tilde{V}_{t+1}(l_t, A_t) \right] \right\}$$

subject to the accounting identity

$$DEF_t = \Delta A_t - \Delta RE_t = L_t - L_{t-1} + E_t - E_{t-1}$$

This corresponds to the financing decision of the firm, given its investment decision, i.e., given DEF_t. In reality, obviously, DEF, ΔE and ΔL are jointly determined, so one must be careful in estimating these equations (see below). The functional form uses constant returns to scale as a benchmark (since everything is scaled by assets), but it allows for deviations from this benchmark: In particular, I will allow the function $\pi_t(.)$ to depend on firm size.

Introducing the variables $x_t = \frac{L_t - L_{t-1}}{A_{t-1}}$, $\delta_t = \frac{DEF_t}{A_{t-1}}$, and $\gamma_t = \frac{A_t}{A_{t-1}}$, we define the new (scaled) value function, $V_t(.)$, by

$$\tilde{V}_t(l_{t-1}, A_{t-1}) = A_{t-1} V_t(l_{t-1})$$

Since

$$l_t = \frac{l_{t-1} + x_t}{\gamma_t} \tag{3}$$

---

[5] Z_t typically includes profitability, R&D intensity, growth options, volatility, etc.. To keep the notations simple I will write $\pi_t(.) = \pi(.; Z_t)$

we can rewrite the problem as

$$V_t\left(l_{t-1}\right) = \max_{x_t}\left\{\pi_t\left(l_{t-1}\right) - F\left(x_t\right) - G\left(\delta_t - x_t\right) + \beta E_t\left[\gamma_t V_{t+1}\left(\frac{l_{t-1} + x_t}{\gamma_t}\right)\right]\right\}$$

And the FOC is

$$f\left(x_t\right) - g\left(\delta_t - x_t\right) = \beta E_t\left[v_{t+1}\left(l_t\right)\right]$$

where lower case letters (f, g, v) denote first derivatives. I assume that the costs functions (F, G) are quadratic so that

$$f\left(x_t\right) = f_1 x_t \; ; \; g\left(\delta_t - x_t\right) = g_1\left(\delta_t - x_t\right)$$

Note that δ_{t+1} is a state variable of the dynamic program and that, as explained above, the function π_t should depends on a vector of firm characteristics, Z_t. The first order approximation to the value function is therefore:

$$\begin{aligned}
v_{t+1}\left(l_t\right) &= v\left(l_t, \delta_{t+1}, Z_{t+1}\right) = v_0 + v_l l_t + v_{lh} lh_t + v_Z Z_{t+1} + v_\delta \delta_{t+1} \\
lh_t &= \left(l_t - \bar{l}\right) \times \left(l_t > \bar{l}\right)
\end{aligned}$$

From figure 3, we know that we should a priori allow for a non linear effect of leverage: lh_t allows the slope to be steeper for large values of l_t, and $\bar{l}$ is set to 0.5, which corresponds to the median of the distribution of leverage[6]. We can write the FOC as:

$$x_t = \frac{\beta v_0}{f_1 + g_1} + \frac{g_1}{f_1 + g_1}\delta_t + \frac{\beta}{f_1 + g_1}\left(v_l l_t + v_{lh} lh_t + v_Z E_t Z_{t+1}\right) + \frac{\beta}{f_1 + g_1} v_\delta E_t \delta_{t+1} \quad (4)$$

Given (3), it is clear that one should not use OLS to estimate (4). Also, we must keep in mind that δ_t is not really exogenous and that we are really estimating one equation out of a system of simultaneous equations. To see why, consider the case where, for some reason, it is cheap to issue debt in a given period: If the firm takes advantage of this to increase its investment, as seems plausible, then x_t will cause δ_t. And one can think of many other examples of reverse causality, for instance if the incentives to pay dividends change over time. So we must use an instrumental variable approach: The instruments are the lagged values of the right-hand-side variables, and the growth rate of sales. These instruments are far from perfect, but they represent an improvement over existing specifications that bypass the issue altogether. I use sales growth because I worry that shocks to financial markets may drive both the choice of debt versus equity as well as the amount of investment expenditures. For sales growth to be a valid instrument, it must be that shocks to this variable are mainly driven by the demand for the firm's products. The firm characteristics, Z_t, are R&D intensity, Tobin's Q, profitability and size, as defined above[7], and I include industry dummies, α_j^0, and industry specific time trends, α_j^1 and α_j^2:

$$\begin{aligned}
x_{it} &= a \times l_{it} + b \times lh_{it} + c \times E_t \delta_{it+1} + d \times \delta_{it} + e' \times E_t Z_{it+1} + \alpha_j^0 + \alpha_j^1 \times t + \alpha_j^2 \times t^2 + \varepsilon_{it} \\
Z_{it+1} &= \left\{\frac{R\&D_{it+1}}{S_{it+1}}; Q_{it+1}; \frac{OI_{it+1}}{A_{it}}; \log\left(A_{it}\right)\right\}
\end{aligned}$$

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[6]I have also tried including other non linear (2d order) terms, but they were not significant and are excluded for the sake of brevity.

[7]So e is a vector.

The estimated coefficients (a, b, c, d, e) are presented in Table 2a. Several results are new and interesting. First, the expected *future* financial deficit is significant, both economically and statistically. This is reassuring since this is a direct prediction of the theory. Its interpretation is also intuitive: firms that expect a sustained financial deficit in the future are less likely to increase their liabilities to finance their deficit today. Second, the non linear effect of leverage that we suspected from figure 3 is clear in the data: the effect of leverage is small for low values of leverage, and much larger for large values of leverage. Third, the effects of firm characteristics are all consistent with the textbook. In particular, more profitable firms tend to issue more debt. This runs counter to most previous research, and this is a direct benefit of specifying an explicit model. In the data, the correlation between leverage and profitability is negative. But this simply means that profitable firms were able to finance their investments without relying on debt. Any model with adjustment costs would rationalize this correlation (the pecking order model being one of them). The interesting result in Table 2 is that, beyond these adjustment costs, profitable firms do have a higher target leverage[8]. Finally, the coefficient for the current financial deficit, which should be an estimate of $\frac{g_1}{f_1 + g_1}$, suggests that the marginal adjustment cost for debt is only a third of the marginal cost for equity, consistent with the pecking order model.

The final step is to construct the value functions. However, one cannot identify the scale of the value functions without assuming values for f_1 and g_1. In what follows, I propose a way to estimate the orders of magnitude of f_1 and g_1, but it is worth emphasizing that the shape of the value functions is independent of this procedure. If one rejects the way I estimate f_1 and g_1, one can simply disregard the scale of the vertical axis of Figure 4 and 5.

Altinkilic and Hansen (2000) estimate the costs of issuing long term bond and equity. Let e_t be the size of the equity issue over lagged assets and $c(e)$ be the cost of the issue, over lagged assets. The spread is then defined as

$$s^e = \frac{c^e(e)}{e}$$

Altinkilic and Hansen (2000) estimate (using their notations, Table 2, p201):

$$s_{it}^e = \beta_0 + \beta_1^e * \frac{1}{A_{it-1} \times e_{it}} + \beta_2^e e_{it}$$

therefore, in terms of the cost function, we get

$$c^e(e) = \frac{\beta_1^e}{A_{it-1}} + \beta_0^e e_{it} + \beta_2^e e_{it}^2$$

The fixed cost β_1^e is \$250,000. The variable costs are $\beta_0^e = 4\%$ and $\beta_2^e = 2.6\%$. For bond issues, they estimate a fixed cost of \$227,000, and $\beta_0^b = 0.5\%$ and $\beta_2^b = 4.6\%$. My specification does not allow for fixed costs: For now, I simply neglect them, but below, I check that, for the firms in my sample, they are indeed smaller than the variable costs.

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[8]I do not mean to imply that adjustment costs are a trivial part of the story. Indeed, they are crucial. But it is important to distinguish them from the implicit target leverage. I do mean however that regressions of current leverage on past leverage and other endogenous variables, that are common in the literature, are mis-specified and do not identify correctly the target leverage.

The Altinkilic and Hansen (2000) results apply to stock and long term debt issues. Firms, however, have other ways to adjust their balance sheets, for instance with short term debt, other liabilities, trade credit, etc.., that are likely to be less costly for small changes. One way to capture this is to assume that, in order to change the book value of liabilities, the firm faces the following costs:

$$F(x) = \min_b c^b(b) + \frac{f_1}{2}(x-b)^2$$

where x is the change in the book value of total liabilities and b is the net issue of long term debt (always normalized by lagged assets). Neglecting the fixed cost, I take from Altinkilic and Hansen (2000) that $c^b(b) = \beta_0^b b + \beta_2^b b^2$. It is obvious that for small values of x, the firm will not issue bonds, and that when it does issue bonds, the following marginal condition should hold:

$$f_1 \times (x - b) = \beta_0^b + 2\beta_2^b b$$

So one can obtain an order of magnitude for f_1 from the median of $\frac{\beta_0^b + 2\beta_2^b b}{x-b}$ when both b and $x - b$ are significantly positive. I compute the median using all the observations for which the sales of long term bonds (#111) is strictly positive and for which $x - b$ is greater than its median absolute deviation. I thus obtain $f_1 = .38$. The same exercise for stocks yields $g_1 = 1.55$. Needless to say, these estimates are very tentative: I am only interested in the orders of magnitude. Nonetheless, these estimates imply that the coefficient of δ_t in regression 4 should be $\frac{g_1}{g_1 + f_1} = 0.8$. The point estimate in Table 1 is 0.76. Both suggest that adjustment costs for debt are smaller than for equity, a very intuitive result which is consistent with the pecking order theory.

I can also verify that, for the firms in my sample, the variable costs are larger than the fixed costs : the mean value of the variable costs [9] is 1.6%. The fixed costs on the other hand are on average .05%, more than three times smaller. I have also run the regressions keeping only firms with more than \$200 millions of assets, for which fixed costs are truly negligible, and the results are in Table 2b. The only significant change is that the coefficient on book leverage is not significant for small values of leverage, which suggest that the value function is even flatter for these firms. The other results are unaffected.

Figure 3 presents the estimated value functions obtained by integrating equation 4. The "average" corresponds to a manufacturing firms during the second half of the 1990s. I also plot the value functions corresponding to firms that are at the 80th percentiles of the distributions of size, profitability and Tobin's Q (for growth). I draw two main conclusions from the picture. The first is that the comparative statics are remarkably in line with standard theories. Profitable firms and large firms have a higher target leverage. Growth firms have a lower target and are very averse to high leverage. The second conclusion is that the value function for the typical firm is quite flat for leverage below 0.5.

Given these conclusions, I made a preliminary investigation of the role of managerial influence on capital structure decisions. I ran the model for firms that belong to both Compustat and Execucomp, controlling for CEO tenure. Agency models predict that CEO's influence grows over time, and, to the extent that CEO dislike debt, we would expect that firms in which the CEO has been in charge for a long time should display a stronger

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[9]The mean of $F(x_t) + G(\delta_t - x_t)$

preference for low leverage. Indeed, Table 3 shows that firms where CEO tenure exceeds 15 years issue 0.8% less debt that comparable firms. Note that more than 2 third of the observations belong to the second half of the 1990s and that, in this sample, adjustment costs for equity are estimated to be of the same order of magnitude as for debt. This is consistent with market timing models. Figure 5 shows the implied value functions, which suggest that CEOs are not eager to lever up their companies.

3 Conclusion

I have estimated a model where firms optimally choose the dynamics of their capital structure, taking into account their target leverage as well as the adjustment costs associated with debt and equity changes.

I have found that the expected financial deficit is a significant determinant of today's financing decisions, as predicted by the dynamic model. Consistent with standard corporate finance theory, I have found that the target is higher for large and profitable firms and lower for firms with growth options and large R&D expenditures. My results also suggest that adjustment costs for debt are smaller than for equity.

The actual shape of the value functions, however, poses an interesting challenge for future research. I have found that the value functions are extremely flat for low value of leverage. This has two straightforward implications. First, many factors can potentially affect capital structure dynamics for moderate leverage, with market timing being a natural candidate. Second, a successful model of capital structure choice must be able to explain the flatness of the value functions. Standard theory based on the tax advantages of debt does not seem promising. Preliminary results on the effect of CEO tenure provide some support for agency models.

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A   Appendix A

The data comes from Compustat. The definitions of book leverage and book equity follow Fama and French (2000).

Preferred Stock = liquidating value (#10) or redemption value (#56 if #10 missing)

Book Equity = Total Assets (#6) - Total Liabilities (#181) - Preferred Stock + Deferred Taxes and Tax Credit (if available) (#35)

Market Equity = stock price (#199) × shares outstanding (#25)

Market Value = Market Equity + Total Assets (#6) - Book Equity

Equity = Book equity - Retained Earnings (#36)

Liabilities = Total Assets - Book Equity = Total Liabilities + Preferred Stocks - Tax Credit

Book Debt = Long term debt (#9) + Short term debt (#34)

Book Leverage = Liabilities/Total Assets

Profitability = Operating Income (#13) / Total Assets lagged one year

Size = log(Total Assets / GDP deflator)

Sales growth = log[Sales (#12) / Sales lagged one year] - log[GDP deflator / GDP deflator lagged one year]

Tobin's Q = Market Value / Total Assets

R&D intensity = R&D expenditures (#46) / Sales

All variables are winsorized at percentiles $(1, 99)$.

Table 1a: OLS Financial Gap Regression. Dependent variable is change in liabilities over lagged assets. Financial deficit is change in book assets minus change in retained earnings. Regression also includes 13 industry dummies (NAICS 1 digit) and industry specific time trends (linear and quadratic).

	Financial Deficit	Constant	R2	N observations	N firms
Point Estimate	0.7231244	0.0000339	0.7961	56926	4181
Standard Error	0.007062	0.000851			

Note: Firms with more than 25 millions of real 1996 dollars of assets. All standard errors are robust and clustered at the firm level. Compustat 1971-2001

Table 1b: OLS Partial Adjustment Regression for Book Leverage. Dependent variable is book leverage. Regression also includes 13 industry dummies (NAICS 1 digit) and industry specific time trends (linear and quadratic).

	R&D over sales (lagged)	Tobin's Q (lagged)	Operating Income over Assets (lagged)	log(Assets) in 1996 dollars (lagged)	Constant	R2	Obs. (firms)
Point Estimate	-0.9804848	-0.005732	-0.6282357	0.0211517	0.5090983	0.2031	56926
Standard Error	0.0615093	0.0023588	0.0194765	0.0013225	0.0100022		(4181)

Note: Firms with more than 25 millions of real 1996 dollars of assets. All standard errors are robust and clustered at the firm level. Compustat 1971-2001.

Table 2: IV Estimation of Value Function Parameters. Compustat Sample 1971-2001. Dependent variable is change in liabilities over lagged assets. Regression also includes 13 industry dummies (NAICS 1 digit) and industry specific time trends (linear and quadratic).

	Book leverage	Excess slope for book leverage>0.5	Future Financial Deficit	Current Financial Deficit	R&D over Sales	Tobin's Q	Operating Income over Assets	log(Assets) in 1996 dollars	Constant
2a: Firms with more than 25 millions of real 1996 dollars of assets. 4181 firms, 56926 observations.									
Point Estimate	-0.0216627	-0.0375331	-0.1244612	0.7622088	-0.1831579	-0.0161819	0.0753999	0.0034268	0.0145546
Standard Error	0.0072737	0.0115941	0.0403355	0.0165047	0.0263388	0.0017896	0.0118857	0.0003438	0.0034564
2b: Firms with more than 200 millions of real 1996 dollars of assets. 2704 firms, 32063 observations.									
Point Estimate	0.0028032	-0.0572815	-0.1109945	0.759162	-0.1553778	-0.0104928	0.0963114	0.0022665	0.0002189
Standard Error	0.01092	0.0160248	0.0476423	0.0168189	0.0315229	0.0018725	0.0167239	0.000486	0.0045483

Note: Instruments used are two lags of right-hand-side variables and growth rate of sales and its lags. All standard errors are robust and clustered at the firm level.

Table 3: IV Estimation of Value Function Parameters. Execucomp Sample 1992-2001. Dependent variable is change in liabilities over assets. Regression also includes 13 industry dummies (NAICS 1 digit) and industry specific time trends (linear and quadratic).

	Book leverage	Excess slope for book leverage>0.5	Future Financial Deficit	Current Financial Deficit	R&D over Sales	Tobin's Q	Operating Income over Assets	log(Assets) in 1996 dollars	Dummy for CEO tenure >= 15 years	Constant
Point Estimate	-0.0051598	-0.0864779	-0.0666618	0.5821125	-0.1997557	-0.0163881	0.2315497	0.0048166	-0.0080906	0.0046871
Standard Error	0.023024	0.032795	0.0689132	0.0313052	0.0544813	0.003291	0.0319043	0.0014518	0.0031764	0.0041903

Note: Instruments used are two lags of right-hand-side variables and growth rate of sales and its lags. Firms with more than 25 millions of real 1996 dollars of assets. Only firms present in both Compustat and Execucomp for which CEO tenure can be computed are included. 1309 firms, 7960 observations. All standard errors are robust and clustered at the firm level.
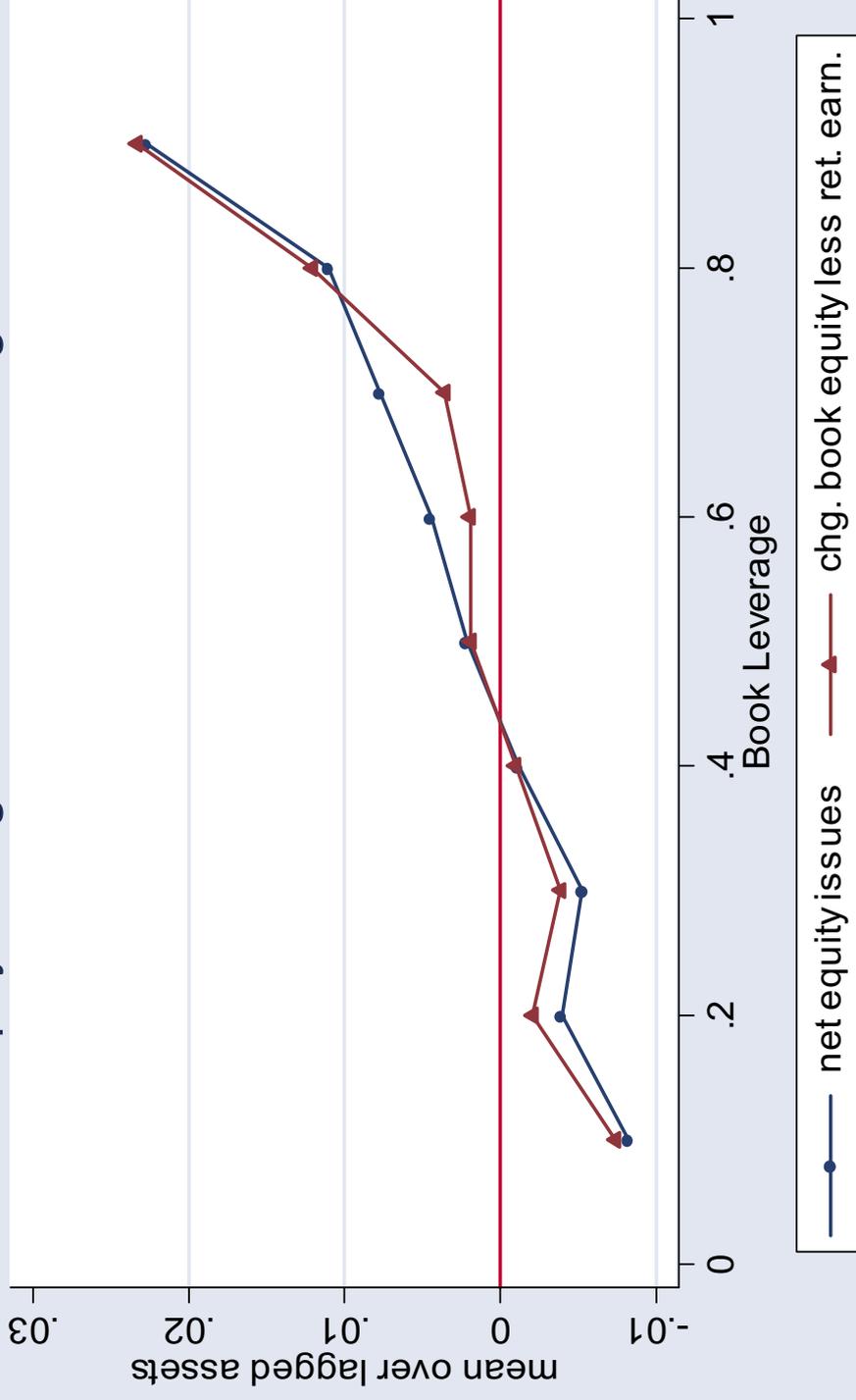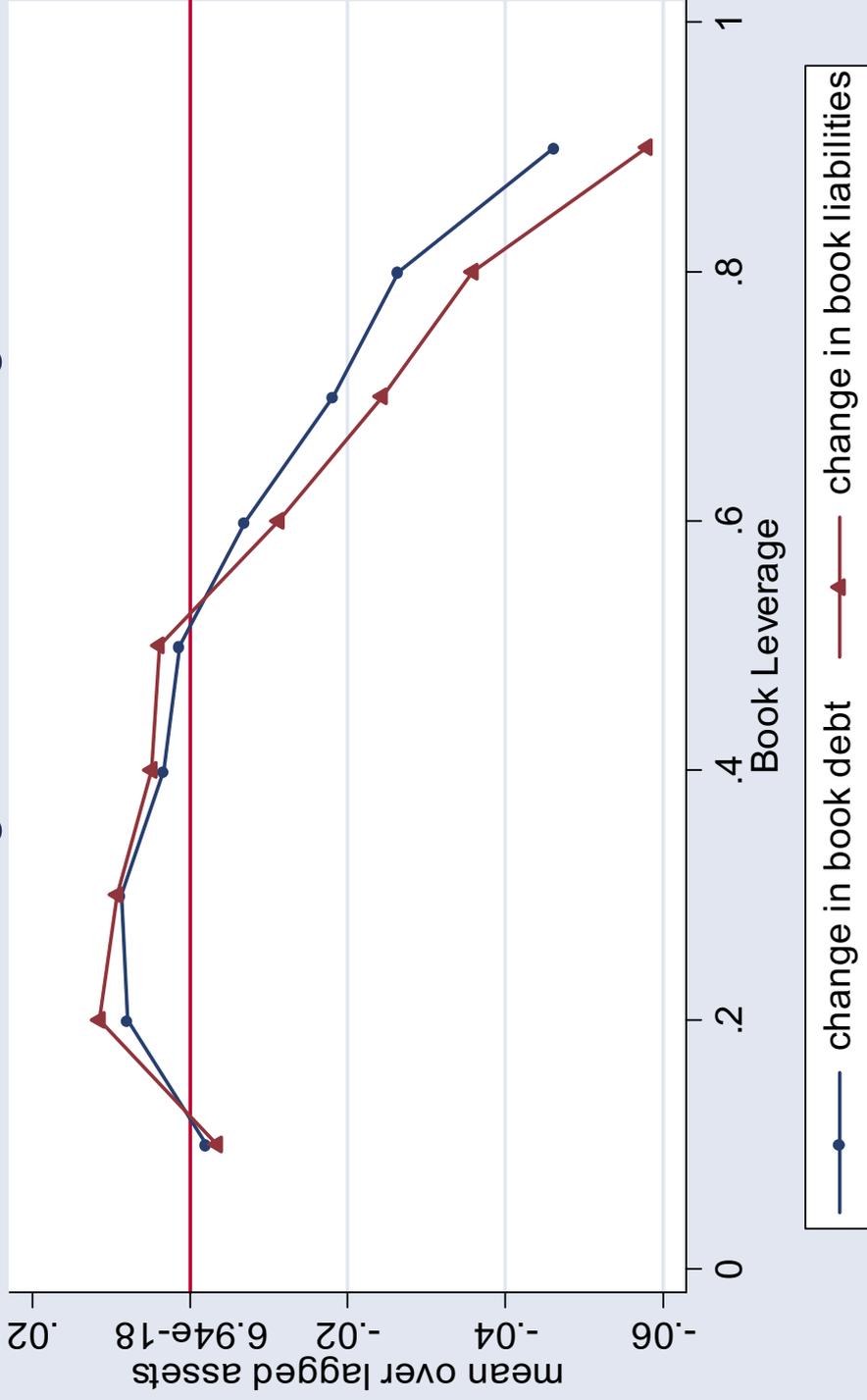
Figure 2: Book leverage is on the horizontal axis. Triangles represent the mean change in book equity less retained earnings over lagged assets. Circles represent the mean value of (sales - purchases of stocks - change in value of preferred stocks) over lagged assets. Only firms with more than 25 millions of 1996 dollars in lagged assets are included.
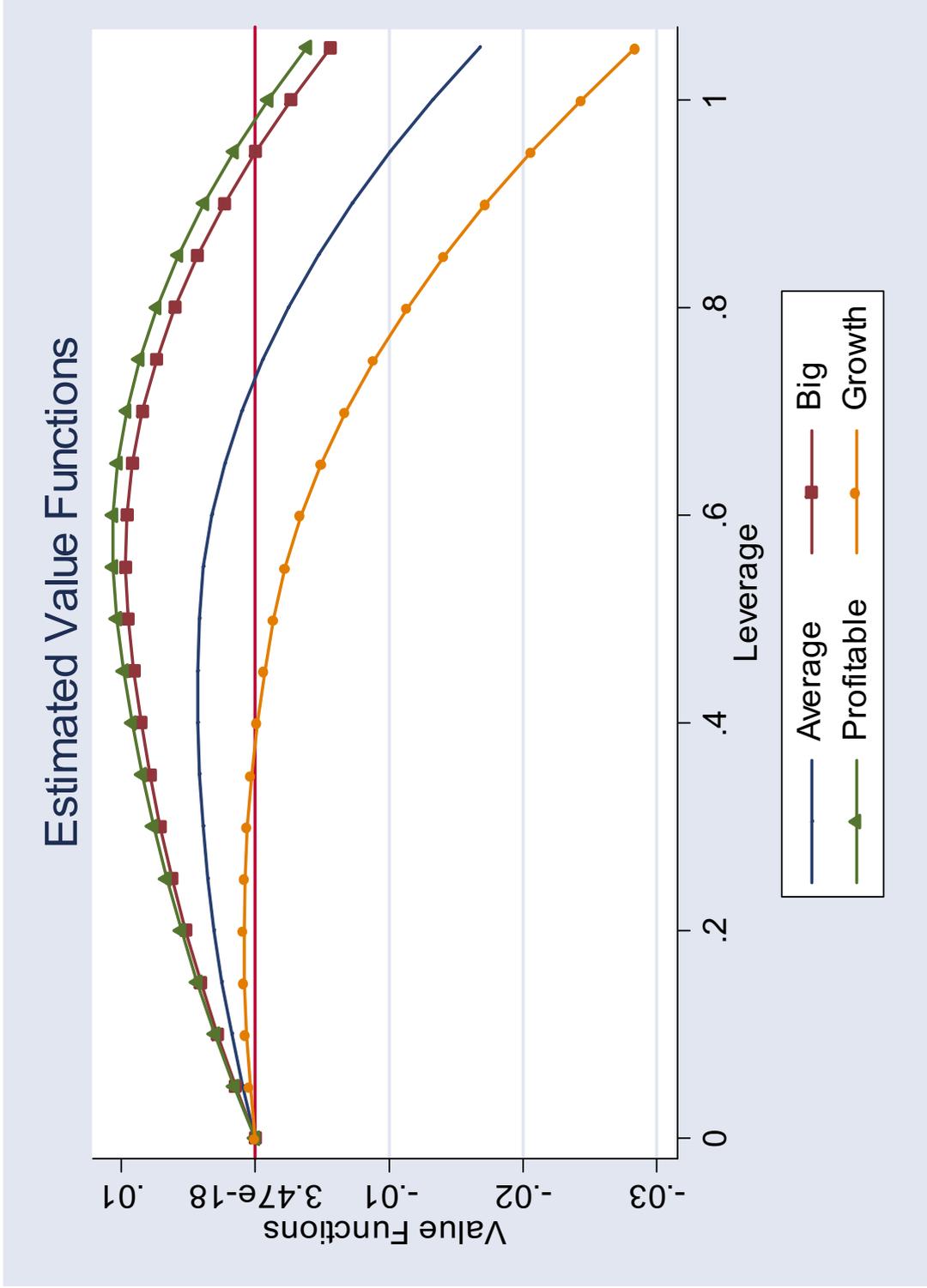
Figure 3: Book leverage is on the horizontal axis. Triangles represent the mean change in book liabilities (including preferred stocks) over lagged assets. Circles represent the mean change in the book value of debt over lagged assets. Only firms with more than 25 millions of 1996 dollars in lagged assets are included.

Figure 4: The value functions are constructed from the parameters estimated in Table 2a. Average is a manufacturing firm with more than 25 millions of book assets in the second half of the 1990s. Big is a firm with a size equal to the 80th percentile of the distribution of assets. Profitable and Growth are firms at the 80th percentiles of the distributions of operating income over assets and Tobin's Q, respectively.
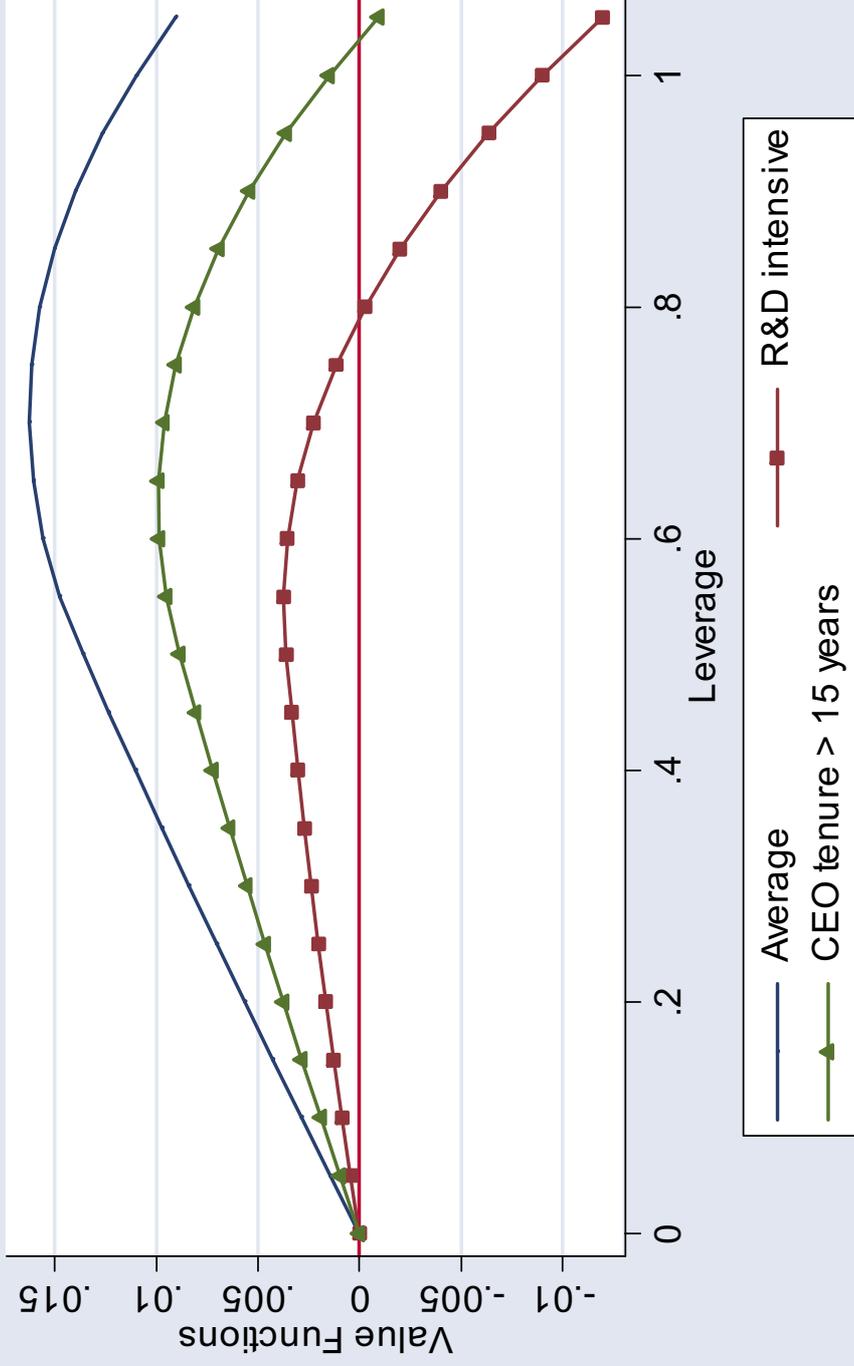
Figure 5: The value functions are constructed from the parameters estimated in Table 2b. Average is a manufacturing firm with more than 25 millions of book assets. Sample includes only firms that are in both Compustat and Execucomp. R&D intensive is a firm with R&D expenditures over sales equal to the 90th percentile of the distribution of R&D over sales. Triangles show the revealed preference curve for a firm where the CEO has been in charge for more than 15 years.

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