



Historical market-to-book in a partial adjustment model of leverage [☆]

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ABSTRACT

Historical market-to-book has been shown to explain current leverage. Prior studies attribute the evidence to market timing. This study shows that with the presence of time-varying targets and adjustment costs, historical market-to-book has a significant impact on leverage even when firms do not time the market. The historical values of alternative market timing proxies, such as insider sales and the market sentiment index, are shown to have no effects on leverage while the historical values of alternative growth-option proxies do have effects. Overall, the evidence is largely consistent with a partial adjustment model of leverage.

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1. Introduction

Traditional trade-off theory argues that a firm has a target leverage ratio and the firm issues, retires, and repurchases debt or equity to keep its leverage at the target level. However, a recent study by Baker and Wurgler (2002) (B–W hereafter) documents a negative relation between firms' debt ratios and historical market-to-book ratios using the percentage of external financing as the weighting scheme. Arguing that market-to-book proxies for stock market misvaluation, B–W interpret the external-finance weighted historical market-to-book ratio variable as capturing firms' market timing attempts. They conclude that because firms do not adjust their leverage ratios toward the targets, the market timing effects get accumulated and finally drive firms' capital structure.

Other studies have questioned the market timing interpretation of the data. For example, Leary and Roberts (2005), Hovakimian (2006), Flannery and Rangan (2006), Alti (2006), and Kayhan and Titman (2007) provide evidence that market timing, even if it exists, does not have long-run impact on firms' leverage and that firms do actively rebalance their leverage ratios toward some target level. Adding to the debate, studies such as those by Elliott et al. (2007), Chen and Zhao (2006), Huang and Ritter (2008), and Chang and Dasgupta (2008) either find supporting evidence for market timing or raise questions regarding the interpretation of target adjustments. The debate regarding the association between historical market-to-book and current

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leverage is ongoing, as summarized in Frank and Goyal's (2008) survey paper: "the magnitude and the durability of" market timing "effects is not a settled issue".¹

This study argues that the relation between the historical market-to-book ratio and current leverage is consistent with a partial adjustment model of leverage. With time-varying targets and adjustment costs, a firm will only make a partial adjustment toward the target each year. Due to partial adjustments, a firm's current leverage relates to past targets. Since the leverage target negatively relates to growth options and the market-to-book ratio proxies for growth options, the model predicts that current leverage is negatively related to historical market-to-book ratios.

Evidence shows that the weighted average of market-to-book ratios, which is constructed according to the partial adjustment model and not based on the amount of external financing, provides evidence similar to that of B–W's timing measure that uses the percentages of external financing as the weights for the past market-to-book ratios. The results suggest that the external-finance weighting scheme is not the driving force for the negative relation between historical market-to-book ratios and leverage.

Further, to differentiate the partial adjustment explanation from the market timing explanation, this study designs tests to evaluate the role of the market-to-book ratio in driving the documented results. The market timing story and the partial adjustment model have different interpretations of the market-to-book ratio. To explain the documented evidence, the market timing story requires that the market-to-book ratio be a proxy for stock market misvaluation, while the partial adjustment model interprets the market-to-book ratio as a proxy for growth options. I then construct and evaluate measures that use different proxies of growth options, such as R&D-to-asset ratios and R&D-to-sales ratios, and different proxies for market misvaluation, such as insider sales and the market sentiment index, all of which use external financing as the weighting scheme. I show that the evidence that is attributed to market timing is supported by these new measures that use growth-option proxies but it is not supported by the measures that use market misvaluation proxies. The evidence suggests that historical market-to-book ratios can explain current leverage because the market-to-book ratio is a proxy for growth options, not because it is a proxy for market misvaluation.

Overall, the evidence is consistent with the explanation that past market-to-book ratios are proxies for growth options and that their relation with current leverage is a result of partial adjustments. Hovakimian (2006) and Kayhan and Titman (2007) make a similar argument about the information content of the market-to-book ratio and show that the market timing results are driven by the fact that historical market-to-book ratios contain information about firms' growth options. This study complements these arguments by showing how the partial adjustment framework can lead naturally to a link between historical market-to-book ratios and a firm's current leverage.

The rest of this paper is organized as follows. Section 2 introduces the market timing model and the partial adjustment model. Section 3 describes the data. Section 4 presents the empirical results and Section 5 concludes the paper.

2. Competing models and predictions

B–W construct a historical external-finance weighted-average market-to-book ratio variable (M/B_{efwa}) and find that this variable negatively relates to a firm's current capital structure even after controlling for the current market-to-book ratio. The variable, M/B_{efwa} , is defined as

$$\left(\frac{M}{B}\right)_{\text{efwa},t-1} = \frac{\sum_{s=0}^{t-1} e_s + d_s}{\sum_{r=0}^{t-1} (e_r + d_r)} \left(\frac{M}{B}\right)_s,$$

where the summations begin from the IPO year, and e and d denote net equity and net debt issues, respectively. As B–W state, "this variable takes high values for firms that raised external finance when the market-to-book ratio was high and vice versa."² Assuming that a high market-to-book ratio proxies for overvaluation, the market timing story argues that firms that raised more external finance at a time when their market-to-book ratios were high are more likely to be the firms that time the market using equity. These firms should thus have more equity in their total external finance. Further, if a firm has no target leverage ratio, it will allow the effects of market timing to accumulate and finally to drive the firm's capital structure. As a result, a negative relation between M/B_{efwa} and the current leverage ratio is consistent with the market timing story.

However, this evidence could very well be consistent with a dynamic leverage target model with partial adjustments, when the market-to-book ratio is interpreted as a proxy for growth options. In a dynamic world, a firm's target leverage ratio is time varying and, due to adjustment costs, the firm will make only a partial adjustment toward the target each year.

The most commonly discussed adjustment costs are transaction costs, such as underwriter fees and equity floatation costs. Altinkihc and Hansen (2000) document direct evidence that, in equity and debt offerings, the issuance costs have a small fixed cost and a convex variable cost. Leary and Roberts (2005) use a duration model to make inferences about the nature of adjustment costs and they conclude that a combination of fixed plus weakly convex costs of adjustment best explains firms' observed financing behaviors. Fixed and convex adjustment costs lead firms to be inactive in certain periods and make only partial adjustments toward their targets

¹ Frank and Goyal (2008) page 52.

² B–W page 3.

when they adjust. Leary and Roberts (2005) document that, on average, firms make adjustments once per year, suggesting that one year is the adjustment period.³

Agency costs can also cause firms to not fully respond to being over-levered or under-levered.⁴ Debt overhang problems (Myers, 1977) may prevent firms from promptly decreasing their leverage when over-levered since contributing new capital and reducing the leverage imply a value transfer from equityholders to debtholders. On the other hand, the conflicts between managers and shareholders may result in an inadequate response to being under-levered. Theories have posited that managers may prefer lower debt ratios than shareholders because risk-averse managers want to reduce risk to protect their underdiversified human capital (Fama, 1980) or underdiversified portfolios (Lewellen, 2006), or because entrenched managers enjoy benefits of control, seeking to avoid the discipline from debt (Jensen, 1986). If these managers have discretion over financing policies, they will not adjust their capital structures upwards as often and by as much as is optimal for shareholders.⁵

A typical partial adjustment model is given by:

$$\begin{aligned} \left(\frac{D}{V}\right)_t - \left(\frac{D}{V}\right)_{t-1} &= \lambda \left(\left(\frac{D}{V}\right)_t^* - \left(\frac{D}{V}\right)_{t-1} \right) + \varepsilon_t \\ \left(\frac{D}{V}\right)_t &= \lambda \left(\frac{D}{V}\right)_t^* + (1-\lambda) \left(\frac{D}{V}\right)_{t-1} + \varepsilon_t \\ &= \lambda \left(\frac{D}{V}\right)_t^* + \lambda(1-\lambda) \left(\frac{D}{V}\right)_{t-1}^* + (1-\lambda)^2 \left(\frac{D}{V}\right)_{t-2} + \varepsilon_t \\ &= \lambda \left(\frac{D}{V}\right)_t^* + \lambda(1-\lambda) \left(\frac{D}{V}\right)_{t-1}^* + \dots + \lambda(1-\lambda)^{k-1} \left(\frac{D}{V}\right)_{t-k+1}^* + (1-\lambda)^k \left(\frac{D}{V}\right)_{t-k} + \varepsilon_t, \end{aligned} \quad (1)$$

where λ captures the adjustment speed and D/V_t^* is the target leverage ratio at time t .⁶

To explain D/V_t^* , growth options are arguably an important factor. Firms with more growth options have lower collateral value and lose more of their value when they go into distress. They thus have a high cost of debt. The underinvestment problem associated with debt is more severe for firms with more growth options (Myers, 1977) and debt mitigates agency problem of free cash flow (Jensen, 1986), which is less severe for firms with more growth options. Considering both the underinvestment problem and the free cash flow problem, Barclay et al. (2006) show that with additional growth options, the underinvestment costs of debt increase and the free cash flow benefits of debt decline, causing the optimal level of debt to decrease. In summary, both the tax-bankruptcy cost trade-off and agency theories predict a negative relation between leverage and growth options.

Growth options are most commonly proxied by market-to-book. Adam and Goyal (2008) evaluate the performance of proxy variables for growth options and conclude that market-to-book is the most informative proxy. Consistent with market-to-book being a growth-option proxy and with these theoretical models' predictions, Smith and Watts (1992), Barclay et al. (1995), Rajan and Zingales (1995), Barclay et al. (2006), and Frank and Goyal (2009) all document negative relations between market-to-book and leverage ratios.

The target leverage ratio is thus modeled as a function of the market-to-book ratio and a set of other firm characteristics:

$$\left(\frac{D}{V}\right)_t^* = \alpha + \beta(\mathbf{X})_t, \quad (2)$$

where \mathbf{X} is a vector of variables including M/B, EBITDA/A, PPE/A and logS. EBITDA/A is operating income to total assets ratio, capturing a firm's profitability. PPE/A is fixed assets to total assets ratio, measuring asset tangibility. logS is the natural log of sales, measuring firm size. These characteristic variables are regularly used in the literature to capture a firm's target leverage ratio (e.g., Rajan and Zingales, 1995; Hovakimian et al., 2001; Fama and French, 2002; Hovakimian, 2006; Flannery and Rangan, 2006; Lemmon et al., 2008).

Substituting the target leverage ratio expression into the partial adjustment system, I obtain

$$\left(\frac{D}{V}\right)_t = \alpha_k + \beta_k(\mathbf{X})_{\text{pawa},t,k} + \gamma_k \left(\frac{D}{V}\right)_{t-k} + \varepsilon_t, \quad (3)$$

³ Another justification for partial adjustment behavior lies in the fact that there are many different ways through which firms can adjust their capital structures. The adjustment costs and the adjustment size for these different mechanisms could be different. It is plausible that the mechanisms that can make large adjustments (such as SEOs) have higher adjustment costs, while the lower adjustment cost mechanisms (such as stock options grants) can make only small adjustments each time. If the leverage of a firm deviates from the target by a small amount, the firm will use low-cost methods to adjust, while with large deviations, the firm will have to adopt high-cost adjustment methods. For scenarios when the size of the deviation falls between the upper bound of the adjustment size of the low-cost methods and the threshold for using the high-cost methods, firms will use only the low-cost mechanisms and make only partial adjustments.

⁴ Adverse selection costs due to information asymmetry (Myers and Majluf (1984)) could be another type of cost associated with raising capital.

⁵ Kayhan (2008) documents that firms with high-discretion managers rebalance their capital structures at a slower speed.

⁶ See, for example, Hovakimian et al. (2001), Fama and French (2002), Flannery and Rangan (2006), and Kayhan and Titman (2007).

where

$$\begin{aligned} \mathbf{X}_{\text{pawa},t,k} &\equiv \sum_{s=1}^k \frac{(1-\lambda)^{s-1}}{\sum_{r=0}^{k-1} (1-\lambda)^r} (\mathbf{X})_{t-s+1} \\ \alpha_k &\equiv \lambda \alpha \sum_{r=0}^{k-1} (1-\lambda)^r, \\ \beta_k &\equiv \lambda \beta \sum_{r=0}^{k-1} (1-\lambda)^r, \\ \gamma_k &= (1-\lambda)^k. \end{aligned}$$

Taking k to be t is a special case of the model, implying that the partial adjustment starts from the first year after an IPO, when the IPO year is defined as year 0. The weighted-average historical variables in this special case become the following:

$$\mathbf{X}_{\text{pawa},t} \equiv \sum_{s=1}^t \frac{(1-\lambda)^{s-1}}{\sum_{r=0}^{t-1} (1-\lambda)^r} (\mathbf{X})_{t-s+1},$$

and the lagged leverage ratio becomes the initial debt level, D/V_0 .

Further assuming that the firm chooses its initial debt level to be at the optimal level, I substitute $(\frac{D}{V})_0 = (\frac{D}{V})_0^*$ into Eq. (3) and set k to t to obtain the following model:

$$\left(\frac{D}{V}\right)_t = \alpha + \beta(\mathbf{X})_{\text{pawa}0,t} + \varepsilon_t, \tag{4}$$

where

$$\mathbf{X}_{\text{pawa}0,t} \equiv \sum_{s=1}^t \lambda(1-\lambda)^{s-1} (\mathbf{X})_{t-s+1} + (1-\lambda)^t (\mathbf{X})_0.$$

Since $\sum_{s=1}^t \lambda(1-\lambda)^{s-1} + (1-\lambda)^t = 1$, $\mathbf{X}_{\text{pawa}0,t}$ is a weighted average of all the past characteristic variables starting from the IPO year (year 0). Slightly different from $\mathbf{X}_{\text{pawa},t,k}$, $\mathbf{X}_{\text{pawa}0,t}$ assigns a relatively higher weight to the variables in the first year. This is due to the fact that the leverage ratio in year 0 is assumed to be at the optimal level, while the leverage ratios in other years are the results of partial adjustments.

The partial adjustment model, as specified in Eq. (3), suggests several predictions. As this study focuses on the impact of the market-to-book ratio, I mainly discuss the predictions with respect to the historical market-to-book variable, $M/B_{\text{pawa},t,k}$. First, the current leverage ratio relates to $M/B_{\text{pawa},t,k}$, an adjustment speed weighted-average market-to-book ratio variable. In constructing $M/B_{\text{pawa},t,k}$, the weights are functions of the adjustment speed, λ , and the recent years' market-to-book ratios carry higher weights with the weights decreasing by a factor of $(1-\lambda)$ for every past year. Second, $M/B_{\text{pawa},t,k}$ negatively relates to the current leverage ratio; that is, $\beta_k < 0$ for $M/B_{\text{pawa},t,k}$. This is obtained from the implication that the adjustment is made toward the target, $\lambda > 0$, and that firms' target leverage ratios negatively relate to their growth options, $\beta < 0$ for M/B , as discussed above. Third, this model evaluates the partial adjustment effects of the most recent k years, with year $t-k+1$ as the starting year of the adjustments. The larger the k is, the bigger the impact $M/B_{\text{pawa},t,k}$ has on the current leverage ratio and the smaller the impact D/V_{t-k} has. That is, $|\beta_k|$ for $M/B_{\text{pawa},t,k}$ increases with k and γ_k decreases with k . Fourth, according to the system as specified in Eq. (1), D/V_{t-1}^* enters into the model via D/V_{t-1} , suggesting that all the past target leverage ratios should have no impact on D/V_t when both D/V_{t-1} and D/V_{t-1}^* are controlled. With $k=1$, Eq. (3) becomes $D/V_t = \lambda\alpha + \lambda\beta(\mathbf{X}_t) + (1-\lambda)(D/V_{t-1})$. In this specification where D/V_t^* is assumed to be fully captured by the most recent firm characteristic variables, \mathbf{X}_t , and where D/V_{t-1} is controlled, historical variables, such as $M/B_{\text{pawa},t-1,k}$, have no impact on D/V_t .

The special case of the model predicts that a firm's current leverage negatively relates to $M/B_{\text{pawa}0}$ and M/B_{pawa} , depending on whether or not the initial debt level is assumed to be at the optimal level. M/B_{pawa} is a weighted average of past market-to-book ratios from the first year post-IPO and $M/B_{\text{pawa}0}$ includes the market-to-book ratio in the IPO year. $M/B_{\text{pawa}0}$ is comparable to M/B_{efwa} constructed by B-W, except for the weighting schemes. If equal weights are used to average all the past market-to-book ratios starting from the IPO year, the variable becomes an equal-weighted-average market-to-book ratio, M/B_{ewa} .

M/B_{efwa} uses the amount of external financing as the weighting scheme, a scheme that intends to capture firms' market timing attempts. Is the external-finance weighting scheme crucial in the negative relation between leverage and historical market-to-book? If it is, alternative weighted-average market-to-book variables, such as $M/B_{\text{pawa}0}$, M/B_{pawa} and M/B_{ewa} , do not explain current leverage.

Besides emphasizing the external-finance weighting scheme, the market timing story requires the market-to-book ratio to be a proxy for stock market overvaluation. On the other hand, the partial adjustment theory interprets the market-to-book ratio as a proxy for growth options. Thus, the market timing story predicts that other historical variables, which are proxies for overvaluation but independent of growth options, are also negatively related to the current leverage ratio. The partial adjustment model makes no such prediction. The partial adjustment model predicts that the historical value of other variables that proxy for

Table 1
Summary statistics.

Panel A: Summary statistics					
	Mean	Median	Std. Dev.	P_{10}	P_{90}
D/V (book)	0.475	0.476	0.215	0.181	0.764
D/V (market)	0.395	0.371	0.248	0.078	0.754
M/B	1.731	1.243	1.651	0.788	3.059
EBITDA/A	0.103	0.125	0.165	-0.042	0.244
PPE/A	0.319	0.270	0.227	0.061	0.672
log S	3.991	3.895	1.974	1.694	6.639
M/B_{efwa}	2.414	1.685	2.816	0.901	4.532
M/B_{ewa}	2.175	1.535	2.183	0.936	3.933
M/B_{pawa0}	2.123	1.472	2.254	0.898	3.825
M/B_{pawa}	1.868	1.350	1.714	0.859	3.311
Panel B: Correlation matrix					
	M/B_{efwa}	M/B_{ewa}	M/B_{pawa0}	M/B_{pawa}	
M/B_{efwa}	1	0.666	0.653	0.516	
M/B_{ewa}		1	0.965	0.854	
M/B_{pawa0}			1	0.846	
M/B_{pawa}				1	

Panel A reports the means, medians, standard deviations, and the 10th and 90th percentiles of the main variables used in this study and Panel B reports the correlation coefficients of four different weighted-average market-to-book variables. The sample includes all firms in the COMPUSTAT dataset from 1967 to 2006, excluding financial firms (SIC codes between 6000 and 6999) and regulated utilities (SIC codes between 4900 and 4999). Firm years with book values of assets smaller than \$10 million or book debt-to-book assets ratio larger than 1 are deleted. All variable definitions are in Appendix A.

growth options will also be negatively related to the current leverage ratio. The market timing story makes no such prediction if the alternative variables are not related to a firm's stock price misvaluation.

3. Data

The dataset includes all firms in the COMPUSTAT database between 1967 and 2006. The returns data are taken from the CRSP database. Financial firms (SIC codes between 6000 and 6999) and regulated utilities (SIC codes between 4900 and 4999) are not included. Firm years that had book values of assets less than \$10 million or a book debt-to-book asset ratio larger than 1 are also deleted.

Book debt is defined as book assets minus book equity.⁷ Book equity is taken as common equity plus deferred taxes. The market value of assets is defined as the book assets minus the book equity plus the market equity. EBITDA is the operating income before depreciation. PPE is the net property, plant, and equipment. S is sales adjusted for inflation to express the value in 1972 dollars. R&D is research and development expenditures. Book leverage is defined as the book debt divided by book assets, while market leverage is book debt divided by the market value of the firm's assets. To eliminate the effects of outliers, all variables are winsorized at the first and 99th percentiles. Appendix A presents detailed definitions of all the variables.

Table 1 reports summary statistics for the main variables used in the analysis. The book leverage has a mean of 0.475 and the mean market leverage is slightly lower at 0.395. M/B averages around 1.731. The profitability ratio (EBITDA/A) has a mean of 0.103 and the tangible asset ratio (PPE/A) has mean of around 0.319.

The four different weighted-average historical market-to-book ratio variables are also summarized. The M/B_{efwa} average is 2.414, which is larger than the average of M/B_{ewa} , which is 2.175, suggesting that firms raise more external finance when M/B is relatively high. M/B_{pawa0} has a mean of 2.123, which is smaller than that of M/B_{ewa} , reflecting the fact that a firm's market-to-book ratio usually decreases over time. M/B_{ewa} 's average of 1.868 is smaller than the average of M/B_{pawa0} since M/B_{pawa0} assigns a higher weight to the IPO year when a high M/B is common. The correlation coefficients of M/B_{efwa} with respect to M/B_{ewa} , M/B_{pawa0} and M/B_{pawa} are 0.666, 0.653 and 0.516, respectively, as shown in Panel B of Table 1.

4. Empirical results

4.1. The partial adjustment model

In this section, I test the partial adjustment model as specified in Eq. (3) and the results are reported in Table 2.

All the standard errors in this study are adjusted for clustering by firm, following Petersen's (2009) suggestion. In the regressions, both the dependent variable (leverage) and the independent variables (market-to-book, profitability, asset tangibility, and firm size) are highly autocorrelated, showing a significant firm effect. Petersen (2009) shows that this unobserved

⁷ This measure of book debt includes all current liabilities. This definition is used for comparability with B-W. An alternative measure, where book debt is calculated as long-term debt plus debt in current liabilities, yields qualitatively similar results.

Table 2

Testing the partial adjustment model.

	Panel A: Book leverage					Panel B: Market leverage				
	(1)	(2)	(3)	(4)	(5)	(1)	(2)	(3)	(4)	(5)
M/B_{t-1}	-0.014 (-29.671)			-0.001 (0.325)	-0.006 (-5.029)	-0.025 (-40.385)			-0.035 (-9.324)	0.004 (5.210)
$M/B_{pawa,t-1,5}$		-0.025 (-23.221)					-0.067 (-36.965)			
$M/B_{pawa,t-1,10}$			-0.029 (-14.591)	-0.030 (-9.566)	0.001 (0.562)			-0.093 (-32.205)	-0.056 (-13.701)	-0.010 (-10.336)
D/A_{t-1}					0.890 (311.244)					0.867 (275.078)
D/A_{t-2}	0.701 (201.043)					0.679 (188.665)				
D/A_{t-6}		0.491 (77.389)					0.382 (56.238)			
D/A_{t-11}			0.361 (39.729)	0.361 (39.724)				0.274 (32.375)	0.282 (33.625)	
N	123105	82668	49545	49544	51422	117567	78824	47282	47282	51580
R ²	0.583	0.377	0.305	0.305	0.805	0.613	0.429	0.419	0.427	0.795

This table reports results of the following regression specification.

$$\left(\frac{D}{V}\right)_t = \alpha_k + \beta_k(X)_{pawa,t-1,k} + \gamma_k \left(\frac{D}{V}\right)_{t-k-1} + \varepsilon_t,$$

where

$$X_{pawa,t-1,k} = \sum_{s=1}^k \frac{(1-\lambda)^{t-1}}{\sum_{r=0}^{t-1} (1-\lambda)^r} X_{t-s},$$

and X is a vector including M/B, EBITDA/A, PPE/A, and logS. $\lambda = 0.3$ is used in variable constructions. D/V measures book leverage in Panel A and market leverage in Panel B. Regressions (1), (2) and (3) report the results when $k = 1, 5$ and 10 , respectively. Regression (4) reports the results when $k = 10$ and M/B_{t-1} is added to the regression. Regression (5) is similar to Regression (4) except that D/V_{t-1} replaces D/V_{t-k-1} as an explanatory variable. Only β_k for $M/B_{pawa,t-1,k}$ and γ_k are reported. All standard errors are adjusted for clustering by firm. T-statistics are shown in parentheses.

firm effect may cause OLS, Fama–MacBeth and even Newey–West standard errors to be biased.⁸ Clustered standard errors by firm are shown to be unbiased and the preferred adjustment, because they account for the residual dependence created by the firm effect. The key feature of clustered standard errors is that the number of clusters is large enough relative to the number of units in each cluster so that it can allow essentially unrestricted within-cluster correlation. Since the panel data in this study have much larger cross-sections (clusters) compared to relatively shorter time series, the adjustment of clustering by firm is appropriate.

Panel A of Table 2 presents the book leverage results and panel B of Table 2 presents the market leverage results. Three cases are evaluated: $k = 1, k = 5$ and $k = 10$. To ensure that the right-hand-side variables are predetermined, I lag them by one period as most previous studies do. $\lambda = 0.3$ is assumed in all the regressions reported in the tables, which is the adjustment speed suggested by Flannery and Rangan (2006), among others. Assuming a more conservative adjustment speed of 0.25 or 0.2 yields quantitatively similar results, which are omitted to save space.

In regressions (1) to (3), the coefficients for $M/B_{pawa,t,k}$ are negative and significant, as predicted by the model. In the book leverage regressions, the coefficient for $M/B_{pawa,t,k}$ is -0.014 when $k = 1$. The coefficient changes to -0.025 and further to -0.029 when k increases to 5 and to 10. At the same time, the coefficients for D/V_{t-k} reduce from 0.701 to 0.491 and further to 0.361. In the market leverage regressions, the coefficient for $M/B_{pawa,t,k}$ changes from -0.025 to -0.067 and further to -0.093 , while the coefficients for D/V_{t-k} reduce from 0.679 to 0.382 and further to 0.274. The patterns of the coefficients are precisely those predicted by the partial adjustment model: the absolute value of the coefficients for $M/B_{pawa,t,k}$ increase with k and the coefficients for D/V_{t-k} decrease with k .

An alternative explanation may argue that the increase of $|\beta_k|$ with k is solely due to the fact that the past leverage ratio is further lagged. To differentiate this alternative explanation from the partial adjustment model, regression (4) incorporates both M/B_{t-1} and $M/B_{pawa,t-1,k}$. In the book leverage regression, the coefficient for M/B_{t-1} is not significant while the coefficient for $M/B_{pawa,t-1,k}$ is significant. The magnitude of the coefficients for $M/B_{pawa,t-1,k}$ remain unchanged, at around -0.030 , whether or not M/B_{t-1} is controlled in the regressions. Both M/B_{t-1} and $M/B_{pawa,t-1,k}$ are significant in the market leverage regression. The results are consistent with the explanation that $M/B_{pawa,t-1,k}$ captures more information in firms' adjustment histories when k increases.

Regression (5) incorporates the one-year-lagged leverage ratio, D/V_{t-1} , by replacing D/V_{t-k-1} . Assuming that D/V_t^* is fully captured by the most recent firm characteristic variables, the model predicts $M/B_{pawa,t-1,10}$ to be insignificant, as discussed in Section 2. In the book leverage regression, $M/B_{pawa,t-1,10}$ becomes insignificant, while M/B_{t-1} is significant with a negative coefficient of -0.006 . In the market leverage regression, $M/B_{pawa,t-1,10}$ is still significant, while its coefficient shrinks a lot, from -0.056 , in regression (4), to -0.010 . M/B_{t-1} has a positive coefficient in the market leverage regression.

⁸ When the lagged dependent variable is also in the regression, the simple fixed effect regression is also biased, because removing the time series average cannot get rid of the dependence between the lagged dependent variable and the residual. The shorter the time series is, the larger the bias is for estimating the demeaned regression. With a panel with large cross-sections and short time series, the bias for a simple fixed effect regression can be substantial. To obtain unbiased estimation, the instrumental variable approach could be used, as in Flannery and Rangan (2006). However, it is commonly difficult to find a suitable instrument, especially for the book leverage ratio.

Table 3
Book leverage ratios and different weighted-average historical market-to-book variables.

	(1)	(2)	(3)	(4)	(5)	(6)	(7)
$M/B_{efwa,t-1}$	-0.008 (-11.628)				-0.006 (-9.073)	-0.006 (-8.760)	-0.005 (-7.598)
$M/B_{ewa,t-1}$		-0.012 (-10.465)					
$M/B_{pawa0,t-1}$			-0.010 (-9.111)			-0.006 (-4.761)	
$M/B_{pawa,t-1}$				-0.019 (-8.638)			-0.014 (-6.348)
M/B_{t-1}	-0.016 (-20.339)	-0.012 (-13.126)	-0.013 (-12.808)	-0.004 (-2.509)	-0.013 (-16.315)	-0.012 (-12.796)	-0.004 (-2.847)
$EBITDA/A_{t-1}$	-0.257 (-28.572)	-0.263 (-28.937)	-0.262 (-28.884)	-0.280 (-31.788)	-0.252 (-29.605)	-0.261 (-28.748)	-0.281 (-31.766)
PPE/A_{t-1}	0.094 (10.754)	0.094 (10.628)	0.095 (10.791)	0.074 (9.027)	0.075 (9.685)	0.093 (10.538)	0.071 (8.634)
$\log S_{t-1}$	0.032 (29.078)	0.033 (29.246)	0.033 (29.359)	0.023 (18.850)	0.021 (18.505)	0.032 (29.043)	0.022 (18.648)
D/V_0				0.331 (19.672)	0.358 (20.781)		0.328 (19.809)
N	86781	86781	86781	78433	86781	86781	78433
R^2	0.139	0.138	0.136	0.271	0.293	0.140	0.274

This table reports regression results for the model.

$$\left(\frac{D}{V}\right)_t = \alpha + \beta \left(\frac{M}{B}\right)_{wa,t-1} + \delta(\mathbf{X})_{t-1} + \varepsilon_t,$$

where D/V measures book leverage ratios and X is a vector including M/B , $EBITDA/A$, PPE/A , and $\log S$. $M/B_{wa,t-1}$ takes four different values: M/B_{efwa} , M/B_{ewa} , M/B_{pawa0} and M/B_{pawa} . Regressions (4), (5) and (7) include D/V_0 , the leverage ratio in the IPO year. All standard errors are adjusted for clustering by firm. T-statistics are shown in parentheses.

The fact that the coefficients for $M/B_{pawa,t-1,10}$ shrink dramatically or become insignificant in the presence of D/V_{t-1} is consistent with the partial adjustment model's prediction. However, in the market leverage regression, $M/B_{pawa,t-1,10}$ is still significant and the coefficient for M/B_{t-1} does not have the predicted sign. These results may arise due to omitted variable problems. Besides M/B , $EBITDA/A$, PPE/A , and $\log S$, other factors may exist that affect a firm's leverage target. Further, if M/B_{t-1} is only a noisy proxy for growth options, $M/B_{pawa,t-1,10}$ may serve as an alternative proxy, thus relating to D/V_t^* . Hovakimian (2006) discusses this possibility in detail and provides evidence that the historical market-to-book ratio relates to the current leverage target because it contains information about growth options not captured by the current market-to-book ratio.

4.2. Different weighted-average historical market-to-book variables

The special case of the partial adjustment model predicts that leverage is negatively related to M/B_{pawa0} and M/B_{pawa} . These variables, and the equal-weighted market-to-book variable, M/B_{ewa} , are all comparable to the market timing measure constructed by B-W, M/B_{efwa} , except for the weighting schemes.

The effects of these different weighted-average market-to-book ratio variables are evaluated in the following model:⁹

$$\left(\frac{D}{V}\right)_t = \alpha + \beta \left(\frac{M}{B}\right)_{wa,t-1} + \delta(\mathbf{X})_{t-1} + \varepsilon_t \quad (5)$$

where $M/B_{wa,t-1}$ takes the value of $M/B_{efwa,t-1}$, $M/B_{ewa,t-1}$, $M/B_{pawa0,t-1}$ and $M/B_{pawa,t-1}$.

This regression specification is comparable to the specification used by B-W. The results are reported in Table 3 for book leverage and in Table 4 for market leverage. In Table 3, the first regression generates a significant negative coefficient for M/B_{efwa} , -0.008, consistent with B-W's results. The second and third regressions show that both M/B_{ewa} and M/B_{pawa0} are significantly negatively related to the current leverage ratio, with coefficients of -0.012 and -0.010, respectively. Regression (4) estimates the effect of M/B_{pawa} , which takes the weighted average of M/B from the first year post-IPO. D/V_0 is added in the regression as suggested by the partial adjustment model. M/B_{pawa} is significant with a coefficient of -0.019. Regression (5) estimates the effects of M/B_{efwa} in the presence of D/V_0 . M/B_{efwa} is still significant with a smaller coefficient of -0.006, compared to -0.008 in regression (1). The last two regressions incorporate both M/B_{efwa} and M/B_{pawa0} or M/B_{pawa} for comparison. All three weighted market-to-book variables have significant coefficients, with the magnitudes of the coefficients for M/B_{efwa} never larger than that for M/B_{pawa0} or M/B_{pawa} . There is no evidence suggesting that the external-finance weighting scheme improves the explanatory power of the historical average market-to-book variables in explaining the observed leverage ratio.

The results for the market leverage regressions are similar, while M/B_{efwa} becomes insignificant when D/V_0 is in the regression. M/B_{efwa} performs better in a model without D/V_0 probably because D/V_0 subsumes the effect of M/B_0 , which is an important component in M/B_{efwa} . The partial adjustment model can evaluate M/B_{pawa} or it can evaluate M/B_{pawa} plus D/V_0 . The latter case may perform better as it puts no restrictions on the initial debt level.

⁹ Alternatively, I estimate the model specified in Eq.(4). The coefficients for historical market-to-book variables estimated from Eq. (4) are similar to those estimated from Eq. (5). I report the results using Eq. (5) to be consistent with the existing literature.

Table 4
Market leverage ratios and different weighted-average historical market-to-book variables.

	(1)	(2)	(3)	(4)	(5)	(6)	(7)
$M/B_{\text{efwa},t-1}$	-0.009 (-13.800)				-0.001 (-0.969)	-0.006 (-9.242)	-0.001 (-2.335)
$M/B_{\text{ewa},t-1}$		-0.018 (-12.487)					
$M/B_{\text{pawa}0,t-1}$			-0.016 (-10.967)			-0.011 (-7.659)	
$M/B_{\text{pawa},t-1}$				-0.017 (-9.900)			-0.016 (-9.008)
M/B_{t-1}	-0.046 (-37.506)	-0.039 (-30.840)	-0.040 (-29.692)	-0.034 (-21.817)	-0.039 (-37.085)	-0.039 (-29.955)	-0.034 (-22.005)
EBITDA/A_{t-1}	-0.265 (-27.428)	-0.275 (-27.739)	-0.273 (-27.709)	-0.257 (-27.235)	-0.236 (-27.034)	-0.272 (-27.609)	-0.257 (-27.209)
PPE/A_{t-1}	0.121 (13.276)	0.118 (12.946)	0.120 (13.118)	0.078 (8.950)	0.082 (9.928)	0.118 (12.889)	0.077 (8.857)
$\log S_{t-1}$	0.027 (22.758)	0.027 (22.822)	0.027 (23.016)	0.014 (12.009)	0.014 (12.866)	0.027 (22.678)	0.014 (11.957)
D/A_0				0.411 (39.193)	0.451 (44.760)		0.408 (38.425)
N	86370	86370	86370	78058	86370	86370	78058
R^2	0.249	0.251	0.249	0.374	0.382	0.252	0.375

This table reports regression results for the model.

$$\left(\frac{D}{V}\right)_t = \alpha + \beta \left(\frac{M}{B}\right)_{\text{wa},t-1} + \delta(\mathbf{X})_{t-1} + \varepsilon_t,$$

where D/V measures market leverage ratios and X is a vector including M/B , EBITDA/A , PPE/A , and $\log S$. $M/B_{\text{wa},t-1}$ takes four different values: M/B_{efwa} , M/B_{ewa} , $M/B_{\text{pawa}0}$ and M/B_{pawa} . Regressions (4), (5) and (7) include D/V_0 , the leverage ratio in the IPO year. All standard errors are adjusted for clustering by firm. T-statistics are shown in parentheses.

To summarize, the results reported in this section show that the alternative weighted averages of market-to-book ratios that are not based on the amount of external financing provide evidence similar to that of the timing measure that uses percentages of external financing as the weights for the past market-to-book ratios. The results suggest that the external-finance weighting scheme is not the driving force for the negative relation between leverage and historical market-to-book ratios.

4.3. Alternative market timing measures

Further, to differentiate the partial adjustment model from the market timing story, I evaluate the role played by the market-to-book ratio in driving the documented results. The market timing story interprets market-to-book as a market misvaluation proxy, while the partial adjustment model as a growth-option proxy. I construct and evaluate new measures that use different proxies of market timing and growth options, both of which use external finance as the weighting scheme.

Insider sales and the market sentiment index are used as alternative market timing proxies and alternative growth-option proxies are tested in the next section.

Insider sales is a proxy that is accepted by proponents of the market timing story. For example, Seyhun (1986) documents that at both the firm level and the aggregate level, insider trading can predict abnormal future stock price changes. Karpoff and Lee (1991) show that there are often large net insider sales prior to secondary share offerings (SEOs). Kahle (2000) shows that SEOs associated with large insider sales are likely to show significant post-SEO underperformance. These results are often cited as evidence of short-run market timing.

The insider trading data are obtained from the Insider Filing Data (TFN) reported on SEC forms 3, 4, 5 and 144. All transactions related to changes in an insider's ownership position of conventional stock or non-derivatives are included in the sample. For example, a "buy" would be an open market purchase, private purchase, or the exercise of a derivative.¹⁰ For each fiscal year and each firm, all the insider trades are summed to obtain total insider purchases and sales.¹¹ The insider sales percentage is defined as

$$\text{Ins_sale}_t = \frac{\text{Sell}_t - \text{Buy}_t}{\text{Shares_outstanding}_t},$$

where $\text{Share_outstanding}_t$ is total shares outstanding at the end of fiscal year t .

The sentiment index variable has been used by Baker and Wurgler (2006) and the data are available from Jeffrey Wurgler's website.¹² This index is a linear combination of six general market sentiment proxies: the closed-end fund discount; the raw turnover ratio; the number of IPOs; the average first-day returns of IPOs; the share of equity issues in total equity and debt issues, and the logarithm of the difference between the average market-to-book ratios of dividend payers and non-payers. All of these six variables have been used in previous studies as measures of investor irrationality. Baker and Wurgler (2006) construct their index as the first principal component of the correlation matrix of the six variables. The index is positively related to market euphoria. Since each of the index components has first been standardized, the index, as a linear combination of the six individual components, has a mean of zero and a standard deviation of one.

¹⁰ Transactions related only to derivative securities such as options, warrants, and convertibles are excluded. Therefore, options granted by the company to insiders are not included in the sample, while option exercises are included.

¹¹ Following previous studies (e.g., Lee (1997)), insiders are defined as the Chairman of the Board, both Officer and Director, Chief Executive Officer, President, Vice President, and Controlling Persons.

¹² Sec, <http://pages.stern.nyu.edu/~jwurgler/>.

Table 5

Alternative market timing proxies – insider sales and the market sentiment index.

	Panel A Book leverage		Panel B Market leverage	
	(1)	(2)	(1)	(2)
$Ins_sale_{efwa,t-1}$	-0.010 (-1.498)		-0.008 (-1.216)	
$Sentiment_{efwa,t-1}$		-0.001 (-0.767)		-0.001 (-0.729)
M/B_{t-1}	-0.021 (-22.568)	-0.022 (-30.581)	-0.043 (-31.981)	-0.053 (-44.490)
$EBITDA/A_{t-1}$	-0.267 (-21.959)	-0.254 (-28.444)	-0.250 (-21.091)	-0.261 (-27.277)
PPE/A_{t-1}	0.091 (8.063)	0.100 (11.383)	0.116 (10.521)	0.127 (13.932)
$\log S_{t-1}$	0.039 (29.727)	0.033 (29.535)	0.026 (19.108)	0.028 (23.334)
N	36141	86780	36090	86370
R^2	0.189	0.132	0.258	0.242

This table reports regression results for the model.

$$\left(\frac{D}{V}\right)_t = \alpha + \beta(\text{Timing})_{efwa,t-1} + \delta(\mathbf{X})_{t-1} + \varepsilon_t,$$

where \mathbf{X} is a vector including M/B , $EBITDA/A$, PPE/A , and $\log S$, and $\text{Timing}_{efwa,t-1}$ takes two values, $Ins_sale_{efwa,t-1}$ and $Sentiment_{efwa,t-1}$. $Ins_sale_{efwa,t-1} = \sum_{s=0}^{t-1} \frac{e_s + d_s}{\sum_{r=0}^{t-1} (e_r + d_r)} (Ins_sale)_s$ and $Ins_sale_s = \frac{Sell_s - Buy_s}{Shares_outstanding_s}$, $Sentiment_{efwa,t-1} = \sum_{s=0}^{t-1} \frac{e_s + d_s}{\sum_{r=0}^{t-1} (e_r + d_r)} (Sentiment)_s$ and $Sentiment_s$ is the market sentiment index at year s , obtained from Jeffrey Wurgler's website. D/V measures book leverage in Panel A and market leverage in Panel B. All the standard errors are adjusted by clustering by firm. T -statistics are shown in parentheses.

The external-finance weighted-average insider trading variable and the external-finance weighted-average sentiment variable are constructed, respectively, as follows:

$$(Ins_sale)_{efwa,t-1} = \sum_{s=0}^{t-1} \frac{e_s + d_s}{\sum_{r=0}^{t-1} (e_r + d_r)} (Ins_sale)_s,$$

$$(Sentiment)_{efwa,t-1} = \sum_{s=0}^{t-1} \frac{e_s + d_s}{\sum_{r=0}^{t-1} (e_r + d_r)} (Sentiment)_s.$$

If high market-to-book ratios, more insider sales and high sentiment all relate to the market overvaluation, Ins_sale_{efwa} and $Sentiment_{efwa}$ should explain the leverage ratio as M/B_{efwa} does.

The model specification is as in Eq. (5) and results are reported in Table 5. Neither Ins_sale_{efwa} nor $Sentiment_{efwa}$ is found to be significant in either the book leverage or the market leverage regressions. Comparing these results with those in Tables 3 and Table 4 suggest that when the historical variables are not associated with a firm's growth options and thus with the firm's target leverage ratio, they cannot explain current leverage.

4.4. Alternative growth-option measures

If the historical market-to-book ratio can explain current leverage because it proxies for growth options, the same would be true for other growth-option proxies.

The R&D-to-assets ratio and the R&D-to-sales ratio are tested as alternative proxies for growth options, as they have been widely used in prior research (e.g., Barclay et al. (2006), Gaver and Gaver (1993) and Flannery and Rangan (2006)). The partial adjustment model predicts that since the market-to-book, R&D-to-assets, and R&D-to-sales ratios are all positively related to growth options, their

Table 6

Alternative growth-option proxies – R&D/A and R&D/S.

	Panel A Book leverage		Panel B Market leverage	
	(1)	(2)	(1)	(2)
$R\&D/A_{efwa,t-1}$	-0.295 (-13.300)		-0.510 (-19.355)	
$R\&D/S_{efwa,t-1}$		-0.012 (-8.244)		-0.019 (-14.271)
M/B_{t-1}	-0.018 (-26.149)	-0.020 (-27.807)	-0.044 (-41.390)	-0.049 (-42.143)
$EBITDA/A_{t-1}$	-0.290 (-30.599)	-0.281 (-28.459)	-0.320 (-32.089)	-0.295 (-28.915)
PPE/A_{t-1}	0.095 (10.366)	0.111 (11.877)	0.112 (11.751)	0.139 (14.383)
$\log S_{t-1}$	0.033 (28.496)	0.033 (26.981)	0.027 (22.196)	0.027 (20.939)
N	75235	73112	74877	72760
R^2	0.150	0.143	0.270	0.252

This table reports regression results for the model.

$$\left(\frac{D}{V}\right)_t = \alpha + \beta \left(\frac{R\&D}{A/S}\right)_{efwa,t-1} + \delta(\mathbf{X})_{t-1} + \varepsilon_t,$$

where \mathbf{X} is a vector including M/B , $EBITDA/A$, PPE/A , and $\log S$. $R\&D/A_{efwa} = \sum_{s=0}^{t-1} \frac{e_s + d_s}{\sum_{r=0}^{t-1} (e_r + d_r)} \left(\frac{R\&D}{A}\right)_s$ and $R\&D/S_{efwa} = \sum_{s=0}^{t-1} \frac{e_s + d_s}{\sum_{r=0}^{t-1} (e_r + d_r)} \left(\frac{R\&D}{S}\right)_s$. Panel A uses book leverage and Panel B uses market leverage. All the standard errors are adjusted by clustering by firm. T -statistics are shown in parentheses.

historical values should all be negatively related to current leverage. An external-finance weighted-average R&D-to-assets variable ($R\&D/A_{efwa}$) and an external-finance weighted-average R&D-to-sales variable ($R\&D/S_{efwa}$) are constructed analogous to the historical market-to-book ratio, insider sales and market sentiment index variables discussed in previous sections.

Table 6 reports the regression results using $R\&D/A_{efwa}$ and $R\&D/S_{efwa}$. Both are found to be significant in both the book leverage and market leverage regressions just as M/B_{efwa} is.

Replicating the tests in this section using R&D-to-assets minus the industry median or R&D-to-sales minus the industry median yields qualitatively similar results that are thus not reported.

This evidence suggests that the results of B–W are not unique to the market-to-book ratio; rather, they apply to other growth-option proxies that are not directly related to market misvaluation.

5. Conclusion

The evidence that the historical market-to-book ratio can explain current leverage has been explained as a result of market timing. This study argues that the documented evidence is consistent with a partial adjustment model of leverage.

With time-varying targets and adjustment costs, firms will make only partial adjustments toward their targets each year. As a result of partial adjustments, firms' current leverage ratios reflect their past targets. Since a firm's target leverage ratio is negatively related to the firm's growth options and since the market-to-book ratio proxies for growth options, the partial adjustment model predicts that current leverage is negatively related to historical market-to-book ratios. The results are largely consistent with the model's predictions.

A weighted average of market-to-book ratios constructed based on the partial adjustment model provides evidence similar to that of the timing measure, which uses external finance as the weights for the past market-to-book ratios.

The historical values of alternative market timing proxies, such as insider sales and the market sentiment index, are shown to have no effects on leverage while the historical value of alternative growth-option proxies, such as the R&D-to-assets ratio and the R&D-to-sales ratio, do have significant effects.

Overall, the evidence is consistent with the explanation that historical market-to-book ratios proxy for growth options and their relation with current leverage is the result of partial adjustments.

Appendix A. Variable definitions

BE	Book equity: Data60 + Data74
D	Book debt: Data6 – BE
D/V	Book leverage or market leverage: $D/\text{Data6}$ as book leverage $D/(\text{Data6} - \text{BE} + \text{Data25} * \text{Data199})$ as market leverage.
M/B	Market value of assets/book assets: $(\text{Data6} - \text{BE} + \text{Data25} * \text{Data199}) / \text{Data6}$
EBITDA/A	Operating income before depreciation/total asset: Data13 / Data6.
PPE/A	Net property, plant and equipment/total assets: Data8 / Data6.
logS	Log value of sales, adjusted for inflation: $\log(\text{Data12} / \text{consumer price index})$, where consumer price index, obtained from the Federal Reserve Bank of St. Louis, takes value of 100 at year 1972.
e_t	Net equity issue at year t : $\Delta(\text{BE}) - \Delta(\text{Data 36})$, where Δ measures change from year t to year $t - 1$.
d_t	Net debt issue at year t : $\Delta(D)$.
$M/B_{efwa,t-1}$	$\sum_{s=0}^{t-1} \frac{e_s + d_s}{\sum_{r=0}^{t-1} (e_r + d_r)} \left(\frac{M}{B}\right)_s$.
$M/B_{ewa,t-1}$	$\sum_{s=0}^{t-1} \frac{1}{t} \left(\frac{M}{B}\right)_s$.
$M/B_{pawa,t-1}$	$\sum_{s=1}^k \frac{(1-\lambda)^{s-1}}{\sum_{r=0}^{t-1} (1-\lambda)^r} \left(\frac{M}{B}\right)_{t-s}$, where $\lambda = 0.3$
$M/B_{pawa,t-1,k}$	$\sum_{s=1}^{t-1} \frac{(1-\lambda)^{s-1}}{\sum_{r=0}^{t-1} (1-\lambda)^r} \left(\frac{M}{B}\right)_{t-s}$ where $\lambda = 0.3$
$M/B_{pawa0,t-1}$	$\sum_{s=1}^{t-1} \lambda (1-\lambda)^{s-1} \left(\frac{M}{B}\right)_{t-s} + (1-\lambda)^t \left(\frac{M}{B}\right)_0$ where $\lambda = 0.3$ and M/B_0 is M/B at IPO year.
Ins_sale_t	Net insider sales as a percentage of shares outstanding, $\frac{Sell_t - Buy_t}{Shares_outstanding_t}$, where $Sell_t$ and Buy_t are insider sales and purchases during year t obtained from Insider Filing Data (TFN) and $Shares_outstanding_t$ is total shares outstanding at the end of fiscal year t (Data25).
$Ins_sale_{efwa,t-1}$	$\sum_{s=0}^{t-1} \frac{e_s + d_s}{\sum_{r=0}^{t-1} (e_r + d_r)} (Ins_sale)_s$.
Sentiment	The market sentiment index obtained from Jeffrey Wurgler's website: http://pages.stern.nyu.edu/~jwurgler/ .
$Sentiment_{efwa,t-1}$	$\sum_{s=0}^{t-1} \frac{e_s + d_s}{\sum_{r=0}^{t-1} (e_r + d_r)} (Sentiment)_s$.
R&D/A	Research and development expenditures/total assets: Data46/Data6.
R&D/S	Research and development expenditures/total sales: Data46/Data12.
$R\&D/A_{efwa,t-1}$	$\sum_{s=0}^{t-1} \frac{e_s + d_s}{\sum_{r=0}^{t-1} (e_r + d_r)} \left(\frac{R\&D}{A}\right)_s$.
$R\&D/S_{efwa,t-1}$	$\sum_{s=0}^{t-1} \frac{e_s + d_s}{\sum_{r=0}^{t-1} (e_r + d_r)} \left(\frac{R\&D}{S}\right)_s$.

References

- Adam, T., Goyal, V.K., 2008. The investment opportunity set and its proxy variables. *Journal of Financial Research* 31 (1), 41–63.
- Alti, A., 2006. How persistent is the impact of market timing on capital structure? *Journal of Finance* 61 (4), 1681–1710.
- Altinkihc, O., Hansen, R.S., 2000. Are there economics of scale in underwriting fees? Evidence of rising external financing costs. *The Review of Financial Studies* 13 (1), 191–218.
- Baker, M., Wurgler, J., 2002. Market timing and capital structure. *Journal of Finance* 57, 1–32.
- Baker, M., Wurgler, J., 2006. Investor sentiment and the cross-section of stock returns. *Journal of Finance* 61, 1645–1680.
- Barclay, M.J., Smith Jr., C.W., Watts, R., 1995. The determinants of corporate leverage and dividend policies. *Journal of Applied Corporate Finance* 7, 4–19.
- Barclay, M.J., Smith Jr., C.W., Morellec, E., 2006. On the debt capacity of growth options. *Journal of Business* 79, 37–59.
- Chang, X. and Dasgupta, S., 2008. Target behavior and financing: How conclusive is the evidence?, *Journal of Finance*, forthcoming.
- Chen, L., Zhao, S.X., 2006. On the relation between the market-to-book ratio, growth opportunity, and leverage ratio. *Finance Research Letters*, 3, 253–266.
- Elliott, W.B., Koeter-Kant, J., Warr, R.S., 2007. A valuation-based test of market timing. *Journal of Corporate Finance* 13, 112–128.
- Fama, E., 1980. Agency problems and the theory of the firm. *Journal of Political Economy* 88, 288–307.
- Fama, E., French, K.R., 2002. Testing trade-off and pecking order predictions about dividends and debt. *Review of Financial Studies*, 15, 1–33.
- Flannery, M., Rangan, K., 2006. Partial adjustment toward target capital structures. *Journal of Financial Economics*, 79, 469–506.
- Frank, M.Z. and Goyal, V.K., 2008. Trade-off and pecking order theories of debt, forthcoming, in B. Espen Eckbo (ed.), *Handbook of Corporate Finance: Empirical Corporate Finance*, Volume 2 (Handbooks in Finance Series, Elsevier/North-Holland), Ch. 12.
- Frank, M.Z., Goyal, V.K., 2009. Capital structure decisions: which factors are reliably important? *Financial Management*. Vol. 38, Issue 1, 1–37.
- Gaver, J.J., Gaver, K.M., 1993. Additional evidence on the association between the investment opportunity set and corporate financing, dividend, and compensation policies. *Journal of Accounting and Economics*, 16, 125–160.
- MarchHovakimian, A., 2006. Are observed capital structures determined by equity market timing? *Journal of Financial and Quantitative Analysis* 41 (1), 221–246.
- MarchHovakimian, A., Opler, T., Titman, S., 2001. Debt–equity choice. *Journal of Financial and Quantitative Analysis* 36 (1), 1–24.
- Huang, R. and Ritter, J.R., 2008. Testing theories of capital structure and estimating the speed of adjustment, *Journal of Financial and Quantitative Analysis*, forthcoming.
- Jensen, M., 1986. Agency costs of free cash flow, corporate finance, and takeovers. *American Economic Review* 76, 323–329.
- Kahle, K.M., 2000. Insider trading and the long-run performance of new security issues. *Journal of Corporate Finance* 25–53 March.
- Karpoff, J.M., Lee, D., 1991. Insider trading before new issue announcements. *Financial Management* 20, 18–26.
- Kayhan, A., 2008. Managerial Discretion and the Capital Structure Dynamics. Louisiana State University. working paper.
- Kayhan, A., Titman, S., 2007. Firms' histories and their capital structure. *Journal of Financial Economics* 83, 1–32.
- Leary, M.T., Roberts, M.R., 2005. Do firms rebalance their capital structures? *Journal of Finance* 60, 2575–2619.
- Lee, I., 1997. Do firms knowingly sell overvalued equity? *Journal of Finance* 52, 1439–1466.
- Lemmon, M.L., Roberts, M.R., Zender, J.F., 2008. Back to the beginning: persistence and the cross-section of corporate capital structure. *Journal of Finance* 63, 1575–1608.
- Lewellen, K., 2006. Financing decisions when managers are risk averse. *Journal of Financial Economics*, 82, 551–589.
- Myers, S., 1977. Determinants of corporate borrowing. *Journal of Financial Economics* 5, 147–175.
- Myers, S., Majluf, N.S., 1984. Corporate financing and investment decisions when firms have information that investors do not have. *Journal of Financial Economics* 13 (2), 187–221.
- Petersen, M.A., 2009. Estimating standard errors in finance panel data sets: comparing approaches. *Review of Financial Studies* 22, 435–480.
- Rajan, R., Zingales, L., 1995. What do we know about capital structure? Some evidence from international data. *Journal of Finance*, 50, 1421–1467.
- Seyhun, H.N., 1986. Insiders' profits, costs of trading, and market efficiency. *Journal of Financial Economics*, 16, 189–212.
- Smith Jr., C.W., Watts, R.L., 1992. The investment opportunity set and corporate financing, dividend, and compensation policies. *Journal of Financial Economics*, 32, 263–292.