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Testing Theories of Capital Structure and Estimating the Speed of Adjustment

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Abstract

This paper examines time-series patterns of external financing decisions and shows that publicly traded U.S. firms fund a much larger proportion of their financing deficit with external equity when the cost of equity capital is low. The historical values of the cost of equity capital have long-lasting effects on firms' capital structures through their influence on firms' historical financing decisions. We also introduce a new econometric technique to deal with biases in estimates of the speed of adjustment toward target leverage. We find that firms adjust toward target leverage at a moderate speed, with a half-life of 3.7 years for book leverage, even after controlling for the traditional determinants of capital structure and firm fixed effects.

I. Introduction

The three preeminent theories of capital structure are the static trade-off, pecking order, and market timing models. Other studies have examined the relative merits of static trade-off and pecking order theories. In this paper, we present empirical evidence regarding the relative importance of all three of these hypotheses. Using a direct measure of the equity risk premium (ERP), we find that U.S. firms during 1964–2001 are much more likely to use external equity financing when the relative cost of equity is low. Furthermore, ERPs have long-lived effects on capital structure through their influence on securities issuance decisions, even

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after controlling for the traditional determinants of capital structure, consistent with the hypothesis that market timing is an important determinant of observed capital structures. After further controlling for firm fixed effects and correcting for biases that are created by some of the firms being present for only a short part of the sample period and leverage ratios being highly persistent, we find that firms adjust toward their target leverage at a moderate speed.

No single theory of capital structure is capable of explaining all of the time-series and cross-sectional patterns that have been documented. The relative importance of these explanations has varied in different studies. In general, the pecking order theory enjoyed a period of ascendancy in the 1990s, but it has recently fallen on hard times. With the publication of Baker and Wurgler's (2002) article relating capital structure to past market-to-book ratios, the market timing theory has increasingly challenged both the static trade-off and pecking order theories. A number of recent papers, however, challenge Baker and Wurgler's evidence that securities issued in a year have long-lived effects on capital structure.

The market timing theory posits that corporate executives issue securities depending on the time-varying relative costs of equity and debt, and these issuance decisions have long-lasting effects on capital structure because the observed capital structure at date t is the outcome of prior period-by-period securities issuance decisions. According to the market timing theory, firms prefer equity when they perceive the relative cost of equity as low, and they prefer debt otherwise. The capital structure literature has, to date, refrained from explicitly measuring the cost of equity. A major contribution of this paper is to link securities issuance explicitly to the cost of equity capital, using a direct measure of the ERP.

Shyam-Sunder and Myers (1999) test the pecking order theory by estimating an ordinary least squares (OLS) regression using a firm's net debt issuance as the dependent variable and its net financing deficit as the independent variable. They find that the estimated coefficient on the financing deficit is close to one for their sample of 157 firms continuously listed during 1971–1989, and they interpret the evidence as supportive of the pecking order theory. Frank and Goyal (2003), however, find that the coefficient on the financing deficit is far below one in the 1990s. We explore the role of changing market conditions in firms' changing financing behavior. We find that our market condition proxies, especially a measure for the time-varying cost of equity capital, have an important impact on the estimated coefficient of the financing deficit.

To measure the relative cost of equity, we use the beginning-of-year implied ERP, estimated using forecasted earnings and long-term growth (LTG) rates. Consistent with the market timing theory, we find that firms fund a large proportion of their financing deficit with external equity when the relative cost of equity is low. The magnitude of the effect is economically and statistically significant. For example, an increase from 3% to 4% in the implied ERP results in approximately 3% more (e.g., from 62% to 65%) of the financing deficit being funded with net debt. To our knowledge, our study is the first to systematically link the time series of financing choices to the time-varying ERP for a large sample of U.S. publicly traded firms.

After establishing the importance of market conditions for securities issuance, we examine the effect of historical ERPs on current leverage. We find that past

ERPs have long-lasting effects on a firm's current capital structure through their influence on historical financing decisions. A firm funds a larger proportion of its financing deficit with debt when the market ERP is higher, resulting in higher leverage for many subsequent years. For example, a financing deficit that was 10% of total assets in 1974, when the ERP was high, results in an increase of 2.91% in book leverage (e.g., increasing from 47.09% to 50%) four years later, while a financing deficit of 10% in 1996, when the ERP was low, results in an increase of only 0.35% in book leverage four years later.

We also estimate the speed with which firms adjust toward target leverage. This is perhaps the most important issue in capital structure research today. If firms adjust quickly toward their target leverage, which changes across time as firm characteristics and market conditions change, then historical financing activities and market conditions will have only short-lived effects on firms' current capital structures, implying that the market timing theory of capital structure is unimportant.

The existing literature has provided mixed results on the speed of adjustment (SOA) toward target financial leverage. Fama and French (2002) estimate an SOA of 7%–18% per year. Lemmon, Roberts, and Zender (2008) find that capital structure is so persistent that the cross-sectional distribution of leverage in the year prior to the initial public offering (IPO) predicts leverage 20 years later, yet they estimate a relatively rapid SOA of 25% per year for book leverage. Flannery and Rangan (2006) estimate an even faster SOA: 35.5% per year using market leverage and 34.2% per year using book leverage, suggesting that it takes about 1.6 years for a firm to remove half of the effect of a shock on its leverage. Both Leary and Roberts (2005) and Alti (2006) find that the effect of equity issuance on leverage completely vanishes within two to four years, suggesting fast adjustment toward target leverage. As Frank and Goyal (2008) state in their survey article: "Corporate leverage is mean reverting at the firm level. The speed at which this happens is not a settled issue" (p. 185).

We reconcile these different findings by showing that the estimated SOA in a dynamic panel model with firm fixed effects is sensitive to the econometric procedure employed when many of the firms are present for relatively brief periods, especially when a firm's debt ratio is highly autocorrelated. A traditional estimator for a dynamic panel model with firm fixed effects involves mean differencing the model. As Flannery and Rangan (2006) observe, however, the bias in the mean differencing estimate of the SOA can be substantial for a dynamic panel data set in which many firms have only a few years of data (the short time dimension bias). To reduce the bias, Flannery and Rangan (2006) rely on an instrumental variable in their mean differencing estimation, while Antoniou, Guney, and Paudyal (2008) and Lemmon et al. (2008) use a system generalized method of moments (GMM) estimator. In the system GMM estimation, the model itself and the first difference of the model are estimated as a "system." The system GMM estimator, however, is biased when the dependent variable is highly persistent, as is the case with debt ratios.

Hahn, Hausman, and Kuersteiner (2007) propose a long differencing estimator for highly persistent data series. In this estimator, a multiyear difference of the model is taken rather than a one-year difference. Our simulations show that the long differencing estimate is much less biased than the OLS estimate ignoring firm fixed effects unless the true SOA is slow, in which case neither procedure has an appreciable bias. The long differencing estimate is also much less biased than the firm fixed effects mean differencing estimate unless the true SOA is fast, in which case neither procedure has an appreciable bias. Hahn et al. (2007) show that the long differencing estimator is also much less biased than the system GMM estimator when the dependent variable is highly persistent (i.e., the true SOA is slow). In a simulation, they show that if the true autoregressive parameter is 0.9, the system GMM estimate is only 0.664, whereas the long differencing estimator produces an estimate of 0.902 with a differencing length of $k = 5$.

Using the long differencing technique, we find that firms only slowly rebalance away the undesired effects of leverage shocks. Using a differencing length of $k = 8$, the SOA is 17.0% per year for book leverage and 23.2% per year for market leverage. Such estimates suggest that it takes about 3.7 and 2.6 years for a firm to remove half of the effect of a shock on its book and market leverage, respectively. This is the most important result of this paper.

Throughout our empirical analysis, we do not give equal attention to the market timing, pecking order, and static trade-off models. This is because many of our findings are consistent with earlier research, and little purpose would be served by long discussions that would largely repeat the existing literature. Instead, we focus on our new findings regarding time variation in the relative cost of equity as it relates to the pecking order and market timing hypotheses, on whether past securities issues have persistent effects on capital structure, and on the SOA to target leverage.

The rest of this paper is organized as follows. Section II describes the data and summary statistics. Section III presents the empirical results of the role of market timing in securities issuance decisions. Section IV examines the effects of securities issues on capital structure. Section V discusses econometric issues and presents estimates of the SOA to target capital structure using the long differencing estimator. Section VI concludes.

II. Data and Summary Statistics

A. Data

The firm-level data are from the Center for Research in Security Prices (CRSP) and Compustat. The sample consists of firms from 1963 to 2001. Since R&D (item 46) is missing for about 39% of firm years, we set the missing value to zero to avoid losing many observations. We rely on a dummy variable to capture the effect of missing values when using R&D in our analysis.[1] Utilities (4900–4949) and financial firms (6000–6999) are excluded because they were regulated during most of the sample period. A small number of firms with a format code

[1]The vast majority of firms with missing R&D are in industries such as clothing retailers for which R&D expenditures are likely to be zero. Capital expenditures and convertible debt are missing for about 2% of firm years. We set missing capital expenditures (128) and convertible debt (79) to zero, although our results are essentially the same if we exclude firm years with missing capital expenditures or convertible debt.

of 4, 5, or 6 are also excluded from the sample.[2] Firm years with beginning-of-year book assets of less than $10 million, measured in terms of 1998 purchasing power, are also excluded to eliminate very small firms and reduce the effect of outliers.[3] Finally, we exclude firm-year observations for which there was an accounting change for adoption of Statement of Financial Accounting Standards (SFAS) No. 94, which required firms to consolidate off-balance sheet financing subsidiaries.[4]

B. Summary Statistics of Financing Activities

Summary statistics of financing activities are presented by year because we are interested in the time-series properties. Figure 1 presents financing activities using information from the balance sheet. Net debt is defined as the change in book debt. Net equity is defined as the change in book equity minus the change in retained earnings. Following Baker and Wurgler (2002) and Fama and French (2002), book debt is defined as total liabilities plus preferred stock (10) minus deferred taxes (35) and convertible debt (79), and book equity is total assets less book debt.[5]

In Figure 1, the average ratios are the annual averages of net financing scaled by beginning-of-year assets (in percent), and the aggregate ratios are the annual aggregate amount of net financing of all firms scaled by the aggregate amount of beginning-of-year total assets (in percent). Figure 1 shows that the average net debt increase exceeded 10% of beginning-of-year assets in eight years. The average net equity issuance exceeded 6% in 12 years. The average change in retained earnings shows a declining trend, with the lowest value in 2001, the last year of our sample period. The aggregate net debt and equity issuances fluctuate substantially, with aggregate net external equity issuance peaking at over 7% of aggregate assets in 2000. The static trade-off theory has been unable to provide a satisfactory explanation for the magnitude of these fluctuations. The pecking

[2]Format code 5 is for Canadian firms, and format codes 4 and 6 are not defined in Compustat.

[3]To further reduce the effect of outliers, we also drop firm-year observations with book leverage or market leverage that is negative or greater than one and Tobin's Q that is negative or greater than 10. These variables will be defined later. Our results are robust to whether or not we keep these firm-year observations.

[4]We exclude 201 such firm years identified with Compustat footnote codes. The Financial Accounting Standards Board (FASB) issued SFAS No. 94 in late 1987. Heavy equipment manufacturers and merchandise retailers were most affected by the standard because they made extensive use of unconsolidated finance subsidiaries. For example, Ford, General Motors, General Electric, and International Business Machines all had a huge increase in debt on their balance sheets from fiscal year 1987 to 1988. More specifically, Ford had a debt increase of about $93.8 billion, while its end-of-year total assets were $45.0 billion in 1987 and $143.4 billion in 1988, largely because Ford Credit was consolidated under the new standard. This standard also caused some firms to divest themselves of unconsolidated subsidiaries because otherwise they would violate debt covenant agreements on the maximum amount of leverage, and their returns on assets would appear too low and financial leverage would appear too high.

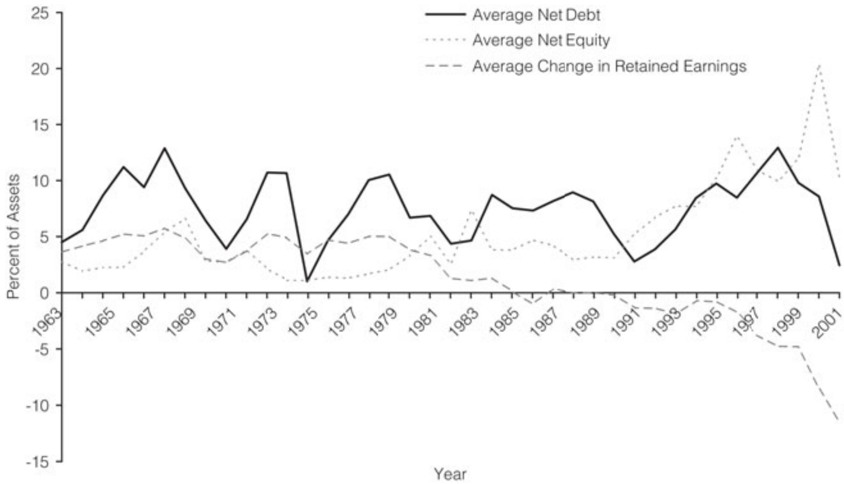
[5]When the liquidating value of preferred stock (item 10) is missing, we use the redemption value of preferred stock (56). When the redemption value is also missing, we use the carrying value of preferred stock (130). As one referee noted, convertible preferred stock is more equity-like than straight preferred stock. In unreported analysis we include the change in the carrying value of convertible preferred stock (214) in our definition of net equity. Our results remain qualitatively the same.

FIGURE 1

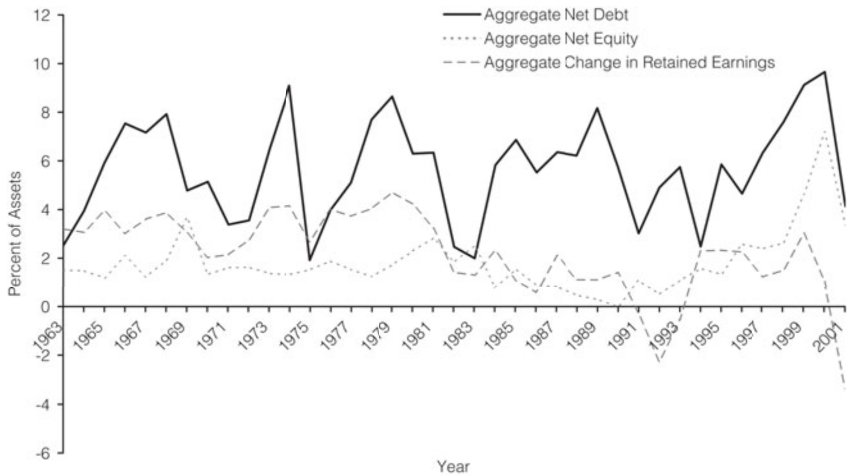
Average and Aggregate Financing Activities from the Balance Sheet

Net debt is the change in debt and preferred stock (Compustat items 181 + 10 − 35 − 79). Net equity is the change in equity and convertible debt (items 6 − 181 − 10 + 35 + 79) minus the change in retained earnings (36). Graph A of Figure 1 shows the equally weighted annual averages of net financing scaled by beginning-of-year assets of each firm (in percent). Graph B shows the annual aggregate amount of net financing of all firms in the sample scaled by the aggregate amount of beginning-of-year assets (in percent).

Graph A. Equally Weighted Averages of Net Financing/Assets



Graph B. Aggregate Amount of Net Financing/Aggregate Amount of Assets



order theory gains some support during 1974–1978, when the average net equity issuance was below 2%. As so often happens, however, the pattern on which the pecking order hypothesis was based began to break down shortly after the publication of Myers (1984).

Figure 1 understates securities issues because other firms that are retiring debt or buying back stock lower the averages. Table 1 reports the percentage of firms that are net securities issuers. Issuing firms in a year are defined as those for

TABLE 1

Percent of Firms in Different Financing Groups across Time

A firm is defined as issuing debt if ΔD scaled by beginning-of-year assets is at least 5%, where ΔD is the change in debt and preferred stock (Compustat items 181 + 10 − 35 − 79) from year $t - 1$ to year t, or issuing equity if ΔE scaled by beginning-of-year assets is at least 5%, where ΔE is the change in equity and convertible debt (6 − 181 − 10 + 35 + 79) minus the change in retained earnings (36). The percentages of debt and equity issuers do not necessarily add up to 100 because firms can issue both debt and equity or neither debt nor equity. Firms with beginning-of-year assets of less than $10 million (1998 purchasing power) are excluded.

Year	Total Number of Firms	Debt Issues (%)	Equity Issues (%)
1963	129	33.3	16.3
1964	465	35.7	12.0
1965	558	45.9	14.3
1966	722	54.2	16.3
1967	1,316	43.8	16.6
1968	1,570	53.9	24.5
1969	1,929	47.4	34.1
1970	2,211	40.9	14.7
1971	2,493	33.8	14.4
1972	2,739	43.0	16.7
1973	2,986	58.6	10.4
1974	3,039	57.9	6.8
1975	3,097	28.1	6.6
1976	3,046	38.6	8.1
1977	2,986	46.9	7.9
1978	2,875	57.7	9.5
1979	2,905	56.9	11.6
1980	2,975	45.5	15.4
1981	2,915	42.4	19.3
1982	3,073	34.8	13.1
1983	3,065	35.7	23.1
1984	3,146	45.3	17.7
1985	3,210	40.2	16.4
1986	3,079	39.6	19.4
1987	3,104	43.9	19.8
1988	3,097	44.4	14.8
1989	3,075	41.2	14.7
1990	3,063	39.7	13.5
1991	3,041	30.6	16.2
1992	3,133	35.8	21.8
1993	3,380	40.2	24.0
1994	3,715	45.0	24.5
1995	3,944	47.6	25.2
1996	4,214	43.5	29.7
1997	4,543	44.8	29.5
1998	4,564	49.5	27.4
1999	4,366	44.7	26.7
2000	4,202	43.1	31.5
2001	4,160	28.4	27.7

which debt or equity increases by more than 5% of beginning-of-year assets, the same definition that has been used, for example, in Hovakimian, Hovakimian, and Tehranian (2004) and Korajczyk and Levy (2003). Once we separate firms with net securities issues from other firms, we see a higher frequency of issuing. The percentage of firms with net debt issuance of at least 5% of assets is never below 28%. The pecking order theory predicts that equity issues will be rare. However, the proportion of net equity issuers (firms issuing at least 5% of assets) never drops below 6.6% in any year, peaks at over 34% in 1969, and is at least 25% in each year from 1995 to 2001.[6]

[6]Our proportion of equity issuers is much higher than in studies such as Jung, Kim, and Stulz (1996) and DeAngelo, DeAngelo, and Stulz (2009), which define an equity issuer as a firm conducting a public seasoned equity offering for cash. Our definition of an equity issuer, which is standard in the empirical capital structure literature, includes firms that conduct private placements of equity or stock-financed acquisitions that increase the book value of equity by at least 5% of assets, net of share repurchases.

Overall, our summary statistics of financing activities cast doubt on the ability of the pecking order model to describe most of the observed capital structures, consistent with Fama and French (2002), (2005), Frank and Goyal (2003), and Hovakimian (2006).

C. Summary Statistics of Macroeconomic Variables

How do firms judge the relative cost of equity? On the one hand, some firm executives may possess private information that is not reflected in market prices about their firms or their industries. On the other hand, they may follow certain psychological patterns. For example, reference points, as suggested by prospect theory, may play a role.[7] Alternatively, they may issue equity to take advantage of publicly observable misvaluations if the equity market becomes temporarily overvalued (Stein (1996)).

Our proxy for the cost of equity is the implied ERP, estimated using analyst earnings forecasts (earnings per share (EPS) and LTG rate) at the end of the previous calendar year for the 30 stocks in the Dow Jones Industrial Average.[8] The implied ERP is defined as the real internal rate of return that equates the current stock price to the present value of all future cash flows to common shareholders of the firm (measured as book value of equity plus forecasted future residual earnings), minus the real risk-free rate (see Appendix A for details). Although they differ in their specific procedures, this is the general approach used by Claus and Thomas (2001), Gebhardt, Lee, and Swaminathan (2001), and Ritter and Warr (2002).[9] We follow Ritter and Warr (2002) to correct for inflation-induced distortions in the estimation of the implied ERP. The equally weighted average of

[7]Casual conversations with investment bankers suggest that when they advise their clients on the choice between debt and external equity financing, the most important factors they consider are whether a client's stock price is near a 52-week high and whether the earnings yield on the stock is below the interest rate on debt.

[8]By using the lagged year-end values during year t for a firm with a Dec. 31 fiscal year, we are using the Dec. 31 of year $t-1$ accounting information and stock price. For a firm with a June 30 fiscal year, during year t we use the June 30 of year $t-1$ accounting information and Dec. 31 of year $t-1$ stock price. We use forecasts from Value Line for 1968–1976 and from Institutional Brokers' Estimate System (IBES) for 1977–2001. We hand-collect Value Line data from *Value Line Investment Survey* for early years when the IBES database is not available. Because previous studies document that IBES and Value Line analysts make systematically different forecasts, we estimate the implied ERP for 1977 using analyst forecasts from both sources and then adjust the implied ERP for 1968–1976 by multiplying the Value Line forecast by the ratio of the 1977 premium using IBES to the 1977 premium using Value Line. Brav, Lehavy, and Michaely (2005) estimate the implied nominal expected market return using target prices and future dividends from Value Line for 1975–2001. They estimate annual nominal expected returns varying from 34.1% in 1975 to 12.1% in 1997. Using their series instead of ours does not change our major results. Our qualitative results are also robust to using the value-weighted book-to-market ratio of equity for all NYSE-listed firms as a proxy for the relative cost of equity rather than the implied ERP.

[9]Consistent with the literature, we assume that analyst EPS forecasts are exogenous. Bayesian analysts, however, may become overly conservative in their forecasts of EPS when the cost of equity is high, and overly optimistic when the cost of equity is low. This is because the market price implies future earnings, and a Bayesian analyst will incorporate these into his or her own forecasts. Furthermore, when P/E ratios are high, more optimistic forecasts are necessary in order to justify "buy" recommendations. The endogeneity results in a dampening of the time series of the implied ERP relative to its true fluctuations and hence creates a bias against our results.

the implied ERP for each of the Dow 30 stocks is used as an estimate of the ERP for the market. The time-variation of the implied ERP may be due to either the time-variation of risk, or of the risk aversion of investors (rational reasons), or to the time-variation of investor sentiment (an irrational reason).

Figure 2 shows the real interest rate (RIR) and the implied ERP at the end of each calendar year. The ERP turned negative during 1996–2001, suggesting overvaluation of the stock market.[10] Firms display a high propensity to issue equity during these years, as indicated in Table 1.

FIGURE 2

Equity Risk Premium and Real Interest Rate

The market equity risk premium is estimated using analyst forecasts at the year-end for the Dow 30 stocks from Value Line for 1968–1976 and from IBES for 1977–2001. The real interest rate is the nominal interest rate minus inflation, where the nominal interest rate is the yield on one-year Treasury bills in the secondary market at the beginning of each calendar year at http://www.federalreserve.gov/, and inflation is the rate of change of the consumer price index during the calendar year from CRSP.

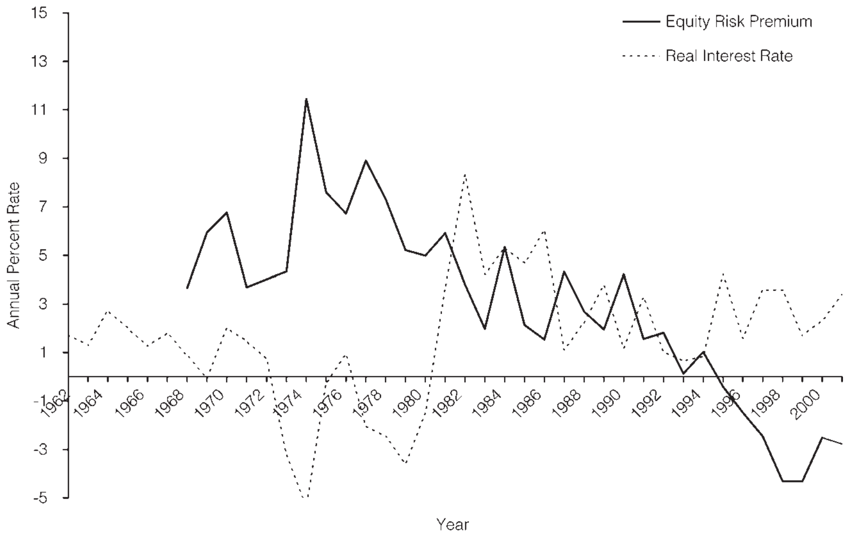


Figure 2 also shows that the RIR was very low in 1973–1974 and 1978–1979, when the percentage of sample firms issuing debt rose to historic highs (over 56%

[10]Although we estimate a negative ERP for some years, our qualitative results are not dependent on the ERPs being negative. The residual income methodology that we employ states that the value of equity is equal to the book value of equity plus the present value of future residual income (economic profits). Because we assume that future residual income is mean-reverting, a large present value of future residual income can only be achieved by using a low discount rate (i.e., since the numerator converges to zero, a small denominator is needed to generate a high ratio). When both the market-to-book ratio and the RIR are high, as was the case in the 1996–2001 period, the model produces a negative implied ERP. Some have argued that a high market-to-book ratio has existed in most years after 1995 because the book value of equity increasingly underrepresents the value of assets in place as intangibles represent more and more of firm value. If so, our estimates may overstate the downtrend in the ERP, and the true ERP may not be as negative as we estimate. Since we use the ERP as an explanatory variable, overestimating its decline would lead to underestimating the slope coefficient on the ERP.

for each of these years in Table 1). The RIR is used as a proxy for the time-varying cost of debt perceived by corporate executives.

Previous studies also use the term spread and the default spread as proxies for the costs of various forms of debt (e.g., Baker, Greenwood, and Wurgler (2003)). It is likely that the time-varying default risk premium can help explain the time-varying financing decisions. We thus include the default spread, which is defined as the difference in yields between Moody's Baa- and Aaa-rated corporate bonds. The term spread, defined as the difference in yields between 10- and one-year Treasuries, is also included because firms might increase the use of long-term debt when the term spread is low.

We also include contemporaneous measures of the statutory corporate tax rate and the real gross domestic product (GDP) growth rate. The statutory corporate tax rate has changed over time and may have a major influence on the financing decisions of U.S. firms (see, among others, Graham (2003) and Kale, Noe, and Ramirez (1991)).[11] The real GDP growth rate controls for growth opportunities. To the degree that these variables are important and have the expected signs, this lends support to the static trade-off model.

The lagged average announcement effect on seasoned equity offerings (SEOs) is included to see whether, as implied by the pecking order theory, time-varying information asymmetry is able to explain time-varying financing activities. Since the pecking order theory assumes that markets are semi-strong-form efficient, the announcement effect associated with equity issues is the primary proxy for the level of information asymmetry (Bayless and Chaplinsky (1996)).

Table 2 reports summary statistics for our proxies for market conditions. The implied ERP is positively correlated with the default spread and the statutory corporate tax rate and is negatively correlated with the RIR.

III. Market Timing and Securities Issuance Decisions

How important are market conditions, especially the ERP, in securities issuance decisions? This section reports and discusses the results from i) annual OLS regressions using a firm's net debt issuance as the dependent variable and its net financing deficit as the independent variable, ii) pooled OLS regressions linking the pecking order slope coefficient to the time-varying cost of capital, and iii) a pooled nested logit regression for the joint decision of whether to issue securities and which security to issue.

A. Pecking Order Tests

Following Shyam-Sunder and Myers (1999), we first estimate

$$\Delta D_{it} = a_t + b_t \mathrm{DEF}_{it} + u_{it}, \tag{1}$$

[11]The statutory corporate tax rate was 52% in 1963, 50% in 1964, 48% in 1965–1967, 52.8% in 1968–1969, 49.2% in 1970, 48% in 1971–1978, 46% in 1979–1986, 40% in 1987, 34% in 1988–1992, and 35% in 1993–2001.

TABLE 2

Summary Statistics of Macroeconomic Variables

ERP_{t-1} is the implied market equity risk premium at the end of year $t-1$, estimated using analyst forecasts for the Dow 30 stocks from Value Line for 1968–1976 and from IBES for 1977–2001. RIR_{t-1} is the nominal interest rate minus realized inflation, where the nominal interest rate is the yield (daily series) on one-year Treasury bills in the secondary market at the end of year $t-1$ at http://www.federalreserve.gov/, and inflation is the rate of change of the consumer price index during year t from CRSP. DSP_{t-1} is the default spread, defined as the difference in yields (weekly series, since daily series only goes back to 1983) between Moody's Baa-rated and Aaa-rated corporate bonds at the end of year $t-1$. TSP_{t-1} is the term spread, defined as the difference in yields (daily series) between 10- and one-year constant maturity Treasuries at the end of year $t-1$. $TAXR_t$ is the statutory corporate tax rate during year t. $RGDP_t$ is the real GDP growth rate during year t from the Bureau of Economic Analysis, Department of Commerce. $RSEO_{t-1}$ is the annual average of market-adjusted returns during year $t-1$ from one day before to one day after the file date of seasoned equity offerings (SEOs), computed by the authors using SEO data from Thomson Financial. The average announcement effect is calculated from 1980, the first year the file date is available for most SEOs. Subscript t denotes the current year and $t-1$ denotes the previous year. TAXR, RGDP, and RIR are available for 1963–2001. ***, **, and * denote statistical significance at the 1%, 5%, and 10% levels, respectively, in a two-tailed test.

	ERP_{t-1}	RIR_{t-1}	DSP_{t-1}	TSP_{t-1}	$TAXR_t$	$RGDP_t$	$RSEO_{t-1}$
N	33	39	39	39	39	39	21
Mean	0.031	0.016	0.011	0.007	0.430	0.033	−0.018
Std Dev	0.037	0.027	0.005	0.011	0.067	0.022	0.005
Min	−0.043	−0.054	0.003	−0.014	0.340	−0.020	−0.028
Median	0.037	0.016	0.009	0.006	0.460	0.036	−0.017
Max	0.114	0.083	0.024	0.031	0.528	0.073	−0.008
Correlation							
ERP_{t-1}	1						
RIR_{t-1}	−0.316*	1					
DSP_{t-1}	0.469***	0.346**	1				
TSP_{t-1}	−0.058	0.218	0.117	1			
$TAXR_t$	0.705***	−0.257	0.126	−0.255	1		
$RGDP_t$	−0.181	−0.035	−0.376**	0.291*	0.158	1	
$RSEO_{t-1}$	0.191	0.259	0.422*	−0.273	0.420*	0.077	1

where ΔD_{it} is the change in book debt as a percentage of beginning-of-year assets for firm i at the end of the fiscal year ending in calendar year t, and DEF_{it} is the change in assets minus the change in retained earnings as a percentage of beginning-of-year assets. To examine how the slope coefficient on the financing deficit has changed across time, we estimate this equation each year. The estimated slope coefficient, $\hat{b}$, known as the pecking order coefficient, shows very interesting time-series patterns and is reported in Figure 3. It ranges from 0.67 to 0.92 in the 1960s and the 1970s, from 0.48 to 0.79 in the 1980s, and from 0.27 to 0.58 from 1990 to 2001. Frank and Goyal (2003) find that the slope coefficient was low in the 1990s as well. However, a time trend does not explain everything. Even within each decade, there are ups and downs that might be explained with our proxy for the relative cost of equity capital.

Since the effect of market conditions on a negative financing deficit is unclear, we focus on the effect of market conditions on a positive financing deficit by estimating the following regression, pooling all firm year observations:

$$(2) \quad \Delta D_{it} = a + b\text{NDEF}_{it} + \big(c + d\text{ERP}_{t-1} + e\text{RIR}_{t-1} + f\text{DSP}_{t-1} + g\text{TSP}_{t-1} + h\text{TAXR}_t + j\text{RGDP}_t + k\text{RSEO}_{t-1}\big) \times \text{PDEF}_{it} + \varepsilon_{it},$$

where $NDEF_{it}$ equals DEF_{it} if $DEF_{it} < 0$ and zero otherwise; $PDEF_{it}$ equals DEF_{it} if $DEF_{it} > 0$ and zero otherwise; ERP_{t-1} is the implied market ERP at the end of year $t-1$; RIR_{t-1} is the expected real interest rate at the end of year $t-1$; DSP_{t-1} is the default spread at the end of year $t-1$; TSP_{t-1} is the term spread at the end of year $t-1$; $TAXR_t$ is the statutory corporate tax rate during year t;

FIGURE 3

Pecking Order Slope Coefficients

Coefficients are computed annually by estimating equation (1).

$RGDP_t$ is the real GDP growth rate during year t; and $RSEO_{t-1}$ is the annual average of market-adjusted returns for the three-day window $[-1, +1]$ surrounding the file date of SEOs during year $t-1$ (SEO data is from Thomson Financial's new issues database). The market timing theory predicts a positive coefficient on the interaction between the ERP and the positive financing deficit. Results are reported in Table 3. Correlation of the observations across time for a given firm and correlation across firms for a given year could result in biased standard errors in our panel data set regressions. Consequently, we report t-statistics using standard errors corrected for clustering by both firm and year (Petersen (2009)).[12]

Consistent with the market timing theory, firms finance a large proportion of their financing deficit with net external equity when the cost of equity is low. In Panel A of Table 3, we follow Baker and Wurgler (2002) to define the financing deficit as including dividends and the change in cash (i.e., higher dividends increase the financing deficit). In regression (1), the implied ERP at the end of year $t-1$ is positively related to the pecking order coefficient in year t. In economic terms, a one-standard-deviation (0.037) increase in the implied ERP is associated with 10.8% more of the financing deficit being funded with net debt (for example, increasing from 60% to 70.8%). Elliott, Koeter-Kant, and Warr (2007) also

[12]Petersen (2009) suggests that the Rogers (1993) standard errors clustered by firm and by year are more accurate than uncorrected standard errors in the presence of both firm and year correlations in a panel data set. The existing STATA software does not have a built-in command to correct for two-dimensional clustering (for example, clustering by both firm and year). However, Mitchell Petersen kindly provides a STATA ado file used in Petersen (2009) for two-dimensional clustering (see http://www.kellogg.northwestern.edu/faculty/petersen/htm/papers/se/se_programming.htm).

TABLE 3

Market Conditions and the Funding of the Financing Deficit

The following equation is estimated:

$$\Delta D_{it} = a + b\text{NDEF}_{it} + (c + d\text{ERP}_{t-1} + e\text{RIR}_{t-1} + f\text{DSP}_{t-1} + g\text{TSP}_{t-1} + h\text{TAXR}_t + j\text{RGDP}_t + k\text{RSEO}_{t-1}) \times \text{PDEF}_{it} + \varepsilon_{it}.$$

In Panel A of Table 3, the financing deficit, DEF_{it}, is defined as $\Delta D_{it} + \Delta E_{it}$, where ΔD_{it} is the change in debt and preferred stock (Compustat items 181 + 10 − 35 − 79) from year $t-1$ to year t as a percentage of beginning-of-year assets for firm i, and ΔE_{it} is the change in equity and convertible debt (items 6 − 181 − 10 + 35 + 79) minus the change in retained earnings (item 36) as a percentage of beginning-of-year assets. In Panel B, the financing deficit excludes dividends (item 127) and the change in cash (item 1). In both panels, NDEF_{it} equals DEF_{it} if the deficit is negative and zero otherwise, and PDEF_{it} equals DEF_{it} if the deficit is positive and zero otherwise. The standard deviations of PDEF_{it} are 35.9% for the sample used in regressions (1) and (2) of Panel A, 40.8% for the sample used in regression (3) of Panel A, 31.9% for regressions (1) and (2) of Panel B, and 35.9% for regression (3) of Panel B. ERP_{t-1} is the implied market equity risk premium at the end of year $t-1$. RIR_{t-1} is the nominal interest rate minus inflation in year t. DSP_{t-1} is the default spread, defined as the difference in yields between Moody's Baa-rated and Aaa-rated corporate bonds at the end of year $t-1$. TSP_{t-1} is the term spread, defined as the difference in yields (daily series) between 10- and one-year constant maturity Treasuries at the end of year $t-1$. TAXR_t is the statutory corporate tax rate during year t. RGDP_t is the real GDP growth rate during year t. RSEO_{t-1} is the annual average of market-adjusted returns during year $t-1$ from one day before to one day after the file date of seasoned equity offerings (SEOs). The average announcement effect is calculated from 1980, the first year the file date is available for most SEOs. All of the macroeconomic variables are presented in decimal form (i.e., a 5% ERP is presented as 0.05). Both the dependent variable and the financing deficit are presented as percentages. In each regression, we exclude firm year observations where $|\Delta D_{it}| > 400\%$ or $|\Delta E_{it}| > 400\%$. The t-statistics are corrected for correlation both across observations of a given firm and across observations of a given year (Rogers (1993)) and for heteroskedasticity (White (1980)).

	(1) 1969–2001		(2) 1969–2001		(3) 1981–2001	
	Coeff.	*t*-Stat.	Coeff.	*t*-Stat.	Coeff.	*t*-Stat.
Panel A. Financing Deficit (defined with dividend payments increasing the deficit)						
NDEF_{it}	0.71	17.18	0.70	17.41	0.68	15.33
PDEF_{it}	0.50	24.22	0.27	1.65	0.33	1.79
$\text{ERP}_{t-1} \times \text{PDEF}_{it}$	2.91	5.06	3.06	3.99	2.95	4.32
$\text{RIR}_{t-1} \times \text{PDEF}_{it}$			−0.56	−0.86	1.33	1.11
$\text{DSP}_{t-1} \times \text{PDEF}_{it}$			−2.03	−0.42	6.30	0.83
$\text{TSP}_{t-1} \times \text{PDEF}_{it}$			−3.70	−2.52	−3.67	−2.34
$\text{TAXR}_t \times \text{PDEF}_{it}$			0.50	1.13	−0.53	−0.86
$\text{RGDP}_t \times \text{PDEF}_{it}$			3.09	2.67	5.12	3.81
$\text{RSEO}_{t-1} \times \text{PDEF}_{it}$					−6.06	−3.33
Constant	0.70	2.96	0.51	2.46	0.85	3.96
Adj. R^2	0.648		0.657		0.625	
N	112,483		112,483		78,696	
Panel B. Financing Deficit (defined with dividend payments not affecting the value of the deficit)						
NDEF_{it}	0.40	10.38	0.39	10.30	0.37	8.81
PDEF_{it}	0.59	37.78	0.45	4.79	0.46	5.00
$\text{ERP}_{t-1} \times \text{PDEF}_{it}$	3.14	7.42	3.27	6.44	3.36	7.14
$\text{RIR}_{t-1} \times \text{PDEF}_{it}$			−0.45	−1.03	0.74	1.04
$\text{DSP}_{t-1} \times \text{PDEF}_{it}$			1.52	0.57	5.80	2.06
$\text{TSP}_{t-1} \times \text{PDEF}_{it}$			−3.42	−3.15	−3.54	−2.93
$\text{TAXR}_t \times \text{PDEF}_{it}$			0.19	0.64	−0.35	−1.03
$\text{RGDP}_t \times \text{PDEF}_{it}$			2.90	3.07	4.28	4.55
$\text{RSEO}_{t-1} \times \text{PDEF}_{it}$					−3.32	−2.90
Constant	−0.14	−0.69	−0.21	−1.17	−0.44	−2.52
R^2	0.676		0.681		0.664	
N	112,467		112,467		78,682	

relate the pecking order slope coefficient to the ERP estimated for each firm and find qualitatively similar results. Our estimate of the ERP at the market level using only the well-established Dow 30 companies with reliable accounting information is relatively conservative and is likely to understate the importance of valuation in the choice between debt and equity.

In regression (2) the estimated coefficient on the interaction between the ERP and the positive financing deficit changes little after controlling for the real rate of return on debt, the default spread, the term spread, the statutory tax rate, and the real GDP growth rate. The regression also shows that firms fund a larger proportion of their financing deficit with net debt when the corporate tax rate is higher, consistent with the trade-off theory prediction that debt is used as a tax shield, although the relation is not statistically significant. The coefficient on the interaction between the real rate of GDP growth and the positive financing deficit is positive and statistically significant, suggesting that firms are more likely to fund their current growth opportunities with debt.

Regression (3) in Table 3 includes the average announcement effect of SEOs as an explanatory variable, using a shorter sample period because our RSEO series does not begin until 1980. This variable measures the adverse selection costs of issuing equity, and has been used by, among others, Korajczyk, Lucas, and McDonald (1990), Choe, Masulis, and Nanda (1993), Bayless and Chaplinsky (1996), and Korajczyk and Levy (2003). The significantly negative sign of the interaction between the average announcement effect and the positive financing deficit is consistent with previous studies. That is, when this negative number is closer to zero, firms issue more equity. Economically, a one-standard-deviation (0.005) increase in the average announcement effect results in a decrease of 3.0% of the financing deficit being funded with net debt. Relative to the impact of the ERP, the average announcement effect (and therefore time-varying asymmetric information) is of secondary importance in the choice of debt and equity financing.

If a firm pays out the cash flow it generated as a dividend, then the financing deficit as defined in Panel A of Table 3 does not include that cash flow because both assets and retained earnings are decreased by the dividend. However, if the firm engages in a stock repurchase, then the financing deficit includes the cash flow because the deficit measures net external financing. In Panel B, we exclude dividends and the change in cash in the definition of the financing deficit (i.e., the payment of dividends does not affect the value of the financing deficit). The coefficient on the interaction between the ERP and the positive financing deficit becomes even larger, suggesting a greater role of the ERP in the choice between external debt and external equity to fund the financing deficit.

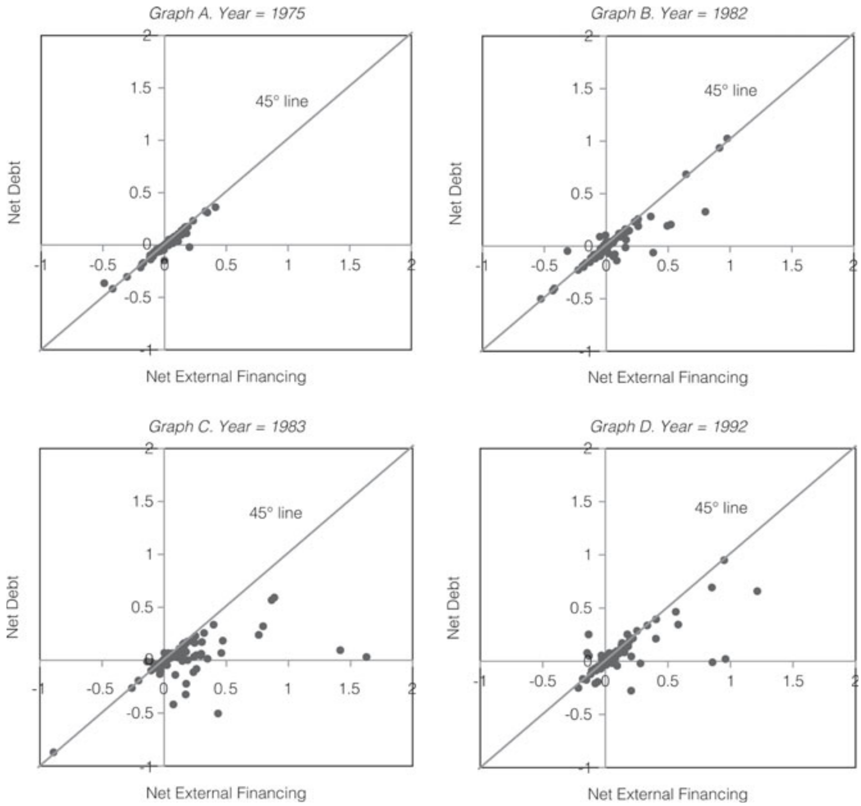
The regression approach has both advantages and disadvantages. The advantages include the summarization of information in the pecking order slope coefficient, convenience for analyzing a large number of firms, and convenience for controlling for other factors in a multivariate framework. The disadvantages include the potentially large influence of a few outliers and the oversimplification of information. Furthermore, Chirinko and Singha (2000) question the validity of Shyam-Sunder and Myers' (1999) pecking order tests.

To gain additional insight, in Figure 4 we randomly select 100 firms each year and draw scatter-plots. We limit the number of randomly selected firms to 100 per year because a larger number makes it difficult to visually identify meaningful patterns. If a firm funds 100% of its financing deficit with net debt, all of the points plotted will lie on the 45° line. A firm with negative net equity issuance will lie on the left-hand side of the 45° line, while a firm with positive net equity issuance will lie on the right-hand side of the 45° line. We report the scatter-plots for only four years because those for other years with similar slope coefficients are qualitatively the same. In 1975, when the slope coefficient is 0.91, only a small number of firms deviate from the 45° line. In 1992, however, when the slope coefficient is 0.42, several percent of the points are far to the right of the 45° line.

FIGURE 4

Scatter-Plots of Net Debt versus Net External Financing

The horizontal axis denotes net external financing scaled by beginning-of-year assets, and the vertical axis denotes net debt scaled by beginning-of-year assets. For each selected year, 100 randomly selected observations are plotted. The pecking order slope coefficient in Figure 3 is 0.909 for 1975, 0.768 for 1982, 0.482 for 1983, and 0.423 for 1992.



These firms issue a lot of equity to finance their financing deficit or to retire debt. Only a few firms are noticeably to the left of the 45° line, suggesting that firms only infrequently repurchase shares in a quantitatively important manner.

B. Nested Logit Model for the Joint Decision

In the pecking order tests, we assume that the financing deficit is exogenous. However, a firm may decide jointly whether to issue securities and which security to issue. Therefore, we also estimate a nested logit model (Greene (2003), pp. 725–727), as do Gomes and Phillips (2007).[13] The nested logit model can also potentially reduce the large influence of a few firms raising a large amount of debt or equity on the pecking order slope coefficient, because firms issuing 6% or

[13] A nested logit model is similar to a multinomial logit model. However, a multinomial logit model assumes that choices between any two alternatives are independent of the other alternatives, while a nested logit model only assumes that the choices are independent within a group or "nest" of alternatives.

60% of assets are both assigned the same value in the nested logit model. Another concern regarding the pecking order tests is that the estimated coefficient from the financing deficit may simply reflect changing firm characteristics rather than changing market conditions (Flannery and Rangan (2006)). We control for firm characteristics in the nested logit model.

Our nested logit model includes two decision levels. The first-level alternatives are security issuance versus no security issuance, and the second-level alternatives are equity versus debt issuance. Let $\Pr(i)$ equal either the probability of security issuance ($i = s$) or the probability of no security issuance ($i = n$), and $\Pr(j|s)$ equal either the probability of equity issuance ($j = e$) or the probability of debt issuance ($j = d$) conditional on $i = s$.[14] Then

$$\Pr(j|s) = \frac{\exp(x_{sj}\beta)}{\exp(x_{se}\beta) + \exp(x_{sd}\beta)} \tag{3}$$

and

$$\Pr(s) = \frac{\exp(y_s\alpha + \eta_s I_s)}{\exp(y_s\alpha + \eta_s I_s) + \exp(y_n\alpha + \eta_n I_n)}, \tag{4}$$

where the inclusive values $I_i = \ln\{\exp(x_{ie}\beta) + \exp(x_{id}\beta)\}$, x_{ij}, and y_i refer to the row vectors of explanatory variables specific to categories (i, j) and (i), respectively, and η_i refers to the inclusive parameters. We use nonissuers as the base alternative at the first decision level, and debt issuers as the base alternative at the second decision level. The nested logit model is estimated using full-information maximum likelihood.[15]

We use the same set of explanatory variables, including both firm characteristics and market conditions, for all alternatives.[16] Firm characteristics include financial slack (the sum of cash and short-term investments), profitability, capital expenditures, Tobin's Q (market-to-book ratio of assets), R&D expenditures, the logarithm of net sales, the logarithm of the number of years the firm has been listed on CRSP, the lagged leverage, the market-adjusted return during the previous fiscal year, and the market-adjusted return during the following three fiscal years. The results for the nested logit model are reported in Table 4.[17] To assist in gauging economic significance, we vary each explanatory variable by plus or minus one standard deviation from its sample value (a two-standard-deviation change), and then we average the change in the predicted probability over all firms in the sample in order to obtain the economic effects, holding other variables

[14] A firm is defined as issuing debt if the net change in debt is at least 5% of its beginning-of-year assets. Similarly, a firm is defined as issuing equity if the net change in equity is at least 5% of its beginning-of-year assets. For convenience, firm years when both debt and equity are issued are excluded in the nested logit regressions. For characteristics of firms issuing both debt and equity, see Hovakimian et al. (2004). We keep these firms in other analyses.

[15] Several previous studies examine the choice between debt versus equity financing in isolation using a logit model (e.g., Jung et al. (1996)) or a probit model (e.g., Mackie-Mason (1990)), implicitly assuming that the choice between issuing versus not issuing security is exogenous.

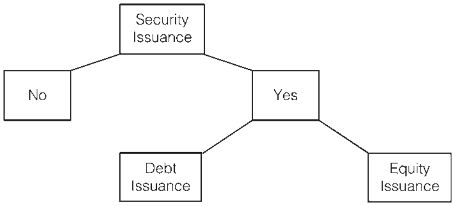
[16] If we restrict both $\eta_s = 1$ and $\eta_n = 1$, then we have a multinomial logit model.

[17] We are not aware of any statistical packages that are able to adjust nested logit regressions for clustering.

TABLE 4

Nested Logit Model of Securities Issuance Decisions

We estimate a nested logit model of the following structure:



We use nonissuers as the base alternative at the first decision level, and debt issuers as the base alternative at the second decision level. Firms that issue both debt and equity in the same year are excluded from the sample, which covers 1969–2001. ΔD is the change in debt and preferred stock (Compustat items 181 + 10 − 35 − 79). ΔE is the change in equity and convertible debt (items 6 − 181 − 10 + 35 + 79) minus the change in retained earnings (36). A firm is defined as issuing debt if $\Delta D/A_{t-1} \geq 0.05$. Similarly, a firm is defined as issuing equity if $\Delta E/A_{t-1} \geq 0.05$. CASH is the sum of cash and short-term investments (1) scaled by assets. OIBD is operating income before depreciation (13) scaled by assets. CAPEX is the capital expenditure (128) scaled by assets. Q is the sum of the market value of equity and the book value of debt divided by the book value of assets. R&D is the research and development expense (46) scaled by assets and is set to zero if it is missing. R&DD is a dummy variable that equals one if R&D is missing and equals zero otherwise. SALE is the log of net sales (12). AGE is the natural log of the number of years the firm has been listed on CRSP. BL is book leverage, defined as book debt (items 181 + 10 − 35 − 79) scaled by assets. MAR_{t-1} is measured as the difference between the firm raw return and the value-weighted market return in the preceding fiscal year. $MAR_{t+1,t+3}$ is measured as the difference between the firm raw return and the value-weighted market return in the following three fiscal years. If a firm is delisted, its post-event three-year raw return is calculated by compounding the CRSP value-weighted market return for the remaining months. ERP_{t-1} is the implied market equity risk premium at the end of year $t-1$. RIR_{t-1} is the nominal interest rate minus inflation in year t. DSP_{t-1} is the default spread, defined as the difference in yields between Moody's Baa-rated and Aaa-rated corporate bonds at the end of year $t-1$. TSP_{t-1} is the term spread, defined as the difference in yields (daily series) between 10- and one-year constant maturity Treasuries at the end of year $t-1$. $TAXR_t$ is the statutory corporate tax rate during year t. $RGDP_t$ is the real GDP growth rate during year t. To help gauge the economic effects, we vary each explanatory variable from one standard deviation below to one standard deviation above its sample value, and use the coefficients from the nested logit regression to calculate the change in the predicted probability, holding all other variables fixed. We then average the change in the predicted probability over all firms in the sample to get economic effects. The t-statistics are calculated using heteroskedastic consistent standard errors (White (1980)).

	First-Level Decision: Issuing (vs. Not Issuing)			Second-Level Decision: Equity (vs. Debt)		
	Coeff.	t-Stat.	Economic Effect	Coeff.	t-Stat.	Economic Effect
$CASH_{it-1}$	−1.051	−15.59	−7.1%	0.369	3.88	2.1%
$OIBD_{it-1}$	−0.793	−7.15	−4.5%	−1.218	−10.50	−5.6%
$CAPEX_{it-1}$	3.213	27.17	11.3%	0.919	7.01	2.7%
Q_{it-1}	0.341	16.17	15.9%	0.384	28.62	14.7%
$R\&DD_{it-1}$	0.071	3.86	1.6%	0.236	9.35	4.3%
$R\&D_{it-1}$	1.565	6.24	4.7%	3.452	14.07	8.3%
$SALE_{it-1}$	0.002	0.36	0.1%	−0.134	−17.20	−9.3%
AGE_{it}	−0.228	−20.32	−8.4%	−0.107	−6.33	−3.2%
BL_{it-1}	0.177	3.17	1.6%	1.035	15.39	7.6%
MAR_{it-1}	0.477	22.12	14.8%	0.384	21.08	9.9%
$MAR_{it+1,t+3}$	−0.068	−11.67	−5.1%	−0.106	−11.93	−6.5%
ERP_{t-1}	−3.164	−7.92	−5.4%	−7.462	−13.30	−10.3%
RIR_{t-1}	−3.488	−9.36	−4.6%	3.510	6.36	3.8%
DSP_{t-1}	−13.417	−5.55	−3.0%	17.005	4.86	3.2%
TSP_{t-1}	−8.514	−11.14	−4.4%	3.889	3.31	1.7%
$TAXR_t$	1.271	6.44	3.7%	0.835	2.83	2.0%
$RGDP_t$	4.452	9.71	4.2%	−4.324	−6.04	−3.4%
N	82,653					

fixed. Because our results are generally consistent with other results in the literature, we will only highlight a few of the results.

We first briefly discuss results for the first-level decision: security issuance versus no security issuance. Consistent with the pecking order theory, firms that have more cash and higher profitability are less likely to access external capital markets, while growth firms, as measured by capital expenditure, Tobin's Q, R&D, and the preissue one-year market-adjusted firm return, are more likely to access external markets. Older firms rely less on external financing. Macroeconomic variables also appear to be important determinants of whether to access external markets.

We proceed to discuss results for the second-level decision: equity issuance versus debt issuance, conditional on the decision of security issuance. Our results are generally consistent with the existing literature. Firms with more cash are more likely to issue equity. Profitable firms are more likely to issue debt. Firms with more growth opportunities, as measured by capital expenditure, Tobin's Q, R&D, and preissue one-year market-adjusted return, are more likely to issue equity. Larger and older firms are more likely to issue debt.

Confirming the importance of market timing, Tobin's Q and the past market-adjusted firm return are among the most important explanatory variables in the decision to issue equity, both statistically and economically. Holding other variables at their sample values, if Tobin's Q is increased from one standard deviation below to one standard deviation above its sample value, the propensity to issue equity increases by 14.7%. Similarly, if the past market-adjusted firm return is increased from one standard deviation below to one standard deviation above its sample value, the propensity to issue equity increases by 9.9%. Firms that subsequently underperform are also more likely to issue equity, and this variable has a larger economic significance than most other variables. An increase in the future market-adjusted return from one standard deviation below to one standard deviation above results in almost a 6.5% reduction in the propensity to issue equity. This provides further support for the market timing theory.[18]

Consistent with the static trade-off theory, high leverage firms are more likely to issue equity rather than debt during 1964–2001. If we increase the lagged book leverage from one standard deviation below to one standard deviation above its sample value, the propensity to issue equity increases by 7.6%.

We are interested in whether the implied ERP has additional explanatory power after controlling for firm characteristics. If the lagged value of the ERP increases from one standard deviation below to one standard deviation above its sample value, the average propensity to issue equity instead of debt decreases by 10.3%. Economically, it is more significant than all other variables except the lagged firm level Tobin's Q.

When the RIR is higher, firms are more likely to issue equity. Economically, an increase from one standard deviation below to one standard deviation above

[18]Jung et al. (1996) include the post-issue firm return as a proxy for expected misvaluation in a logit model for firms' choice between debt and equity issuance, although they do not find this variable to be statistically significant for a small sample of U.S. firms from 1977 to 1984. Consistent with our results, DeAngelo et al. (2009) also find a statistically significant negative relation between the probability of conducting an SEO and future three-year market-adjusted returns for U.S. firms from 1982 to 2001. However, they find that the propensity to issue equity increases by only 1.5% for a swing of a 75% loss to a 75% gain over three subsequent years, far below our 6.5%. The difference in results appears to be primarily due to two reasons: i) The definitions of equity issuers are different. They use SEOs, whereas we use the change in the book value of equity (net of increases in retained earnings), which includes private placements and stock-financed acquisitions. ii) Their 1.5% is the percent of equity issuers among all firms, while our 6.5% is the percent of equity issuers among debt issuers and equity issuers.

its sample value is associated with an increase of 3.8% in the propensity to issue equity. The default and term spreads have an even more modest effect on the debt versus equity choice. Inconsistent with the static trade-off theory that views the tax rate as a major factor in the decision to issue debt, the tax rate has only a secondary effect on the propensity to issue debt or equity.

The statistical and economic importance of our cost of capital proxies is consistent with the hypothesis that firms time their securities offerings to take advantage of intertemporal variation in the relative cost of different sources of capital. One could also interpret these results as being consistent with the static trade-off model, with firms moving to a new optimum as the relative costs of debt and equity change. Traditionally, researchers have assumed that the relative costs do not vary over time. Instead, researchers have assumed that firm characteristics might change over time, but the market-determined costs of debt and equity do not change.

In summary, the nested logit results in Table 4 suggest that Tobin's Q, the preissue stock price run-up, and the implied ERP are the three most important determinants of firms' choice between equity and debt.[19] This is consistent with the market timing theory, although not necessarily inconsistent with the static trade-off theory with an optimal target that depends on the time-varying relative costs of debt and equity and growth opportunities. To further distinguish the alternative theories, in the next section we investigate how historical market conditions influence a firm's current leverage through their important role in the firm's historical financing activities.

IV. Effects of Market Timing on Capital Structure

Firms may adjust their capital structure with internal funds or external funds. The pecking order theory posits that external funds are more expensive than internal funds and external equity is more expensive than external debt. Therefore, securities issues, especially equity issues, should be rare and only have a material impact on the capital structure of firms with insufficient internal funds. The market timing theory is similar to the pecking order theory in that observed capital structure is the outcome of historical external financing decisions, rather than a primary goal in itself.

In contrast, in the static trade-off theory, firms issue securities to adjust toward their target leverage. Once target leverage and partial adjustment are properly controlled for, past securities issues and market conditions should have no important impact on current leverage (although with adjustment costs, Fischer, Heinkel, and Zechner (1989), Hennessy and Whited (2005), Ju, Parrino, Poteshman, and Weisbach (2005), Leary and Roberts (2005), Strebulaev (2007),

[19]We did several robustness checks: i) using a multinomial logit model even if our unreported test shows that choices between any two alternatives are not independent of the other alternatives; ii) using the value-weighted market-to-book ratio of equity of all NYSE-listed firms prior to fiscal year t as an alternative proxy for the cost of equity at the market level; iii) including convertible preferred stock in equity; and iv) excluding firm-year observations with major mergers and acquisitions and spin-offs. Our results are not qualitatively affected.

and others allow for a role). Therefore, it is important to examine the effects of past securities issues and market conditions on observed capital structures in order to compare the relative strength of each theory. This is especially important because there is widespread agreement that market timing considerations appear to be important in determining securities issues (see Alti (2006) and Hovakimian (2004), (2006), among others). The main debate is regarding the persistence of the effects of securities issues and market conditions on capital structure.

To control for target leverage when estimating the effects of past securities issues on current leverage, we estimate the following regression:

$$(5) \qquad L_{it} = f(\text{TARGET\_LEVERAGE\_PROXIES}_{it-1}, \text{PDEF}_{it-k}, \text{ERP}_{t-k-1} \times \text{PDEF}_{it-k}),$$

where L_{it} is the leverage ratio of firm i at the end of year t, k is the lag length in years, PDEF_{it-k} equals DEF_{it-k} if $\text{DEF}_{it-k} > 0$ and zero otherwise (DEF_{it-k} is the change in assets minus the change in retained earnings scaled by beginning-of-year assets for firm i in year $t-k$), and ERP_{t-k-1} is the implied ERP at the end of year $t-k-1$. Target leverage proxies include lagged firm characteristics, lagged or current macroeconomic variables, and year dummies. We examine whether the ERP k+1 years ago and firm i's financing deficit k years ago still have an impact on the firm's current leverage. The static trade-off theory predicts that the coefficients on $\text{ERP}_{t-k-1} \times \text{PDEF}_{it-k}$ and PDEF_{it-k} should be insignificant when k is large. The market timing theory predicts that the effect of $\text{ERP}_{t-k-1} \times \text{PDEF}_{it-k}$ on year t leverage should be positive and statistically significant until k becomes very large.

Table 5 reports pooled OLS results with book leverage (Panel A) or market leverage (Panel B) as the dependent variable for $k = 0$, 4, 6, and 8. To remove the effects of clustering on the estimated standard errors, we report t-statistics corrected for correlation both across observations of a given firm and across observations of a given year (Petersen (2009)). Since the results regarding the target leverage proxies are generally consistent with previous studies, we focus our discussions on the effects of the historical ERPs and financing deficits. Also, we focus our discussions on book leverage, since there is evidence that firms only slowly undo the effect on market leverage induced by stock price movements (Welch (2004)). In the market leverage regressions, the large t-statistics on Q are partly due to the mechanical relation induced by the market value of equity being in the numerator of Q and the denominator of the dependent variable.

The regression (1) results with $k=0$ are generally consistent with the results in Table 3. The coefficient on the interaction between the ERP and the financing deficit is statistically significant. The effect of the financing deficit on book leverage is $(3.687 \times \text{ERP}_{t-1} + 0.242) \times \text{PDEF}_{it}$. Consistent with the market timing theory, the effect of the financing deficit on leverage is positively related to the implied ERP. The minimum estimated ERP is −0.043 (−4.3% per year) in 1999, and the maximum is 0.114 (11.4% per year) in 1974. For a firm with a financing deficit of 10% (the sample mean) in 1999, the effect on its book leverage is $(3.687 \times (-0.043) + 0.242) \times 10\% = 0.83\%$. For a firm with a financing deficit of 10% in 1974, the effect on its book leverage is $(3.687 \times 0.114 + 0.242) \times 10\% = 6.62\%$. Thus, the financing deficit results in a smaller increase in book leverage

TABLE 5

Effects of Historical Financing Activities and Market Conditions on Leverage

The following equation is estimated using firms from the period 1969–2001:

$$L_{it} = f(\text{TARGET\_LEVERAGE\_PROXIES}_{it-1}, \text{ERP}_{t-k-1} \times \text{PDEF}_{it-k}, \text{PDEF}_{it-k}).$$

The dependent variable, L_{it}, is either book leverage or market leverage of firm i at the end of year t. Book leverage is defined as book debt (items 181 + 10 − 35 − 79) divided by book assets (item 6). Market leverage is defined as book debt divided by market assets (items 181 + 10 − 35 + 25 × 199). Target proxies include firm characteristics, market conditions, and year dummies. Q is the sum of the market value of equity and the book value of debt divided by the book value of assets. R&D is the research and development expense (46) and is set to zero if it is missing. R&DD is a dummy variable that equals one if R&D is missing and equals zero otherwise. CAPEX is the capital expenditure (128). SALE is the log of net sales (12). OIBD is the operating income before depreciation (13). TANG is the net property, plant, and equipment (8). R&D, CAPEX, OIBD, and TANG are scaled by end-of-year assets. ERP_{t-k-1} is the implied market equity risk premium at the end of year $t-k-1$. RIR_{t-1} is the nominal interest rate at the end of year $t-1$ minus inflation in year t. DSP_{t-1} is the default spread at the end of year $t-1$. TSP_{t-1} is the term spread at the end of year $t-1$. TAXR_t is the statutory corporate tax rate during year t. RGDP_t is the real GDP growth rate during year t. PDEF_{it-k} is the positive financing deficit during fiscal year $t-k$, scaled by total assets at the end of year t. PDEF_{it-k} equals zero if the financing deficit during fiscal year $t-k$ is negative. Firm year observations where $\text{PDEF}_{it-k} > 10$ are dropped. The standard deviations of PDEF_{it}, PDEF_{it-4}, PDEF_{it-6}, and PDEF_{it-8} are, respectively, 16.1%, 16.0%, 16.7%, and 18.2%. Year dummies and the intercept are included, but their coefficients are not reported. We report t-statistics using standard errors corrected for correlation across both observations of a given firm and observations of a given year (Rogers (1993)).

	(1) $k=0$		(2) $k=4$		(3) $k=6$		(4) $k=8$	
	Coeff.	*t*-Stat.	Coeff.	*t*-Stat.	Coeff.	*t*-Stat.	Coeff.	*t*-Stat.
Panel A. Book Leverage								
Q_{it-1}	−0.037	−23.54	−0.030	−11.45	−0.026	−8.36	−0.023	−6.58
$\text{R\&DD}_{it-1}$	0.028	7.09	0.020	4.53	0.020	4.29	0.019	3.85
$\text{R\&D}_{it-1}$	−0.456	−7.93	−0.480	−8.45	−0.486	−7.64	−0.498	−7.41
CAPEX_{it-1}	0.055	1.86	0.126	2.38	0.108	2.14	0.083	1.57
SALE_{it-1}	0.031	16.86	0.032	15.91	0.033	15.87	0.033	15.79
OIBD_{it-1}	−0.347	−9.34	−0.439	−9.60	−0.488	−9.86	−0.524	−9.51
TANG_{it-1}	0.002	0.13	−0.020	−1.44	−0.023	−1.68	−0.026	−1.76
ERP_{t-1}	−0.479	−1.78	−0.284	−1.10	−0.476	−1.48	−0.332	−1.00
RIR_{t-1}	0.189	1.17	0.256	1.43	0.317	1.88	0.390	2.26
DSP_{t-1}	−0.198	−0.18	−0.514	−0.43	−0.528	−0.45	−0.325	−0.31
TSP_{t-1}	0.037	0.10	−0.104	−0.27	−0.096	−0.26	−0.090	−0.20
TAXR_t	−0.525	−3.66	−0.474	−2.56	−0.506	−2.75	−0.606	−3.18
RGDP_t	−0.159	−0.80	−0.106	−0.48	−0.129	−0.50	−0.071	−0.27
$\text{ERP}_{t-k-1} \times \text{PDEF}_{it-k}$	3.687	9.01	2.170	4.43	1.909	4.19	0.867	1.15
PDEF_{it-k}	0.242	14.46	0.044	2.53	0.017	1.23	0.028	1.00
Year dummies	Yes		Yes		Yes		Yes	
N	111,413		68,757		55,236		44,630	
R^2	0.217		0.182		0.181		0.179	
Panel B. Market Leverage								
Q_{it-1}	−0.088	−26.50	−0.099	−19.12	−0.101	−19.19	−0.099	−18.75
$\text{R\&DD}_{it-1}$	0.026	5.74	0.018	3.60	0.017	3.20	0.016	2.99
$\text{R\&D}_{it-1}$	−0.624	−10.38	−0.669	−11.93	−0.684	−11.31	−0.676	−10.72
CAPEX_{it-1}	−0.066	−2.34	−0.044	−0.95	−0.043	−0.95	−0.041	−0.83
SALE_{it-1}	0.021	21.51	0.021	17.33	0.021	16.22	0.022	14.78
OIBD_{it-1}	−0.451	−8.82	−0.574	−9.27	−0.634	−10.08	−0.669	−10.54
TANG_{it-1}	0.028	1.82	0.016	1.07	0.018	1.23	0.018	1.13
ERP_{t-1}	−0.415	−1.41	−0.471	−1.93	−0.594	−1.70	−0.498	−1.31
RIR_{t-1}	0.229	0.89	0.369	2.07	0.428	2.12	0.553	2.80
DSP_{t-1}	−2.373	−1.75	−2.077	−1.55	−2.044	−1.35	−1.397	−1.10
TSP_{t-1}	−0.265	−0.63	−0.129	−0.43	−0.169	−0.52	−0.188	−0.57
TAXR_t	−0.428	−2.01	−0.340	−1.50	−0.351	−1.49	−0.480	−2.11
RGDP_t	−0.523	−2.57	−0.523	−3.27	−0.569	−2.19	−0.436	−2.07
$\text{ERP}_{t-k-1} \times \text{PDEF}_{it-k}$	1.388	3.78	1.905	3.96	2.146	4.49	0.754	1.04
PDEF_{it-k}	0.136	9.77	0.015	0.79	−0.014	−0.91	0.016	0.61
Year dummies	Yes		Yes		Yes		Yes	
N	111,413		68,757		55,236		44,630	
R^2	0.399		0.393		0.386		0.384	

when the cost of equity is low (1999) than when the cost of equity is high (1974), a pattern not predicted by the pecking order hypothesis. The total effect of the financing deficit on market leverage in Panel B also depends on the magnitude of the ERP, although the quantitative effect is smaller.

In regression (2) with $k = 4$, the effect of the financing deficit five years ago on current book leverage is $(2.170 \times \text{ERP}_{t-5} + 0.044) \times \text{PDEF}_{it-4}$. For example, a 10% financing deficit in 1996, when the implied ERP was low, would increase a firm's book leverage five years later by only $(2.170 \times (-0.004) + 0.044) \times 10\% = 0.35\%$. In contrast, a 10% deficit in 1974, when the implied ERP was high, would increase book leverage five years later by $(2.170 \times 0.114 + 0.044) \times 10\% = 2.91\%$. The difference in the impact on book leverage of the 10% financing deficit between 1974 and 1996 is 2.56%.

The difference in the impact is economically significant. In our sample, the standard deviation of the change in book leverage during one year is only 10.08%, consistent with the high persistence in leverage documented by, among others, Kayhan and Titman (2007) and Lemmon et al. (2008)). Relative to the standard deviation, a 2.56% difference in leverage is not a small number. It should be noted that the role of the cost of equity capital is understated in this paper because our measure at the market level does not capture the cross-sectional variations at the firm level.

The coefficient on the interaction term continues to be statistically significant in regression (3) with $k = 6$, suggesting that the ERP six years ago still has an impact on current leverage. The coefficient on the interaction term becomes much smaller in regression (4) with $k = 8$, however, reassuringly suggesting that the ERP's effect on future leverage does not implausibly persist forever.

Hovakimian (2006) and Kayhan and Titman (2007) suggest that the importance of the external finance weighted average of historical market-to-book ratios in Baker and Wurgler (2002) is driven by the mean value of historical market-to-book ratios. They argue that the historical mean market-to-book ratio captures the cross-sectional variation in growth opportunities, which is one of the major determinants of long-term target leverage. Our measure of the cost of equity capital at the market level largely captures time-series variations instead of cross-sectional variations. The long-lasting effect of historical ERPs through their influence on financing decisions is inconsistent with the static trade-off theory, although it is not necessarily inconsistent with a dynamic trade-off theory with costly adjustment.

Our results also complement those of Alti (2006), who restricts his analysis to firms that have issued equity. It is possible that at least some debt issuers issued debt instead of equity because of a high ERP. Therefore, although using only equity issuers to examine the impact of market conditions on capital structure is informative, it provides an incomplete picture.

V. Estimating the Speed of Adjustment

In the previous section, we regress leverage on a set of variables that predict leverage in order to generate a target leverage equation. In the Table 5 analysis, we do not control for firm fixed effects. It is possible that past securities issues capture unobserved firm characteristics that determine current target leverage. If this is true, then the persistent effects of past securities issues are consistent with the trade-off theory. Among recent studies, Flannery and Rangan (2006) estimate a dynamic panel model with firm fixed effects to address this issue.

The dynamic panel model with firm fixed effects can be summarized in the following two structural equations, assuming that target leverage is determined by observed firm characteristics and unobserved characteristics that are captured by firm fixed effects:

$$L_{it} - L_{it-1} = \gamma(\text{TL}_{it} - L_{it-1}) + \tilde{\varepsilon}_{it} \tag{6}$$

and

$$\text{TL}_{it} = \alpha_i + \beta X_{it-1}, \tag{7}$$

where L_{it} is the leverage ratio of firm i at the end of year t, TL_{it} is target leverage, α_i is the firm fixed effect, and X_{it-1} is a vector of lagged firm characteristics of firm i, current or lagged macroeconomic variables, and year dummies. If TL_{it} is observable, then we can estimate equation (6) to find the SOA toward the target capital structure, γ. Unfortunately, we cannot observe target leverage. Therefore, we have to rely on a reduced form specification:

$$L_{it} = (1-\gamma)L_{it-1} + \gamma\alpha_i + \gamma\beta X_{it-1} + \tilde{\varepsilon}_{it}. \tag{8}$$

Two properties are well established for a dynamic panel in which the lagged dependent variable is an explanatory variable (Hsiao (2003)). First, the estimated coefficient on the lagged dependent variable with a pooled OLS estimator ignoring firm fixed effects is biased upward under reasonable assumptions. Second, the estimated coefficient using the standard approach of mean differencing the model is biased downward, especially when the time dimension is short (Nickell (1981)). In essence, the mean differencing estimator first takes the mean for each firm:

$$\bar{L}_i = (1-\gamma)\bar{L}_i + \gamma\alpha_i + \gamma\beta\bar{X}_i + \bar{\tilde{\varepsilon}}_i. \tag{9}$$

It then subtracts equation (9) from equation (8) to get rid of firm fixed effects:

$$L_{it} - \bar{L}_i = (1-\gamma)(L_{it-1} - \bar{L}_i) + \gamma\beta(X_{it-1} - \bar{X}_i) + (\tilde{\varepsilon}_{it} - \bar{\tilde{\varepsilon}}_i). \tag{10}$$

Since the average firm has continuous Compustat data for only about six years, the coefficient on L_{it-1}, $1-\gamma$, may be biased substantially downward. Recognizing this problem, Flannery and Rangan (2006) focus on market leverage ratios and use lagged book leverage as an instrument for their lagged dependent variable, lagged market leverage. They report an SOA toward target market leverage of 35.5% per year (regression (7) in Table 5). It is not clear, however, that lagged book leverage is a valid instrument for lagged market leverage, because at least some shocks are likely to affect both book leverage and market leverage. Similarly, they report an SOA toward target book leverage of 34.2% per year (regression (2) of Table 5).

With a large dynamic panel data set, we are able to evaluate the sensitivity of the estimated adjustment speed with respect to the time dimension with some experiments. We first focus only on firms with data for exactly five consecutive years in Panel A of Table 6. For book leverage, the adjustment speed is 15.6% per year (1 − 0.844, where 0.844 is the coefficient on lagged book leverage) when the pooled OLS estimator ignoring firm fixed effects is used; the adjustment speed is 73.8% per year when the mean differencing estimator is used. For market leverage, the adjustment speed is 13.6% using the pooled OLS estimator ignoring firm fixed effects and 76.5% using the mean differencing estimator. The gap between the OLS estimates and the mean differencing estimates, which are biased in opposite directions, is huge.

TABLE 6

Time Dimension and the Speed of Adjustment toward Target Leverage

We estimate the following equations:

$$L_{it} = (1-\gamma)L_{it-1} + \gamma\beta X_{it-1} + \tilde{\varepsilon}_{it}$$

and

$$L_{it} = (1-\gamma)L_{it-1} + \gamma\alpha_i + \gamma\beta X_{it-1} + \tilde{\varepsilon}_{it}.$$

The first equation is estimated using the pooled OLS estimator. The second equation is estimated using the mean differencing OLS estimator. The dependent variable is either book leverage or market leverage of firm i at the end of year t. Book leverage (BL) is defined as book debt (items 181 + 10 − 35 − 79) divided by book assets (item 6). Market leverage (ML) is defined as book debt divided by market assets (items 181 + 10 − 35 + 25 × 199). X includes lagged firm characteristics, market conditions, and year dummies. Q is the sum of the market value of equity and the book value of debt divided by the book value of assets. R&D is the research and development expense (46) and is set to zero if it is missing. R&DD is a dummy variable that equals one if R&D is missing and equals zero otherwise. CAPEX is the capital expenditure (128). SALE is the log of net sales (12). OIBD is the operating income before depreciation (13). TANG is the net property, plant, and equipment (8). R&D, CAPEX, OIBD, and TANG are scaled by assets. ERP_{t-1} is the implied market equity risk premium at the end of year $t-1$. RIR_{t-1} is the nominal interest rate at the end of year $t-1$ minus inflation in year t. DSP_{t-1} is the default spread at the end of year $t-1$. TSP_{t-1} is the term spread at the end of year $t-1$. $TAXR_t$ is the statutory corporate tax rate during year t. $RGDP_t$ is the real GDP growth rate during year t. Panel A presents results for firms listed on Compustat for exactly five consecutive years. This restriction results in a sample of 894 firms for which there are four years of lagged data. Panel B presents results for 425 firms continuously listed on Compustat for the 30 years from 1972 to 2001 for which there are 29 years of lagged data. Panel C examines the same 425 firms as in Panel B, but uses only five years of data during 1997–2001. In Panel C, we drop DSP, TSP, TAXR, and RGDP to avoid perfect multicollinearity. For brevity, the coefficients on year dummies and the intercept are not reported. For the mean differencing regressions, the "within" R^2 statistics (i.e., R^2 statistics from running OLS on the mean differenced data) are reported. The pooled OLS t-statistics use heteroskedastic consistent standard errors (White (1980), further adjusted for correlation across observations of a given firm (Rogers (1993)).

	Book Leverage				Market Leverage			
	Without Firm Fixed Effects		With Firm Fixed Effects		Without Firm Fixed Effects		With Firm Fixed Effects	
	Coeff.	t-Stat.	Coeff.	t-Stat.	Coeff.	t-Stat.	Coeff.	t-Stat.
Panel A. Regressions on Firms Continuously Listed on Compustat for Exactly Five Years								
BL_{it-1}	0.844	65.8	0.262	12.3				
ML_{it-1}					0.864	66.4	0.235	10.0
Q_{it-1}	−0.010	−5.1	−0.011	−4.3	−0.002	−1.2	−0.002	−0.6
$R\&DD_{it-1}$	−0.002	−0.5	−0.031	−2.2	0.006	1.2	−0.018	−1.2
$R\&D_{it-1}$	−0.089	−2.4	−0.119	−2.2	−0.179	−6.0	−0.182	−3.1
$CAPEX_{it-1}$	0.056	1.8	0.058	1.5	0.117	3.5	0.161	3.8
$SALE_{it-1}$	0.006	4.3	0.010	2.1	0.006	4.0	0.031	5.9
$OIBD_{it-1}$	−0.107	−5.7	−0.096	−3.8	−0.072	−3.6	−0.088	−3.2
$TANG_{it-1}$	0.002	0.2	0.023	0.7	−0.012	−1.0	−0.020	−0.5
ERP_{t-1}	−0.313	−1.1	−0.326	−0.9	−0.609	−1.8	−0.468	−1.2
RIR_{t-1}	−0.150	−0.6	−0.181	−0.7	−0.039	−0.1	−0.110	−0.4
DSP_{t-1}	−0.852	−0.6	−0.314	−0.2	−1.643	−0.9	−0.643	−0.4
TSP_{t-1}	1.127	1.7	1.299	2.0	0.597	0.8	0.941	1.3
$TAXR_t$	0.309	0.8	0.687	1.5	−0.525	−1.4	0.212	0.4
$RGDP_t$	−0.617	−2.3	−0.760	−2.4	−0.999	−3.0	−1.148	−3.4
Year dummies	Yes		Yes		Yes		Yes	
R^2	0.718		0.164		0.741		0.222	
N	3,576		3,576		3,576		3,576	

(continued on next page)

TABLE 6 (continued)

Time Dimension and the Speed of Adjustment toward Target Leverage

	Book Leverage				Market Leverage			
	Without Firm Fixed Effects		With Firm Fixed Effects		Without Firm Fixed Effects		With Firm Fixed Effects	
	Coeff.	*t*-Stat.	Coeff.	*t*-Stat.	Coeff.	*t*-Stat.	Coeff.	*t*-Stat.
Panel B. Regressions on Firms Continuously Listed on Compustat during 1972–2001								
BL_{it-1}	0.907	171.2	0.803	143.6				
ML_{it-1}					0.890	153.3	0.754	109.8
Q_{it-1}	−0.001	−0.9	−0.002	−1.8	−0.004	−3.4	−0.006	−3.9
$R\&DD_{it-1}$	0.001	0.5	−0.001	−0.3	0.001	0.5	0.000	0.2
$R\&D_{it-1}$	−0.020	−0.7	0.077	1.7	−0.149	−5.9	−0.103	−1.8
$CAPEX_{it-1}$	0.077	4.5	0.088	5.5	0.173	8.0	0.169	8.5
$SALE_{it-1}$	0.004	8.9	−0.002	−2.0	0.002	5.0	0.007	4.3
$OIBD_{it-1}$	−0.083	−7.1	−0.099	−9.1	−0.093	−7.1	−0.125	−9.1
$TANG_{it-1}$	−0.013	−2.7	−0.012	−1.4	−0.022	−4.0	−0.007	−0.7
ERP_{t-1}	−0.021	−0.3	−0.048	−0.6	−0.354	−3.4	−0.401	−3.8
RIR_{t-1}	0.036	0.6	0.057	0.8	0.252	3.1	0.309	3.6
DSP_{t-1}	−0.940	−2.2	−0.906	−2.2	−4.227	−7.0	−3.679	−7.1
TSP_{t-1}	−0.220	−1.8	−0.212	−1.4	−0.014	−0.1	0.012	0.1
$TAXR_t$	−0.028	−0.3	−0.071	−0.7	−0.256	−2.1	−0.293	−2.3
$RGDP_t$	0.013	0.2	−0.007	−0.1	−0.350	−4.4	−0.390	−4.8
Year dummies	Yes		Yes		Yes		Yes	
R^2	0.860		0.674		0.849		0.658	
N	12,325		12,325		12,325		12,325	
Panel C. Regressions Using Only Five Years of Data (1997–2001) on Firms Continuously Listed on Compustat during 1972–2001								
BL_{it-1}	0.926	75.7	0.300	6.2				
ML_{it-1}					0.921	59.6	0.159	3.7
Q_{it-1}	0.001	0.3	−0.004	−0.8	0.002	1.0	0.004	0.8
$R\&DD_{it-1}$	−0.002	−0.5	0.015	0.7	−0.001	−0.2	0.013	0.4
$R\&D_{it-1}$	−0.131	−1.8	0.349	1.3	−0.330	−3.9	0.512	1.5
$CAPEX_{it-1}$	0.122	2.3	0.179	2.4	0.181	3.1	0.400	3.8
$SALE_{it-1}$	0.002	1.6	−0.019	−1.4	−0.002	−1.8	0.032	1.9
$OIBD_{it-1}$	−0.054	−1.3	−0.134	−2.2	−0.066	−2.1	−0.215	−3.7
$TANG_{it-1}$	−0.009	−0.8	0.152	2.7	−0.016	−1.2	0.027	0.4
ERP_{t-1}	0.229	0.6	0.229	0.6	−1.799	−3.3	−1.370	−2.6
RIR_{t-1}	0.195	0.8	0.100	0.4	1.335	3.7	1.552	4.3
Year dummies	Yes		Yes		Yes		Yes	
R^2	0.837		0.155		0.787		0.192	
N	1,700		1,700		1,700		1,700	

In Panel B of Table 6, we keep only the 425 firms continuously listed on Compustat for 30 years from 1972 to 2001. While the OLS estimator ignoring firm fixed effects suggests a slightly slower adjustment toward target book leverage for this longer panel of firms than for the short panel (9.3% per year for firms with 30 years of data vs. 15.6% per year for firms with five years of data in Panel A), when the mean differencing estimator is implemented, a much slower SOA is estimated for firms with 30 years of data than for firms with five years of data (19.7% per year in Panel B vs. 73.8% per year in Panel A). Even though the implied SOA using the mean differencing estimator is biased upwards in Panel B, it still provides an adjustment speed of only 19.7% per year for book leverage and 24.6% for market leverage. The gap between the OLS estimates ignoring firm fixed effects and the mean differencing estimates is greatly reduced for this longer panel of firms. If the true adjustment speed lies between the OLS estimates ignoring firm fixed effects and the mean differencing estimates, the results here suggest a much slower adjustment speed than is suggested in Flannery and Rangan (2006).

It should be noted that not all the differences between Panels A and B are necessarily due to the differential time dimension bias. Panel A is intensive in recent IPOs, whereas Panel B is not. To address this issue, in Panel C we further examine the 425 firms that are continuously listed on Compustat from 1972 to 2001. In the regressions, we restrict the use of data to a five-year period from 1997 to 2001 for these relatively old firms. The estimated coefficients on the lagged dependent variable using the mean differencing estimator are close to those in Panel A and substantially different from those in Panel B, suggesting that the main reason for the different results between Panels A and B is the difference in the time dimension, rather than the longevity of the firms. We also restrict the use of data to other five-year periods (1972–1976, 1977–1981, 1982–1986, 1987–1991, and 1992–1996) for the same 425 firms. These unreported results are essentially the same as what we obtain for the period 1997–2001.

To avoid the short time dimension bias, early studies focus on first-differenced instrumental estimators and GMM estimators (Anderson and Hsiao (1981), Arellano and Bond (1991), among others). These estimators rely on first differencing or related transformations to eliminate an unobserved firm-specific effect, and use lagged values of endogenous or predetermined variables as instruments for first differences. However, these estimators are found to incur substantial finite sample biases when the autoregressive parameter is close to one, largely because first differences of highly persistent data series are close to being innovations. These estimators are thus not reliable for our data because firm leverage is highly persistent. Arellano and Bover (1995) propose a system GMM estimator (also called extended GMM), which imposes additional moment restrictions. Blundell and Bond (1998) suggest that the system GMM estimator performs better with persistent data series than first differencing estimators. This is the procedure used by Antoniou et al. (2008) and Lemmon et al. (2008).

Specifically, the system GMM estimator takes the first difference of equation (8):

$$(11)\quad L_{it} - L_{it-1} \quad = \quad (1-\gamma)(L_{it-1} - L_{it-2}) + \gamma\beta(X_{it-1} - X_{it-2}) + \tilde{\varepsilon}_{it} - \tilde{\varepsilon}_{it-1}.$$

Equations (8) and (11) are then simultaneously estimated as a "system." The system GMM estimator uses the lagged differences $(L_{it-2} - L_{it-3}, \ldots, L_{i1} - L_{i0})$ as instruments for equation (8) and the lagged levels $(L_{it-2}, \ldots, L_{i0})$ as instruments for equation (11). The set of moment conditions for the system GMM estimator tends to explode as the time dimension increases, however, resulting in finite sample problems.[20] Proper choices of a smaller set of moment restrictions could help (e.g., Antoniou et al. (2008)), although the literature has not yet provided clear-cut guidelines for such choices when implementing the system GMM estimator. Roodman (2009) cautions that the system GMM estimate of the coefficient on the lagged dependent variable could be very sensitive to the choice of instruments.

Hahn et al. (2007) show that the usual first-order asymptotic advice of using the full set of moment conditions does not provide proper guidance in the dynamic

[20]A finite sample may have insufficient information to estimate a large instrument matrix. Also, a large set of instruments could overfit the endogenous variables.

panel data model when the autoregressive parameter is close to one. They also show that a long differencing estimator, which alleviates the problem of weak instruments and relies on a smaller than the full set of moment conditions, is much less biased than the GMM estimators. In a simulation, they show that if the true autoregressive parameter is 0.9, the system GMM estimate is only 0.664, whereas the long differencing estimator produces an estimate of 0.902 with the differencing length of $k = 5$.

Note that leverage at the end of year $t - k$ is determined by the following equation:

$$L_{it-k} = (1-\gamma)L_{it-k-1} + \gamma\alpha_i + \gamma\beta X_{it-k-1} + \tilde{\varepsilon}_{it-k}. \tag{12}$$

Subtracting equation (12) from equation (8), we obtain

$$L_{it} - L_{it-k} = (1-\gamma)(L_{it-1} - L_{it-k-1}) + \gamma\beta(X_{it-1} - X_{it-k-1}) + \tilde{\varepsilon}_{it} - \tilde{\varepsilon}_{it-k} \tag{13}$$

or

$$\Delta L_{it,t-k} = \lambda\Delta L_{it-1,t-k-1} + \delta\Delta X_{it-1,t-k-1} + \tilde{u}_{it,t-k}. \tag{14}$$

The long differencing technique estimates equation (14) with iterated two-stage least squares (2SLS) (see Appendix B for details).

In Figure 5, we show the results of simulations that demonstrate the magnitude of the bias in the estimated SOA when either i) a pooled OLS estimator ignoring firm fixed effects is used, ii) a mean differencing (or within-group) estimator is used, or iii) a long differencing estimator is used. The data-generating process is given by

$$L_{it} = (1-\gamma)L_{it-1} + \gamma \mathrm{TL}_i + \tilde{\varepsilon}_{it}, \tag{15}$$

where $L_{i0} \sim \mathrm{NORMAL}(0.25, 0.25)$, $\mathrm{TL}_i \sim \mathrm{NORMAL}(0.25, 0.25)$, and $\varepsilon_{it} \sim \mathrm{NORMAL}(0, 0.1)$. The simulations are repeated 10,000 times, each time using 1,000 firms and 10 years of data for each firm. The values plotted are the first-order autoregressive coefficients, so subtracting each from 1.0 gives the SOA. In Graph A, we do not restrict the actual level to be between 0 and 1, whereas in Graph B, we do. Inspection of the graphs shows that this restriction is relatively unimportant.

The simulations show that without fixed effects, the estimated SOA is biased downwards (since the estimated autoregressive parameter is biased upwards), and that the estimated SOA using a mean differencing estimator is biased upwards, with the bias being especially large for slow true speeds. These results corroborate Welch's (2007) findings. Consistent with Hahn et al. (2007), the long differencing estimator works well even when the autoregressive parameter is close to one.

Therefore, we implement the long differencing technique. We report the results in Table 7.[21] Using differencing lengths of $k=4$, 8, 18, and 28 years, Panel A

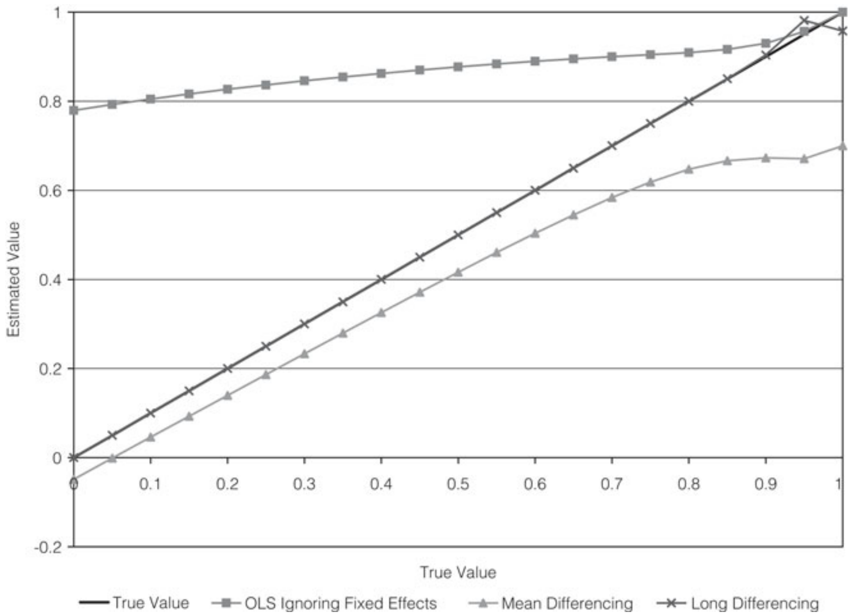
[21] In unreported analysis, we did two robustness checks. First, we tried not to include the changes in the macroeconomic variables as explanatory variables. Second, we excluded firm-year observations with major mergers and acquisitions and spin-offs. The estimates for the SOA are qualitatively the same.

FIGURE 5

The Estimated Speed of Adjustment as a Function of the True Speed

Simulations for the estimated speed of adjustment (SOA) with i) OLS and no firm fixed effects, ii) the firm fixed effects mean differencing estimator (also known as the within-group estimator), and iii) the long differencing estimator. The values plotted are the first-order autoregressive coefficients, so subtracting each from 1.0 gives the SOA. The data-generating process is given by $L_{it} = (1 - \gamma)L_{it-1} + \gamma TL_i + \tilde{\varepsilon}_{it}$, where $L_{i0} \sim NORMAL(0.25, 0.25)$, $TL_i \sim NORMAL(0.25, 0.25)$, and $\varepsilon_{it} \sim NORMAL(0, 0.1)$. L is leverage, and TL is target leverage. The simulations are repeated 10,000 times, each time using 1,000 firms and 10 years of data (k = 8) for each firm.

Graph A. Leverage < 0 or > 1 Allowed



Graph B. 0 ≤ Leverage ≤ 1

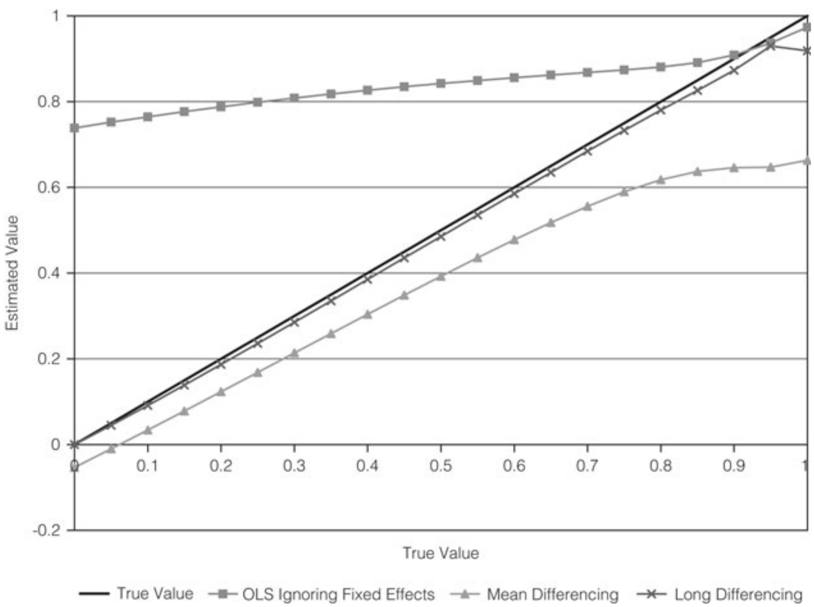


TABLE 7

Long Differencing Estimation of the Speed of Adjustment toward Target Leverage

Using the long differencing technique, we estimate the following equation (see Appendix B for details) using firms from 1969–2001:

$$L_{it} - L_{it-k} = \lambda(L_{it-1} - L_{it-k-1}) + \delta(X_{it-1} - X_{it-k-1}) + \tilde{\varepsilon}_{it} - \tilde{\varepsilon}_{it-k}$$

$$\text{or} \quad \Delta L_{it,t-k} = \lambda\Delta L_{it-1,t-k-1} + \delta\Delta X_{it-1,t-k-1} + \tilde{u}_{it,t-k}.$$

The dependent variable is the change in either book leverage or market leverage between the end of year t and the end of year $t-k$ of firm i (k = 4, 8, 18, or 28). Book leverage is defined as book debt (items 181 + 10 − 35 − 79) divided by book assets (item 6). Market leverage is defined as book debt divided by market assets (items 181 + 10 − 35 + 25 × 199). X includes lagged firm characteristics, lagged or current market conditions, and year dummies. Q is the sum of the market value of equity and the book value of debt divided by the book value of assets. R&D is the research and development expense (46) scaled by assets and is set to zero if it is missing. R&DD is a dummy variable that equals one if R&D is missing and equals zero otherwise. CAPEX is the capital expenditure (128). SALE is the log of net sales (12). OIBD is the operating income before depreciation (13). TANG is the net property, plant, and equipment (8). R&D, CAPEX, OIBD, and TANG are scaled by assets. ERP_{t-1} is the implied market equity risk premium at the end of year $t-1$. RIR_{t-1} is the nominal interest rate at the end of year $t-1$ minus inflation in year t. DSP_{t-1} is the default spread at the end of year $t-1$. TSP_{t-1} is the term spread at the end of year $t-1$. $TAXR_t$ is the statutory corporate tax rate during year t. $RGDP_t$ is the real GDP growth rate during year t. Some year dummies are dropped to avoid multicollinearity. For brevity, the coefficients on year dummies are not reported. The t-statistics use heteroskedastic consistent standard errors, further adjusted for correlation across observations of a given firm (White (1980), Rogers (1993)).

	(1) k = 4		(2) k = 8		(3) k = 18		(4) k = 28	
	Coeff.	t-Stat.	Coeff.	t-Stat.	Coeff.	t-Stat.	Coeff.	t-Stat.
Panel A. Book Leverage								
$\Delta L_{it-1,t-k-1}$	0.789	221.8	0.830	187.5	0.873	142.4	0.885	67.0
$\Delta Q_{it-1,t-k-1}$	−0.007	−8.7	−0.006	−6.8	−0.002	−1.7	−0.003	−1.5
$\Delta R\&DD_{it-1,t-k-1}$	−0.002	−1.7	−0.001	−0.7	0.000	−0.1	−0.001	−0.1
$\Delta R\&D_{it-1,t-k-1}$	−0.016	−0.7	0.013	0.5	0.053	1.3	−0.066	−0.9
$\Delta CAPEX_{it-1,t-k-1}$	0.108	11.0	0.068	6.5	0.092	4.6	0.132	4.0
$\Delta SALE_{it-1,t-k-1}$	0.001	0.7	0.001	0.8	−0.001	−0.6	−0.003	−1.7
$\Delta OIBD_{it-1,t-k-1}$	−0.130	−15.2	−0.120	−15.2	−0.110	−8.3	−0.076	−2.5
$\Delta TANG_{it-1,t-k-1}$	0.009	1.3	0.011	1.7	−0.003	−0.4	−0.021	−1.4
$\Delta ERP_{t-1,t-k-1}$	−0.055	−1.2	0.168	3.7	0.070	0.5	0.756	1.1
$\Delta RIR_{t-1,t-k-1}$	0.038	0.9	0.018	0.5	−0.019	−0.3	−0.294	−0.8
$\Delta DSP_{t-1,t-k-1}$	−0.839	−3.3	−0.780	−3.0	−0.408	−0.6	0.754	0.2
$\Delta TSP_{t-1,t-k-1}$	−0.055	−0.7	−0.323	−4.2	−0.095	−0.5	−1.347	−1.0
$\Delta TAXR_{t,t-k}$	−0.112	−1.9	−0.181	−3.1	−0.283	−0.8	0.086	0.2
$\Delta RGDP_{t,t-k}$	−0.049	−1.5	0.185	4.0	−0.022	−0.3	0.453	0.9
Year dummies	Yes		Yes		Yes		Yes	
N	61,145		38,162		11,002		2,099	
Panel B. Market Leverage								
$\Delta L_{it-1,t-k-1}$	0.777	168.7	0.768	139.7	0.828	103.8	0.844	44.8
$\Delta Q_{it-1,t-k-1}$	0.005	6.5	−0.001	−1.3	−0.003	−2.3	−0.006	−2.3
$\Delta R\&DD_{it-1,t-k-1}$	0.000	0.0	−0.002	−1.3	0.000	0.2	−0.001	−0.2
$\Delta R\&D_{it-1,t-k-1}$	−0.082	−4.4	−0.116	−5.0	−0.074	−1.5	−0.169	−1.9
$\Delta CAPEX_{it-1,t-k-1}$	0.206	17.0	0.119	9.5	0.227	9.0	0.234	5.0
$\Delta SALE_{it-1,t-k-1}$	0.026	18.0	0.020	17.2	0.008	5.6	0.002	0.7
$\Delta OIBD_{it-1,t-k-1}$	−0.131	−13.6	−0.163	−17.9	−0.126	−8.8	−0.114	−3.2
$\Delta TANG_{it-1,t-k-1}$	−0.010	−1.2	0.016	2.2	−0.015	−1.4	−0.015	−0.7
$\Delta ERP_{t-1,t-k-1}$	−0.228	−4.1	0.061	1.1	−0.097	−0.6	0.380	0.4
$\Delta RIR_{t-1,t-k-1}$	0.128	2.6	0.145	3.1	−0.154	−1.6	−1.015	−2.5
$\Delta DSP_{t-1,t-k-1}$	−2.247	−6.9	−4.593	−13.6	−4.119	−4.8	−12.376	−2.9
$\Delta TSP_{t-1,t-k-1}$	−0.246	−2.6	−0.141	−1.4	−0.254	−1.0	0.168	0.1
$\Delta TAXR_{t,t-k}$	−0.464	−6.9	−0.175	−2.6	−0.101	−0.3	−0.954	−1.4
$\Delta RGDP_{t,t-k}$	−0.376	−8.9	−0.211	−3.6	−0.447	−4.0	−0.288	−0.4
Year dummies	Yes		Yes		Yes		Yes	
N	61,145		38,162		11,002		2,099	

presents the results using book leverage. The long differencing estimator provides an estimated SOA that is much less sensitive to the time dimension than the mean differencing estimator. Depending on the differencing length, the estimated

SOA toward target book leverage varies from 11.5% to 21.1% per year. Panel B presents the results for market leverage. The estimated SOA toward target market leverage varies from 15.6% to 23.2%. In both panels, the sensitivity of the estimates to the differencing length is partly because different firms are examined. For regressions with $k = 18$ or 28, one could argue that a firm fixed effect is unlikely to be invariant for 20 or 30 years. The vast majority of firms used in regressions with $k = 8$ do not have at least 20 years of data, however, so the assumption of a time-invariant firm fixed effect should be a less important issue. With $k = 8$, the long differencing estimates of the SOA are 17.0% per year for book debt ratios and 23.2% per year for market debt ratios.

Intuitively, it seems strange that the SOA is faster with market debt ratios than with book debt ratios, given that Welch (2004) demonstrates that firms do not actively offset increases in the market value of equity caused by stock price increases. Perhaps firms whose market debt ratios precipitously increase due to a stock price decrease either see the stock price recover and remain in the sample, or drop out of the sample due to financial distress or being taken over. The resulting sample selection bias would create a bias toward estimating a high SOA.

Chang and Dasgupta (2009) and Chen and Zhao (2007) also question whether evidence of mean reversion in debt ratios is conclusive evidence of targeting a debt ratio, rather than just a manifestation of a mechanical relation if firms are financing randomly or semirandomly. The evidence in our Table 4 on the securities issuance decision, however, suggests that firms are not financing randomly. Chang and Dasgupta (2009) also show that some of the evidence in the actual data can only be replicated if their simulation samples are modified to accommodate market timing behavior.

By comparing the data in Tables 6 and 7, we can get estimates of the magnitude of the biases using OLS without fixed effects and the mean differencing method, relative to the long differencing estimates. When $k = 28$, the long differencing estimate of the SOA for book debt ratios is 11.5%, which is above the Table 6, Panel B, OLS estimate without fixed effects of 9.3% and below the mean differencing estimate of 19.7%. When $k = 28$, the long differencing estimate for market value of 15.6% is above the Table 6, Panel B, OLS estimate without fixed effects of 11.0% and below the mean differencing estimate of 24.6%. This confirms that the OLS estimates ignoring firm fixed effects understate the SOA, while the mean differencing estimates overstate the SOA.

To facilitate comparisons, estimates of the SOA in existing empirical studies of capital structure for U.S. firms are reported in Table 8. Fama and French (2002) and Kayhan and Titman (2007) use OLS ignoring firm fixed effects. As discussed earlier, these estimates are likely to be biased downwards. The other four papers control for firm fixed effects: Flannery and Rangan (2006) use the mean differencing (or within-group) estimator; Antoniou et al. (2008) and Lemmon et al. (2008) use the system GMM estimator; and this paper uses the long differencing estimator. As we discussed earlier, the mean differencing and system GMM estimates are likely to be biased upwards. Consistent with these predictions, the long differencing estimates for the SOA are much lower than the mean differencing and the system GMM estimates, and higher than the OLS ignoring firm fixed effects estimates.

TABLE 8

Estimates of the Speed of Adjustment in Empirical Studies of Capital Structure

Table 8 reports the estimated annual speed of adjustment (SOA) toward target leverage per year in existing empirical studies of capital structure. The annualized numbers from Kayhan and Titman (2007) are computed as the compounded annual speed that achieves the five-year SOA that they report in their Table 2, 41% for book leverage and 35% for market leverage (i.e., $0.90^5 = 0.59$, and $0.917^5 = 0.65$). The estimate from Antoniou et al. (2008) is for U.S. firms in their Table 5. Half-life is the number of years that the SOA implies for a firm to move halfway toward its target capital structure. NA is not available.

		Book Leverage		Market Leverage	
Article	Estimator	SOA	Half-Life	SOA	Half-Life
Fama and French (2002)	OLS ignoring firm fixed effects	10%[a] 18%[b]	6.6 years 3.5 years	7%[a] 15%[b]	9.6 years 4.3 years
Kayhan and Titman (2007)	OLS ignoring firm fixed effects	10%	6.6 years	8.3%	8.0 years
Flannery and Rangan (2006)	Firm fixed effects, mean differencing estimator with an instrumental variable	34.2%	1.7 years	35.5%	1.6 years
Antoniou, Guney, and Paudyal (2008)	Firm fixed effects, system GMM	NA	NA	32.2%	1.8 years
Lemmon, Roberts, and Zender (2008)	Firm fixed effects, system GMM	25%	2.4 years	NA	NA
This paper	Firm fixed effects, long differencing estimator	17%	3.7 years	23.2%	2.6 years

[a]Dividend-paying firms.
[b]Firms that do not pay dividends.

VI. Conclusion

The pecking order theory predicts that external equity is used as the last resort. Under the market timing theory, equity issues are not necessarily more expensive than debt issues when the equity risk premium (ERP) is low. Furthermore, firms may want to raise funds when the cost of equity is low in order to build a stockpile of internal funds. Consistent with the market timing theory, we find that firms fund a larger proportion of their financing deficit with net external equity when the expected ERP is lower.

When we estimate leverage regressions, we find that historical ERPs have long-lasting effects on leverage through their influence on securities issuance decisions, even after controlling for firm characteristics that have been identified as the most important determinants of capital structure. When a firm funds a smaller proportion of its financing deficit with debt, which occurs when the market ERP is lower, leverage is lowered for many subsequent years, with the impact gradually diminishing over time. This finding provides further support for the market timing theory.

We also reconcile the different findings on the speed of adjustment (SOA) toward target leverage in Fama and French (2002), Kayhan and Titman (2007), Flannery and Rangan (2006), Antoniou, Guney, and Paudyal (2008), and Lemmon, Roberts, and Zender (2008). Flannery and Rangan (2006), using a mean differencing estimator, and Antoniou et al. (2008) and Lemmon et al. (2008), using a system GMM estimator, find a much faster SOA toward a target capital structure than do Fama and French (2002) and Kayhan and Titman (2007), who use OLS without firm fixed effects. All three of the methods used are biased when some of the firms in the data set are present for a small number of years and when leverage is highly persistent. The quantitative extent of the biases can be large.

We reduce the biases due to a short time dimension and a highly persistent dependent variable by instead using the long differencing procedure introduced by Hahn, Hausman, and Kuersteiner (2007). They show that this estimator is much less biased than conventional GMM estimators for a dynamic panel, especially when the dependent variable is highly persistent. The application of this new technique to our data suggests that firms adjust slowly toward their target leverage. Using a differencing length of $k = 8$, we estimate an SOA of 17.0% per year for book leverage and 23.2% per year for market leverage. These numbers imply a half-life of 3.7 and 2.6 years, respectively, to remove the effect of a shock to target capital structure.

Our estimates of the SOA toward target debt ratios suggest that firms do move toward target debt ratios, although at a moderate pace. Our evidence implies that both the market timing model and the static trade-off model are important determinants of capital structure. In periods when the cost of equity is high, such as 1974–1981, firms act as if they follow a pecking order model with a strict preference for debt when external financing is needed. In periods when the cost of equity is lower, however, the pecking order model fails as a descriptive model of how firms behave.

The long differencing estimator has far-reaching implications extending beyond capital structure research. Existing empirical studies of corporate payout and investment policies using dynamic models suffer from a similar short time dimension bias. A long differencing estimation of such models would shed light on issues such as how much earnings firms pay out to shareholders, how quickly firms adjust toward a long-term target payout ratio, and why firms smooth dividends.

Appendix A. The Residual Income Model

Following Ritter and Warr (2002), we use the following model to estimate the real cost of equity for each stock in the Dow. This approach extends the basic residual income model to correct for inflation-induced distortions:

$$
\begin{aligned}
V_t \;=\; & \mathrm{ReB}_t + \frac{\dfrac{\mathrm{FEPS}_{t+1}}{(1+p_t)} + p_t D_t - \mathrm{DA}_t - r \times \mathrm{ReB}_t}{(1+r)^1} \\
& + \frac{\dfrac{\mathrm{FEPS}_{t+2}}{(1+p_{t+1})(1+p_t)} + \dfrac{p_{t+1} D_{t+1}}{(1+p_t)} - \mathrm{DA}_t - \dfrac{r \times \mathrm{ReB}_{t+1}}{(1+p_t)}}{(1+r)^2} \\
& + \frac{\dfrac{\mathrm{FEPS}_{t+3}}{(1+p_{t+2})(1+p_{t+1})(1+p_t)} + \dfrac{p_{t+2} D_{t+2}}{(1+p_{t+1})(1+p_t)} - \mathrm{DA}_t - \dfrac{r \times \mathrm{ReB}_{t+2}}{(1+p_{t+1})(1+p_t)}}{(1+r)^2 (r-g)},
\end{aligned}
$$

where

where	V_t	=	the value per share of the firm's equity at time t,
	ReB_t	=	the replacement book equity per share at time t,
	FEPS_{t+i}	=	the $t+i$ earnings per share forecast for the period ending $t+i$,
	p_t	=	the expected rate of inflation at time t,
	D_t	=	the value per share of the firm's debt at time t,
	DA_t	=	the depreciation adjustment at time t,
	r	=	the real cost of equity, and
	g	=	the real rate of growth of the economic value added (EVA).

ReB_t is book equity per share at time t adjusted for the effects of inflation on historical cost depreciation, as defined by Ritter and Warr ((2002), p. 42). We use the one-year-ahead forecast (FEPS_{t+1}) and the two-years-ahead forecast (FEPS_{t+2}) from IBES or Value Line. The three-years-ahead forecast (FEPS_{t+3}) is calculated as $\text{FEPS}_{t+2} \times$ LTG, where LTG is the LTG rate from IBES or Value Line. If LTG is missing, we compute FEPS_{t+3} as $(\text{FEPS}_{t+2})^2/\text{FEPS}_{t+1}$. We use the quarterly prediction of the next year's GDP deflator from the Survey of Professional Forecasters to compute the expected rate of inflation. Depreciation adjustment, DA_t, is computed as Depreciation Expense $\times$ $[\text{GDP}_t/(\text{GDP}_{t-n/2}) - 1]$, where GDP_t = the level of the GDP deflator at time t, and $n/2$ is an estimate of half the depreciable life of the assets. We rely on the clean surplus relation to compute future book values per share: $B_{t+1} = B_t + \text{EPS}_{t+1} - \text{DIV}_{t+1}$, where EPS_{t+1} = earnings per share at $t+1$ and DIV_{t+1} = dividend per share at $t+1$. Following Ritter and Warr (2002), we use a value of g of -10% per year, representing a decay rate of residual earnings of 10% per year (see Ritter and Warr (2002) for additional details).

We then calculate the implied equity risk premium (ERP) as the difference between the real cost of equity and the expected real rate of return, which is defined as (1 + the annualized nominal rate of return on one-month T-bills from Ibbotson Associates)/ (1 + forecasted growth rate of GDP deflator) − 1.

Appendix B. The Long Differencing Estimator

The long differencing estimator for a dynamic panel is first proposed by Hahn, Hausman, and Kuersteiner (2007) for a dynamic panel with a highly persistent data series and a short time dimension. We are interested in the estimation of the following equation:

$$L_{it} - L_{it-k} = \lambda(L_{it-1} - L_{it-k-1}) + \delta(X_{it-1} - X_{it-k-1}) + \tilde{\varepsilon}_{it} - \tilde{\varepsilon}_{it-k} \quad \text{(B-1)}$$

or

$$\Delta L_{it,t-k} = \lambda \Delta L_{it-1,t-k-1} + \delta \Delta X_{it-1,t-k-1} + \tilde{u}_{it,t-k}. \quad \text{(B-2)}$$

Hahn et al. (2007) suggest that L_{it-k-1} is a valid instrument. Using this instrument, we first estimate equation (B-2) with two-stage least squares (2SLS) and obtain the initial values of the estimated coefficients $\hat{\lambda}$ and $\hat{\delta}$. Hahn et al. (2007) suggest that the residuals $L_{it-1} - \hat{\lambda}L_{it-2} - \hat{\delta}X_{it-2}, \ldots$, and $L_{it-k} - \hat{\lambda}L_{it-k-1} - \hat{\delta}X_{it-k-1}$ are also valid instruments. We then use L_{it-k-1} and the residuals as instruments to estimate equation (B-2) with 2SLS. We call this the first iteration. We then further iterate this estimation. Hahn et al. (2007) suggest that three iterations are often sufficient. We report the results for the third iteration in Table 7.

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