The Relation Between Capital Structure and Expected Returns

by

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A Thesis submitted to the Faculty of Graduate Studies of

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ABSTRACT

A basic tenet of capital structure theory is that the firm should choose its capital structure so as to maximize the value of the firm. This thesis explores the relationship between capital structure and expected returns by way of three studies. The objective is to increase understanding of how capital structure is related to the value of the firm under changing expectations.

The first study is a theoretical paper that presents a mean-variance trade-off model of capital structure for the aggregate economy, examining capital structure in a mean-variance environment similar to the CAPM (capital asset pricing model). Whereas the standard trade-off model makes the counter-factual prediction that leverage should be positively related to expected returns, the mean-variance trade-off model shows that optimal leverage is negatively related to expected returns under conditions of leverage costs and investor portfolio choice. The intuition of this result is that average investors hold a portfolio containing both stock and bonds issued by firms, and the excess return per unit of risk rises more rapidly for unlevered equity than for levered equity with increasing expected return, inducing a shift in portfolio allocation toward lower leverage.

The second study is an empirical paper that examines the value that debt contributes to the value of the firm in the context of the book-to-market equity effect. The Kemsley and Nissim (2002) debt valuation model is used to proxy the value of debt and the capitalization rate[1], and the book-to-market equity ratio is used to proxy for expected profitability. The results show a *leverage effect* where the proportional value that debt contributes to firm value is negatively related to the book-to-market equity ratio [2]

[1] The capitalization rate is the discount rate, or cost of capital for unlevered equity.
[2] BE/ME = (book value of issued equity shares) / (market value of issued equity) .

(BE/ME), equivalent to a positive relation with expected growth prospects for cash flows (profitability); this leverage effect will influence the firm to use more debt and less equity as the BE/ME ratio decreases. There is also a concurrent *capitalization rate effect* where the capitalization rate is positively related to the BE/ME ratio, reflecting the cost of equity capital; this capitalization rate effect will influence the firm to use less debt and more equity as the BE/ME ratio decreases. These opposing forces on the leverage level of the firm explain the puzzle of the low covariance between the leverage ratio and changes in the BE/ME ratio.

The third study is an empirical analysis of the impact of market timing on capital structure for seasoned equity offerings (SEOs), using the hot-market timing measure of Alti (2006). In a sample of SEO events organized in event time, the results show that firms issuing equity in "hot markets" issue higher proportions of equity compared to their "cold-market" counterparts, but this market timing effect becomes insignificant within three years of the SEO year. This market timing effect is driven largely by "hot-market" firms with high market-to-book (M/B) asset ratios [3,4]. In a window of SEO events organized on the M/B mean-reversion cycle, the results show market timing increases with the M/B ratio, suggesting that market-timing reflects expected growth opportunities. These results are consistent with a dynamic form of the trade-off theory of capital structure.

Overall, this dissertation contributes to the existing literature on capital structure and shows that the leverage level of firms is influenced by changing expectations.

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[3] M/B = (market value of equity + book value of debt) / (book value of equity + book value of debt).

[4] The BE/ME and M/B ratios are very similar in definition and implications, but different ratios are used in studies two and three to be consistent with practice in the previous literature that motivates these studies.

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CHAPTER 1

INTRODUCTION

The fountainhead of capital structure theory is the capital structure propositions of Modigliani and Miller (1958, 1963). The seminal work of Modigliani and Miller (MM) has motivated a large body of research that seeks to understand the determinants of capital structure. Subsequent theoretical work on capital structure explores the consequences of relaxing the assumptions of perfect markets underlying the irrelevance propositions of MM (1958); Modigliani and Miller (1963) adds corporate taxes, Miller (1977) adds personal taxes, DeAngelo and Masulis (1981) adds alternative tax shields such as depreciation, and Dammon and Senbet (1988) add the effect of technology on tax shields. Other models look at the implications of the characteristics of debt, such as term structure. These models are consistent with the trade-off theory, which says that the optimal capital structure of the firm occurs at the point where the marginal benefits of debt equal the marginal costs. Competing alternative explanations include the adverse selection model of Meyers and Majluf (1984) that implies market timing because firms will issue more equity when information asymmetry between management and investors is low, and the related pecking order model of Meyers (1984) where asymmetric information costs cause the firm to prefer to finance investments first by retained earnings, then by debt, and finally by equity.

Early empirical studies relax the assumptions of MM to test the prediction that the tax shield benefits of debt will favour the use of debt over equity financing. Such studies use various forms of debt-to-equity ratios to test whether non-debt tax shields, such as amortization or investment tax credits, substitute for the debt tax shield. Examples of such studies include Bradley, Jarrell, and Kim (1984), and Titman and Wessels (1988), but these do not find significant effects. However, later studies examine incremental financing decisions and find evidence that issue of debt is positively related to high marginal tax rates. Examples of such studies include MacKie-Mason (1990), Trezevant (1992), and Graham (1996, 1999). More recently, research seeks to apply competing theories to empirical evidence; for example, testing the abilities of the trade-off theory versus the pecking order theory to explain observed variations in capital structure, as in Fama and French (2002). Most recently, a body of empirical research has emerged that examines the relationship between leverage and stock returns, such as Welch (2004) or Kayhan and Titman (2007).

This thesis contributes three studies to the extant capital structure literature, exploring the relationship between capital structure and expected returns. The first study extends the traditional trade-off model of capital structure into a mean-variance environment similar to CAPM, providing a theoretical model of the relation between leverage and expected return. The second study is an empirical test of how the value that debt contributes to firm value changes with the book-to-market equity ratio[1] (BE/ME), interpreting the BE/ME ratio to proxy for changing expectations of profitability or returns. The third study is an empirical test of the persistence of market timing effects for seasoned equity offerings (SEOs), using the *a posteriori* behavior of the leverage ratio following the SEO to examine the predictions of competing models of capital structure,

[1] The book-to-market equity ratio (BE/ME) is defined as the book value of equity divided by the market value of equity. The book-to-market equity ratio is commonly used in asset pricing research to proxy for expected growth or expected profitability.

and interpreting the market-to-book asset ratio[2,3] (M/B) to proxy for expected growth of profitability. These three studies present different, but related, perspectives of how changing expectations impact capital structure.

Chapter 2 derives a mean-variance form of the trade-off model, with analysis of the model to show the relation between leverage and changes in expected equity return, equity return volatility, and the bond rate. Modelling in the mean-variance plane removes several major restrictions of the traditional static trade-off model. The traditional model does not include an explicit representation of leverage costs, and is interpreted from the perspective of cash flows to the firm. In contrast, the mean-variance form incorporates leverage costs and investor portfolio choice. This mean-variance trade-off model connects the capital structure models of Modigliani and Miller (1958, 1963) and Miller (1977) with the CAPM (capital asset pricing model) of asset pricing theory; the resulting model incorporates personal and corporate taxes, leverage costs, and shows both levered and unlevered expected equity returns. This mean-variance trade-off model bridges capital structure and asset pricing theories to model the relationship between expected returns and the optimal leverage level.

The standard trade-off model of capital structure has major limitations, because neither leverage costs nor risk are explicitly modelled. The standard trade-off model makes some counter-factual predictions; for instance, the standard model implies

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[2] The market-to-book asset ratio (M/B) is defined as the book value of debt plus the market value of equity divided by the book value of debt plus the book value of equity. The M/B ratio is commonly used in corporate finance research to proxy for expected growth or expected profitability.

[3] The BE/ME and M/B ratios are closely connected and usually produce similar results when used as a proxy for expected growth or profitability. Chapter three uses the BE/ME ratio while Chapter 4 uses the M/B ratio in order to be consistent with the prior literature in asset pricing and corporate finance that is most closely connected to the respective chapters.

that leverage should be positively related to profitability whereas the observed relationship is negative. This chapter asks how the predictions of the trade-off model change when representing the trade-off model in the mean-variance plane similar to the CAPM. The mean-variance model is analyzed to explore the relationships between leverage and expected returns and volatility, to show the predictions of the trade-off model under conditions of leverage costs and portfolio choice. This mean-variance trade-off model extends both the capital structure and asset pricing literature.

Chapter 3 is an empirical examination of the value of debt using the Kemsley and Nissim (2002) debt valuation model to proxy for the value of debt and the capitalization rate (cost of capital). Capital structure theory, such as the trade-off model, postulates that firms utilize debt capital for financing because it provides net increases to the value of the firm, but actual empirical evidence on this subject is quite sparse. When an empirical regression model is tested with firm value or some proxy as the dependent variable on the left-hand side and an explanatory leverage variable on the right-hand side, the regression coefficient for the leverage variable is negative rather than the postulated positive. An example of this is Fama and French (2002), who suggest that such a negative coefficient is likely the result of measurement error. It is not until Kemsley and Nissim (2002) that a regression model is developed that addresses the econometric issues to show a positive value for debt in a direct regression with clear and unequivocal results. So it is only recently that an empirical model is available that allows measurement of the value that debt adds to firm value.

This chapter examines the empirical question of how the observed value of debt and the capitalization rate change with a changing book-to market equity ratio (BE/ME), using the BE/ME ratio as a proxy for expected profitability. Theory suggests that expected profitability and the capitalization rate will have opposing effects on the optimal leverage choice of the firm. For on the one hand, increased profitability implies that the firm should increase its leverage level by using more debt and less equity capital in order to make use of tax shield opportunities. On the on the other hand, a decreasing capitalization rate implies a lower cost of unlevered equity and so the firm should decrease its leverage by using more equity and less debt capital to obtain the benefits of low cost capital. *A priori*, it is not clear how these effects are connected to expected profitability or to firm value – this is an empirical question. This chapter extends the literature by testing the empirical relationships between observed BE/ME levels and the value of debt and the capitalization rate.

Chapter 4 is an empirical analysis of the impact of market timing on capital structure in a dataset of seasoned equity offerings (SEOs), using a hot-market timing measure similar to Alti (2006), and using the market-to-book ratio (M/B) as a proxy for expected growth. Competing theories of capital structure make different predictions about the *a posteriori* behavior of the leverage ratio following the SEO issue. The trade-off theory predicts that the observed leverage ratio should smoothly return to the prior level in response to equilibrium forces; the pecking order theory predicts that the leverage level should remain unchanged if investment level is unchanged; and the transaction cost theory predicts that the leverage level should change slowly in a step-wise fashion to reflect high fixed costs of issuing capital. More recently, Baker and Wurlgler (2002) present an empirical model that suggests that observed capital structure is no more than the accumulated result of past decisions, with no return to an equilibrium level. If true, the Baker and Wurgler model would obviate the standard trade-off model of capital structure equilibrium, making the traditional determinants of capital structure meaningless. Capital structure has been intensely studied in the 50 years since the seminal work of Modigliani and Miller (1958, 1963), but the relative influence of the competing models of capital structure is still not resolved – much work remains to be done. Alti (2006) uses IPO data to examine the *a posteriori* behavior of the leverage ratio following the IPO issue; the results of Alti generally support a dynamic form of the trade-off model, but Alti (2006) also shows the Baker and Wurgler (2002) model to be strongly significant, so the Alti results are ambiguous.

This chapter examines a sample of SEO issues, rather than IPO data as in Alti (2006), because SEO data represents the long-term equilibrium for ongoing firms rather than the one-time circumstances of IPO issues. The *a posteriori* behavior of the leverage ratio following the SEO issue is examined to compare the predictions of competing models of capital structure for the ongoing firm. The data is also sorted by the market-to-book (M/B) ratio, using the M/B ratio as a proxy for expected growth in profitability, to examine the relationship between market timing and changes in expected growth. These empirical tests extend the literature on market timing and capital structure.

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CHAPTER 2

THE NEGATIVE RELATIONSHIP BETWEEN LEVERAGE AND PROFITABILITY: A MEAN-VARIANCE TRADE-OFF MODEL

2.1 Introduction

The trade-off model is generally accepted to be the fundamental theory of capital structure, yet one of the main predictions of the standard trade-off model contradicts observed empirical evidence. The standard trade-off model, sometimes called the static trade-off model, predicts that leverage should be positively related to profitability because firms can benefit from the tax shield of increased leverage; however, a large body of empirical studies shows the observed relationship between profitability[1] and leverage[2] to be negative. Fama and French (2002) describe this contradiction between this prediction and observed behavior as "the important failure of the trade-off model".

Competing models of capital structure such as the pecking order theory [Meyers (1984)] or the market timing theory offer asymmetric information arguments [Meyers and Majluf (1984)] to explain the observed negative relationship between leverage and profitability. Asymmetric information between firm management and investors implies adverse selection for capital issues; firms will tend to issue equity when management

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[1] Expected return is taken to be expected earnings per unit of equity, which is equivalent to profitability. This treatment of returns and profitability is consistent with the capital structure literature emanating from the seminal work of Modigliani and Miller (1958, 1963). .

[2] In this paper, leverage is defined as the ratio of debt to equity, B / S, where B is debt (bonds) and S is equity (stocks). An alternate definition of leverage could be the ratio of debt to equity plus debt, $B/(B+S)$. These two definitions of leverage are monotonic transforms of one another, $B/(B+S) = 1/[1+1/(B/S)]$, but the ratio of debt to equity is used in keeping with previous literature.

considers it to be over-valued, so investors compensate by increasing the required rate of return for new capital issues. Under the pecking order theory, firms prefer to raise capital by first using available retained earnings from profits, then issuing debt, and finally issuing equity, thereby minimizing the costs of asymmetric information. More profitable firms require less external capital and so the accumulation of retained earnings will tend to reduce their leverage level. Under the market timing theory, firms will issue more equity when stock prices are relatively high and the cost of equity is low. Since increased profitability tends to lead to higher market valuations, this results in higher equity issuance and therefore lower leverage levels for more profitable firms[3].

The importance of modeling the relationship between profitability and leverage cannot be overstated; for if asymmetric information models such as the pecking order and market timing theories are true, then firms do not have an optimal target leverage level as implied by the trade-off theory, suggesting a minimal role for the traditional determinants of capital structure. The need to extend the trade-off theory to explain the negative relationship between profitability and leverage is especially important in examining the determinants of long-term leverage levels.

The capital structure literature emanating from the seminal work of Modigliani and Miller (1958, 1963) defines expected equity return to be the expected earnings cash flow per unit of equity. These expected earnings cash flows to be received for invested equity capital create the intrinsic value that determines asset pricing and returns[4]. Higher expected returns are required for higher leverage as compensation for the higher volatility

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[3] This market timing effect augments the direct market valuation effect, as rising market valuation depresses leverage levels even in the absence of market timing.
[4] A competing view is that market pricing and return is determined primarily by a varying discount factor that reflects changing market risk. Ultimately, resolution of this longstanding debate is an empirical question.

(risk) of expected earnings cash flows. This paper extends the classical literature by modelling the risk-return trade-off for leverage in a mean-variance environment similar to the CAPM (capital asset pricing model), so that optimal leverage is an endogenous variable which is a function of both expected returns and the volatility (risk) of returns.

This paper contributes to the understanding of capital structure in two ways. First, it shows that the trade-off model predicts a negative relationship between profitability and leverage when modeled in a mean-variance setting. Second, whereas most research on capital structure is presented from the perspective of the firm, this paper examines optimal capital structure from the viewpoint of investors in the aggregate economy. The results are derived by applying comparative static analysis to the mean-variance model of capital structure shown in Kim (1982).

The mean-variance model of Kim (1982) can be thought of as the CAPM with the addition of leverage costs and personal taxation. Kim (1982) provides the foundation for a coherent theoretical model connecting capital structure and expected return (equivalent to profitability). Kim (1982) extends the capital structure model of Miller (1977) to the mean-variance environment and adds leverage costs. However, the limitation of Kim (1982) is that it is essentially a graphical model without a mathematical representation. Using the framework of Kim (1982) under the standard assumption that leverage costs are exponentially increasing in leverage[5], this paper presents a mathematical form for Kim (1982) and conducts a comparative static analysis of how optimal leverage changes

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[5] Leverage cost = $\sum_{i=0}^{N} a_i \cdot L^i$, and a_i is a polynomial coefficient and L is the leverage ratio with $L = \in [0, \infty]$.

in response to variation in expected equity return, volatility, and the corporate bond rate.

The mean-variance trade-off model of capital structure demonstrates three fundamental characteristics of leverage:

1. $\frac{dl}{dR} < 0, \frac{dl}{dR^L} < 0$ Optimal leverage is negatively related to expected unlevered and levered returns.
2. $\frac{dl}{d\sigma} < 0, \frac{dl}{d\sigma^L} < 0$ Optimal leverage is negatively related to unlevered and levered volatility.
3. $\frac{dl}{dr} > 0$ Optimal leverage is positively related to the expected corporate bond rate.

The intuition of these results is straight forward. In the mean-variance model of capital structure, investors' portfolios hold both the debt and equity issued by firms, and investors will shift their portfolio holdings toward the more attractive asset. In the mean-variance plane, the investor Sharpe ratio[6] of levered equity is always greater than that of unlevered equity but when expected equity return increases then, ceteris paribus, the Sharpe ratio of unlevered equity increases at a faster rate than for levered equity. Consequently, unlevered equity becomes increasingly attractive relative to levered equity as expected equity return increases, inducing investors to shift their portfolio allocation toward lower leverage.

Similarly, when volatility increases, then ceteris paribus, the investor Sharpe ratio of unlevered equity declines more slowly than for levered equity, inducing a shift toward

[6] $Sharpe\ Ratio = \frac{E[R] - R_f}{\sigma}$
where $E[R]$ is expected return, R_f is the risk free rate, and σ is volatility.

lower leverage. In financial markets, returns and volatility tend to covary in the same direction, so a change in expected return exerts a powerful force on the optimum / equilibrium leverage level. And finally, when the expected corporate bond rate increases, then ceteris paribus, it is the investor Sharpe ratio of levered equity that then increases faster than for unlevered equity, inducing a shift toward higher leverage.

Prior literature examines capital structure from the perspective of expected cash flows to the firm, viewing the interests of stockholders and bondholders as being separate or even opposing. This perspective of opposing interests is reflected in such models as the agency cost model of capital structure [Jensen and Meckling (1976)], or the pecking order theory [Donaldson (1961), Meyers (1984)]. Considering capital structure from the firm perspective has led to the widely held view that the negative relationship between leverage and return on assets is a failure of the trade-off model because the standard trade-off model implies that the firm should increase its debt ratio as long as the tax shield for debt increases the firm's expected cash flows [e.g. Fama and French (2002)]. But the mean-variance trade-off model recognizes that the investors in the aggregate economy hold both debt and equity issued by firms, and so the decision of the aggregate optimal debt ratio is a function of the expected returns of both debt and equity.

Whereas the perspective of the firm views the leverage trade-off decision to be between the expected tax shield cash flows to the firm and the expected financial distress costs, the mean-variance perspective is that the optimal aggregate leverage level is selected by investors to maximize portfolio excess return on investment per unit of risk. When the trade-off model is recast in the mean-variance environment, the negative relationship between leverage and equity returns is not a failure of the trade-off theory;

rather, it is simply the optimal result for risk averse investors who hold the corporate bonds and levered stocks that comprise the capital of the aggregate economy. Furthermore, the mean-variance trade-off model shows that firms' cost of capital is lowered by the change in leverage that is optimal for investors, meaning that the interests of investors and firms are aligned.

In summary, the theoretical results of this paper show that the trade-off model correctly predicts the observed negative relationship between profitability and leverage when the model is set in the mean-variance environment. These results support a modified form of the trade-off model, where target leverage may vary with expectations.

The remainder of the paper is organized as follows. Section 2.2 provides an overview of prior research on capital structure. Section 2.3 derives the relationship between leverage and expected returns, volatility, and bond rate in the mean-variance environment. Section 2.4 discusses tax clientele effects. Section 2.5 concludes.

2.2 Overview of Prior Research

2.2.1 Theory

The trade-off model is generally accepted as the fundamental theory of capital structure, predicting an optimal leverage level in equilibrium where the marginal benefits of debt equal the marginal costs of debt. The most prominent version of the trade-off model is the tax shield model emanating from the seminal work of Modigliani and Miller (1958, 1963), but there are other versions such as the agency cost model of Jensen and

Meckling (1976). All standard versions of the trade-off model make similar predictions with respect to the relationship between leverage and the determinants of leverage.

This paper focuses upon the tax shield form of the trade-off model, which is commonly called the static trade-off model or often just the trade-off model. This model emanates from the results of Modigliani and Miller (1963), which presents the famous MM Propositions I and II with corporate taxes[7]:

$$\text{I.} \qquad \begin{aligned} V_L &= \frac{EBIT \times (1 - T_c)}{r_0} + \frac{T_c r_B B}{r_B} \\ &= V_U + T_c B \end{aligned}$$

$$\text{II.} \qquad r_S = r_0 + \frac{B}{S} \times (1 - T_c) \times (r_0 - r_B)$$

where V_L and V_U are the levered and unlevered value of the firm, $EBIT$ is earnings before interest and taxes, T_c is the corporate tax rate, r_B, r_0, and r_S are the risk-free bond rate, expected return rate on unlevered equity, and expected return rate on levered equity, respectively, and B and S are the value of debt (bonds) and equity (stock). The expected rates of return (r_B, r_0, and r_S) are for a given class of risk. In the absence of default risk, Proposition II indicates that expected levered returns are positively related to leverage.

The basic form of the static trade-off model is obtained by subtracting financial distress costs from MM Proposition I:

$$\begin{aligned} V_L &= \frac{EBIT \times (1 - T_c)}{r_0} + \frac{T_c r_B B}{r_B} - PV(\mathit{financial\ distress}) \\ &= V_U + T_c B - PV(\mathit{financial\ disress}) \end{aligned}$$

[7] See Ross, Westerfield, Jaffe and Roberts (2005) for detailed discussion of the MM propositions

Here, the present value of financial distress is subtracted from the no-default value of the levered firm. This equation illustrates the standard interpretation of the trade-off model that leverage should be positively related to profitability, since increased profitability in the form of higher $EBIT$ per unit of unlevered equity should reduce the present value of financial distress and allow the firm to carry more debt to increase the tax shield benefits and therefore increase the optimal leverage level. The static trade-off model is illustrated in the figure below:

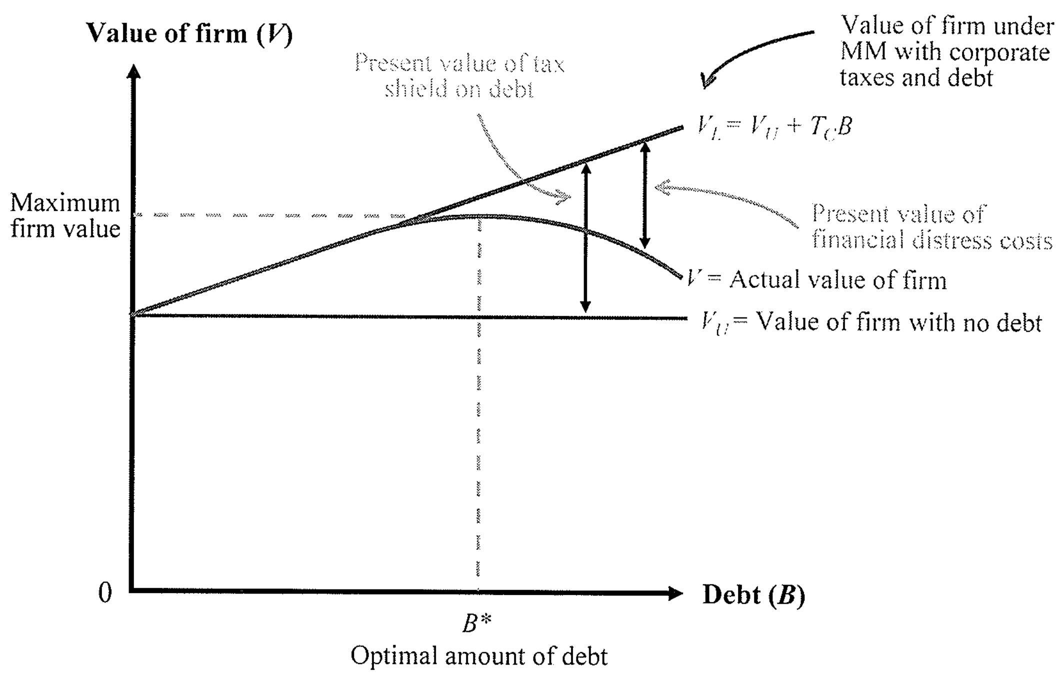

Figure 2.1. Static Trade-off Model[8].

This figure shows that the optimal leverage level occurs where the marginal benefits of debt equal the marginal costs.

[8] This figure is reproduced from "Corporate Finance", by Ross, Westerfield, Jordan, and Roberts (2005), with permission from the publisher, MrGraw-Hill Ryerson.

Miller (1977) extends the MM model by adding personal taxes for equity and debt, resulting in a less restricted form of the MM Propositions[9]:

$$\text{III.} \quad V_L = \frac{EBIT \times (1-T_c) \times (1-T_{ps})}{r_0 \times (1-T_{ps})} + \frac{r_B B \times (1-T_{pb})}{r_B \times (1-T_{pb})} \times \left[1 - \frac{(1-T_c)\times(1-T_{ps})}{1-T_{pb}}\right]$$
$$= V_U + \left[1 - \frac{(1-T_c)\times(1-T_{ps})}{1-T_{pb}}\right] \times B$$

$$\text{IV.} \quad r_S = r_0 + \frac{B}{S} \times \left[\frac{(1-T_c)\times(1-T_{ps})}{1-T_{pb}}\right] \times (r_0 - r_B)$$

where T_{ps} is the personal tax rate on equity returns (capital gains and dividends) and T_{pb} is the personal tax rate on interest income from corporate bonds. Whereas Modigliani and Miller (1963) implies 100% debt for the capital structure of the firm because debt always adds positive value, Miller (1977) shows that debt may add either positive or negative value to the firm, depending upon the relative values for corporate and personal taxes. If distress costs are added to the Miller model, as shown above for the MM model, then Miller (1977) also implies a positive relationship between profitability and leverage for the range of tax rates that give a positive value for the tax shield from debt.

The most important contribution of Miller (1977) is that it implies a target leverage level below 100% for the aggregate economy, at the leverage level where the after-tax value of cash flows to shareholders is equal to the after-tax cash flows to bondholders [i.e. $(1-T_c)\times(1-T_{ps}) = (1-T_{pb})$]. This target leverage level is a function of supply of debt by firms and demand for debt by tax clientele. However, the model implies that investors with a tax rate on bond income below the equilibrium value will choose to invest only in bonds,

[9] See Ross, Westerfield, Jaffe and Roberts (2005) for detailed discussion of the Miller (1977) model

while those with a higher tax rate on bond income will invest only in stocks. This implication is problematic because empirical evidence shows that most investors concurrently hold both bonds and stocks in their investment portfolios irrespective of their personal tax rates[10].

Early models of capital structure make many simplifying assumptions to produce a tractable mathematical form that typically examines cash flows to the firm without leverage costs [e.g. Modigliani and Miller (1963), Miller (1977)]. Later models of capital structure introduce stochastic costs of bankruptcy and other costs of financial distress to show that a firm's optimal leverage will occur at less than 100% of debt capacity [e.g. Kim (1978), Bradley, Jarrell and Kim (1984), Raymar (1991)]. In such models, the value of the firm is maximized, and the value of the firm is the expected present value of equity plus the expected present value of debt. In these models, expected cash flows are treated as expected returns, continuing to imply that optimal leverage is positively related to profitability. Other researchers such as DeAngelo and Masulis (1980) and Dammon and Senbet (1988) use state pricing models to show that alternate tax shields such as depreciation and investment tax credits decrease the marginal tax benefit of debt, and therefore reduce optimal leverage to below 100%. These later models provide valuable insights by relaxing the restrictions of Modigliani and Miller (1963) and Miller (1977), but they do not resolve the important question of the observed negative relationship between profitability and leverage.

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[10] Iindividual investors will not all hold bonds (issued debt) and equity from the same firms but, in aggregate, they will hold all of the securities issued by firms. Furthermore, investors may hold government bonds as well as corporate bonds. However, Miller (1977) argues that tax clientele groups among investors will hold specific securities to reflect personal tax rates, and that individual firms will pay different bond rates to reflect firm risk and have different leverage levels to reflect tax clientele, but that such clientele effects are consistent with an aggregate optimal leverage level because arbitrage forces will move the market toward such an equilibrium.

This paper pursues the relationship between profitability and leverage by analyzing the mean-variance model of Kim (1982). Kim (1982) extends the static model of Miller (1977) to show that the addition of leverage costs, L, reduces the optimal level of leverage from B^0 in Miller (1977) to a lower value of B^*, as shown below:

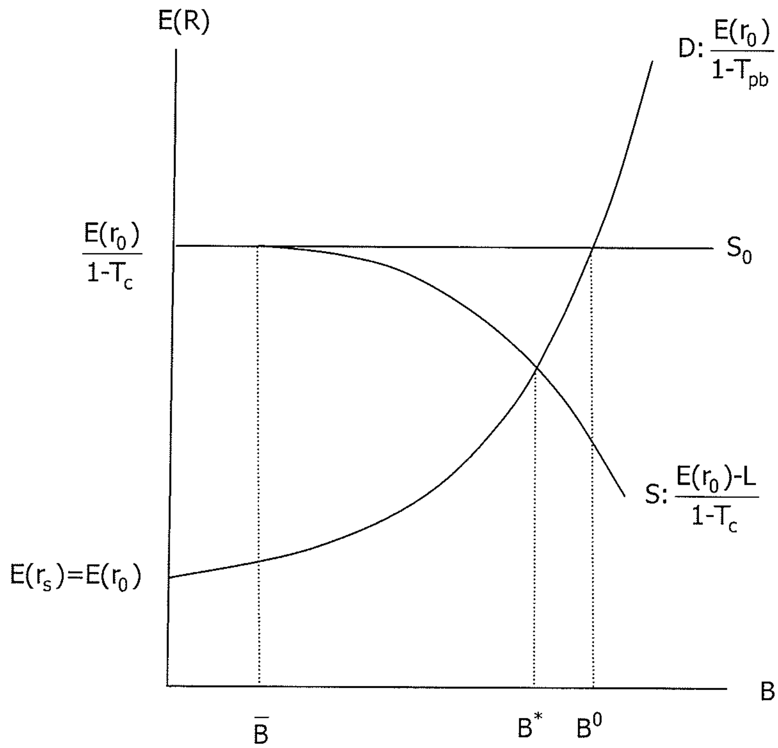

Figure 2.2. Equilibrium Leverage for Miller (1977) versus Kim (1982)[11].

This figure shows that leverage costs are paid out of the surplus returns to bondholders, and that leverage costs reduce the optimal leverage level.

In this figure, Miller (1977) makes the simplifying assumption that the tax rate for equity is zero ($T_{ps} = 0$), so that equilibrium leverage B^0 occurs when $1-T_c = 1-T_{pb}$

[11] This figure is reproduced from Kim (1982), with permission from the publisher, Blackwell Publishing.

(rather then when $(1-T_c)(1-T_{ps}) = 1-T_{pb}$ as shown above for the full model). The Miller (1977) model assumes no-default and perpetual cash flows, implying that all bonds are riskless. In Miller (1977), the firm will not pay a higher interest rate for debt than the tax-free riskless bond rate adjusted for the corporate tax shield. At this point the tax-adjusted cost of debt, $D = E(r_0)/(1-T_{pb})$, equals the tax-adjusted cost of unlevered equity, $S_0 = E(r_0)/(1-T_c)$. Kim (1982) adds leverage costs for the firm's debt, L, so the value that the firm is willing to pay for debt declines to $S = (E(r_0)-L)/(1-T_c)$; this decline erodes the economic surplus received by bondholders and thereby assigns the leverage costs to bondholders, with optimal leverage decreasing from B^0 to B^*.

Kim (1982) then represents Miller (1977) with leverage costs in a mean-variance setting similar to the CAPM, thereby adding both risk aversion and leverage costs to Miller (1977) as shown below. This figure depicts the minimum-variance boundary for unlevered firms, with the no short-selling condition of Miller (1977) and Black (1972). Whereas the conventional minimum variance boundary of the CAPM is comprised of stocks which may be levered or unlevered, the boundary in Kim (1982) consists only of unlevered firms. Only unlevered firms form the minimum-variance boundary because this reflects MM Proposition II, which defines levered returns (straight line L) as a function of unlevered return (point M) and the leverage ratio in the equation $r_S = r_0 + B/S \times (1-T_c) \times (r_0 - r_B)$.

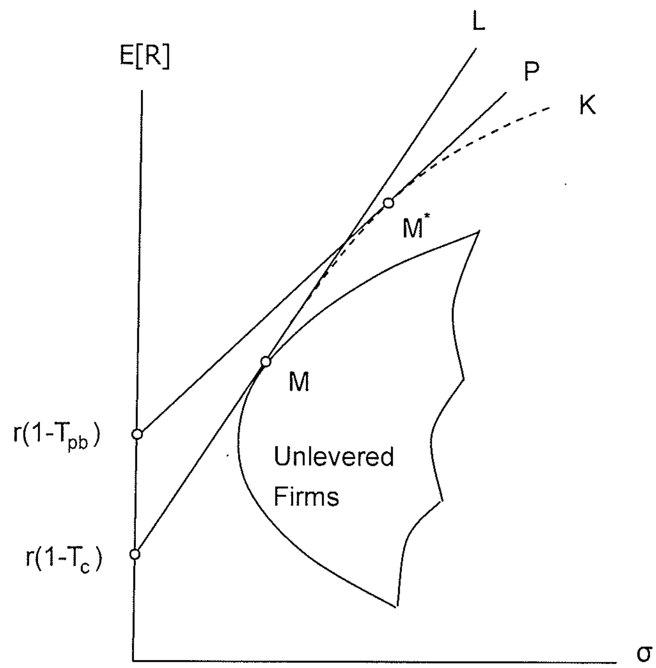

Figure 2.3. The Kim (1982) Mean-Variance Model of Capital Structure[12]. This figure shows that investors will hold a portfolio containing both bonds and levered equity, and that optimal leverage is less than 100%.

Kim (1982) individually discusses the three possibilities where the personal tax rate on bond interest may be less than or equal to or greater than the corporate tax rate, $T_{pb} < T_c$ or $T_{pb} = T_c$ or $T_{pb} > T_c$, in order to explore the issue of tax clientele. However, this paper focuses on the single case where $T_{pb} < T_c$ for the representative investor in the aggregate economy because this represents the observed situation of positive overall leverage for firms in the aggregate economy[13]. Furthermore, the simplifying assumption

[12] This figure is reproduced from Kim (1982) with permission of the publisher, Blackwell Publishing.
[13] Kemsley and Nissim (2002) estimate the personal tax rate of investors through a regression model that estimates the value that debt contributes to share price, and find it to be statistically insignificant from zero. Other empirical research also finds that investors tend to behave as if their personal tax rate was low; for

is made that personal and corporate tax rates, T_{pb} and T_c, are constants. In a later section, after presenting the comparative static results for the relations between leverage and return / profitability, volatility and bond rate, the issue of tax clientele implications for the situation where T_{pb} and T_c are not constants will be discussed.

With a riskless after-tax interest rate of $r(1-T_c)$ for firms, the tangent portfolio M represents the condition of 100% equity without lending or borrowing debt in the aggregate economy. In the absence of leverage costs, firms' leverage choices lie on the straight line L, with firms being net savers and lenders to the left of M and net borrowers of debt to the right. In other words, to the right of M, firms are leveraged in the aggregate economy.

The representative investor can borrow or lend at the after-tax interest rate $r(1-T_{pb})$, where T_{pb} is the average personal tax rate on interest income from corporate bonds in the aggregate economy. Investors hold portfolios containing a combination of corporate bonds and equity issued by firms in this aggregate economy. The investors' portfolio choices are represented by the efficient set line P, sometimes also called the capital market line.

In the mean-variance plane, the equilibrium market portfolio occurs at the tangent point between the investors efficient set line, P, and the investment opportunity set line. In the absence of leverage costs, the investment opportunity set is the straight line L. Since P and L are both straight lines, tangency can only occur between lines P and L at infinity, implying 100% leverage in the absence of leverage costs. The implication of

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example, the market prices are usually identical for dual class shares where one class issues a cash dividend and the other issues a share dividend. Thus, the assumptions of $T_{pb} < T_c$ and $T_{ps} = 0$ seem reasonable.

100% leverage with no leverage costs is consistent with the MM (1963) result with corporate taxes but no bankruptcy.

However, with the addition of leverage costs, the investment opportunity set becomes the curved line, K. A fundamental characteristic of the trade-off model is that the probability of eventual bankruptcy increases to certainty at 100% leverage. The trade-off model holds that the optimal leverage level will occur at the point where marginal benefits equal marginal costs, which must therefore occur at a point below 100% leverage. Figure 2.3 illustrates that this result holds true in the mean-variance framework with exponentially increasing leverage costs, where optimal leverage occurs at market portfolio M^*.

In contrast to the model of Miller (1977), the mean-variance model of Kim (1982) shows that the personal tax rate, T_{pb}, need not be equal to the corporate tax rate, T_c, to achieve a viable equilibrium. Equilibrium occurs at tangent point between the investors efficient set line, P, and the investment opportunity set line, K. The tangent portfolio is M^*, which indicates that equilibrium occurs with an investment portfolio that contains positive aggregate corporate borrowing (positive leverage).

The mean-variance model of capital structure is fundamentally different from its antecedents in three ways: first, the model incorporates risk aversion; second, it views the leverage decision from the perspective of investors' portfolio choice; third, there is a finite wealth endowment (finite demand). However, the limitation of the mean-variance model of capital structure presented in Kim (1982) is that it is essentially a graphical model. It is not obvious from visual inspection of Figure 2.3 above whether the relationship between optimal leverage and expected equity returns is positive or negative in the mean-variance plane. Hence, Kim (1982) does not provide an answer to the question of why more profitable firms use less leverage.

Competing models of capital structure such as the pecking order theory [Meyers (1984)] or the market timing theory offer asymmetric information arguments [Meyers and Majluf (1984)] to explain the observed negative relationship between returns and leverage. Asymmetric information between firm management and investors implies the potential for adverse selection for capital issues; managers are more likely to issue stock when investors are overvaluing the share price relative to its true (fundamental) value, and so investors will compensate by increasing the required rate of return by way of a lower share price for new equity issues.. Under the pecking order theory, firms prefer to raise capital by first using available retained earnings from profits, then issuing debt, and finally issuing equity, thereby minimizing the costs of asymmetric information. More profitable firms require less external capital and so the accumulation of retained earnings will tend to reduce leverage. Under market timing theory, the firm will issue more equity at times when information asymmetry between the firm and investors is low and so the costs of information asymmetry are low, as reflected in a relatively high stock price that offers the firm a low cost of capital. Since increased profitability tends to lead to higher market valuations, this results in higher equity issuance by way of market timing and therefore lower leverage levels for more profitable firms.

2.2.2 Empirical

The static trade-off model implies that firms will have a target leverage level. This prediction is generally supported by studies that examine adjustments of capital structure around a long-run optimum, such as Hovakiam, Opler, and Titman (2001), or Kayhan and Titman (2007) among others, though firms with leverage deficits (from the target value) move slowly toward the target. However, another fundamental implication of the static trade-off theory is that profitability should be positively related to leverage. But a large body of empirical studies that examine the determinants of leverage, such as Titman and Wessels (1988) or Rajan and Zingales (1995), find the relationship to be negative.

The most prevalent explanation for the negative relationship between profitability and leverage is the pecking order theory [Donaldson (1961), Meyers (1984)] of financing preferences. The pecking order theory uses adverse selection arguments based upon information asymmetry to imply that internally generated equity is less costly than equity capital that is raised externally. Fama and French (2002) test the empirical determinants of leverage against the predictions of both the trade-off model and the pecking order model, generally confirming the predictions of the trade-off model, with the notable exception of profitability. Fama and French (2002) identify the negative relationship between leverage and profitability as the "one scar on the trade-off model".

An alternate explanation for the negative relationship between profitability and leverage is tax effects due to personal taxation of bond interest. However, empirical tests of personal tax effects on capital structure, such as Kemsley and Nissim (2002), find such personal tax effects to be small or insignificant.

2.3 Comparative Statics of the Mean-Variance Trade-off Model

This section determines the relationships between optimal capital structure and changing expectations of returns and risk in the mean-variance setting of Kim (1982). The method of comparative statics analysis is used to solve for the relationship between optimal leverage and expectations of return and volatility. Most of economic theory is derived from comparative statics analysis. Comparative statics is the determination of the changes in endogenous variables of a model that result from changes in the exogenous variables or parameters in the model. In this analysis, the exogenous variables are the expected equity return, volatility of equity return, and the expected riskless corporate bond rate. In addition, the simplifying assumption is made that the corporate and personal tax rates are constant.

The Kim (1982) mean-variance model of capital structure translates the Miller (1977) capital structure model into the mean-variance plane, and Kim (1982) may loosely be thought of as the CAPM with the addition of leverage costs and taxes. The investors' efficient set line, P, in the mean-variance model is similar to the capital market line of the CAPM. In the CAPM, idiosyncratic leverage costs are eliminated by diversification, and the remaining systematic leverage costs are embedded out of sight in overall stock returns. But the mean-variance model of Kim (1982) explicitly shows systematic leverage costs, thereby providing the foundation for a coherent theoretical model connecting capital structure and asset pricing. Examining capital structure in a mean-variance framework with systematic leverage costs provides insight into the implications of changes of expected returns, interest rates, and volatility of returns upon optimal capital structure.

In the mean-variance environment with tax clientele, Kim (1982) shows that it is a feasible equilibrium for investors to hold both bonds and levered equity at the same time. This theoretical result is consistent with the fact that individual investors indirectly hold both securities through purchases of mutual funds, and the empirical evidence of Wolf (2000), who analyzes data to show that households concurrently hold both bonds and stocks. Furthermore, Wolf (2000) shows that the holdings of investments are concentrated within the population, with approximately 10% of households holding 80% of all investments in bonds and stocks, and that this concentration of ownership has changed little over time. This stable concentration of wealth implies that changes in expected returns result in shifts in valuation and holdings of bonds and stocks within this group of households to achieve the optimum level of leverage.

2.3.1 Objective Function of the Investor and the Consequence for the Firm

This section sets out the objective function of the investor and the consequence for the firm's cost of capital in this model. The terms "investor"and "firm" denote representative agents in the aggregate economy. The investor's return on investment and the firm's cost of capital are represented by their respective Sharpe ratios[14]:

$$S = \frac{R - r(1 - T_p)}{\sigma}$$ Levered shareholder's return on investment.

$$F = \frac{R - r(1 - T_c)}{\sigma}$$ Firm's cost of equity capital.

[14] In these Sharpe ratios, after-tax riskless bond rate is shown as $r(1 - T_p)$ for investors and $r(1 - T_c)$ for the firm, while after-tax equity return is shown as R because of the simplifying assumption that $T_{ps} = 0$, and so $R(1 - T_{ps}) \to R$.

The investor's objective function and the consequence for the firm are given below:

POSTULATE 0.

$$S^L = Max \frac{R - r(1 - T_p)}{\sigma}$$

The investor's objective function is to choose a leverage level that maximizes excess return per unit of risk.

$$F^L \Big|_{S^L} \rightarrow Lower \frac{R - r(1 - T_c)}{\sigma}$$

Given S^L, the firm's cost of capital moves in the direction of lower excess payout per unit of risk.

Here S^L is the investor's optimal return on equity at optimal leverage, and F^L is the firm's associated cost of equity capital, where these Sharpe ratios are calculated at point M^* in Figure 2.3. That investors select their portfolio to maximize return on investment in the mean-variance plane is well known from the CAPM. However, the mean-variance trade-off model also shows that when investors shift their choice of leverage level to maintain maximum returns, then firms are concurrently moved in the direction of a lower cost of capital relative to what the cost of capital would be without the change in leverage This means that both investors and firms benefit from investors' choice of optimal leverage to maximize returns, and so the interests of both investors and firms are aligned in the same direction with respect to changes in leverage.

2.3.2 Optimal Capital Structure and Expected Equity Return

Consider the case where expected unlevered equity returns increase while holding all other factors constant:

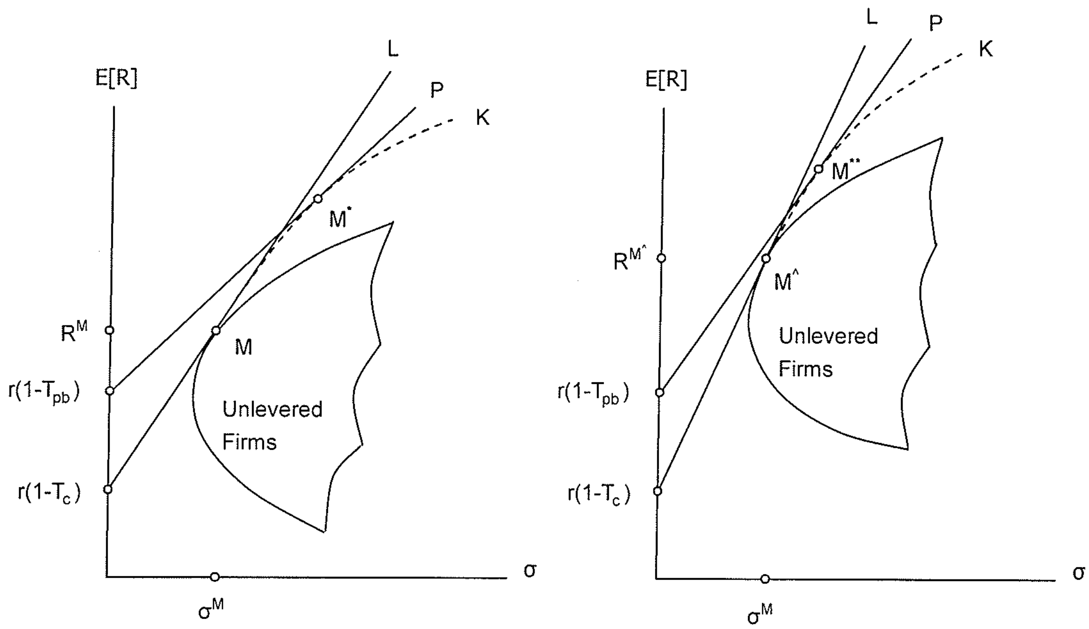


Figure 2.4. Decrease in Optimal Leverage with Increase in Expected Return.

This figure shows that an increase in expected return from R^M to $R^{M^\wedge}$ induces a decrease in aggregate optimal leverage from M^* to M^{**}, ceteris paribus.

Here, volatility is held constant at σ^M, and the interest rate $r(1-T_c)$ and tax rates T_c and T_{pb} are also held constant, while expected unlevered equity return increases from R^M to $R^{M^\wedge}$. The result is that the optimal leverage point moves from M^* to M^{**}. In order to achieve tangency at point $M^\wedge$ with a higher unlevered return while holding volatility constant, the efficient frontier (solid curve labeled Unlevered Firms) in the right-hand diagram has shifted upward and reduced its curvature in the region of tangency; this reduced curvature of the efficient frontier means that investors get a higher additional unlevered equity return per additional unit of risk (volatility).

The focus of the model in this paper is on the unlevered return, R^M, and unlevered volatility, σ^M. Among practitioners, levered return is usually the variable examined, but in the trade-off model of capital structure it is unlevered return that is the driving variable. However, it is shown in the attached proofs of the mean-variance model that the results are the same whether expressed in terms of unlevered returns or levered returns; this follows because there is a one-to-one mapping between unlevered and levered returns and between unlevered and levered volatility for any feasible set of parameter values. In other words, results shown in terms of unlevered return or unlevered volatility also apply to their levered counterparts. As in the static trade-off model, the optimal leverage level in the mean-variance trade-off model is a function of expected unlevered return and leverage costs. It follows then that expected levered return occurs at the optimal leverage point, M^*, and so is simply a function of expected unlevered return and leverage costs.

POSTULATE 1.

$\frac{dl}{dR} < 0, \frac{dl}{dR^L} < 0$ *The optimal leverage level is negatively related to expected unlevered return and to expected levered return.*

Proof: See Appendix A, Sections A5, A6 and A7.

In the mean-variance model presented in this paper, leverage costs are taken to be a function of leverage squared, $leverage\ cost = a \cdot l^2$, and unlevered return R is normalized to a range of [0,1]. For brevity, proofs are given in Appendix A, but the equation for optimal leverage is:

$$l = \frac{\sqrt{a^2 + ab\sqrt{-(R-1)(R+1)}} - a}{a}$$

Here, a is the weighting parameter for leverage costs and $b = r(1 - T_{pb})$ is the investor's after-tax return on bond income (intercept on the vertical axis). The characteristic of equilibrium leverage l versus expected unlevered R with $a = 0.10$ and $b = 0.20$ is plotted below:

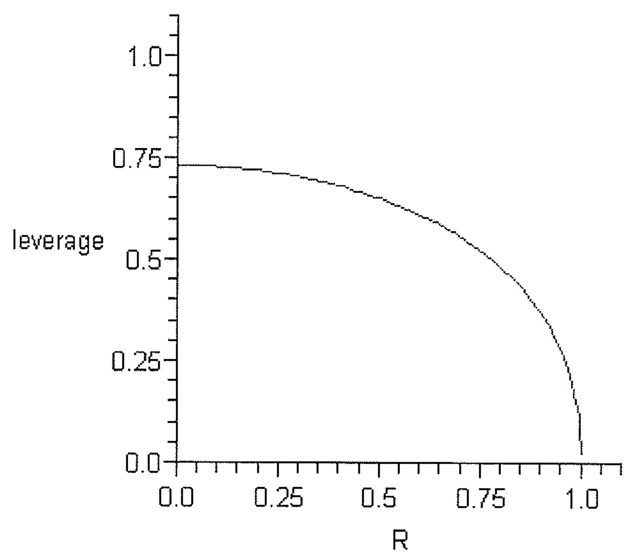


Figure 2.5. Plot of l versus R for $a = 0.1$ and $b = 0.2$.

This figure shows that optimal leverage is negatively related to expected return.

The intuition of this result is simple. In the mean-variance model of capital structure, investors' portfolios hold both debt and equity issued by firms to finance investment, and portfolio weighting will shift toward the more attractive asset. The negative relationship between leverage and expected return is driven by shifts in the relative Sharpe ratios of unlevered versus levered equity. The investor's Sharpe ratio of unlevered equity, S, is calculated at points M and $M^{\wedge}$ in Figure 2.4 and the Sharpe ratio of levered equity, S^L, is calculated at points M^* and M^{**}. To compare the properties of the unlevered versus levered Sharpe ratios (investor's return on equity), S and S^L, the ratios are plotted together below:

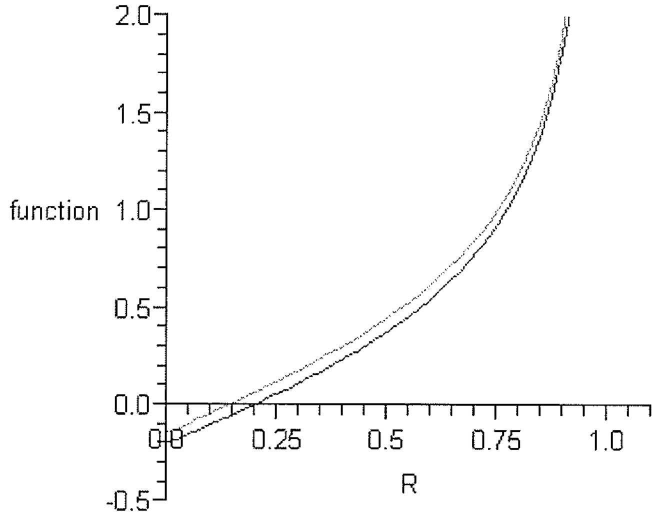


Figure 2.6. Plot of S and S^L versus R for $a = 0.1$ and $b = 0.2$.

This figure shows that the Sharpe ratio for unlevered equity increases faster than for levered equity as expected return increases, implying a shift toward lower leverage as expected return increases.

Negative values for the Sharpe ratios are outside the relevant range of the model because negative values occur when returns are below the risk-free corporate bond rate; in a rational economy, the expected return on risky equity is always greater than the risk-free rate. The upper line in the plot is the levered Sharpe ratio S^L, showing that the levered ratio is greater than the unlevered Sharpe ratio S, but the lines converge at high R because the unlevered Sharpe ratio is increasing faster than the levered ratio, as illustrated below:

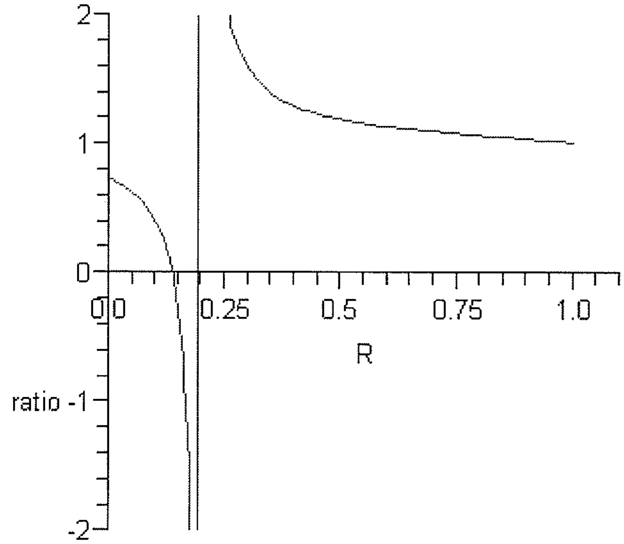


Figure 2.7. Plot of $\frac{S^L}{S}$ versus R for $a = 0.1$ and $b = 0.2$.

This figure shows that the levered Sharpe ratio is always greater than the unlevered Sharpe ratio, but the ratios converge at high expected return.

Here the relevant range for expected return R is where both Sharpe ratios are positive, on the right-hand side of the plot. It can be seen that the unlevered Sharpe ratio S is increasing relative to the levered Sharpe ratio S^L with increasing expected unlevered return R. When expected return on equity increases, then ceteris paribus, investors prefer a higher portion of unlevered equity in their portfolios because they receive a higher cash flow per unit of risk relative to levered equity, causing a shift in the optimal leverage level for the market portfolio. Change in the leverage level may occur simply by changes in market prices for bonds and stocks without any actual buying and selling of securities, reflecting supply and demand, or by way of net issues or repurchases of debt and equity.

In this paper, returns are taken to be return on equity (ROE) in keeping with prior capital structure literature, and so returns are equivalent to profitability. Thus, the negative relationship between leverage and returns proven under Postulate 1also shows a negative relationship between leverage and profitability. This result is opposite to the prediction of the traditional static trade-off model that the relationship should be positive. The traditional trade-off model shows that expected ROE monotonically increases with leverage, and this result is interpreted as predicting that the firm should increase its leverage as profitability increases. Now, the mean-variance trade-off model also shows that ROE monotonically increases with leverage, as seen from line k in Figure 2.3. However, the mean-variance model reveals that optimal leverage is not determined solely by expected return – rather, it is determined by expected return per unit of risk, and this results in a negative relationship between leverage and return / profitability.

The result of Postulate 1 represents the investor point of view of the trade-off between the benefits and costs of debt in the mean-variance environment. This result is opposite to the standard prediction from the firm's cash flow perspective, because Postulate 1 implies that the firm and its shareholders will reduce debt when expected earnings cash flow increases, meaning that shareholders choose to forgo the available corporate tax shield from increased leverage . In the standard model, an individual firm is a price taker in the debt market, and the firm is limited in the amount of the debt it can issue only by the firm's ability to support debt payments. In the mean-variance model, investors have finite resources and, when they choose between equity and corporate debt, they consider the optimal portfolio return from both. As expected returns per unit of risk increase for unlevered equity relative to levered equity, investors who hold levered equity face a form of opportunity cost which reduces the optimal leverage level for their portfolios. Thus, the aggregate leverage level of firms is determined by the portfolio choices of investors who, in aggregate, hold both debt and equity issued by firms.

But an obvious question that arises from the result of Postulate I is, how does the optimal investor choice of aggregate leverage connect to firm management in the real world? What is the economic incentive that aligns the interests of firm management with that of investors? The answer is that a shift in leverage to the optimal level that maximizes investor returns also causes the firm's cost of capital to move in the direction of a lower cost of capital relative to what the cost of capital would be without the change in leverage. The firm Sharpe ratio of unlevered equity, F, is calculated at points M and $\mathsf{M}^{\wedge}$ in Figure 2.4 and the Sharpe ratio of levered equity, F^{L}, is calculated at points M^{*} and M^{**}. This Sharpe ratio represents the risk adjusted cost of capital that the firm must pay to investors. To compare the properties of the unlevered versus levered Sharpe ratios (firm cost of equity), F and F^{L}, the ratios are plotted together below. The upper line in the plot is the unlevered Sharpe ratio F for the firm, showing that the unlevered ratio is greater than the levered Sharpe ratio F^{L}, but the lines converge at high R. In contrast, for the investor, the top line was the levered Sharpe ratio, S^{L}.

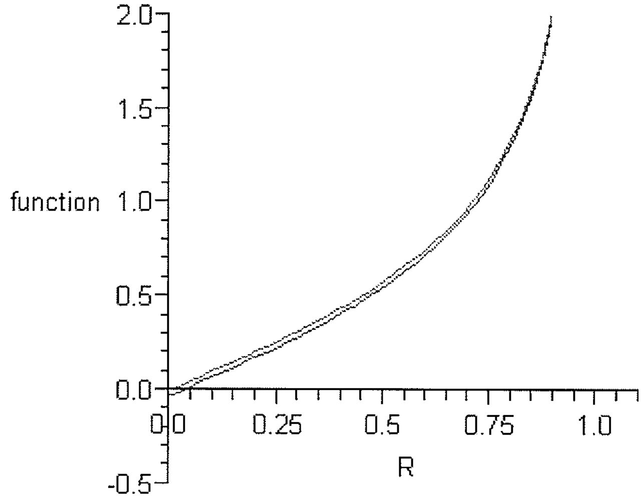


Figure 2.8. Plot of F and F^L versus R for $a = 0.1$ and $b = 0.2$.

This figure shows that the firm's levered Sharpe ratio is increasing relative to the unlevered Sharpe ratio as expected return increases, implying that the firm is motivated to reduce leverage as expected return increases.

The ratio of the firm's levered and unlevered Sharpe ratio is plotted below. The relevant range of the plot for the $\frac{F^L}{F}$ ratio is the right-hand side of the plot which corresponds to the region where the unlevered return R is above the risk-free rate. Here, the ratio rises to unity with increasing returns as the firm's Sharpe ratio of levered equity increases relative to the unlevered Sharpe ratio. What this means is that the firm's cost of levered equity rises relative to unlevered equity with increasing return, and so the investor choice of lower leverage with increasing return benefits the firm in form of a lower cost of capital relative to what the cost would be without the reduction in leverage as expected return increases. Hence, both the investor and the firm benefit from lower leverage, aligning the interests of firm management with those of investors.

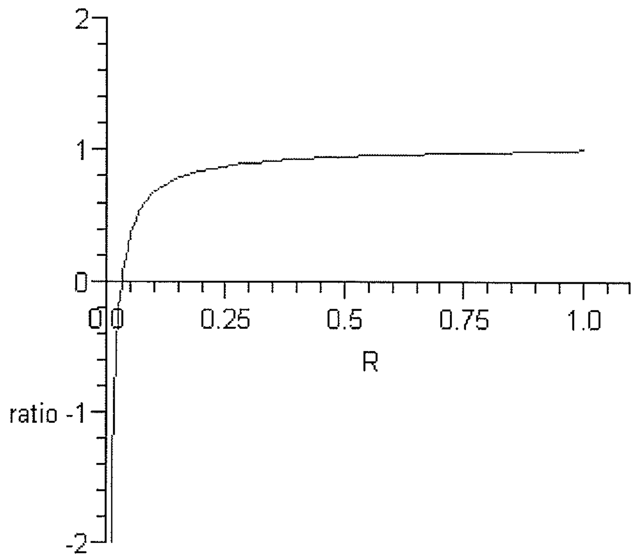


Figure 2.9. Plot of $\frac{F^L}{F}$ versus R for $a = 0.1$ and $b = 0.2$.

This figure shows that the firm's levered Sharpe ratio converges to the unlevered ratio at high returns.

As previously observed, most empirical studies show the relationship between leverage and profitability to be negative. Thus, the mean-variance form of the trade-off model provides a prediction in agreement with the bulk of observed evidence, thereby obviating the main criticism leveled at the trade-off model. The importance of this result is that it supports the existence of a target leverage level at equilibrium, and diminishes importance of competing models such as the pecking order theory or market timing. Pecking order and market timing theories remain important for explaining short term variations in capital structure, but the trade-off model provides a more complete description of long-term capital structure.

In summary, leverage is negatively related to the expected equity return at equilibrium, and this implies that leverage is negatively related to profitability.

2.3.3 Optimal Capital Structure and Volatility of Equity Returns

Consider next the case where unlevered volatility increases while holding all other variables constant:

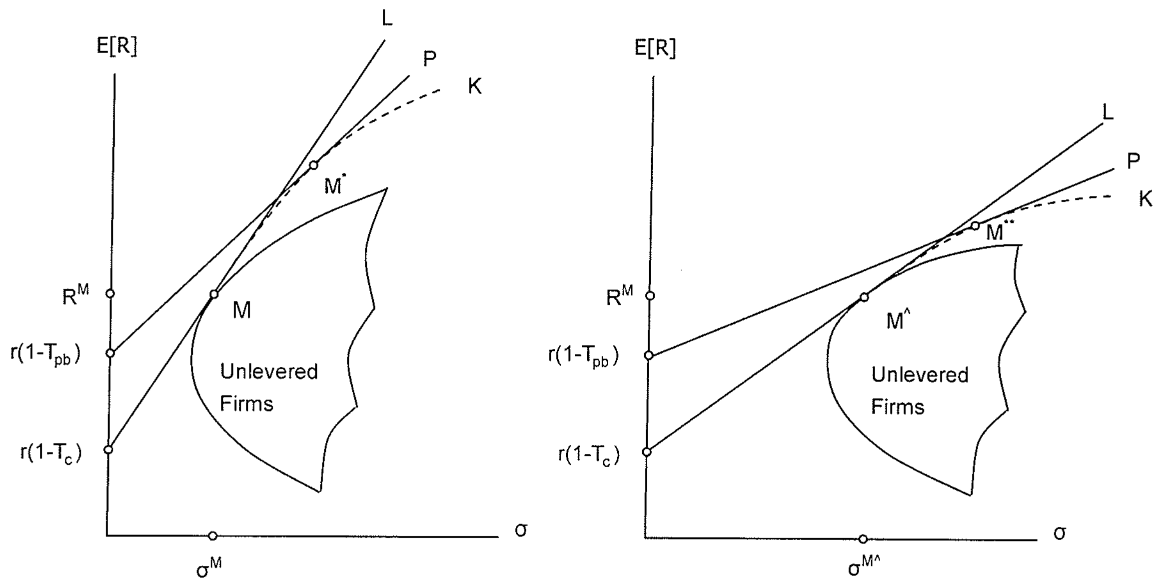


Figure 2.10. Decrease in Optimal Leverage with Increase in Volatility.

This figure shows that an increase in volatility from σ^M to $\sigma^{M^\wedge}$ induces a decrease in aggregate optimal leverage from M^* to M^{**}, ceteris paribus.

Here, expected unlevered equity return is held constant at R^M, and the interest rate $r = r_0/(1-T_c)$ and tax rates T_c and T_{pb} are also held constant, while unlevered volatility increases from σ^M to $\sigma^{M^\wedge}$. The result is that the optimal leverage point moves from M^* to M^{**}. In order to achieve tangency at point $M^\wedge$ with a higher volatility while holding unlevered return constant, the efficient frontier (solid curve labeled Unlevered Firms) in the right-hand diagram has shifted to the right and increased its curvature in the region of tangency; this increased curvature of the efficient frontier means that investors get a lower additional unlevered equity return per additional unit of risk (volatility).

POSTULATE 2.

$\frac{dl}{d\sigma} < 0, \frac{dl}{d\sigma^L} < 0$ *The optimal leverage level is negatively related to the unlevered volatility and to the levered volatility.*

Proof: See Appendix A, Sections A8, A9, and A10.

In the mean-variance model presented in this paper, leverage costs are taken to be a function of leverage squared, $\textit{leverage cost} = a \cdot l^2$, and unlevered volatility σ is normalized to a range of [0,1]. For brevity, proofs are given in Appendix A, but the equation for optimal leverage is:

$$l = \frac{\sqrt{a^2 - ab\sqrt{-(\sigma-1)(\sigma+1)}} - a}{a}$$

Here, a is the weighting parameter for leverage costs and $b = r(1 - T_{pb})$ is the investor's after-tax return on bond income (intercept on the vertical axis). The characteristic of equilibrium leverage l versus expected unlevered σ with $a = 0.1$ and $b = 0.2$ is plotted below:

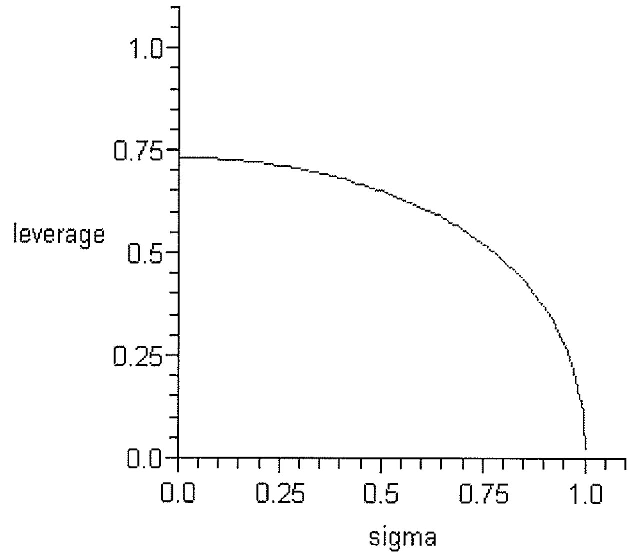


Figure 2.11. Plot of l versus σ for $a = 0.1$ and $b = 0.2$.

This figure shows that optimal leverage is negatively related to volatility of returns.

The intuition of this result is that the Sharpe ratio of unlevered equity declines more slowly than the Sharpe ratio of levered equity as volatility increases. The investor's Sharpe ratio of unlevered equity, S, is calculated at points M and M^ in Figure 2.10 and the Sharpe ratio of levered equity, S^L, is calculated at points M^* and M^{**}. To compare the properties of the unlevered versus levered Sharpe ratios (return on equity), S and S^L, the ratios are plotted together below:

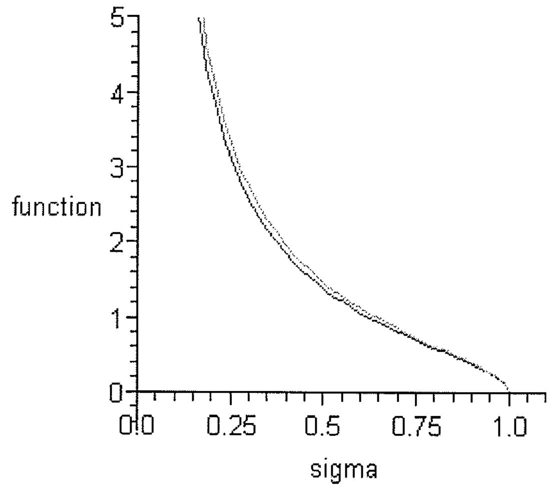


Figure 2.12. Plot of S and S^L versus σ for $a = 0.1$ and $b = 0.2$.

This figure shows that the Sharpe ratio for unlevered equity decreases more slowly than for levered equity as volatility increases, implying a shift toward lower leverage as volatility increases.

The upper line in the plot is the levered Sharpe ratio S^L, showing that the levered ratio is greater than the unlevered Sharpe ratio S, but the lines converge at high volatility σ because the unlevered Sharpe ratio is decreasing more slowly than the levered ratio, as illustrated in the plot below. Here, the $\frac{S^L}{S}$ ratio declines to unity with increasing volatility as the Sharpe ratio of unlevered equity declines more slowly relative to the levered Sharpe ratio.

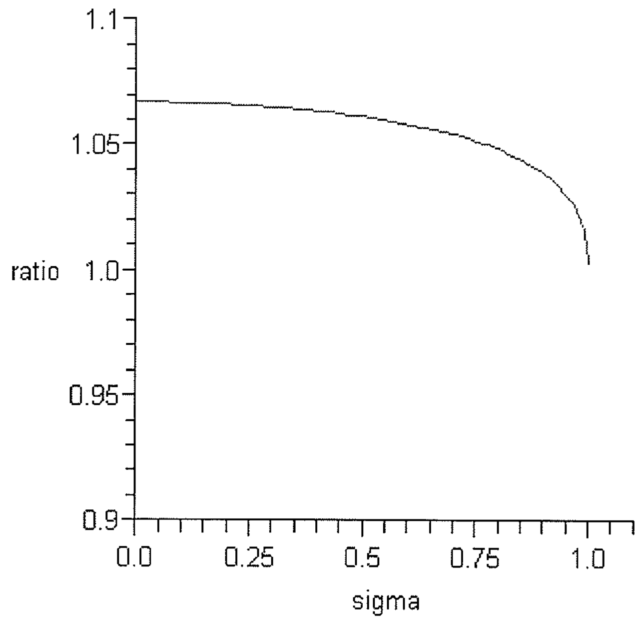


Figure 2.13. Plot of $\frac{S^L}{S}$ versus σ for $a = 0.1$ and $b = 0.2. b = 0.2.$

This figure shows that the levered Sharpe ratio is always greater than the unlevered Sharpe ratio, but the ratios converge at high volatility.

When volatility of return on equity increases, then ceteris paribus, investors prefer a higher portion of unlevered equity in their portfolio because they receive an increasing excess return per unit of risk (Sharpe ratio) for unlevered equity relative to levered equity as volatility increases. This result is consistent with the standard interpretation of the trade-off theory, where higher volatility of earnings (profitability) will increase the probability of financial distress and, by extension, increase the cost of leverage. Thus, both the standard static and mean-variance forms of the trade-off model predict that the optimal leverage level is negatively related to the volatility of earnings / returns.

While the trade-off model predicts a negative relationship between leverage and volatility of equity returns, the pecking order theory implies a positive relationship because of increased costs of asymmetric information for equity. The market timing theory does not make a prediction with respect to volatility of equity return. In empirical literature, the proxy for volatility is often taken to be the log of firm sales or the log of market value of equity. The empirical research shows that larger firms have less volatile earnings and have higher leverage levels. Thus, the negative relationship between optimal leverage and volatility is generally accepted by extant empirical literature.

In the mean-variance plane, increased returns are positively related to increased volatility. Since both expected returns and volatility have a negative relationship with leverage in the mean-variance trade-off model, both variables work in the same direction with respect to leverage. Volatility increases as expected return increases, in combination exerting a powerful force to decrease the optimal leverage level.. In the mean-variance plane, investors become increasingly averse to debt as expected returns and volatility increase together. These combined forces help explain why firms, acting as the agents of investors, prefer low levels of debt.

Once again, the investor choice of optimal leverage benefits both the investor and the firm. The firm's Sharpe ratio of unlevered equity, F, is calculated at points M and $M^{\wedge}$ in Figure 2.10 and the Sharpe ratio of levered equity, F^{L}, is calculated at points M^{*} and M^{**}. To compare the properties of the unlevered versus levered Sharpe ratios (cost of equity), F and F^{L}, the ratios are plotted together below:

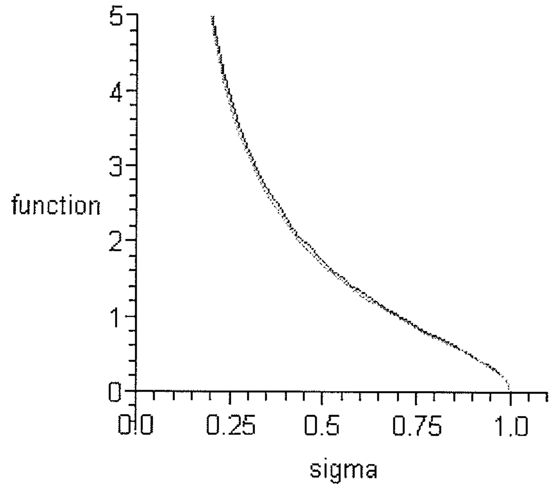


Figure 2.14. Plot of F and F^{L} versus σ for $a = 0.1$ and $b = 0.2$.

This figure shows that the firm's levered Sharpe ratio is rising relative to the unlevered ratio as volatility increases, implying that the firm is motivated to reduce leverage as volatility increases.

The upper line in the plot is the unlevered Sharpe ratio F for the firm, showing that the unlevered ratio is greater than the levered Sharpe ratio F^{L}, but the lines converge at high σ. In contrast, for the investor, the top line was the levered Sharpe ratio, S^{L}.

The ratio of the firm's levered Sharpe ratio over unlevered Sharpe ratio is plotted below. Here, the ratio rises to unity with increasing volatility as the firm's Sharpe ratio of levered equity increases relative to the unlevered Sharpe ratio. This shows again that the reduction in optimal leverage chosen by the investor benefits both the investor in the form of maintaining maximum return on equity for the investor and the firm in the form of a lower cost of capital relative to what the cost would be if the firm did not decrease leverage as volatility increases. And so again, the interests of firm management are aligned with those of investors.

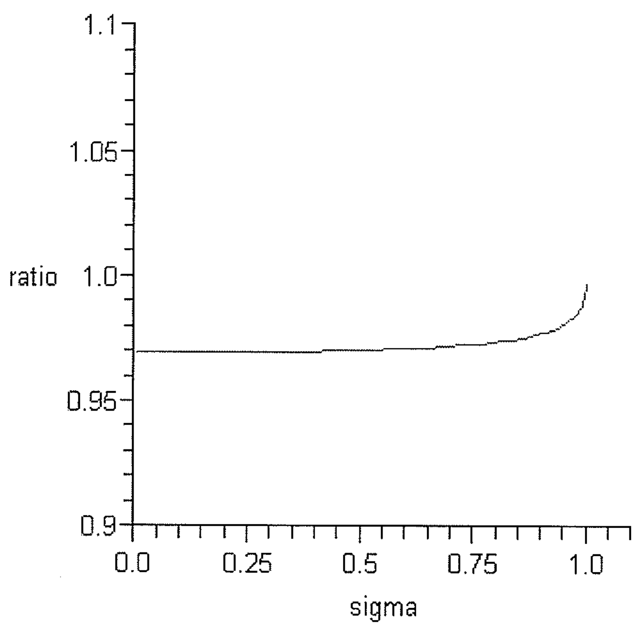


Figure 2.15. Plot of $\frac{F^L}{F}$ versus σ for $a = 0.1$ and $b = 0.2$.

This figure shows that the firm's levered Sharpe ratio converges to the unlevered ratio at high volatility.

In summary, leverage is negatively related to volatility in the mean-variance trade-off model.

2.3.4 Optimal Capital Structure and Expected Corporate Bond Returns

Consider next the case where expected corporate bond rate r increases while the efficient frontier of investment opportunities and other parameters are held constant:

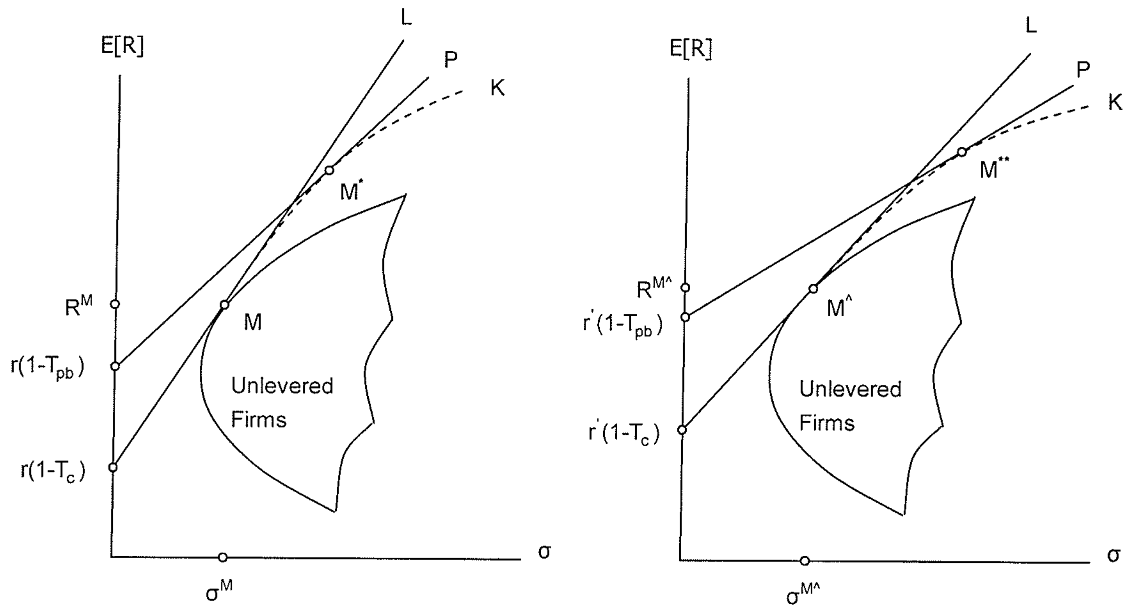


Figure 2.16. Increase in Optimal Leverage with Increase in Expected Bond Rate.

This figure shows that an increase in expected bond rate from r to r' induces a increase in aggregate optimal leverage from M^* to M^{**}, ceteris paribus.

Here the increase from in the riskless bond rate from r to r' results in an increase of the optimal leverage level from M^* to M^{**}. The efficient frontier (solid curve labeled Unlevered Firms) does not change, but the increase from r to r' results in the tangent point on the efficient frontier moving from M to $M^\wedge$ with an accompanying increase in unlevered return from R^M to $R^{M^\wedge}$ and volatility from σ^M to $\sigma^{M^\wedge}$. In effect, investors are requiring higher returns on equity to remain invested in equity as the bond rate increases. The effect of these conditions upon the optimal leverage level is given in the following postulate:

POSTULATE 3.

$\frac{dl}{dr} > 0$ *The optimal leverage level is positively related to the risk-free bond rate.*

Proof: See Appendix A, Sections A11 and A12.

The relevant range of the expected corporate bond rate r is set to [0,1] in the plots that follow, by selecting the value for the unlevered return R to be equal to one minus the personal tax rate, $1-T_p$. With the unlevered return R set to $1-T_p$, the Sharpe ratio of unlevered equity S declines to zero when the corporate bond rate r increases to unity, $r=1.0$; in a rational economy, the Sharpe ratio of unlevered equity cannot become negative and so the relevant range of r is effectively restricted to [0,1]. For brevity, proofs are given in Appendix A, but the equation for optimal leverage is:

$$l = -\left(\frac{\sqrt{-(R-1)(R+1)}}{\sqrt{(R-r(1-T_c))^2+(1-R^2)}} \sqrt{-\frac{1-2Rr+2RrT_c+r^2-2r^2T_c+r^2T_c^2}{(R-1)(R+1)}} - \frac{\sqrt{a^2-2a^2Rr+2a^2RrT_c+a^2r^2-2a^2r^2T_c+a^2r^2T_c^2}+arT_c-arT_p}{a} \right)$$

Here, a is the weighting parameter for leverage costs and $b = r(1 - T_{pb})$ is the investor's after-tax return on bond income (intercept on the vertical axis). The characteristic of equilibrium leverage l versus expected corporate bond rate r with $R = 0.70$ [15], $a = 0.1$, $T_c = 0.35$ and $T_p = 0.30$ is plotted below:

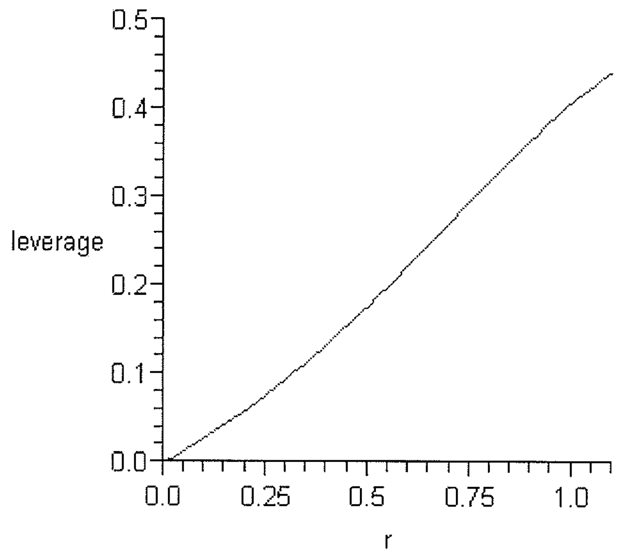


Figure 2.17. Plot of l versus r for $R = 0.70$, $a = 0.1$, $T_c = 0.35$ and $T_p = 0.30$.

This figure shows that optimal leverage is positively related to expected bond return.

The intuition of this result is that the Sharpe ratio of levered equity declines slower than the Sharpe ratio of unlevered equity as the bond rate increases. To compare the properties of the unlevered versus levered Sharpe ratios, S and S^L, the ratios are plotted together below:

[15] The normalized unlevered return, R, is related to the normalized unlevered volatility, σ, by the equation $R = \sqrt{1 - \sigma^2}$, and so normalized $R = 0.70$ implies that normalized $\sigma = 0.71$. In the real world, this relative size of normalized values translates to any similarly sized nominal values; for example a nominal expected return of 10% with a nominal standard deviation of 10.2%.

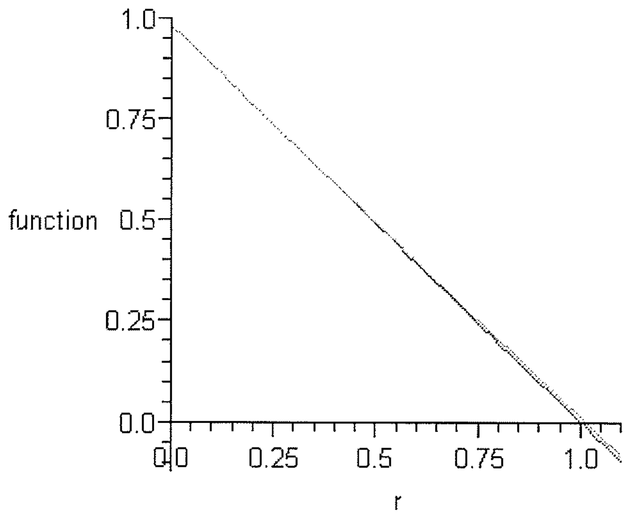


Figure 2.18. Plot of S and S^L versus r for $R = 0.70$, $a = 0.1$, $T_c = 0.35$ and $T_p = 0.30$.

This figure shows that the Sharpe ratio for levered equity decreases more slowly than for unlevered equity as expected bond rate increases, implying a shift toward higher leverage as the bond rate increases.

The upper line in the plot is the levered Sharpe ratio S^L, showing that the levered ratio is greater than the unlevered Sharpe ratio S, but the lines diverge at high r because the levered Sharpe ratio is decreasing slower than the unlevered ratio, as illustrated below:

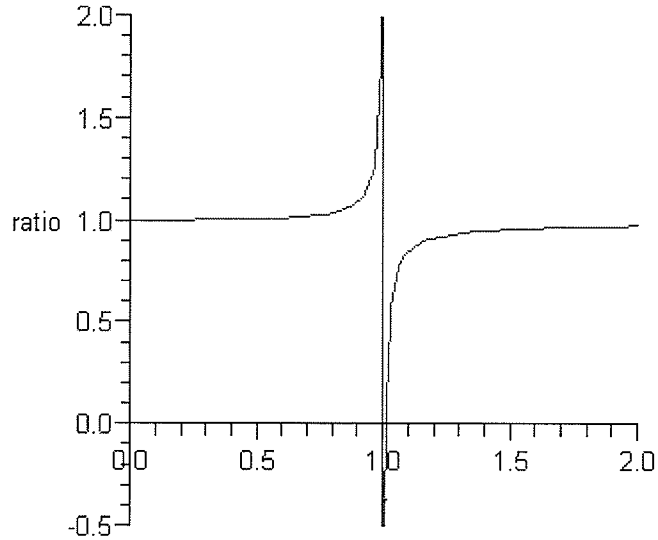


Figure 2.19. Plot of $\frac{S^L}{S}$ versus r for $R = 0.70$, $a = 0.1$, $T_c = 0.35$ and $T_p = 0.30$.

This figure shows that the levered Sharpe ratio is always greater than the unlevered Sharpe ratio, and the ratios diverge at high volatility.

Here the relevant range for expected bond rate r is where both Sharpe ratios are positive, on the left-hand side of the plot. It can be seen that the levered Sharpe ratio S^L is increasing relative to the unlevered Sharpe ratio S with increasing expected bond rate r.

When the Sharpe ratio of levered equity increases relative to the Sharpe ratio of unlevered equity, then investors prefer a higher portion of levered equity in their portfolios, inducing a shift toward higher leverage. In contrast, the standard static trade-off model is generally interpreted to imply that leverage is negatively related to the bond rate because increased interest payments will increase the probability of financial distress. Similarly, the pecking order and market timing theories imply a negative relationship between leverage and the bond rate, since the cost of debt increases relative to equity.

Thus, the mean-variance trade-off model contradicts the predictions of these other models.

The relevant range of the expected corporate bond rate r increases from [0,1] to [0,1.17] in the plots that follow for the firm's Sharpe ratios, F and F^L, because the vertical intercept is lower in Figure 2.16 for the firm, $r(1-T_c)$ versus $r(1-T_{pb})$ for the investor, and so the firm's Sharpe ratio F declines to zero at a higher value of r than previously seen for the investor's Sharpe ratio S. The properties of the unlevered versus levered Sharpe ratios (cost of equity), F and F^L, the ratios are plotted together below:

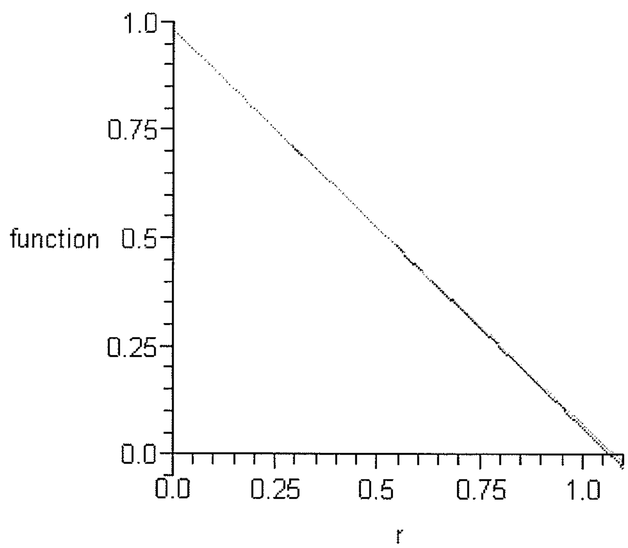


Figure 2.20. Plot of F and F^L versus r for $R = 0.70$, $a = 0.1$, $T_c = 0.35$ and $T_p = 0.30$.

This figure shows that the firm's levered Sharpe ratio is declining relative to the unlevered ratio as the bond rate increases, implying that the firm is motivated to increase leverage as the bond rate increases.

The upper line in the plot is the unlevered Sharpe ratio F for the firm, showing that the unlevered ratio is greater than the levered Sharpe ratio F^L, but the lines diverge at high r. In contrast, for the investor, the top line was the levered Sharpe ratio, S^L.

The ratio of the firm's levered Sharpe ratio over unlevered Sharpe ratio is plotted below:

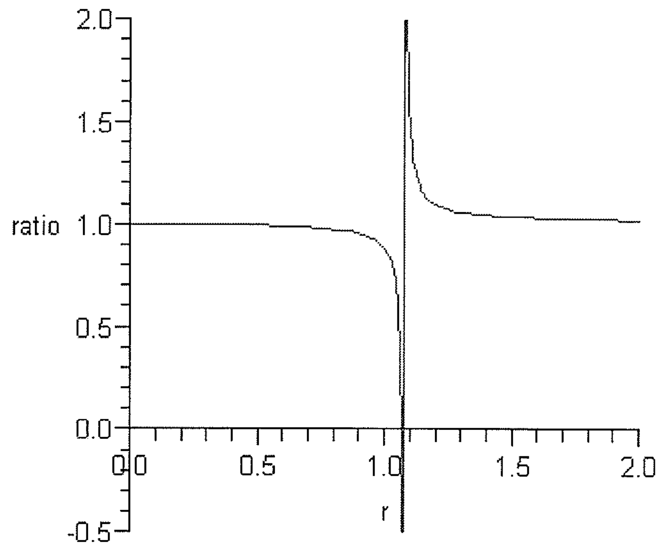


Figure 2.21. Plot of $\frac{F^L}{F}$ versus r for $R = 0.70$, $a = 0.1$, $T_c = 0.35$ and $T_p = 0.30$.

This figure shows that the firm's levered Sharpe ratio diverges from the unlevered ratio at high bond rate.

Here, the ratio declines to zero with increasing bond rate as the Sharpe ratio of levered equity declines relative to the unlevered Sharpe ratio. Hence, the investor choice of increased leverage to maintain maximum returns again benefits the firm in the form of lower relative cost of equity relative to what the cost would be if the firm did not increase leverage as the bond rate increases, and so the interests of firm and investor are aligned.

Most empirical work on the relationship between leverage and bond rates has been done on credit spreads at the firm level, where research confirms a positive relationship between the credit spread and leverage, reflecting increasing risk with increasing leverage. However, research on the relationship between the aggregate leverage level in the economy and long-term corporate bond rates is sparse. But there is some empirical evidence to support a positive relationship between aggregate leverage and short-term bond rates. For example, Frank and Goyal (2004) find that leverage among firms is positively related to the Treasury bill rate.

In summary, leverage is positively related to the expected bond rate in the mean-variance trade-off model.

2.4 Tax Clientele and Individual Firm Leverage

The preceding analysis has assumed that the personal tax rate, T_{pb}, and the corporate tax rate, T_c, are constant. In reality, there is a continuum of tax rates among investors and firms, creating a spectrum of tax clientele with various optimal leverage levels. The preceding analysis focused upon the aggregate economy and showed a single investment opportunity set (curve K) and a single investor efficient set line (line P) for a representative investor, but each tax clientele group would have its own set of lines and optimal leverage level. But tax clientele and varying firm leverage are entirely consistent with the mean-variance trade-off model presented herein. As Miller (1977) argues, firms may individually choose leverage levels below or above the optimal aggregate level to reflect tax clientele, provided that the overall leverage level is at the optimum. If aggregate leverage drifts away from the optimum, market forces will act to alter the prices of debt and equity and then individual firms will adjust their leverage levels to return to equilibrium.

In empirical tests, the effects predicted by the mean-variance trade-off model should be apparent at the aggregate level as shown by a cross-sectional regression of a large sample of firms, provided that the regression model contains appropriate controls for firm-level factors. Such controls are required because, at the individual firm-level, demand for debt by tax clientele and idiosyncratic factors such as the firm's technology and growth opportunities will result in a wide range of observed leverage levels. And empirical evidence does generally support the predictions of the mean-variance trade-off model. Frank and Goyal (2004) conduct a comprehensive examination of 39 factors in the leverage decisions of publicly traded firms and they find that, in relation to financial leverage, profitability has a negative effect (-), variance of own stock returns has a negative effect (-), and the Treasury bill rate has a positive effect (+); these results are consistent with the predictions of the mean-variance trade-off model presented in this paper.

2.5 Conclusions

This paper presents a mean-variance trade-off model of capital structure that provides a bridge between the standard static trade-off model of capital structure and the CAPM of asset pricing. The mean-variance trade-off model offers a perspective of capital structure that incorporates risk aversion and investor portfolio choice, providing a straight-forward and intuitive explanation for the observed negative relationship between leverage and profitability, and thereby obviating the major criticism of the trade-off model. In the mean-variance environment, investors hold both the equity and debt issued by firms, and changing expectations induce investors to shift their portfolio holdings toward the more attractive asset, varying optimal leverage to maximize portfolio returns per unit of risk. Moreover, the interests of investors and firms are aligned in the mean-variance trade-off model because the shifts in optimal leverage that maintain maximum returns for investors also lower the cost of capital for firms.

This paper contributes to the understanding of capital structure in two ways. First, it shows that the trade-off model predicts a negative relationship between profitability and leverage when modeled in a mean-variance setting under conditions of risk aversion and investor portfolio choice, so resolving the major shortcoming of the standard trade-off model. Second, whereas most research on capital structure is presented from the perspective of the firm, optimal capital structure is examined herein from the viewpoint of the investor, so showing the connection between the investment choice of the investor and the leverage choice of the firm.

The model's implication that firms will choose to forgo available tax shielding as profitability increases is consistent with evidence that more profitable firms use leverage conservatively, well below the level that would offset taxable income [Graham (2000)]. The characteristics of mean-variance trade-off model are consistent with other observed behaviors, such as the size effect on capital structure. Larger firms have lower expected returns and lower volatility of returns, and the higher leverage of larger firms is consistent with the predictions of the mean-variance trade-off model. The mean-variance trade-off model is also consistent with the observed counter-cyclical issuance of debt by unconstrained firms [Koracjczyk and Levy (2003)], where firms tend to issue equity at the height of the business cycle when profitability is high, and debt at the bottom of the business cycle when profitability is low. Competing models of capital structure such as the pecking order theory and the market timing theory have gained prominence because they offer an explanation for observed behavior that is not explained by the standard trade-off model, such as the negative relationship between leverage and profitability or the counter-cyclical issuance of debt. The ability of the mean-variance trade-off model to explain the negative relationship between profitability and leverage is important; for if asymmetric information models such as the pecking order and market timing theories were true, then firms would not have an optimal target leverage level as implied by the trade-off theory, suggesting a minimal role for the traditional determinants of capital structure. The predictions of the mean-variance trade-off model provide theoretical support for the large body of empirical research that finds that firms have a long-term target leverage level.

In summary, the theoretical results of this paper show that the trade-off model correctly predicts the observed negative relationship between profitability and leverage when the model is set in the mean-variance environment, where conditions of risk aversion and optimal investor portfolio choice better represent the real world than the standard versions of the trade-off model. These results support a modified form of the trade-off model, where target leverage may vary with expectations.

Appendix A: Derivation of the Mean-variance Trade-Off Model

This appendix provides the detailed calculations for the mean-variance model, deriving the relationships between leverage (debt ratio) and expected unlevered equity return, unlevered volatility, and expected corporate bond rates.

The key feature of the model is that leverage (debt ratio) is normalized to the range [0,1] to maintain the correct relationship between leverage and expected returns and volatilities.

A1: Description of the Model.

The proof of the negative relationship between expected equity returns and optimal leverage is based upon the determination of the tangent point between the investor efficient set straight line P and the investment opportunity set curved line K shown in Figure 2.3. The main steps of the proof are outlined below:

1. Represent lines P and K in the form $y_1 = f(x)$ and $y_2 = f(x)$.
2. Derive slope equations m_1 and m_2.
3. Equate slopes so that $m_1 - m_2 = 0$ to determine optimal leverage (tangent point).
4. Re-arrange terms of slope equality and solve to obtain leverage function $l = f(x)$.
5. Take derivative $\frac{dl}{dx}$ and examine to show relationship.

I assume that leverage costs are related to the leverage line L by a polynomial relationship of the form:

$$leverage\ cost = a \cdot l^2 + b \cdot l + c$$

where the variable l is the leverage or debt ratio $l = B/(B+S)$ and $l \in [0,1]$. I make the simplifying assumption that only the $a \cdot l^2$ term is relevant [i.e. $b = c = 0$], as shown below:

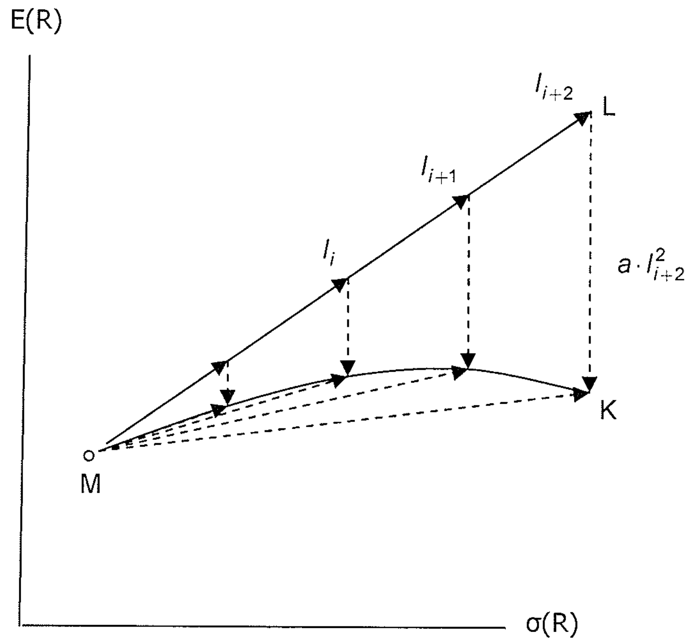


Figure A1. Model of Exponentially Increasing Leverage Costs. This figure shows that leverage costs are modeled as an exponential function of the leverage level.

The result is a constant scale, exponential relationship between the leverage line L, without leverage costs, and the opportunity set line K, with leverage costs.

Leverage is defined here as $l = B/(B+S)$ so that $l \in [0,1]$, which is a form of normalization. An essential characteristic of the proof is normalization to this range in order to maintain the proper relationships between leverage and leverage costs as the expected return values and associated volatility change.

The representation of the curve K is uses some basic properties of geometry, as shown below:

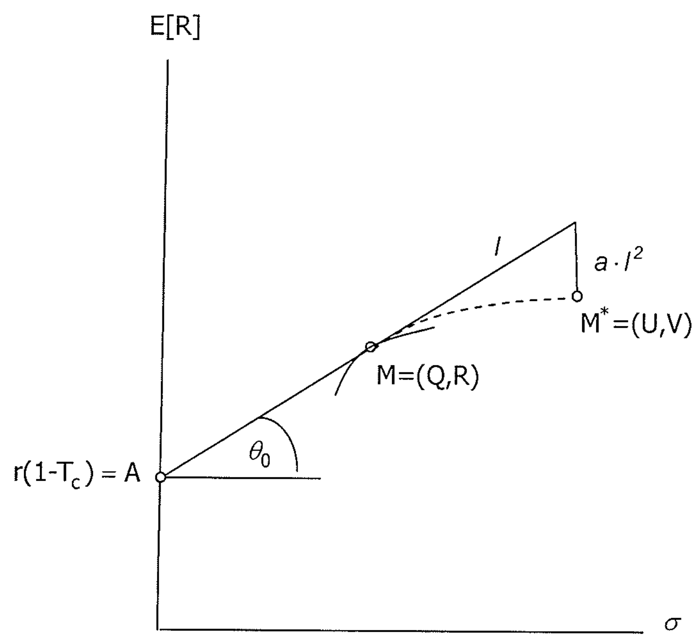


Figure A2. Modeling of Curve *K*.

This figure shows how leveraged returns are modeled.

This diagram is related to the mean-variance plane variables as shown below:

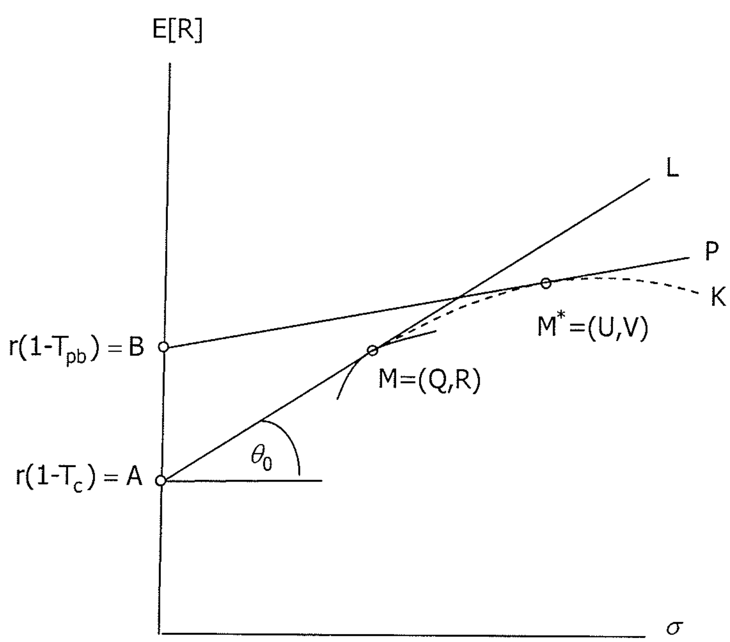


Figure A3. Variables in the Mean-Variance Plane.

This figure shows the modeling of the tangency between the investor's optimal set (line P) and the investment opportunity set (curve K).

The key element of this model is that the mean-variance plane, where expected return $E[R]$ is the vertical axis and volatility σ is the horizontal axis, is represented in normalized form as shown below:

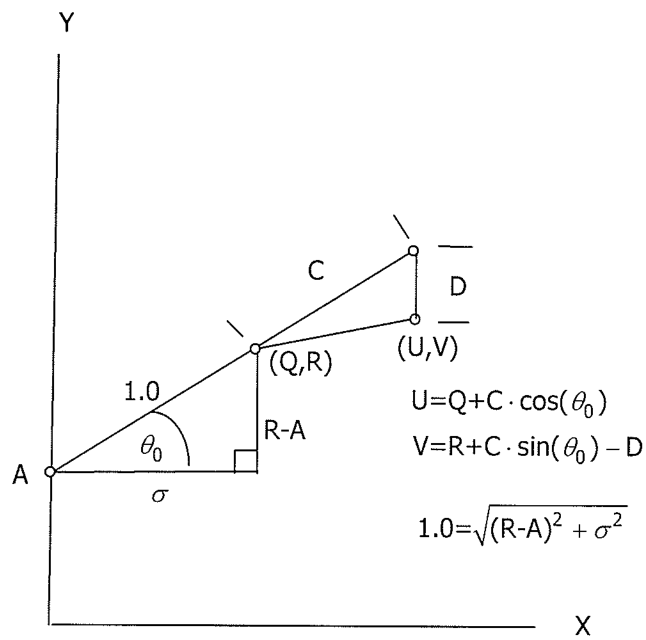


Figure A4. Geometric Relationships among Normalized Variables.
This figure shows how expected return and volatility are normalized.

Here, R is the normalized expected unlevered return and σ is the normalized unlevered volatility; with normalization, R and σ are now related by the equation $1.0 = \sqrt{(R-A)^2 + \sigma^2}$. The nominal values of return and volatility are in the range zero to infinity, $R \in [0, \infty]$, $\sigma \in [0, \infty]$, but normalizing these variables maps them into the range of zero to one, $R \in [0,1]$, $\sigma \in [0,1]$. The variables X and Y are used for the horizontal and vertical axes in the normalized mean-variance plane. The point (Q,R) is the expected unlevered return. The point (U,V), which is the tangent point between lines P and K, is the expected levered return. The equilibrium leverage ratio is the length of line segment C.

Define angle θ_0 as the intermediate variable:

$$\theta_0 = \text{atan}\left(\frac{E[R]-r(1-T_c)}{E[\sigma]}\right) = \text{atan}\left(\frac{R\text{ - }A}{Q}\right)$$

To simplify equations, define the risk-free rates for the corporation and investors as intermediate variables:

$$A = r(1-T_c)$$
$$B = r(1-T_p)$$

Normalized leverage is given by:

$$l = {}^{(x-\sigma)}\!\big/_{\cos(\theta_0)} \equiv C$$

And normalized leverage cost is given by:

$$al^2 = aC^2 = a\left({}^{(x-\sigma)}\!\big/_{\cos(\theta_0)}\right)^2 \equiv D$$

A2: Slope of Opportunity Set K.

The equation for the investment opportunity set line K can now be defined as a function of x and y in the normalized mean-variance plane:

$$y = R + \left(\frac{x-\sigma}{\cos(\theta_0}\right)\sin(\theta_0) - a\left(\frac{x-\sigma}{\cos(\theta_0}\right)^2$$

It can be seen that the second term in brackets captures the reduction in returns due to exponentially increasing leverage costs, and that this is the equation of a curve. The next step is to take the derivative of this line equation to obtain the slope of line K, as follows:

$$\frac{dy}{dx} = m_1 = \frac{\sin(\theta_0)}{\cos(\theta_0)} - 2a\left(\frac{x-\sigma}{\cos(\theta_0)}\right)\frac{1}{\cos(\theta_0)}$$

Now substitute the definition of normalized leverage to obtain the slope in terms of leverage:

$$m_1 = \frac{\sin(\theta_0)}{\cos(\theta_0)} - \frac{2al}{\cos(\theta_0)}$$

A3: Slope of Investment Efficient Set Line P.

The slope of the investors' opportunity set line P can similarly be defined as a function of x and y in the normalized mean-variance plane:

$$\frac{dy}{dx} = m_2 = \frac{R + \left(\frac{x-\sigma}{\cos(\theta_0}\right)\sin(\theta_0) - a\left(\frac{x-\sigma}{\cos(\theta_0}\right)^2 - B}{\sigma + \left(\frac{x-\sigma}{\cos(\theta_0}\right)\cos(\theta_0)}$$

Now substitute the definition of normalized leverage to obtain the slope in terms of leverage:

$$m_2 = \frac{R + l\sin(\theta_0) - al^2 - B}{\sigma + l\cos(\theta_0)}$$

A4: Solve for Optimal Leverage Level.

The objective is to define the optimal leverage level, or debt ratio. The optimal debt ratio occurs at the tangent point between the lines K and P where the two slopes are equal:

$$m_1 = m_2$$

To solve for the optimal leverage level l, subtract one slope from the other:

$$m_1 - m_2 = 0 = \frac{\sin(\theta_0)}{\cos(\theta_0)} - \frac{2al}{\cos(\theta_0)} - \frac{R + l\sin(\theta_0) - al^2 - B}{\sigma + l\cos(\theta_0)}$$

Multiply through to eliminate denominators:

$$\begin{aligned} 0 = {} & \sigma\sin(\theta_0) - 2\sigma al + l\sin(\theta_0)\cos(\theta_0) - 2al^2\cos(\theta_0) - R\cos(\theta_0) \\ & - l\sin(\theta_0)\cos(\theta_0) + al^2\cos(\theta_0) + B\cos(\theta_0) \end{aligned}$$

Re-arrange and collect terms:

$$l^2[a\cos(\theta_0)] + l[2\sigma a] + [(R - B)\cos(\theta_0) - \sigma\sin(\theta_0)] = 0$$

The result is a quadratic equation of the form $al^2 + bl + c = 0$, which can be solved for l. This equation has two roots, one positive and one negative, but only the positive root is relevant.

This completes the definition of the model and it now remains to solve for the specific relationships between leverage and returns, leverage and volatility, and leverage and the bond rate.

A5: Proof of Relationship between Unlevered Returns and Leverage : $\frac{dl}{dR} < 0$.

The objective of this section is to establish the relationship between the optimal leverage level l and changes in the expected unlevered return R, ceteris paribus.

Only the expected unlevered return R changes; all other variables in the mean-variance plane such as volatility, the bond rate, and tax rates remain constant. The analysis can therefore be simplified by assuming that $r(1 - Tc) = A = 0$. This simplifying assumption does not affect the generality of the result. The relationship between variables in the normalized mean-variance plane is shown below:

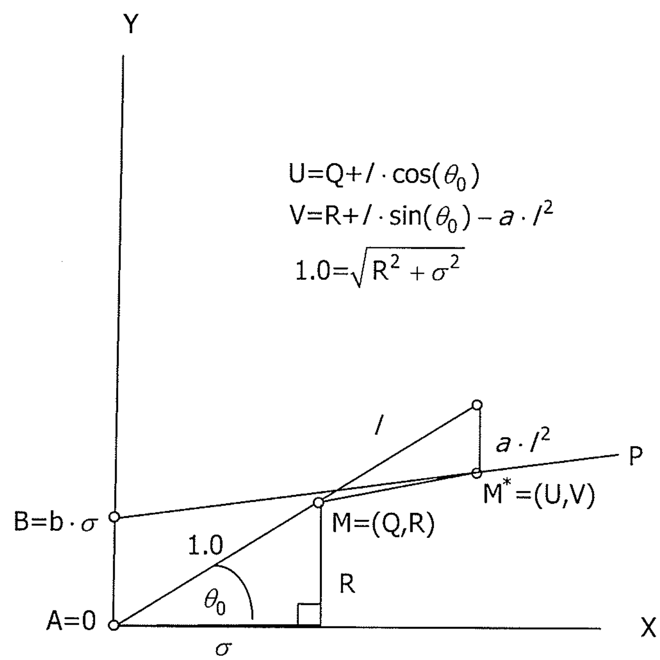


Figure A5. Model of the Relationship between Returns and Leverage. This figure shows the model with the simplifying assumption that the risk-free corporate bond rate is zero, A=0.

Point B represents investors' expected after-tax return on the risk-free corporate bond. The point B on the vertical axis has a fixed ratio with volatility σ, determined by the constant b, to maintain the proper relationship between these variables. This fixed relationship between B and σ mirrors the situation on the nominal (not normalized) mean-variance plane, when the value of return R varies but the values of other variables remain fixed. If point A were not set to zero, then it too would need to defined as having a fixed ratio with volatility σ (e.g. $A=c \cdot \sigma$), but setting A to zero simplifies the solution. In effect, $\sigma = \sqrt{1-R^2}$ is the numeraire, or common unit of measure, in the mean-variance plane.

With appropriate choice of values for R, σ, and b, this normalized model provides a valid representation of any feasible combination of actual expected returns and volatilities in the mean-variance plane. Normalizing values in this manner maintains the correct relationship between leverage and portfolio returns.

The proof of the negative relationship between leverage and returns follows the methodology outlined above. The slopes of lines K and P, representing the investment opportunity set and the investor efficient set respectively, are equated and a solution for optimal leverage is derived, as shown below:

$$\theta_0 = \arctan\left(\frac{R}{\sqrt{1-R^2}}\right)$$

$$m_1 = \frac{\sin(\theta_0)}{\cos(\theta_0)} - \frac{2al}{\cos(\theta_0)} = \frac{R}{\sqrt{1-R^2}} - \frac{2al}{\sqrt{1-R^2}}$$

$$m_2 = \frac{R + l\sin(\theta_0) - al^2 - b\sqrt{1-R^2}}{\sqrt{1-R^2} + l\cos(\theta_0)} = \frac{R + lR - al^2 - b\sqrt{1-R^2}}{\sqrt{1-R^2} + l\sqrt{1-R^2}}$$

$$m_1 - m_2 = 0 = \frac{R}{\sqrt{1-R^2}} - \frac{2al}{\sqrt{1-R^2}} - \frac{R + lR - al^2 - b\sqrt{1-R^2}}{\sqrt{1-R^2} + l\sqrt{1-R^2}}$$

Solving, the positive root of this quadratic equation is:

$$l = \frac{\sqrt{a^2 + ab\sqrt{-(R-1)(R+1)}} - a}{a}$$

The characteristic of equilibrium leverage l versus unlevered R for $a = 0.1$ and $b = 0.2$ is plotted below:

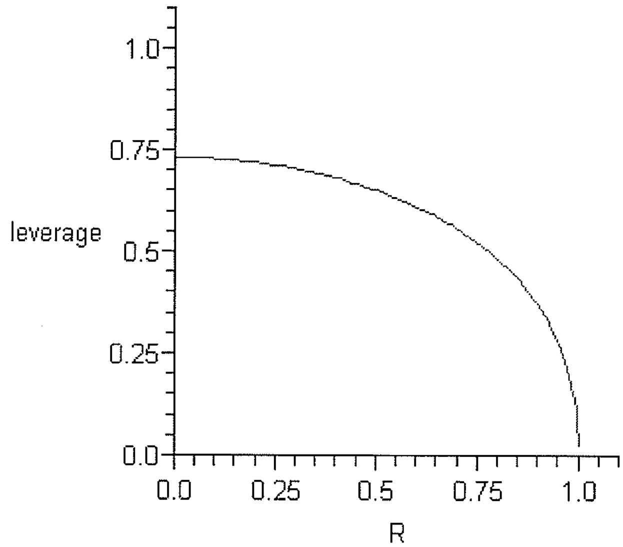


Figure A6. Plot of l versus R for $a = 0.1$ and $b = 0.2$.

This figure shows that optimal leverage declines with increasing return.

Then take the derivative of this function with respect to the expected unlevered return R:

$$\frac{dl}{dR} = -\frac{1}{2}\frac{bR}{\sqrt{a^2 + ab\sqrt{-(R-1)(R+1)}}\sqrt{-(R-1)(R+1}}$$

For feasible values of a, b and R, the value of this derivative is negative. As an example, the characteristic of $\frac{dl}{dR}$ for $a = 0.1$ and $b = 0.2$ is plotted below:

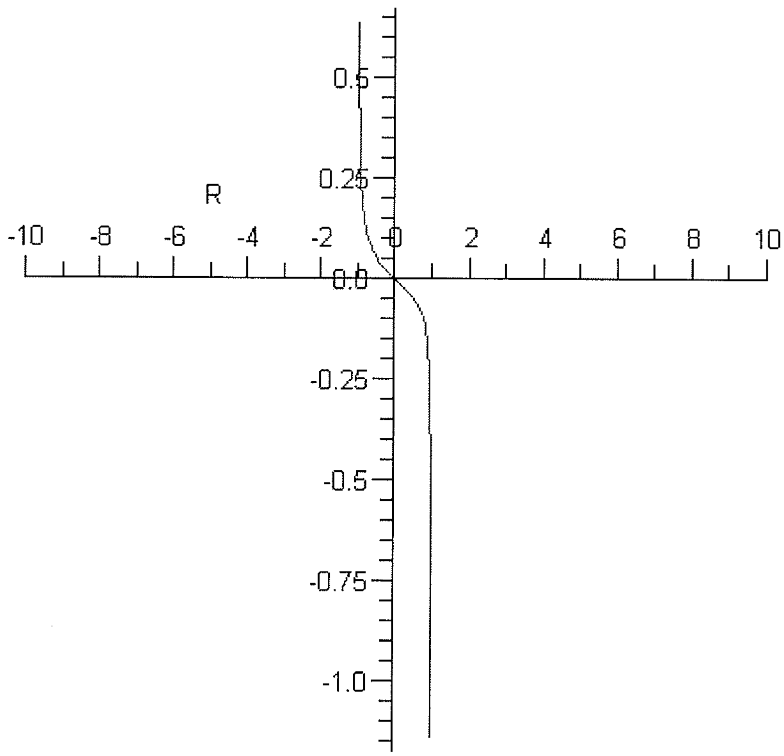


Figure A7. Plot of $\frac{dl}{dR}$ versus R for $a = 0.1$ and $b = 0.2$.

This figure show that leverage is negatively related to expected return.

This plot shows that $\frac{dl}{dR} < 0$ for positive expected unlevered returns. This negative relationship holds for all feasible values for variables in the model, giving the result:

$\frac{dL}{dR} < 0$ Q.E.D.

A6: The Relationship between Unlevered Returns and Levered Returns

The objective of this section is to extend the previous result for the relationship between leverage and unlevered returns R to levered returns R^L, because it is levered returns that are most commonly of interest in the real world.

Using the result of the previous section:

$$l = \frac{\sqrt{a^2 + ab\sqrt{-(R-1)(R+1)}} - a}{a}$$

The levered return at the equilibrium leverage point has been defined as :

$$V = R + l \cdot \sin(\theta_0) - a \cdot l^2 = R^L$$

Substituting for l and θ into this equation gives:

$$R^L = R - \frac{R\left(a - \sqrt{a^2 + ab\sqrt{-(R-1)(R+1)}}\right)}{a} - \frac{\left(a - \sqrt{a^2 + ab\sqrt{-(R-1)(R+1)}}\right)^2}{a}$$

The characteristic of R^L versus unlevered R for $a = 0.1$ and $b = 0.2$ is plotted below:

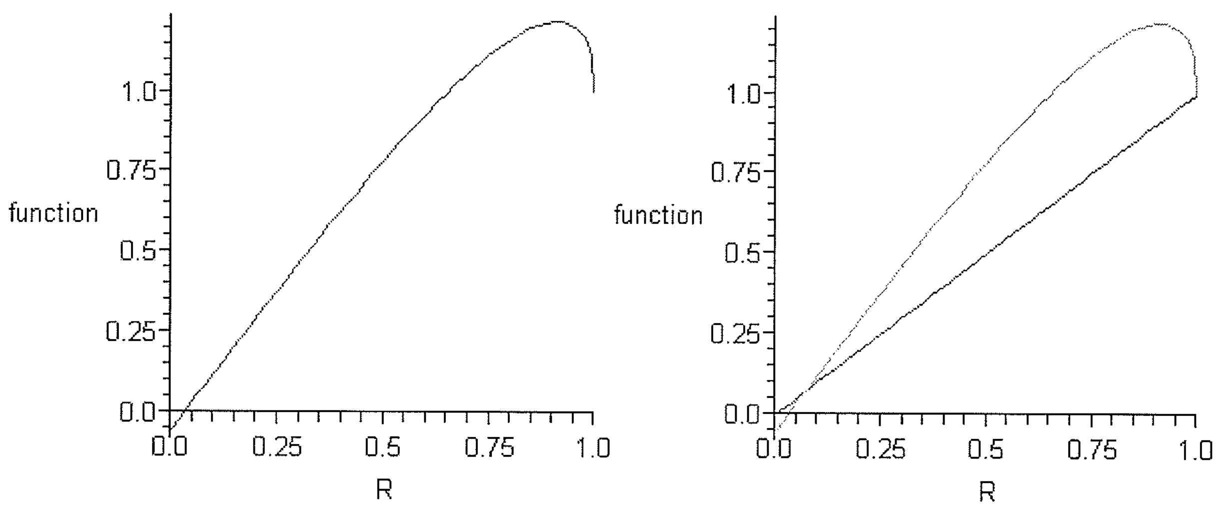


Figure A8. Plot of R^L versus R for $a = 0.1$ and $b = 0.2$.

This figure shows the relationship between normalized levered and unlevered returns.

The plot to the right includes a 45^0 line, showing where the normalized levered return R^L is lesser or greater than the unlevered return R, where R^L and R are both normalized values . To show the relationship between unlevered and levered returns, it is necessary to obtain the equation for the derivative $\frac{dR^L}{dR}$. However, it is not appropriate to simply take the derivative of the plot shown above because the result would show a negative relationship between R^L and R at high values of R (at the right-hand side of the plot) due to the non-linear manner in which returns are normalized to the range [0,1] in this proof. For both the levered return R^L and unlevered return R are normalized to the range [0,1] with the numeraire, or common unit of measure, implicitly being $\sigma = \sqrt{1-R^2}$. Therefore, the normalized values must be converted to nominal values using this numeraire before calculating derivatives that compare one variable with the other:

$$R^* = \frac{R}{\sqrt{1-R^2}}$$

$$R^{L*} = \frac{R^L}{\sqrt{1-R^2}} = \frac{R}{\sqrt{1-R^2}} - \frac{R\left(a-\sqrt{a^2+ab\sqrt{-(R-1)(R+1)}}\right)}{a\sqrt{1-R^2}} - \frac{\left(a-\sqrt{a^2+ab\sqrt{-(R-1)(R+1)}}\right)^2}{a\sqrt{1-R^2}}$$

The nominal functions for R^* and R^{L*} are plotted versus normalized R below with $a = 0.1$ and $b = 0.2$:

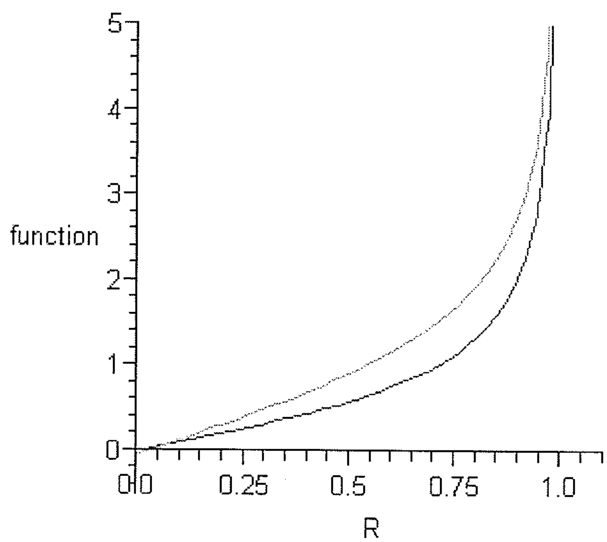


Figure A9. Plot of R^* and R^{L*} versus R for $a = 0.1$ and $b = 0.2$.

This figure shows the relationship between nominal unlevered and levered returns.

The levered return R^{L*} line starts out negative, where unlevered return R^* is below the risk-free rate, but rises above the unlevered returns line thereafter. Next, take derivatives of these functions and combine to obtain the intermediate results:

$$\frac{dR^*}{dR} = \frac{R}{\sqrt{1-R^2}} + \frac{R^2}{\left(1-R^2\right)^{3/2}}$$

$$\begin{aligned}\frac{dR^{L*}}{dR} = \frac{1}{\sqrt{1-R^2}}&\left(1-\frac{1}{2}\frac{bR^2}{\sqrt{a^2+ab\sqrt{-(R-1)(R+1)}}\sqrt{-(R-1)(R+1)}} - \frac{a-\sqrt{a^2+ab\sqrt{-(R-1)(R+1)}}}{a}\right.\\ &\left. - \frac{\left(a-\sqrt{a^2+ab\sqrt{-(R-1)(R+1)}}\right)bR}{\sqrt{a^2+ab\sqrt{-(R-1)(R+1)}}\sqrt{-(R-1)(R+1)}}\right)\\ &+\frac{1}{\left(1-R^2\right)^{3/2}}\left(R\left(R-\frac{R\left(a-\sqrt{a^2+ab\sqrt{-(R-1)(R+1)}}\right)}{a}-\frac{\left(a-\sqrt{a^2+ab\sqrt{-(R-1)(R+1)}}\right)^2}{a}\right)\right)\end{aligned}$$

The desired derivative is then simply the ratio of the two intermediate results:

$$\frac{dR^L}{dR} = \frac{dR^{L*}}{dR}\Big/\frac{dR^*}{dR}$$

The resultant equation for $\frac{dR^L}{dR}$ is omitted for brevity. The derivative $\frac{dR^L}{dR}$ and its inverse $\frac{dR}{dR^L} = 1\Big/\frac{dR^L}{dR}$ are plotted below with $a = 0.1$ and $b = 0.2$:

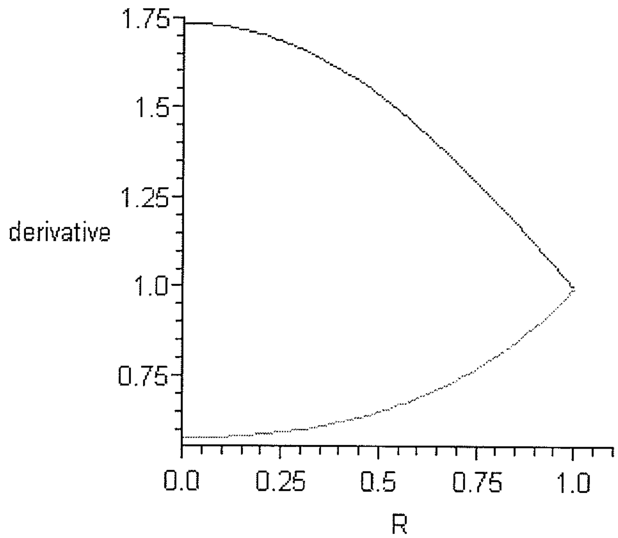


Figure A10. Plot of $\frac{dR^L}{dR}$ and its Inverse $\frac{dR}{dR^L}$ versus R for $a = 0.1$ and $b = 0.2$.

This figure shows that levered and unlevered returns converge with increasing unlevered return, reflecting the reduction in leverage.

The upper line is the derivative $\frac{dR^L}{dR} \geq 1.0$, showing that levered return is positively related to unlevered return R. However, the relative rate of change for levered returns decreases to the same rate as unlevered returns, that is to say $\frac{dR^L}{dR} = 1.0$, at the point where unlevered return $R = 1.0$ in normalized value (infinity in nominal) which corresponds to a leverage level of zero, $l = 0.0$.

The final step is to extend the result between leverage and unlevered returns to levered returns. The previous section showed that levered is negatively related to unlevered returns:

$$\frac{dL}{dR} < 0$$

This derivative can be expanded to show the relationship between leverage and levered returns:

$$\frac{dL}{dR^L} = \frac{dL}{dR}\frac{dR}{dR^L} = \underset{(-ve)}{\frac{dL}{dR}} \underset{(+ve)}{\left(1 \Big/ \frac{dR^L}{dR}\right)} < 0$$

Again for brevity, the resultant equation for $\frac{dL}{dR^L}$ is omitted since it is simply a combination of previously shown intermediate results. The plot of both $\frac{dL}{dR}$ and $\frac{dL}{dR^L}$ for $a = 0.1$ and $b = 0.2$ is shown below:

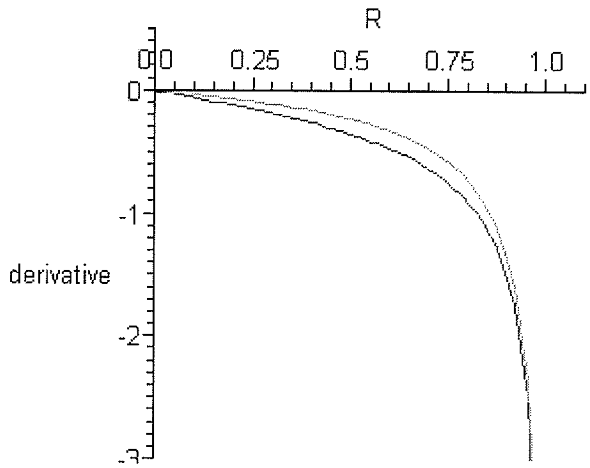


Figure A11. Plot of $\frac{dL}{dR}$ and $\frac{dL}{dR^L}$ versus R for $a = 0.1$ and $b = 0.2$.

This figure shows that leverage per unit of levered return declines more slowly than per unit of unlevered return.

The upper line is the derivative of leverage with respect to levered returns $\frac{dL}{dR^L}$, showing that leverage declines more slowly per unit of levered return than for per unit of unlevered return, which simply reflects that levered returns are always greater than unlevered returns. The plot shows that leverage is negatively related to levered returns:

$$\frac{dL}{dR^L} < 0$$

Thus, leverage is negatively related to both unlevered and levered returns, giving the general result:

$$\frac{dL}{dR} < 0, \quad \frac{dL}{dR^L} < 0. \qquad \text{Q.E.D.}$$

A7: Sharpe Ratios of Unlevered and Levered Equity

The objective of this section is to show that the Sharpe ratio of unlevered equity increases faster than for levered equity with increasing returns, explaining the motivation for the negative relationship between leverage and returns. The investor Sharpe ratio gives the excess return per unit of risk, and so if the Sharpe ratio of unlevered equity is increasing faster than for levered equity as returns increase, then investors will shift their portfolio allocation toward less leverage as returns increase. The Sharpe ratio is defined as:

$$S = \frac{R - R_f}{\sigma}$$

However, the investor and the firm have somewhat different Sharpe ratios[16]:

Investor:	$S = \frac{R - B}{\sigma}$	measures return on investment
Firm:	$F = \frac{R - A}{\sigma}$	measures cost of capital

[16]In these Sharpe ratios, after-tax riskless bond returns are shown as $A = r(1 - T_c)$ for the firm and $B = r(1 - T_{pb})$ for investors, while after-tax equity return is shown as R because of the simplifying assumption that $T_{ps} = 0$, and so $R(1 - T_{ps}) \to R$.

A7.1: Sharpe Ratios of Investors

For unlevered equity, the investor Sharpe ratio is simply:

$$S = \frac{R - B}{\sigma} = \frac{R - b\sqrt{1 - R^2}}{\sqrt{1 - R^2}}$$

The unlevered Sharpe ratio S versus unlevered return R is plotted below with $b = 0.2$:

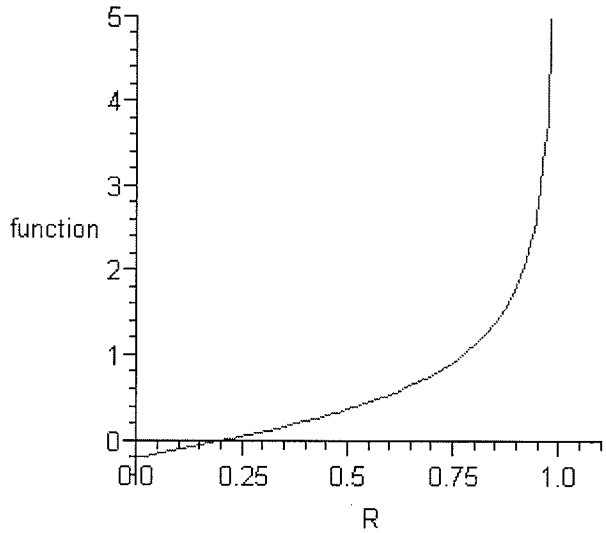


Figure A12. Plot of S versus R for $b = 0.2$.

This figure shows that the unlevered Sharpe ratio increases with unlevered return.

The Sharpe ratio is negative for low values of unlevered returns, indicating that the unlevered return is less than the risk-free rate and so investors' opportunity set line P is downward sloping. Such negative values are outside the feasible range in a rational market. In other words, in a rational market, the optimal leverage point cannot occur where the Sharpe ratio is negative.

To determine how the Sharpe ratio for unlevered equity varies with unlevered returns, differentiate:

$$\frac{dS}{dR} = \frac{1 + \frac{bR}{\sqrt{1-R^2}}}{\sqrt{1-R^2}} + \frac{R\left(R - b\sqrt{1-R^2}\right)}{(1-R)^{3/2}}$$

The characteristic of $\frac{dS}{dR}$ versus unlevered return R for $b = 0.2$ is plotted below:

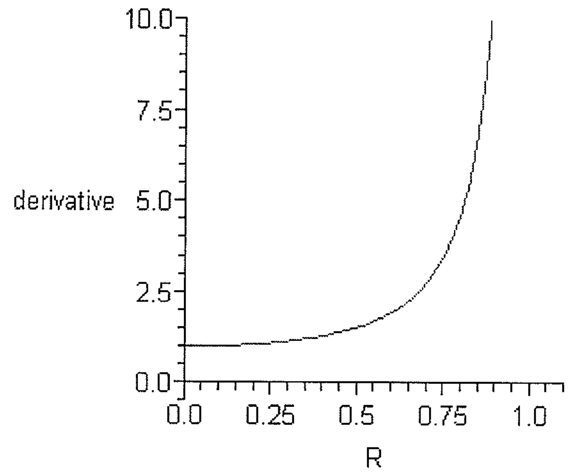


Figure A13. Plot of $\frac{dS}{dR}$ versus R for $b = 0.2$.

This figure shows that the slope of the unlevered Sharpe ratio is always positive.

This plot shows that the rate of change of the Sharpe ratio for unlevered equity positively relatively to unlevered returns:

$$\frac{dS}{dR} > 0$$

For levered equity, the Sharpe ratio defined in terms of unlevered returns is the slope at the point of equilibrium leverage, which has been previously defined as the slope m_2:

$$S^L = m_2 = \frac{R + l\sin(\theta_0) - al^2 - b\sqrt{1-R^2}}{\sqrt{1-R^2} + l\cos(\theta_0)} = \frac{R + lR - al^2 - b\sqrt{1-R^2}}{\sqrt{1-R^2} + l\sqrt{1-R^2}}$$

At the equilibrium leverage point, optimal leverage l has been previously found to be:

$$l = \frac{\sqrt{a^2 + ab\sqrt{-(R-1)(R+1)}} - a}{a}$$

Substituting for leverage gives the equation:

$$S^L = \frac{1}{1 + \frac{\sqrt{a^2 + ab\sqrt{-(R-1)(R+1)}} - a}{a}} \cdot \left(R - \frac{R\left(a - \sqrt{a^2 + ab\sqrt{-(R-1)(R+1)}}\right)}{a} - \frac{\left(a - \sqrt{a^2 + ab\sqrt{-(R-1)(R+1)}}\right)^2}{a} - b\sqrt{1 - R^2} \right)$$

The characteristic of the levered Sharpe ratio S^L versus unlevered return R for $a = 0.1$ and $b = 0.2$ is plotted below:

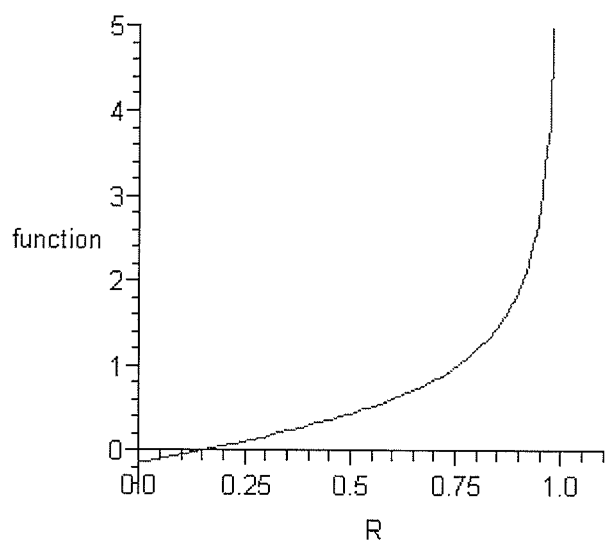


Figure A14. Plot of S^L versus R for $a = 0.1$ and $b = 0.2$.

This figure shows that the levered Sharpe ratio increases with levered return.

The Sharpe ratio is negative for low values of unlevered returns, indicating that the unlevered return is less than the risk-free rate and so investors' opportunity set line P is downward sloping. Such negative values are outside the feasible range in a perfectly rational market.

Differentiating the levered Sharpe ratio with respect to unlevered returns gives:

$$
\begin{aligned}
\frac{dS^L}{dR} = {} & \frac{1}{1+\dfrac{\sqrt{a^2+ab\sqrt{-(R-1)(R+1)}}-a}{a}}\left(1-\frac{1}{2}\frac{bR^2}{\sqrt{a^2+ab\sqrt{-(R-1)(R+1)}}\sqrt{-(R-1)(R+1)}}\right. \\
& \left. -\frac{\left(a-\sqrt{a^2+ab\sqrt{-(R-1)(R+1)}}\right)}{a} - -\frac{bR\left(a-\sqrt{a^2+ab\sqrt{-(R-1)(R+1)}}\right)}{\sqrt{a^2+ab\sqrt{-(R-1)(R+1)}}\sqrt{-(R-1)(R+1)}}+\frac{bR}{\sqrt{1-R^2}}\right) \\
& +\frac{1}{2}\left(\left(R-\frac{R\left(a-\sqrt{a^2+ab\sqrt{-(R-1)(R+1)}}\right)}{a}-\frac{\left(a-\sqrt{a^2+ab\sqrt{-(R-1)(R+1)}}\right)^2}{a}-b\sqrt{1-R^2}\right)bR\right) \\
& \Bigg/ \left(\left(1-\frac{\left(a-\sqrt{a^2+ab\sqrt{-(R-1)(R+1)}}\right)}{a}\right)^2 \sqrt{a^2+ab\sqrt{-(R-1)(R+1)}}\,(-(R-1)(R+1))^{1/2}\right)
\end{aligned}
$$

The characteristic of $\frac{dS^L}{dR}$ versus R for $a = 0.1$ and $b = 0.2$ is plotted below:

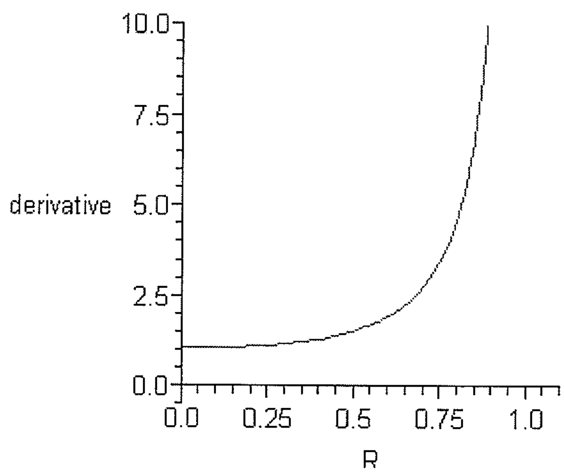


Figure A15. Plot of $\frac{dS^L}{dR}$ versus R for $a = 0.1$ and $b = 0.2$.

This figure shows that the slope of the levered Sharpe ratio is always positive.

This plot shows that the rate of change of the Sharpe ratio for levered equity is positively relatively to unlevered returns:

$$\frac{dS^L}{dR} > 0$$

To compare the properties of the unlevered versus levered Sharpe ratios, S and S^L, the ratios are plotted together below:

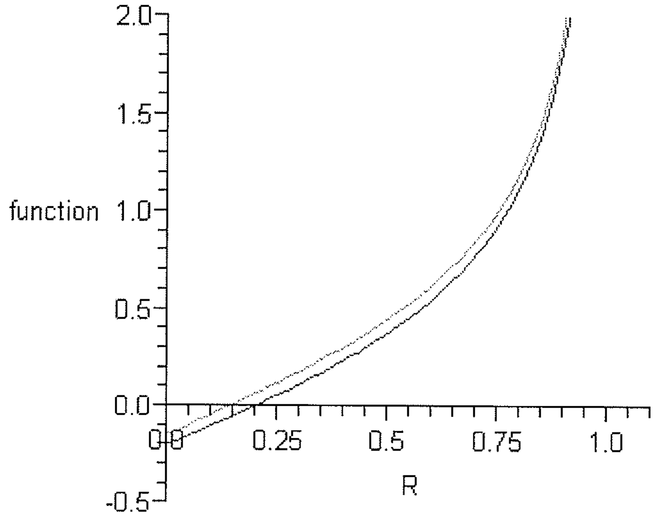


Figure A16. Plot of S and S^L versus R for $a = 0.1$ and $b = 0.2$.

This figure shows that the Sharpe ratio for unlevered equity increases faster than the ratio for levered equity as expected return increases, implying a shift toward lower leverage as expected return increases.

The upper line in the plot is the levered Sharpe ratio S^L, showing that the levered ratio is greater than the unlevered Sharpe ratio S, but the lines converge at high R:

$$S^L \geq S$$

$$\lim_{R \to 1} S \to S^L$$

The ratio of levered Sharpe ratio over unlevered Sharpe ratio is plotted below:

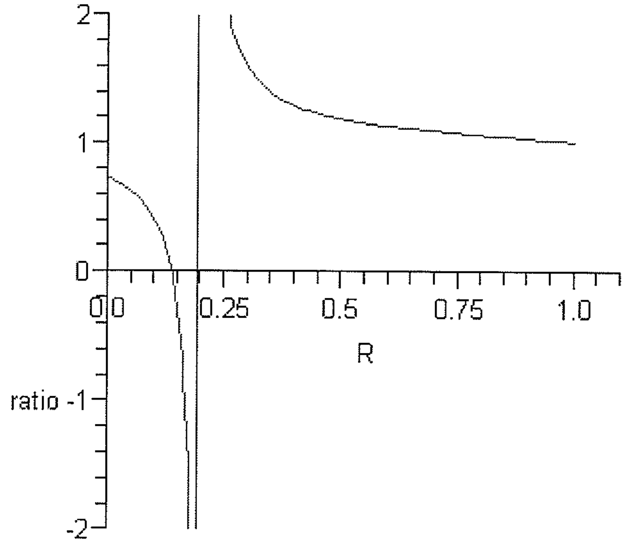
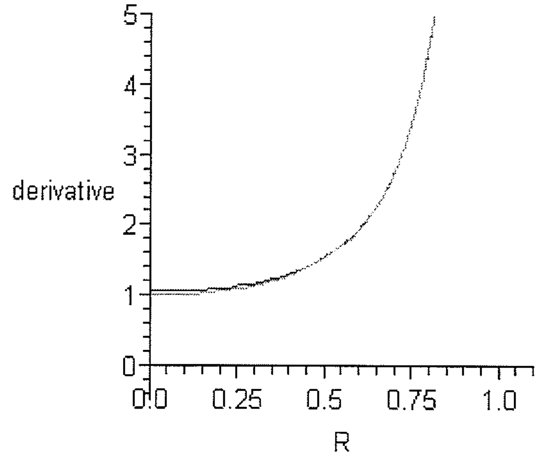


Figure A17. Plot of $\frac{S^L}{S}$ versus R for $a = 0.1$ and $b = 0.2$.

This figure shows that the levered Sharpe ratio is always greater than the unlevered Sharpe ratio, but the ratios converge at high expected return.

The relevant range of the plot for the $\frac{S^L}{S}$ ratio is the right-hand side of the plot which corresponds to the region where the unlevered return R is above the risk-free rate. Here, the ratio declines to unity with increasing returns as the Sharpe ratio of unlevered equity increases relative to the levered Sharpe ratio.

Next, the derivatives of the unlevered and levered Sharpe ratios are plotted together:



b

Figure A18. Plot of $\frac{dS}{dR}$ and $\frac{dS^L}{dR}$ versus R for $a = 0.1$ and $b = 0.2$.

This figure shows that the slope of the unlevered Sharpe ratio increases faster than the slope of the levered Sharpe ratio.

The plot shows that the rate of change for the levered Sharpe ratio $\frac{dS^L}{dR}$ is initially greater than for unlevered rate of change $\frac{dS}{dR}$, but the lines cross over as R increases. The crossover is illustrated by plotting the difference between the two rates of change:

$$difference = \frac{dS^L}{dR} - \frac{dS}{dR}$$

The difference between the two derivatives is plotted below with $a = 0.1$ and $b = 0.2$:

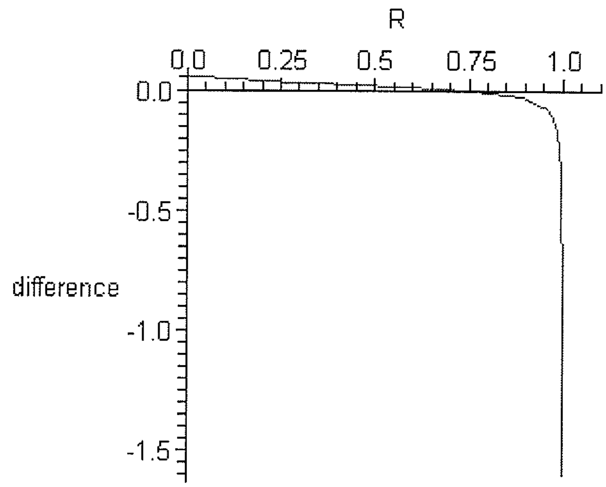


Figure A19. Plot of $\frac{dS^L}{dR} - \frac{dS}{dR}$ versus R for $a = 0.1$ and $b = 0.2$.

This figure shows the difference in slopes between the levered and unlevered ratios.

The implication of this difference line is that the Sharpe ratio for unlevered equity is increasing at a faster the rate, $\frac{dS}{dR}$, than the rate of increase for levered equity $\frac{dS^L}{dR}$, with the unlevered rate of change becoming greater at high return R:

$$\lim_{R \to 0} \frac{dS}{dR} < \frac{dS^L}{dR}$$

$$\lim_{R \to 1} \frac{dS}{dR} > \frac{dS^L}{dR}$$

A7.2: Sharpe Ratios of Firms

The Sharpe ratios for the firm are:

$$F = \frac{R - A}{\sigma} = \frac{R}{\sqrt{1 - R^2}}$$

$$F^L = m_2 = \frac{R + l\sin(\theta_0) - al^2 - A}{\sqrt{1 - R^2} + l\cos(\theta_0)} = \frac{R + lR - al^2}{\sqrt{1 - R^2} + l\sqrt{1 - R^2}}$$

Recall that the simplifying assumption has been made that the corporate risk-free rate is zero, $A = r(1 - T_c) = 0.0$. This assumption does not affect the generality of the results. The Sharpe ratios for the firm are similar to those of the investor and so, for brevity, their derivation is not shown here. To compare the properties of the unlevered versus levered Sharpe ratios, F and F^L, the ratios are plotted together below:

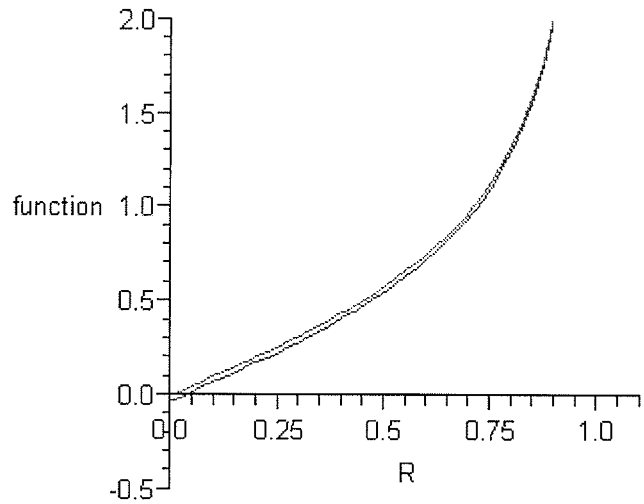


Figure A20. Plot of F and F^L versus R for $a = 0.1$ and $b = 0.2$.
This figure shows that the firm's levered Sharpe ratio is increasing relative to the unlevered ratio as expected return increases, implying that the firm is motivated to reduce leverage as expected return increases.

The upper line in the plot is the unlevered Sharpe ratio F, showing that the unlevered ratio is greater than the levered Sharpe ratio F^L, but the lines converge at high R. In contrast, for the investor, the top line was the levered Sharpe ratio, S^L.

The ratio of the firm's levered Sharpe ratio over unlevered Sharpe ratio is plotted below:

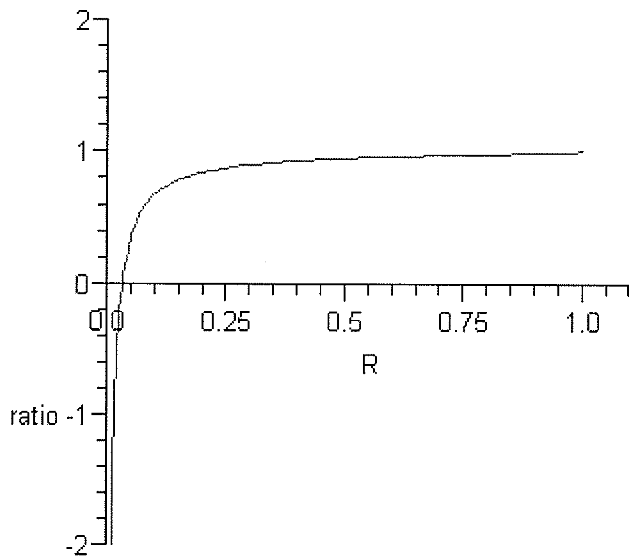


Figure A21. Plot of $\frac{F^L}{F}$ versus R for $a = 0.1$ and $b = 0.2$.

This figure shows that the firm's levered Sharpe ratio converges to the unlevered ratio at high returns.

The relevant range of the plot for the $\frac{F^L}{F}$ ratio is the right-hand side of the plot which corresponds to the region where the unlevered return R is above the risk-free rate. Here, the ratio rises to unity with increasing returns as the Sharpe ratio of levered equity increases relative to the unlevered Sharpe ratio. The investor's ratio, $\frac{S^L}{S}$, showed the opposite pattern.

The relative behavior of the Sharpe ratios of unlevered and levered equity provides the intuition for the negative relationship between leverage and returns. For while the investor's levered Sharpe ratio is always greater than or equal to the unlevered Sharpe ratio, $S^L \geq S$, the ratios converge as returns increase. The result is that unlevered equity becomes increasingly attractive relative to levered equity as return R increases, inducing a shift in portfolio allocation from levered to unlevered equity by investors. The firm's Sharpe ratios also push toward lower leverage as return R increases because the levered Sharpe ratio, which represents the cost of levered equity capital, rises relative to unlevered equity as R increases.

For brevity, the equations for some results such as $S^L \geq S$ are not derived here since the results are apparent from inspection of the plots. Also for brevity, all results have been shown with normalized returns R as the horizontal axis in the various plots; use of the normalized levered return R^L as the horizontal axis would shift the profile of the plots somewhat, but would not change the general results shown here.

A8: Proof of Relationship between Unlevered Volatility and Leverage: $\frac{dl}{d\sigma} < 0$.

The objective of this section is to establish the relationship between the optimal leverage level l and changes in the unlevered volatility σ, ceteris paribus.

Only the unlevered volatility σ changes; all other variables in the mean-variance plane such as returns, the bond rate, and tax rates remain constant. As in the previous analysis for returns, the analysis can therefore be simplified by assuming that $r(1-Tc) = A = 0$. This simplifying assumption does not affect the generality of the result. The relationship between variables in the normalized mean-variance plane is shown below:

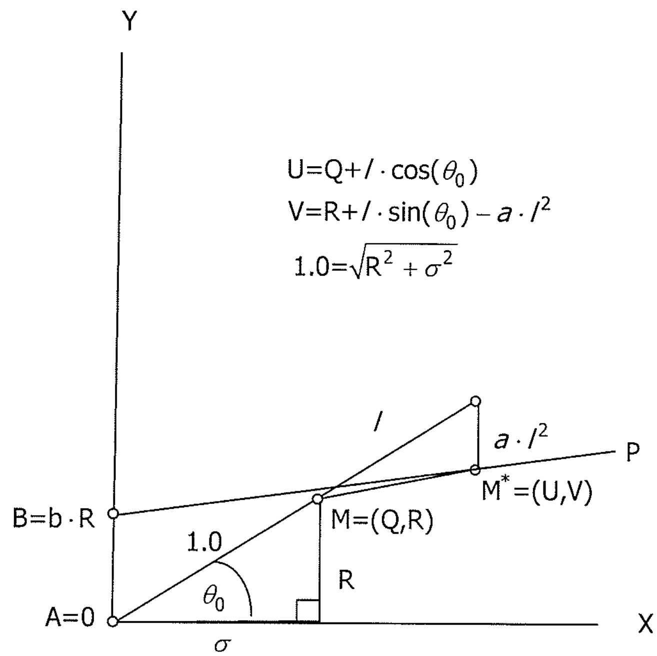


Figure A22. Model of Relationship between Volatility and Leverage.
This figure shows the model with the simplifying assumption that the risk-free corporate bond rate is zero, A=0.

This diagram is very similar to that in the previous analysis for expected unlevered returns, but the definition of point B changes. The point B on the vertical axis now has a fixed ratio with return R, determined by the constant b, because only the unlevered volatility σ varies in this analysis. If point A were not set to zero, then it too would need to defined as having a fixed ratio with return R (e.g. $A = c \cdot R$), but setting A to zero simplifies the solution. In effect, $R = \sqrt{1-\sigma^2}$ is the numeraire, or common unit of measure, in the mean variance plane.

Once again, the slopes of lines K and P, representing the investment opportunity set and the investor efficient set respectively, are equated and a solution for optimal leverage is derived. However, this time the equations are defined in terms of unlevered volatility σ, as shown below:

$$\theta_0 = \arctan\left(\frac{\sqrt{1-\sigma^2}}{\sigma}\right)$$

$$m_1 = \frac{\sin(\theta_0)}{\cos(\theta_0)} - \frac{2al}{\cos(\theta_0)} = \frac{\sqrt{1-\sigma^2}}{\sigma} - \frac{2al}{\sigma}$$

$$m_2 = \frac{\sqrt{1-\sigma^2} + l\sin(\theta_0) - al^2 - b\sqrt{1-\sigma^2}}{\sigma + l\cos(\theta_0)} = \frac{\sqrt{1-\sigma^2} + l\sqrt{1-\sigma^2} - al^2 - b\sqrt{1-\sigma^2}}{\sigma + l\sigma}$$

$$m_1 - m_2 = 0 = \frac{\sqrt{1-\sigma^2}}{\sigma} - \frac{2al}{\sigma} - \frac{\sqrt{1-\sigma^2} + l\sqrt{1-\sigma^2} - al^2 - b\sqrt{1-\sigma^2}}{\sigma + l\sigma}$$

Solving, the positive root of this quadratic equation is:

$$l = \frac{\sqrt{a^2 - ab\sqrt{-(\sigma-1)(\sigma+1)}} - a}{a}$$

The characteristic of equilibrium leverage l versus unlevered σ for $a = 0.1$ and $b = 0.2$ is plotted below:

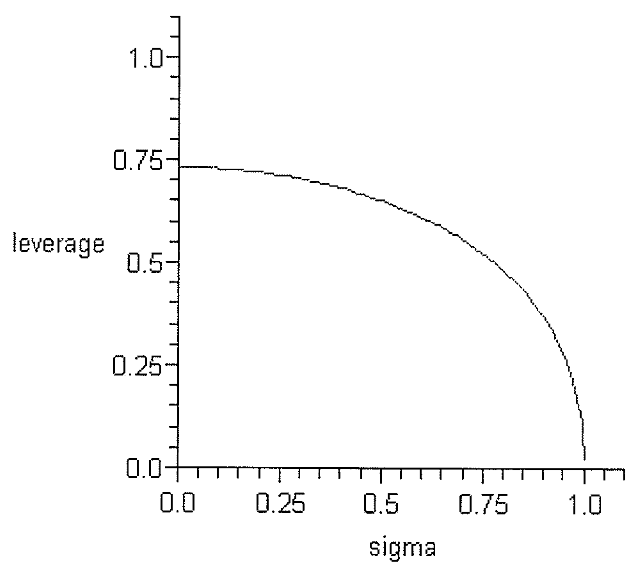


Figure A23. Plot of l versus σ for $a = 0.1$ and $b = 0.2$.

This figure shows that optimal leverage declines with increasing volatility.

Take the derivative of this function with respect to the unlevered volatility σ :

$$\frac{dl}{d\sigma} = -\frac{1}{2}\frac{b\sigma}{\sqrt{a^2 - ab\sqrt{-(\sigma-1)(\sigma+1)}}\sqrt{-(\sigma-1)(\sigma+1)}}$$

For feasible values of a , b and σ , the value of this derivative is negative. As an example, the characteristic of $\frac{dl}{d\sigma}$ for $a = 0.1$ and $b = 0.2$ is plotted below:

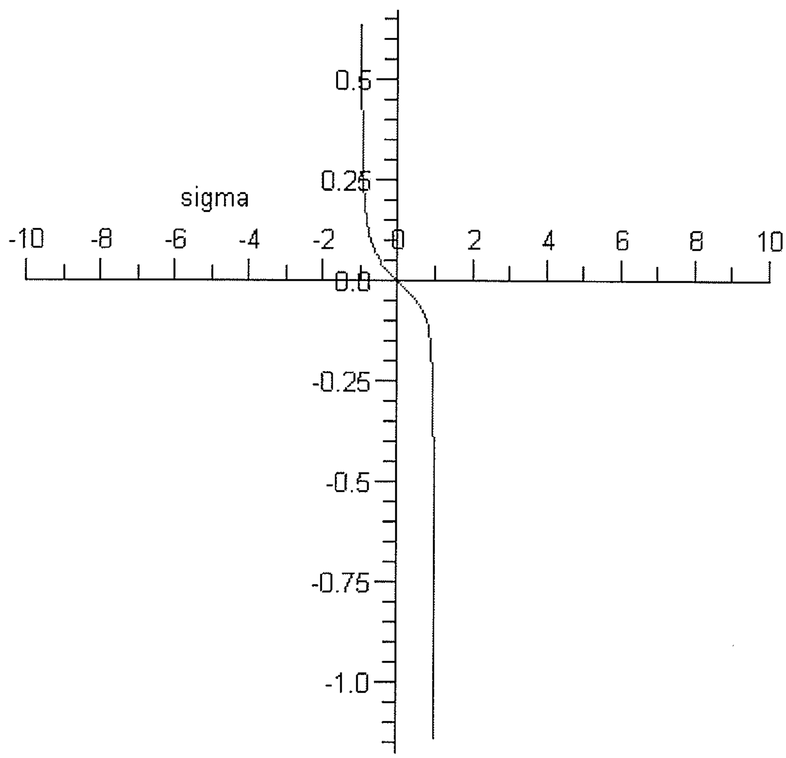


Figure A24. Plot of $\frac{dl}{d\sigma}$ versus σ for $a = 0.1$ and $b = 0.2$.

This figure shows that leverage is negatively related to volatility.

This plot shows that $\frac{dl}{d\sigma} < 0$ for positive unlevered volatility. This negative relationship holds for all feasible values for variables in the model, and therefore I conclude:

$$\frac{dl}{d\sigma} < 0 \qquad \text{Q.E.D.}$$

A9: Extension to Relationship between Levered Volatility and Leverage : $\frac{dl}{d\sigma^L} < 0$.

The objective of this section is to extend the previous result for the relationship between leverage and unlevered volatility σ to levered returns σ^L, because it is levered volatilities that are most commonly of interest in the real world.

Using the result of the previous section:

$$l = \frac{\sqrt{a^2 - ab\sqrt{-(\sigma-1)(\sigma+1)}} - a}{a}$$

The levered volatility at the equilibrium leverage point has been defined as:

$$U=Q+l\cdot\cos(\theta_0)=\sigma^L$$

Substituting for l and θ into this equation gives:

$$\sigma^L = \sigma - \frac{\sigma\left(a - \sqrt{a^2 + ab\sqrt{-(\sigma-1)(\sigma+1)}}\right)}{a}$$

The characteristic of σ^L versus unlevered σ for $a = 0.1$ and $b = 0.2$ is plotted below:

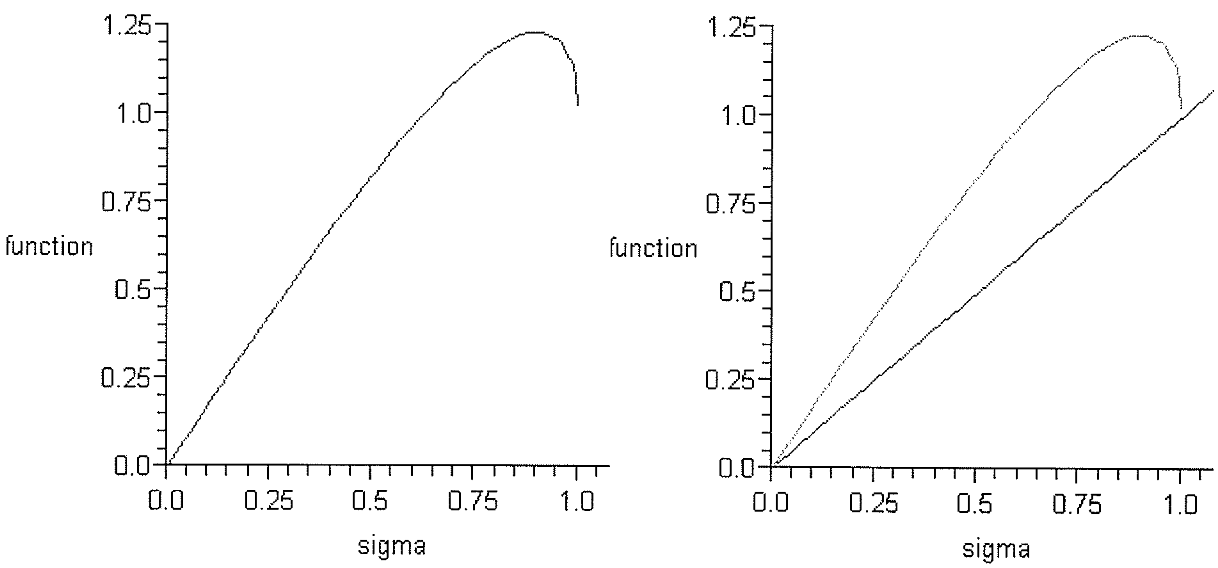


Figure A25. Plot of σ^L versus σ for $a = 0.1$ and $b = 0.2$.

This figure shows the relationship between normalized levered and unlevered returns.

The plot to the right includes a 45^0 line, showing where the normalized levered volatility σ^L is lesser or greater than the unlevered volatility σ, where σ^L and σ are both normalized values . To show the relationship between unlevered and levered volatilities, it is necessary to obtain the equation for the derivative $\frac{d\sigma^L}{d\sigma}$. However, it is not appropriate to simply take the derivative of the plot shown above because the result would mistakenly show a negative relationship between σ^L and σ at high values of σ (at the right-hand side of the plot) due to the non-linear manner in which volatilities are normalized to the range [0,1] in this proof. For both the levered volatility σ^L and unlevered volatility σ are normalized to the range [0,1] with the numeraire, or common unit of measure, implicitly being $R = \sqrt{1-\sigma^2}$. Therefore, the normalized values must be converted to nominal values using this numeraire before calculating derivatives that compare one variable with the other:

$$\sigma^* = \frac{\sigma}{\sqrt{1-\sigma^2}}$$

$$\sigma^{L*} = \frac{\sigma^L}{\sqrt{1-\sigma^2}} = \frac{\sigma}{\sqrt{1-\sigma^2}} - \sigma\frac{\left(a - \sqrt{a^2 + ab\sqrt{-(\sigma-1)(\sigma+1)}}\right)}{a\sqrt{1-\sigma^2}}$$

The nominal functions for σ^* and σ^{L*} are plotted versus normalized σ below with $a = 0.1$ and $b = 0.2$:

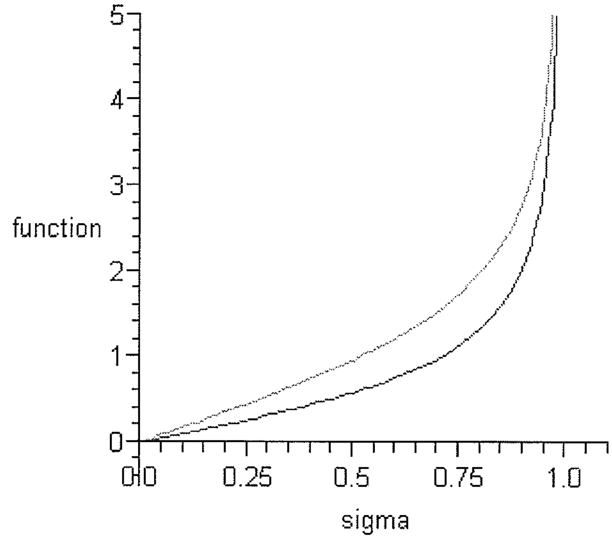


Figure A26. Plot of σ^* and σ^{L*} versus σ for $a = 0.1$ and $b = 0.2$.
This figure shows the relationship between nominal unlevered and levered volatility.

The levered return σ^{L*} is the upper line and is always greater than or equal to unlevered volatility σ^*. Next, take derivatives of these functions and combine to obtain the intermediate results:

$$\frac{d\sigma^*}{d\sigma} = \frac{1}{\sqrt{1-\sigma^2}} + \frac{\sigma^2}{\left(1-\sigma^2\right)^{3/2}}$$

$$\frac{d\sigma^{L*}}{d\sigma} = \frac{1}{\sqrt{1-\sigma^2}}\left(1 - \frac{1}{2}\frac{b\sigma^2}{\sqrt{a^2 + ab\sqrt{-(\sigma-1)(\sigma+1)}}\sqrt{-(\sigma-1)(\sigma+1)}} - \frac{a - \sqrt{a^2 + ab\sqrt{-(\sigma-1)(\sigma+1)}}}{a}\right) + \frac{1}{\left(1-\sigma^2\right)^{3/2}}\left(\sigma\left(\sigma - \frac{\sigma\left(a - \sqrt{a^2 + ab\sqrt{-(\sigma-1)(\sigma+1)}}\right)}{a}\right)\right)$$

The desired derivative is then simply the ratio of the two intermediate results:

$$\frac{d\sigma^L}{d\sigma} = \frac{d\sigma^{L*}}{d\sigma} \Bigg/ \frac{d\sigma^*}{d\sigma}$$

The resultant equation for $\dfrac{d\sigma^L}{d\sigma}$ is omitted for brevity. The derivative $\dfrac{d\sigma^L}{d\sigma}$ and its inverse $\dfrac{d\sigma}{d\sigma^L} = 1 \Big/ \dfrac{d\sigma^L}{d\sigma}$ are plotted below with $a = 0.1$ and $b = 0.2$:

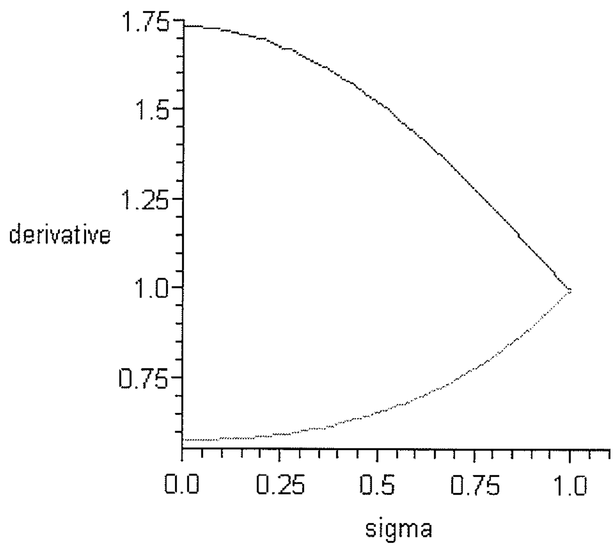


Figure A27. Plot of $\dfrac{d\sigma^L}{d\sigma}$ and its Inverse $\dfrac{d\sigma}{d\sigma^L}$ versus σ for $a = 0.1$ and $b = 0.2$.

This figure shows that levered and unlevered volatilities converge with increasing unlevered volatility, reflecting the reduction in leverage.

The upper line is the derivative $\dfrac{d\sigma^L}{d\sigma} \geq 1.0$, showing that levered volatility is positively related to unlevered volatility. Here, the relative rate of change for levered volatility decreases to the same rate as unlevered volatility, that is to say $\dfrac{d\sigma^L}{d\sigma} = 1.0$, at the point where the unlevered volatility $\sigma = 1.0$ in normalized value (infinity in nominal) which corresponds to a leverage level of zero, $l = 0.0$.

The final step is to extend the result between leverage and unlevered volatility to levered volatility. The previous section showed that levered is negatively related to unlevered volatility:

$$\frac{dL}{d\sigma} < 0$$

This derivative can be expanded to show the relationship between leverage and levered volatility:

$$\frac{dL}{d\sigma^L} = \frac{dL}{d\sigma}\frac{d\sigma}{d\sigma^L} = \underset{(-ve)}{\frac{dL}{d\sigma}}\underset{(+ve)}{\left(1\Big/\frac{d\sigma^L}{d\sigma}\right)} < 0$$

Again for brevity, the resultant equation for $\frac{dL}{d\sigma^L}$ is omitted since it is simply a combination of previously shown intermediate results. The plot of both $\frac{dL}{d\sigma}$ and $\frac{dL}{d\sigma^L}$ for $a = 0.1$ and $b = 0.2$ is shown below:

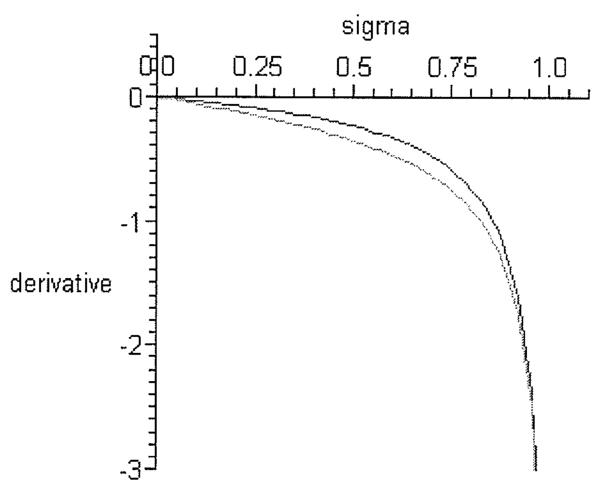


Figure A28. Plot of $\frac{dL}{d\sigma}$ and $\frac{dL}{d\sigma^L}$ versus σ for $a = 0.1$ and $b = 0.2$.

This figure shows that leverage per unit of levered volatility declines more slowly than per unit of unlevered volatility.

The upper line is the derivative of leverage with respect to levered returns $\frac{dL}{dR^L}$, showing that leverage declines less rapidly per unit of levered volatility than for per unit of unlevered volatility, which simply reflects that levered volatility is always greater than unlevered volatility. The plot shows that leverage is negatively related to levered volatility:

$$\frac{dL}{d\sigma^L} < 0$$

Thus, leverage is negatively related to both unlevered and levered volatility, giving the general result:

$$\frac{dL}{d\sigma} < 0, \quad \frac{dL}{d\sigma^L} < 0. \qquad \text{Q.E.D.}$$

A10: Sharpe Ratios of Unlevered and Levered Volatility

The objective of this section is to show that the Sharpe ratio of unlevered equity decreases more slowly than for levered equity with increasing volatility, explaining the motivation for the negative relationship between leverage and volatility. The investor Sharpe ratio gives the excess return per unit of risk, and so if the Sharpe ratio of unlevered equity is decreasing more slowly than for levered equity as volatility increases, then investors will shift their portfolio allocation toward less leverage as volatility increases. The Sharpe ratio is defined as:

$$S = \frac{R - R_f}{\sigma}$$

However, the investor and the firm have somewhat different Sharpe ratios:

Investor:	$S = \frac{R - B}{\sigma}$	measures return on investment
Firm:	$F = \frac{R - A}{\sigma}$	measures cost of capital

A10.1: Sharpe Ratios of Investors

For unlevered equity, the investor Sharpe ratio is simply:

$$S = \frac{R - B}{\sigma} = \frac{\sqrt{1-\sigma^2} - b\sqrt{1-\sigma^2}}{\sigma}$$

The unlevered Sharpe ratio S versus unlevered volatility σ is plotted below with $b = 0.2$:

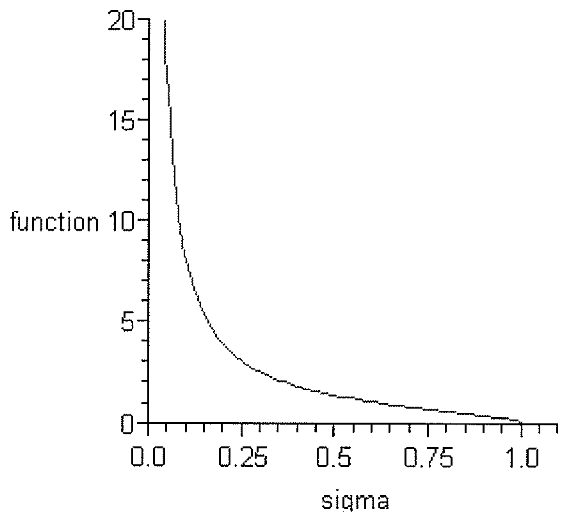


Figure A29. Plot of S versus σ for $b = 0.2$.

This figure shows that the unlevered Sharpe ratio decreases with unlevered volatility.

The Sharpe ratio declines rapidly with increasing volatility. To determine how the Sharpe ratio for unlevered equity varies with unlevered returns, differentiate:

$$\frac{dS}{d\sigma} = \frac{-\frac{1}{2}\frac{1}{\sqrt{1-\sigma^2}} + \frac{b\sigma}{\sqrt{1-\sigma^2}}}{\sigma} - \frac{\sqrt{1-\sigma^2} - b\sqrt{1-R^2}}{\sigma^2}$$

The characteristic of $\frac{dS}{d\sigma}$ versus unlevered volatility σ for $b = 0.2$ is plotted below:

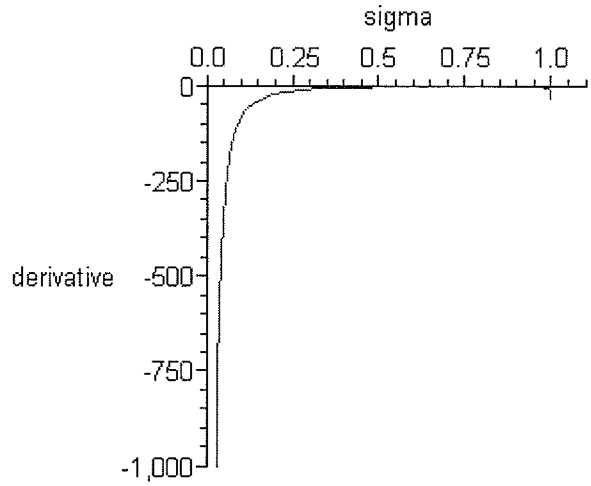


Figure A30. Plot of $\frac{dS}{d\sigma}$ versus σ for $b = 0.2$.

This figure shows that the slope of the unlevered Sharpe ratio is always negative.

This plot shows that the rate of change of the Sharpe ratio for unlevered equity is negatively relatively to unlevered volatility:

$$\frac{dS}{d\sigma} < 0$$

For levered equity, the Sharpe ratio defined in terms of unlevered volatility is the slope at the point of equilibrium leverage, which has been previously defined as the slope m_2:

$$S^L = m_2 = \frac{R + l\sin(\theta_0) - al^2 - B}{\sigma + l\cos(\theta_0)} = \frac{\sqrt{1-\sigma^2} + l\sqrt{1-\sigma^2} - al^2 - b\sqrt{1-\sigma^2}}{\sigma + l\sigma}$$

At the equilibrium leverage point, optimal leverage l has been previously found to be:

$$l = \frac{\sqrt{a^2 - ab\sqrt{-(\sigma-1)(\sigma+1)}} - a}{a}$$

Substituting for leverage gives the equation:

$$S^L = \frac{1}{\sigma - \frac{\sigma\left(\sqrt{a^2 + ab\sqrt{-(\sigma-1)(\sigma+1)}} - a\right)}{a}} \cdot \left(\sqrt{1-\sigma^2} - \frac{\sqrt{1-\sigma^2}\left(a - \sqrt{a^2 + ab\sqrt{-(\sigma-1)(\sigma+1)}}\right)}{a} - \frac{\left(a - \sqrt{a^2 + ab\sqrt{-(\sigma-1)(\sigma+1)}}\right)^2}{a} - b\sqrt{1-\sigma^2} \right)$$

The characteristic of the levered Sharpe ratio S^L versus unlevered volatility σ for $a = 0.1$ and $b = 0.2$ is plotted below:

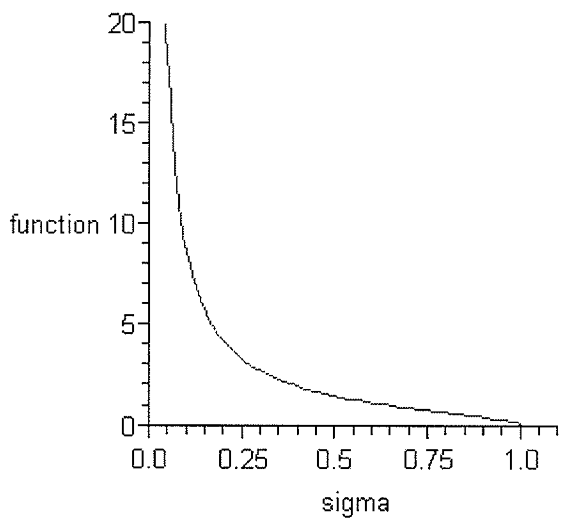


Figure A31. Plot of S^L versus σ for $a = 0.1$ and $b = 0.2$.

This figure shows that the levered Sharpe ratio decreases with unlevered volatility.

The levered Sharpe ratio is again negatively related to unlevered volatility. Differentiating the levered Sharpe ratio equation with respect to unlevered volatility gives:

$$\frac{dS^L}{dR} = \frac{1}{\sigma - \frac{\sigma\left(\sqrt{a^2 + ab\sqrt{-(\sigma-1)(\sigma+1)}} - a\right)}{a}} \left(- - \frac{\sigma}{\sqrt{1-\sigma^2}} - \frac{1}{2}\frac{b\sigma\sqrt{1-\sigma^2}}{\sqrt{a^2 + ab\sqrt{-(\sigma-1)(\sigma+1)}}\sqrt{-(\sigma-1)(\sigma+1)}} \right.$$

$$+ \frac{\sigma\left(a - \sqrt{a^2 + ab\sqrt{-(\sigma-1)(\sigma+1)}}\right)}{a\sqrt{1-\sigma^2}} - - \frac{b\sigma\left(a - \sqrt{a^2 + ab\sqrt{-(\sigma-1)(\sigma+1)}}\right)}{\sqrt{a^2 + ab\sqrt{-(\sigma-1)(\sigma+1)}}\sqrt{-(\sigma-1)(\sigma+1)}} \left. + \frac{b\sigma}{\sqrt{1-\sigma^2}} \right)$$

$$- \left(\left(\sqrt{1-\sigma^2} - \frac{\sqrt{1-\sigma^2}\left(a - \sqrt{a^2 + ab\sqrt{-(\sigma-1)(\sigma+1)}}\right)}{a} \frac{\left(a - \sqrt{a^2 + ab\sqrt{-(\sigma-1)(\sigma+1)}}\right)^2}{a} - b\sqrt{1-\sigma^2} \right) \right.$$

$$\left. \left(1 - \frac{1}{2}\frac{b\sigma^2}{\sqrt{a^2 + ab\sqrt{-(\sigma-1)(\sigma+1)}}\sqrt{-(\sigma-1)(\sigma+1)}} - \frac{\left(a - \sqrt{a^2 + ab\sqrt{-(\sigma-1)(\sigma+1)}}\right)}{a} \right) \right)$$

$$\Bigg/ \left(\sigma - \frac{\sigma\left(a - \sqrt{a^2 + ab\sqrt{-(\sigma-1)(\sigma+1)}}\right)}{a} \right)^2$$

The characteristic of $\frac{dS^L}{d\sigma}$ versus σ for $a = 0.1$ and $b = 0.2$ is plotted below:

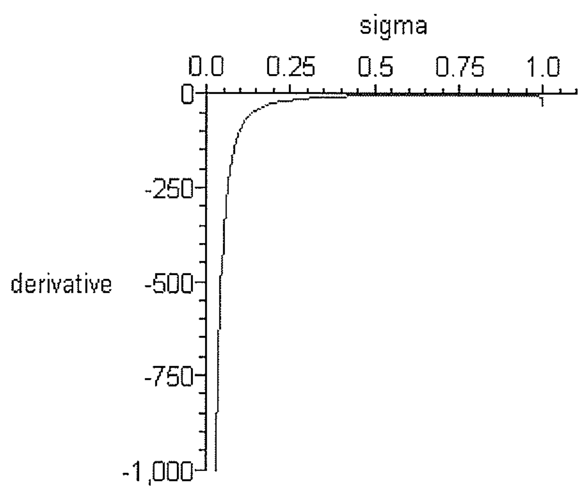


Figure A32. Plot of $\frac{dS^L}{d\sigma}$ versus σ for $a = 0.1$ and $b = 0.2$.

This figure shows that the slope of the levered Sharpe ratio is always negative.

This plot of $\frac{dS^L}{d\sigma}$ shows that the rate of change of the Sharpe ratio for levered equity is negatively relatively to unlevered volatility:

$$\frac{dS^L}{d\sigma} < 0$$

To compare the properties of the unlevered versus levered Sharpe ratios, S and S^L, the ratios are plotted together below:

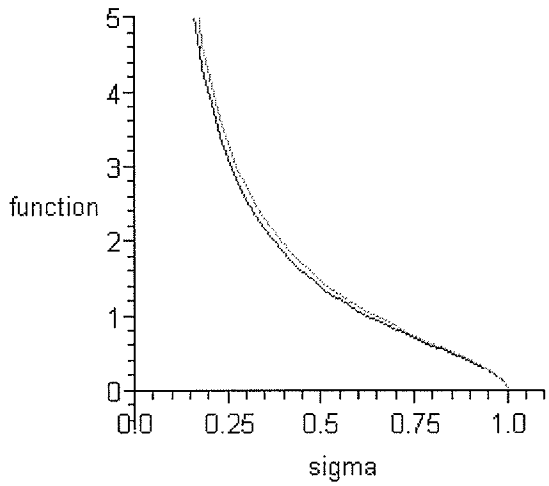


Figure A33. Plot of S and S^L versus σ for $a = 0.1$ and $b = 0.2$.
This figure shows that the Sharpe ratio for unlevered equity decreases more slowly than for levered equity as volatility increases, implying a shift toward lower leverage as volatility increases.

The upper line in the plot is the levered Sharpe ratio S^L, showing that the levered ratio is greater than the unlevered Sharpe ratio S, but the lines converge at $\sigma = 1.0$ (infinite volatility):

$$S^L \geq S$$

$$\lim_{\sigma \to 1} S \to S^L$$

The ratio of levered Sharpe ratio over unlevered Sharpe ratio is plotted below:

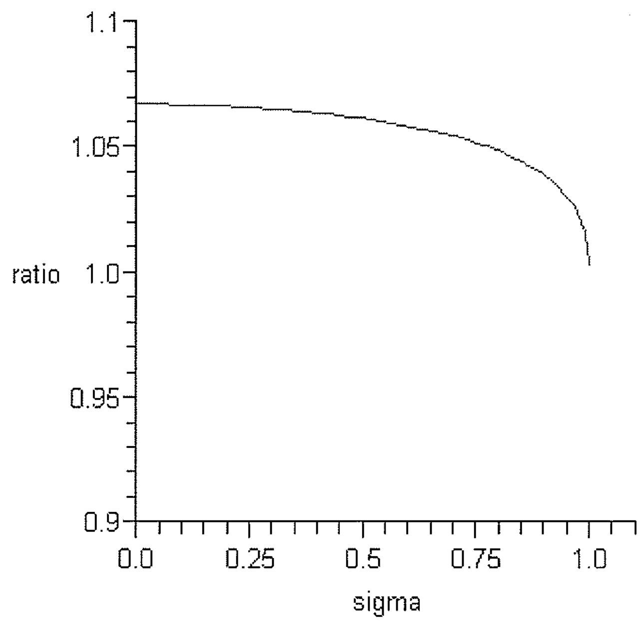


Figure A34. Plot of $\frac{S^L}{S}$ versus σ for $a = 0.1$ and $b = 0.2$.

This figure shows that the levered Sharpe ratio is always greater than the unlevered Sharpe ratio, but the ratios converge at high volatility.

Here, the $\frac{S^L}{S}$ ratio declines to unity with increasing volatility as the Sharpe ratio of unlevered equity declines more slowly relative to the levered Sharpe ratio. Next, the derivatives of the unlevered and levered Sharpe ratios are plotted together:

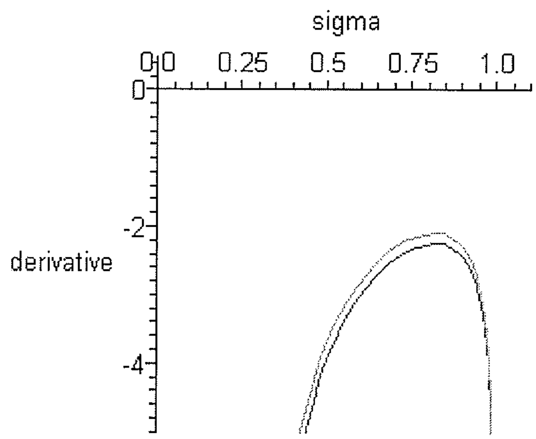


Figure A35. Plot of $\frac{dS}{d\sigma}$ and $\frac{dS^L}{d\sigma}$ versus σ for $a = 0.1$ and $b = 0.2$.

This figure shows that the slope of the levered Sharpe ratio is always lower than for the unlevered Sharpe ratio.

The lower line is the rate of decline for the levered Sharpe ratio $\frac{dS^L}{dR}$, showing that the levered Sharpe ratio declines more rapidly than the unlevered Sharpe ratio as volatility increases. This is illustrated by plotting the difference between the two rates of change:

$$difference = \frac{dS^L}{dR} - \frac{dS}{dR}$$

The difference between the two derivatives is plotted below with $a = 0.1$ and $b = 0.2$:

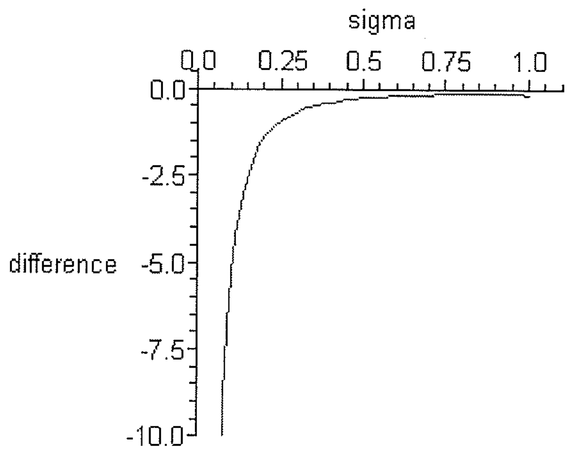


Figure A36. Plot of $\frac{dS^L}{d\sigma} - \frac{dS}{d\sigma}$ versus σ for $a = 0.1$ and $b = 0.2$.

This figure shows the difference in slopes between the levered and unlevered ratios.

The implication of this difference line is that the Sharpe ratio for unlevered equity is declining at a slower rate, $\frac{dS}{d\sigma}$, relative to the rate of decline for levered equity $\frac{dS^L}{d\sigma}$:

$$\frac{dS^L}{d\sigma} < \frac{dS}{d\sigma} < 0$$

$$\lim_{\sigma \to 1} \frac{dS}{d\sigma} \to \frac{dS^L}{d\sigma}$$

A10.2: Sharpe Ratios of Firms

The Sharpe ratios for the firm are:

$$F = \frac{R - A}{\sigma} = \frac{\sqrt{1 - \sigma^2}}{\sigma}$$

$$F^L = m_2 = \frac{R + l\sin(\theta_0) - al^2 - A}{\sigma + l\cos(\theta_0)} = \frac{\sqrt{1 - \sigma^2} + l\sqrt{1 - \sigma^2} - al^2}{\sigma + l\sigma}$$

Recall that the simplifying assumption has been made that the corporate risk-free rate is zero, $A = r(1 - T_c) = 0.0$. This assumption does not affect the generality of the results. The Sharpe ratios for the firm are similar to those of the investor and so, for brevity, their derivation is not shown here. To compare the properties of the unlevered versus levered Sharpe ratios, F and F^L, the ratios are plotted together below:

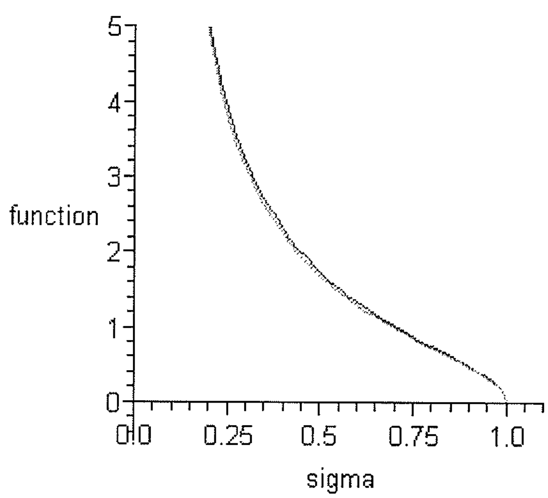


Figure A37. Plot of F and F^L versus σ for $a = 0.1$ and $b = 0.2$.
This figure shows that the firm's levered Sharpe ratio is rising relative to the unlevered ratio as volatility increases, implying that the firm is motivated to reduce leverage as volatility increases.

The upper line in the plot is the unlevered Sharpe ratio F, showing that the unlevered ratio is greater than the levered Sharpe ratio F^L, but the lines converge at high σ. In contrast, for the investor, the top line was the levered Sharpe ratio, S^L.

The ratio of the firm's levered Sharpe ratio over unlevered Sharpe ratio is plotted below:

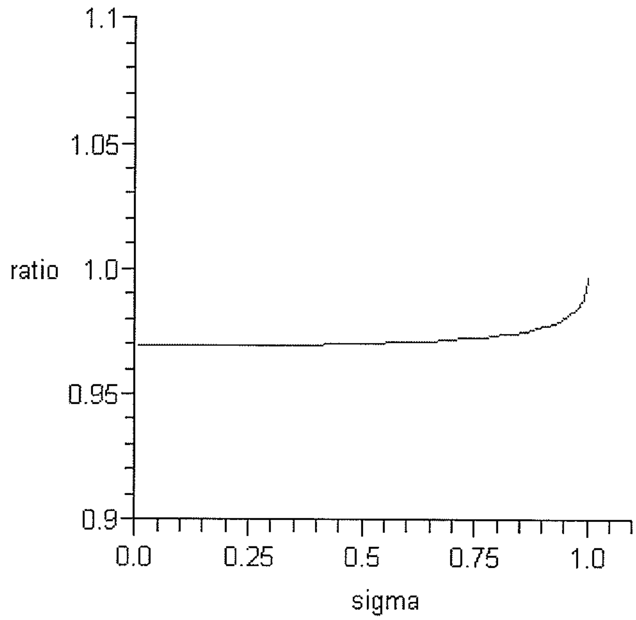


Figure A38. Plot of $\frac{F^L}{F}$ versus σ for $a = 0.1$ and $b = 0.2$.

This figure shows that the firm's levered Sharpe ratio converges to the unlevered ratio at high volatility.

Here, the ratio rises to unity with increasing volatility as the Sharpe ratio of levered equity increases relative to the unlevered Sharpe ratio. The investor's ratio, $\frac{S^L}{S}$, showed the opposite pattern.

The relative behavior of the Sharpe ratios of unlevered and levered equity provides the intuition for the negative relationship between leverage and volatility. The unlevered Sharpe ratio is always greater than or equal to the levered Sharpe ratio, $S \geq S^L$, but the rate of decline for unlevered equity is lower relative to levered equity with increasing volatility. The result is that unlevered equity becomes increasingly attractive relative to levered equity as volatility σ increases, inducing a shift in portfolio allocation from levered to unlevered equity by investors. The firm's Sharpe ratios also push toward lower leverage as volatility σ increases because the levered Sharpe ratio, which represents the cost of levered equity capital, rises relative to unlevered equity as σ increases.

For brevity, the equations for some results such as $S \geq S^L$ are not derived here since the results are apparent from inspection of the plots. Also for brevity, all results have been shown with normalized volatility σ as the horizontal axis in the various plots; use of the normalized levered volatility σ^L as the horizontal axis would shift the profile of the plots somewhat, but would not change the general results shown here.

A11: Proof of Relationship between the Bond Rate and Leverage : $\frac{dl}{dr} > 0$.

This section is shows the relationship between the optimal leverage level l and changes in the expected risk-free bond rate r, ceteris paribus.

Only the expected risk-free bond rate r changes; all other variables in the mean-variance plane such as unlevered return, volatility, and tax rates remain constant. The relationship between variables in the normalized mean-variance plane is shown below:

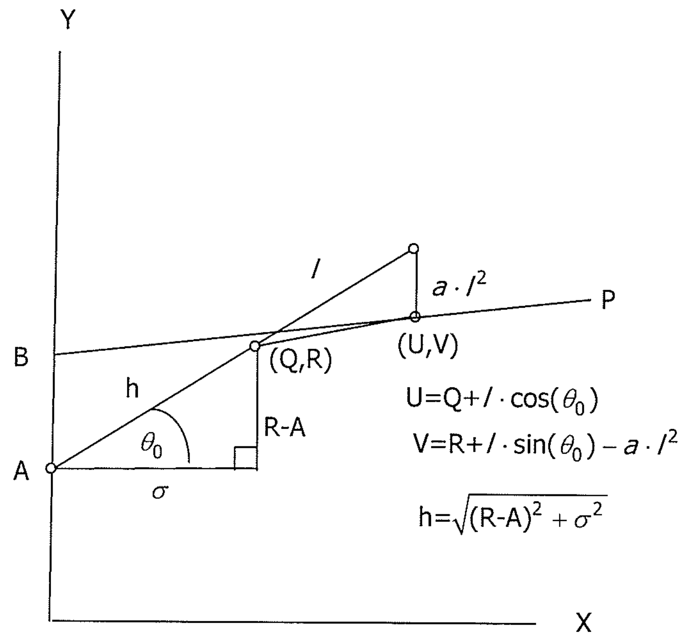


Figure A39. Model of Relationship between Bond Rate and Leverage.

As before, the slopes of lines K and P, representing the investment opportunity set and the investor efficient set respectively, are equated and a solution for optimal leverage is derived. However, this time the equations are defined in terms of a constant expected unlevered equity return minus the changing bond rate, $R-A$.

In this proof, unlevered return R and unlevered volatility remain constant, while the bond rate r varies. Define the constant value for volatility as the value that makes the hypotenuse $h=1.0$ when $A=0.0$:

$$h=\sqrt{(R-A)^2+\sigma^2}$$

$$1.0=\sqrt{R^2+\sigma^2}$$

$$\sigma=\sqrt{1-R^2}$$

The value of the hypotenuse h will decrease below unity as A increases, so a scaling factor will be required to adjust the leverage variable l to give a range of [0,1] for l in the mean variance plane that corresponds to a range of 0 to 100% for the debt ratio:

$$scale\ factor = sf = \frac{1}{\sqrt{(R-A)^2+\sigma^2}} = \frac{1}{\sqrt{(R-A)^2+(\sqrt{1-R^2})^2}} = \frac{1}{\sqrt{(R-A)^2+(1-R^2)}}$$

The risk-free bond rate is r, the corporate tax rate is T_c, and the investors' personal tax rate is T_p:

$$A = r(1 - T_c)$$

$$B = r(1 - T_p)$$

$$\theta_0 = \arctan\left(\frac{R - A}{\sqrt{1 - R^2}}\right)$$

$$m_1 = \frac{\sin(\theta_0)}{\cos(\theta_0)} - \frac{2al}{\cos(\theta_0)} = \left(\frac{R - r(1 - T_c)}{\sqrt{1 - R^2}\sqrt{1 + \frac{(R - (1 - T_c))^2}{1 - R^2}}} - 2al\right)\sqrt{1 + \frac{(R - (1 - T_c))^2}{1 - R^2}}$$

$$m_2 = \frac{R + l\sin(\theta_0) - al^2 - B}{\sigma + l\cos(\theta_0)} = \frac{R + \frac{l(R - r(1 - T_c))}{\sqrt{1 + \frac{(R - r(1 - T_c))^2}{1 - R^2}}} - al^2 - r(1 - T_p)}{\sqrt{1 - R^2} + \frac{l}{\sqrt{1 + \frac{(R - r(1 - T_c))^2}{1 - R^2}}}}$$

$$m_1 - m_2 = 0 = \left(\frac{R - r(1 - T_c)}{\sqrt{1 - R^2}\sqrt{1 + \frac{(R - (1 - T_c))^2}{1 - R^2}}} - 2al\right)\sqrt{1 + \frac{(R - (1 - T_c))^2}{1 - R^2}} - \frac{R + \frac{l(R - r(1 - T_c))}{\sqrt{1 + \frac{(R - r(1 - T_c))^2}{1 - R^2}}} - al^2 - r(1 - T_p)}{\sqrt{1 - R^2} + \frac{l}{\sqrt{1 + \frac{(R - r(1 - T_c))^2}{1 - R^2}}}}$$

Solving, the positive root of this quadratic equation is:

$$l' = -\left(\sqrt{-(R - 1)(R + 1)}\sqrt{-\frac{1 - 2Rr + 2RrT_c + r^2 - 2r^2T_c + r^2T_c^2}{(R - 1)(R + 1)}} - \frac{\sqrt{a^2 - 2a^2Rr + 2a^2RrT_c + a^2r^2 - 2a^2r^2T_c + a^2r^2T_c^2 + arT_c - arT_p}}{a}\right)$$

Now apply the scaling factor to leverage l' to obtain a constant scale for leverage:

$$l = sf \cdot l' = \frac{l'}{\sqrt{(R-A)^2 + (1-R^2)}} = -\left(\frac{\sqrt{-(R-1)(R+1)}}{\sqrt{(R-r(1-T_c))^2 + (1-R^2)}} \sqrt{-\frac{1-2Rr+2RrT_c+r^2-2r^2T_c+r^2T_c^2}{(R-1)(R+1)}} - \frac{\sqrt{a^2-2a^2Rr+2a^2RrT_c+a^2r^2-2a^2r^2T_c+a^2r^2T_c^2+arT_c-arT_p}}{a} \right)$$

The leverage characteristic l for parameters $R = 0.70$ [17], $a = 0.1$, $T_c = 0.35$ and $T_p = 0.30$ is plotted below:

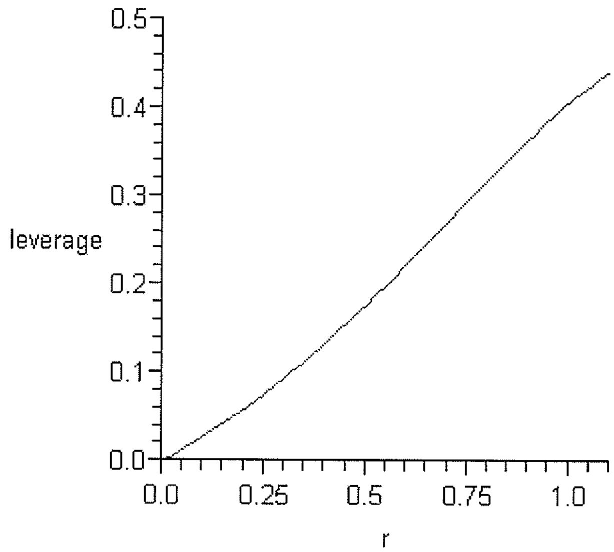


Figure A40. Plot of l versus r for $R = 0.70$, $a = 0.1$, $T_c = 0.35$ and $T_p = 0.30$.

This figure shows that optimal leverage increases with increasing bond return.

[17]The normalized unlevered return, R, is related to the normalized unlevered volatility, σ, by the equation $R = \sqrt{1-\sigma^2}$, and so normalized $R = 0.70$ implies that normalized $\sigma = 0.71$. In the real world, this relative size of normalized values translates to any similarly sized nominal values; for example a nominal expected return of 10% with a nominal standard deviation of 10.2%.

Next, obtain the derivative of I with respect to r, $\frac{dI}{dr}$:

$$\frac{dI}{dr} = \frac{1}{a\left(1-R^2+\left(R-r\left(1-T_c\right)\right)^2\right)^{\frac{3}{2}}}\left(\left(a\sqrt{-(R-1)(R+1)}\sqrt{-\frac{1-2Rr+2RrT_c+r^2-2r^2T_c+r^2T_c^2}{(R-1)(R+1)}}\right.\right.$$
$$\left.\left.-\sqrt{a^2-2a^2Rr+2a^2RrT_c+a^2r^2-2a^2r^2T_c+a^2r^2T_c^2+arT_c-arT_p}\right)\left(R-r\left(1-T_c\right)\right)\left(-1+T_c\right)\right)$$
$$-\frac{1}{a\sqrt{1-R^2+\left(R-r\left(1-T_c\right)\right)^2}}\left(-\frac{1}{2}\frac{a\sqrt{-(R-1)(R+1)}\left(-2R+2RT_c+2r-4rT_c+2rT_c^2\right)}{\sqrt{-\frac{1-2Rr+2RrT_c+r^2-2r^2T_c+r^2T_c^2}{(R-1)(R+1)}}(R-1)(R+1)}\right.$$
$$\left.-\frac{1}{2}\frac{-2a^2R+2a^2RT_c+2a^2r-4a^2rT_c+2a^2rT_c^2+a_c-aT_p}{\sqrt{a^2-2a^2Rr+2a^2RrT_c+a^2r^2-2a^2r^2T_c+a^2r^2T_c^2+arT_c-arT_p}}\right)$$

The characteristic of $\frac{dI}{dr}$ for for $R = 0.70$, $a = 0.1$, $T_c = 0.35$ and $T_p = 0.35$ is plotted below:

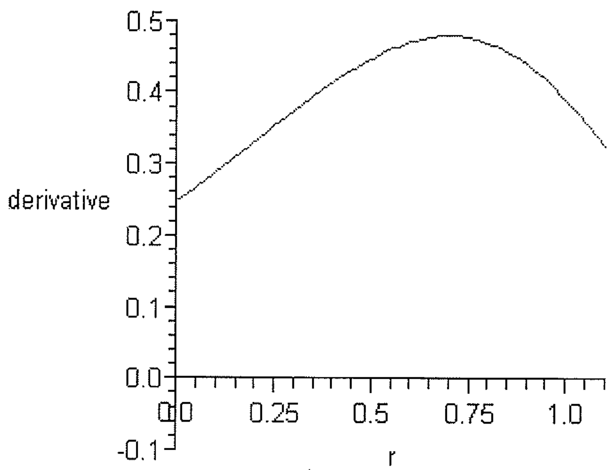


Figure A41. Plot of $\frac{dI}{dr}$ versus r for $R = 0.70$, $a = 0.1$, $T_c = 0.35$ and $T_p = 0.30$.

This figure show that leverage is positively related to expected bond return.

For feasible values of R, a, T_c, T_p and r, the slope of the leverage function is positive. The relevant range of bond rate r is $r \in [0,1]$ for the chosen parameter values because, as will be shown in the next section on Sharpe ratios, at $r = 1.0$ the Sharpe ratio of unlevered equity declines to zero. And in a rational economy, the Sharpe ratio of unlevered equity cannot be negative.

This plot shows that $\frac{dl}{dr} > 0$ for positive expected risk-free bond rates in the relevant range. This positive relationship holds for all feasible values for variables in the model, and therefore:

$$\frac{dl}{dr} > 0 \qquad \text{Q.E.D.}$$

A12: Sharpe Ratios with Varying Bond Rate

The objective of this section is to show that the Sharpe ratio of unlevered equity declines more rapidly than the Sharpe ratio for levered equity declines as the bond rate increases, explaining the motivation for the positive relationship between leverage and the bond rate. The investor Sharpe ratio gives the excess return per unit of risk, and so if the Sharpe ratio of unlevered equity is decreasing more rapidly than the ratio for levered equity, then investors will shift their portfolio allocation toward more leverage as the bond rate increases. The Sharpe ratio is defined as:

$$S = \frac{R - R_f}{\sigma}$$

However, the investor and the firm have somewhat different Sharpe ratios:

Investor: $S = \frac{R - B}{\sigma}$ measures return on investment

Firm: $F = \frac{R - A}{\sigma}$ measures cost of capital

A12.1: Sharpe Ratios of Investors

For unlevered equity, the Sharpe ratio is simply:

$$S = \frac{R-B}{\sigma} = \frac{R-r(1-T_p)}{\sqrt{1-R^2}}$$

For levered equity, the Sharpe ratio defined in terms of unlevered volatility is the slope at the point of equilibrium leverage, which has been previously defined as the slope m_2. The original unscaled solution for leverage l' is used since the slope is not a function of the leverage scale:

$$S^L = m_2 = \frac{R + l'\sin(\theta_0) - al'^2 - B}{\sigma + l'\cos(\theta_0)} = \frac{R + l'(R - r(1-T_c)) - al'^2 - r(1-T_p)}{\sqrt{1-R^2} + l'\sqrt{1-R^2}}$$

$$= \left(R - \frac{1}{a\sqrt{1-R^2}\sqrt{1+\frac{(R-r(1-T_c))^2}{1-R^2}}} \left(\left(a\sqrt{-(R-1)(R+1)}\sqrt{-\frac{1-2Rr+2aRrT_c+r^2-2r^2T_c+r^2T_c^2}{(R-1)(R+1)}} \right. \right. \right.$$

$$\left. - \sqrt{a^2-2a^2Rr+2a^2RrT_c+a^2r^2-2a^2r^2T_c+a^2r^2T_c+arT_c-arT_p} \right) (R-r(1-T_c)) \Bigg)$$

$$- \frac{1}{a} \left(\left(a\sqrt{-(R-1)(R+1)}\sqrt{-\frac{1-2Rr+2aRrT_c+r^2-2r^2T_c+r^2T_c^2}{(R-1)(R+1)}} \right. \right.$$

$$\left. \left. - \sqrt{a^2-2a^2Rr+2a^2RrT_c+a^2r^2-2a^2r^2T_c+a^2r^2T_c+arT_c-arT_p} \right)^2 \right) - r(1-T_p \Bigg)$$

$$\Bigg/ \left(\sqrt{1-R^2} - \frac{1}{a\sqrt{1-R^2}\sqrt{1+\frac{(R-r(1-T_c))^2}{1-R^2}}} \left(a\sqrt{-(R-1)(R+1)}\sqrt{-\frac{1-2Rr+2aRrT_c+r^2-2r^2T_c+r^2T_c^2}{(R-1)(R+1)}} \right. \right.$$

$$\left. \left. - \sqrt{a^2-2a^2Rr+2a^2RrT_c+a^2r^2-2a^2r^2T_c+a^2r^2T_c+arT_c-arT_p} \right) \right)$$

To compare the properties of the unlevered versus levered Sharpe ratios, S and S^L, the ratios are plotted together below:

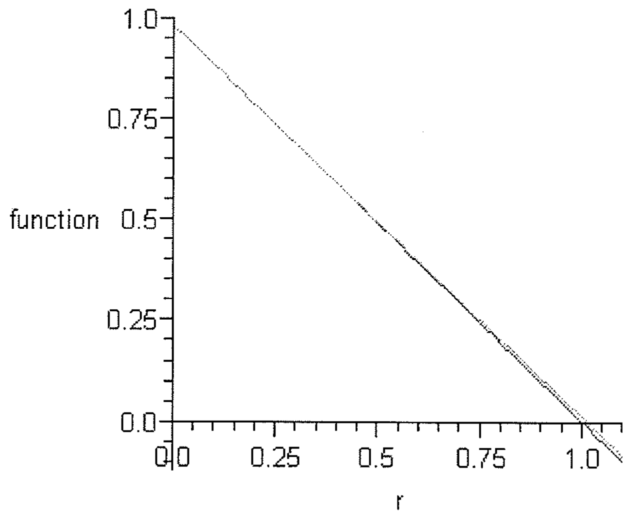


Figure A42. Plot of S and S^L versus r with $R = 0.70$, $a = 0.1$, $T_c = 0.35$ and $T_p = 0.30$. This figure shows that the Sharpe ratio for levered equity decreases more slowly than for unlevered equity as expected bond rate increases, implying a shift toward higher leverage as the bond rate increases.

At $r = 0.0$, leverage is nil, $l = 0.0$, and the two Sharpe ratios are equal, $S = S^L$. As the bond rate r increases, the Sharpe ratios decline, with the unlevered Sharpe ratio S declining more rapidly than the levered Sharpe ratio S^L. At $r = 1.0$, the unlevered Sharpe ratio has declined to zero, $S = 0.0$, while the levered Sharpe ratio remains positive, $S^L > 0.0$. With the selected parameters, the feasible range of the bond rate r is $r \in [0,1]$, since at $r = 1.0$ the Sharpe ratio for unlevered equity is equal to zero. In a rational economy, the bond rate will not go beyond this point.

The ratio of levered Sharpe ratio over unlevered Sharpe ratio is plotted below:

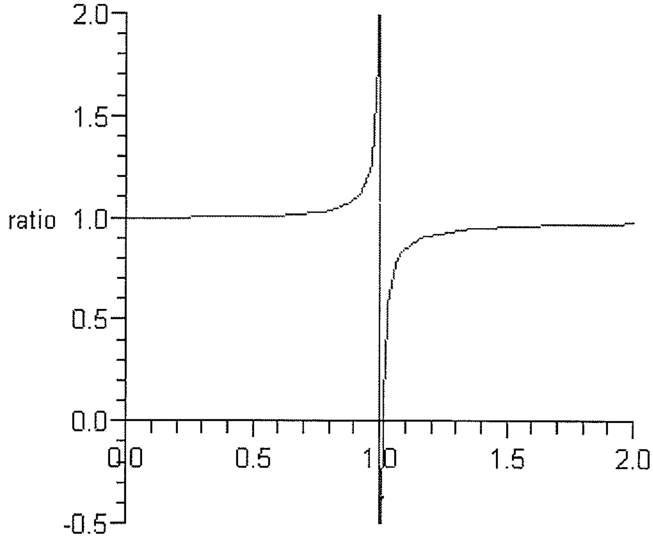


Figure A43. Plot of $\frac{S^L}{S}$ versus r with $R = 0.70$, $a = 0.1$, $T_c = 0.35$ and $T_p = 0.30$.

This figure shows that the levered Sharpe ratio is always greater than the unlevered Sharpe ratio, and the ratios diverge at high volatility.

Here, the $\frac{S^L}{S}$ ratio increases from unity at $r = 0.0$ to infinity at $r = 1.0$ as the Sharpe ratio of unlevered equity declines more rapidly than the Sharpe ratio of levered equity with increasing bond rate. Thus, the relative strength of the levered Sharpe ratio will induce a portfolio re-allocation by investors toward increased leverage as the bond rate increases.

A12.2: Sharpe Ratios of Firms

The Sharpe ratios for the firm are:

$$F = \frac{R - A}{\sigma} = \frac{R - r(1 - T_c)}{\sqrt{1 - R^2}}$$

$$F^L = m_2 = \frac{R + l\sin(\theta_0) - al^2 - A}{\sigma + l\cos(\theta_0)} = \frac{R + l\sin(\theta_0) - al^2 - r(1 - T_c)}{\sqrt{1 - R^2} + l\cos(\theta_0)}$$

The Sharpe ratios for the firm are similar to those of the investor and so, for brevity, their derivation is not shown here. The relevant range of the expected corporate bond rate r increases from [0,1] to [0,1.17] in the plots that follow for the firm's Sharpe ratios, F and F^L, because the vertical intercept is lower for the firm, $r(1-T_c)$, versus $r(1-T_c)$ for the investor. To compare the properties of the unlevered versus levered Sharpe ratios, F and F^L, the ratios are plotted together below:

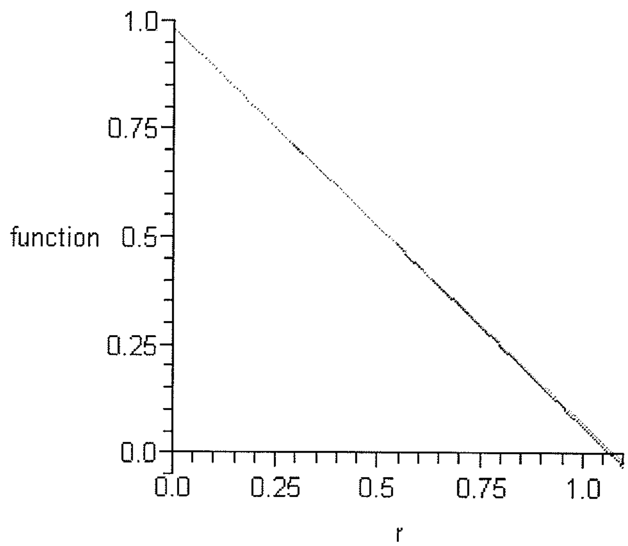


Figure A44. Plot of F and F^L versus r with $R = 0.70$, $a = 0.1$, $T_c = 0.35$ and $T_p = 0.30$.

This figure shows that the firm's levered Sharpe ratio is declining relative to the unlevered ratio as the bond rate increases, implying that the firm is motivated to increase leverage as the bond rate increases.

The upper line in the plot is the unlevered Sharpe ratio F, showing that the unlevered ratio is greater than the levered Sharpe ratio F^L, but the lines diverege at high σ. In contrast, for the investor, the top line was the levered Sharpe ratio, S^L.

The ratio of the firm's levered Sharpe ratio over unlevered Sharpe ratio is plotted below:

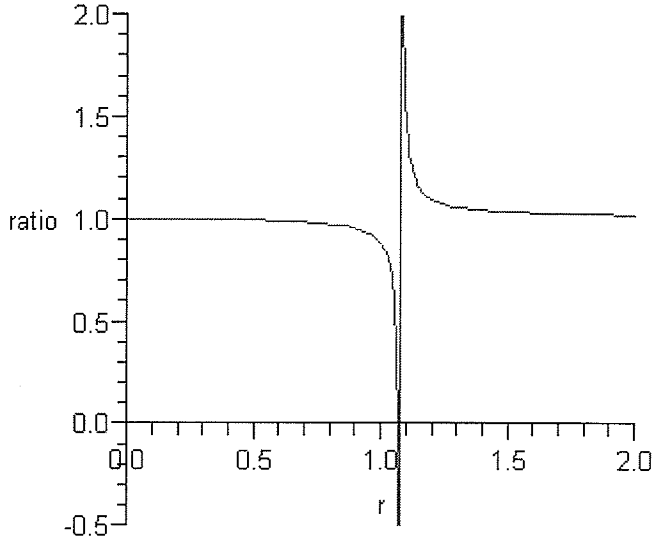


Figure A45. Plot of $\frac{F^L}{F}$ versus r with $R = 0.70$, $a = 0.1$, $T_c = 0.35$ and $T_p = 0.30$.

This figure shows that the firm's levered Sharpe ratio diverges from the unlevered ratio at high bond rate.

Here, the $\frac{F^L}{F}$ ratio declines from unity at $r = 0.0$ to zero as r increases because the Sharpe ratio of levered equity declines more rapidly relative to the Sharpe ratio of unlevered equity with increasing bond rate. Thus, the relative decline of the levered Sharpe ratio, which represents the cost of levered equity, will induce portfolio re-allocation by investors toward increased leverage as the bond rate increases.

A13: Summary of Results

The preceding proof has shown several significant results:

1. $\frac{dl}{dR} < 0, \frac{dl}{dR^L} < 0$. Leverage is negatively related to expected unlevered and levered returns.

2. $\frac{dl}{d\sigma} < 0, \frac{dl}{d\sigma^L} < 0$. Leverage is negatively related to unlevered and levered volatility.

3. $\frac{dl}{dr} > 0$. Leverage is positively related to the expected corporate bond rate.

The results showing negative relations between leverage and returns and volatility, and a positive relationship between the bond rate and leverage match empirical findings, providing support for the validity of the mean-variance form of the static trade-off model. The characteristics of this mean-variance model of capital structure are consistent with the findings of a wide body of empirical research [e.g. Frank and Goyal (2004)].

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CHAPTER 3

THE VALUE OF DEBT AND THE CAPITALIZATION RATE

3.1 Introduction

This paper tests the hypothesis that the value added by debt to the value[1] of the firm varies positively with expected profitability of the firm , while the capitalization rate (a.k.a. cost of equity or required rate of return) varies negatively with expected profitability. The changes in the value of debt and capitalization rate in response to changes in expected profitability can explain observed behavior such as the low covariance between debt level and changes in share price, or the book-to-market returns reversal effect.

The debt valuation model of Kemsley and Nissim (2002) is used to estimate the marginal value of debt and the capitalization rate[2], while the expected profitability of the firm is proxied by the book-to-market equity ratio[3,4]. These empirical tests are conducted in the context of the book-to-market effect because the mean reversion cycle of the book-to-market equity ratio forms a natural experiment where there are large reversals in equity market returns in conjunction with concurrent changes in the book-to-market ratio

[1] In capital structure literature, the value of the firm is defined as the value of equity plus the value of debt. In the empirical tests of this paper, the value of the firm is taken to be the market value of shares plus the book value of debt.
[2] The capitalization rate is the cost of capital for unlevered equity.
[3] The book-to-market equity ratio (BE/ME) is the book value of shares divided by their market value. The book-to-market ratio is interpreted to reflect future profitability.
[4] Empirical research such as Vuolteenaho (2002) shows, using vector-autoregressive methods, that the ratio of the book-to-market-value of U.S. firms explains a substantial fraction of changes in future firms' earnings. Cohen, Polk, and Vuolteenaho (2003) conclude that 75 to 80 percent of the variation across firms in their book-to-market ratios can be explained in terms of future variation in profits.

and debt levels and profitability, and theory implies that such changes should be reflected in shifts in the value that debt adds to the firm and shifts in the capitalization rate.

Kemsley and Nissim (2002) presents a debt valuation model and shows that the aggregate market value of the debt tax shield over the long term is about 10% of the value of firms listed on the NYSE and AMEX exchanges, a result that is in agreement with the projections of Graham (2000). The contribution of this paper is to apply the KN model to portfolios sorted on the book-to-market equity ratio throughout the mean reversion cycle of the BE/ME ratio, thereby demonstrating the dynamic relationship between the marginal value of debt, the equity capitalization rate, and growth prospects / expected profitability.

The static trade-off model is generally considered the fundamental model of capital structure. The static trade-off model implies that there is an optimal leverage point for the firm where the marginal benefit of debt equals the marginal cost. The direct benefit of debt is the associated tax shield for interest payments and the cost is an increased probability of financial distress. The implication of the static trade-off model is that leveraged firms use debt financing because it adds value to the levered firm in the form of a higher firm value[5]. Modigliani and Miller (1963) first hypothesize that the tax benefits of debt decrease the cost of debt financing and so increase the value of the firm. However, Miller (1977) presents the counter argument that firms must distribute the tax benefits of corporate debt back to debt holders in the form of higher interest rates to

[5] In theoretical models such as MM (1963) where there is no bankruptcy, the value added by the use of debt accrues entirely to equity (common share value) while the unit value of debt remains constant. In reality, the unit price of bonds will vary in reflection of the likelihood that financial distress will impact cash flows to bondholders. In the presence of financial distress costs, the price of bonds will decline as the leverage level of the firm increases, ceteris paribus; but this is not necessarily the case if expected earnings are increasing at the same time as leverage increases.

compensate for the personal tax cost of debt. And others, such as DeAngelo and Masulis (1980) argue that that financial distress costs offset some part of the tax benefits of debt. Hence, the impact of debt upon firm valuation and optimal capital structure is not clear, a priori, and so the question must be answered by empirical investigation.

The idea that firms use debt capital because it increases firm value is intuitively appealing but direct market evidence is sparse in the research literature. Masulis (1980) finds debt-for-equity swaps usually increase share price and Engel, Erickson, and Maydew (1999) find positive net tax benefits when firms swap trust preferred stock that is tax-deductible for regular preferred stock that is nondeductible. However, direct tests of the value of debt have typically found a negative relationship between debt and firm value. For example, Fama and French (2002) regress firm value upon interest expense (proxy for debt) and find a negative relationship between debt and firm value; however, Fama and French opine that imperfect controls for profitability probably drive the negative relation. It is only recently that Kemsely and Nissim (2002) provides a direct regression model that properly controls for measurement error, and demonstrates a direct positive relationship between debt and firm value as predicted by theory.

In the 50 years since the seminal work of Modigliani and Miller (1958, 1963) established the theoretical foundations for capital structure research much has been learned, but many fundamental questions about the capital structure decisions of the firm remain open. An area of recent research examines the relationship between share price and leverage levels. Welch (2004) finds that variation in the market leverage ratio is almost entirely explained by the change in share price, with only a small part explained by the change in debt level; these results highlight the question of why debt level covaries so little with share price if leverage contributes positive value toward firm value. Similarly, Kayhan and Titman (2007) finds that share price influences capital structure, but change in debt level occurs slowly and that capital structure tends to revert toward a target leverage ratio.

3.2 Summary of Findings

Cross sectional regressions through a window of the mean reversion cycle of the BE/ME ratio show that the marginal value of debt is positively related to expected profitability (negatively related to BE/ME ratio). The intuition of this result is that an increase in expected future earnings increase the value that debt contributes toward firm value by way of leverage effects. At the same time, the equity capitalization rate is negatively related to expected profitability (positively related to BE/ME ratio). The intuition of this result is that the decreasing capitalization rate (a.k.a. discount rate) increases the share price for expected cash flows. Thus, both the value of debt and the capitalization rate impact firm value.

Theory implies that the use of debt should have a positive effect upon the value of the firm, where the value of the firm is the sum of equity (shares of common stock) and debt (bonds). In the empirical tests of this paper, the value of the firm is the dependent variable, and the explanatory variable of main interest is the amount of debt held by the firm. The loading on the debt variable in the regression model estimates the impact of debt upon the value of the firm. The market value of shares varies much more than bond price, and so it is reasonable to interpret a positive regression coefficient for debt to mean that share value is positively related to debt. However, the impact of debt upon bond value is uncertain because the larger variance of share value may subsume the empirical relationship between debt and bond value. Separation of the effects of debt upon share value and bond value is beyond the scope of this current paper, and will be pursued in future research.

These results illustrate that there are two opposing forces associated with changes in the BE/ME ratio (or, effectively, changes in the market share price (ME) since the book value of equity (BE) is relatively unchanging) upon the optimal debt level for the firm. On the one hand, a decrease in the BE/ME ratio implies expectations of increased future cash flows, which increases the marginal value of debt through leverage effects – this *leverage effect* influences the firm toward a higher debt level. On the other hand, a decreasing BE/ME ratio means a lower capitalization rate (lower cost of equity capital), which implies that a higher marginal value is required for debt capital – this *capitalization rate effect* influences the firm toward a lower debt level. These countervailing forces explain why debt level covaries so little with variation in firm value or the share price.

These results also provide an alternate explanation for the book-to-market effect of asset pricing, where previous research has shown that when portfolios are formed according to book-to-market equity ratio, next period returns for high BE/ME portfolios (value stocks) are greater than for low BE/ME portfolios (growth stocks), which is a reversal of the prior relationship. The results of this paper suggest that the observed returns reversal pattern of the book-to-market effect may be explained by reversal in the value that debt contributes to share price, and the concurrent reversal in the capitalization rate. The net result is that share prices for high BE/ME firms (value stocks) increase faster than for low BE/ME firms (growth stocks) after the reversal of debt value and capitalization rate, which is reflected in higher returns for the high BE/ME firms.

In additional empirical tests, the connection between leverage and returns is examined by using the Fama and French (1993) factor model to test a contrarian book-to-market investment strategy. Contrarian book-to-market portfolios with a high capitalization rate earn higher future returns than portfolios with a low capitalization rate; the Fama and French three-factor model does not adequately explain these returns, but a leverage factor provides a partial explanation. Overall, the evidence is consistent with the prediction of capital structure theory that the value of leverage is related to variation in expected cash flows (as proxied by the BE/ME ratio or profitability measures), thereby affecting the value of the firm and, consequently, returns.

The remainder of the paper is organized as follows. Section 3.3 is a literature review. Section 3.4 describes the sample and estimates the capitalization rate and marginal value of debt for BE/ME portfolios using the Kemsley and Nissim (2002) debt valuation model, and shows how value of debt and capitalization rate varies with the BE/ME ratio. Section 3.5 documents the return patterns for buy-and-hold portfolios formed on BE/ME and capitalization rate, and examines whether the abnormal return patterns can be explained by differences in systematic risk, or by a leverage factor, using the Fama and French (1993) factor model. Section 3.6 concludes.

3.3 Literature Survey and Hypothesis Development

3.3.1 Value of Debt

Empirical investigation of the debt tax shield follows three main lines of inquiry. The first line of inquiry examines the Modigliani and Miller prediction that the tax shield benefits of debt will favour the use of debt over equity financing. Earlier studies use various forms of debt/equity ratios to test whether nondebt tax shields, such as amortization or investment tax credits, substitute for the debt tax shield. Examples of such studies include Bradley, Jarrell, and Kim (1984), Long and Malitz (1985), Titman and Wessels (1988), and Fischer, Heinkel, and Zechner (1989), but these do not find significant effects. However, later studies examine incremental financing decisions and find evidence that issuance of debt is positively related to high marginal tax rates. Examples of such studies include MacKie-Mason (1990), Trezevant (1992), and Graham (1996, 1999).

In a second approach, Graham (2000) calculates the tax benefit of debt using firm-level financial data, estimating that the mean corporate tax benefit equals approximately 10% of total firm share value. Though not a direct empirical test, the projections of Graham (2000) indicate that firms obtain significant tax benefits from debt.

In a third line of inquiry, studies investigate direct market evidence of the value of the debt tax shield. Masulis (1980) finds debt-for-equity swaps usually increase share price and Engel, Erickson, and Maydew (1999) find positive net tax benefits when firms swap trust preferred stock that is tax-deductible for regular preferred stock that is nondeductible. But direction regressions between share value and debt typically show a negative coefficient for the debt variable. For example, Fama and French (2002) regress firm value upon interest expense (proxy for debt) and find a negative relationship between debt and firm value; however, Fama and French conclude that imperfect controls for profitability probably drive the negative relation. Kemsely and Nissim (2002) present a regression model that better controls for measurement error, and find that debt contribute approximately 10% of the share value of firms listed on the NYSE and AMEX exchanges, in agreement with the calculated value of Graham (2000).

3.3.2 Book-to-Market Effect

Empirical research generally agrees that simple value strategies based upon ratios such as book-to-market equity have produced superior returns over time. Explaining these returns is more controversial. When portfolios are formed according to book-to-market equity ratios, next period returns for high BE/ME portfolios are greater than for low BE/ME portfolios, which is a reversal of the prior relationship. The cause of this book-to-market effect is not obvious, as the low BE/ME portfolios have persistently higher cash flows and return on assets, and persistently lower equity capitalization rates.

The prevalent rational explanation of the book-to-market equity premium is that high BE/ME firms must provide higher returns because they have greater risk of distress. Supporting this view, Fama and French (1995) and Chen and Zhang (1998) show that firms with high BE/ME ratios have lower earnings, greater earnings uncertainty, greater debt ratio, and more uncertain dividends compared to lower BE/ME firms. However, the risk of severe financial distress for a diversified portfolio is generally accepted to be low. Dichev (1998) tests the connection between financial distress and returns using measures of bankruptcy proposed by Altman (1968) and Ohlson (1980), but finds that firms with a higher probability of financial distress tend to have low future stock returns, a result which contradicts the distress premium argument. Lemmon and Griffin (2002) present evidence that suggests that the Dichev (1998) result can be explained for the smallest low BE/ME firms as mispricing due to low analyst coverage, but the Lemmon and Griffin results do not offer an explanation for the majority of the market.

Other researchers such as Lakonishok, Shleifer, and Vishny (1994) suggest an irrational-pricing story to explain to explain the observed behavior of the earnings and stock market returns of high and low book-to-market stocks. The irrational-pricing argument is that investors do not understand the mean reversion nature of earnings growth, and incorrectly extrapolate the past strong earnings growth of low BE/ME stocks and the weak growth of high BE/ME into the future. This extrapolation hypothesis says that when earnings revert to the mean, low BE/ME stocks then have low average returns because earnings growth is weaker than investors expected and high BE/ME have high average returns because earnings growth is higher than expected.

Related research on "winner" and "loser" stocks by DeBondt and Thaler (1985) puts forward the overreaction hypothesis, whereby stocks are irrationally mispriced because investors overreact to good or bad news, to explain the price-reverting pattern. The counter argument in favor of rational pricing maintains that the high returns of loser stocks reflect increased risk due to leverage effects. A long-running debate among researchers centers on the question of whether a contrarian winner / loser investment strategy can harvest excess profits after adjustment for risk. Empirical research explores this question by examining shifts in portfolio betas to estimate risk adjusted returns to compensate for leverage-induced, time-varying risk. Some, like Fama and French (1988), Chan (1988), Ball and Kothari (1989), Gloston, Jagannathan, and Runkle (1993), and Ball, Kothari, and Shanken (1995), maintain that mean reverting patterns of returns reflect rational pricing of stocks by investors in response to changing volatility. Others, such as Chopra, Lokanishok, and Ritter (1992), Jones (1993), Balvers, Wu, and Gilland (2000), and Nam, Pyun, and Avard (2001) support the overreaction hypothesis, claiming that risk-adjusted excess returns are available through a contrarian investment strategy.

The essence of a contrarian investment strategy is the price reversal pattern of stock returns, commonly referred to as the book-to-market effect. Which of the competing theories has merit is a question that must be answered by empirical investigation.

3.3.3 Hypothesis Development

The fountainhead of capital structure theory is the seminal work of Modigliani and Miller (1958, 1962), which postulates that the equity capitalization rate, value of debt, and cash flows are directly related. The models that follow, such as Miller (1977) or DeAngelo and Masulis (1980), for example, are based upon the concept that managers should maximize the value of the firm, where value of the firm is defined as the sum of the market values of both equity and debt. The theoretical interrelation of cash flows, equity capitalization rate and value of debt implies that puzzling observed phenomena such as the low covariance between debt level and share price, or the book-to-market effect of returns reversal for high and low BE/ME portfolios can be (at least partially) explained by changes in the capitalization rate and the value of debt.

The book-to-market effect is a natural experiment, where a returns reversal pattern reflects investors' changing expectations about future cash flows. If capital structure theory is correct, then the returns reversal pattern of the book-to-market effect should be mirrored by concurrent reversal patterns in cash flows, equity capitalization rate, and value of debt.

This paper tests a joint hypothesis for the dynamic relation among the value of debt, the equity capitalization rate, and expected profitability:

H0a: The value of debt is positively related to expected profitability.

H0b: The equity capitalization rate is negatively related to expected profitability.

This joint hypothesis implies that these two factors, namely the value of debt and the capitalization rate, act as opposing forces upon optimal debt level and this is reflected in a low covariance between debt level and share price. Similarly, this hypothesis implies that the book-to-market returns reversal effect is induced by associated reversals in the value of debt and the capitalization rate.

3.4 The Relationship between the Value of Debt and Profitability

3.4.1 Data Description

The sample is comprised of nonfinancial NYSE, AMEX, and Nasdaq stocks for the period from 1970 to 2005[6]. Returns are taken from CRSP and financial statement data from Compustat. The dataset is restricted to exclude financial firms, those with assets less than \$10 million, and extreme values of the market-to-book ratio. Firms that do not have a minimum of 5 observations of future operating income are deleted in order to reduce the sample to firms that do not face imminent bankruptcy. In addition, to mitigate the effects of outliers, dataset observations have been deleted for which any of the variables, deflated by total book assets, is outside the 0.5 to 99.5 percent range of its pooled empirical distribution.

Table 3.1 shows how filtering shapes the dataset. In the first empirical section that examines the value of debt, the regression model for debt valuation is applied to a dataset of 62,112 firm-year observations, and a window of 204,247 observations[7] is used to show changes in the estimated values of the capitalization rate and value of debt through the mean reversion cycle of the BE/ME ratio. In the second empirical section that tests the relationship between leverage and returns, the dataset of 106,138 firm-year observations is used.

[6] As a robustness check, a data sample for the period 1963 to 1993 was also tested to replicate the dataset used by Kemsley and Nissim (2002), with similar results.

[7] An 11-year window is formed around a sort of the 18,581 observations in Table 3.1 upon the BE/ME ratio, and so each of the 18,581 observations is repeated approximately 11 times in the total 204,247 observation.

Table 3.1
Book-to-Market Dataset

	Data Filter	Firm-Year Observations
1	Compustat observations 1971 to 2005	560,335
2	Exclude financial firms (SIC codes 6000 to 6999)	458,475
3	Exclude observations with book assets < $10 million	149,404
4	Exclude outliers with M/B ratio < 0.2 or > 10.0	114,078
5	Exclude firms with no book leverage ratio D/A < 0	106,138
6	Require 5 forward lags of operating income f_1 to f_5	65,057
7	Winsorize 0.5% to 99.5% for regression variables	62,112
8	Require 5 forward lags and 5 backward lags of operating income	18,581
8	Observations in event window from t_{-5} to t_{+5}	204,247

3.4.2 Estimated Equity Capitalization Rate and Value of Debt

Capital structure theory implies that variation in cash flows, equity capitalization rate, and value of debt affects the value of the firm, and consequently affects returns. However, the capitalization rate and the value that debt contributes to the value of the firm cannot be directly measured, so a structural model is needed to estimate those values. The debt valuation model of Kemsley and Nissim (2002) (see Appendix A for a summary of the model) is used to jointly estimate the equity capitalization rate and the marginal value of debt:

$$V_L = V_U + \tau D = \frac{E[FOI]}{\rho} + \tau D \tag{1.1}$$

Re-arranging terms, and inserting regression variables:

$$FOI = \rho(V_L - \tau D) = \left[\alpha_1 + \alpha_2 \beta_U + \alpha_3 \frac{V_L - \tau D}{NOA} + \alpha_4 \log(NOA) + \alpha_5 \log(OL)\right](V_L - \tau D) \qquad (1.2)$$

Here FOI is future operating income, ρ is the equity capitalization rate, V_L is the market value of levered equity plus the book value of debt and preferred stock, τ is the marginal value of debt, and D is the book value of debt. The equity capitalization rate is estimated by a vector of variables that is comprised of unlevered beta (β_U), unlevered market-to-book ratio ($\frac{V_l - \tau D}{NOA}$), size as proxied by net operating assets (NOA), and operating risk as proxied by operating liabilities (OL). The control variables of the model are omitted here for brevity.

The future operating income, FOI, is proxied by using the current period value of income before extraordinary items plus after-tax interest expense, which is essentially equal to $EBIT(1 - T_c)$. The regression provides a joint estimate of the firm's equity capitalization rate and the marginal value of debt. The vector of variables for the equity capitalization rate reflects both expected returns and risk.

The Kemsley and Nissim (2002) model estimates the equity capitalization rate and debt value by non-linear regression using accounting values at fiscal yearend. The data sample is segmented into three book-to-market groups based on the breakpoints for the bottom 30 percent (Low), middle 40 percent (Medium), and top 30 percent (High) of the ranked values of BE/ME at fiscal yearend. Panel A of Table 3.2 shows the regression coefficients used to estimate the capitalization rate for observations in the dataset, while Panel B gives the summary characteristics.

The Kemsley and Nissim model is estimated using non-linear OLS, and observations are weighted by the reciprocal of the square of total assets to control for heteroskedasticity. A fixed effects regression model with 48 Fama-French industry classifications is used to control for industry effects. The data set is winsorized 0.5% to 99.5% to and filtered as described in Table 3.1 to remove outliers. The White and Breusch-Pagan tests are used to examine regression residuals for heteroskedasticity. The Shapiro-Wilk W test is used to examine regression residuals for normality. The VIF (variance inflation factor) method is used to test explanatory variables for collinearity. These test statistics confirm that the model is adequately specified.

Table 3.2 shows that the low BE/ME group has a higher marginal value of debt (Panel A) and a lower capitalization rate (Panel B) than the high BE/ME group. The low equity capitalization rate of the low BE/ME firms indicates that they can raise equity capital at low cost, meaning that investments financed by equity provide high returns to existing shareholders, and so low BE/ME firms will not issue debt unless that debt provides a sufficiently high marginal value to outweigh the benefits of low cost equity financing. In contrast, the high BE/ME firms have a high equity capitalization rate and low marginal value of debt, and Panel C of Table 3.2 shows that they have higher debt levels. The high equity capitalization rate of high BE/ME firms means that equity financing is more costly and therefore provides less benefits to shareholders, and so it is to the advantage of the firm to finance investments with a higher proportion of debt.

Table 3.2
Estimated Equity Capitalization Rate and Marginal Value of Debt for Portfolios Sorted on BE/ME Ratio

The statistics for the period 1971 to 2005 are obtained for book-to-market groups segmented on the breakpoints for the bottom 30 percent (Low), middle 40 percent (Medium), and top 30 percent (High) of the ranked values of BE/ME at fiscal yearend. The dependent variable is future operating income, FOI, proxied by using the current period value of EBITA. Here, ρ is the equity capitalization rate, V_L is the sum of market value of levered equity plus the book value of debt, τ is the marginal value of debt, and D is the book value of debt. The capitalization rate is estimated by a vector of variables that is comprised of unlevered beta (β_U), unlevered market-to-book ratio ($(V_l - \tau D) / NOA$), net operating assets (NOA), and operating liabilities (OL).The observations are weighted by the reciprocal of the square of book total assets. Control variables such as industry dummies are not shown. T-values are shown in parentheses. Coefficients marked ** and * are significant at 1% and 5% confidence intervals, respectively.

Panel B shows mean estimated values and Panel C shows mean firm characteristics, with standard deviations shown in brackets.

		L + M + H		L		M		H	
	Panel A: Regression results								
α_1	Intercept	0.080	(20.37) **	0.078	(8.80) **	0.194	(9.83) **	0.337	(11.19) **
α_2	Unlevered beta	0.003	(4.93) **	0.003	(3.27) **	0.000	(0.15)	-0.001	(-1.24)
α_3	Market-to-book	-0.013	(-24.37) **	-0.013	(-12.06) **	-0.042	(-7.43) **	-0.140	(-7.67) **
α_4	Size of assets	-0.020	(-15.51) **	-0.022	(-9.28) **	-0.048	(-10.83) **	-0.068	(-8.91) **
α_5	Operating liabilities	0.029	(29.12) **	0.034	(20.24) **	0.051	(16.61) **	0.060	(10.42) **
τ	**Marginal value of debt**	**0.610**	**(13.11)** **	**1.097**	**(7.54)** **	**0.251**	**(3.84)** **	**0.032**	**(1.08)**
R^2		0.16		0.18		0.17		0.18	
N		66,661		19,929		26,692		20,040	
Firms		7,524		5,221		5,429		4,181	
	Panel B: Calculated values	L + M + H		L		M		H	
ρ	**Capitalization rate ***	**0.125**	**(0.05)**	**0.088**	**(0.04)**	**0.117**	**(0.03)**	**0.172**	**(0.04)**
Portion of share value from debt *		**0.180**	**(0.35)**	**0.339**	**(0.57)**	**0.161**	**(0.17)**	**0.047**	**(0.05)**
	Panel C: Summary characteristics	L + M + H		L		M		H	
BE/ME		1.013	(0.77)	0.395	(0.10)	0.829	(0.16)	1.875	(0.88)
Market capitalization		1172	(5574)	2198	(8703)	1000	(4102)	376	(1911)
Market debt ratio		0.334	(0.22)	0.184	(0.16)	0.326	(0.18)	0.494	(0.21)
Book debt ratio		0.281	(0.16)	0.247	(0.17)	0.288	(0.16)	0.307	(0.15)
Net operating asset ratio		0.750	(0.11)	0.739	(0.12)	0.752	(0.10)	0.758	(0.10)
Operating liability ratio		0.250	(0.11)	0.261	(0.12)	0.248	(0.10)	0.242	(0.10)
Return on assets		0.135	(0.09)	0.162	(0.10)	0.135	(0.08)	0.108	(0.08)
Current fiscal year return		0.150	(0.29)	0.335	(0.68)	0.137	(0.46)	-0.003	(0.44)
Following fiscal year return		0.167	(0.59)	0.104	(0.58)	0.143	(0.53)	0.262	(0.66)
O-score		-1.125	(1.96)	-1.619	(2.23)	-1.196	(1.78)	-0.587	(1.79)
Unlevered beta		0.591	(3.19)	0.856	(1.51)	0.455	(2.22)	0.506	(4.97)

3.4.3 Variation of Value of Debt and Capitalization Rate versus BE/ME Ratio

This section shows the relationship between cash flows and the equity capitalization rate and the value of debt during the 11-year interval (from t_{-5} to t_{+5}) surrounding the book-to-market effect. Capital structure theory emphasizes that cash flows, capitalization rate, and value of debt determine the value of the firm, and by implication must affect returns. If capital structure theory is correct, then the returns reversal pattern of the book-to-market effect should be matched by concurrent reversal patterns in cash flows, capitalization rate, and value of debt.

Figure 3.1 presents mean characteristics of BE/ME portfolios in the 11-year interval surrounding portfolio formation, from five years before portfolio formation to five years afterward. For this analysis, the requirement is that there are no missing data values for debt in any of the 11 time periods; with overlapping data intervals, the resultant dataset has 204,247 observations. It can be seen from Figure 3.1 that the mean ratios for BE/ME, ROA and leverage vary show reversal patterns around the period of portfolio formation. The low BE/ME group has persistently higher return on assets than the other groups, consistent with the persistently higher earnings reported by Fama and French (1995). This data suggests that capital structure is connected to the book-to-market returns effect.

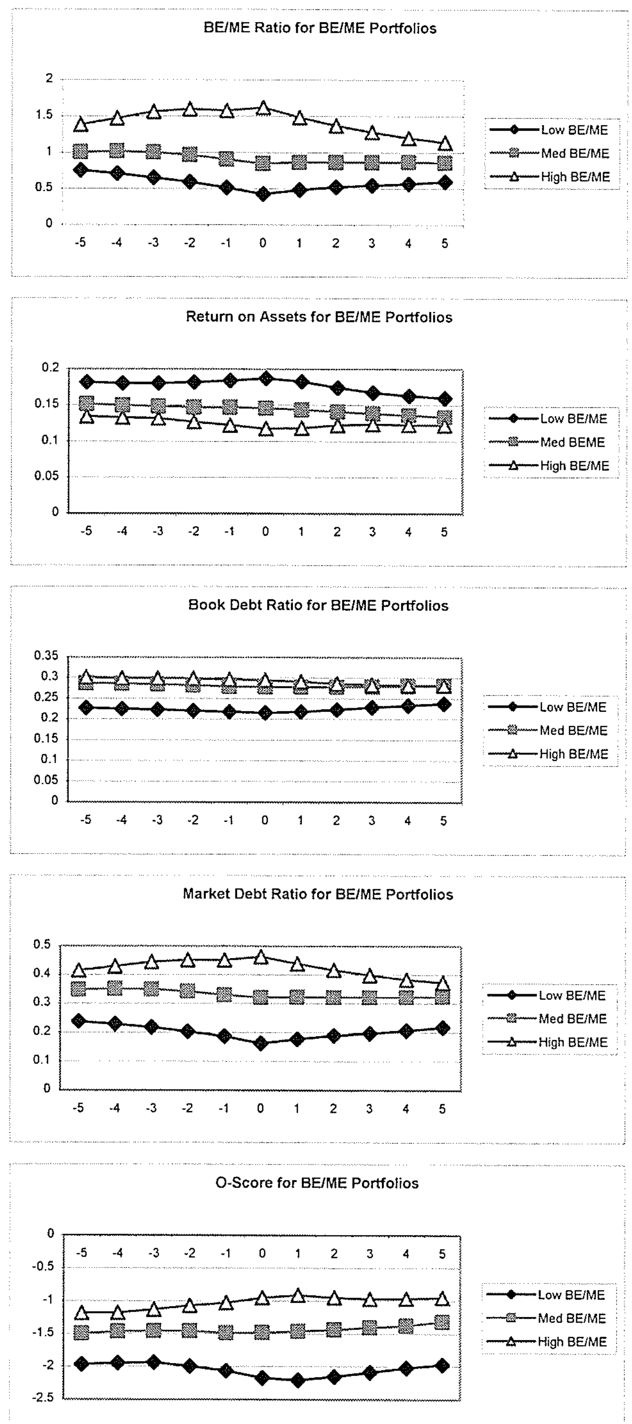


Figure 3.1. Mean Financial Ratios for BE/ME Groups.
This figure shows mean financial ratios for the three BE/ME groups for the fiver-year period before and after the portfolio formation year. The sample consists of NYSE, AMEX, and Nasdaq firms from 1971 to 2005, which are ranked according to their BE/ME ratio at the end of the fiscal year. The data sample includes only those firms with Compustat reported debt values for all eleven years in the interval.

The plot of Ohlson (1980) O-score values shown in Figure 3.1 illustrates the contradictory evidence reported by Dichev (1998), where the O-score proxies for the risk of financial distress. The prevalent rational explanation for the book-to-market effect says that the high future returns of high BE/ME firms are a premium for higher financial risk. Figure 3.1 shows that high BE/ME firms have higher mean O-scores than low BE/ME firms persistently throughout the entire interval, but empirical evidence shows that high BE/ME have higher future returns in the period following portfolio formation. Figure 3.1 suggests that financial distress risk, of itself, cannot explain the book-to-market returns effect.

To explain the BE/ME returns reversal phenomena as a consequence of leverage effects requires calculation of the market value that debt contributes to firm value, not just its marginal value. The proportional market value of debt shown can be calculated from the basic Modigliani and Miller (1963) tax-adjusted valuation model that underlies the Kemsley and Nissim (2002) model:

$$V_L = V_U + \tau D \tag{1.3}$$

Dividing both sides by V_L gives:

$$1 = \frac{V_U}{V_L} + \frac{\tau D}{V_L} \tag{1.4}$$

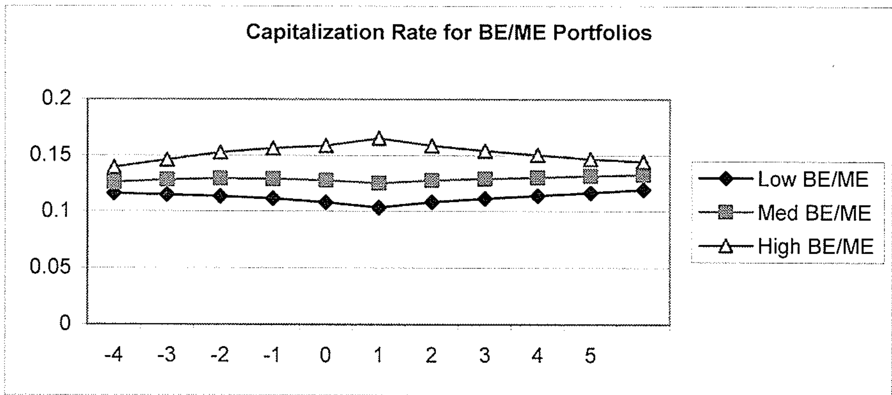
Thus, the proportion of firm value contributed by debt is $\frac{\tau D}{V_L}$, where D (debt value) and V_L (firm value) are known and τ is estimated by the Kemsley and Nissim (2002) model.

Figure 3.2 shows average estimated capitalization rate and proportional value of debt in the 11-year interval, t_{-5} to t_{+5}, around the book-to-market effect, where the estimated values are calculated by applying the estimated regression coefficients shown in Table 3.2 to the 204,247 observations in the interval. The dataset is sorted in three

BE/ME size portfolios (30% low, 40% medium, and 30% high) in the centre year t_0, with the requirement that there are data points in all 11 years in the interval to eliminate survival bias.

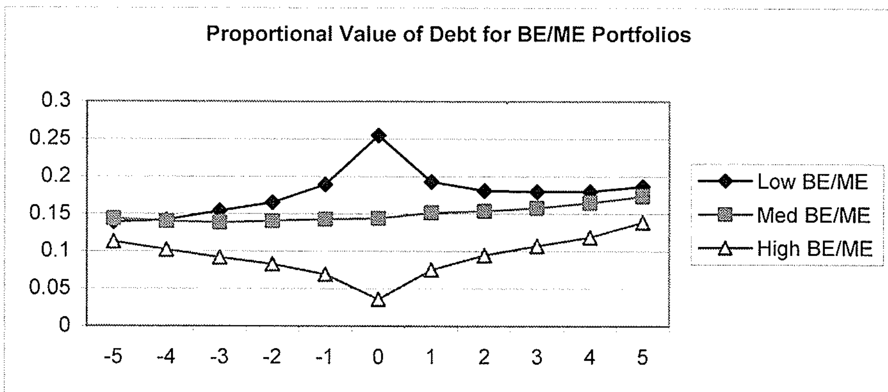
In Figure 3.2, the book-to-market effect is associated with an accompanying reversal pattern in the estimated capitalization rate and the marginal value of debt. Consistent with the Fama and French (1995) argument of lower risk being associated with persistently higher earnings, the capitalization rate of the low BE/ME group remains below that of the middle and high BE/ME groups for the entire interval. The proportional value that debt contributes to firm value begins from a common starting point, then separates for the three BE/ME groups, before reverting to the mean at the end of the interval. The capitalization rate shows similar mean reversion.

Figure 3.2 shows that the proportion of firm value contributed by debt for the low BE/ME portfolio of firms is an estimated 15 percent of share value at t_{-5}, rising to over 25 percent at t_0, and then reverting to the original value of 25 percent at t_{+5}. The financial characteristics of Figure 3.1 show that the book debt ratio of the low BE/ME group declines slowly from t_{-5} to t_0, and then remains essentially constant, while the market debt ratio falls and then rises over the period. Reflecting the return on assets shown in Figure 3.1, Figure 3.2 shows that debt contributes an increasing proportion of firm value as return on assets increases, and then reverts to the mean in concert with the decline of return on assets. This behaviour is consistent with leverage effects that reflect cash flows from assets. The mean capitalization rate for the low BE/ME portfolio show a similar mean reverting pattern, declining from 12 percent to 10 percent and then reverting to its original level.



The equity capitalization rate, ρ, and the marginal value of debt, τ, are estimated from the coefficients of the following regression:

$$FOI = \rho(V_L - \tau D) = \left[\alpha_1 + \alpha_2\beta_U + \alpha_3 \frac{V_l - \tau D}{NOA} + \alpha_4 \log(NOA) + \alpha_5 \log(OL)\right](V_L - \tau D)$$



The proportional value that debt contributes to share price is calculated as:

$$\textit{proportional contribution to firm value} = \frac{\tau D}{V_L}$$

Figure 3.2. Equity Capitalization Rate, and Proportional Value of Debt.
This figure shows the interaction between the capitalization rate and value of debt for the three BE/ME groups for the five-year period before and after the portfolio formation year. The capitalization rate and proportional value of debt are calculated by applying the regression coefficients of Table 3.1 to the window of the Low, Medium and High portfolios used in Table 3.1. The sample consists of NYSE, AMEX, and Nasdaq firms from 1971 to 2005 which are ranked according to their BE/ME ratio at the end of the fiscal year.

For the high BE/ME portfolio, Figure 3.2 shows the opposite pattern, again reflecting the behaviour of return on assets shown in Figure 3.1. For the high BE/ME firms, the proportion of firm value contributed by debt declines from 10 percent at t_{-5} to near zero at t_{-1} before reverting to its original range at t_{+5}. Again, this behaviour is consistent with leverage effects that reflect cash flows. The mean capitalization rate for the low BE/ME portfolio show a similar mean reverting pattern, rising from 14 percent to 16 percent and then reverting to its original level.

Looking at Figure 3.2, it can be seen that the slope of the lines for value of debt for both the low or high BE/ME portfolios are steeper than the respective slopes of the book debt ratio or the return on assets. The evidence suggests that this difference in slopes is a property of leverage effects, as leverage multiplies the effects of changes in cash flows. This leverage effect implies that small changes in cash flows or debt ratios can induce large swings in the value that debt contributes to firm value, thereby influencing returns. The empirical results presented in Figure 3.2, derived from a structural empirical model based upon the principles of capital structure, suggest that leverage effects induce much of the observed variation in returns for BE/ME portfolios, by way of the changes in firm value caused by the value of debt.

The estimated equity capitalization rate and value of debt given by the Kemsley and Nissim model tells a story that is consistent with rational behaviour by firms. A low equity capitalization rate means that equity is an inexpensive way to finance investments compared to debt, and so the firm will tend to issue equity. As the cost of equity declines and equity becomes more attractive, debt will be used only if the marginal value it contributes to share price is high enough to equal the benefits of equity. The trade-off theory of capital structure says that there is an optimal level of debt for the firm at the point where the benefits of debt equal the distress costs of debt. Discussion of the costs of debt are usually focused upon the costs of financial distress, but the empirical results from the Kemsley and Nissim model suggest that the opportunity costs of equity financing are typically more important than bankruptcy risk. That is to say, the optimal level of debt occurs where the marginal benefit of debt financing equals the marginal benefit of equity financing.

The Berens and Cuny (1995) model indicates that firms with higher growth opportunities will have lower debt ratios because the benefits of growth accrue to shareholders and not to bondholders, increasing the value of equity. Also, researchers such as Auerbach (1979) and others observe that personal taxation of distributions gives tax advantages to retaining equity, and that will influence more profitable firms to reduce their debt ratios. Thus, for growth firms with low BE/ME (high share price), their low cost of equity and high expected earnings growth implies a low leverage level.

The results shown in Figure 3.2 provide insight into the puzzle of the observed low covariance between debt levels of the firm and changes in variables such as share price or BE/ME ratio that reflect increased expected profitability. This low covariance is puzzling because increased profitability implies that the firm should increase leverage to advantage of available tax shield benefits. The results illustrate that there are two opposing forces associated with changes in the BE/ME ratio (or, effectively, changes in the market share price (ME) since the book value of equity (BE) is relatively unchanging) upon the debt level chosen by the firm. For on the one hand, a decrease in the BE/ME ratio implies expectations of increased future cash flows, which increases the value that debt contributes to firm value or share price through leverage effects – this *leverage effect* influences the firm toward a higher debt level. But on the other hand, a decreasing BE/ME ratio means a lower capitalization rate (lower cost of equity capital), which implies that a higher marginal value is required for debt equity – this *capitalization rate effect* influences the firm toward a lower debt level. Observed behavior among firms is that a lower BE/ME ratio (or higher share price) is associated with a lower debt level, suggesting the influence of the capitalization rate effect (cost of capital) is stronger than the leverage effect. These opposing forces, the *leverage effect* and the *capitalization rate effect*, upon debt level explain why debt level covaries so little with variation in firm value or share price.

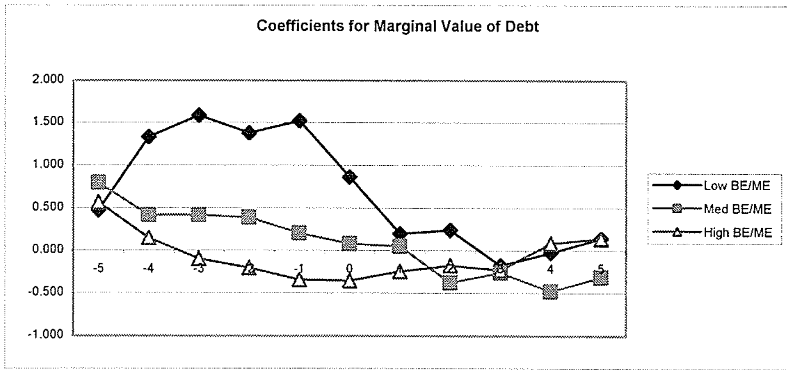
3.4.4 Regressions in Window around BE/ME Portfolio Formation

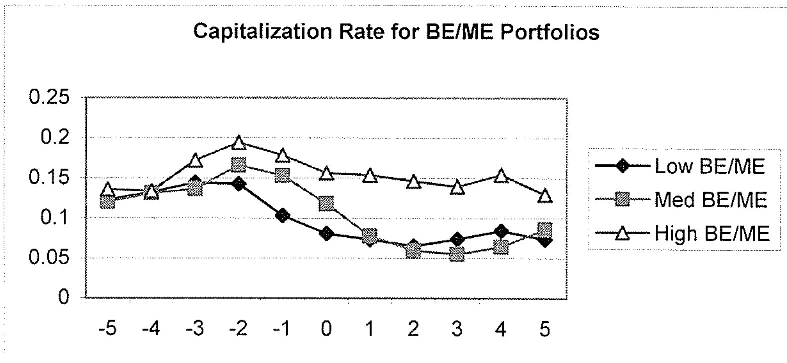
In this section, the Kemsley and Nissim model is applied to the three BE/ME portfolios for each year in the window in portfolio formation on the BE/ME ratio. As in the previous section, the requirement is that there are no missing data values for debt in any of the 11 time periods; with overlapping data intervals, the resultant dataset has 204,247 observations. Figure 3.3 again shows the mean estimated capitalization rate and proportional value of debt in the 11-year interval around the book-to-market effect, but now the estimated values are calculated by 33 separate cross-sectional regressions (11 years x 3 size portfolios).

The results of Figure 3.3 are consistent with the results of Figure 3.2, but show the year-by-year variation in the capitalization rate and value of debt. The results are less symmetric around the year t_0 portfolio formation, showing larger changes for the low

BE/ME portfolio (growth stocks) than for the high BE/ME portfolio (value stocks). Also, the range of values is wider in the years t_{-5} to t_{-1} before portfolio formation compared to afterward in years t_{+1} to t_{+5}. Extant theories do not provide an obvious explanation for this interval asymmetry, and so additional future research may be warranted to investigate this phenomena. But the results again show strong reversals in the value of debt and the capitalization rate around the year t_0 portfolio formation.

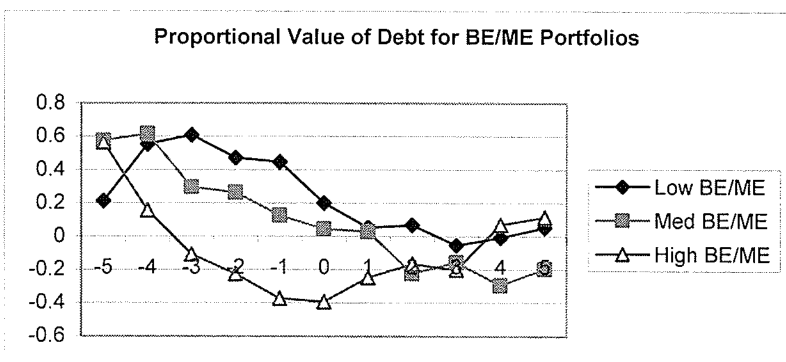
As a robustness check, the 33 interval regressions were also run with only winsorizing for outliers but no requirement for longevity throughout the entire 11-year interval; the results remain essentially the same, except that the estimated marginal debt values for the middle and high BE/ME groups exhibit greater volatility.





The equity capitalization rate, ρ , and the marginal value of debt, τ , are estimated from the coefficients of the following regression:

$$FOI = \rho(V_L - \tau D) = \left[\alpha_1 + \alpha_2\beta_U + \alpha_3 \frac{V_l - \tau D}{NOA} + \alpha_4 \log(NOA) + \alpha_5 \log(OL)\right](V_L - \tau D)$$



The proportional value that debt contributes to share price is calculated as:

$$\textit{proportional contribution to firm value} = \frac{\tau D}{V_L}$$

Figure 3.3. Cross-Sectional Regressions for Capitalization Rate and Value of Debt.
This figure shows the results of 33 cross-sectional regression for the value of debt and capitalization rate for the 11-year window surrounding portfolio formation on the BE/ME ratio, using the 1971 to 2005 data set.

3.5 The Relationship between Capital Structure and Returns

3.5.1 Buy-and-Hold Returns Analysis

While the results from the Kemsley and Nissim model are intuitively appealing, and the results are consistent with theory and previous empirical findings, it might nonetheless be argued that the results are simply a tautological artefact of model construction. This section provides a more direct empirical test of the relation between the capital structure and returns by examining the buy-and-hold returns of portfolios formed on book-to-market and estimated equity capitalization rate. These buy-and-hold returns are then tested against the Fama-French (1993) three-factor model.

Table 3.3 presents median summary statistics of the characteristics of stocks in each group of the buy-and-hold analysis. Within the capitalization rate quintiles, there is a monotonically increasing relationship with the median BE/ME ratio in each group. The capitalization rate for each observation used in Table 3.3 is calculated by applying the vector of regression coefficients of Table 3.2 for the capitalization rate, ρ, to each observation. A similar monotonic relationship can be seen with debt ratios, buy-and-hold returns, return on assets, market capitalization, Ohlson O-score, and unlevered beta.

The sorts of data shown in Table 3.3 suggest that the estimated equity capitalization rate and the BE/ME ratio are positively related to size and the debt ratio, and inversely related to return on assets, which is consistent with the view that larger firms have lower growth prospects and greater debt ratios. If the capitalization rate and BE/ME ratio capture unique information about risk levels, then it is expected that both the capitalization rate and the BE/ME ratio will be positively related to future returns.

Table 3.3

Summary Statistics of Firm Characteristics for Portfolios Sorted on BE/ME and the Estimated Equity Capitalization Rate

NYSE, AMEX and NASDAQ firms from 1971 to 2005 are ranked independently annually based upon market-to-book and capitalization rate, where the equity capitalization rate is estimated using the Kemsley and Nissim (2002) model. The values shown in the table are the median values for the sorted portfolios.

	Book-to-Market Equity								
Capitalization Rate	L	M	H	L	M	H	L	M	H
	Capitalization Rate (Percent)			BE/ME			O-score		
L	2.83	6.96	13.02	0.25	0.70	1.30	-2.84	-2.77	-2.02
2	4.11	9.02	16.95	0.33	0.75	1.39	-1.98	-1.80	-1.19
3	4.89	10.25	19.15	0.36	0.80	1.45	-1.39	-1.19	-0.67
4	5.83	11.48	21.27	0.36	0.82	1.60	-0.90	-0.79	-0.19
H	7.72	13.53	24.10	0.36	0.85	1.88	-0.26	-0.24	0.53
	Prior 12-month Returns (Percent)			Prior 36-month Returns (Percent)			Following 12-Month Returns (Percent)		
L	23.97	8.95	-0.18	90.00	40.42	12.72	-1.38	4.35	8.30
2	18.44	10.87	1.10	72.62	37.07	11.99	1.39	6.39	9.53
3	17.44	9.29	1.25	69.68	31.85	12.20	0.46	6.90	8.50
4	15.00	9.02	-0.76	54.55	31.58	7.60	2.29	6.29	9.83
H	10.42	8.56	-5.03	37.19	30.44	-4.05	3.12	9.14	9.06
	Market Capitalization			Market Debt Ratio			Book Debt Ratio		
L	71	40	26	0.02	0.08	0.23	0.06	0.10	0.17
2	63	50	32	0.08	0.19	0.39	0.15	0.20	0.27
3	72	63	36	0.14	0.28	0.47	0.22	0.26	0.32
4	93	80	37	0.21	0.36	0.54	0.27	0.31	0.34
H	147	121	38	0.34	0.46	0.63	0.33	0.35	0.33
	Beta			Unlevered Beta			Growth in Retained Earnings (Percent)		
L	1.18	1.17	1.03	1.18	1.09	0.74	26.08	13.98	6.62
2	1.16	1.10	1.01	1.08	0.89	0.50	22.64	12.98	6.61
3	1.16	1.08	1.03	1.00	0.76	0.33	21.06	12.14	6.63
4	1.13	1.04	1.06	0.91	0.55	0.22	18.16	11.32	5.48
H	1.12	1.02	1.09	0.71	0.20	0.47	14.36	10.16	3.33
	Net Operating Asset Ratio			Operating Liability Ratio			Return on Assets (Percent)		
L	0.84	0.84	0.85	0.11	0.08	0.05	20.79	16.28	11.27
2	0.79	0.80	0.80	0.10	0.08	0.05	20.09	16.07	11.67
3	0.76	0.77	0.77	0.09	0.07	0.05	18.70	14.73	11.28
4	0.74	0.74	0.74	0.08	0.06	0.04	16.90	13.66	10.34
H	0.70	0.70	0.67	0.06	0.06	0.03	14.07	12.27	8.57

To investigate whether differences in risk captured by the BE/ME ratio and the estimated capitalization rate are reflected in stock returns, Table 3.4 presents the next period annual buy-and-hold returns for each market-to-book and capitalization rate portfolio. The buy-and-hold dataset for the period 1971 to 2005 has 149,404 observations, filtered as shown in Table 3.1. Adjustment for size is made as a simple average of the means of the small and big groups. Stocks are formed into two groups according to size, small or big, using the NYSE median of firm market values each June. Most AMEX and NASDAQ stocks are smaller than the NYSE median, and so the small group contains many more stocks (2,562 out of 3,428 in 1990), but the small group contains far less than half (about 9 percent in 1990) of the combined value of the two size groups. Results are reported separately for the small and big market capitalization groups, as well as size adjusted returns. Annual value-weighted buy-and-hold returns are adjusted for delisting bias using the method suggested by Shumway (1997). Statistical significance is assessed using p-values calculated from the time series of monthly returns.

Table 3.4 shows that the book-to-market effect is similar across capitalization portfolios. The average annual size-adjusted percentage return difference between the high and low BE/ME portfolios is 13.14, 9.77, 9.77, 8.96, and 8.91 within capitalization quintiles one through five respectively. A similar pattern is seen for both the small and big portfolios. For small (big) firms, the spread of returns between high and low BE/ME stocks is 16.57 (9.71) percent for low capitalization rate firms and 10.19 (7.63) percent for high capitalization rate firms. In both size groups, the return differences are statistically significant at the 1% confidence level.

Table 3.4
Average Annual Buy-and-Hold Returns for Portfolios Sorted on BE/ME and the Estimated Capitalization Rate

Percentage value weighted annual buy-and-hold returns for NYSE, AMEX, and Nasdaq firms from July 1971 to June 2005 are displayed for portfolios formed on end-of-fiscal year rankings of the estimated capitalization rate calculated using the Kemsley and Nissim (2002) debt valuation model and book-to-market equity (BE/ME). Stocks are also ranked into two groups on size. The size-adjusted groupings are a simple average of the big and small time series. Size groupings are based on the NYSE median breakpoints. The tests for statistical differences between groups are based on the time series of monthly returns from July 1970 to June 2005. The high minus low BE/ME portfolio differences are calculated within capitalization groups by forming a portfolio that is long in the high BE/ME portfolio and short in the low BE/ME portfolio. Similarly, differences between capitalization groups are calculated using returns from a high capitalization minus a low capitalization portfolio within each BE/ME grouping.

	Book-to-Market Equity				
Capitalization Rate	L	M	H	Ret (H - L)	(p-value)
	Size-Adjusted				
L	1.88	9.45	15.02	13.14	(0.000)
2	5.19	10.76	14.96	9.77	(0.008)
3	5.58	11.30	15.35	9.77	(0.000)
4	7.32	12.49	16.27	8.95	(0.000)
H	6.64	11.79	15.55	8.91	(0.000)
Ret (H - L)	4.76	2.34	0.53		
(p-value)	(0.055)	(0.190)	(0.069)		
	Small Firms				
L	-0.41	10.29	16.16	16.57	(0.000)
2	3.48	12.11	17.91	14.44	(0.001)
3	3.83	12.38	16.00	12.17	(0.000)
4	6.16	12.63	17.33	11.17	(0.000)
H	6.50	13.06	16.69	10.19	(0.000)
Ret (H - L)	6.92	2.77	0.53		
(p-value)	(0.014)	(0.248)	(0.025)		
	Big Firms				
L	4.17	8.61	13.88	9.71	(0.014)
2	6.91	9.42	12.01	5.10	(0.143)
3	7.33	10.21	14.70	7.38	(0.017)
4	8.49	12.35	15.21	6.72	(0.001)
H	6.78	10.52	14.42	7.63	(0.002)
Ret (H - L)	2.61	1.91	0.53		
(p-value)	(0.237)	(0.241)	(0.405)		

The return differences within BE/ME groups is similar, with average size-adjusted percentage return differences between the high and low capitalization rate portfolios of 4.76, 2.34, and 0.53 within BE/ME groups L to H respectively. Small and big firms show a similar pattern, but the differences for small firm size are greater than for big firm size. These findings indicate that the effects of the capitalization rate are greatest for small size and low BE/ME ratio. Comparing the results of Table 3.4 with the median portfolio capitalization rates given in Table 3.3, it may be seen that a higher equity capitalization rate is associated with a higher next period buy-and-hold return across BE/ME groups, and within the quintiles of the low and medium BE/ME groups, but return is essentially constant within the quintiles of the high BE/ME group.

Several robustness checks are performed. First, the capitalization rate sorts are repeated using regression estimates for the average of five future lags of operating income FOI, and the general pattern of results are found to be unchanged. Second, Table 3.4 is repeated using equal-weighted instead of value-weighted returns, and again the results are similar. Third, the sorts are repeated after removing firms that have been in the CRSP database for less than five years in order to remove the bias of low returns for initial public offerings, and similar results are obtained. Finally, the results are assessed to determine if they are affected by the stock exchange listing (NYSE /AMEX and Nasdaq), or time periods formed from 1970 to 1990 and 1991 to 2005, and it is found in each case that a higher equity capitalization rate is associated with a higher buy-and-hold return as shown in Table 3.4.

3.5.2 Fama-French Three-Factor Abnormal Returns

The previous results indicate that low BE/ME firms have low equity capitalization rates and low future returns. As shown by Table 3.3, median capitalization rates increase across the three BE/ME groupings, and within the capitalization rate quintiles. One possible explanation for the low future returns is that the risk of low BE/ME firms with low capitalization rates is largely diversifiable; if this is so, then the Fama and French (1993) three factor model should explain those returns. This section provides evidence on this issue.

Table 3.5 presents post-ranking factor loadings for the portfolios in each book-to-market, capitalization rate, and size group from the three-factor model of Fama and French (1993). The factor loadings from the FF model are estimated from time-series regressions of monthly value-weighted portfolio excess returns on the market index (Mkt), size (SMB), and book-to-market (HML) factors over the entire 1970 to 2005 period. The monthly returns of Table 3.5 compound over 12 months to equal the annual value-weighted returns used in Table 3.4. Within the small firm group, Table 3.5 shows that the SMB size factor loading increases as the capitalization rate increases within the low and high BE/ME rankings, which is consistent with the capitalization rate increasing with leverage level as shown in Table 3.3, whereas there is no pattern for the medium BE/ME rankings. Within the large firm group, the SMB size factor loading decreases for low and medium BE/ME rankings as the capitalization rate increases, consistent with lower a lower risk premium as size increases, but increases within high BE/ME rankings, suggesting financial constraints. There is a size difference, with the small groups having greater loading values than the big groups, consistent with small firms being riskier than

Table 3.5
Three-Factor Regressions for Portfolios Sorted on BE/ME and the Equity Capitalization Rate

NYSE, AMEX, and Nasdaq firms from July 1971 to June 2005 are ranked independently at the end of the prior fiscal year based upon the capitalization rate estimated using the Kemsley and Nissim (2002) valuation model, book-to-market, and two groupings of size based on the NYSE median. Fama and French three-factor loadings are estimated from time-series regressions over the entire time period for each portfolio using the following model:

$$r_t = a + mMkt + sSMB + hHML + \varepsilon_t$$

r_t is excess return for the portfolio, Mkt is the excess return on the market portfolio, SMB is the factor portfolio for the returns on small minus big stocks, and HML is the factor portfolio for the returns on the high minus low BE/ME stocks. The factor coefficients (in percent) and their t -statistics are reported below. Coefficients marked ** and * are significant at 1% and 5% confidence intervals, respectively.

	a			$t(a)$			a			$t(a)$		
L	**3.51 ** **	**-0.02**	**-1.42 ** **	12.45	-0.15	-9.40	**3.47 ** **	**0.78 ** **	**0.01**	15.50	3.61	0.05
2	**2.24 ** **	**0.15 ** **	**-1.22 ** **	10.73	-10.31	-11.04	**2.18 ** **	**0.57 ** **	**-0.20**	13.64	5.47	-1.76
3	**1.96 ** **	**0.09**	**-1.15 ** **	11.54	0.95	-9.56	**1.52 ** **	**0.41 ** **	**-0.25 * **	12.71	4.01	-2.43
4	**1.72 ** **	**0.07**	**-1.20 ** **	11.70	0.81	-9.28	**1.11 ** **	**0.52 ** **	**-0.49 ** **	10.46	5.42	-4.11
H	**0.65 ** **	**0.10**	**-1.57 ** **	4.73	1.07	-9.76	**0.90 ** **	**0.38 ** **	**-0.78 ** **	9.09	3.98	-5.86
	m			$t(m)$			m			$t(m)$		
L	1.32 **	1.08 **	1.13 **	19.56	30.88	31.13	1.17 **	1.07 **	0.97 **	21.90	20.55	23.23
2	1.33 **	1.14 **	1.08 **	26.61	38.04	31.33	1.06 **	1.08 **	0.95 **	27.88	43.38	34.75
3	1.27 **	1.10 **	1.10 **	31.22	48.92	38.40	1.01 **	0.97 **	0.95 **	35.31	40.19	38.08
4	1.28 **	1.06 **	1.10 **	36.42	49.89	35.77	1.00 **	0.96 **	1.00 **	39.38	42.01	35.22
H	1.25 **	1.07 **	1.13 **	37.84	47.01	29.35	0.95 **	0.98 **	1.17 **	40.36	42.56	36.57
	s			$t(s)$			s			$t(s)$		
L	0.81 **	0.87 **	0.94 **	9.32	19.15	19.99	-0.05	0.08	0.09	-0.70	1.18	1.73
2	0.86 **	0.83 **	0.93 **	13.24	25.30	30.68	-0.04	0.06	0.07	-0.81	1.88	1.83
3	0.86 **	0.83 **	0.98 **	16.37	28.53	26.28	-0.07	0.04	0.09 *	-2.00	1.15	2.90
4	0.91 **	0.86 **	1.02 **	19.97	31.14	25.49	-0.27 **	-0.01	0.12 *	-8.22	-0.46	3.13
H	0.91 **	0.84 **	1.15 **	21.27	28.49	23.05	-0.24 **	-0.04	0.32 **	-7.96	-1.45	7.80
	h			$t(h)$			h			$t(h)$		
L	-0.41 **	0.01	0.30 **	-4.08	0.13	5.53	-0.87 **	-0.20 *	0.12	-10.81	-2.60	1.89
2	-0.19 *	0.24 **	0.48 **	-2.56	11.18	11.51	-0.56 **	-0.02	0.31 **	-9.80	-0.63	7.60
3	-0.11	0.37 **	0.66 **	-1.73	10.99	15.39	-0.55 **	0.17 **	0.46 **	-12.89	3.87	12.36
4	0.10	0.47 **	0.61 **	1.98	14.92	13.08	-0.33 **	0.11	0.54 **	-8.65	3.25	12.75
H	0.35 **	0.49 **	0.76 **	7.17	14.40	13.18	-0.24 **	0.25 **	0.73 **	-4.63	7.19	15.37
				R^2						R^2		
L				0.66	0.82	0.81				0.71	0.60	0.61
2				0.77	0.88	0.86				0.77	0.85	0.76
3				0.82	0.91	0.86				0.84	0.82	0.79
4				0.85	0.91	0.85				0.84	0.83	0.76
H				0.90	0.90	0.80				0.84	0.83	0.78

big firms. The loadings for the HML book-to-market factor increase in the same direction as the capitalization rate for all three BE/ME groups, which is consistent with leverage increasing with equity capitalization rate as shown in Table 3.3. Again, the loadings in the small groups are greater than for the big groups.

If the risk factors of the three-factor model describe returns, then the intercepts from the time-series regressions reported in Table 3.5 should be statistically indistinguishable from zero values. However, this is not the case. The intercepts for all portfolios are large and most are statistically significant at the 1% or 5% confidence levels, with values as high as 3.51 and 3.47 percent for the lowest capitalization rate quintiles of the low BE/ME groups of the small and big firms respectively. Moreover, the intercepts exhibit sign reversal between the low BE/ME groups versus the high BE/ME groups, with positive intercepts for the low BE/ME groups and negative intercepts for high BE/ME groups, indicating that these groups respond differently to the risk factors of the three-factor model. The abnormal returns given by the intercepts move in the opposite direction to the pattern shown in Table 3.3 for returns of portfolios formed on BE/ME and estimated capitalization rate; whereas Table 3.3 shows returns increasing with increasing capitalization rate, Table 3.5 shows the abnormal returns given by intercept loading decreasing as the capitalization rate increases.

The statistical significance and pattern of the intercepts in Table 3.5 indicates that the equity capitalization rate estimated by the Kemsley and Nissim model captures returns characteristics that are not explained by the systematic risk factors of the Fama and French three-factor model. To the extent that the factor model captures differences across firms, the patterns in the factor loadings and intercept values support the view that the buy-and-hold returns displayed by portfolios sorted on capitalization rate are not due to systematic risk of financial distress.

3.5.3 Abnormal Returns with a Leverage Factor

This section provides an empirical test of the relationship between the estimated equity capitalization rate and returns, by inserting a leverage factor into the Fama and French factor model. The loading on the leverage factor represents next period buy-and-hold returns due to leverage. If the Kemsley and Nissim model results are valid, then the factor model should show increasing loading on the leverage factor as the capitalization rate increases across and within BE/ME groups. Such a positive relationship between current period capitalization rate and next period returns due to leverage would be consistent with the story told by the Kemsley and Nissim regression results, where sorting on BE/ME leads to next period reversals in the trend of the value of debt and the capitalization rate. As previously discussed, the next period reversals in value of debt and capitalization rate for portfolios sorted on the BE/ME ratio imply the book-to-market returns reversal effect; the addition of a leverage factor in the FF model should reflect the next period returns reversal shown in Table 3.3, where Table 3.3 shows a negative relationship between leverage and prior returns and a positive relationship between leverage and next period returns.

Table 3.6 reports the postranking factor loadings for the portfolio in each book-to-market, equity capitalization rate, and size group from the factor model of Fama and French (1993). In addition to the regular three factors of market index (Mkt), size (SMB), and book-to-market (HML), a fourth factor (CMU) is included that represents leverage.

The CMU leverage factor is constructed in a similar manner to the Fama and French HML factor. At the end of June of each year t (1970-2005), NYSE, AMEX, and

Table 3.6
Four-Factor Regressions for Portfolios Sorted on BE/ME and the Equity Capitalization Rate

NYSE, AMEX, and Nasdaq firms from July 1971 to June 2005 are ranked independently at the end of the prior fiscal year based upon the capitalization rate estimated using the Kemsley and Nissim (2002) valuation model, book-to-market, and two groupings of size based on the NYSE median. A leverage factor is added to the Fama and French three-factor and loadings are estimated from time-series regressions over the entire time period for each portfolio using the following model:

$$r_t = a + mMkt + sSMB + hHML + cCMU + \varepsilon_t$$

r_t is excess return for the portfolio, Mkt is the excess return on the market portfolio, SMB is the factor portfolio for the returns on small minus big stocks, and HML is the factor portfolio for the returns on the high minus low BE/ME stocks, and the CMU is the factor portfolio for the returns of constrained firms with high leverage minus unconstrained firms with low leverage. The factor coefficients and their associated t-statistics are reported below. The factor coefficients (in percent) and their t-statistics are reported below. Coefficients marked ** and * are significant at 1% and 5% confidence intervals, respectively.

Cap. Rate	LBM	M	HBM	LBM	M	HBM	LBM	M	HBM	LBM	M	HBM
		a			*t(a)*			*a*			*t(a)*	
L	**1.01 ****	**-0.37**	**-0.57 ***	3.80	-2.01	-2.86	**0.60 ***	**0.13**	**0.38**	2.24	0.56	1.88
2	**0.72 ****	**0.21**	**-0.31**	3.72	1.30	-1.78	**0.90 ****	**0.34**	**0.39**	4.13	2.00	1.94
3	**0.78 ****	**0.43 ***	**-0.11**	4.12	2.95	-0.66	**0.74 ****	**0.12**	**0.44 ***	3.72	0.67	2.35
4	**0.93 ****	**0.63 ****	**-0.09**	4.74	4.42	-0.48	**0.39**	**0.48 ***	**0.52 ***	2.00	2.61	2.59
H	**0.68 ****	**0.69 ****	**-0.16**	3.34	4.78	-0.72	**0.76 ****	**0.77 ****	**0.37**	3.74	4.28	1.52
		m			*t(m)*			*m*			*t(m)*	
L	1.07 **	0.93 **	0.98 **	27.62	35.12	33.56	1.02 **	0.92 **	0.92 **	25.84	26.77	31.08
2	1.12 **	1.03 **	1.05 **	39.89	44.09	41.39	0.98 **	1.03 **	0.97 **	30.77	41.14	32.76
3	1.09 **	1.04 **	1.04 **	39.54	49.27	41.23	1.01 **	1.00 **	0.99 **	34.26	37.90	36.44
4	1.15 **	1.01 **	1.03 **	40.25	48.45	37.77	1.03 **	0.99 **	1.07 **	36.25	36.93	36.78
H	1.13 **	1.01 **	1.02 **	38.11	47.72	32.06	0.98 **	0.99 **	1.18 **	32.68	37.73	33.48
		s			*t(s)*			*s*			*t(s)*	
L	1.20 **	1.03 **	1.15 **	20.53	25.69	26.08	0.34 **	0.18 **	-0.15 **	5.79	3.50	-3.35
2	1.15 **	0.98 **	0.98 **	26.92	27.80	25.79	0.11	0.09	-0.09	2.36	2.44	-2.03
3	1.12 **	0.99 **	1.12 **	26.88	30.92	29.44	-0.05	-0.07	-0.01	-1.18	-1.82	-0.12
4	1.15 **	1.02 **	1.21 **	26.56	32.28	29.26	-0.18 **	-0.08	0.15 **	-4.22	-1.86	3.48
H	1.15 **	1.02 **	1.34 **	25.67	31.78	27.90	-0.19 **	-0.13 **	0.33 **	-4.27	-3.34	6.17
		h			*t(h)*			*h*			*t(h)*	
L	0.10	0.09	0.09	1.03	1.31	1.22	0.01	0.08	0.25 *	0.06	0.92	3.18
2	0.12	0.06	0.16 *	1.56	0.93	2.49	-0.34 **	0.02	0.17 *	-4.10	0.27	2.19
3	0.07	0.06	0.27 **	0.90	1.00	4.01	-0.39 **	0.25 **	0.21 *	-5.02	3.67	2.98
4	0.16	0.12	0.14	2.08	2.11	1.96	-0.17 *	0.07	0.07	-2.28	1.01	0.96
H	0.16	0.12	0.24 *	2.07	2.08	2.88	-0.19 *	0.02	0.30 *	-2.48	0.26	3.20
		u			*t(u)*			*u*			*t(u)*	
L	**-0.86 ****	**-0.08**	**0.34 ****	-7.29	-1.00	3.82	**-1.13 ****	**-0.05**	**0.27 ***	-9.53	-0.52	3.08
2	**-0.54 ****	**0.10**	**0.44 ****	-6.38	1.44	5.80	**-0.53 ****	**-0.05**	**0.34 ****	-5.47	-0.73	3.78
3	**-0.41 ****	**0.15**	**0.47 ****	-4.87	0.96	6.09	**-0.32 ****	**-0.16**	**0.37 ****	-3.57	-1.95	4.46
4	**-0.29 ****	**0.29 ****	**0.46 ****	-3.32	4.53	5.62	**-0.35 ****	**-0.06**	**0.55 ****	-4.09	-0.71	6.20
H	**0.00**	**0.28 ****	**0.62 ****	-0.05	4.34	6.43	**-0.12**	**0.13**	**0.50 ****	-1.31	1.64	4.66
					R^2						R^2	
L				0.90	0.92	0.91				0.87	0.79	0.79
2				0.94	0.94	0.93				0.89	0.90	0.81
3				0.94	0.95	0.93				0.89	0.87	0.85
4				0.94	0.95	0.93				0.89	0.87	0.86
H				0.93	0.95	0.91				0.85	0.86	0.84

Nasdaq stock are allocated into two size groups (small or big; S or B) based upon the NYSE median market equity. In an independent sort, NYSE, AMEX and Nasdaq stocks are allocated to three market leverage groups (unconstrained = low leverage, medium, and constrained = high leverage; U, M,or C) based upon on the breakpoints for the bottom 30 percent, middle 40 percent, and top 30 percent of the values for all stocks. Six monthly returns on the portfolios are then calculated. CMU is the difference between the size-leverage portfolios (S/U, S/M, S/C, B/U, B/M, and B/C) are defined as the intersections of the two market equity and three leverage portfolios. Value-weighted average of the returns of the two high leverage portfolios and the average of the returns of the two low leverage portfolios:

$CMU =$ the average return on the two high leverage portfolios
− the average return on the two low leverage portfolios

= ½ (Small high leverage + Big high leverage)
− ½(Small low leverage + Big low leverage)

The loadings on the CMU factor shown in Table 3.6 represent the effects of leverage. It can be seen that the CMU loading values are indeed consistent with the story told by the Kemsley and Nissim model estimates of equity capitalization rate and value of debt. The CMU loadings show that the book-to-market returns reversal effect is strongly influenced by leverage as the loadings on the leverage factor are increasing with capitalization rate across BE/ME groups and within BE/ME capitalization rate quintiles. These results are consistent with the Kemsley and Nissim model estimates shown in Figures 3.2 and 3.3, where shifts in next period value of debt and next period capitalization rate after portfolio formation at time t_0 are reflected in higher next period returns for the high BE/ME portfolios with high leverage and lower next period returns for the low BE/ME portfolios with low leverage. Table 3.3 shows that the capitalization rate is positively related to leverage level among the buy-and-hold portfolios, and so the loading on the CMU leverage factor in Table 3.6 increases with both the capitalization rate and the leverage level.

The intercepts values shown in Table 3.6 are smaller than those shown in Table 3.5 in most cases, indicating that addition of the CMU leverage factor provides explanatory power beyond that shown by the standard HML book-to-market factor. However, the most of the intercepts remain statistically significant at the 1% or 5% confidence levels, indicating that a firm's equity capitalization rate is related to returns for reasons beyond those captured by the leverage factor.

Table 3.6 includes both the HML factor and the CMU factor but unreported robustness checks show that the CMU factor can entirely replace the HML factor while providing very similar results. The ability of the CMU factor to replace the HML factor in the three-factor model suggests that the HML factor reflects the effects of capital structure. To the extent that the factor model captures differences across firms, the patterns in the leverage factor loadings and intercept values support the view that the equity capitalization rate and the value that debt contributes to firm value or share price are important determinants of returns.

3.6. Conclusions

3.6.1 The Low Covariance between Debt Level and BE/ME Ratio

Standard interpretations of capital structure theory assume that the capitalization rate (cost of unlevered equity) is held constant. For example, the arbitrage pricing model of Modigliani and Miller (1958, 1963) examines a representative risk class so that the capitalization rate may be held constant. This line of reasoning has become pervasive in discussion and analyses of capital structure, leading to the commonly held viewpoint that observed phenomena such as the negative relationship between leverage and profitability, or the low covariance between leverage and share price, are puzzles that seem to contradict theory.

The empirical evidence presented in this paper shows that the variation in the capitalization rate is related to shifts in the value of debt. These results suggest that variation in the BE/ME ratio (or, effectively, variation in share price) that proxies for expected profitability induces two opposing forces on the optimal debt level for the firm. On the one hand, there is a *leverage effect* where the value that debt contributes to share price is positively related to expected profitability (negatively related to the BE/ME ratio). This *leverage effect* implies that the firm will be inclined to use more debt as expected profitability increases because leverage benefits work in the direction of increased firm value or share price. On the other hand, there is a *capitalization rate effect* where the capitalization rate is negatively related to expected profitability. This *capitalization rate effect* implies that the firm will be inclined to use less debt as expected profitability increases because the cost of equity capital (capitalization rate) declines as share price rises and so, ceteris paribus, the equilibrium level of debt declines to the point where the marginal value of debt is high enough to equal the high marginal value of low cost equity.

These two opposing forces provide an explanation for the low covariance observed between debt ratios and share price, for an increase in expected profitability generates countervailing forces that stabilize the optimal debt level for the firm while at the same time inducing an increase in share price. Similarly, the observed negative relationship between leverage and profitability reflects the relative strength of these opposing forces, implying that the *capitalization effect* dominates over the *leverage effect*. Thus, apparent puzzles with respect to the observed capital structure choices of firms are simply rational behavior in response to the value of debt and the capitalization rate.

3.6.2 The Book-to-Market Effect

The irrational-pricing explanation for the observed book-to-market returns reversal effect is that investors extrapolate past performance into the future. Lakonishok, Shleifer, and Vishny (1994) argue that the predictive ability of the BE/ME ratio with respect to future returns can be enhanced by conditioning on prior period measures such as sales growth.

The competing rational behaviour hypothesis argues that observed returns reflect investors' response to information shocks driven by changing economic risk factors. Fama and French (1995, 1996) show that average returns on common stocks are related to firm characteristics such as size, earnings/price, cash flow/price, and sales growth. They find that, with the exception of portfolios formed on the basis of short-term returns, the three-factor model can explain observed returns for portfolios sorted on a wide variety of characteristics. Fama and French (1995) shows that the three-factor model can explain the returns of portfolios double sorted on BE/ME and cash flow/ price or sales growth, as given in Lakonishok, Shleifer and Vishny (1994), which suggests that the three-factor model can subsume the extrapolation model. However, the results of this paper show that the three-factor model cannot provide an adequate explanation for the returns of buy-and-hold portfolios sorted on book-to-market and the estimated equity capitalization rate, implying that systematic financial distress is not the explanation for the BE/ME reversal pattern.

Related empirical research in asset pricing on winner and loser stocks, such as Jones (1993), argues that risk-adjusted returns reflect leverage effects. Consistent with this view, this paper presents empirical evidence, using both the Kemsley and Nissim debt valuation model and the Fama and French factor model, that book-to-market returns reversal is driven by reversals in the value of debt and in the capitalization rate. The jointly estimated equity capitalization rate and marginal value of debt are closely connected with cash flow variables such as return on assets. The reversal pattern of the book-to-market returns, where high BE/ME portfolios produce higher returns than low BE/ME portfolios following portfolio formation, is mirrored by a concurrent reversal of the estimated capitalization rate and marginal value of debt. The reversal pattern is accompanied by large changes in the proportional value that debt contributes to firm value or the share price. The reversal patterns exhibit mean reversion through the period before and after portfolio formation, in a manner that tracks cash flows.

These findings suggest that the observed returns pattern for the BE/ME effect is strongly influenced by leverage effects. The intuition is straightforward. The value that debt contributes to share price and the equity capitalization rate are a joint function of expected cash flows. While the value of debt is negatively related to the capitalization rate, these variables work in concert to move share price in the same direction. An increase (decrease) in value of debt is associated with a decrease (increase) in the capitalization rate, but both are associated with an increase (decrease) in share price. Thus, small changes in expected cash flow produce large changes in share price. The observed pattern of cash flows is that low BE/ME firms exhibit increasing return on assets (ROA) up to the period of portfolio formation on the BE/ME ratio, and then declining ROA afterward; high BE/ME firms exhibit the reverse pattern. Thus, following portfolio formation on the BE/ME ratio, reversals in the value of debt and the capitalization result in share prices for high BE/ME firms increasing faster than for low BE/ME firms, creating the observed returns reversal effect.

3.6.3 Future Research

This paper contributes to the line of empirical literature that examines how debt increases the value of the firm by showing the dynamic relationship among the value of debt, the capitalization rate and expected profitability. It also contributes to another line of empirical research that investigates the determinants of the debt level of the firm by showing that changes in expected profitability induce countervailing forces upon the debt level in the form of a leverage effect and a capitalization rate effect. While it is well known through previous research that leverage level is related to variables such as the book-to-market ratio or profitability, the specific mechanism of these relationships remains opaque. The methodology of this paper to jointly estimate the value of debt and the capitalization rate is applicable to further research along these lines.

Appendix A: Summary of the Kemsley and Nissim (2002) Model

The Kemsley and Nissim (2002) model is derived from the basic model relating debt to the value of the firm:

$$V_L = V_U + \tau D \tag{1.5}$$

where the value of the unlevered firm is equal to discounted future cash flows, $V_U = \frac{E[FOI]}{\rho}$, so that the equation can be expressed as:

$$V_L = \frac{E[FOI]}{\rho} + \tau D \tag{1.6}$$

Here FOI is future operating income, and ρ is the equity capitalization rate. Re-arranging terms creates the basic form of the Kemsley and Nissim model:

$$E[FOI] = \rho(V_L - \tau D) \tag{1.7}$$

The empirical representation of this model is:

$$FOI = \alpha'\chi(V_L - \tau D) + \gamma'\chi + \sum_{i=1}^{44} \alpha_{1i} DIND_i + \upsilon \tag{1.8}$$

This empirical model allows the concurrent estimation of the value of debt, as represented by the coefficient τ, and the capitalization rate applied to unlevered cash flows is represented by the coefficient vector χ. Control variables are represented by the coefficient vector γ.

Showing specific variables, this becomes:

$$\begin{aligned} FOI = &\left[\alpha_1 + \alpha_2\beta_U + \alpha_3\frac{V_L - \tau D}{NOA} + \alpha_4 \log(NOA) + \alpha_5 \log(OL)\right](V_L - \tau D) \\ &+ \sum_{i=1}^{44} \gamma_{2i} DIND_i + \gamma_3 \frac{V_L - \tau D}{NOA} + \gamma_4 \log(NOA) + \gamma_5 \log(OL) + \upsilon \end{aligned} \tag{1.9}$$

Here β_U is unlevered beta, V_L is the market value of the levered firm, D is the book value of debt, NOA is the book value of net operating assets, OL is operating liabilities, and $DIND$ is a vector of industry dummies.

Examining the capitalization rate vector χ, it can be seen that the estimated capitalization rate reflects expected returns (β_U),expected growth ($\frac{V_L - \tau D}{NOA}$), size (NOA), and (operating risk (OL). The variable $\frac{V_L - \tau D}{NOA}$ represents growth as it is the unlevered market-to-book ratio. Thus, applying the Kemsley and Nissim model provides a joint estimate of the market capitalization rate and the associated market value of debt.

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CHAPTER 4

THE PERSISTENCE OF SEO MARKET TIMING

4.1 Introduction

Timing of equity offerings is an important factor in firms' capital structure decisions. Empirical studies show that firms tend to issue equity when the cost of equity appears to be low relative to the mean. Since their market valuation is high, these issues are followed by long-run underperformance. Most direct tests of market timing are based upon the positive relationship between firms' market valuation, as proxied by the market-to-book ratio, and their equity issuance. This tendency toward timing markets is confirmed by direct surveys of financial managers [e.g. Graham and Harvey (2001), Bancel and Mittoo (2004)].

While it is generally accepted that managers try to time markets when issuing equity, an ongoing question is the long-term impact of market timing on capital structure. Empirical studies of the speed of mean reversion toward a target leverage ratio vary widely in their results for the persistence of changes in capital structure. The persistence of market timing effects has profound implications; a high persistence of market timing effects implies that leverage targets are not very important and, by extension, capital structure policy has little impact on the value of the firm. Baker and Wurgler (2002) examine the persistence of initial public offering (IPO) equity issues upon capital structure, using a weighted average of the market-to-book ratio to measure market timing effects, asserting that the persistence of market timing extends beyond 10 years. In contrast, Alti (2006) examines the persistence issue of IPO effects, using a "hot-market" dummy variable to measure the effect of market timing on the book leverage ratio, and finds that that IPOs have only short-term market timing effects that are completely reversed within two years after the IPO. However, the results of Alti (2006) are ambiguous insofar as Alti tests both the hot-market dummy measure and the Baker and Wurgler weighted average book-to-market measure together in the same regression, and finds that the Baker and Wurgler measure remains persistently significant at the 1% confidence level even though Alti's hot-market measure becomes insignificant within two years.

The persistence of market timing provides a means to test competing theoretical models, because competing theoretical models of capital structure imply different characteristics for the persistence of market timing following an issue of equity. The trade-off model implies that the effect of market timing upon the leverage ratio should fade in a smooth and continuous manner as equilibrium forces push the leverage level back to equilibrium. The pecking order theory implies that the impact of market timing upon the leverage ratio should remain unchanged if investment level[1] does not change. And the transaction costs theory implies that the impact of market timing upon the leverage ratio should decline in a step-wise or lumpy fashion because of the fixed costs of issuing capital as the leverage level returns to its equilibrium value. Thus, the persistence of market timing effects following the issuance of equity provides insight into the forces shaping the capital structure choices of the firm.

This paper focuses upon the financing of seasoned equity offerings (SEOs) to examine market timing and its effects upon capital structure, using a hot-market timing measure similar to Bayless and Chaplinsky (1996) and Alti (2006). While most research on market timing studies the initial public offering (IPO) market, this paper examines the seasoned equity offering (SEO) market for several reasons. First, much of the empirical

[1] Investment level is defined as INV / A, capital investment expenditures per unit of total book assets.

literature that examines the persistence of capital structure specifically excludes IPO data because IPOs are one-time events, and so it is important to determine the contribution of SEO market timing towards the persistence of capital structure. Second, the SEO market represents the capital structure policy of ongoing firms, complementing studies of capital structure that examine the determinants and theories of capital structure. Finally, seasoned equity offerings represent the majority of the dollar value of equity capital raised on US stock exchanges and so the influence of the SEO market is economically significant. Hence, the examination of an SEO sample provides valuable insight into how market timing affects long-range financial policy.

The empirical model of this paper uses a "hot-market" dummy variable in the manner of Bayless and Chaplinsky (1996) and Alti (2006) to measure the effects of SEO market timing, characterized by whether the SEO takes place in a hot issue market. The rationale for this market timing measure is that firms will tend to issue more equity in markets where the cost of capital is perceived to be low. As discussed in Alti (2006), this market timing measure has econometric advantages because it does not pick up firm-level characteristics, being instead a function of market conditions. The hot-market dummy variable avoids the confounding firm-level effects associated with the commonly used market-to-book ratio.

Examining the data sample organized in SEO event time, the empirical results show a substantial hot-market effect on the amount of equity issued by SEO firms. The average SEO for cold-market firms amounts to 23.87% of pre-SEO book assets, compared to 38.88% for hot-market firms. Consistent with the findings of Alti (2006), the hot-market effect is largely orthogonal to other factors known to affect equity issues, meaning that the size and significance of the hot-market dummy coefficient does not greatly change in the presence of control variables for industry and firm level effects. Thus, focusing upon market conditions by means of a hot market dummy variable is effective in detecting market timing behavior. However, in marked contrast to the Baker and Wurgler (2002) and Alti (2006) results for IPOs, the results of this paper show that the weighted average market timing measure of Baker and Wurgler (2002) has negligible effects for SEOs.

Hot and cold-market firms do not differ greatly in pre-SEO book leverage levels, so avoiding financial distress does not appear to be the reason for issuing more equity in hot markets. The negative impact of market timing on book leverage declines in the years following SEO issuance. Within three years after the SEO event, the effects of market timing become insignificant, suggesting that market timing has only a temporary impact on the capital structure policy of the firm. Similarly, hot-market firms make lower investments and have lower profitability than cold-market firms, but these differences also become insignificant within three years of the SEO.

Portfolios formed on the market-to-book ratio show how the financial strength of the firm influences the impact of market timing on capital structure. Leary and Roberts (2005) examine market timing for an IPO sample and find that the market timing effects are generally similar for high, medium and low book-to-market portfolios, but that that the effects are greatest for high market-to-book. Kayhan and Titman (2007) examine a sample that excludes IPOs and find that the speed of reversion to target leverage varies significantly among portfolios formed on the market-to-book ratio. Thus, under the interpretation that the market-to-book ratio reflects expected growth opportunities, the persistence of capital structure shifts seems to vary with the expected growth for the firm.

The results of this paper show that the impact of market timing is very different for high and low market-to-book portfolios formed on the M/B ratio[2]. The results from sub samples sorted on the M/B ratio show that the results for the overall dataset are dominated by the results of the high M/B sub sample. So while most of the previous research uses overall samples, such results may not represent the majority of firms. That is to say, low and medium M/B firms do not exhibit strong marketing timing effects. This is an issue explored throughout this paper. The amount of equity issued by low and medium M/B firms is mostly influenced by general market conditions and firm specific determinants, with little difference between firms in hot or cold markets, whereas the level of equity issued by high M/B firms is strongly affected by market timing.

In order to test the effects of cyclical changes in the market-to-book ratio, the dataset is also organized into an 11-year data window (from time t_{-5} to t_{+5}) around the time of sorting into portfolios on the basis of the market-to-book ratio (at t_0), as shown later in Figure 4.4. This 11-year data window includes many observations outside of the SEO event window previously examined, thereby including non-issuers of SEOs and so providing a perspective of the broader market. The 11-year window results are generally consistent with the results from the SEO event time interval; hot-market firms exhibit strong market timing effects as evidenced by a decrease in book leverage in the SEO issue year followed by increases in book leverage in the years after the SEO, and hot-market firms also exhibit persistently lower earnings. However, a noteworthy difference is that hot-market firm exhibit persistently higher investment levels than non-issuers of equity.

[2] The market to book ratio M/B used in this paper is defined as book debt plus market equity (common shares times market share price) divided by total book assets. This definition of market-to-book is commonly used in corporate finance research.

Examination of the 11-year data window shows the effects of cyclical variation in the market-to-book ratio upon the market timing behavior of firms. Empirical research in asset pricing shows that the book-to-market equity ratio, BE / ME [3], is time varying and mean reverting. Since the M / B market-to-book firm valuation ratio used in corporate finance research is closely related to the BE / ME equity ratio used in asset pricing research, forming portfolios upon the M / B ratio creates a natural experiment to examine if there are cyclical market-to-book effects between leverage and market timing. This data window shows that the sub sample of hot-market firms with a high M / B ratio have significantly lower book leverage levels during the interval when the market-to-book ratio is increasing (t_{-5} to t_0), with this difference becoming insignificant thereafter as the M / B ratio reverts to the mean. Hot-market firms in the sub samples of low and medium M / B firms show no significant difference in book leverage level. These results show an asymmetric characteristic where increases in the M / B ratio are associated with market timing that reduces book leverage levels below the long-term mean, and then leverage rapidly reverts to the mean when the M / B ratio is declining (but does not go above the mean). Under the common interpretation that the M / B ratio reflects growth opportunities, these results suggest that market timing is a characteristic of firms with increasing growth opportunities, consistent with the Berens and Cuny (1995) growth model of capital structure which predicts that high-growth firms will have a lower target leverage level than low-growth firms because growth increases the value of equity relative to debt.

[3] The book-to-market equity ratio BE / ME is defined as book equity (common shares times book price) divided by the market equity (common shares times market price). This definition of market-to-book is prevalent in asset pricing research.

The results of this paper indicate that neither transaction cost theory nor pecking order theory can explain the observed persistence of market timing. Similar to the Alti (2006) results for IPOs, the results of this paper for SEOs show that hot-market firms more actively increase their book leverage levels in each year following SEO issuance than do cold-market firms; as argued by Alti, this implies that high capitalization transaction costs are not the reason that hot-market firms choose to decrease leverage by means of the SEO. Furthermore, the evidence of an active increase of leverage level following SEO issuance is also contrary to the pecking order theory because hot-market firms exhibit persistently lower investment than cold-market firms, inferring that need for investment capital does not drive the observed market timing behavior. Market timing plays a significant role in secondary equity financing activity, but these effects reverse rapidly in the period following the SEO. The results do not support the view of Baker and Wurgler (2002) that capital structure is the cumulative outcome of past market timing activities.

In conclusion, the results of this paper have two main implications. First, the results support the existence of a target leverage level in keeping with a dynamic form of the trade-off theory of capital structure, for capital structure may temporarily vary from the long-term target leverage level to reflect current conditions but thereafter reverts to the target. Second, observed market timing behavior is consistent with the growth model form of the trade-off theory, as market timing by firms is occurs when there are increasing growth opportunities.

The remainder of the paper is organized as follows. Section 4.2 is a literature review and overview of related capital structure theories. Section 4.3 defines the hot-market timing measure. Section 4.4 uses a dataset organized in SEO event time to test the effect of market timing upon capital structure. Section 4.5 examines a dataset organized into an 11-year window around the time of portfolio formation on the market-to-book ratio, to show the connection between cyclical variation in the market-to-book ratio and market timing effects. Section 4.6 concludes.

4.2 Literature Review and Capital Structure Models

There is considerable empirical evidence of market timing. Taggart (1977), Marsh (1982), Jalilvand and Harris (1984), and Asquith and Mullins (1986) examine market timing from the perspective of past stock returns. More recent studies such as Rajan and Zingales (1995), Jung, Kim, and Stulz (1996), Pagano, Panetta, and Zingales (1998), Hovakimian , Opler, and Titman (2001), and Leary and Roberts (2005) focus on the market-to-book ratio to capture market timing. These studies show that firms tend to issue equity when their market valuation is high relative to book values.

Interpreting the results of such studies is difficult because of the confounding effects of other determinants of financing policy. A related thread of research examines the effects of overvalued equity sales by analyzing stock returns subsequent to equity issuance. Ritter (1991) and Loughran and Ritter (1995) show that IPOs and SEOs under perform in the long run. Ritter (1991) shows that this under performance is more pronounced for hot-market IPOs, while Rajan and Servaes (1997) shows more pronounced under performance where analysts previously forecast high growth. These results support the use of hot and cold markets as a measure of market timing. Survey evidence by Graham and Harvey (2001) for American financial managers and Bancel and Mittoo (2004) for European financial managers demonstrates that market timing is an important factor in corporate financing decisions.

The influential study of Baker and Wurgler (2002) represents market timing as a weighted average of a firm's past market-to-book ratio, where the weighting is a function of external equity versus debt financing. If firms issue more equity when the market-to-book ratio is high, then this external finance weighted average is negatively related to leverage. The Baker and Wurgler measure of timing suggests that the influence of market timing extends past 10 years. However, an econometric criticism of this weighted average measure is that it is confounded by the many other factors that influence the market-to-book ratio, such as macroeconomic conditions and the firm's technology and growth prospects. Technology firms, for example, may tend to issue equity when their market-to-book ratio is high regardless of market timing issues or immediate growth prospects in order to maintain future financial flexibility.

In a recent study, Kayhan and Titman (2007) decompose the external finance weighted average of Baker and Wurgler (2002) to show that its persistence effect is due to the covariance between the past mean of the firm's market-to-book ratio and the firm's external financing. Thus, the Baker and Wurgler measure likely reflects the persistence of the market-to-book ratio in IPO data more than market timing efforts. Kayhan and Titman examine a sample that excludes IPOs to show that the past history of the firm is related to the current leverage level, but that leverage levels tend to revert to a target value over the long-term. Similarly, Leary and Roberts (2005) present empirical evidence that firms tend to rebalance leverage back to previous levels following IPOs. Leary and Roberts find similar results among portfolios sorted on the market-to-book ratio, though high market-to-book firms tend to issue more equity initially. These more recent results argue against the long-term persistence of market timing claimed by Baker and Wurgler.

Empirical research generally supports the view that market timing effects are eventually reversed as the firm's leverage level reverts to a target level. Theory suggests that the reversal of market timing effects could be implemented by firms in two ways. The first way is that firms actively increase their leverage levels to return to their target leverage level, consistent with a dynamic form of the trade-off theory where leverage may deviate from the optimal target in the short-term to reflect transient conditions but reverts to the target over the long-term. The second way is that firm characteristics change in a manner so that the firm's target leverage shifts to realign with the actual leverage level, consistent with the transaction cost theory.

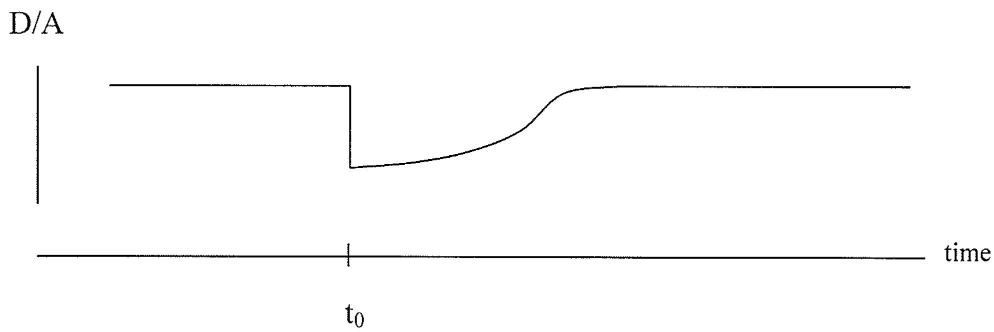
There are two main classes of theoretical models of market timing. In the first, mispricing of equity by the market, either real or simply perceived by the issuer, provides an opportunity for the firm to issue more equity at overvalued prices. Under this model, hot markets are times of high valuation relative to fundamentals, and this leads to a high incidence of equity issues from both IPOs and SEOs. A second type of theoretical model is based upon the adverse selection scenario of Myers and Majluf (1984). In such models, investors and managers are both rational, but market timing opportunities reflect the degree of asymmetric information. Under this model, hot markets reflect periods of low information asymmetry and therefore low adverse selection costs for issuers of equity. The determination of which model of market timing is correct is an empirical question that is beyond the scope of this paper.

The main competing models of capital structure in current literature are the trade-off theory, pecking order theory, and transaction cost theory. All of these theories imply some degree of market timing effects because firms will issue more equity when it has a low cost relative to debt, but they make differing predictions as to how capital structure changes following market timing. The pecking order theory postulates that firms normally raise capital for new investment by first using retained earnings in order to minimize asymmetric information costs and then, if the firm is in a financial deficit situation such that retained earnings are insufficient to implement investment policy, it will usually issue debt before equity. Thus, following market timing by the firm to take advantage of low information asymmetry costs, the pecking order theory implies that firms will change their capital structure in a manner that reflects their financial deficit for investment. In contrast, the trade-off theory implies that the firm will revert to an optimal, or target leverage level following market timing by actively issuing debt to revert to the target in reflection of the long-term costs and benefits of debt versus equity. Transaction cost theory maintains that issuing capital is a costly process with high fixed costs that discourage continuous adjustment of leverage levels. Such models imply that firms will tend to issue capital in discrete amounts that will cause firms to oscillate over or under their long-term target leverage level. Under this scenario, firms that issue a large SEO may appear to be under-leveraged according to standard control variables, but this under-leverage position may actually be an optimal strategy when transaction costs are considered. Firms will issue a large SEO and then wait for changing conditions, such as declining share price or increased liabilities, to achieve mean reversion to the target leverage level.

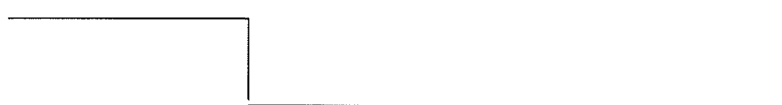
The trade-off theory of capital structure may be thought of as a class of general equilibrium models that balance the benefits and costs of debt, with various forms that make similar predictions. The most often discussed form is the static trade-off model, which examines the benefits of the tax shield of debt interest versus the probable costs of financial distress. However, a short-coming of standard trade-off models is that the probability of financial distress is simply not great enough to explain the observed low levels of corporate debt. But the growth model presented by Berens and Cuny (1995) shows that growth of future cash flows has a major impact upon the optimal or target leverage ratio, since equity value reflects the benefit of future cash flow growth while the tax shield benefit of current debt does not. The growth model implies that market timing effects should be seen for firms with increasing growth opportunities because their optimal leverage level is decreasing, but that such effects should fade as the firms' growth rates revert to the mean.

The persistence of market timing provides a means to test these competing theoretical models, because the models imply different characteristics for the persistence of market timing following an issuance of equity. The different implications of these theoretical models are shown graphically in Figure 4.1. In Figure 4.1, the vertical axis is the debt ratio (D/A where debt is normalized by assets), and the horizontal axis is the time surrounding the SEO issue at t_0. The trade-off model implies that the impact of market timing upon the leverage ratio should fade in a smooth and continuous manner in response to equilibrium forces. The pecking order theory implies that the effects of market timing upon leverage should remain unchanged while investment level does not change. And the transaction costs theory implies that the impact of market timing upon the debt ratio should decline in a step-wise or lumpy fashion in response to equilibrium forces because of the fixed costs of issuing capital. Thus, the persistence of market timing effects following the issuance of equity provides insight into the forces shaping the capital structure choices of the firm.

a. Trade-off theory: the impact of market timing upon the leverage ratio will fade smoothly / continuously as the leverage level returns to the previous equilibrium level



b. Pecking order theory: the impact of market timing upon the leverage ratio will remain unchanged while investment level is unchanged



c. Transaction cost theory: the impact of market timing upon the leverage ratio will decline in a step-wise fashion as the leverage level returns to equilibrium

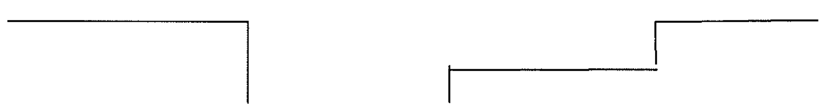


Figure 4.1. A Posteriori Implication of Competing Capital Structure Theories

The hot markets measure of market timing used in this paper may be influenced by general market conditions. That is to say, market conditions may be important for both hot and cold market SEOs. To control for this, this paper uses a market dummy variable which equals one when the number of issues of SEOs in the current year is above the long-term median. This control dummy shows that general market conditions are indeed a significant influence, but this control variable does not alter the general results showing the presence of market timing effects as represented by the significance of the hot-market SEO dummy at the firm level. Similarly, results are robust to the inclusion of the traditional market-to-book variable for identification of market timing.

4.3 Definition of Hot and Cold Markets

Hot and cold markets are defined similar to the method of Bayless and Chaplinsky (1996) and Alti (2006), on the basis of annual SEO volume. Compustat data is used to determine the number of SEOs for each year in the period 1971 to 2005. Since the number of firms in the Compustat database has varied over time, the annual SEO volume is detrended by the number of firms in the database. Hot (cold) years are then defined as those above (below) the median of the distribution of SEOs across all years in the sample. For each SEO in the sample, the dummy variable HOT_i is assigned a value of one if the firm makes a secondary equity offering in a year where issuance level is above the median.

Figure 4.2 plots the detrended SEO volume from 1971 to 2005. The horizontal line is the median. As the figure illustrates, there is considerable variation between hot and cold years in terms of SEOs.

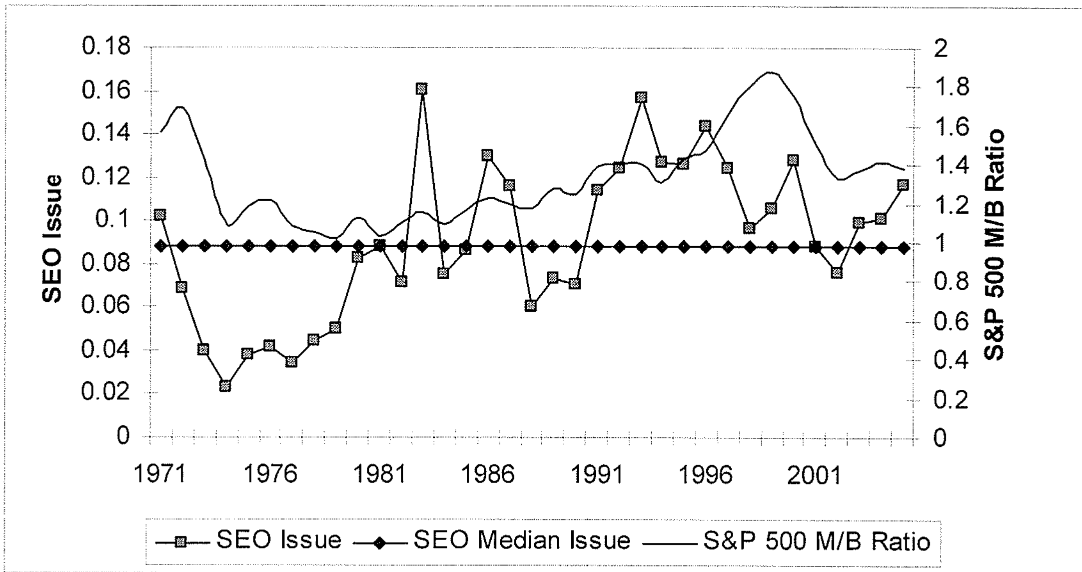


Figure 4.2. Time Series of the Annual Ratio of Firms Issuing SEOs.

Figure 4.2 also includes the S&P 500 index *M / B* ratio to illustrate that the market volume measure of SEO market timing captures different information than the market-to-book ratio.

Korajczyk, and Levy (2003) uses an alternate measure of market timing that captures the boom and bust of the business cycle by using a vector of macroeconomic variables; this vector of business cycle variables includes measures such as stock market index return, bond rate, and manufacturing activity. As a robustness check, the regressions models used in this paper were run with the inclusion of the Korajczyk and Levy (2003) market timing measure; the *HOT* market timing dummy variable of this paper remained significant and the regressions produced similar results. Colak, Wang, and Yung (2008) use a moving average to define hot markets, but their robustness check using the hot market measure of Bayless and Chaplinsky (1996) and Alti (2006) produces similar results.

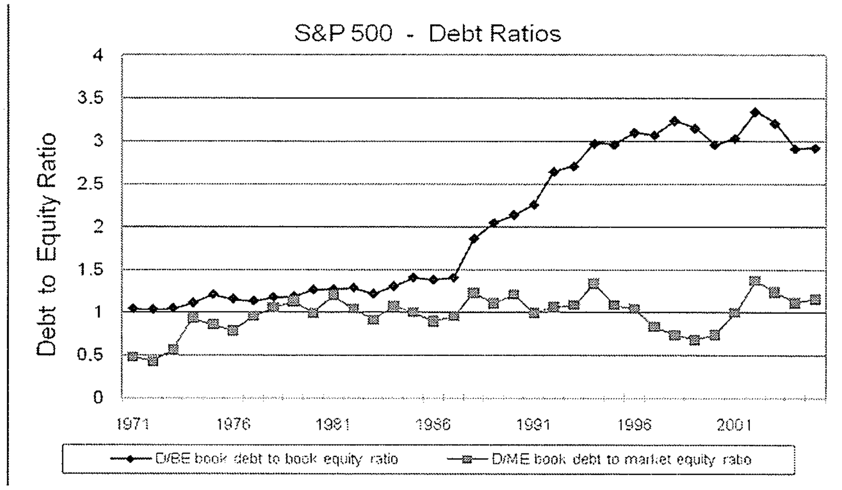


Figure 4.3. A Time Series of the Debt Ratios of the S&P 500 Index.

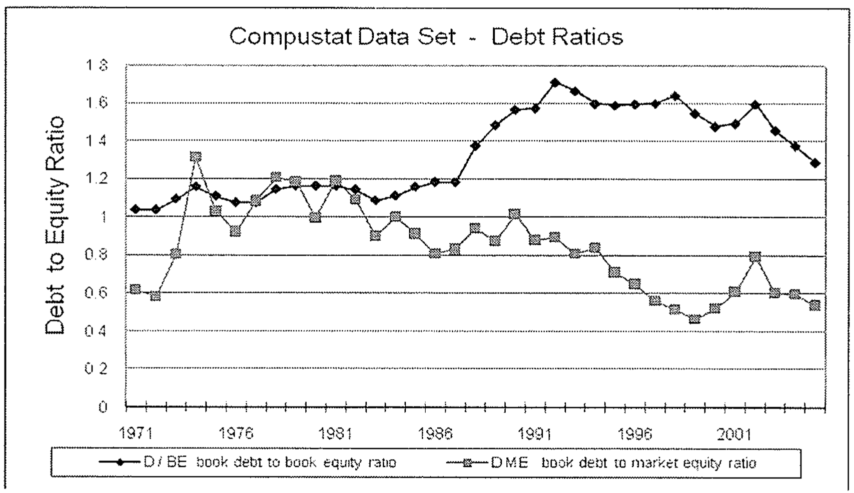


Figure 4.3. B Time Series of the Debt Ratios of the Compustat Data Set.

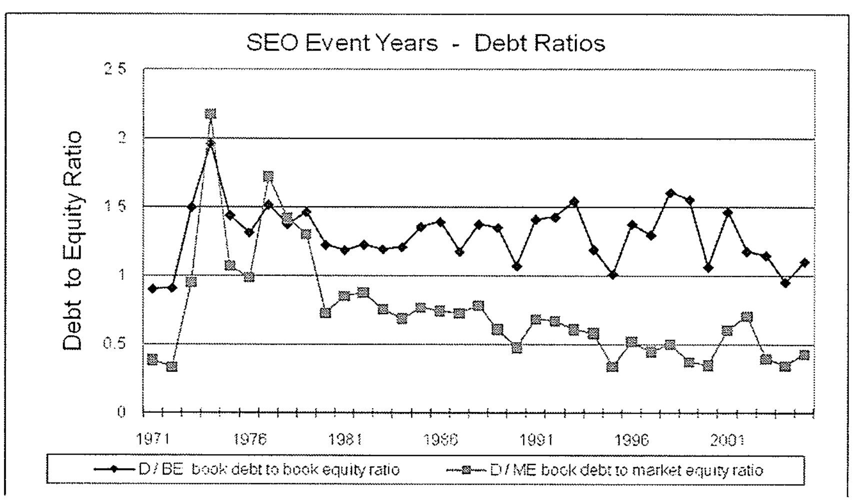


Figure 4.3. C Time Series of the Debt Ratios of SEO Events.

Figure 4.3 shows the debt ratios of the S&P 500 index, the overall Compustat data set, and the sub sample of SEO events in that Compustat data. Each plot shows both the ratio of book debt to book equity and the ratio of book debt to market equity. Comparison of the hot market measure shown in Figure 4.2 and the debt ratios shown in Figure 4.3 suggests that hot markets do not have a long-term impact on debt ratios.

4.4 SEO Event Time Sample: The Impact of Market Timing on Capital Structure

This section examines the issue of market timing using a dataset sorted and organized around SEO issue events. The effects of market timing are explored in SEO time. This dataset has the advantage of focusing on the SEO event, but such a dataset excludes data observations that are distant from the time of an equity issue. A later section will also examine an alternative, broader dataset that includes observations outside the SEO event window.

4.4.1 Sample and Summary Characteristics

The initial sample consists of seasoned equity offerings (SEOs) from the Compustat database for the period 1971 to 2005. To be included in the sample, firms must have financial statement data in the SEO issue year and in the two preceding years. Firms in the financial sector are excluded from the sample because their capital structure is typically different from other firms in the sample. Firms with book values of assets below $10 million are also excluded. Firm-year observations that are outliers are dropped, as described below.

Secondary equity issues (SEO) are identified from the statement of change in cash flows as reported in Computstat, following the method of Hovakimian, Opler, and Titiman (2001)[4] to define an SEO event as the annual net of sale of stock less the purchase of stock. Table 4.1 shows the construction of the SEO dataset using the exclusions and conditions described above. The resultant dataset has 10,746 SEO events, and a data window from time t_{-5} to t_{+5} has 114,026 firm-year observations.

Variable definitions are as follows. Book debt, D, is defined as total liabilities (Compustat Annual Item 181) and preferred stock (Item 10, replaced by the value of preferred stock (Item 56) when missing, minus deferred taxes (Item 35) and minus convertible debt (Item 79). Book equity, E, is defined as total book assets A (Item 6) minus book debt. Book leverage, D/A, is defined as book debt divided by total assets. Firm-year observations where book leverage exceeds 100% of total book assets are dropped to eliminate negative equity conditions and bankruptcy conditions. Market-to-book ratio, M/B, is book debt plus market equity (common shares (Item 25) times share price (Item 199) divided by total book assets. Observations for which M/B exceeds 10.0 are dropped.

Net equity issues, e/A, is sales of stock less repurchase divided by total assets ((Item 108 – Item 115) / Item 6), taken to be an SEO event when this value exceeds 5%. Net debt issues, d/A, is the change in book debt. New retained earnings, $\Delta RE/A$, is the change in retained earnings. Profitability is proxied by $EBITDA/A$, which is earnings before interest, taxes, and depreciation (Item 13). $SIZE$ is the logarithm of net sales (Item 12) in millions of 2000 dollars. Tangible assets, PPE/A, is defined as plant property, and equipment (Item 8). Research and development expense (Item 46), $R\&D/A$, is replaced with zero when missing;

[4] A firm is defined as issuing an SEO when net equity issued for cash divided by the book value of assets exceeds 5% (i.e. equity issued when (Compustat Annual Item 108 – Compustat Item 115) / Compustat Item 6 > 5%).

dummy variable RDD is assigned a value of one when Item 46 is missing. INV/A is capital investment expenditures (Item 128). DIV/E is common dividends (Item 21) divided by book equity. $CASH/A$ is cash and short-term investments (Item 1). The variables d/A, e/A, $\Delta RE/A$, $EBITDA/A$, PPE/A, $R\&D/A$, INV/A, and $CASH/A$ are normalized by total assets.

Table 4.1

SEO Event Dataset

	Data Filter	Firm-Year Observations
1	Compustat observations 1971 to 2005	640,825
2	Exclude financial firms (SIC codes 6000 to 6999)	515,542
3	Exclude observations with book assets < \$10 million	172,771
4	Exclude outliers with M/B ratio > 10	171,847
5	Exclude distressed firms with book leverage ratio D/A > 1	162,962
7	Restrict sample to SEO events at t_0	15,589
6	Require book leverage data in lags t_{-1} and t_{-2}	10,746
8	Observations in event window from t_{-5} to t_{+5}	114,026

Data observations are weighted by total assets to control for heteroskedasticity. A fixed effects regression model is used with 3-digit SIC industry classifications to control for industry effects. The data set is filtered as described in Table 4.1 to remove outliers. The White and Breusch-Pagan tests are used to examine regression residuals for

Table 4.2
Summary Statistics of Firm Characteristics

This table reports the means and standard deviations of firm characteristics in the period surrounding SEO issuance. All variables except M/B and $SIZE$ are in percentage terms. Book leverage, D/A, is the ratio of book debt to total book assets. Market-to-book ratio, M/B, is book debt plus market value of equity divided by total book assets. Net debt issues, d/A, is the change in book debt. Net equity issues, e/A, is the change in book equity minus the earnings before interest, taxes, and depreciation. $SIZE$ is the logarithm of net sales in millions of 2000 dollars. Tangible assets, PPE/A, is net plant, property and equipment. $R\&D/A$ is research and development expense. INV/A is capital expenditures. DIV/E is common dividends divided by year-end book equity. $CASH/A$ is cash and short-term equivalents. The variables d/A, e/A, $R\&D/A$, INV/A, DIV/E, and $CASH/A$ are normalized by fiscal year-end total book assets. The sample consists of SEOs between 1971 and 2005. The sample excludes financial firms, firms that have less than $10 million in assets, and firms with a debt ratio greater than one.

	N	D/A	M/B	d/A	e/A	ΔRE/A	EBITDA/	SIZE	PPE/A	R&D/	INV/A	DIV/E	CASH/A
Panel A: Full Sample													
SEO - 5	6,487	47.76	1.82	4.63	8.34	-4.43	6.93	4.70	37.90	4.86	9.51	2.70	16.70
		(23.41	(1.50)	(20.06	(22.87)	(25.78	(19.50)	(2.11	(27.21)	(11.93	(10.16)	(30.52	(22.58)
SEO - 4	7,560	47.40	1.89	4.20	9.25	-5.44	5.98	4.61	37.48	5.19	9.43	2.16	17.40
		(23.68	(1.50)	(25.37	(26.71)	(29.93	(20.62)	(2.15	(27.42)	(11.97	(9.86)	(7.93)	(23.14)
SEO - 3	8,852	47.54	1.92	4.39	9.57	-6.73	5.00	4.54	36.86	5.62	9.52	2.05	17.66
		(23.91	(1.50)	(24.32	(24.80)	(30.32	(22.15)	(2.13	(27.31)	(12.75	(10.21)	(9.67)	(23.23)
SEO - 2	10,746	48.29	2.00	5.02	11.32	-8.04	4.54	4.48	36.12	5.77	9.64	2.62	17.53
		(24.19	(1.54)	(22.38	(27.01)	(32.02	(22.28)	(2.11	(27.26)	(12.27	(10.67)	(32.14	(22.81)
SEO - 1	10,746	48.69	2.13	5.14	11.47	-7.74	4.08	4.65	36.66	6.04	9.55	2.22	16.18
		(23.36	(1.60)	(77.40	(57.70)	(50.56	(23.78)	(2.06	(27.30)	(13.48	(10.30)	(27.42	(21.39)
SEO	10,746	44.63	2.15	1.88	22.91	-9.45	4.05	4.83	34.56	5.78	9.11	1.71	19.40
		(22.94	(1.57)	(97.91	(70.68)	(52.03	(22.81)	(2.05	(27.21)	(13.26	(10.39)	(12.50	(22.75)
SEO + 1	8,158	43.88	2.11	2.48	9.17	-5.86	6.18	4.96	36.24	5.31	9.15	1.53	16.87
		(22.19	(1.51)	(94.22	(45.32)	(41.36	(20.21)	(2.00	(27.49)	(12.33	(9.73)	(9.32)	(21.48)
SEO + 2	7,129	44.70	1.86	5.32	7.90	-4.31	6.43	5.19	36.99	5.24	8.40	1.51	15.98
		(21.99	(1.37)	(44.29	(32.83)	(31.36	(20.23)	(1.97	(27.52)	(12.41	(8.57)	(4.15)	(20.86)
SEO + 3	6,847	45.57	1.72	4.23	6.57	-4.09	7.03	5.39	37.86	4.82	7.93	1.93	15.00
		(21.63	(1.27)	(24.84	(44.76)	(31.53	(18.60)	(1.93	(27.60)	(11.76	(8.15)	(23.53	(20.01)
SEO + 4	6,322	46.19	1.67	1.76	5.92	-4.16	7.31	5.51	38.31	4.53	7.74	1.77	14.61
		(21.34	(1.28)	(90.00	(30.16)	(35.55	(18.09)	(1.92	(27.68)	(10.78	(7.90)	(7.87)	(19.78)
SEO + 5	5,613	46.75	1.63	2.46	5.62	-3.28	7.96	5.63	38.67	4.32	7.41	1.72	14.14
		(21.60	(1.24)	(23.12	(26.89)	(29.95	(16.46)	(1.90	(27.51)	(10.54	(7.59)	(4.37)	(19.22)
Panel B: Low market-to-book													
SEO - 5	953	51.52	1.29	5.06	5.92	-0.83	9.28	5.17	46.02	1.31	10.20	2.31	9.53
		(21.62	(0.88)	(17.49	(16.50)	(14.55	(10.63)	(2.03	(28.48)	(4.56)	(11.34)	(5.49)	(14.83)
SEO - 4	1,061	50.59	1.35	2.70	7.25	-2.67	7.93	5.04	45.56	1.54	10.21	1.92	10.33
		(22.20	(0.99)	(35.23	(17.95)	(25.26	(13.28)	(2.12	(28.35)	(5.59)	(10.82)	(4.35)	(16.03)
SEO - 3	1,189	50.73	1.36	3.23	7.19	-3.50	6.76	4.98	45.69	1.77	10.16	1.71	10.25
		(22.54	(1.09)	(23.44	(24.48)	(26.08	(18.67)	(2.09	(28.24)	(7.20)	(11.32)	(3.71)	(15.83)
SEO - 2	1,409	51.09	1.30	4.15	8.90	-4.47	6.17	4.88	44.05	2.02	9.81	2.14	10.18
		(22.56	(0.93)	(20.89	(20.76)	(22.48	(15.41)	(2.07	(28.82)	(6.77)	(12.01)	(20.98	(15.41)
SEO - 1	1,409	51.21	1.23	5.07	8.51	-4.09	5.85	5.03	44.57	1.87	9.67	1.32	8.52
		(21.67	(0.86)	(23.16	(21.68)	(22.29	(14.85)	(1.96	(28.82)	(6.95)	(12.62)	(3.04)	(13.14)
SEO	1,409	48.60	0.90	0.41	15.74	-6.93	4.01	5.13	43.87	1.83	8.89	1.23	9.62
		(20.36	(0.16)	(57.25	(23.51)	(23.84	(16.83)	(1.95	(29.14)	(7.19)	(12.59)	(5.16)	(14.05)
SEO + 1	1,203	48.65	0.90	1.50	1.58	-4.94	5.42	5.22	45.14	1.56	8.05	1.29	8.64
		(19.98	(0.15)	(42.30	(29.24)	(20.94	(15.75)	(1.93	(28.80)	(5.72)	(9.26)	(4.51)	(13.95)
SEO + 2	983	50.78	0.99	2.67	2.16	-5.12	5.76	5.36	45.39	1.50	8.08	1.23	8.89
		(19.95	(0.44)	(31.33	(20.55)	(24.31	(19.95)	(1.95	(28.61)	(5.91)	(9.50)	(2.53)	(14.29)
SEO + 3	856	51.21	1.04	1.83	1.80	-3.28	6.65	5.44	45.48	1.46	7.63	1.28	9.54
		(19.82	(0.59)	(33.71	(28.51)	(21.33	(19.25)	(1.99	(28.37)	(6.14)	(8.95)	(2.33)	(14.90)
SEO + 4	756	52.33	1.10	-0.89	0.30	-1.53	7.34	5.49	46.87	1.31	7.89	1.83	9.43
		(19.42	(0.69)	(56.15	(40.71)	(29.60	(12.16)	(2.00	(28.10)	(6.80)	(8.70)	(10.26	(14.77)
SEO + 5	669	53.22	1.12	0.83	2.14	-1.57	8.32	5.57	47.24	0.93	7.80	1.72	8.70
		(19.87	(0.63)	(26.30	(20.66)	(21.93	(11.48)	(1.96	(27.97)	(3.67)	(9.30)	(6.71)	(13.58)

	N	D/A	M/B	d/A	e/A	ΔRE/	EBITDA/	SIZE	PPE/A	R&D/	INV/A	DIV/E	CASH/
Panel C: Medium market-to-book													
SEO - 5	2,618	52.68	1.46	5.14	5.96	-1.63	10.26	5.22	42.76	2.54	9.84	3.67	11.19
		(21.73	(1.02)	(20.91)	(19.76)	(22.56	(14.15)	(1.91	(27.78)	(7.97)	(10.54)	(45.42	(16.02)
SEO - 4	2,986	52.84	1.50	5.38	5.69	-1.89	9.56	5.14	42.92	2.62	9.89	2.76	11.23
		(21.85	(1.06)	(23.27)	(22.77)	(24.31	(14.83)	(1.97	(28.20)	(7.51)	(10.64)	(9.00)	(15.97)
SEO - 3	3,409	53.19	1.48	4.87	6.43	-2.76	8.88	5.08	42.01	2.80	9.76	2.58	11.16
		(22.00	(0.95)	(28.39)	(19.50)	(23.24	(14.68)	(1.93	(28.16)	(7.98)	(10.61)	(11.76	(16.29)
SEO - 2	4,050	54.07	1.51	5.75	7.64	-3.52	7.82	4.98	41.13	2.99	9.93	3.19	11.30
		(22.52	(1.01)	(25.26)	(20.06)	(22.40	(15.52)	(1.98	(28.30)	(7.89)	(11.12)	(42.44	(16.87)
SEO - 1	4,050	55.14	1.53	4.72	6.50	-3.11	7.22	5.13	41.50	2.97	9.67	3.11	10.01
		(21.57	(0.92)	(120.41	(79.89)	(63.75	(16.66)	(1.90	(28.37)	(8.15)	(10.53)	(42.83	(15.26)
SEO	4,050	51.94	1.32	3.88	17.64	-5.98	6.81	5.29	39.87	2.93	9.32	2.24	11.90
		(21.70	(0.29)	(63.05)	(39.82)	(43.80	(15.61)	(1.90	(28.30)	(8.47)	(10.35)	(17.76	(16.27)
SEO + 1	3,509	51.12	1.31	4.68	4.80	-2.64	8.51	5.42	41.35	2.61	9.16	2.12	10.03
		(20.80	(0.29)	(33.18)	(57.96)	(36.89	(12.48)	(1.84	(28.49)	(7.53)	(10.07)	(14.12	(14.88)
SEO + 2	3,083	52.35	1.29	4.51	4.69	-2.51	8.62	5.63	41.91	2.47	8.37	1.93	9.59
		(19.87	(0.58)	(67.07)	(31.04)	(18.56	(12.66)	(1.80	(28.55)	(7.66)	(8.55)	(4.13)	(14.76)
SEO + 3	2,743	52.80	1.29	4.19	2.76	-1.80	9.28	5.80	42.71	2.16	8.20	2.06	8.98
		(19.56	(0.67)	(22.82)	(61.84)	(18.72	(11.67)	(1.81	(28.62)	(6.57)	(8.40)	(4.27)	(14.15)
SEO + 4	2,434	53.40	1.29	0.91	3.51	-0.76	9.29	5.90	43.20	2.09	7.94	2.08	8.86
		(18.97	(0.73)	(138.47	(18.29)	(30.90	(14.22)	(1.81	(28.66)	(6.12)	(8.28)	(3.97)	(14.11)
SEO + 5	2,164	53.73	1.26	2.11	3.48	-1.22	9.80	5.99	43.66	2.06	7.46	2.12	8.76
		(19.46	(0.71)	(24.22)	(22.90)	(17.51	(12.04)	(1.78	(28.50)	(6.45)	(7.26)	(3.62)	(13.88)
Panel D: High market-to0book													
SEO - 5	2,629	40.96	2.38	3.84	12.30	-8.94	2.51	3.92	28.61	8.81	8.96	1.75	25.78
		(23.93	(1.87)	(18.91)	(28.07)	(32.15	(25.40)	(2.08	(22.81)	(15.84	(9.45)	(14.22	(27.54)
SEO - 4	3,165	40.57	2.44	3.63	13.91	-10.32	1.65	3.88	28.18	9.22	8.74	1.53	26.49
		(24.07	(1.79)	(22.84)	(32.94)	(36.45	(26.22)	(2.09	(22.97)	(15.68	(8.82)	(8.03)	(27.92)
SEO - 3	3,842	41.04	2.48	4.32	13.72	-11.84	0.95	3.85	28.32	9.69	9.12	1.51	26.56
		(24.24	(1.78)	(20.12)	(29.31)	(37.00	(27.65)	(2.09	(23.19)	(16.41	(9.57)	(8.93)	(27.53)
SEO - 2	4,907	42.18	2.61	4.91	15.93	-13.19	1.26	3.88	28.35	9.55	9.36	2.24	25.77
		(24.50	(1.81)	(19.99)	(33.40)	(40.28	(27.79)	(2.07	(23.25)	(15.43	(9.98)	(25.55	(26.53)
SEO - 1	4,907	42.00	2.88	5.84	17.29	-12.81	0.86	4.07	28.92	10.29	9.39	1.58	24.51
		(23.28	(1.85)	(29.43)	(38.37)	(42.16	(30.01)	(2.05	(23.26)	(17.28	(9.43)	(9.90)	(25.14)
SEO	4,907	36.79	3.19	1.79	30.87	-13.18	1.60	4.31	26.48	9.53	8.98	1.27	29.13
		(22.05	(1.74)	(104.77	(89.20)	(60.63	(28.80)	(2.05	(22.78)	(16.45	(9.69)	(8.36)	(25.69)
SEO + 1	4,298	35.99	3.10	2.15	14.91	-9.09	4.33	4.44	28.46	8.87	9.44	0.96	25.37
		(21.17	(1.68)	(106.41	(37.38)	(46.12	(25.95)	(2.02	(23.58)	(15.85	(9.64)	(4.08)	(24.78)
SEO + 2	3,751	36.45	2.55	6.76	12.16	-5.71	4.60	4.72	29.52	8.80	8.44	1.04	23.65
		(21.14	(1.63)	(15.62)	(37.25)	(40.79	(25.20)	(2.01	(23.82)	(15.75	(8.31)	(3.90)	(24.11)
SEO + 3	3,248	37.60	2.27	4.85	11.13	-6.14	4.99	4.98	30.60	8.23	7.71	1.84	22.16
		(21.02	(1.53)	(24.39)	(30.15)	(39.94	(22.95)	(1.94	(24.25)	(15.24	(7.74)	(34.57	(23.35)
SEO + 4	2,878	38.12	2.15	3.09	9.59	-7.84	5.37	5.14	30.72	7.73	7.46	1.33	21.49
		(20.92	(1.57)	(27.13)	(35.32)	(41.03	(22.08)	(1.92	(24.31)	(13.79	(7.40)	(9.60)	(23.15)
SEO + 5	2,546	38.84	2.08	3.17	8.40	-5.50	6.06	5.29	30.94	7.38	7.15	1.19	20.78
		(21.18	(1.53)	(21.87)	(31.56)	(37.27	(20.44)	(1.92	(24.01)	(13.55	(7.32)	(3.89)	(22.56)

heteroskedasticity. The Shapiro-Wilk W test is used to examine regression residuals for normal distribution. The VIF (variance inflation factor) method is used to test explanatory variables for collinearity. These test statistics confirm that the model is adequately specified.

Table 4.2 summarizes firm characteristics in SEO time. All variables except M/B and $SIZE$ are shown in percentage terms. The SEO year is defined as the year in which the SEO takes place. Year SEO + k is the kth fiscal year after the SEO. The characteristics shown in Table 4.2 are consistent with the results of previous studies. Book leverage declines in the SEO year, and increases thereafter. Cash balance increases with the infusion of new capital in the SEO, and declines thereafter.

4.4.2 The Influence of Hot Markets

In the context of SEOs, market timing has two main implications. First, firms are more likely to issue equity when managers perceive market conditions to be favourable , when equity prices in the market are relatively high as proxied by a high M / B ratio. Second, firms are likely to issue more equity in favourable markets versus unfavourable markets. A HOT market timing measure is used, which is constructed on the basis of this first implication. This section examines the evidence for the second implication by examining the relative amounts of equity issued by hot- and cold-market issuers of SEOs.

Table 4.3 shows the mean value in percent of equity issued by hot- and cold market firms in Panel A. Two measures of the amount of equity are shown. The first, e / A_t, gives the amount of equity issued divided by assets at the fiscal year-end of the issuing year. The second, e / A_{t-1}, gives the equity issued as a fraction of the assets in the preceding year. Both measures show that hot-market firms tend to issue more equity. For the current year measure, the levels of issuance are 21.70% versus 15.85% for hot- and cold-market firms respectively.

Table 4.3
Market Timing Effects on Issuance Activity

For each variable Y_t, Panel A shows the mean value for hot- and cold-market firms and the *t*-value of their difference. The time subscript *t* denotes the SEO year. Panel B reports the regression:

$$Y_t = c_0 + c_1 HOT + c_2 M/B_t + c_3 EBITDA/A_{t-1} + c_4 SIZE_{t-1} + c_5 PPE/A_{t-1} + c_6 R\&D/A_{t-1} + c_7 RDD_{t-1} + c_8 D/A_{t-1} + \varepsilon_t$$

All regressions are estimated with industry fixed effects proxied by the three-digit SIC codes. The constant and industry dummies are suppressed. The dependent variable Y_t is the total SEO issuance divided by year-end assets, SEO issuance divided by prior year-end assets, net debt issuance divided by year-end assets, financial deficit divided by year-end assets, and dividends divided by market equity in columns 1-6 respectively. All variables are expressed in percentage terms. Robust *t*-statistics are reported in parentheses. Coefficients marked ** and * are significant at 1% and 5% confidence intervals, respectively.

Y_t	e/A_t	e/A_{t-1}	d/A_t	$(e+d)/A_t$	DIV/E_t
		Panel A: Mean Values for Full Sample			
Hot	21.70	38.88	0.47	22.25	1.20
Cold	15.85	23.87	1.99	17.81	2.74
t-value (difference)	(16.73) **	(13.09) **	(5.37) **	(10.36) **	(5.84) **
		Panel B: Regression Analysis for Full Sample			
HOT	2.12 **	12.33 *	-3.07	0.73	-0.63 *
	(6.28)	(2.20)	(-1.65)	(1.78)	(-2.34)
M/B_t	2.03 **	2.21	-2.09 *	1.49 **	0.13
	(16.92)	(1.11)	(-3.18)	(10.18)	(1.42)
$EBITDA/A_{t-1}$	-8.42 **	-46.03 *	6.50	-13.85 **	1.53
	(-8.51)	(-2.82)	(1.20)	(-11.49)	(1.95)
$SIZE_{t-1}$	-2.56 **	-7.08 **	-1.32	-2.59 **	0.55 **
	(-24.23)	(-4.06)	(-2.28) *	(-19.94)	(6.58)
PPE/A_{t-1}	-0.56 **	-8.58	17.25 *	-0.76	0.94
	(-0.57)	(-0.52)	(3.18)	(-0.63)	(1.19)
$R\&D/A_{t-1}$	22.34 **	13.41	10.03	25.77 **	1.25
	(12.64)	(0.46)	(1.04)	(11.93)	(0.89)
RDD_{t-1}	0.41	18.78 *	-2.12	1.37 *	-0.13
	(0.90)	(2.44)	(-0.83)	(2.42)	(-0.35)
D/A_{t-1}	0.47 **	20.58	-44.64 **	-5.01 **	-0.23
	(6.03)	(1.57)	(-10.25)	(-5.14)	(-0.37)
R^2	0.33	0.02	0.02	0.29	0.06
N	10,128	10,128	10,128	10,128	10,107
		Panel C: Mean Values for Low M/B Portfolio			
Hot	14.61	23.34	1.54	15.95	1.10
Cold	14.15	18.56	1.35	15.63	1.65
t-value (difference)	(0.62)	(2.38) *	(0.22)	(0.29)	(1.81)
		Panel D: Regression Analysis for Low M/B Portfolio			
HOT	0.67	2.23	-6.23	-0.73	-0.27
	(0.83)	(0.56)	(-1.63)	(-0.58)	(-1.30)
M/B_t	-0.54	17.83	62.53 **	10.85 *	0.79
	(-0.21)	(1.42)	(5.24)	(2.74)	(1.19)
$EBITDA/A_{t-1}$	6.15	10.39	26.40	12.94 *	0.67
	(1.87)	(0.64)	(1.70)	(2.46)	(0.78)
$SIZE_{t-1}$	-1.90 **	-4.34 **	0.83	-2.15 **	0.20 **
	(-8.05)	(-3.71)	(0.75)	(-5.83)	(3.34)
PPE/A_{t-1}	-5.07 *	-14.92	13.35	-0.99	0.46
	(-2.54)	(-1.51)	(1.42)	(-0.32)	(0.88)
$R\&D/A_{t-1}$	65.23 **	148.72 **	12.54	85.55 **	0.38
	(8.72)	(4.01)	(0.36)	(6.99)	(0.20)
RDD_{t-1}	0.54	2.42	-3.85	1.63	0.28
	(0.53)	(0.47)	(-0.79)	(1.02)	(1.03)
D/A_{t-1}	7.90 **	-14.22	-81.39 **	-7.11 *	-1.96 **
	(4.04)	(-1.47)	(-8.86)	(-2.35)	(-3.82)
R^2	0.28	0.39	0.19	0.27	0.69
N	1,372	1,372	1,372	1,372	1,370

Y_t	e/A_t	e/A_{t-1}	d/A_t	$(e+d)/A_t$	DIV/E_t
		Panel E: Mean Values for Medium M/B Portfolio			
Hot	17.62	29.18	1.00	18.72	1.62
Cold	12.76	18.99	2.99	15.66	3.48
t-value (difference)	(11.94) **	(6.79) **	(4.21) **	(5.30) **	(3.06) *
		Panel F: Regression Analysis for Medium M/B Portfolio			
HOT	0.88	24.16	2.08	-0.18	-1.36
	(1.86)	(1.53)	(0.85)	(-0.28)	(-1.99)
M/B_t	7.27 **	-32.22	-3.12	4.45 **	2.39
	(8.63)	(-1.15)	(-0.72)	(3.77)	(1.97)
$EBITDA/A_{t-1}$	-0.64	-116.60 **	6.81	-4.84 *	3.51
	(-0.41)	(-3.15)	(0.83)	(-2.20)	(1.54)
$SIZE_{t-1}$	-2.27 **	-8.86	-0.25	-2.31 **	0.98 **
	(-17.03)	(-1.99)	(-0.37)	(-12.28)	(5.08)
PPE/A_{t-1}	0.76	8.58	22.75 **	-1.98	1.01
	(0.61)	(0.21)	(3.53)	(-1.12)	(0.56)
$R\&D/A_{t-1}$	27.83 **	-109.77	7.57	27.55 **	4.28
	(8.31)	(-0.98)	(0.44)	(5.91)	(0.89)
RDD_{t-1}	-0.13	35.41	1.17	1.07	-0.74
	(-0.23)	(1.85)	(0.40)	(1.34)	(-0.90)
D/A_{t-1}	1.80	47.27	-46.12 **	-10.26 **	-1.26
	(1.73)	(1.36)	(-8.59)	(-7.03)	(-0.84)
R^2	0.28	0.02	0.06	0.22	0.09
N	3,990	3,990	3,990	3,990	3,976
		Panel G: Mean Values for High M/B Portfolio			
Hot	27.92	52.90	-0.33	27.62	0.75
Cold	19.36	30.32	1.29	20.62	2.20
t-value (difference)	(13.88) **	(11.33) **	(4.29) **	(10.01) **	(6.19) **
		Panel H: Regression Analysis for High M/B Portfolio			
HOT	3.80 **	14.47 **	-10.89 *	2.16 *	-0.55
	(6.19)	(4.69)	(-3.08)	(3.16)	(-2.15)
M/B_t	1.34 **	3.48 **	-2.19	1.00 **	-0.12
	(7.32)	(3.78)	(-2.08)	(4.91)	(1.67)
$EBITDA/A_{t-1}$	-11.68 **	-7.79	8.38	-18.60 **	1.30
	(7.86)	(-1.05)	(0.98)	(-11.36)	(2.07)
$SIZE_{t-1}$	-2.99 **	-5.70 **	-3.38 *	-2.91 **	0.32 **
	(-15.57)	(-5.92)	(-3.06)	(-13.66)	(4.02)
PPE/A_{t-1}	-0.24	-11.04	14.17	-0.13	0.85
	(-0.14)	(-1.20)	(1.34)	(-0.06)	(1.10)
$R\&D/A_{t-1}$	17.93 **	57.41 **	8.50	20.61 **	0.29
	(7.44)	(4.75)	(0.61)	(7.70)	(0.29)
RDD_{t-1}	1.36	6.54	-4.84	1.74	0.53
	(1.57)	(1.50)	(-0.97)	(1.80)	(1.45)
D/A_{t-1}	7.39 **	8.04	-41.89 **	-0.43	0.77
	(5.45)	(1.18)	(-5.36)	(-0.29)	(1.35)
R^2	0.32	0.33	0.03	0.33	0.15
N	4,766	4,766	4,766	4,766	4,761

The third column of Panel A shows that hot-market issuers of seasoned equity issue less debt per unit of assets, shown as d/A_t, than cold-market firms, at 0.47% versus 1.99%. The fourth column shows that hot-market firms have a higher financial deficit[6] $(e+d)/A$

[6] The financial deficit $(e+d)/A$ is defined as the sum of equity and debt issues per unit of total book assets – a positive financial deficit implies that the firm is raising outside capital.

than cold-market firms, at 22.25% versus 17.81%. The fifth column shows that the dividend yield, DIV / E, is again lower for the hot-market firm at 1.20% versus 2.74% for cold-market firms. These timing effects are statistically significant at the 1% confidence level.

Panel B of Table 4.3 reports the results of the regression analysis. The observed differences between hot- and cold-market firms might be due to firm characteristics rather than market timing. To test for this, the following regression model for the determinants of issue levels is applied:

$$\begin{aligned} Y_t = {} & c_0 + c_1 HOT + c_2 M / B_t + c_3 EBITDA / A_{t-1} + c_4 SIZE_{t-1} + c_5 PPE / A_{t-1} \\ & + c_6 R\&D / A_{t-1} + c_7 RDD_{t-1} + c_8 D / A_{t-1} + \varepsilon_t \end{aligned} \tag{1.1}$$

where t is the SEO year, and the regression is run in the cross-section of SEOs. The dependent variable, Y_t, is the issuance variables described above; each column in Table 4.3 represents a regression where the dependent variable Y_t represents one of equity issuance normalized by current assets e / A_t, equity issuance normalized by previous assets e / A_{t-1}, debt issuance normalized by assets d / A_t, total capital issuance normalized by assets $(e + d) / A_t$, or dividend yield DIV / E. The dummy variable, HOT, proxies the market timing effect. The control variables are the market-to-book ratio, profitability normalized by assets, the logarithm of size, physical plant and equipment expenditure normalized by assets, research and development expense normalized by assets, dummy for missing research and development expense data, and lagged book leverage as defined by debt level normalized by assets. These control variables are the main determinants identified in previous research such as Titman and Wessels (1988) and Rajan and Zingalies (1995). The dummy variable

RDD is assigned a value of one when *R & D* is missing in the Compustat database. The control variables are lagged except for the market-to-book ratio, which is observed in the SEO year to represent market effects.

The results confirm that hot-market firms tend to have significantly different issuance patterns than cold-market firms. The *HOT* market timing variable remains robust in the face of the control variables. The hot-market firms exhibit issuance behavior that is consistent with the implications of market timing.

Panels C and D, E and F, and G and H, present results for sub sample portfolios sorted on the the M / B ratio. The low, medium and high portfolios are sorted on 30% /40% / 30% proportions for the entire Compustat sample, prior to a second sort for SEO activity. As shown in Table 4.2, the result is that the high M / B portfolio contains 4,907 SEOs compared to 1,409 and 4,050 for the low and medium portfolios respectively. For the low M / B portfolio, panels C and D show that there is little statistically significant difference between hot- and cold-market firms. For the medium M / B portfolio, Panel E shows a significant difference between hot- and cold market firms at the 1% and 5% confidence levels, but the regression results in Panel F show the *HOT* timing variable is generally not significant. However, for the high portfolio, the difference between hot- and cold-market firms is highly significant in both Panels G and H at the 1% and 5% confidence levels. The results from panels C to H suggest that the results for the overall SEO sample is driven primarily by the strength of the high M / B portfolio, reflecting the relatively high number of SEOs issued by high M / B firms compared to the low and medium M / B firms, as well as the large spreads between the levels of explanatory variables of hot- and cold-market firms in the high M / B portfolio. The dominance of the high M / B firms suggests that the results from the overall sample given in Panels A and B may not represent the characteristics of the general market.

An alternative explanation for the equity issue activity of hot-market firms is they are growing faster, and so they raise a part of investment funding requirements through equity issues. Table 4.4 examines the growth characteristics of hot- and cold-market firms. Contradicting the growth explanation, Panel B of Table 4.4 for the full sample shows that hot-market firms invest less than their cold-market counterparts in the SEO issue year, and that the difference remains significant until three years after the SEO.

While Alti (2006) finds hot-market IPO issuers invest significantly less only in the IPO year, Panel B of Table 4.4 shows that hot-market firms issuing SEOs also invest less than cold-market issuers in the two years following the SEO year. Panels C to H of Table 4.4 shows that this persistence of low investment is driven primarily by the high M/B portfolio sub sample as the HOT market variable for low and medium M/B portfolio sub samples are generally statistically insignificant at the 5% confidence level. The HOT market timing of the low M/B portfolio in Panel D is significant at the 5% confidence level only in the SEO year , whereas it remains highly significant for two more years following the SEO in Panel G for the high M/B firms.

Table 4.4 also show that there is no significant difference in return on assets for hot- and cold-market firms in the SEO year, as proxied by earnings before interest, taxes, depreciation and amortization per unit of assets, $EBITDA/A$. This holds true for all of the low, medium and high M/B firms. However, Panel B shows that hot-market firms are significantly less profitable in the two years following the SEO issue.

Table 4.4
Comparison of Hot and Cold Market Firms

For each variable Y_t, Panel A shows the mean value for hot- and cold-market firms and the *t*-value of their difference. The time subscript *t* denotes the SEO year. Panel B reports the regression:

$$Y_t = c_0 + c_1 HOT + c_2 M/B_{SEO} + c_3 M/B_{t-1} + c_4 EBITDA/A_{t-1} + c_5 SIZE_{t-1} + c_6 PPE/A_{t-1} + c_7 R\&D/A_{t-1} + c_8 RDD_{t-1} + \varepsilon_t$$

The dependent variable Y_t is the leverage ratio prior to SEO issuance, capital investment divided by year-end assets, and earnings before interest, taxes, depreciation, and amortization divided by year-end assets, in columns 1-2, 3-6, and 7-10 respectively. Constant and SIC dummies are suppressed. Robust *t*-statistics are reported in parentheses. Coefficients marked ** and * are significant at 1% and 5% confidence intervals, respectively.

Y_t	$D/A_{PRE\text{-}SEO}$		INV/A_t				$EBITDA/A_t$			
t	SEO-2	SEO-1	SEO	SEO+1	SEO+2	SEO+3	SEO	SEO+1	SEO+2	SEO+3
			Panel A: Mean Values for Full Sample							
Hot	46.00	46.21	8.49	8.75	7.99	7.47	3.80	4.29	4.85	5.70
Cold	49.97	50.86	10.64	10.15	9.26	8.68	7.40	8.93	9.09	9.08
t-value (difference)	(8.00) **	(9.81) **	(9.75) **	(6.32) **	(6.20) **	(5.89) **	(7.81) **	(10.09) **	(9.33) **	(7.29) **
			Panel B: Regression Analysis for Full Sample							
HOT	-0.50	-0.77	-1.58 **	-0.74 **	-0.51 *	-0.43 *	0.22	-1.12 **	-0.87 *	0.03
	(-1.04)	(-1.77)	(-8.27)	(-3.93)	(-2.97)	(-2.41)	(0.70)	(-3.44)	(-2.66)	(0.11)
M/B_{SEO}	-0.98 **	-0.97 **	0.17	0.87 **	0.14	-0.02	1.04 **	0.60 **	-0.49 *	-0.34
	(-5.14)	(-5.52)	(2.14)	(11.66)	(1.75)	(-0.37)	(7.63)	(4.68)	(-3.16)	(-2.17)
M/B_{t-1}	-2.26 **	-2.24 **	0.82 **	--	0.84 **	0.79 **	-0.87 **	--	1.18 **	1.13 **
	(-11.60)	(-12.73)	(10.47)	--	(9.36)	(8.71)	(-6.55)	--	(6.88)	(6.24)
$EBITDA/A_{t-1}$	-17.56 **	-22.12 **	6.28 **	9.15 **	7.90 **	7.72 **	60.81 **	59.18 **	50.04 **	51.95 **
	(-11.05)	(-14.93)	(10.43)	(13.18)	(12.75)	(11.27)	(60.18)	(49.37)	(42.20)	(37.81)
$SIZE_{t-1}$	2.38 **	2.57 **	-0.54 **	-0.47 **	-0.26 **	-0.25 **	1.49 **	1.78 **	1.57 **	1.46 **
	(16.15)	(19.08)	(-9.03)	(-7.75)	(-4.71)	(-4.26)	(14.76)	(16.92)	(14.55)	(12.39)
PPE/A_{t-1}	9.25 **	9.88 **	16.43 **	16.86 **	15.77 **	14.91 **	4.93 **	7.33 **	5.88 **	6.65 **
	(6.39)	(7.45)	(28.33)	(28.71)	(28.86)	(24.82)	(5.09)	(7.26)	(5.65)	(5.83)
$R\&D/A_{t-1}$	-9.62 **	-13.25 **	-0.35	2.15	2.31	3.19 *	-5.37 *	-5.33 *	-21.85 **	-19.42 **
	(-3.55)	(-5.07)	(-0.33)	(1.75)	(1.95)	(2.61)	(-3.00)	(-2.51)	(-9.64)	(-7.92)
RDD_{t-1}	2.27 **	2.33 **	-0.33	-0.19	-0.36	-0.27	0.41	1.14 *	-0.04	0.35
	(3.44)	(3.83)	(-1.27)	(-0.75)	(-1.50)	(-1.09)	(0.92)	(2.48)	(-0.10)	(0.70)
R^2	0.35	0.33	0.38	0.39	0.43	0.50	0.60	0.54	0.53	0.50
N	6,702	8,007	8,482	7,960	6,831	6,101	8,572	8,068	6,912	6,101
			Panel C: Mean Values for Low M/B Portfolio							
Hot	51.42	51.44	9.06	8.53	8.52	8.11	5.03	4.97	6.07	6.96
Cold	48.14	49.15	8.93	7.35	7.53	6.74	3.85	5.32	6.47	7.59
t-value (difference)	(2.60) *	(1.90)	(0.17)	(2.06)	(1.54)	(2.23) *	(1.31)	(0.28)	(0.31)	(0.66)
			Panel D: Regression Analysis for Low M/B Portfolio							
HOT	0.03	-1.95	-1.93 *	0.02	-0.10	0.90	0.11	-1.32	-0.59	0.53
	(0.02)	(-1.56)	(-2.37)	(0.04)	(-0.15)	(1.39)	(0.15)	(-1.02)	(-0.36)	(0.53)
M/B_{SEO}	14.29 *	21.11 **	5.34	4.98 *	3.77	0.80	7.65 *	16.47 **	0.23	1.84
	(3.21)	(5.47)	(2.11)	(2.67)	(1.57)	(0.35)	(3.23)	(3.80)	(0.04)	(0.51)
M/B_{t-1}	-1.59 *	-2.56 **	1.58 **	--	1.74	2.52 **	1.30 *	--	8.18 **	-2.69 **
	(-2.28)	(-3.69)	(3.29)	--	(2.15)	(4.97)	(-2.91)	--	(4.17)	(-3.39)
$EBITDA/A_{t-1}$	-8.44	-10.64 *	12.74 **	11.63 **	1.68	1.18	50.10 **	45.62 **	9.35	10.83 **
	(-2.10)	(-2.35)	(3.63)	(4.47)	(1.03)	(0.81)	(15.37)	(7.73)	(2.11)	(4.76)
$SIZE_{t-1}$	2.83 **	2.81 **	-0.43	-0.44 *	-0.39	-0.32	6.77 *	0.86 *	1.51 *	1.28 **
	(7.39)	(8.16)	(-1.79)	(-2.66)	(-1.98)	(-1.75)	(3.08)	(2.35)	(3.17)	(4.45)
PPE/A_{t-1}	2.80	5.28	12.92 **	13.66 **	12.38 **	12.12 **	2.83	7.56 *	6.32	1.54
	(0.74)	(1.63)	(6.09)	(9.57)	(6.71)	(6.97)	(1.44)	(2.35)	(1.44)	(0.57)
$R\&D/A_{t-1}$	-21.47	-27.08	0.99	8.00	-11.58	-16.74	-8.44	-0.10	-96.99 **	-73.02 **
	(-1.48)	(-2.09)	(1.26)	(1.18)	(-1.42)	-2.31) *	(-1.15)	(-0.01)	(-4.99)	(-6.54)
RDD_{t-1}	4.16	5.22 *	1.14	1.57	0.84	1.12	1.17	0.85	-2.95	-1.18
	(2.19)	(3.20)	(1.07)	(2.05)	(0.90)	(1.22)	(1.19)	(0.49)	(-1.30)	(-0.82)
R^2	0.41	0.43	0.33	0.48	0.46	0.50	0.54	0.26	0.22	0.42
N	982	1,125	1,177	1,095	870	778	1,193	1,115	887	783

Y_t	$D/A_{PRE\text{-}SEO}$		INV/A_t				$EBITDA/A_t$			
t	*SEO-2*	*SEO-2*	*SEO*	*SEO+1*	*SEO+2*	*SEO+3*	SEO	*SEO+1*	*SEO+2*	*SEO+3*
Panel E: Mean Values for Medium M/B Portfolio										
Hot	51.99	53.06	8.97	9.14	8.43	8.00	6.83	7.42	8.09	8.55
Cold	55.53	56.96	10.07	9.34	8.35	8.38	7.88	8.74	9.56	9.60
t-value (difference)	(4.83) **	(5.60)	(3.22) *	(0.56)	(0.23)	(1.13)	(2.07)	(2.66)	(3.05) *	(1.82)
Panel F: Regression Analysis for Medium Portfolio										
HOT	0.32	0.49	-0.89 *	-0.31	0.72 *	0.29	0.49	-0.11	-0.34	0.70
	(0.39)	(0.65)	(-2.70)	(-0.86)	(2.34)	(0.92)	(1.14)	(-0.28)	(-0.85)	(1.17)
M/B_{SEO}	-4.12 *	-5.16 **	0.78	2.86 **	-1.02	-0.70	0.41 **	0.75	-0.77	-1.76
	(-2.75)	(-3.68)	(1.27)	(4.30)	(-1.67)	(-1.09)	(5.18)	(0.98)	(-0.95)	(-1.48)
M/B_{t-1}	-2.34 **	-2.43 **	1.04 **	--	2.05 **	1.12 **	-1.38 **	--	-0.02	1.19 *
	(-5.37)	(-6.43)	(5.71)	--	(7.81)	(4.81)	(-5.77)	--	(-0.05)	(2.77)
$EBITDA/A_{t-1}$	-26.97 **	-26.43 **	7.96 **	13.85 **	13.27 **	15.08 **	47.82 **	60.53 **	60.55 **	62.93 **
	(-8.35)	(-9.26)	(6.79)	(8.89)	(9.54)	(9.80)	(30.99)	(33.40)	(32.53)	(22.05)
$SIZE_{t-1}$	2.32	2.41 **	-0.73 **	-0.56 **	-0.46 **	-0.45 **	0.95 **	0.96 **	0.78 **	0.98 **
	(1.24)	(11.49)	(-7.81)	(-5.33)	(-5.06)	(-4.74)	(7.67)	(7.89)	(6.44)	(5.53)
PPE/A_{t-1}	6.71 *	6.46 *	15.93 **	14.67 **	13.75 **	11.85 **	5.81 **	6.24 **	4.18 **	3.42
	(3.01)	(3.13)	(17.71)	(14.56)	(15.80)	(12.76)	(4.92)	(5.33)	(3.62)	(1.99)
$R\&D/_{t-1}A$	-21.54 **	-27.91 **	0.79	6.18 *	6.13 *	10.54 **	-30.67 **	-26.19 **	-17.54 **	-12.85 *
	(-3.91)	(-4.54)	(0.31)	(2.26)	(2.35)	(3.61)	(-9.06)	(-8.22)	(-5.02)	(-2.37)
RDD_{t-1}	0.97	1.47	-0.26	-0.24 *	-0.41	-0.07	-0.21	1.00	0.00	-0.03
	(0.98)	(1.59)	(-0.65)	(2.26)	(-1.11)	(-0.19)	(-0.40)	(1.93)	(0.00)	(-0.04)
R^2	0.33	0.31	0.42	0.38	0.46	0.45	0.52	0.55	0.57	0.39
N	2,815	3,274	3,428	3,214	2,794	2,481	3,468	3,262	2,830	2,510
Panel G: Mean Values for High M/B Portfolio										
Hot	38.82	38.31	7.87	8.47	7.45	6.80	0.68	1.30	1.64	2.77
Cold	45.71	46.10	11.62	11.63	10.47	9.42	8.00	10.10	9.35	9.01
t-value (difference)	(9.42) **	(11.38) **	(12.41) **	(9.87) **	(10.49) **	(9.24) **	(8.60) **	(10.83) **	(9.70) **	(7.68) **
Panel H: Regression Analysis for High M/B Portfolio										
HOT	-1.24	-1.99 *	-1.59 **	-0.69 *	-0.80 **	-0.86 **	0.26	-1.47 *	-0.85	0.46
	(-1.58)	(-2.83)	(-6.12)	(-2.58)	(-3.30)	(-3.31)	(0.43)	(-2.53)	(-1.60)	(0.80)
M/B_{SEO}	-1.03 **	-0.83 **	-0.02	0.44 **	-0.01	-0.12	0.36	0.39	-0.51 *	-0.32
	(-4.16)	(-3.62)	(-0.32)	(5.08)	(-0.09)	(-1.36)	(1.76)	(2.11)	(-2.66)	(-1.59)
M/B_{t-1}	-2.09 **	-1.93 **	0.57 **	--	0.60 **	0.54 **	-0.74 **	--	1.01 **	0.92 **
	(-8.73)	(-8.96)	(7.03)	--	(6.55)	(5.49)	(-3.91)	--	(5.07)	(4.18)
$EBITDA/A_{t-1}$	-17.47 **	-22.29 **	3.63 **	5.09 **	6.68 **	7.45 **	60.65 **	55.01 **	60.68 **	67.32 **
	(-7.91)	(-11.14)	(5.36)	(6.24)	(8.26)	(7.87)	(38.53)	(31.28)	(34.33)	(31.97)
$SIZE_{t-1}$	2.25 **	2.44 **	-0.38 **	-0.28 **	-0.13	-0.25 *	2.46 **	2.87 **	1.73 **	1.40 **
	(9.12)	(11.16)	(-4.57)	(-3.26)	(-1.66)	(-2.83)	(12.70)	(15.26)	(9.67)	(6.92)
PPE/A_{t-1}	16.99 **	14.76 **	17.70 **	20.99 **	18.81 **	16.87 **	5.48 *	8.24 **	7.37 **	9.82 **
	(7.25)	(6.94)	(22.20)	(24.38)	(23.86)	(19.88)	(2.97)	(4.47)	(4.30)	(5.25)
$R\&D/A_{t-1}$	-7.42 *	-10.63 **	-1.81	-0.97	2.27	2.96	-0.95	-1.31	-8.54 *	-3.86
	(-2.23)	(-3.37)	(-1.69)	(-0.73)	(1.73)	(2.14)	(-0.38)	(-0.46)	(-2.97)	(-1.25)
RDD_{t-1}	3.10 *	1.84	-0.54	-0.36	-0.54	-0.57	0.33	0.85	0.31	1.09
	(2.80)	(1.82)	(-1.45)	(-0.94)	(-1.58)	(-1.55)	(0.39)	(1.04)	(0.42)	(1.32)
R^2	0.34	0.31	0.48	0.49	0.49	0.44	0.64	0.61	0.64	0.62
N	2,905	3,608	3,877	3,651	3,167	2,776	3,911	3,691	3,195	2,808

Another possible explanation for market timing is that hot-market firms are over-leveraged compared to cold-market firms. However, this is not the case as the second column of Panel B of Table 4.4 shows that hot-market firms have marginally less book leverage than cold-market firms in the year prior to the SEO. However, once again, the significance of pre-SEO leverage levels is dependent upon the M / B ratio; for low and medium M / B firms there is no statistical significant difference between hot- and cold-market firms at the 1% or 5% level, but hot-market firms with high M / B have significantly lower leverage. Thus, the evidence from Table 4.4 does not support the over-leverage argument.

Most prior literature interprets the positive relationship between the M / B ratio and the level of equity issuance as evidence of market timing effects. However, the results of Table 4.3 shows that the M / B ratio and the HOT market timing dummy have comparable explanatory power for the size of SEO issues. The coefficient of the M / B_t market-to-book variable in Panel B of Table 4.3 is 2.03%. Table 4.2 shows that the standard deviation of M / B in the SEO cross-section is 1.57%. Thus, a one standard deviation of M / B implies a 3.18% increase in SEO proceeds. Since the M / B ratio is driven by many other factors than market timing, such as growth prospects, the market timing effect captured by the M / B ratio is likely considerably less than this 3.18%. This compares to a 2.12% effect from the HOT market timing dummy variable shown in Table 4.3. So the HOT dummy variable provides explanatory power by reflecting market conditions, while avoiding the confounding effects of firm characteristics associated with the M / B ratio.

In summary, the SEO market volume is a highly significant indicator of market timing effects. Firms that issue equity in hot markets issue more equity than those issuing equity in cold markets. This market timing behavior does not seem to be motivated by differences in leverage prior to the SEO, or investment financing needs subsequent to the SEO.

4.4.3 The Short-Term Influence of Hot Markets

The previous results show that market timing affects the amount of equity issued by firms. These results imply that the effect of market timing will be to reduce book leverage in the SEO year. This section quantifies the effect and relates it to other performance measures.

Table 4.5 examines the change in book leverage, where the change in book leverage can be decomposed as follows:

$$D / A_t - D / A_{t-1} = -e / A_t + (E / A)_{t-1} x(\Delta Cash + \Delta Other\ Assets) / A_t - \Delta RE / A_t \qquad (1.2)$$

Here $(E / A)_{t-1}$ is total book equity normalized by assets. To determine the market timing effect upon changes in book leverage, Table 4.5 shows the following regression:

$$\begin{aligned} Y_t = c_0 + c_1 HOT_t + c_2 M / B_t + c_3 EBITDA / A_{t-1} + c_4 SIZE_{t-1} \\ + c_5 PPE / A_{t-1} + c_6 R \& D / A_{t-1} + c_7 RDD_{t-1} + D / A_{t-1} + \varepsilon_t \end{aligned} \qquad (1.3)$$

where the dependent variable Y_t is assigned the values of the components of the change in book leverage. Each column of Table 4.5 shows the results of regression where the dependent variable Y_t is set to be one of the change debt normalized by assets $D / A_t - D / A_{t-1}$, equity issuance normalized by assets e / A_t, the change in cash normalized by assets $\Delta Cash / A_t$, change in other assets normalized by assets $\Delta Other\ Assets / A_t$, change in retained earnings normalized by assets $\Delta RE / A_t$, or the leverage ratio as defined by debt level normalized by assets D / A_t. The sixth column of Table 4.5 estimates the leverage level

Table 4.5
Short-Term Impact of Market Timing

For each variable Y_t, Panel A shows the mean value for hot- and cold-market firms and the *t*-value of their difference. The time subscript *t* denotes the SEO year. Panel B reports the regression:

$$Y_t = c_0 + c_1 HOT + c_2 M/B_{t-1} + c_3 EBITDA/A_{t-1} + c_4 SIZE_{t-1} + c_5 PPE/A_{t-1} + c_6 R\&D/A_{t-1} + c_7 RDD_{t-1} + c_8 D/A_t + \varepsilon_t$$

The dependent variable Y_t is the change in leverage ratio, SEO issuance divided by year-end assets, change in cash divided by ear-end assets, change in other assets divided by year-end assets, change in retained earnings divided by year-end assets, and the leverage ratio, in columns 1-6 respectively. Constant and SIC dummies are suppressed. Robust *t*-statistics are shown in parentheses. Coefficients marked ** and * are significant at 1% and 5% confidence intervals, respectively.

Y_t	D/A_t - D/A_{t-1}	e/A_t	$\Delta Cash/A_t$	ΔOther Assets/A_t	$\Delta RE/A_t$	D/A_t
Panel A: Mean Values for Full Sample						
Hot	-4.85	21.70	7.16	-11.66	-6.70	41.56
Cold	-2.39	15.85	3.53	-8.99	-4.97	48.73
t-value (difference)	(7.32) **	(16.73) **	(9.35) **	(3.00) *	(2.54) *	(15.70) **
Panel B: Regression Analysis for Full Sample						
HOT	-2.80 **	2.12 **	2.45 **	-1.32	3.24 *	-2.93 **
	(-8.51)	(6.28)	(4.81)	(-1.26)	(3.17)	(-7.05)
M/B_t	-1.20 **	2.03 **	0.91 **	0.05	-1.35 **	-2.11 **
	(-10.28)	(16.92)	(5.03)	(0.15)	(-3.73)	(-14.39)
$EBITDA/A_{t-1}$	-18.88 **	-8.42 **	18.58 **	-28.15 **	66.99 **	-29.88 **
	(-19.58)	(-8.51)	(12.46)	(-9.21)	(22.43)	(-24.88)
$SIZE_{t-1}$	1.37 **	-2.56 **	-0.91 **	1.56 **	2.32 **	3.15 **
	(13.32)	(-24.23)	(-5.76)	(4.80)	(7.26)	(24.98)
PPE/A_{t-1}	-0.61	-0.56	4.83 **	-3.61	0.55	5.00 **
	(-0.64)	(-0.57)	(3.23)	(-1.18)	(0.18)	(4.13)
$R\&D/A_{t-1}$	-9.87 **	22.34 **	27.42 **	-20.38 **	2.59	-15.59 **
	(-5.73)	(12.64)	(10.29)	(-3.73)	(0.49)	(-7.13)
RDD_{t-1}	0.17	0.41	0.44	-0.60	-0.10	2.34 **
	(0.38)	(0.90)	(0.63)	(-0.42)	(-0.07)	(4.11)
D/A_{t-1}	-41.05 **	0.47 **	1.01	24.14 **	4.39	--
	(-52.98)	(6.03)	(0.85)	(9.83)	(1.83)	--
R^2	0.26	0.33	0.05	0.03	0.16	0.30
N	10,128	10,128	10,096	10,128	10,001	10,128
Panel C: Mean Values for Low M/B Portfolio						
Hot	-2.76	14.61	2.68	-7.74	-5.42	48.68
Cold	-1.25	14.15	0.99	-5.24	-7.41	47.90
t-value (difference)	(1.65)	0.62	(2.42) *	(2.45) *	(1.62)	(0.68)
Panel D: Regression Analysis for Low M/B Portfolio						
HOT	-2.71 *	0.67	1.40	1.03	-0.46	-3.33 *
	(-2.95)	(0.83)	(1.73)	(0.80)	(-0.33)	(-3.03)
M/B_t	18.36 **	-0.54	1.02	-24.70 **	11.87	29.10 **
	(6.39)	(-0.21)	(0.40)	(-6.07)	(2.70)	(8.61)
$EBITDA/A_{t-1}$	-5.56	6.15	8.58 *	-24.49 **	44.89 **	-9.84 *
	(-1.49)	(1.87)	(2.61)	(-4.63)	(7.75)	(-2.20)
$SIZE_{t-1}$	1.48 **	-1.90 **	-0.47	0.42	0.79	2.95 **
	(5.56)	(-8.05)	(-2.03)	(1.13)	(1.94)	(9.51)
PPE/A_{t-1}	4.43	-5.07 *	-0.12	5.17	1.21	5.94 *
	(1.96)	(-2.54)	(-0.06)	(1.62)	(0.35)	(2.20)
$R\&D/A_{t-1}$	-27.98 **	65.23 **	28.15 **	-35.19 *	-12.41	-44.03 **
	(-3.31)	(8.72)	(3.78)	(-2.94)	(-0.96)	(-4.36)
RDD_{t-1}	0.64	0.54	0.03	-1.50	1.73	2.88
	(0.55)	(0.53)	(0.03)	(-0.90)	(0.96)	(2.05)
D/A_{t-1}	-50.32 **	7.90 **	1.96	29.03 **	8.69 *	--
	(-22.75)	(4.04)	(1.01)	(9.28)	(2.57)	--
R^2	0.41	0.28	0.15	0.23	0.30	0.43
N	1,372	1,372	1,372	1,372	1,359	1,372

Y_t	D/A_t - D/A_{t-1}	e/A_t	$\Delta Cash/A_t$	$\Delta Other\ Assets/A_t$	$\Delta RE/A_t$	D/A_t
			Panel E: Mean Values for Medium M/B Portfolio			
Hot	-4.30	17.62	4.67	-10.32	-4.64	48.76
Cold	-0.95	12.76	2.09	-7.10	-4.42	56.01
t-value (difference)	(6.41) **	(11.94) **	(6.38) **	(5.46) **	(0.26)	(10.33) **
			Panel F: Regression Analysis for Medium M/B Portfolio			
HOT	-2.36 **	0.88	1.66 *	-2.66 *	4.00 *	-2.06 *
	(-4.09)	(1.86)	(3.22)	(-2.80)	(2.32)	(-2.79)
M/B_t	-8.44 **	7.27 **	5.33 **	-3.33	3.88	-11.36 **
	(-8.22)	(8.63)	(5.79)	(-1.97)	(0.13)	(-8.66)
$EBITDA/A_{t-1}$	-21.94 **	-0.64	14.14 **	-28.68 **	53.55 **	-14.94 **
	(-11.38)	(-0.41)	(8.18)	(-9.02)	(9.29)	(15.54)
$SIZE_{t-1}$	1.48 **	-2.27 **	-0.76 **	1.25 **	1.03	3.16
	(9.12)	(-17.03)	(-5.21)	(4.69)	(2.12)	(0.37)
PPE/A_{t-1}	-2.39	0.76	5.33 **	-4.70	10.51 *	0.71 **
	(-1.57)	(0.61)	(3.91)	(-1.88)	(2.30)	(-6.29) **
$R\&D/A_{t-1}$	-10.32 *	27.83 **	19.93 **	-11.11	-16.83	-32.69
	(-2.53)	(8.31)	(5.44)	(-1.65)	(-1.39)	(-6.29)
RDD_{t-1}	0.54	-0.13	0.85	-2.55 *	9.32	1.02
	(0.78)	(-0.23)	(1.37)	(-2.21)	(0.45)	(1.15)
D/A_{t-1}	-37.89 *	1.80	-1.00	25.79 **	3.81	--
	(-29.91)	(1.73)	(-0.89)	(12.34)	(1.00)	--
R^2	0.26	0.28	0.10	0.12	0.09	0.29
N	3,990	3,990	3,964	3,990	3,920	3,990
			Panel G: Mean Values for High M/B Portfolio			
Hot	-6.09	27.92	11.09	-14.57	-9.33	32.22
Cold	-4.07	19.36	5.74	-12.16	-4.41	42.03
t-value (difference)	(3.90) **	(13.88) **	(7.07) **	(1.26)	(4.33) **	(15.44) **
			Panel H: Regression Analysis for High M/B Portfolio			
HOT	-3.80 **	3.80 **	2.70 *	1.58	5.43 *	-4.44
	(-7.38)	(6.19)	(2.60)	(0.73)	(3.03)	(-6.99)
M/B_t	-0.67 **	1.34 **	0.40	0.93	-2.50 **	-1.38 **
	(-4.41)	(7.32)	(1.30)	(1.43)	(-4.68)	(-7.34)
$EBITDA/A_{t-1}$	-17.79 **	-11.68 **	20.77 **	-27.73 **	64.64 **	-27.62 **
	(-14.26)	(7.86)	(8.24)	(-5.25)	(14.93)	(-18.20)
$SIZE_{t-1}$	1.11 **	-2.99 **	-1.17 **	2.34 **	4.52 **	2.72
	(6.93)	(-15.57)	(-3.60)	(3.44)	(8.04)	(14.01)
PPE/A_{t-1}	-1.65	-0.24	6.47	-4.42	-7.31	7.59 **
	(-1.07)	(-0.14)	(2.08)	(-0.68)	(-1.36)	(4.03)
$R\&D/A_{t-1}$	-8.54 **	17.93 **	28.30 **	-18.64	6.59	-10.44 **
	(-4.22)	(7.44)	(6.92)	(-2.18)	(0.94)	(-4.19)
RDD_{t-1}	-0.21	1.36	-3.71	1.71	-2.24	2.54 *
	(-0.29)	(1.57)	(-0.25)	(0.55)	(-0.88)	(2.84)
D/A_{t-1}	-44.57 **	7.39 **	3.09	22.65 **	4.48	--
	(-39.12)	(5.45)	(1.35)	(4.70)	(1.13)	--
R^2	0.32	0.32	0.05	0.04	0.23	0.26
N	4,766	4,766	4,760	4,766	4,722	4,766

in the SEO year, with Panel B showing that it is significantly lower at the end of the issue year for hot-market firms. Again, this is

consistent with market timers issuing more equity than required for investment purposes. The *HOT* market timing dummy is negative and significant at the 1% confidence level, showing that the book leverage level of hot-market firms is not explained by the other standard determinant variables in the regression equation.

Examining the results for low, medium and high M / B portfolio sub samples given in Panels C to H, shows that the short-term impact of market timing is significant for the change in leverage and the leverage level for all portfolios, but that the low portfolio shows no significant difference between hot- and cold- market firms for amount of equity issue, or changes in cash, retained earnings, or assets. This suggests that low M / B firms tend to reduce leverage when equity markets are favourable, but they raise no more capital than required for immediate investment purposes.

4.4.4 The Persistence of Hot Markets

The previous sections present evidence that market timing affects capital structure in the short-term. The related question is how persistent are these effects over the long-term. The previous section showed that hot-market firms have similar or lower leverage ratios prior to their SEO but that these firms reduce leverage in the SEO year compared to cold-market firms. This section examines if these effects are reversed in subsequent years following the SEO.

To examine the question of persistence, the following regression is shown in Table 4.6:

$$\begin{aligned} Y_t &= c_0 + c_1 HOT_t + c_2 M / B_{t-1} + c_3 EBITDA / A_{t-1} + c_4 SIZE_{t-1} \\ &\quad + c_5 PPE / A_{t-1} + c_6 R\&D / A_{t-1} + c_7 RDD_{t-1} + D / A_{PRE-SEO} + \varepsilon_t \end{aligned} \tag{1.4}$$

where the dependent variable Y_t is the cumulative change in book leverage from the level prior to the SEO, $D / A_t - D / A_{PRE-SEO}$, or the book leverage level, D / A_t.

If the effects of market timing upon leverage are permanent, then the cumulative change should remain significant in the years following the SEO. As shown in the first three columns of Table 4.6, the statistical significance of market timing fades below the 5% confidence level within three years of the SEO year. In the first year following the SEO, in column one of Panel B of Table 4.6, the hot-market dummy coefficient has a value of -1.08%, versus the value of -2.80% given in Panel B of Table 4.5. This suggests that more than one-half of the market timing effects are gone in the first fiscal year following the SEO. Within three years following the SEO year, there is no hot-market effect remaining.

Columns three to six of Table 4.6 re-estimate the regression equation without the market-to-book variable, to demonstrate that the fading of the market timing effect is not due to interaction between the hot-market dummy and the book-to-market ratio. The hot-market dummy still becomes insignificant within three years of the SEO year, showing the robustness of the result.

While the first six columns examine the cumulative change in leverage, the last six columns in Table 4.6 estimate the results for the annual level of leverage. This annual leverage level represents the short-term effects of market timing. Again, the influence of market timing becomes statistically insignificant at the 5% confidence level within three years in Panel B of Table 4.6.

Examining the results for the M/B sub portfolios shows a marked difference between low M/B portfolios versus medium and high portfolios. In the years following SEO issuance, hot-market firms in the low M/B portfolio exhibit a positive increase in cumulative leverage, whereas medium and low firms show negative coefficients for the hot-market dummy. This result is consistent with Korajczyk and Levy (2003), who find

Table 4.6
Persistence of Market Timing

For each variable Y_t, Panel A shows the mean value for hot- and cold-market firms and the t-value of their difference. The time subscript t denotes the SEO year. Panel B reports the regression:

$$Y_t = c_0 + c_1 HOT + c_2 M/B_{SEO} + c_3 M/B_{t-1} + c_4 EBITDA/A_{t-1} + c_5 SIZE_{t-1} + c_6 PPE/A_{t-1} + c_7 R\&D/A_{t-1} + c_8 RDD_{t-1} + \varepsilon_t$$

All regressions are estimated with industry fixed effects proxied by the three-digit SIC codes. The constant and industry dummies are suppressed. The dependent variable Y_t is the cumulative change in the leverage ratio and the leverage ratio, in columns 1-6 and 7-12 respectively. All variables are expressed in percentage terms. Robust t-statistics are shown in parentheses. Coefficients marked ** and * are significant at 1% and 5% confidence intervals, respectively.

Y_t	$D/A_t - D/A_{PRE\text{-}SEO}$						Book Leverage D/A_t					
t	SEO+1	SEO+2	SEO+3	SEO+1	SEO+2	SEO+3	SEO+1	SEO+2	SEO+3	SEO+1	SEO+2	SEO+3
					Panel A: Mean Values for Full Sample							
Hot	-3.46	-2.42	-1.49	--	--	--	42.94	44.08	45.26	--	--	--
Cold	-2.13	-2.47	-2.53	--	--	--	48.59	48.20	47.98	--	--	--
t-value (difference)	(3.17) *	(0.11)	(2.00)	--	--	--	(11.39)	(7.91) **	(5.00) **	--	--	--
					Panel B: Regression Analysis for Full Sample							
HOT	-1.08 *	-0.59	0.02	-1.80 **	-0.89	-0.13	-0.92	-0.76	-0.28	-2.01 **	-1.23 *	-0.47
	(-2.94)	(-1.46)	(0.07)	(-4.88)	(-2.18)	(-0.31)	(-2.10)	(-1.65)	(-0.58)	(-4.55)	(-2.62)	(-0.98)
M/B_{t-1}	-2.03 **	-2.21 **	-2.21 **	--	--	--	-3.06 **	-2.95 **	-2.78 **	--	--	--
	(-13.87)	(-12.46)	(-10.87)	--	--	--	(-17.69)	(-14.65)	(-12.43)	--	--	--
$EBITDA/A_{t-1}$	-31.59 **	-27.45 **	-28.22 **	-34.27 **	-30.52 **	-31.61	-32.31 **	-26.84 **	-27.00 **	-36.43 **	-31.00 **	-31.28 **
	(-23.38)	(-18.96)	(-16.93)	(-25.31)	(-21.14)	(-19.06)	(-20.14)	(16.24)	(-14.73)	(-22.51)	(-18.76)	(-17.10)
$SIZE_{t-1}$	1.65 **	1.90 **	1.94 **	1.80 **	2.06 **	2.09 **	2.74 **	2.80 **	2.65 **	3.01 **	3.02 **	2.86 **
	(13.76)	(14.04)	(13.05)	(14.88)	(15.07)	(14.01)	(19.39)	(18.28)	(16.37)	(21.08)	(19.53)	(17.52)
PPE/A_{t-1}	7.82 **	8.12 **	7.29 **	9.29 **	8.99 **	0.22 **	10.97 **	8.96 **	6.49 **	13.35 **	10.33 **	7.64 **
	(6.86)	(6.25)	(5.10)	(8.08)	(6.88)	(5.72)	(8.11)	(6.04)	(4.12)	(9.73)	(6.90)	(4.82)
$R\&D/A_{t-1}$	-4.80	1.21	-3.38	-11.12 **	-6.39 *	-10.26 **	-10.55 **	-1.77	-7.56 *	-20.46 **	-12.32 **	-16.48 **
	(-2.00)	(0.45)	(-1.19)	(-4.67)	(-2.39)	(-3.67)	(-3.71)	(-0.57)	(-2.43)	(-7.20)	(-4.02)	(-5.36)
RDD_{t-1}	1.12 *	1.01	1.09	1.35 *	1.14	1.19	2.42 **	2.67 **	2.34 **	2.83 **	2.85 **	2.53 **
	(2.18)	(1.76)	(1.74)	(2.59)	(1.97)	(1.88)	(3.96)	(4.08)	(3.39)	(4.54)	(4.28)	(3.64)
$D/A_{PRE\text{-}SEO}$	-47.99 **	-53.17 **	-59.53 **	-46.41 **	-52.17 **	-58.62 **	--	--	--	--	--	--
	(-52.04)	(-51.32)	(-51.94)	(-50.11)	(-49.99)	(-50.83)	--	--	--	--	--	--
R^2	0.34	0.36	0.39	0.33	0.34	0.37	0.35	0.33	0.34	0.32	0.31	0.32
N	8,018	6,968	6,134	8,018	7,031	6,202	8,018	6,968	6,134	8,018	7,031	6,202
					Panel C: Mean Values for Low M/B Portfolio							
Hot	0.16	1.29	2.69	--	--	--	52.29	53.19	54.31	--	--	--
Cold	1.12	1.12	-1.02	--	--	--	50.38	50.04	48.27	--	--	--
t-value (difference)	(0.85)	(0.13)	(2.56)	--	--	--	(1.47)	(2.29) *	(4.26) **	--	--	--
					Panel D: Regression Analysis for Low M/B Portfolio							
HOT	-1.34	1.88	4.13 *	0.19	1.45	4.50 **	-2.06	2.40	4.19 *	0.84	1.88	4.64
	(-1.12)	(1.46)	(2.98)	(0.17)	(1.14)	(3.29)	(-1.52)	(1.72)	(2.88)	(0.65)	(1.37)	(3.24)
M/B_{t-1}	13.93 **	0.73 **	1.60	--	--	--	25.97 **	1.28	2.05	--	--	--
	(3.49)	(46.00)	(1.39)	--	--	--	(5.81)	(0.75)	(1.71)	--	--	--
$EBITDA/A_{t-1}$	-30.16 **	-4.89	-5.79	-27.22 **	-4.34	-5.74	-22.14 **	0.15	-2.22	-15.88 *	0.94	-2.16
	(-5.49)	(-1.47)	(-1.72)	(-4.99)	(-1.30)	(-1.69)	(-3.56)	(0.04)	(-0.64)	(-2.54)	(0.26)	(-0.62)
$SIZE_{t-1}$	1.74 **	1.97 **	2.27 **	1.83 **	2.04 **	2.35 **	2.79 **	2.87 **	2.91 *	3.05 *	2.97 *	2.99 **
	(5.02)	(4.84)	(5.18)	(5.27)	(5.01)	(5.35)	(7.19)	(6.68)	(6.45)	(7.76)	(6.94)	(6.62)
PPE/A_{t-1}	5.40	1.80	10.81 *	5.44	1.15	10.71 *	6.63	4.06	10.33	6.81	3.38	10.22 *
	(1.79)	(0.49)	(2.71)	(1.80)	(0.32)	(2.67)	(1.93)	(1.03)	(2.47) **	(1.95)	(0.39)	(2.44)
$R\&D/A_{t-1}$	-19.96	4.91	-32.26	-15.92	4.58	-25.46	-29.72	-4.31	-35.76	-22.67	-3.69	-27.13
	(-1.40)	(0.30)	(-1.94)	(-1.12)	(0.30)	(-1.56)	(-1.84)	(-0.25)	(-2.05)	(-1.38)	(-0.22)	(-1.59)
RDD_{t-1}	0.47	2.74	2.08	0.38	2.32	1.85	2.56	5.48 *	3.35	2.56	4.75 *	3.15
	(0.29)	(1.41)	(0.98)	(0.24)	(1.20)	(0.88)	(1.39)	(2.64)	(1.51)	(1.37)	(2.30)	(1.44)
$D/A_{PRE\text{-}SEO}$	-50.08 **	-62.03 **	-70.20 **	-48.14 **	-61.94 **	-70.52 **	--	--	--	--	--	--
	(16.49)	(-17.58)	(-18.18)	(-16.02)	(-17.96)	(-18.36)	--	--	--	--	--	--
R^2	0.38	0.44	0.49	0.37	0.44	0.49	0.38	0.41	0.43	0.36	0.40	0.43
N	1,101	885	786	1,101	903	802	1,101	885	786	1,101	903	802

Yt	D/At - D/APRE-SEO						Book Leverage D/At					
t	SEO+1	SEO+2	SEO+3	SEO+1	SEO+2	SEO+3	SEO+1	SEO+2	SEO+3	SEO+1	SEO+2	SEO+3
Panel E: Mean Values for Med M/B Portfolio												
Hot	-2.87	-2.12	-1.73	--	--	--	50.40	51.41	52.26	--	--	--
Cold	-0.82	-1.57	-1.62	--	--	--	55.68	54.94	54.77	--	--	--
t-value (difference)	(3.22) *	(0.78)	(0.14)	--	--	--	(7.30) **	(4.70) **	(3.27) *	--	--	--
Panel F: Regression Analysis for Med M/B Portfolio												
HOT	-0.52	-1.08	-0.43	-2.42 **	-1.50 *	-0.81	0.07	-0.92	-0.21	-2.34 **	-1.48	-0.61
	(-0.81)	(-1.64)	(-0.63)	(-4.10)	(-2.30)	(-1.19)	(0.10)	(-1.23)	(-0.28)	(-3.32)	(-2.00)	(-0.82)
M/Bt-1	-8.65 **	-2.88 *	-2.25 **	--	--	--	-10.98 **	-3.34 **	-2.28 **	--	--	--
	(-7.32)	(-4.92)	(-4.21)	--	--	--	(-7.80)	(-5.00)	(-3.91)	--	--	--
EBITDA/A t-1	-45.61 **	-43.28 **	-36.51 **	-46.65 **	-44.94 **	-38.44 **	-44.67 **	-41.60 **	-34.84 **	-45.99 **	-43.56 **	-36.93 **
	(-16.54)	(-13.38)	(-10.20)	(-16.80)	(-13.91)	(-10.87)	(-13.57)	(-11.31)	(-8.93)	(-13.85)	(-11.87)	(-9.60)
SIZE t-1	1.70 **	2.12 **	2.11 **	1.78 **	2.18 **	2.16 **	2.77 **	3.01 **	2.81 **	2.88 **	3.07 **	2.83 **
	(8.98)	(9.87)	(9.35)	(9.33)	(10.16)	(9.63)	(12.39)	(12.46)	(11.56)	(12.80)	(12.69)	(11.75)
PPE/A t-1	4.64 *	5.83 *	3.61	6.16 **	6.34 *	4.45	6.03 *	5.16 *	1.70	7.99 **	5.68 *	2.51
	(2.60)	(2.89)	(1.66)	(3.40)	(3.14)	(2.05)	(2.83)	(2.25)	(0.72)	(3.73)	(2.48)	(1.07)
R&D/A t-1	-11.89 *	-15.08 *	-22.84 **	-14.38 *	-20.57 **	-28.83 **	-25.27 **	-29.95 **	-37.59 **	-28.63 **	-36.54 **	-44.21 **
	(-2.45)	(-2.48)	(-3.31)	(-2.94)	(-3.42)	(-4.34)	(-4.37)	(-4.35)	(-5.03)	(-4.92)	(-5.37)	(-6.14)
RDD t-1	1.85 *	1.27	1.29	1.77 *	1.14	1.11	2.38 *	2.61 *	2.49 *	2.28 *	2.43 *	2.25 *
	(2.35)	(1.44)	(1.38)	(2.23)	(1.30)	(1.20)	(2.54)	(2.61)	(2.45)	(2.41)	(2.42)	(2.23)
D/APRE-SEO	-46.59 **	-52.57 **	-61.23 **	-45.99 **	-52.61 **	-61.57 **	--	--	--	--	--	--
	(-31.22)	(-30.83)	(-32.95)	(-30.60)	(-30.86)	(-33.26)	--	--	--	--	--	--
R2	0.36	0.37	0.41	0.35	0.37	0.41	0.31	0.30	0.32	0.30	0.29	0.31
N	3,241	2,846	2,519	3,241	2,873	2,551	3,241	2,846	2,519	3,241	2,873	2,551
Panel G: Mean Values for High M/B Portfolio												
Hot	-5.14	-3.81	-2.57	--	--	--	33.31	34.84	36.13	--	--	--
Cold	-4.12	-4.15	-3.69	--	--	--	42.08	41.95	42.04	--	--	--
t-value (difference)	(1.61)	(0.47)	(1.41)	--	--	--	(12.89) **	(9.78) **	(7.55) **	--	--	--
Panel H: Regression Analysis for High M/B Portfolio												
HOT	-1.43 *	-1.24	-0.62	-2.34 **	-1.39 *	-0.74	-1.93 *	-0.86	-0.41	-3.35 **	-2.56 **	-1.85 *
	(-2.50)	(-2.03)	(-0.93)	(-4.18)	(-2.26)	(-1.10)	(-2.89)	(-0.96)	(-0.54)	(-5.09)	(-3.67)	(-2.49)
M/Bt-1	-1.27 **	-1.50 **	-1.66 **	--	--	--	-1.94 **	-1.98 **	-2.26 **	--	--	--
	(-6.88)	(-7.27)	(-6.88)	--	--	--	(-8.99)	(-8.59)	(-8.75)	--	--	--
EBITDA/A t-1	-26.79 **	-28.97 **	-33.59 **	-27.60 **	-31.26 **	-37.03 **	-27.78 **	-31.11 **	-38.81 **	-29.06 **	-32.21 **	-37.65 **
	(-15.47)	(-14.38)	(-13.98)	(-15.87)	(-15.61)	(-15.54)	(-13.69)	(-13.34)	(-14.32)	(-14.19)	(-14.19)	(-14.44)
SIZE t-1	1.56 **	1.96 **	2.09 **	1.65 **	2.16 **	2.34 **	2.36 **	2.70 **	2.90 **	2.52 **	2.89 **	2.98 **
	(8.42)	(9.26)	(8.60)	(8.85)	(10.19)	(9.59)	(10.93)	(11.32)	(10.92)	(11.57)	(12.10)	(11.24)
PPE/A t-1	-12.41 **	12.81 **	12.71 **	13.68 **	13.46 **	13.76 **	17.90 **	13.73 **	13.06 **	20.02 **	16.18 **	15.28 **
	(6.82)	(6.30)	(5.61)	(7.51)	(6.60)	(6.03)	(8.43)	(6.00)	(5.27)	(9.37)	(7.00)	(6.13)
R&D/A t-1	-0.94	0.36	-4.63	-3.69	-4.27	-9.56 *	-5.38	-5.79	-13.47 **	-9.74 *	-7.25	-13.98 **
	(-0.33)	(0.11)	(-1.38)	(-1.30)	(-1.33)	(-2.91)	(-1.61)	(-1.54)	(-3.39)	(-2.92)	(-2.00)	(-3.85)
RDD t-1	0.42	-0.07	0.38	0.60	0.11	0.53	1.85	0.89	0.89	2.16	1.38	1.48
	(0.53)	(-0.09)	(0.39)	(0.75)	(0.13)	(0.53)	(1.96)	(0.89)	(0.82)	2.27	(1.36)	(1.35)
D/APRE-SEO	-51.96 **	-56.23 **	-61.83 **	-51.04 **	-55.60 **	-60.99 **	--	--	--	--	--	--
	(-38.88)	(-37.62)	(-36.63)	(-38.13)	(-36.96)	(-35.73)	--	--	--	--	--	--
R2	0.40	0.42	0.44	0.40	0.37	0.43	0.32	0.32	0.33	0.30	0.30	0.31
N	3676	3,237	2,829	3,676	3,255	2,849	3,676	3,196	2,794	3,676	3,255	2,849

that constrained firms (low market-to-book) issue debt cyclically in the same direction as the business cycle, where the business cycle is proxied by equity market and interest rate indices, while other firms (medium and high market-to-book) issue debt counter cyclically.

The results of this section, showing that market timing effects for SEOs fade within three years of seasoned equity issuance, are consistent with prior research done on IPOs [e.g. Leary and Roberts (2005), Alti (2006)]. However, the evidence that market timing is a short-term phenomenon contrasts with the results of Baker and Wurgler (2002), who use an external finance weighted average of the market-to-book ratio with an IPO dataset to argue that the effect of market timing persists for more than 10 years.

Table 4.7 reports regression results that include both the hot-market dummy, HOT, and the external finance weighted average market-to-book ratio, $M / B_{efwa,t-1}$, as defined in Baker and Wurgler (2002):

$$Y_t = c_0 + c_1 HOT + M / B_{efwa,t-1} + c_3 M / B_{t-1} + \varepsilon_t \tag{1.5}$$

where the dependent variable Y_t is the cumulative change in book leverage from the level prior to the SEO, $D / A_t - D / A_{PRE-SEO}$, or the book leverage level, D / A_t.

The results of Table 4.7 show that the Baker and Wurgler measure is statistically insignificant in explaining leverage levels and cumulative changes, while the hot-market dummy shows that market timing effects disappear within a few years of SEO issuance. The insignificance of the Baker and Wurgler measure for SEO data contrasts with the ambiguous results of Alti (2006) that use IPO data, for Alti shows that the Baker and Wurgler measure is highly significant in all years even though the hot-market dummy becomes insignificant within two years of the IPO issue. The results for SEOs in this paper support the view of Kayhan and Titman (2007) that the Baker and Wurgler results for IPOs reflect the persistence of the market-to-book ratio in IPO data rather than market timing effects.

Table 4.7
Hot-Market and Historical Market-to-Book Effects on Leverage

For each dependent variable Y_t, this table reports the regression:

$$Y_t = c_0 + c_1 HOT + M/B_{efwa,t-1} + c_3 M/B_{t-1} + \varepsilon_t$$

The time subscript t denotes the SEO event year. All regressions are estimated with industry fixed effects proxied by the three-digit SIC codes. The constant and industry dummies are suppressed. The dependent variable Y_t is the cumulative change in the leverage ratio and the leverage ratio, in columns 1-4 and 5-8 respectively. All variables are expressed in percentage terms. Robust t-statistics are shown in parentheses. Coefficients marked ** and * are significant at 1% and 5% confidence intervals, respectively.

Y_t	D/At - D/A$_{PRE\text{-}SEO}$				Book Leverage D/A$_t$			
t	SEO	SEO+1	SEO+2	SEO+3	SEO	SEO+1	SEO+2	SEO+3
				Panel A: Regression Analysis for Full Sample				
HOT	-1.96 **	-0.21	0.68	1.49	-3.28	-0.91	-0.70	-0.21
	(-5.28)	(-0.46)	(1.32)	(2.59)	(-7.08)	(-1.84)	(-1.34)	(-0.38)
$M/B_{efwa,t-1}$	-0.01	0.00	0.00	-0.02	-0.01	-0.01	0.00	-0.01
	(-2.20)	(-0.23)	(-0.42)	(-1.32)	(-1.49)	(-0.72)	(-0.20)	(-1.32)
M/B_{t-1}	-0.03	-1.23 **	-1.43 **	-1.34 **	-3.36 **	-3.62 **	-3.29 **	-3.14 **
	(-0.23)	(-7.09)	(-6.73)	(-5.36)	(-20.46)	(-19.38)	(-15.43)	(-13.30)
R^2	0.05	0.05	0.05	0.06	0.28	0.29	0.28	0.29
N	7,902	6,901	6,044	5,301	7,902	6,901	6,044	5,301
				Panel B: Regression Analysis for Low M/B Portfolio				
HOT	-0.54	-0.31	2.29	4.94 *	-0.15	-3.59 *	2.65	4.47 *
	(-0.50)	(-0.21)	(1.31)	(2.52)	(-0.13)	(-2.29)	(1.62)	(2.66)
$M/B_{efwa,t-1}$	-0.01	-0.01	0.00	-0.01	0.01	-0.02	0.01	0.01
	(-0.41)	(-0.18)	(-0.08)	(-0.29)	(0.34)	(-0.51)	(0.46)	(0.28)
M/B_{t-1}	-1.31	-1.37	-1.02	0.27	-3.21 **	30.93 **	1.61	0.31
	(-2.14)	(-0.30)	(-0.56)	(0.20)	(-4.64)	(6.39)	(0.95)	(0.26)
R^2	0.20	0.20	0.18	0.18	0.38	0.38	0.38	0.39
N	1,064	907	738	654	1,064	907	738	654
				Panel C: Regression Analysis for Med M/B Portfolio				
HOT	-3.54 **	-1.32	-1.13	-0.11	-4.28 **	0.17	-0.84	-0.04
	(-5.84)	(-1.62)	(-1.33)	(-0.11)	(-5.43)	(0.20)	(-0.99)	(-0.04)
$M/B_{efwa,t-1}$	-0.01	-0.01	0.00	-0.01	-0.01 **	0.00	0.00	-0.02
	(-0.58)	(-0.30)	(-0.04)	(-0.45)	(-0.54)	(-0.80)	(-0.12)	(-1.01)
M/B_{t-1}	-0.06	-5.05 **	-1.64 *	-1.67 *	-3.95 **	-12.79 **	-3.73 **	-2.94 **
	(-0.17)	(-3.39)	(-2.24)	(-2.49)	(-9.05)	(-7.96)	(-5.08)	(-4.68)
R^2	0.09	0.09	0.09	0.11	0.24	0.25	0.24	0.28
N	3,136	2,735	2,422	2,128	3,136	2,735	2,422	2,128
				Panel D: Regression Analysis for High M/B Portfolio				
HOT	-1.93	0.33	1.20	1.72	-4.77	-2.13	-2.62	-2.49
	(-3.41)	(0.46)	(1.52)	(1.96)	(-6.95)	(-2.83)	(-3.37)	(-3.05)
$M/B_{efwa,t-1}$	0.00	0.01	-0.01	0.00	0.01	0.00	0.00	0.00
	(0.16)	(0.52)	(-0.40)	(-1.05)	(0.69)	(0.29)	(-0.17)	(-0.82)
M/B_{t-1}	0.59	-0.48	-1.01	-1.15	-2.24	-2.22	-2.17	-2.48
	(3.61)	(-2.08)	(-3.93)	(-3.80)	(-11.29)	(-9.45)	(-8.62)	(-8.82)
R^2	0.08	0.08	0.08	0.1	0.24	0.25	0.25	0.27
N	3,702	3,259	2,884	2,519	3,702	3,259	2,884	2,519

4.4.5 The Reversal of the Influence of Hot Markets

The previous section shows that market timing effects due to hot markets are reversed within three years of the SEO event. This section examines the process by which the reversal is enacted. The reversal of market timing effects could be implemented by firms in two ways. The first way is that firms actively increase their leverage levels to return to their target leverage level, consistent with a dynamic trade-off theory where leverage may deviate from the optimal target in the short-term to reflect transient conditions but reverts to the target over the long-term. The second way is that firm characteristics change in a manner so that the firm's target leverage shifts to realign with the actual leverage level, consistent with the transaction costs theory.

Transaction cost theory says that issuing capital is a costly process with high fixed costs that discourage continuous adjustment of leverage levels. Such models imply that firms will tend to issue capital in discrete amounts that will cause firms to oscillate over or under their long-term target leverage level. Under this scenario, firms that issue a large SEO may appear to be under-leveraged according to standard control variables, but this under-leverage position may actually be an optimal strategy when transaction costs are considered. Firms may issue a large SEO and then wait for changing conditions to effect mean reversion to the target leverage level.

Alti (2006) argues that the transaction cost hypothesis can be tested by examining how hot- and cold market firms change their leverage levels following the SEO event. Alti suggests that hot-market firms should issue debt at a slower rate than cold-market firms in the years following the SEO event if the transaction cost model is the motivation for the observed reversal of the difference between hot- and cold-market SEO issuers.

Following the method of Alti (2006), following regression of changes in leverage following the SEO year is estimated:

$$Y_t = c_0 + c_1 HOT + c_2 Market_t + c_3 M / B_{t-1} + c_4 EBITDA / A_{t-1} + c_5 SIZE_{t-1} + c_6 PPE / A_{t-1} + c_7 R \& D / A_{t-1} + c_8 RDD_{t-1} + c_9 d_{high} + c_{10} d_{low} + \varepsilon_t \qquad (1.6)$$

where the dependent variable Y_t is assigned the value of financing variables, namely change in book leverage level, $D / A_t - D / A_{t-1}$, net debt issues normalized by assets, d / A_t, net SEO issues normalized by assets e / A_t, and the financial deficit defined as total capital issuance normalized by assets $(d + e) / A_t$. The $Market$ variable is a dummy variable that is assigned a value of one if the volume of SEO issues is above the long-term median, controlling for general market conditions. The dummy variable d_{high} is assigned a value of one if the firm's debt level is above 80% and the dummy variable d_{low} is assigned a value of one if the firm's debt level is below 10%, thereby controlling for the bias of extreme leverage.

The first two columns of Panel B in Table 4.8, where the dependent variable Y_t is the chnge in book leverage level, $D / A_t - D / A_{t-1}$, show that hot-market firms are increasing their leverage levels faster than cold market firms. Columns three and four, where Y_t is the net debt issues , d / A_t , show that hot-market firms moving to the same levels of debt issuance as cold-market firms. Columns five and six show a move of hot-market firms to a lower level of equity issuance than cold-market firms, and columns seven and eight show hot-market firms move to a lower financial deficit than cold market firms. These results suggest that hot-market firms actively return to target leverage levels

Table 4.8
Reversal of Market Timing Effects

For each variable Y_t, Panel A shows the mean value for hot- and cold-market firms and the t-value of their difference. The time subscript t denotes the SEO year. Panel B reports the regression:

$$Y_t = c_0 + c_1 HOT + c_2 Market_t + c_3 M/B_{t-1} + c_4 EBITDA/A_{t-1} + c_5 SIZE_{t-1} + c_6 PPE/A_{t-1} + c_7 R\&D/A_{t-1} + c_8 RDD_{t-1} + c_9 d_{high} + c_{10} d_{low} + \varepsilon_t$$

Constant and SIC dummies are suppressed. Robust t-statistics are shown in parentheses. Coefficients marked ** and * are significant at 1% and 5% confidence intervals, respectively.

Y_t	ΔBook Leverage D/At - D/At-1		*Net Debt Issues d/At*		*Net SEO Issues e/At*		*Financial Deficit (e+d)/At*	
t	*SEO+1*	*SEO+2*	*SEO+1*	*SEO+2*	*SEO+1*	*SEO+2*	*SEO+1*	*SEO+2*
Panel A: Mean Values for Full Sample								
Hot	2.34	1.93	0.22	3.41	21.63	5.75	21.91	9.26
Cold	0.92	0.20	2.07	3.26	15.47	4.93	17.49	8.23
t-value (difference)	(5.11) **	(6.12) **	(6.43) **	(0.55)	(16.96) **	(2.44)	(10.13) **	(2.40) *
Panel B: Regression Analysis for Full Sample								
HOT	1.66 **	1.26 **	-1.45 **	0.34	2.32 **	-1.55 **	0.86	-1.04 *
	(5.54)	(4.27)	(-4.70)	(1.16)	(7.03)	(-5.22)	(2.08)	(-2.57)
Market	-1.30 **	-0.89 **	-0.36	-0.73 *	-1.39 **	-0.45	-1.62 **	-1.12 *
	(-4.48)	(-3.06)	(-1.2)	(-2.58)	(-4.34)	(-1.52)	(-4.02)	(-2.81)
M/Bt-1	-0.56 **	-0.47 **	-0.16	-0.26	2.07 **	3.21 **	1.83 **	2.91 **
	(-4.89)	(-3.63)	(-1.39)	(-2.11)	(16.35)	(24.62)	(11.57)	(16.39)
EBITDA/At-1	-3.97 **	-3.84 **	-10.35 **	-3.80 **	-17.44	-22.58	-28.19	-26.36
	(-3.72)	(-3.65)	(-9.50)	(-3.73)	(-14.84)	(-21.43)	(-19.21)	(-18.35)
SIZEt-1	-0.54 **	-0.16	0.22 *	0.04	-1.98 **	-0.72 **	-1.75 **	-0.71 **
	(-5.68)	(-1.66)	(2.28)	(0.39)	(-18.88)	(-7.23)	(-13.26)	(-5.26)
PPE/At-1	-0.94	-1.91	-0.22	4.05 **	-9.37 **	-0.60	-10.03	3.47 *
	(-1.04)	(-2.02)	(-0.24)	(4.39)	(-9.48)	(-0.64)	(-8.03)	(2.67)
R&D/At-1	-5.36 *	-7.07 **	-5.12 *	-6.79 **	-13.26 **	3.42	-18.13 **	-2.59
	(-2.84)	(-3.59)	(-2.69)	(-3.57)	(-6.44)	(1.72)	(-7.06)	(-0.96)
RDDt-1	0.09	-0.85	0.49	0.47	-0.01	0.13	0.61	0.66
	(0.22)	(-2.03)	(1.17)	(1.15)	(-0.02)	(0.30)	(1.09)	(1.16)
dhigh	-9.17 **	-8.89 **	6.63 **	1.52 *	-2.99 **	-1.69 *	3.72 **	0.45
	(-13.37)	(-12.74)	(9.44)	(2.25)	(-3.97)	(-2.40)	(3.94)	(0.47)
dlow	3.80 **	3.93 **	-1.80 *	-0.01	10.03 **	2.91 **	0.94 **	2.96 *
	(5.51)	(5.39)	(-2.24)	(-0.01)	(13.17)	(3.88)	(9.94)	(2.91)
R2	0.07	0.07	0.09	0.07	0.35	0.29	0.28	0.22
N	8,018	6,968	7,693	6,655	8,106	6,751	7,693	6,397
Panel C: Mean Values for Low M/B Portfolio								
Hot	3.57	2.06	1.43	2.34	14.51	2.17	15.64	4.46
Cold	2.41	0.27	1.67	0.59	13.55	1.48	15.30	2.10
t-value (difference)	(1.67)	(2.23) **	(0.27)	(2.24) **	(1.25)	(1.52)	(0.31)	(2.66) **
Panel D: Regression Analysis for Low M/B Portfolio								
HOT	1.60	1.73	-0.87	1.96 *	1.52	0.36	0.27	2.47 *
	(1.87)	(1.80)	(-0.81)	(2.25)	(1.94)	(0.72)	(0.23)	(2.50)
Markett	-2.10 *	-1.41	0.38	-0.63	-2.01 *	-0.18	-1.62	-0.85
	(-2.67)	(-1.53)	(0.38)	(-0.74)	(-2.75)	(-0.37)	(-1.43)	(-0.89)
M/Bt-1	-1.86	-3.31 *	6.84	-1.58	3.39	3.03 **	10.24 *	1.54
	(-0.66)	(-2.82)	(1.86)	(-1.52)	(1.28)	(4.92)	(2.47)	(1.31)
EBITDA/At-1	-6.87	1.08	-8.55	-0.94	-9.56 *	-0.72	-18.11 *	-1.71 *
	(-1.77)	(0.45)	(-1.70)	(-0.44)	(-2.65)	(-0.57)	(-3.19)	(-2.34)
SIZEt-1	-0.11	-0.11	-0.35	-0.05	-1.16 **	-0.61 **	-1.49 **	-0.71
	(-0.46)	(-0.37)	(-1.12)	(-0.18)	(-5.07)	(-3.93)	(-4.22)	(-2.34)
PPE/At-1	-3.13	-4.41	2.74	2.57	-7.81 **	5.35 **	-4.43	8.27 *
	(-1.46)	(-1.65)	(1.00)	(1.05)	(-3.95)	(3.81)	(-1.43)	(2.98)
R&D/At-1	-1.79	16.81	-6.06	-0.18	29.94 *	12.04	25.61	14.24
	(-0.18)	(1.42)	(-0.48)	(-0.02)	(3.17)	(1.92)	(1.79)	(1.19)
RDDt-1	-1.57	-1.06	0.17	0.74	-1.05	0.67	-0.76	2.23
	(-1.37)	(-0.76)	(0.12)	(0.58)	(-0.98)	(0.90)	(-0.47)	(1.52)
dhigh	-6.72 **	-7.49 **	15.79 **	0.38	-2.99	-0.39	13.18 **	-0.43
	(-3.45)	(-3.38)	(6.27)	(0.19)	(-1.64)	(-0.32)	(4.63)	(-0.18)
dlow	1.79	8.43 *	1.88	0.10	9.10 **	2.03	8.48	1.65
	(0.65)	(2.50)	(0.53)	(0.03)	(3.56)	(1.11)	(2.11)	(0.45)
R2	0.34	0.23	0.26	0.25	0.33	0.25	0.34	0.26
N	1,101	885	1,045	841	1,119	865	1,045	815

Y_t	ΔBook Leverage D/At - D/At-1		Net Debt Issues d/At		NetSEO Issues e/At		(e+d)/At	
t	SEO+1	SEO+2	SEO+1	SEO+2	SEO+1	SEO+2	SEO+1	SEO+2
				Panel E: Mean Values for Med M/B Portfolio				
Hot	2.34	1.49	0.84	4.05	17.31	3.28	18.23	7.39
Cold	0.78	-0.12	3.05	2.48	12.42	3.40	15.40	5.94
t-value (difference)	(3.72) **	(4.00) **	(4.62) **	(3.61) **	(11.75) **	(0.36)	(4.81) **	(2.70) *
				Panel F: Regression Analysis for Med M/B Portfolio				
HOT	1.44 *	1.00	-1.52 *	2.06 **	0.97	-1.04 **	-0.47	1.05
	(2.85)	(2.19)	(-2.69)	(4.20)	(2.20)	(-3.05)	(-0.71)	(1.81)
Markett	-0.57	-0.36	-0.44	-0.07	-1.14 *	0.09	-1.63 *	-0.10
	(-1.26)	(-0.81)	(-0.87)	(-0.14)	(-2.83)	(0.26)	(-2.69)	(-0.18)
M/Bt-1	-0.90	-1.45	-0.96	-0.15	8.40 **	4.61 **	7.42 **	4.17 **
	(-0.95)	(-3.55)	(-0.91)	(-0.33)	(10.18)	(14.97)	(5.98)	(7.85)
EBITDA/At-1	-1.59	-7.57	-11.64 **	-8.03 **	-6.73 **	-16.96 **	-18.67 **	-25.17 **
	(-0.73)	(-3.40)	(-4.81)	(-3.32)	(-3.52)	(-10.12)	(-6.55)	(-8.62)
SIZEt-1	-0.69 **	-0.14	0.29	0.04	-1.89 **	-0.36 *	-1.59 **	-0.33
	(-4.66)	(-0.92)	(1.75)	(0.23)	(-14.48)	(-3.27)	(-8.12)	(-1.72)
PPE/At-1	-2.12	-1.35	-1.53	4.46 *	-4.69 **	-0.76	-6.51 **	3.82
	(-1.51)	(-0.97)	(-0.97)	(2.97)	(-3.81)	(-0.72)	(-3.51)	(2.11)
R&D/At-1	0.42	-9.02	-6.00	-13.16 *	-3.25	2.13	-8.56	-11.09
	(0.11)	(-2.17)	(-1.43)	(-2.97)	(-0.97)	(0.67)	(-1.73)	(-2.08)
RDDt-1	0.49	-1.03	0.73	0.22	-0.66	0.24	0.09	0.19
	(0.79)	(-1.70)	(1.05)	(0.33)	(-1.22)	(0.52)	(0.11)	(0.24)
dhigh	-6.73 **	-5.51	5.42 **	2.14 *	-1.44	-0.91	3.67 *	1.78
	(-7.67)	(-6.29)	(5.55)	(2.30)	(-1.88)	(-1.36)	(3.20)	(1.56)
dlow	6.25 **	0.92	0.63	-1.22	12.24 **	1.76	12.99 **	0.63
	(4.55)	(0.62)	(0.41)	(-0.77)	(10.15)	(1.57)	(7.14)	(0.34)
R2	0.10	0.1	0.16	0.12	0.33	0.26	0.23	0.18
N	3,241	2,846	3,096	2,714	3,271	2,768	3,096	2,618
				Panel G: Mean Values for High M/B Portfolio				
Hot	1.95	2.27	-0.69	3.17	27.71	9.06	27.06	12.39
Cold	0.63	0.46	1.36	4.59	18.60	7.12	19.87	11.74
t-value (difference)	(3.04) **	(4.10) **	(5.41) **	(3.53) **	(14.72) **	(3.07) **	(10.35) **	(0.88)
				Panel H: Regression Analysis for High M/B Portfolio				
HOT	1.87 **	1.62 **	-1.56 **	-0.32	3.41 **	-2.92 **	1.97 *	-2.98 **
	(3.80)	(3.40)	(-3.66)	(-0.75)	(5.56)	(-5.10)	(2.89)	(-4.29)
Markett	-2.09 **	-0.82	-0.33	-0.26	-1.83 *	-1.29 *	-1.89 *	-1.36
	(-4.40)	(-1.77)	(-0.79)	(-0.61)	(-3.08)	(-2.30)	(-2.86)	(-2.01)
M/Bt-1	-0.36 *	-0.45 *	-0.06	-0.76 **	1.20 **	3.00 **	1.05 **	2.22 **
	(-2.32)	(-2.82)	(-0.43)	(-5.25)	(6.18)	(15.40)	(4.91)	(9.51)
EBITDA/At-1	-4.80 **	-5.20 **	-12.19 **	-6.70 **	-22.12 *	-32.88 **	-35.02 **	-39.83 **
	(-3.29)	(-3.33)	(-9.75)	(-4.77)	(-12.16)	(-17.52)	(-17.45)	(-17.60)
SIZEt-1	-0.52 **	-0.17	0.44	0.21	-2.33 **	-0.96 **	-1.83 **	-0.80 **
	(-3.28)	(-1.01)	(3.24)	(1.40)	(-11.77)	(-4.79)	(-8.34)	(-3.28)
PPE/At-1	0.22	-2.16	0.04	5.11 **	-14.91 **	-3.64	-15.60 **	1.11
	(0.15)	(-1.37)	(0.03)	(3.59)	(-7.81)	(-1.92)	(-7.34)	(0.49)
R&D/At-1	-6.92 *	-8.61 **	-6.42 *	-8.98 **	-20.67 **	-6.86 *	-27.07 **	-15.29 **
	(-2.90)	(-3.43)	(-3.16)	(-3.99)	(-7.02)	(-2.26)	(-8.31)	(-4.21)
RDDt-1	0.15	-0.73	0.09	0.28	1.25	0.09	1.63	0.69
	(0.23)	(-1.05)	(0.16)	(0.44)	(1.48)	(0.11)	(1.74)	(0.70)
dhigh	-17.13 **	-15.45 **	2.86 *	1.64	-3.55	-4.04 *	0.02	-1.18
	(-11.81)	(-10.81)	(2.30)	(1.28)	(-1.97)	(-2.38)	(0.01)	(-0.58)
dlow	2.76 *	3.61 **	-0.98	0.12	8.46 **	2.77 *	7.65 **	3.07 *
	(3.13)	(3.91)	(-1.28)	(0.15)	(7.62)	(2.43)	(6.26)	(2.24)
R2	0.11	0.11	0.12	0.14	0.35	0.35	0.34	0.30
N	3,676	3,237	3,552	3,100	3,716	3,118	3,552	2,964

after making a large SEO issue. The same general results hold for low, medium and high M/B firms, indicating an overall trend of an active return to the target leverage level. The regression results of Panel B, D, F, and G offer no support for the transaction cost model. Similarly, the mean values given in Panels A, C, E, and F show hot-market firms increasing leverage faster than cold-market firms.

The results of Table 4.8 are consistent with the firm characteristics shown in Table 4.2. Comparing low and high M/B firms in Table 4.2, it can be seen that high M/B firms, who issue the highest level of seasoned equity, subsequently greatly reduce their equity issuance level, reduce cash levels, and increase tangible asset levels. These behaviors are consistent with an active return to a target leverage level, thereby contradicting the transaction cost theory.

While consistent with the dynamic trade-off theory, the observed financing patterns might also reflect pecking order choices. Under pecking order theory, there should be a positive relationship between financial deficits and issuance of debt because firms have insufficient earnings to finance investment. As well, the pecking order theory implies a slow return to a target leverage level because capital issuance is driven by retained earnings being too low to finance investment, and so a target leverage level is of little importance. However, the pecking order argument is contradicted by there being no difference in earnings in the SEO issuing year and persistently lower investment in all years (Table 4.4), and the rapid reversion to a target leverage level (Table 4.6). Thus, the observed variation in capital structure cannot be explained by the pecking order theory.

4. 5 11-Year Window Sample: The Impact of Market-to-Book Portfolio Formation

The following sections examine the effects of cyclical variation in the market-to-book ratio upon the market timing behavior of firms. The data set is organized around a sort on the market-to-book ratio, creating an 11-year window that captures the mean reversion cycle of the market-to-book ratio. Under the interpretation that the market-to-book ratio representes future growth opportunities, this 11-year window reflects the changing expectations for growth. This alternative dataset includes many observations outside of the previous SEO event window, thereby providing a broader perspective of the market that includes both issuers and non-issuers of seasoned equity. Empirical research in asset pricing shows that the book-to-market equity ratio[8], BE / ME, is time varying and mean reverting. Furthermore, following portfolio formation upon the BE / ME equity, the returns of low BE / ME portfolios provide greater returns than for high BE / ME portfolios, a phenomenon known as the book-to-market effect (also known as the value effect). Since the M / B market-to-book firm valuation ratio[9] used in corporate finance research is closely related to the BE / ME equity ratio used in asset pricing research, forming portfolios upon the M / B ratio creates a natural experiment to examine if there are portfolio formation effects upon leverage and market timing.

In the previous sections, the data sample was restricted to observations within the SEO event windows, where dataset was organized in SEO time. That dataset enabled a

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[8] The book-to-market equity ratio BE / ME is defined as book equity (common shares times book price) divided by the market equity (common shares times market price).

[9] The market to book ratio M / B used in this paper is defined as book debt plus market equity (common shares times market share price) divided by total book assets

focus on the time adjacent to the SEO issue event. The HOT market dummy of Alti (2006) is used to represent market timing events. Alti argues that the HOT dummy is orthogonal to the traditional M / B market-to-book proxy for market timing. Alti (2006) examines IPO data, and the claim of orthogonality is based upon there being little impact upon the HOT dummy by the presence or absence of the M / B control variable in regression results. In this paper, which examines SEO data, the M / B variable has greater influence, as evidenced by the observable effect of the absence of the M / B_t control variable upon the HOT coefficient (see Table 4.6) and also by the marked differences between HOT coefficients in low and high M / B portfolio sub samples. In this section, organizing the dataset in a window around portfolio formation on the market-to-book ratio allows a direct examination of the influence of the market-to-book ratio.

4.5.1 Sample and Summary Characteristics

The dataset for the window around portfolio formation on the BE/ME ratio uses the Compustat dataset as before, with annual observations for the period from 1971 to 2005. Again, financial firms, observations with asset value below $10 million, and observations with an M / B ratio greater than ten are excluded. The annual data observations in the sample are then segmented into three book-to-market groups based on the breakpoints for the bottom 30 percent (Low), middle 40 percent (Medium), and top 30 percent (High) of the ranked values of M / B at fiscal yearend. In order to compare apples to apples, the dataset includes only those firms for which Compustat provides debt values in all eleven years of the interval. The requirement for data in all eleven years minimizes distortions due to IPO effects and delistings.

Table 4.9 shows the construction of the 11-year window dataset using the exclusions and conditions described above. The resultant dataset has 49,973 market-to-book observations, and the associated data window has 474,199 firm-year observations.

Table 4.9
11-Year Window Dataset

	Data Filter	Firm-Year Observations
1	Compustat observations 1971 to 2005	640,825
2	Exclude financial firms (SIC codes 6000 to 6999)	515,542
3	Exclude observations with book assets < $10 million	172,771
4	Exclude outliers with M/B ratio > 10	171,847
5	Exclude distressed firms with book leverage ratio D/A > 1	162,962
7	Restrict sample to SEO events at t_0	138,450
6	Require book leverage data in lags t_{-1} and t_{-2}	49,973
8	Observations in event window from t_{-5} to t_{+5}	474,199

This method of creating an 11-year data window results in individual data observations being used in the data window up to eleven times. The overlapping intervals have the potential to induce bias, lagged correlation between the dependent and independent variables, and heteroskedasticity in the residuals. As a robustness check, a bootstrap method similar to that of Titman and Kayhan (2006) is used to verify the values and statistical significance of the estimated coefficients. The bootstrapping results are similar to those obtained by the OLS regressions presented below in Tables 4.11 to 4.14. For brevity, the bootstrapping results are omitted here.

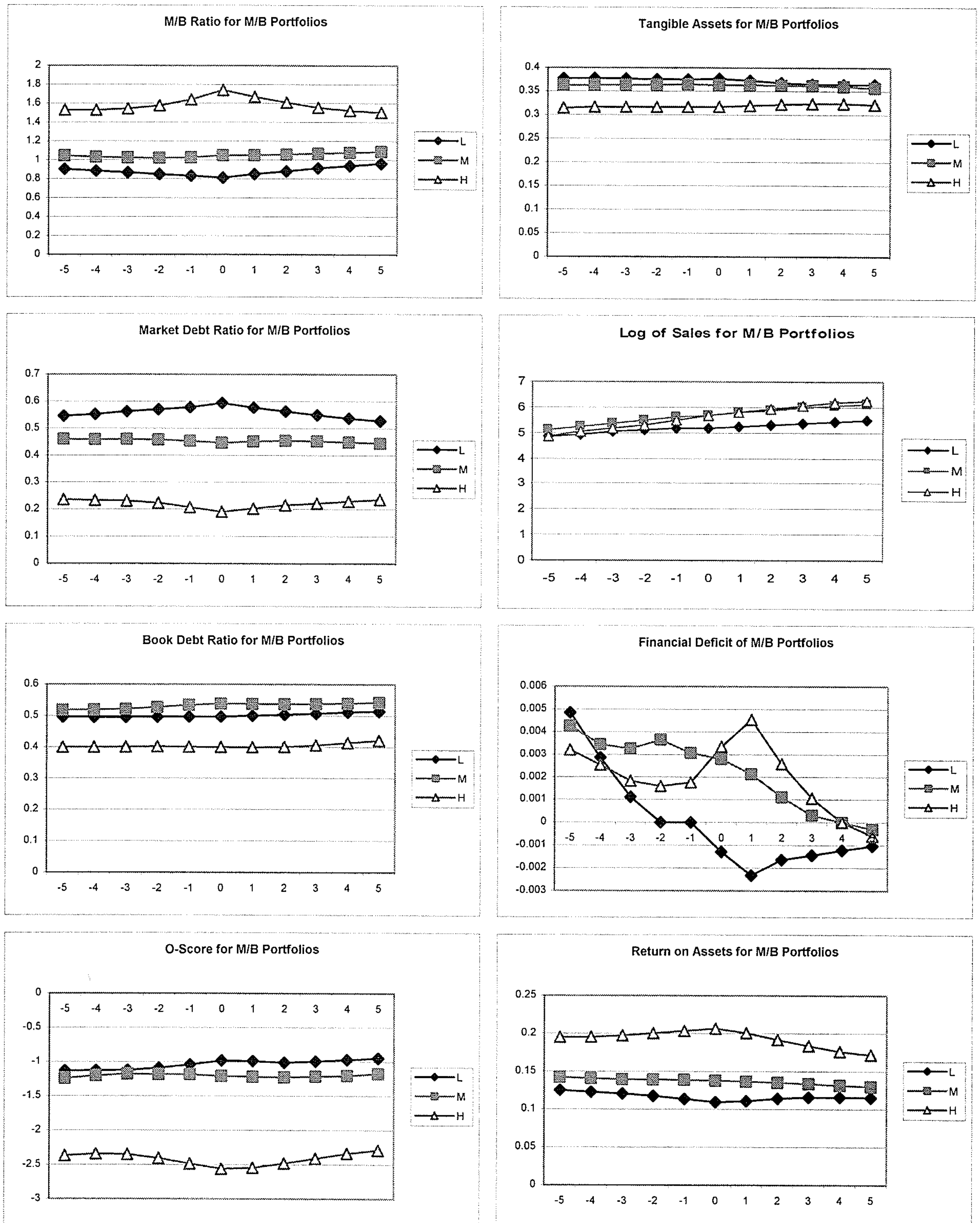

Figure 4.4. Summary of Median Characteristics for M/B Portfolios.
This figure shows changes in median financial ratios for the three M/B groups for the 11-year interval surrounding the ranking year. The sample consists of NYSE, AMEX, and Nasdaq firms from 1971 to 2005, which are ranked according to their M/B ratio at the end of the fiscal year. The data sample includes only those firms with Compustat reported total asset values for all eleven years in the interval.

Table 4.10

Summary Statistics of Firm Characteristics for the 11-Year Dataset

This table reports the means and standard deviations of firm characteristics in the period surrounding portfolio formation on the market-to-ratio. All variables except M / B and $SIZE$ are in percentage terms. Book leverage, D / A, is the ratio of book debt to total book assets. Market-to-book ratio, M / B, is book debt plus market value of equity divided by total book assets. Net debt issues, d / A, is the change in book debt. Net equity issues, e / A, is the change in book equity minus the earnings before interest, taxes, and depreciation. $SIZE$ is the logarithm of net sales in millions of 2000 dollars. Tangible assets, PPE / A, is net plant, property and equipment. $R\&D / A$ is research and development expense. INV / A is capital expenditures. DIV / E is common dividends divided by year-end book equity. $CASH / A$ is cash and short-term equivalents. The variables d / A, e / A, $R\&D / A$, INV / A, DIV / E, and $CASH / A$ are normalized by fiscal year-end total book assets. The sample consists of firm-year observations between 1971 and 2005. The sample excludes financial firms, firms that have less than $10 million in assets, and firms with a debt ratio greater than one.

	N	D/A	M/B	d/A	e/A	ΔRE/	EBITDA/	SIZE	PPE/A	R&D/	INV/A	DIV/E	CASH/A
						Panel A: Full Sample							
t - 5	49,973	48.47	1.39	2.46	2.66	2.33	14.51	5.99	42.22	1.72	8.14	3.65	9.62
		(18.86	(0.93)	(142.8	(9.43)	(10.03	(9.93)	(1.85	(25.76)	(4.11)	(6.93)	(17.48	(12.94)
t - 4	49,973	48.15	1.37	2.57	2.82	2.34	14.38	6.05	42.16	1.74	8.02	3.57	9.48
		(18.62	(0.89)	(134.7	(10.34)	(10.41	(9.70)	(1.83	(25.59)	(4.15)	(6.59)	(15.69	(12.70)
t - 3	49,973	48.22	1.35	2.57	2.28	2.22	14.27	6.10	42.07	1.76	7.91	3.49	9.29
		(18.50	(0.86)	(133.7	(9.84)	(10.65	(9.79)	(1.82	(25.43)	(4.20)	(6.44)	(11.30	(12.48)
t - 2	49,973	48.31	1.35	2.33	2.12	2.10	14.16	6.15	41.95	1.78	7.80	3.47	9.21
		(18.41	(0.84)	(133.7	(10.59)	(10.98	(9.64)	(1.81	(25.30)	(4.33)	(6.37)	(7.94)	(12.42)
t - 1	49,973	48.34	1.36	2.04	2.04	2.04	14.08	6.19	41.76	1.77	7.66	3.50	9.18
		(18.27	(0.86)	(133.9	(10.72)	(10.93	(9.48)	(1.81	(25.19)	(4.28)	(6.27)	(8.25)	(12.42)
t	49,973	48.47	1.37	2.13	2.06	1.93	14.01	6.23	41.46	1.80	7.58	3.53	9.12
		(18.17	(0.86)	(134.0	(11.75)	(12.33	(9.44)	(1.81	(25.12)	(4.38)	(6.23)	(8.92)	(12.48)
t + 1	49,973	48.47	1.37	2.13	1.84	1.93	14.01	6.23	41.32	1.82	7.49	3.56	9.03
		(18.17	(0.86)	(134.0	(9.30)	(12.33	(9.44)	(1.81	(25.04)	(4.48)	(6.15)	(9.20)	(12.47)
t + 2	49,973	48.65	1.37	2.32	1.76	1.80	13.74	6.27	41.14	1.85	7.33	3.57	9.01
		(18.13	(0.84)	(133.1	(9.76)	(11.27	(9.33)	(1.81	(24.99)	(4.64)	(6.04)	(9.72)	(12.54)
t + 3	49,973	48.88	1.37	2.14	1.76	1.49	13.43	6.31	40.90	1.85	7.15	3.62	9.02
		(18.22	(0.83)	(133.1	(9.50)	(12.20	(9.41)	(1.81	(24.94)	(4.53)	(5.94)	(15.02	(12.61)
t + 4	49,973	49.09	1.38	1.79	1.75	1.26	13.13	6.33	40.60	1.87	6.94	3.72	9.06
		(18.39	(0.83)	(133.2	(9.56)	(11.76	(9.38)	(1.81	(24.91)	(4.64)	(5.83)	(30.32	(12.67)
t + 5	49,973	49.32	1.39	1.70	1.63	0.95	12.82	6.36	40.19	1.89	6.72	3.80	9.13
		(18.63	(0.83)	(124.9	(9.55)	(12.23	(9.57)	(1.82	(24.90)	(4.79)	(5.66)	(32.13	(12.77)
						Panel B: Low market-to-book							
t - 5	14,588	49.11	1.07	-0.39	2.53	1.71	12.25	5.79	43.15	1.08	7.74	2.88	8.40
		(18.58	(0.56)	(258.2	(8.59)	(9.59)	(8.18)	(1.79	(26.55)	(2.90)	(6.94)	(16.10	(11.81)
t - 4	14,588	48.62	1.03	-0.21	2.72	1.75	11.94	5.84	43.00	1.08	7.52	2.56	8.30
		(18.15	(0.49)	(246.3	(9.53)	(9.87)	(7.83)	(1.78	(26.36)	(2.86)	(6.48)	(4.26)	(11.72)
t - 3	14,588	48.54	0.99	0.44	2.08	1.58	11.65	5.87	42.85	1.08	7.27	2.55	8.07
		(17.85	(0.42)	(230.3	(9.16)	(10.28	(7.60)	(1.78	(26.19)	(2.91)	(6.08)	(6.89)	(11.50)
t - 2	14,588	48.39	0.95	-0.17	1.75	1.35	11.16	5.89	42.73	1.10	7.02	2.43	7.94
		(17.58	(0.34)	(230.0	(8.34)	(9.71)	(7.46)	(1.78	(25.99)	(2.96)	(5.85)	(4.51)	(11.36)
t - 1	14,588	48.31	0.91	-1.50	1.35	0.94	10.51	5.89	42.60	1.10	6.74	2.31	7.84
		(17.38	(0.27)	(245.8	(8.76)	(9.73)	(8.15)	(1.79	(25.81)	(3.00)	(5.70)	(3.62)	(11.32)
t	14,588	48.47	0.85	-2.04	0.84	0.29	9.87	5.88	42.44	1.13	6.40	2.23	7.79
		(17.21	(0.14)	(246.2	(12.02)	(14.09	(8.49)	(1.80	(25.68)	(3.06)	(5.49)	(5.68)	(11.38)
t + 1	14,588	48.47	0.85	-2.04	0.49	0.29	9.87	5.88	42.10	1.15	6.17	2.25	7.85
		(17.21	(0.14)	(246.2	(8.38)	(14.09	(8.49)	(1.80	(25.58)	(3.12)	(5.35)	(5.04)	(11.43)
t + 2	14,588	49.28	0.91	-0.38	0.80	-0.19	10.00	5.88	41.67	1.17	6.25	2.28	8.04
		(17.39	(0.26)	(229.6	(10.84)	(13.59	(7.96)	(1.81	(25.50)	(3.20)	(5.49)	(5.68)	(11.58)
t + 3	14,588	49.80	0.96	-1.16	1.06	0.21	10.35	5.90	41.30	1.18	6.32	2.34	8.16
		(17.60	(0.34)	(245.3	(10.34)	(15.12	(8.06)	(1.81	(25.43)	(3.21)	(5.65)	(8.45)	(11.81)
t + 4	14,588	50.18	1.01	-1.19	1.13	0.28	10.45	5.91	40.94	1.21	6.29	2.36	8.23
		(17.90	(0.38)	(245.3	(10.41)	(14.60	(8.18)	(1.81	(25.32)	(3.49)	(5.61)	(9.49)	(12.00)
t + 5	14,588	50.54	1.05	-0.68	1.26	0.25	10.41	5.92	40.58	1.22	6.17	2.43	8.35
		(18.27	(0.43)	(229.9	(10.69)	(14.83	(8.38)	(1.81	(25.29)	(3.59)	(5.46)	(10.07	(12.20)

	N	D/A	M/B	d/A	e/A	ΔRE/	EBITDA/	SIZE	PPE/A	R&D/	INV/A	DIV/E	CASH/A
					Panel C: Medium market-to-book								
t - 5	19,416	50.54	1.28	3.54	2.42	2.29	14.38	6.10	41.13	1.60	8.17	3.51	8.84
		(18.79	(0.70)	(40.16	(8.76)	(9.41)	(8.80)	(1.83	(24.82)	(3.53)	(6.92)	(18.33	(11.46)
t - 4	19,416	50.39	1.27	3.69	2.54	2.28	14.20	6.16	41.09	1.62	8.08	3.48	8.67
		(18.64	(0.64)	(30.49	(9.93)	(9.82)	(8.47)	(1.81	(24.69)	(3.73)	(6.61)	(19.14	(11.28)
t - 3	19,416	50.63	1.25	3.77	2.07	2.16	14.05	6.22	41.00	1.63	8.01	3.29	8.49
		(18.55	(0.59)	(20.54	(8.87)	(9.14)	(8.72)	(1.80	(24.56)	(3.67)	(6.59)	(9.13)	(11.12)
t - 2	19,416	50.98	1.24	3.83	1.92	2.04	13.96	6.27	40.88	1.64	7.93	3.33	8.37
		(18.49	(0.52)	(20.94	(11.24)	(10.31	(8.42)	(1.79	(24.48)	(3.61)	(6.63)	(9.08)	(11.14)
t - 1	19,416	51.28	1.23	3.79	1.90	2.08	13.95	6.32	40.73	1.62	7.82	3.33	8.30
		(18.27	(0.44)	(19.14	(10.62)	(9.45)	(7.40)	(1.79	(24.43)	(3.49)	(6.55)	(7.43)	(11.11)
t	19,416	51.76	1.20	3.92	1.82	1.92	13.82	6.37	40.47	1.65	7.78	3.32	8.12
		(18.08	(0.26)	(21.37	(9.61)	(9.73)	(7.17)	(1.78	(24.40)	(3.70)	(6.39)	(6.94)	(10.96)
t + 1	19,416	51.76	1.20	3.92	1.78	1.92	13.82	6.37	40.32	1.67	7.67	3.34	8.05
		(18.08	(0.26)	(21.37	(7.85)	(9.73)	(7.17)	(1.78	(24.33)	(3.77)	(6.21)	(7.81)	(11.04)
t + 2	19,416	51.71	1.24	2.65	1.85	1.93	13.60	6.42	40.15	1.68	7.47	3.38	8.08
		(17.86	(0.43)	(76.57	(7.76)	(9.06)	(7.55)	(1.78	(24.31)	(3.88)	(6.13)	(10.62	(11.29)
t + 3	19,416	51.76	1.26	3.16	1.79	1.61	13.35	6.45	39.91	1.69	7.30	3.41	8.13
		(17.86	(0.51)	(16.33	(7.79)	(8.64)	(7.79)	(1.78	(24.26)	(3.89)	(6.06)	(20.03	(11.41)
t + 4	19,416	51.85	1.28	2.75	1.84	1.31	13.00	6.48	39.60	1.71	7.04	3.62	8.23
		(17.95	(0.56)	(17.40	(8.57)	(8.71)	(8.08)	(1.79	(24.26)	(4.04)	(5.97)	(46.50	(11.48)
t + 5	19,416	51.91	1.30	2.31	1.69	0.93	12.70	6.50	39.16	1.73	6.78	3.71	8.34
		(18.20	(0.58)	(17.81	(8.14)	(10.38	(8.52)	(1.80	(24.26)	(4.43)	(5.81)	(49.35	(11.62)
					Panel D: High market-to0book								
t - 5	11,173	41.38	2.01	4.30	3.72	3.70	17.92	5.72	32.87	3.36	8.57	3.90	15.11
		(18.91	(1.32)	(14.78	(12.70)	(12.91	(13.50)	(1.92	(19.08)	(6.18)	(7.23)	(11.78	(16.58)
t - 4	11,173	41.01	2.01	4.31	3.96	3.70	18.03	5.82	33.02	3.42	8.55	3.97	14.97
		(18.56	(1.28)	(14.50	(13.29)	(13.25	(13.23)	(1.88	(19.00)	(6.13)	(6.91)	(11.60	(16.08)
t - 3	11,173	41.06	2.02	4.28	3.29	3.70	18.21	5.92	33.12	3.49	8.55	3.86	14.81
		(18.51	(1.24)	(15.08	(13.28)	(14.34	(13.24)	(1.87	(19.02)	(6.29)	(6.80)	(7.34)	(15.74)
t - 2	11,173	40.98	2.07	4.05	3.29	3.77	18.53	6.01	33.14	3.55	8.55	4.02	14.84
		(18.40	(1.22)	(15.79	(13.41)	(14.49	(12.93)	(1.86	(19.04)	(6.68)	(6.71)	(9.59)	(15.58)
t - 1	11,173	40.63	2.20	3.74	3.55	3.98	19.00	6.10	33.03	3.54	8.55	4.26	14.95
		(18.16	(1.25)	(21.00	(14.21)	(15.14	(12.54)	(1.85	(19.08)	(6.62)	(6.57)	(12.96	(15.58)
t	11,173	40.16	2.35	4.64	4.42	4.59	19.70	6.22	32.75	3.56	8.74	4.43	15.06
		(17.88	(1.21)	(15.58	(15.58)	(14.83	(11.80)	(1.82	(19.21)	(6.66)	(6.83)	(14.10	(15.77)
t + 1	11,173	40.16	2.35	4.64	4.01	4.59	19.70	6.22	33.01	3.62	8.90	4.44	14.68
		(17.88	(1.21)	(15.58	(12.80)	(14.83	(11.80)	(1.82	(19.46)	(6.83)	(6.93)	(14.20	(15.74)
t + 2	11,173	40.06	2.20	5.50	3.16	4.53	18.67	6.31	33.28	3.69	8.45	4.41	14.24
		(17.86	(1.21)	(11.68	(12.19)	(12.56	(11.97)	(1.81	(19.68)	(7.16)	(6.60)	(12.16	(15.66)
t + 3	11,173	40.41	2.09	4.82	2.93	3.20	17.29	6.38	33.30	3.67	7.89	4.47	14.07
		(18.14	(1.18)	(11.65	(11.91)	(14.81	(12.49)	(1.81	(19.90)	(6.81)	(6.26)	(13.51	(15.63)
t + 4	11,173	40.69	2.04	3.95	2.72	2.58	16.43	6.44	33.17	3.67	7.48	4.46	13.99
		(18.40	(1.19)	(13.94	(11.19)	(13.86	(12.19)	(1.81	(20.08)	(6.81)	(6.03)	(13.85	(15.56)
t + 5	11,173	41.13	2.00	3.58	2.28	1.91	15.68	6.49	32.85	3.69	7.12	4.51	13.96
		(18.72	(1.17)	(14.09	(11.41)	(13.38	(12.32)	(1.82	(20.21)	(6.78)	(5.86)	(14.06	(15.56)

The median characteristics for the dataset are shown in plot form in Figure 4.4. Figure 4.4 confirms that the market-to-book ratio for firms is time varying and mean reverting. This raises the question of how this variation influences capital structure. In response to this question, this section examines how market timing effects are influenced by variation in the market-to-book ratio.

Table 4.10 summarizes firm characteristics of the data in the 11-year interval around portfolio formation on the market-to-book ratio. All variables except M/B and SIZE are shown in percentage terms. The year t is defined as the year in which the portfolio formation takes place. Year $t+k$ is the kth fiscal year after portfolio formation. Table 4.10 shows that the market-to-book ratio is essentially constant for the overall sample, but that the M/B ratio increases (decreases) before portfolio formation and decreases (increases) afterwards for high (low) market-to-book portfolios, in keeping with Figure 4.4.

4.5.2 The Influence of Market-to-Book on Market Timing Effects

Forming portfolios on the market-to-book ratio provides several advantages for examining the influence of market timing. First, sorting on the market-to-book ratio controls for influences on capital structure that are associated with the market-to-book ratio but unrelated to market timing, such as the influence of future growth opportunities. Second, the alternative dataset includes observations outside the SEO event window used in the first dataset, thereby allowing a comparison between hot-market issuers of seasoned equity with other firms who are non-issuers of seasoned equity[10]. Third, the influence of dynamic variation of the market-to-book ratio upon market timing effects can be observed.

[10] The sample includes observations for cold-market issuers of seasoned equity, but the influence of non-issuers is predominant due to larger numbers of observations for non-issuers. The inclusion of the cold-market observations produces conservative regression results, since statistical significance for hot-market firms must overcome the opposing influence of cold-market observations.

In order to examine how leverage varies in the 11-year window surrounding portfolio formation in fiscal year t_0, from t_{-5} to t_{+5}, the following regression is estimated in Table 4.11:

$$D/A_t = c_0 + c_1 HOT + c_2 HOT_{t-1} + c_3 HOT_{t-2} + c_4 Market_t + c_5 M/B_{t-1} \\ + c_6 EBITDA/A_{t-1} + c_7 SIZE_{t-1} + c_8 PPE/A_{t-1} + c_9 R\&D/A_{t-1} + c_{10} RDD_{t-1} + e_t \tag{1.7}$$

where t is the year in the window, and the regression is run in the cross-section of window years. The dependent variable is the book leverage level, D/A_t. The explanatory variables are the same as previously defined, except that the HOT_t market timing dummy now has a time subscript to denote its time relative to the current cross section year (cross sections t_{-5} to t_{+5}). The HOT_t dummy refers to the current cross section year, while HOT_{t-1} and HOT_{t-2} refer to prior (or lagged) years. As previously, the control variables are a market dummy variable to control for general market conditions that is assigned a value of one if the volume of SEO issues is above the long-term median, the market-to-book ratio, profitability normalized by assets, the logarithm of size, physical plant and equipment expenditure normalized by assets, research and development expense normalized by assets, and a dummy for missing research and development expense data.

Panel B of Table 4.11 gives the results for the overall dataset, prior to sorting in to low, medium, and high portfolios. The results of Panel B show that the HOT_t market timing dummy is significant and negative in the years preceding and including the year of portfolio formation, at the 1% and 5% confidence levels respectively, but the lagged values of the market timing dummy become insignificant in the years following the SEO event. The lagged market timing dummies HOT_{t-1} and HOT_{t-2} capture the leverage effects of hot-market SEOs one and two years prior to the current cross-sectional regression, and show that the leverage level of hot-market firms becomes insignificantly different from other firms within two years after the SEO event.

Panels C to H of Table 4.11 give the results for the sub portfolios sorted on M/B. For the low and medium portfolios, the HOT_t, HOT_{t-1}, and HOT_{t-2} dummies are generally insignificant in all years in the data window. However, the HOT_t dummy for the high M/B portfolio are highly significant at the 1% confidence level in years prior to and including the year of portfolio formation year, and then become insignificant within one year thereafter. The results for the high market-to-book portfolio in Panel H are the source of the statistical significance seen for the overall dataset in Panel B. The magnitudes of coefficients for current year HOT_t dummy, and the lagged HOT_{t-1} and HOT_{t-2} dummies are of similar magnitude in the years preceding and including the year of portfolio formation, indicating that market timing effects are persistent during this period, but the magnitudes of the coefficients decline thereafter and become insignificant.

Panel H of Table 4.11 shows that high M/B firms that issue an SEO in a hot-market display significant market timing effects in the form of reduced book leverage levels, as evidenced by the HOT_t dummy, in the years up to and including the year of portfolio formation, with this market timing effect becoming insignificant within three years thereafter. This pattern suggest that increases in the M/B ratio above the mean induce market timing by firms, but the market timing effect subsequently fades as the M/B ratio reverts to the mean. The observed behavior has an asymmetric characteristic, insofar as hot-market firms exhibit book leverage levels below the mean when the

Table 4.11
Persistence of Market Timing Effects for M/B Portfolios

For the leverage ratio D / A_t, Panel A shows the mean value for hot-market and other firms and the t-value of their difference. The time subscript t denotes the year relative to portfolio formation. Panel B reports the regression:

$$D / A_t = c_0 + c_1 HOT + c_2 HOT_{t-1} + c_3 HOT_{t-2} + c_4 Market_t + c_5 M/B_{t-1} + c_6 EBITDA/A_{t-1} + c_7 SIZE_{t-1} + c_8 PPE/A_{t-1} + c_9 R\&D/A_{t-1} + c_{10} RDD_{t-1} + e_t$$

Constant and SIC dummies are suppressed. Robust t-statistics are shown in parentheses. Coefficients marked ** and * are significant at 1% and 5% confidence intervals, respectively.

	Book Leverage D/A_t						
t	*t-5*	*t-3*	*t-1*	*t0*	*t+1*	*t+3*	*t+5*
	Panel A: Mean Values for Full Sample						
Hot	41.19	40.70	42.74	43.04	43.88	46.09	47.65
Other	47.61	47.36	47.54	47.79	48.06	48.57	49.28
t-value (difference)	(14.66) **	(14.70) **	(10.14) **	(10.14) **	(8.58) **	(4.98) **	(3.23) *
	Panel B: Regression Analysis for Full Sample						
HOT_t	-1.52 **	-1.93 **	-1.23 **	-0.96 *	-0.61	0.28	0.55
	(-3.26)	(-4.83)	(-2.99)	(-2.35)	(-1.45)	(0.66)	(1.26)
HOT_{t-1}	0.15	-0.61	-0.73	-0.24	-0.45	0.59	0.86
	(0.36)	(-1.71)	(-1.77)	(0.59)	(-1.12)	(1.36)	(1.97)
HOT_{t-2}	-0.11	-0.63	-1.30 **	-0.55	-0.55	-0.15	0.69
	(-0.26)	(-1.74)	(-3.36)	(-1.35)	(-1.36)	(-0.35)	(1.55)
$Market_t$	0.04	-0.03	0.11	-0.48 *	-0.35 *	-0.37 *	-0.70 **
	(0.29)	(-0.23)	(0.75)	(-3.14)	(-2.32)	(-2.41)	(-4.30)
M/B_{t-1}	-2.04 **	-2.12 **	-2.02 **	-2.01 **	-2.04 **	-1.90 **	-1.88 **
	(-16.27)	(-19.34)	(-17.52)	(-17.74)	(-18.07)	(-16.13)	(-15.22)
$EBITDA/A_{t-1}$	-51.30 **	-48.63 **	-46.16 **	-45.38 **	-44.64 **	-46.89 **	-50.92 **
	(-47.29)	(-50.60)	(-48.41)	(-47.14)	(-46.40)	(-46.07)	(-48.57)
$SIZE_{t-1}$	2.58 **	2.71 **	3.01 **	3.11 **	3.20 **	3.38 **	3.38 **
	(47.02)	(54.98)	(61.15)	(63.40)	(64.90)	(66.59)	(63.71)
PPE/A_{t-1}	0.81	1.89 **	1.44 *	1.10	0.55	0.30	0.78
	(1.36)	(3.50)	(2.65)	(2.02)	(1.01)	(0.54)	(1.33)
$R\&D/A_{t-1}$	-52.44 **	-47.61 **	-44.50 **	-44.65 **	-40.93 **	-38.02 **	-34.05 **
	(-17.54)	(-19.21)	(-18.27)	(-18.06)	(-16.39)	(-16.44)	(-14.01)
RDD_{t-1}	0.99 **	1.10 **	0.98 **	0.84 **	0.85 **	0.65 *	0.34
	(4.50)	(5.58)	(4.93)	(4.22)	(4.18)	(3.12)	(1.55)
R^2	0.34	0.33	0.31	0.31	0.30	0.30	0.28
N	33,604	41,868	42,502	42,370	42,290	42,524	42,131
Firms	3,715	4,639	4,681	4,699	4,692	4,678	4,656
	Panel C: Mean Values for Low M/B Portfolio						
Hot	43.72	42.74	46.00	49.74	50.33	48.51	48.42
Other	48.87	48.35	48.18	48.37	49.20	50.16	51.13
t-value (difference)	(6.69) **	(7.17) **	(2.34) *	(1.24)	(1.05)	(1.80)	(3.13)
	Panel D: Regression Analysis for Low M/B Portfolio						
HOT_t	-1.29	-1.55 *	-0.47	0.29	0.77	-0.82	-0.79
	(-1.60)	(-2.22)	(-0.58)	(0.31)	(0.85)	(-1.03)	(-1.03)
HOT_{t-1}	0.39	-0.65	-1.21	-0.12	-1.12	-0.68	-0.78
	(0.52)	(-1.05)	(-1.58)	(-0.16)	(-1.21)	(-0.84)	(-0.96)
HOT_{t-2}	-0.46	0.35	-0.17	0.08	-0.31	2.61 *	0.54
	(-0.61)	(0.56)	(-0.26)	(0.11)	(-0.41)	(2.74)	(0.64)
$Market_t$	0.41	0.60 *	1.12 **	0.91 **	-0.98 **	0.50	-0.67 *
	(1.42)	(2.32)	(4.42)	(3.58)	(-3.83)	(1.91)	(-2.37)
M/B_{t-1}	-0.58	-0.89 *	1.69 **	4.03 **	28.81 **	3.90 **	0.76
	(-1.64)	(-2.87)	(3.86)	(7.62)	(29.31)	(9.07)	(2.05)
$EBITDA/A_{t-1}$	-51.22 **	-41.61 **	-42.08 **	-29.08 **	-32.10 **	-45.06 **	-52.45 **
	(-24.55)	(-22.20)	(-21.68)	(-17.15)	(-19.36)	(-24.25)	(-27.06)
$SIZE_{t-1}$	2.68 **	2.98 **	3.31 **	3.32 **	3.00 **	3.57 **	3.60 **
	(26.98)	(33.41)	(37.69)	(38.00)	(34.30)	(38.86)	(36.57)
PPE/A_{t-1}	-1.14	-1.92	0.13	-0.07	-0.82	-2.06	-2.15
	(-1.13)	(-2.12)	(0.15)	(-0.09)	(-0.92)	(-2.17)	(-2.14)
$R\&D/A_{t-1}$	-51.88 **	-53.81 **	-65.10 **	-64.11 **	-57.85 **	-46.58 **	-44.64 **
	(-7.49)	(-8.71)	(-10.98)	(-11.10)	(-9.91)	(-7.99)	(-7.44)
RDD_{t-1}	2.15 **	2.24	1.71 **	1.50 **	1.15 **	1.24 **	0.76
	(5.49)	(-2.09)	(5.01)	(4.40)	(3.37)	(3.37)	(1.93)
R^2	0.36	0.34	0.33	0.32	0.34	0.30	0.30
N	11,183	13,558	13,806	13,894	13,970	13,749	13,550
Firms	2,276	2,822	2,864	2,872	2,863	2,839	2,813

	Book Leverage D/A_t						
t	*t-5*	*t-3*	*t-1*	*t0*	*t+1*	*t+3*	*t+5*
	Panel E: Mean Values for Med M/B Portfolio						
Hot	44.45	32.97	47.77	49.19	48.54	49.32	50.67
Other	50.25	40.82	50.93	51.45	51.51	51.73	52.05
t-value (difference)	(8.59) **	(9.18) **	(4.56) **	(3.35) **	(4.29) **	(3.39) **	(1.88)
	Panel F: Regression Analysis for Med M/B Portfolio						
HOT_t	-1.08	-2.29 **	-0.48	-0.30	-1.03	0.37	0.27
	(-1.49)	(-3.78)	(-0.79)	(-0.51)	(-1.71)	(0.61)	(0.42)
HOT_{t-1}	0.41	0.28	-0.31	0.35	0.40	0.77	1.42
	(0.63)	(0.50)	(-0.51)	(0.60)	(0.71)	(1.26)	(2.22)
HOT_{t-2}	0.54	0.03	-0.74	-0.29	0.42	-0.32	0.64
	(0.81)	(0.07)	(-1.25)	(-0.49)	(0.71)	(-0.54)	(1.00)
$Market_t$	-0.71 *	-0.67 *	-0.54 *	-1.71 **	-1.06 **	-1.25 **	-0.72 **
	(-2.75)	(-2.85)	(-2.33)	(-7.12)	(-4.37)	(-5.41)	(-3.01)
M/B_{t-1}	-1.99 *	-2.52 **	-3.30 **	-3.30 **	-5.23 **	-1.88 **	-1.93 **
	(-2.75)	(-11.72)	(-12.97)	(-10.79)	(-10.42)	(-7.28)	(-7.93)
$EBITDA/A_{t-1}$	-56.52 **	-58.50 **	-48.85 **	-63.09 **	-63.19 **	-49.21 **	-51.49 **
	(-30.92)	(-36.46)	(-31.98)	(-36.08)	(-35.95)	(-28.43)	(-3.36)
$SIZE_{t-1}$	2.19 **	2.26 **	2.46 **	2.55 **	2.68 **	2.91 **	3.08 **
	(25.78)	(29.79)	(32.34)	(33.87)	(35.85)	(38.02)	(38.57)
PPE/A_{t-1}	0.22	1.67	0.16	-0.26	-0.05	-0.65	1.24
	(0.23)	(1.96)	(0.19)	(-0.31)	(-0.06)	(-0.76)	(1.36)
$R\&D/A_{t-1}$	-67.42 **	-61.74 **	-60.99 **	-64.41 **	-62.46 **	-54.38 **	-36.32 **
	(-12.32)	(-14.68)	(-13.81)	(-14.04)	(-14.62)	(-13.17)	(-8.84)
RDD_{t-1}	0.51	0.50	0.57	0.44	0.34 *	0.14	0.10
	(1.50)	(1.65)	(1.86)	(1.45)	(2.60)	(0.45)	(0.31)
R^2	0.32	0.32	0.30	0.32	0.32	0.29	0.28
N	14,368	18,070	18,355	18,349	18,518	18,378	18,205
Firms	2,869	3,545	3,587	3,600	3,597	3,574	3,562
	Panel G: Mean Values for High M/B Portfolio						
Hot	33.80	33.80	32.85	32.18	34.08	38.06	40.90
Other	41.18	41.18	40.58	40.39	40.28	40.80	41.88
t-value (difference)	(9.15) **	(9.15) **	(9.39) **	(10.98) **	(7.68) **	(2.88) *	(0.95)
	Panel H: Regression Analysis for High M/B Portfolio						
HOT_t	-3.05 **	-2.51 **	-4.10 **	-3.94 **	-2.12 *	0.18	1.57
	(-3.50)	(-3.23)	(-5.62)	(-5.77)	(-2.91)	(0.22)	(1.74)
HOT_{t-1}	-1.46	-2.58 **	-2.22 *	-2.88 **	-2.67 **	-0.31	1.08
	(-1.50)	(-3.88)	(-2.88)	(-3.95)	(-3.91)	(-0.37)	(1.28)
HOT_{t-2}	-1.58	-2.78 **	-4.12 **	-2.85 **	-3.64 **	-0.46	0.65
	(-2.00)	(-4.15)	(-5.55)	(-3.76)	(-4.99)	(-0.63)	(0.76)
$Market_t$	0.27	0.37	-0.18	-0.80 *	-0.03	-0.75 *	-1.03 *
	(0.79)	(1.21)	(-0.60)	(-2.53)	(0.10)	(-2.42)	(-3.14)
M/B_{t-1}	-1.99 **	-1.99 **	-1.65 **	-1.45 **	-1.65 **	-1.00 **	-96.00 **
	(-11.83)	(-13.29)	(-10.43)	(-9.76)	(-10.86)	(-6.31)	(-5.67)
$EBITDA/A_{t-1}$	-42.39 **	-42.75 **	-44.56 **	-42.71 **	-38.39 **	-38.34 **	-41.46 **
	(-23.22)	(-26.49)	(-26.95)	(-25.60)	(-22.43)	(-21.80)	(-22.50)
$SIZE_{t-1}$	2.70 **	2.68 **	3.01 **	3.12 **	3.23 **	3.80 **	3.90 **
	(24.09)	(27.10)	(30.32)	(31.43)	(31.72)	(35.64)	(34.99)
PPE/A_{t-1}	6.51 **	8.77 **	6.45 **	7.00 **	6.16 **	6.43 **	6.29 **
	(5.15)	(7.87)	(5.75)	(6.15)	(5.23)	(5.36)	(5.04)
$R\&D/A_{t-1}$	-34.21 **	-33.88 **	-28.32 **	-27.13 **	-19.08 **	-18.01 **	-18.25 **
	(-8.19)	(-9.43)	(-8.27)	(-7.86)	(-5.29)	(-5.55)	(-5.20)
RDD_{t-1}	-0.77	-0.48	-0.55	-0.72	-0.29	-0.11	-0.01
	(-1.69)	(-1.18)	(-1.34)	(-1.74)	(-0.68)	(-0.25)	(-0.03)
R^2	0.38	0.35	0.33	0.33	0.31	0.31	0.30
N	7,783	10,240	10,361	10,397	10,432	10,397	10,376
Firms	1,754	2,297	2,315	2,325	2,322	2,312	2,308

M/B ratio is increasing, but revert back to the mean when the M/B ratio is decreasing (but do not cross below the mean). Under the common interpretation that the M/B ratio reflects growth opportunities, this result suggests that market timing is a characteristic of firms with increasing expectations of future cash flow growth.

Table 4.11 shows the effects of variation in the market-to-book ratio upon the market timing behavior of firms. Figure 4.4 and Table 4.10 show that the M / B ratio of high market-to-book firms rises before and falls after the year of portfolio formation.

4.5.3 The Influence of Market-to-Book on Investment and Earnings

This section examines the investment and profitability of the firm for the 11-year window around portfolio formation on the market-to-book ratio. Before proceeding, it is useful to recapitulate the results from the earlier analysis using the dataset formed on a window of SEO events. For the SEO event dataset, it was found that hot-market firms had lower investment in the SEO year and two following years compared to cold-market firms, and that hot-market earnings were lower in the two years following the SEO. These SEO event dataset results of a prior section are consistent with the findings of Alti (2006) and others who use IPO event data. However, this section, using the 11-year window formed on market-to-book, shows that the investment activity of hot-market issuers is persistently greater than that of non-issuers of seasoned equity while earnings are persistently lower.

Table 4.12 shows the following regression equation of investment level:

$$\begin{aligned} INV / A_t = {} & c_0 + c_1 HOT + c_2 Hot_{t-1} + c_3 Hot_{t-2} + c_4 Market_t + c_5 M/B_{t-1} \\ & + c_6 EBITDA/A_{t-1} + c_7 SIZE_{t-1} + c_8 PPE/A_{t-1} + c_9 R \,\&\, D/A_{t-1} + c_{10} RDD_{t-1} + e_t \end{aligned} \tag{1.8}$$

where the dependent variable is capital investment normalized by total assets, INV / A_t.

Panel A of Table 4.12 shows that hot-market issuers of SEOs in the overall sample have higher investment levels than non-issuers for all time periods in the 12-year window around portfolio formation sorted on the M / B ratio. Panel B shows the HOT_t, HOT_{t-1}, and HOT_{t-2} dummies are positive and significant at the 1% or 5% confidence level in all years in the data window. These positive coefficients indicate that hot-market firms invest more in the SEO year and that the high level of investment persists in the two following years. Panels C to H shows this result generally holds for all of the low, medium and high M / B sub sample portfolios. These results suggest that the firm is actively investing the proceeds of the SEO issue. The coefficient values of the HOT_t dummy in Table 4.12 are greatest in the t_0 year of portfolio formation and the following year, when Figure 4.4 shows the median market-to-book ratio at its peak, suggesting that hot-market firms are investing most when the market valuation of the firm implies the highest growth prospects. In addition, Table 4.12 shows that the $Market_t$ dummy is negative and strongly significant for all portfolios, suggesting that overall investment per unit of book assets is lower in hot markets than in cold markets. The negative coefficient on the $Market_t$ dummy may be due to higher book value on total assets in strong markets increasing the denominator in the INV / A_t variable, rather than a decrease in capital investment. The $Market_t$ dummy is assigned a value of one when SEO issuance level is above the long-term median, and increased merger and acquisition activity associated with high levels of SEO issuance may be driving up the valuation of assets.

Table 4.12
Comparison of Investment Level for Hot and Cold Market Firms

For capital investment INV / A_t, Panel A shows the mean value for hot-market and other firms and the t-value of their difference. The time subscript t denotes the year relative to portfolio formation. Panel B reports the regression:

$$INV / A_t = c_0 + c_1 HOT + c_2 Hot_{t-1} + c_3 Hot_{t-2} + c_4 Market_t + c_5 M/B_{t-1} + c_6 EBITDA/A_{t-1} + c_7 SIZE_{t-1} + c_8 PPE/A_{t-1} + c_9 R\&D/A_{t-1} + c_{10} RDD_{t-1} + e_t$$

Constant and SIC dummies are suppressed. Robust t-statistics are shown in parentheses. Coefficients marked ** and * are significant at 1% and 5% confidence intervals, respectively.

	INV/A_t						
t	*t-5*	*t-3*	*t-1*	*t0*	*t+1*	*t+3*	*t+5*
				Panel A: Mean Values for Full Sample			
Hot	9.53	9.22	8.62	8.53	8.62	8.01	7.61
Other	8.08	7.87	7.65	7.58	7.49	7.13	6.66
t-value (difference)	(8.79) **	(8.28) **	(5.86) **	(5.80) **	(6.76) **	(5.47) **	(6.33) **
				Panel B: Regression Analysis for Full Sample			
HOT_t	0.40 *	0.36 *	0.33 *	0.76 **	0.80 **	0.65 **	0.62 **
	(2.51)	(2.62)	(2.43)	(5.69)	(5.96)	(5.05)	(5.12)
HOT_{t-1}	1.29 **	1.50 **	1.16 **	1.10 **	0.92 **	1.23 **	1.18 **
	(8.89)	(12.25)	(8.51)	(8.31)	(7.13)	(9.52)	(9.83)
HOT_{t-2}	0.85 **	1.00 **	1.06 **	0.95 **	0.66 **	0.60 **	0.77 **
	(5.84)	(8.04)	(8.33)	(7.13)	(5.14)	(4.70)	(6.33)
$Market_t$	-0.46 **	-0.50 **	-0.80 **	-1.23 **	-1.15 **	-0.95 **	-0.71 **
	(-8.05)	(-9.59)	(-16.14)	(-24.91)	(-23.95)	(-20.73)	(-15.89)
M/B_{t-1}	0.77 **	0.80 **	0.76 **	0.71 **	0.66 **	0.50 **	0.53 **
	(18.23)	(21.42)	(19.76)	(19.38)	(18.59)	(14.37)	(15.83)
$EBITDA/A_{t-1}$	13.09 **	12.87 **	13.12 **	13.03 **	12.82 **	13.86 **	12.10 **
	(35.56)	(39.19)	(41.89)	(42.01)	(42.18)	(45.81)	(42.41)
$SIZE_{t-1}$	-0.15 **	-0.17 **	-0.12 **	-0.11 **	-0.12 **	-0.12 **	-0.10 **
	(-7.85)	(-9.99)	(-7.33)	(-7.22)	(-7.49)	(-8.19)	(-7.07)
PPE/A_{t-1}	13.95 **	13.87 **	13.30 **	13.09 **	12.87 **	12.05 **	11.71 **
	(68.03)	(74.74)	(74.11)	(74.11)	(73.95)	(71.61)	(72.29)
$R\&D/A_{t-1}$	11.25 **	8.56 **	7.63 **	7.62 **	8.63 **	9.30 **	8.08 **
	(11.09)	(10.10)	(9.52)	(9.55)	(10.93)	(13.53)	(12.19)
RDD_{t-1}	-0.06	-0.10	0.04	0.09	0.14	0.14	0.14
	(-0.79)	(-1.45)	(0.66)	(1.46)	(2.22)	(2.25)	(2.30)
R^2	0.39	0.39	0.40	0.41	0.41	0.41	0.41
N	33,252	41,396	41,960	42,176	42,360	41,973	41,584
Firms	3,705	4,639	4,681	4,699	4,692	4,678	4,656
				Panel C: Mean Values for Low M/B Portfolio			
Hot	9.44	8.67	8.29	8.38	7.58	7.30	7.97
Other	7.67	7.23	6.72	6.39	6.18	6.31	6.15
t-value (difference)	(6.06) **	(5.30) **	(5.10) **	(5.63) **	(4.17) **	(3.47) **	(7.23) **
				Panel D: Regression Analysis for Low M/B Portfolio			
HOT_t	0.29	0.01	0.36	1.20 **	0.53	0.42	0.65 *
	(1.05)	(0.03)	(1.37)	(4.03)	(1.89)	(1.79)	(3.09)
HOT_{t-1}	0.86 **	0.88 **	0.84 **	0.92 **	0.28	1.20 **	1.09 **
	(3.30)	(4.15)	(3.41)	(3.60)	(0.98)	(4.92)	(4.86)
HOT_{t-2}	0.40	0.84 **	1.28 **	1.45 **	0.57 *	0.62	0.66 *
	(1.53)	(3.92)	(6.01)	(6.12)	(2.33)	(2.18)	(2.84)
$Market_t$	-0.50 **	-0.43 **	-0.51 **	-0.97 **	-1.01 **	-0.72 **	-0.60 **
	(-4.97)	(-4.97)	(-6.20)	(-12.08)	(-12.79)	(-9.14)	(-7.68)
M/B_{t-1}	2.08 **	1.72 **	1.62 **	1.52 **	1.83 **	1.41 **	1.44 **
	(17.10)	(16.19)	(11.46)	(9.08)	(6.07)	(11.00)	(13.98)
$EBITDA/A_{t-1}$	13.92 **	15.23 **	16.50 **	11.73 **	11.01 **	14.48 **	12.90 **
	(19.30)	(24.02)	(26.40)	(22.00)	(21.70)	(26.18)	(24.16)
$SIZE_{t-1}$	-0.01	-0.03	0.00	0.02	-0.07 *	-0.09 **	-0.06
	(-0.36)	(-0.86)	(-0.03)	(-0.87)	(-2.58)	(-3.28)	(-2.25)
PPE/A_{t-1}	11.50 **	11.19 **	10.15 **	9.43 **	8.83 **	8.87 **	9.17 **
	(32.92)	(36.22)	(34.93)	(33.04)	(32.03)	(31.19)	(32.92)
$R\&D/A_{t-1}$	9.76 **	8.27 **	9.77 **	8.09 **	10.14 **	8.28 **	10.00 **
	(4.12)	(3.98)	(5.13)	(4.42)	(5.65)	(4.76)	(6.06)
RDD_{t-1}	-0.03	0.01	0.09	0.17	0.03	0.13	0.21
	(-0.22)	(0.11)	(0.80)	(1.56)	(0.33)	(1.16)	(1.89)
R^2	0.39	0.38	0.37	0.36	0.35	0.37	0.38
N	11,057	13,386	13,611	13,705	13,791	13,577	13,398
Firms	2,271	2,822	2,864	2,872	2,863	2,839	2,813

Y_t	INV/A_t						
t	*t-5*	*t-3*	*t-1*	*t0*	*t+1*	*t+3*	*t+5*
			Panel E: Mean Values for Med M/B Portfolio				
Hot	9.75	9.93	9.11	8.51	8.66	8.57	7.63
Other	8.12	7.96	7.81	7.79	7.67	7.27	6.77
t-value (difference)	(6.36) **	(7.88) **	(5.16) **	(2.96) **	(4.09) **	(5.40) **	(3.74) **
			Panel F: Regression Analysis for Med M/B Portfolio				
HOT_t	0.44	0.51 *	0.44	0.55 *	0.47 *	0.70 **	0.50 *
	(1.80)	(2.45)	(2.12)	(2.88)	(2.46)	(3.75)	(2.75)
HOT_{t-1}	0.77 **	1.23 **	0.98 **	0.88 **	0.82 **	0.85 **	0.89 **
	(3.49)	(6.34)	(4.69)	(4.57)	(4.48)	(4.59)	(4.98)
HOT_{t-2}	0.45	1.08 **	0.92 **	0.87 **	0.76 **	0.65 **	1.13 **
	(2.00)	(5.55)	(4.59)	(4.42)	(4.07)	(3.58)	(6.31)
$Market_t$	-0.48 **	-0.46 **	-0.99 **	-1.23 **	-0.89 **	-0.83 **	-0.65 **
	(-5.54)	(-5.68)	(-12.41)	(-15.81)	(-11.48)	(-11.87)	(-9.59)
M/B_{t-1}	1.03 **	1.08 **	1.35 **	1.11 **	0.51 *	0.68 **	0.76 **
	(12.94)	(14.76)	(15.74)	(11.19)	(3.21)	(8.76)	(11.26)
$EBITDA/A_{t-1}$	14.63 **	14.59 **	13.69 **	16.23 **	15.81 **	17.55 **	13.75 **
	(23.84)	(26.50)	(26.64)	(28.71)	(28.34)	(33.66)	(29.17)
$SIZE_{t-1}$	-0.24 **	-0.23 **	-0.18 **	-0.21 **	-0.18 **	-0.15 **	-0.12 **
	(-8.34)	(-9.04)	(-7.01)	(-8.74)	(-7.58)	(-6.35)	(-5.57)
PPE/A_{t-1}	13.75 **	13.28 **	13.41 **	13.23 **	12.74 **	12.00 **	12.27 **
	(42.96)	(45.46)	(46.27)	(48.29)	(47.92)	(45.91)	(48.08)
$R\&D/A_{t-1}$	14.19 **	6.89 **	6.78 **	9.03 **	10.58 **	11.73 **	10.19 **
	(7.74)	(4.77)	(4.54)	(6.08)	(7.80)	(9.44)	(8.91)
RDD_{t-1}	0.04	-0.18	0.20	0.10	0.18	0.28 *	0.24 *
	(0.34)	(-1.75)	(1.90)	(1.05)	(1.81)	(2.97)	(2.59)
R^2	0.41	0.41	0.41	0.44	0.43	0.44	0.44
N	14,482	17,872	18,114	18,206	18,270	18,130	17,940
Firms	2,861	3,545	3,587	3,600	3,597	3,574	3,562
			Panel G: Mean Values for High M/B Portfolio				
Hot	9.32	8.70	8.13	8.61	9.13	7.78	7.08
Other	8.57	8.60	8.63	8.84	8.98	7.98	7.17
t-value (difference)	(2.35) *	(0.30)	(-1.59)	(-0.77)	(0.48)	(-0.62)	(-0.28)
			Panel H: Regression Analysis for High M/B Portfolio				
HOT_t	-0.12	-0.20	-0.27	0.45	1.11 **	0.36	0.33
	(-0.40)	(-0.71)	(-1.08)	(1.91)	(4.47)	(1.39)	(1.33)
HOT_{t-1}	1.70 **	1.82 **	1.29 **	1.43 **	1.17 **	1.74 **	1.36 **
	(5.87)	(7.64)	(4.93)	(5.68)	(5.01)	(6.61)	(5.90)
HOT_{t-2}	1.45 **	0.73 *	0.71 *	0.48	0.61 *	0.38	-0.13
	(5.14)	(3.04)	(2.82)	(1.86)	(2.47)	(1.69)	(-0.56)
$Market_t$	-0.53 **	-0.58 **	-0.82 **	-1.28 **	-1.24 **	-1.29 **	-0.92 **
	(-4.40)	(-5.35)	(-7.92)	(-11.67)	(-11.54)	(-13.54)	(-10.37)
M/B_{t-1}	0.51 **	0.59 **	0.51 **	0.44 **	0.33 **	0.43 **	0.44 **
	(8.48)	(11.08)	(9.55)	(8.62)	(6.48)	(8.84)	(9.44)
$EBITDA/A_{t-1}$	10.40 **	8.87 **	8.72 **	8.28 **	7.99 **	8.77 **	8.59 **
	(16.00)	(15.37)	(15.66)	(14.43)	(13.77)	(16.40)	(17.20)
$SIZE_{t-1}$	-0.19 **	-0.24 **	-0.20 **	-0.19 **	-0.20 **	-0.12 **	-0.08 *
	(-4.80)	(-6.83)	(-5.94)	(-5.62)	(-5.68)	(-3.71)	(-2.62)
PPE/A_{t-1}	17.78 **	18.57 **	17.74 **	18.48 **	19.52 **	16.46 **	14.05 **
	(39.33)	(46.43)	(46.86)	(47.22)	(48.96)	(45.09)	(41.56)
$R\&D/A_{t-1}$	9.30 **	7.62 **	4.67 **	4.16 **	5.32 **	5.56 **	4.58 **
	(6.22)	(5.91)	(4.05)	(3.51)	(4.36)	(5.63)	(4.80)
RDD_{t-1}	-0.33	-0.16	- 0.46 **	-0.11	0.18	-0.23	-0.14
	(-2.02)	(-1.11)	(-3.28)	(-0.77)	(1.21)	(-1.68)	(-1.07)
R^2	0.45	0.45	0.47	0.49	0.49	0.47	0.45
N	7,713	10,138	10,235	10,265	10,299	10,266	10,246
Firms	1,748	2,297	2,315	2,325	2,322	2,312	2,308

The results of the SEO event time dataset shown in Table 4.4, and the results from 11-year window dataset shown in Table 4.12, offer complementary perspectives of the impact of market timing on capital investment. The SEO event time dataset results show that hot-market firms invest less than their cold-market firms in the SEO year and three following years. In comparison, the 11-year window dataset shows that hot-market firms persistently invest more than non-issuers of seasoned equity in all years of the 11-year data window. Thus, hot-market firms invest at a lower rate than their cold-market counterparts, but at a significantly higher rate than non-issuers, indicating that market timing is nonetheless associated with higher than average levels of investment.

In unreported regressions, the HOT_t dummy in Table 4.12 was replaced with a $COLD_t$ dummy. Those results show that cold-market firms invest more than other firms, where other firms now include hot-market firms and firm-year observations outside the SEO event window. This results show that both hot-market and cold-market firms invest more than other firms who do not issue equity. The positive coefficient on the $COLD_t$ dummy was larger in magnitude than for the HOT_t dummy, consistent with the previous analysis of the SEO dataset showing that hot-market firms invest less than cold-market firms.

To examine profitability for the alternate dataset, the following regression equation is estimated:

$$\begin{aligned} EBITDA / A_t = c_0 + c_1 HOT + c_2 Hot_{t-1} + c_3 Hot_{t-2} + c_4 Market_t + c_5 M/B_{t-1} \\ + c_6 SIZE_{t-1} + c_7 PPE/A_{t-1} + c_8 R\ \&\ D/A_{t-1} + c_9 RDD_{t-1} + e_t \end{aligned} \tag{1.9}$$

where the dependent variable is earnings before interest, taxes, depreciation and amortization, deflated by total book assets.

Panel A of Table 4.13 shows that hot-market issuers of SEOs in the overall sample have lower profitability levels than non-issuers for all time periods in the 11-year window around portfolio formation sorted on the M/B ratio. Panel B shows the HOT_t, HOT_{t-1}, and HOT_{t-2} dummies are negative and significant in all 11 years in the data interval. These negative coefficients indicate that hot-market firms have lower profitability in the year of the SEO issue and that the lower profitability persists in the two following years. Moreover, Panels C to H shows this result holds for all of the low, medium and high M/B sub sample portfolios.

The results of Table 4.13 indicate that the operating profitability of hot-market SEO firms is lower than non-issuers of seasoned equity, which may reflect the higher investment activity of hot-market firms shown in the previous section, as there is typically a lag between capital investment and profits. As well, Table 4.12 shows that the $Market_t$ dummy is negative and strongly significant for all portfolios, suggesting that overall profitability per unit of existing assets is lower in strong markets than in weak markets. As in the previous discussion of investment level, the negative coefficient on the $Market_t$ dummy may be due to higher book value on total assets in strong markets, increasing the denominator in the $EBITDA/A_t$ variable, as rising markets are generally associated with increased earnings levels but even faster increases in asset valuation in conjunction with a high level of merger and acquisition activity.

Table 4.13
Comparison of Earnings for Hot and Cold Market Firms

For profitability $EBITDA / A_t$, Panel A shows the mean value for hot-market and other firms and the t-value of their difference. The time subscript t denotes the year relative to portfolio formation. Panel B reports the regression:

$$EBITDA / A_t = c_0 + c_1 HOT + c_2 Hot_{t-1} + c_3 Hot_{t-2} + c_4 Market_t + c_5 M/B_{t-1} + c_6 SIZE_{t-1} + c_7 PPE/A_{t-1} + c_8 R\ \&\ D/A_{t-1} + c_9 RDD_{t-1} + e_t$$

Constant and SIC dummies are suppressed. Robust t-statistics are shown in parentheses. Coefficients marked ** and * are significant at 1% and 5% confidence intervals, respectively.

	$EBITDA/A_t$						
t	*t-5*	*t-3*	*t-1*	*t0*	*t+1*	*t+3*	*t+5*
	Panel A: Mean Values for Full Sample						
Hot	12.81	10.76	10.70	10.61	10.46	10.02	8.80
Other	15.07	14.77	14.38	14.22	13.91	13.25	12.63
t-value (difference)	(10.08) **	(17.11) **	(15.29) **	(14.93) **	(13.91) **	(12.87) **	(14.56) **
	Panel B: Regression Analysis for Full Sample						
HOT_t	-4.02 **	-3.91 **	-2.62 **	-1.99 **	-1.64 **	-1.55 **	-2.06 **
	(-16.75)	(-18.13)	(-12.26)	(-9.14)	(-7.53)	(-7.17)	(-9.06)
HOT_{t-1}	-3.01 **	-3.43 **	-3.88 **	-3.61 **	-3.58 **	-2.54 **	-2.72 **
	(-13.69)	(-17.82)	(-18.02)	(-16.76)	(-17.19)	(-11.70)	(-12.09)
HOT_{t-2}	-1.80 **	-2.34 **	-3.16 **	-3.34 **	-3.36 **	-2.79 **	-2.57 **
	(-8.12)	(-11.96)	(-15.71)	(-15.43)	(-16.10)	(-13.13)	(-11.26)
$Market_t$	-1.80 **	-1.71 **	-2.48 **	-1.96 **	-1.44 **	-0.84 **	-0.12
	(-20.77)	(-20.95)	(-31.81)	(-24.48)	(-18.55)	(-10.92)	(-1.44)
M/B_{t-1}	4.49 **	4.36 **	4.64 **	4.32 **	4.22 **	4.45 **	4.47 **
	(77.39)	(81.64)	(83.53)	(78.95)	(79.65)	(83.12)	(77.64)
$SIZE_{t-1}$	0.61 **	0.71 **	0.66 **	0.70 **	0.72 **	0.80 **	1.05 **
	(21.80)	(26.78)	(25.86)	(27.45)	(28.95)	(32.18)	(39.35)
PPE/A_{t-1}	7.01 **	7.71 **	8.53 **	8.81 **	9.29 **	10.10 **	10.62 **
	(22.59)	(26.52)	(30.33)	(30.90)	(33.36)	(36.23)	(35.43)
$R\&D/A_{t-1}$	-42.55 **	-46.89 **	-45.59 **	- 49.62 **	-52.77 **	-50.81 **	-65.22 **
	(-28.07)	(-35.88)	(-36.88)	(-39.20)	(-42.43)	(-45.95)	(-55.02)
RDD_{t-1}	-0.50 **	-0.48 **	-0.49 **	-0.51 **	-0.49 **	-0.37 **	-0.62 **
	(-4.38)	(-4.45)	(-4.71)	(-4.83)	(-4.66)	(-3.54)	(-5.38)
R^2	0.28	0.27	0.28	0.27	0.28	0.30	0.31
N	33,584	41,843	42,471	42,691	42,881	42,492	42,083
Firms	3,705	4,639	4,681	4,699	4,692	4,678	4,656
	Panel C: Mean Values for Low M/B Portfolio						
Hot	12.59	10.79	9.02	8.18	8.53	9.50	8.88
Other	12.50	11.87	10.65	9.97	10.08	10.54	10.32
t-value (difference)	(-0.27)	(3.29) **	(3.74) **	(3.38) **	(3.19) **	(2.51) *	(3.45) **
	Panel D: Regression Analysis for Low M/B Portfolio						
HOT_t	-2.32 **	-1.88 **	-1.27 *	-1.16 *	-0.94	-1.05 *	-1.31 **
	(-6.19)	(-5.82)	(-3.06)	(-2.32)	(-2.10)	(-2.70)	(-3.32)
HOT_{t-1}	-1.41 **	-1.98 **	-3.32 **	-2.69 **	- 1.42 **	-1.63 **	-2.15 **
	(-4.03)	(-6.89)	(-8.40)	(-6.33)	(-3.12)	(-4.10)	(-5.17)
HOT_{t-2}	-0.87 *	-1.29 **	-2.45 **	-2.63 **	-2.03 **	-1.72 **	-1.49 **
	(-2.45)	(-4.42)	(-7.15)	(-6.65)	(-5.26)	(-3.70)	(-3.47)
$Market_t$	-1.47 **	-1.33 **	-1.90 **	-1.34 **	-1.23 **	-0.62 **	0.01
	(-10.85)	(-11.19)	(-14.55)	(-10.08)	(-9.81)	(-4.84)	(0.04)
M/B_{t-1}	4.75 **	3.72 **	4.65 **	3.16 **	7.02 **	5.65 **	4.57 **
	(30.93)	(27.19)	(21.45)	(11.52)	(14.68)	(27.90)	(25.14)
$SIZE_{t-1}$	0.29 **	0.34 **	0.39 **	0.45 **	0.35 **	0.54 **	0.98 **
	(6.34)	(8.41)	(8.65)	(9.84)	(8.28)	(12.11)	(19.77)
PPE/A_{t-1}	7.47 **	7.83 **	8.23 **	8.61 **	8.84 **	9.40 **	9.16 **
	(15.94)	(18.92)	(17.94)	(18.33)	(20.45)	(20.59)	(18.03)
$R\&D/A_{t-1}$	-22.97 **	-20.17 **	-26.90 **	-29.62 **	-24.26 **	-34.52 **	-54.64 **
	(-7.16)	(-7.12)	(-8.80)	(-9.78)	(-8.53)	(-12.28)	(-18.17)
RDD_{t-1}	-0.70 **	-0.38 *	-0.49 *	-0.22	-0.08	-0.25	-0.47 *
	(-3.83)	(-2.40)	(-2.77)	(-1.24)	(-0.47)	(-1.41)	(-2.30)
R^2	0.21	0.18	0.18	0.18	0.20	0.20	0.21
N	11,172	13,546	13,790	13,882	13,960	13,732	13,529
Firms	2,271	2,822	2,864	2,872	2,863	2,839	2,813

	EBITDA/A_t						
t	*t-5*	*t-3*	*t-1*	*t0*	*t+1*	*t+3*	*t+5*
			Panel E: Mean Values for Med M/B Portfolio				
Hot	13.30	12.42	12.15	11.62	11.33	11.17	9.58
Other	14.78	14.38	14.14	14.00	13.77	13.15	12.63
t-value (difference)	(4.83) **	(6.14) **	(7.17) **	(8.91) **	(8.39) **	(6.24) **	(8.67) **
			Panel F: Regression Analysis for Med M/B Portfolio				
HOT_t	-2.97 **	-2.46 **	-1.71 **	-1.74 **	-1.34 **	-1.18 **	-1.97 **
	(-8.71)	(-7.91)	(-6.54)	(-6.84)	(-4.90)	(-4.10)	(-6.30)
HOT_{t-1}	-1.88 **	-2.79 **	-2.04 **	-1.61 **	-2.24 **	-1.80 **	-2.12 **
	(-6.10)	(-9.65)	(-7.66)	(-6.31)	(-8.56)	(-6.37)	(-6.84)
HOT_{t-2}	-1.06 **	-1.60 **	-2.03 **	-2.39 **	-2.66 **	-1.84 **	-2.66 **
	(-3.38)	(-5.54)	(-7.93)	(-9.23)	(-9.97)	(-6.59)	(-8.60)
$Market_t$	-1.51 **	-1.48 **	-1.73 **	-0.78 **	-0.94 **	-0.73 **	0.01
	(-12.44)	(-12.41)	(-17.09)	(-7.65)	(-8.55)	(-6.91)	(0.12)
M/B_{t-1}	4.29 **	4.04 **	3.14 **	2.00 **	3.93 **	4.54 **	4.82 **
	(42.50)	(39.55)	(29.83)	(15.97)	(17.50)	(40.43)	(44.64)
$SIZE_{t-1}$	0.51 **	0.52 **	0.38 **	0.34 **	0.31 **	0.50 **	0.72 **
	(12.76)	(13.50)	(11.68)	(10.58)	(9.23)	(14.20)	(18.91)
PPE/A_{t-1}	6.93 **	7.45 **	7.87 **	8.58 **	9.20 **	9.93 **	10.99 **
	(15.65)	(17.22)	(21.52)	(24.08)	(24.65)	(25.33)	(25.29)
$R\&D/A_{t-1}$	-27.88 **	-35.99 **	- 21.43 **	-29.87 **	-34.33 **	-47.38 **	-66.01 **
	(-10.92)	(-16.93)	(-11.34)	(-15.36)	(-17.99)	(-25.75)	(-34.77)
RDD_{t-1}	-0.39 *	-0.50 *	-0.05	-0.26	-0.33 *	-0.42 *	-0.46 *
	(-2.43)	(-3.21)	(-0.38)	(-1.97)	(-2.39)	(-2.88)	(-2.85)
R^2	0.23	0.19	0.20	0.2	0.19	0.24	0.28
N	14,633	18,063	18,325	18,422	18,500	18,367	18,183
Firms	2,861	3,545	3,587	3,600	3,597	3,574	3,562
			Panel G: Mean Values for High M/B Portfolio				
Hot	12.33	8.10	9.79	10.37	10.29	8.60	7.22
Other	19.07	19.37	19.94	20.52	19.44	17.10	15.71
t-value (difference)	(12.74) **	(20.12) **	(19.37) **	(21.91) **	(18.02) **	(14.25) **	(12.99) **
			Panel H: Regression Analysis for High M/B Portfolio				
HOT_t	-6.51 **	-6.71 **	-4.43 **	-4.39 **	-3.08 **	-2.58 **	-2.92 **
	(-11.68)	(-13.29)	(-9.83)	(-10.45)	(-6.87)	(-5.17)	(-5.55)
HOT_{t-1}	5.36 **	-4.12 **	-5.25 **	-5.08 **	-5.85 **	-4.18 **	-3.93 **
	(-10.33)	(-9.49)	(-11.05)	(-11.40)	(-14.10)	(-8.27)	(-8.04)
HOT_{t-2}	-2.91 **	-3.64 **	-3.56 **	-3.80 **	-4.67 **	-4.52 **	-3.18 *
	(-5.75)	(-8.31)	(-7.78)	(-8.18)	(-10.48)	(-10.45)	(-6.37)
$Market_t$	-2.25 **	-1.82 **	-2.58 **	-1.48 **	-1.18 **	-1.01 **	-0.56 *
	(-10.32)	(-9.12)	(-13.59)	(-7.61)	(-6.06)	(-5.49)	(-2.92)
M/B_{t-1}	3.58 **	3.36 **	3.06 **	2.12 **	2.12 **	3.36 **	3.62 **
	(36.80)	(37.76)	(34.05)	(24.57)	(23.55)	(38.93)	(40.25)
$SIZE_{t-1}$	0.89 **	1.09 **	0.90 **	0.86 **	1.07 **	1.30 **	1.50 **
	(12.58)	(17.20)	(14.81)	(14.36)	(17.35)	(21.19)	(23.93)
PPE/A_{t-1}	5.09 **	6.68 **	8.55 **	8.00 **	9.05 **	10.28 **	11.05 **
	(6.25)	(9.17)	(12.35)	(11.50)	(12.61)	(14.65)	(15.42)
$R\&D/A_{t-1}$	-54.78 **	-58.76 **	-61.99 **	-61.02 **	-63.22 **	-53.03 **	-66.10 **
	(-21.38)	(-26.26)	(-31.34)	(-31.19)	(-30.63)	(-30.19)	(-35.02)
RDD_{t-1}	0.28	0.23	-0.25	-0.18	-0.19	0.07	-0.84 *
	(-0.94)	(-0.86)	(-0.98)	(-0.70)	(-0.71)	(-0.27)	(-2.99)
R^2	0.38	0.37	0.38	0.35	0.34	0.38	0.40
N	7,779	10,234	10,356	10,387	10,421	10,393	10,371
Firms	1,748	2,297	2,315	2,325	2,322	2,312	2,308

4.5.4 The Reversal of Market Timing Effects for Market-to-Book Portfolios

This section examines the reversal of market timing effects in the 11-year window surrounding portfolio formation on market-to-book. The following regression equation for the change in book leverage is estimated in Table 4.14:

$$\begin{aligned} D/A_t - D/A_{t-1} = {} & c_0 + c_1 HOT + c_2 Hot_{t-1} + c_3 Hot_{t-2} + c_4 Market_t + c_5 M/B_{t-1} \\ & + c_6 EBITDA/A_{t-1} + c_7 SIZE_{t-1} + c_8 PPE/A_{t-1} + c_9 R\,\&\,D/A_{t-1} + c_{10} RDD_{t-1} + e_t \end{aligned} \quad (1.10)$$

where the dependent variable is the change in leverage.

In Panel B of Table 4.14, for all portfolios, the HOT_t market timing dummies in the cross-section year are negative, while the lagged dummies HOT_{t-1} and HOT_{t-2} are positive. All the dummies are significant at the 1% or 5% confidence levels. These results support the results of the previous reversal analysis in SEO event time, again showing that hot-market firms issue equity in the SEO year and then actively add debt in following years. Panel A supports the regression results of Panel B, showing that hot-market firms decrease their leverage, while other firms show a slight increase. The results given in Panels C to H of Table 4.14, for the sub portfolios sorted on the M/B ratio, show that the current period HOT_t market timing dummy is negative and significant for all portfolios, while the HOT_{t-1} and HOT_{t-2} dummies are positive and generally significant. These results indicate that market timing effects are followed by active reversion to a target leverage level.

Table 4.14
Reversal of Market Timing Effects for M/B Portfolios

For the change in leverage $D/A_t - D/A_{t-1}$, Panel A shows the mean value for hot-market and other firms and the *t*-value of their difference. The time subscript *t* denotes the year relative to portfolio formation. Panel B reports the regression:

$$D/A_t - D/A_{t-1} = c_0 + c_1 HOT + c_2 Hot_{t-1} + c_3 Hot_{t-2} + c_4 Market_t + c_5 M/B_{t-1} + c_6 EBITDA/A_{t-1} + c_7 SIZE_{t-1} + c_8 PPE/A_{t-1} + c_9 R\&D/A_{t-1} + c_{10} RDD_{t-1} + e_t$$

Constant and SIC dummies are suppressed. Robust *t*-statistics are shown in parentheses. Coefficients marked ** and * are significant at 1% and 5% confidence intervals, respectively.

	Change in Book Leverage D/A_t - D/A_{t-1}						
t	*t-5*	*t-3*	*t-1*	*t0*	*t+1*	*t+3*	*t+5*
			Panel A: Mean Values for Full Sample				
Hot	-11.06	-6.28	-5.76	-5.59	-5.32	-5.13	-4.33
Other	0.19	0.38	0.32	0.47	0.48	0.43	0.63
t-value (difference)	(53.70) **	(34.24) **	(30.17) **	(30.02) **	(27.57) **	(25.88) **	(22.48) **
			Panel B: Regression Analysis for Full Sample				
HOT_t	-6.72 **	-6.59 **	-6.30 **	-6.23 **	-6.09 **	-5.83 **	-5.35 **
	(-28.31)	(-32.40)	(-30.36)	(-29.81)	(-28.35)	(-26.74)	(-24.11)
HOT_{t-1}	1.78 **	1.76 **	1.26 **	1.08 **	1.01 **	0.79 **	0.75 **
	(8.20)	(9.70)	(6.05)	(5.24)	(4.92)	(3.65)	(3.18)
HOT_{t-2}	0.60 *	0.60 **	0.93 **	1.09 **	0.76 **	1.05 **	0.51 *
	(2.98)	(3.31)	(4.78)	(5.24)	(3.68)	(4.92)	(2.31)
$Market_t$	-0.12	0.07	0.12	-0.02	0.02	0.09	-0.09
	(-1.49)	(0.93)	(1.67)	(-0.30)	(0.28)	(1.26)	(-1.17)
M/B_{t-1}	0.06	0.07	0.06	-0.09	-0.16 *	-0.32 **	-0.09
	(1.07)	(1.36)	(1.03)	(-1.56)	(-2.83)	(-5.49)	(-1.55)
$EBITDA/A_{t-1}$	-3.68 **	-4.56 **	-1.67 **	-1.44 *	-1.92 **	-0.58	-4.03 **
	(-6.62)	(-9.28)	(-3.45)	(-2.93)	(-3.92)	(-1.14)	(-7.63)
$SIZE_{t-1}$	-0.02	-0.08 **	-0.03	-0.05	-0.07 *	-0.07 *	-0.13 **
	(-0.87)	(-3.41)	(-1.51)	(-2.10)	(-2.77)	(-2.99)	(-4.90)
PPE/A_{t-1}	0.62	0.58	0.53	0.62	0.88 *	1.12 **	1.51 **
	(2.05)	(2.12)	(1.93)	(2.24)	(3.16)	(3.95)	(5.07)
$R\&D/A_{t-1}$	4.20 *	5.25 **	-1.63	1.02	3.60 *	0.35	1.60
	(2.76)	(4.17)	(-1.33)	(0.81)	(2.85)	(0.31)	(1.32)
RDD_{t-1}	-0.24	-0.15	-0.22	-0.23 *	-0.20	-0.37 **	-0.29 *
	(-2.13)	(-1.53)	(-2.21)	(-2.30)	(-1.96)	(-3.55)	(-2.61)
d_{high}	5.76 **	5.28 **	5.39 **	5.91 **	6.18 **	6.87 **	7.83 **
	(23.00)	(23.14)	(24.25)	(27.01)	(29.10)	(34.88)	(43.67)
d_{low}	-3.43 **	-3.54 **	-3.28 **	-3.13 **	-3.43 **	-3.08 **	-3.21 **
	(-10.21)	(-12.02)	(-10.89)	(-10.12)	(-10.94)	(-9.68)	(-9.55)
R^2	0.05	0.05	0.05	0.05	0.05	0.05	0.07
N	33,604	41,868	42,502	42,730	42,920	42,524	42,131
Firms	3,705	4,639	4,681	4,699	4,692	4,678	4,656
			Panel C: Mean Values for Low M/B Portfolio				
Hot	-11.67	-7.47	-6.23	-3.47	-2.64	-4.90	-4.11
Other	-0.03	0.24	0.16	0.33	0.89	0.52	0.70
t-value (difference)	(31.70) **	(21.96) **	(15.90) **	(8.26) **	(7.54) **	(12.99) **	(11.97) **
			Panel D: Regression Analysis for Low M/B Portfolio				
HOT_t	-7.58 **	-6.80 **	-6.62 **	-3.67 **	-3.50 **	-5.28 **	-4.87 **
	(-18.06)	(-18.24)	(-15.85)	(-7.81)	(-7.52)	(-12.60)	(-12.07)
HOT_{t-1}	2.22 **	2.20 **	1.48 **	1.70 **	0.75	1.26 *	0.92
	(5.68)	(6.65)	(3.76)	(4.28)	(1.60)	(2.94)	(2.16)
HOT_{t-2}	1.32 **	1.05 *	1.82 **	1.81 **	1.29 *	1.44 *	1.45 **
	(3.35)	(3.14)	(5.32)	(4.85)	(3.10)	(2.89)	(3.30)
$Market_t$	0.07	0.24	0.31 *	0.16	-0.04	-0.03	-0.05
	(0.52)	(1.75)	(2.38)	(1.31)	(-0.35)	(-0.28)	(-0.37)
M/B_{t-1}	-0.59 **	-0.60 **	-0.86 **	-1.56 **	-4.95 **	-1.79 **	-1.08 **
	(-3.26)	(-3.61)	(-3.82)	(-5.95)	(-9.78)	(-7.92)	(-5.55)
$EBITDA/A_{t-1}$	-1.63	-2.93 *	-0.02	1.02	-1.50	-2.23	-5.16 **
	(-1.50)	(-2.93)	(-0.02)	(1.21)	(-1.77)	(-2.27)	(-5.04)
$SIZE_{t-1}$	-0.02	-0.17 **	-0.08	-0.08	-0.07	-0.25 **	-0.25 **
	(-0.56)	(-3.55)	(-1.81)	(-1.83)	(-1.57)	(-5.19)	(-4.96)
PPE/A_{t-1}	0.48	0.19	1.31 *	0.57	0.07	0.97	1.36 *
	(0.92)	(0.40)	(2.82)	(1.29)	(0.16)	(1.95)	(2.58)
$R\&D/A_{t-1}$	-2.63	1.30	4.91	4.59	13.13 **	8.11 *	-2.97
	(-0.73)	(0.40)	(1.60)	(1.61)	(4.29)	(2.65)	(-0.96)
RDD_{t-1}	-0.37	-0.21	-0.15	-0.10	0.02	-0.50 *	-0.58 *
	(-1.81)	(-1.20)	(-0.86)	(-0.63)	(0.11)	(-2.62)	(-2.79)
d_{high}	5.97 **	4.51 **	5.05 **	4.92 **	7.85 **	7.21 **	8.46 **
	(13.53)	(10.10)	(11.52)	(11.86)	(20.91)	(20.55)	(26.99)
d_{low}	-3.44 **	-3.90 **	-2.71 **	-3.09 **	-3.71 **	-4.73 **	-4.59 **
	(-6.15)	(-7.87)	(-5.55)	(-6.50)	(-7.25)	(-8.19)	(-7.19)
R^2	0.07	0.06	0.06	0.04	0.07	0.07	0.09
N	11,183	13,558	13,806	13,894	13,970	13,749	13,550
Firms	2,271	2,822	2,864	2,872	2,863	2,839	2,813

	Change in Book Leverage D/A_t - D/A_{t-1}						
t	*t-5*	*t-3*	*t-1*	*t0*	*t+1*	*t+3*	*t+5*
	Panel E: Mean Values for Med M/B Portfolio						
Hot	-10.13	-5.99	-5.62	-5.33	-5.72	-5.64	-5.08
Other	0.32	0.51	0.63	0.79	0.25	0.32	0.46
t-value (difference)	(32.52) **	(22.22) **	(21.28) **	(20.60) **	(19.90) **	(19.40) **	(17.28) **
	Panel F: Regression Analysis for Med M/B Portfolio						
HOT_t	-5.57 **	-6.74 **	-6.59 **	- 6.36 **	-6.14 **	-6.06 **	-5.82 **
	(-15.14)	(-22.14)	(-21.91)	(-20.62)	(-19.89)	(-19.42)	(-17.85)
HOT_{t-1}	1.46 **	2.20 **	1.25 **	0.82 *	1.01 **	0.65	1.13 **
	(4.42)	(7.79)	(4.10)	(2.65)	(3.43)	(2.13)	(3.51)
HOT_{t-2}	0.52	0.60	0.94 *	1.10 **	0.94 *	0.82 *	0.44
	(1.56)	(2.13)	(3.23)	(3.51)	(3.13)	(2.71)	(1.40)
$Market_t$	-0.23	0.03	0.20	-0.22	-0.09	0.11	-0.25
	(-1.77)	(0.33)	(1.77)	(-1.84)	(-0.78)	(1.02)	(-2.12)
M/B_{t-1}	-0.16	-0.13	0.24	0.35	0.80 *	-0.82 **	-0.30 *
	(-1.37)	(-1.28)	(1.97)	(2.24)	(3.15)	(-6.37)	(-2.52)
$EBITDA/A_{t-1}$	-3.48 **	-3.69 **	-0.45	-2.15 *	1.58	1.63	-5.05 **
	(-4.13)	(-4.56)	(-0.60)	(-2.35)	(1.75)	(1.86)	(-5.92)
$SIZE_{t-1}$	-0.07	-0.09 *	-0.10 *	-0.08	-0.02	0.00	-0.05
	(-1.66)	(-2.36)	(-2.65)	(-2.20)	(-0.46)	(-0.10)	(-1.29)
PPE/A_{t-1}	1.28 *	0.81	0.34	0.34	1.41 **	1.50 **	1.93 **
	(2.68)	(1.92)	(0.80)	(0.79)	(3.31)	(3.46)	(4.19)
$R\&D/A_{t-1}$	9.76 **	7.06 **	1.20	6.00 **	7.92 **	5.26 *	8.11 **
	(3.53)	(3.35)	(0.55)	(6.96)	(3.63)	(2.53)	(3.94)
RDD_{t-1}	0.03	-0.05	0.01	-0.07	-0.32	-0.15	-0.17
	(0.19)	(-0.35)	(0.06)	(-0.49)	(-2.09)	(-0.97)	(-1.02)
d_{high}	5.54 **	4.97 **	4.85 **	5.53 **	5.34 **	6.36 **	6.91 **
	(15.81)	(16.34)	(16.85)	(19.12)	(18.75)	(23.78)	(27.42)
d_{low}	-3.88 **	-3.93 **	-3.93 **	-3.37 **	-3.29 **	-2.50 **	-2.91 **
	(-6.71)	(-7.44)	(-7.13)	(-5.53)	(-5.56)	(-4.24)	(-4.83)
R^2	0.06	0.07	0.06	0.06	0.06	0.07	0.08
N	14,368	18,070	18,335	18,349	18,518	18,378	18,205
Firms	2,861	3,545	3,587	3,600	3,597	3,574	3,562
	Panel G: Mean Values for High M/B Portfolio						
Hot	-11.79	-5.38	-5.62	-6.84	-6.20	-4.50	-3.25
Other	0.25	0.34	-0.02	0.08	0.34	0.51	0.83
t-value (difference)	(28.57) **	(14.73) **	(14.42) **	(19.16) **	(16.69) **	(11.65) **	(8.86) **
	Panel H: Regression Analysis for High M/B Portfolio						
HOT_t	-7.48 **	-5.88 **	-5.37 **	-6.76 **	-6.79 **	-5.39 **	-4.73 **
	(-15.64)	(-14.14)	(-13.16)	(-17.45)	(-16.39)	(-12.09)	(-10.12)
HOT_{t-1}	2.01 **	0.78	0.99 *	1.11 *	1.48 **	1.38 *	0.36
	(4.51)	(2.21)	(2.31)	(2.70)	(3.84)	(3.05)	(0.83)
HOT_{t-2}	0.08	0.18	0.04	0.37	0.39	1.05 *	-0.06
	(0.20)	(0.50)	(0.10)	(0.88)	(0.96)	(2.73)	(-0.15)
$Market_t$	-0.05	0.14	-0.37	-0.26	0.21	0.33	0.24
	(-0.28)	(0.86)	(-2.15)	(-1.45)	(1.19)	(2.04)	(1.42)
M/B_{t-1}	0.28 *	0.31 **	0.23 *	0.16	0.01	-0.28 **	-0.13
	(3.10)	(3.88)	(2.63)	(1.89)	(0.06)	(-3.37)	(-1.49)
$EBITDA/A_{t-1}$	-4.92 **	-6.27 **	-3.22 **	-1.75	-2.88 *	-1.60	-1.69
	(-4.91)	(-7.22)	(-3.47)	(-1.85)	(-2.96)	(-1.72)	(-1.77)
$SIZE_{t-1}$	-0.03	-0.04	0.06	0.02	0.03	-0.01	-0.14 *
	(-0.52)	(-0.78)	(1.15)	(0.32)	(0.55)	(-0.16)	(-2.53)
PPE/A_{t-1}	-0.26	-0.15	-1.26	0.20	-0.47	-0.08	0.96
	(-0.38)	(-0.25)	(-2.02)	(0.32)	(-0.71)	(-0.13)	(1.50)
$R\&D/A_{t-1}$	2.55	3.42	-5.15 *	-1.65	-0.99	-4.71 *	0.24
	(1.12)	(1.78)	(-2.69)	(-0.85)	(-0.49)	(-2.75)	(0.13)
RDD_{t-1}	-0.51	-0.32	-0.47	-0.37	0.15	-0.35	-0.02
	(-2.04)	(-1.46)	(-2.06)	(-1.57)	(0.65)	(-1.49)	(-0.09)
d_{high}	7.35 **	8.67 **	9.13 **	9.68 **	9.39 **	9.53 **	10.41 **
	(10.75)	(14.48)	(14.73)	(15.14)	(15.03)	(17.16)	(21.94)
d_{low}	-3.11 **	-3.03 **	-3.25 **	-3.03 **	-3.61 **	-2.53 **	-2.79 **
	(-4.91)	(-5.68)	(-5.86)	(-5.40)	(-6.47)	(-4.83)	(-5.09)
R^2	0.05	0.07	0.07	0.08	0.08	0.08	0.08
N	7,783	10,240	10,361	10,397	10,432	10,397	10,376
Firms	1,748	2,297	2,315	2,325	2,322	2,312	2,308

The results of the 11-year market-to-book window show that firms issuing seasoned equity in hot markets exhibit the effects of market timing, and that these effects fade in the years following the SEO. But the 11-year market-to-book window also shows that the market-to-book ratio impacts the effect of market timing on leverage, with market timing being driven by increases in the market-to-book ratio above the mean for high M/B firms. Also, hot-market firms have persistently lower profitability but persistently higher investment than non-issuers of seasoned equity.

Similar to the results for the SEO event dataset, the results of the 11-year market-to-book window show that costly capitalization due to transaction costs is not the motive force behind market timing. Hot-market firms actively increase their leverage levels in each year following the SEO year, and this should not be the case if transaction costs were an important factor in the raising of capital.

While consistent with rebalancing toward leverage targets as predicted by the trade-off theory, the displayed pattern of increasing leverage could also emanate from pecking order choices as well, in reflection of the lower profitability of hot-market firms compared to non-issuers. However, this argument is contradicted by the persistence of both lower earnings and higher investment while the difference in leverage rapidly diminishes.

Overall, the evidence supports the existence of leverage targets in a dynamic form of the trade-off model of capital structure, where capital structure may temporarily vary from the long-term target leverage level to reflect current conditions but thereafter reverts to the target. Exhibited market timing behavior during the cyclical variation in the market-to-book ratio is consistent with the growth model of Berens and Cuny (1995).

4.6 Conclusions

This paper examines the impact of market timing upon capital structure in the context of SEO issues. Consistent with the findings of Alti (2006) for IPO data, the results for SEO event data show that hot-market firms issue more equity than their cold-market counterparts, but the market timing effects on leverage reverse themselves within three years of the SEO event year. The reversal results show that hot-market firms actively increase their leverage levels in the immediate years following the SEO, which contradicts the transaction cost hypothesis, and supports a modified trade-off model. Hot-market firms invest less than cold-market firms and have lower profitability, again consistent with Alti (2006). Examining the results for sub sample portfolios formed on the market-to-book ratio shows that market timing effects are largely driven by the high market-to-book firms, as low and medium firms are largely unaffected by market timing effects. These results for market-to-book portfolios suggest that expected growth opportunities play an important role in market timing opportunities.

In the second part of the paper, the data is organized to create an 11-year window around portfolio formation on the market-to-book ratio to show the influence of the market-to-book cycle upon market timing. Most of the firm-year observations in the 11-year window are outside the event window of the SEO dataset, and so the 11-year data window represents the perspective of the overall market. The results for the 11-year window dataset are largely consistent with the results for the SEO event time dataset, insofar as hot-market firms have lower leverage levels in the SEO year compared to other firms in the overall market, followed by rapid reversal of market timing effects in the following years. Similarly, market timing effects are driven by the sub sample of firms with high market-to-book ratios. However, while results for the SEO event dataset show hot-market firms investing less than cold-market firms, hot-market firms in the 11-year window dataset invest more than non-issuers of equity in the overall market. So while hot-market firms time the market by issuing more equity than non-issuers, they also invest more. Furthermore, the market timing effect is significant in years when firm market-to-book ratio is increasing but this effect becomes insignificant as the market-to-book ratio subsequently reverts back to the mean. Under the prevalent interpretation that the M / B ratio reflects growth opportunities, these results suggest that market timing is a characteristic of firms with increasing expected growth in future cash flows.

In summary, the results of this paper show that firms tend to time the market for SEOs, but that these market timing efforts are subsequently reversed within a few years. The evidence supports a dynamic form of the trade-off theory of capital structure, where the capital structure policy of the firm may change in the short-term in response to changing expectations for future growth but reverts toward a long-term target leverage level. The exhibited market timing behavior is consistent with the growth model of capital structure.

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CHAPTER 5

CONCLUSIONS AND FUTURE RESEARCH

5.1 Conclusions

Three different perspectives of the relationship between leverage and expected returns are examined in this thesis by way of three studies. These studies indicate several general conclusions. The first study presents a theoretical model that examines the predictions of the trade-off model under conditions of leverage costs and investor portfolio choice in a mean-variance setting similar to the CAPM. The mean-variance trade-off model makes some very different predictions than the standard trade-off model. The mean-variance trade-off model provides a picture of the relationship between capital structure and expected returns that is closer to observed behavior in the real world than the standard model. The main result is that the mean-variance trade-off model correctly predicts that leverage should be negatively related to expected returns. The mean-variance model is consistent with the standard model, insofar as both show that the expected return of levered equity increases monotonically with leverage. However, the mean-variance model goes further to show that the excess return per unit of risk for unlevered equity increases faster than for levered equity as expected returns increase, and so there is a shift toward lower leverage as expected returns increase.

The second study examines how the value of debt and the capitalization rate vary with expected profitability, using the book-to-market equity ratio (BE/ME) as a proxy for expected profitability. The empirical results indicate that there are two opposing forces associated with an increase in expected profitability. There is a *leverage effect* where there is a positive relationship between the value that debt capital contributes to overall firm value – this leverage effect works to increase the leverage level of the firm. On the other hand, there is a *capitalization rate effect* where there is a negative relationship between the cost of equity capital and expected profitability – this capitalization rate effect works to reduce the leverage level of the firm. These opposing forces on the leverage level of the firm explain why there is a low observed covariance between the debt ratio and the book-to-market ratio of the firm. The observed negative relationship between leverage and profitability suggests that the capitalization rate effect is dominant. These results are consistent with a dynamic form of the trade-off model, in which the debt ratio shifts with changes in expected return but reverts to a long-term target leverage level determined by a balance between the two opposing effects.

The third study examines the a posteriori observed behavior of the leverage level following an SEO issue to test the predictions of competing capital structure models. This empirical study of the effect of seasoned equity offering (SEO) market timing upon the capital structure of the firm shows that the debt ratio of the firm rapidly returns to the previous equilibrium level within 3 years. These market timing effects are driven by firms with high market-to-book asset ratios (M/B). In a window of SEO events organized on the M/B mean-reversion cycle, where the M/B ratio proxies for expected growth in profitability, the results show market timing occurs when expected growth is increasing. Unlike the ambiguous result of Alti (2006) using IPO data that supports both the trade-off model and the Baker and Wurgler (2002) moving average model, the results for SEO data show that the Baker and Wurgler model is insignificant. These results are again consistent with a dynamic form of the trade-off model.

5.2 Implications and Future Research

The findings of this thesis have several implications for research in capital structure. The first study shows that a mean-variance trade-off model with the properties of leverage costs and investor portfolio predicts the observed behavior of the real world better than the standard trade-off model. This finding suggests that standard theoretical models can be extended by representing them in the mean-variance plane. This concept has implications for option models of the firm, as the value of the underlying equity is connected to the leverage level of the firm.

The second study shows the empirical implication that the market-to-book ratio represents two concurrent and opposing effects, the *leverage effect* and the *capitalization rate effect*, suggesting that alternate variables should be used to investigate the determinants of leverage. Since the traditional market-to-book M/B ratio incorporates both of these effects, new methods such as the Kemsley and Nissim (2002) debt valuation model should be used to separate these effects in empirical studies. Separating these effects can provide new insight into the puzzles of capital structure, such as why the debt ratio varies so little with changes in share price or the book-to-market equity ratio.

The third study illustrates the use of a hot-market dummy to provide an alternate method of testing capital structure theory. It is also illustrates that an SEO dataset can provide a clearer, less ambiguous picture of capital structure than IPO data, as SEO data represents long-term equilibrium for the ongoing firm. Future research could examine industry effects on the long-term capital structure and the time of reversion within different industries.

Overall, this thesis shows a strong connection between optimal leverage and expected returns. These results support continued research in this direction.