BUSINESS RISK AND THE TRADEOFF THEORY OF CAPITAL STRUCTURE: PREDICTING THE USE OF LONG-TERM DEBT IN THE HEALTHCARE SECTOR

by

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DEDICATION

To my wife, Lila, for her graceful support, patience, and love.

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CHAPTER I

Introduction and Literature Review

The primary question this dissertation seeks to answer is: What is the appropriate use of long-term debt for not-for-profit (NFP) healthcare providers? The most recent Healthcare Expenditure Account data indicate healthcare spending currently accounts for 16% of the Gross Domestic Product (GDP) and is projected to account for 19% of GDP by 2017 (Center for Medicare and Medicaid Services 2007). Even though healthcare spending will represent nearly one fifth of GDP by 2017, very limited research has been conducted in the area of healthcare capitalization. Many questions remain unanswered, such as how much debt should NFP healthcare entities be allowed to incur, should the public sector continue to subsidize the debt costs of healthcare firms, and what is the optimal capital structure of a healthcare organization?

A major area of research in corporate finance is capital structure and why firms use debt (Harris and Raviv 1991; Frank 2005). However, due to the unique ownership composition of the sector, relatively little work has been done within the NFP dominated healthcare setting. NFP hospitals account for approximately 70% of all hospital beds and 55% of hospital facilities, while for profit (FP) hospitals account for 29% of healthcare facilities and an even smaller percentage of hospital beds (CDC 2006). The pervasiveness of NFP entities is not limited to hospitals; NFP predominance occurs across the healthcare spectrum. NFP facilities account for approximately 34% of all nursing care facilities (NNHS 2000), while slightly more than 64% of home and hospice facilities are NFP (NCHS 2004). Unfortunately, the high prevalence of non/limited reporting of financial statements by NFP firms limits the type of information available to researchers to much less than is readily accessible for publicly held corporations. Consequently, traditional corporate finance research is more challenging in the NFP environment.

The arc of this dissertation will provide insight into the capital structure of healthcare providers by examining the relationship between capital structure and risk, identifying accounting variables that can predict risk, and assessing the predicted risk and capital structure of healthcare firms.[1] The balance of this chapter outlines the dissertation, summarizes the capital structure literature, briefly explores the concepts of risk and financial distress, and introduces healthcare finance within the NFP healthcare environment.

The first paper (Chapter 2) begins with business risk as measured by the Capital Asset Pricing Model (CAPM) and makes adjustments to account for the financial risk associated with the use of debt. What remains is a cumulative measure that captures the unique and market risk faced by both the debt and equity holders of a firm. The business risk and the volatility of that risk are then used to explain a firm's use of long-term debt.

The use of the CAPM to predict risk is predicated upon the use of stock prices and stock market fluctuations. As a result, in order for CAPM to predict risk as it is measured in Chapter 2, a firm must be publicly traded. This is particularly problematic given the

[1] The relationship between risk and capital structure is examined for the entire market, by sector, and then explicitly for healthcare delivery firms.

predominance of NFP firms in the healthcare sector. If one is to evaluate risk for NFP firms in the healthcare sector then a mechanism to measure risk not dependent upon market-derived data must be implemented. The second paper (Chapter 3) uses accounting information to develop a prediction of risk as measured by the CAPM in the previous chapter. This accounting-based prediction of risk serves as a crosswalk between a publicly traded, market environment where the CAPM functions and the NFP environment where, due to a lack of information, it does not. The use of accounting variables to impute risk removes reliance on market mechanisms and opens the NFP environment to risk analysis.[2]

Chapters Four and Five apply the relationships explored in the previous chapters to investor owned (IO) and NFP firms in the Healthcare Sector. Specifically, accounting variables are used to predict business risk (after adjusting for the use of debt). That risk, in conjunction with other, known predictors, is used to predict the use of long-term debt financing. Actual versus predicted use of long-term debt is reported by hospital ownership status. Although limited to hospitals in this dissertation, the same process can be used to analyze the use of debt among a host of NFP providers ranging from health maintenance organizations to nursing and home healthcare entities. A concluding chapter summarizes the material and suggests areas of future research.

[2] Specifically, the use of accounting removes reliance on the CAPM to measure risk.

Capital Structure Literature

When firms pay for operational activities, make acquisitions, or replace assets, they are faced with the question of whether to pay for those activities with debt, equity or some hybrid financing method. Capital structure can be thought of as the accumulation of each individual financing decision to arrive at the firm's cumulative use of debt and equity.[3] According to the seminal Irrelevancy Theorem (Modigliani and Miller 1958), how a firm decides to finance itself does not change the value of the firm. Investors can replicate the financial gearing of firms by borrowing to purchase equity and thus earn the same return as firms that use debt. In perfect capital markets a firm cannot change its value or investment behavior by changing its capital structure.

The markets, however, are far from perfect, and capital structure is relevant to the value of a firm. The U.S. tax code provides an interest expense tax shield; there exist non-trivial information asymmetries among firm insiders, lenders and potential investors; and there are substantial costs of financial distress, bankruptcy, and liquidation. Moreover, risk class identification is difficult, monitoring costs associated with imperfect contracts are prohibitive, and individual borrowing cannot be substituted for firm borrowing (Stiglitz 1988).

Understanding these market imperfections and how they affect the value of firms has been the focus of much research subsequent to Modigliani and Miller. The efforts

[3] This overly simplistic interpretation knowingly ignores other considerations in the determination of capital structure. The role strategy and other consideration have in determining capital structure is briefly considered when discussing the current areas of capital structure research.

can be roughly sorted into four main categories -- agency costs, asymmetric information, product/input market interactions, and corporate control considerations. [4]

I. Agency Costs

Agency costs arise when the incentives of stakeholders are not aligned with or do not reinforce each other (Jensen and Meckling 1976; Jensen and Murphy 1990). This may be best illustrated with the asset substitution phenomenon (Myers 1977; Gavish and Kalay 1983). As a firm's proportion of debt financing increases, equity holders/managers have an increased incentive to carry out more risky projects. Equity holders/managers are insulated from potential losses if the project is a failure since the debt issuers bear the bulk of the downside risk. If the project is successful, debt issuers do not share in the upside gains and the benefits accrue to the managers and equity holders. By not sharing in the downside risk, the expected payout to equity holders skews managerial behavior toward riskier projects that have the potential to decrease the value of the firm. Under the asset substitution framework the increased use of debt is related to firm value destruction.

Another example of an agency cost is related to what managers do with free cash flows. If firms have positive free cash flows that are not distributed back to equity holders, managers will have excess cash to direct toward pet projects, perquisites, and empire building. Demonstrated investment sensitivity to cash flow indicates that when excess cash resources are available, managers are more likely to seek out investment options. These options are not held to the same decision making rigor as when excess cash flows are not available. Under this heuristic managers are overly optimistic about cash flow, and/or executives are overconfident in their ability to achieve high returns for the firm (Shefrin 2007). Consequently, equity holders would prefer to have excess free

[4] These categories should not be considered mutually exclusive.

cash flows returned via a dividend or stock repurchase and altogether avoid the poor behavior of managers with excess cash (so they can reinvest at a higher expected return given the same underlying risk profile). When debt financing is implemented free cash flows are reduced and/or covenants set in place that limit the investment behavior of managers. Thus, some debt financing (leverage) does increase the value of the firm by imposing financial discipline on managers.

Borrowing again from the field of behavioral finance, reputational concerns may also play into how investment decisions are made (Diamond 1989; Hirshleifer and Thakor 1992). Not wanting to appear risk-prone or overly unconventional, managerial concern for reputation may encourage pursuit of overly conservative business strategies. This behavior runs counter to the asset substation effect and aligns management with debt holders at the expense of equity holders. When lenders recognize managerial conservatism they are more likely to make additional debt available and the firm becomes more leveraged. While the firm generates benefits from the additional debt capacity and increased return on equity, it also destroys the overall value of the firm through overly conservative management.

II. Asymmetric Information

Asymmetric information problems arise in corporate finance when firm insiders have or are thought to have more information than people outside the firm such as investors or debt issuers (Myers and Majluf 1984). The Pecking Order Theory (Myers 1984) maintains that because of information asymmetries, firms have a preferred sequence of financing. Firms will first seek to fund projects with internal funding (retained earnings or internal debt), move to external debt markets when internal funding is not available, and, finally, raise funds in external equity markets when other funding resources have been depleted. There are multiple reasons for the preferences but they can be fundamentally thought of as ease of administration and an effort to limit the financial impact on equity holders.[5]

The pecking order phenomenon is consistent with firms slowly changing their capital structure as internal equity is made available or debt levels can be supported. This is borne out by Leary and Roberts who find that frequently changing capital structure is very expensive and that capital structure remains relatively stable over time (Leary and Roberts 2005). It is worth noting that there does appear to be differential preferences for use of debt depending upon firm size (Frank and Goyal 2003). Additionally, evidence from the implementation of hybrid securities does not reinforce pecking order theory (Brennan and Kraus 1987).[6]

III. Product/Input Market Interactions (Industrial Organization)

In addition to the agency and asymmetric problems associated with debt, strategic signals (Leland and Pyle 1977; Ross 1977) may be sent to both competitors and the market through the use of capital structure. Firms that are highly leveraged have a limited ability to compete on a price basis (Poitevin 1989). As price declines, the margin between profitability and their debt obligations (and other fixed costs) decreases. When prices fall low enough, the highly leveraged firm runs the risk of falling into default. As

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[5] Firm insiders are presumed to have a more detailed understanding of the state of the firm. When managers raise capital in the external equity markets investors interpret the action as a managerial belief in the market's overestimation of firm value. Investors will account for the overestimation by lowering their price point and, as a result, new equity holders will expropriate wealth from existing equity holders.

[6] Issuing equity is a negative signal; however, simultaneously issuing equity and retiring/repurchasing debt with some of the proceeds perceived as a positive signal that does not negatively impact share price (Harris and Raviv 1991). See also Amy Ditmar, Why do firms issue equity, JF, Feb 07. Find that when managers thing mkt opinion aligned with that of firm, they use equity; otherwise debt.

a result, debt levels lower than industry norms may allow a corporation to increase market share through price predation or posturing. Conversely, debt levels at or above industry norms may signal an inability to compete based on price and emphasis on continuing with the status quo.

Debt levels also impact the bargaining position with external customers and suppliers. For the same reason cited above (smaller margin between revenue and fixed costs), highly leveraged firms are in a stronger or less flexible bargaining position with suppliers and customers (Sarig 1998). These highly leveraged firms can point to a reduced ability to extend price concessions to customers and a constrained capacity to cope with increased input costs.

IV. Corporate Control Considerations

The final area of research has focused on corporate control and how a firm's mix of debt and equity interact with governance and ownership. Not surprisingly, leverage is one of the many resistance techniques employed by firms to stave off takeover attempts (Harris and Raviv 1988).[7] First, debt covenants often include restrictions that limit managerial behavior or ownership and consequently the benefits that may accrue to future managers and equity holders. Second, leverage restrains behavior by using interest and principal payments that reduce future cash flows (Jensen 1986). Finally, as long as the incumbent has greater voting power than the rival, "issuing debt reduces the probability of the incumbent being voted out" by concentrating ownership (Harris and Raviv 1988).

[7] Other methods include targeted share repurchases, voting trusts, nonvoting equity, and targeted share repurchases.

It is clear that the relationships among firm value, competition, control, strategy and use of long-term debt are complex. The impact debt has on the firm is a mosaic- it has the ability to increase firm value under some circumstances and decrease the value of the firm in response to others.

Risk and Financial Distress

Risk can be defined as anything that may cause a firm to lose value. If there are no factors that act upon the firm and the probability of incurring any type of loss is nil then the firm carries no risk. This riskless environment is purely theoretical because firms exist in an environment where numerous forces expose them to potential losses. Some of these forces are a result of capital structure, some are endogenous to the firm but unrelated to capital structure, and yet other risks are completely exogenous to the firm. These potential losses can be divided into three different risk categories: unique risk, systematic risk, and financial risk.

Often referred to as unsystematic risk or idiosyncratic risk, unique risk is specific to the company.[8] The Brealey, Myers, and Allen (Brealey, Myers et al. 2008) corporate finance textbook maintains that these firm specific risks stem "from the fact that many of the perils that surround an individual company are peculiar to that company and perhaps its immediate competitors (p. 162)." Unique risks faced by those in the healthcare sector may include stagnant contractual reimbursements, local or regional price constraints, dissatisfied physicians and nursing shortages.

[8] Under modern portfolio theory, unique risk can be thought of as fully diversifiable risk.

Systematic risk, sometimes referred to as market risk, is risk that is tied to the economy as a whole. These risks include dangers such as a falling dollar, recession, and war. Regardless of diversification, these risks are "economy-wide perils that threaten all businesses" and cannot be avoided through diversification (Brealey, Myers et al. 2008). Combined together, unique and systematic risk are referred to as business risk.

Financial risk is directly related to the capital structure of the firm and refers to the possibility that a firm will not be able to meet its financial obligations. This financial default may be a result of too much leverage or inadequate cash flow. In either situation the firm has an obligation greater than the liquid assets available to make payments. Consequently, firms are forced into default or a “fire sale” liquidation of an asset that they would prefer not to liquidate (Shleifer and Vishny 1992).[9]

The trade-off theory is one of the leading models used to explain a firm’s overall use of debt and equity. The original trade-off theory of capital structure maintains that firms balance the deadweight costs of bankruptcy and tax benefits of debt (Kraus and Litzenberger 1973). The marginal costs of entering or being close to bankruptcy are set equal to the marginal tax benefits of debt (i.e. interest tax shield) such that the value of the firm is maximized. An expanded and more dynamic version of this initial trade-off interpretation accounts for bankruptcy and bankruptcy costs but also allows for the risks associated with information asymmetries, agency costs, corporate control, and market interactions. It does this by allowing for not only the interest tax shield of debt but for the other upside benefits of debt (i.e. reduced empire building, increased managerial discipline, etc.) and other downside risks independent of bankruptcy that associated with

[9] Sale prices that are a result of a fire sale are almost always well below the book value of the asset. This is largely attributable to the poor bargaining position of the seller.

debt (i.e. asset substitution, sub-optimal investment behavior, overly conservative managerial oversight).[10]

Using the Modigliani and Miller (MM) Irrelevancy Theorem as the starting point, the trade-off theory maintains the value of the firm with debt (V_L) is equal to the value of the firm without debt (V_U) if perfect markets persist. Recognizing that markets are not perfect and there are certain benefits to using debt financing (interest tax shield,[11] managerial discipline, etc.), the value of the leveraged firm can be increased by using more debt. However, debt financing cannot be used indefinitely without accounting for some of the costs discussed in the literature above. At low debt levels the costs of using debt are minimal to non-existent but as the proportion of debt increases so do the associated costs. At some point, the marginal costs of debt equal the marginal benefits and the firm arrives at its optimized firm value.

As discussed earlier, there are multiple factors that influence the use of long-term debt.[12] The corporate finance literature has used very specific measures such as the probability of bankruptcy or financial distress (Altman 1968; Piotroski 2000), the costs associated with being in bankruptcy or near bankruptcy, and other composite measures of distress (Warner 1977; Campbell, Hilscher et al. 2006) as a proxy for the costs of using debt. As the risk associated with these measures increases the required return to lenders increases and the use of debt decreases. Unfortunately, the specificity of these risk measures only partially captures the costs associated with debt and ignores many others

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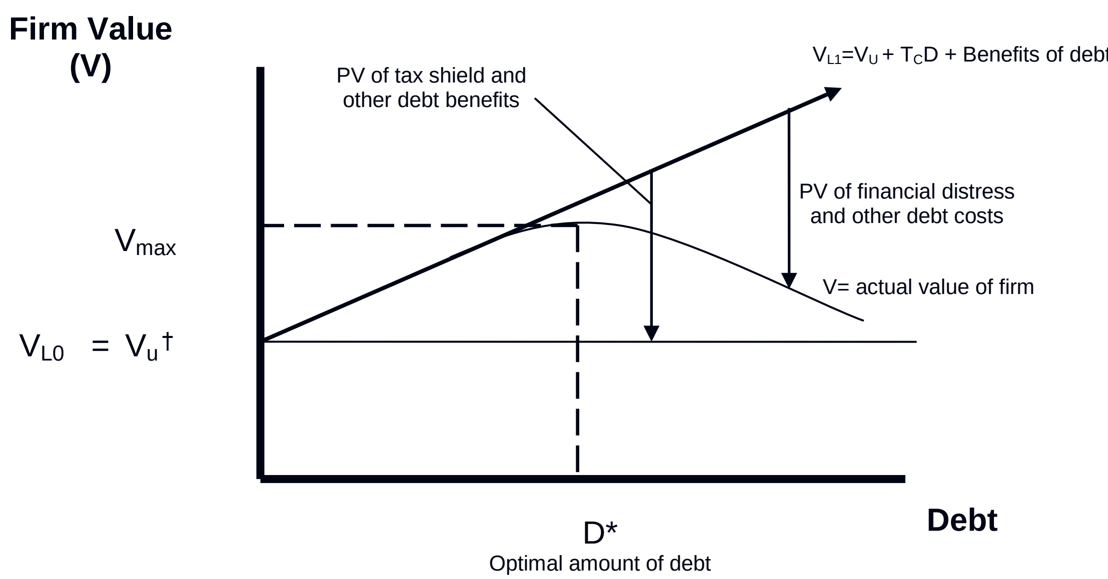
[10] The Pecking Order hypothesis is not entirely consistent with the tradeoff theory and is often put forth as a competing theory of capital structure.

[11] Tax shield = marginal tax rate (T_C) x debt (D)

[12] The decision of how much debt to use reflects a tradeoff of the benefits and costs of debt. The impact of these factors is not uniform—some lead to more debt and an increase in firm value and some lead to a decrease in debt and/or firm value.

(differential managerial incentives, asset substitution, debt overhang, etc.).[13] The benefits and costs of long-term debt are more than a single measure. The impact and interplay of debt and the firm span each of the four risk categories.

Figure 1.0 Dynamic trade-off theory (accounting for additional benefits, costs, and taxes associated with debt)



V_{max} occurs when marginal benefit of debt = marginal costs of debt.

† perfect market assumption

Movement away from very specific measures of risk is needed if one is looking to predict overall use of debt and not just incremental responses to specific risk factors. Built upon the work of Harry Markowitz (Markowitz 1952), the Capital Asset Pricing Model (CAPM) determines equity-specific required rates of return. As risk to equity

[13] For example, the Altman Z-score is a composite measure used to predict insolvency. It examines five financial ratios ranging from sales/assets to working capital/assets. These ratios may be able to predict bankruptcy but they do little to account for costs associated with asset substitution, information asymmetries, or other downside risks that are associated with the use of debt.

holders increases so do their required returns. Using the risk-reward relationship of the market, one can employ the CAPM to quantify all of the known risks faced by individual firms and then unleverage the firm to tease apart measures of financial risk from idiosyncratic and systematic risk (business risk). The result is a measure of the firm's inherent (business) risk due to the (co)fluctuations of the firm stock price and the overall market.

The Capital Asset Pricing Model (equation 1.0) maintains the required return to equity holders (R_E) is a function of the underlying risk-free return in the market (R_F),[14] a relative measure of risk (β_E), and the difference in return between the market portfolio (R_M) and the risk-free rate:[15]

$$R_E = R_F + \underbrace{\beta_E}_{\text{Risk (relative to market)}} * \underbrace{(R_M - R_F)}_{\text{Market risk premium}} \qquad \text{(Eq. 1.0)}$$

B_E, the risk to equity holders relative to the market, includes both business risk and financial risk. Because financial risk is largely dependent upon the capital structure of firms, β_E should be adjusted by removing the effect of leverage (Bowman 1979) to arrive at a measure of risk (β_A) that is independent of its capital structure (discussed in detail in Chapter Two). In as much as the market is aware of the risks faced by firms and has priced these risks into their expected return, β_A is a more inclusive measure of risk. It removes the effects of financial risk while simultaneously capturing financing constraints

[14] The risk free rate of return (R_F) is usually measured as the return on a one year treasury note.
[15] Equity beta (β_E) is measured as the covariance (stock return, market index) / variance (market index).

(debt overhang), differential incentives between equity holders and managers, asset substitution and a host of other market and firm specific risks.

The CAPM produces a cumulative measurement of the benefits and downside risks faced by the individual firm relative to the market. Firms carrying less risk relative to the market have a β_E<1 and have fewer costs that move them from V_{L1} in Figure 1.0. As a result these firms will be more highly leveraged since the risks and potential costs of debt are not as severe as others in the market. For these firms it takes more debt to arrive at the point where marginal benefits equal marginal costs. The converse is also true- those firms with β_E>1 experience more volatility relative to the market. Consequently, these firms will have greater forces moving them downward from V_{L1}. These firms will carry comparatively less leverage relative to the market.

Healthcare Finance and NFP Providers

The current scope of the healthcare capital structure literature is relatively limited. What does exist has found that NFP firms can also increase firm value from V_U to V_{L1} (Figure 1.0) by taking on debt. NFP firms derive similar financial benefit from debt financing (Gapenski 2003) as their FP peers. Although NFP firms do not benefit from the interest tax shield associated with debt, they do benefit from lower cost, tax-exempt debt.[16] But as in the FP context, the use of tax-exempt debt has costs as well as benefits. It is a source of low cost financing but it also generates similar debt related costs (debt overhang, pricing inflexibility, etc).

[16] Required return on tax-exempt debt (R_{NFP}) is equal to the required return on debt in the taxable arena (R_{FP}) minus the personal tax rate.

NFP healthcare firms do have some distinct advantages and disadvantages. First, the very nature of NFP firms may exacerbate the investment sensitivity to free cash flows found by Jensen (1986). Specifically, their inability to return equity to shareholders may make them particularly susceptible to poor investment behavior (Kauer and Silvers 1991).[17] Rather than distribute excess free cash flows to shareholders, the NFP administrator either builds the endowment or seeks out investment (Wedig, Hassan et al. 1996; Gentry 2002). Conversely, when free cash flows are scarce their limited access to equity may make them more risk averse than their FP peers (Wedig 1994) and may make changing capital structure relatively more difficult (Wheeler, Smith et al. 2000). Moreover, due to the disparate nature of stakeholders, NFP firms are not subject to the same oversight and market discipline as FP firms (Smith, Wheeler et al. 2000). Finally, the information asymmetries and agency issues that arise in the FP arena also affect NFP healthcare institutions (Calem and Rizzo 1995).

Second, NFP firms are also exempt from most federal, state, and local taxes. In exchange for this exemption these firms are expected to provide community benefits equivalent to the taxes they would have paid if they were a FP institution. Increasingly, healthcare providers are under state and federal pressure to demonstrate they are providing these benefits and are consistently threatened with loss of their 501c3 tax status (Bryson 2005; AHA 2008). To guarantee NFP firms are providing the required benefits,

[17] In traditional investor owned firms it is clear who has a residual claim on the assets of the firm once debt obligations have been met – the shareholders. Equity can be distributed to easily identifiable shareholders. The residual claim on assets is not as clear in NFP firms. Should the equity be distributed to consumers of healthcare goods in the form of lower charges, distributed among employees, returned to the community where the NFP operates, or returned to the local and national government whose forgone taxes have supported the enterprise?

the federal government (and a number of states) have increased the reporting requirements and stipulated charity care guidelines for NFP providers.[18]

Third, as mentioned earlier, NFP firms have access to tax-exempt debt (municipal bonds). This debt provides a return to investors that is not taxed at the local, state, or federal levels.[19]

Fourth and fifth, NFP firms have some favorable contractual procurement processes and are not perceived by the community to be driven by the profit motive (Steinberg and Gray 1993). As a result, the relationships between NFP healthcare providers and the communities they serve tend to be better than between FP providers and their communities.

On the flip side, NFP firms do not have access to the equity markets and consequently rely on government grants, retained earnings, and donations to generate equity. Moreover, the traditional market discipline instituted by investors is not in full play with NFP firms. FP firms are directly responsible to their shareholders. The stakeholders in NFP firms are much less concentrated and include physicians, patients, administrators and the general community. The disparate nature of NFP stakeholders often means balancing multiple agendas that are not necessarily consistent with market discipline.

Finally, payment schemes and contractual obligations are putting more pressure on the margins of all providers. The result is a NFP provider community that is beginning to more closely resemble the business model and practices of their FP peers

[18] IRS Form 990 Schedule H reporting requirements are mandated starting in 2009.

[19] The return on tax exempt debt is equivalent to taxable debt minus personal taxes (assuming debt markets are efficient). Moreover, to limit any potential arbitrage opportunities for NFP firms, tax regulations have prohibited the use of tax-exempt debt for anything other than very specific capital projects (project financing constraint clauses).

(Keeler, Melnick et al. 1999). NFP providers are just as concerned about their profitability- not because they are looking to distribute money back to equity holders, but because they are interested in sustainability and mission fulfillment.

The trade-off theory of capital structure set forth by Kraus and Litzenberger is an important framework for understanding how firms choose to finance their assets. Managers seek to balance the risks of debt financing outlined above with the benefits of debt financing. While prior research has looked at the impact specific risk measures have on the use of debt, it has been narrowly focused.[20] These narrowly focused measures of risk have then been used in the trade-off theory to predict capital structure. The next chapter in this dissertation will use a less specific, more comprehensive measure of risk to predict the use of long-term debt in both the overall market and in the healthcare sector. A more comprehensive measure of risk should more accurately predict the balance of risks and benefits due to the inclusion of more information. Because the healthcare sector is heavily composed of NFP firms, accounting data are used in Chapter Three to create a prediction of risk faced by healthcare firms where the CAPM is not available to predict risk. Chapters Four and Five predict risk (using accounting relationships from Chapter Three) and the use of long-term debt among FP and NFP healthcare provider and service firms in the Healthcare Sector. The concluding chapter summarizes the dissertation and posits directions for future research.

[20] For example, measures that capture the probability of bankruptcy fail to account for debt overhang or discipline of free cash flow investment.

CHAPTER II

Business Risk and the Two-Part Model

Is capital structure determined by risk? The use of leverage has received substantial attention in the last year and a half as the market has turned south and the government has become more involved in the propping up of companies that are overly indebted. As outlined in chapter one, prior research on capital structure and the use of long-term debt has focused on four particular factors: agency costs, asymmetric information, product/input market interactions, and corporate control considerations. The impact of these factors is not uniform—some lead to the use of more debt and others result in the decreased use of long-term debt. While important for marginal analysis, reliance on any one of the four research areas to predict the use of debt at the exclusion of others will result in a skewed prediction of long-term debt usage.

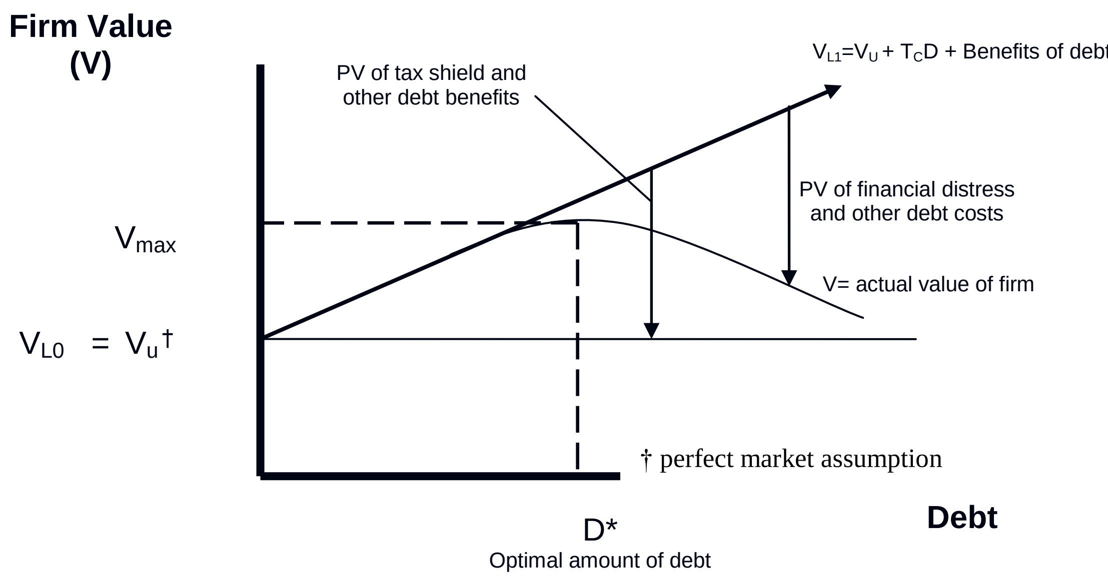
To more accurately predict the use of long-term debt one should employ a cumulative measure that accounts for the benefits and costs associated with each of the four areas noted above. The cumulative measure can then be used to predict use of long-term debt and identify outlier firms that are using debt in a way that does not reflect the risks and benefits they face. This chapter utilizes the Capital Asset Pricing Model (CAPM) to predict cumulative business risk to equity holders and then adjusts that measurement to account for the business risk to the entire firm. The CAPM derived, cumulative measure of risk is then used in a Duan, two-part model that first predicts the firm's probability of having long-term debt and then predicts the level of long-term debt for all firms conditional on nonzero leverage (Duan, Manning et al. 1983; Buntin and Zaslavsky 2004). The unconditional, predicted firm leverage is then estimated as the product of the probability of having debt (arrived at in the first stage) and the predicted leverage (derived in the second stage).

Background

The trade-off theory of capital structure is one of the leading models used to explain a firm's use of debt and equity. The original trade-off theory maintains that firms balance the dead-weight costs of bankruptcy and the tax benefits of debt (Kraus and Litzenberger 1973). The marginal costs of entering or being close to bankruptcy are set equal to the marginal tax benefits of debt (i.e. interest tax shield) such that the value of the firm is maximized (Figure 2.0).

Expanded and more dynamic versions of this initial trade-off interpretation have been explored but they have primarily focused on better measurements of potential bankruptcy or near bankruptcy costs while ignoring the potential costs of reduced pricing flexibility, covenant restrictions, asset substitution, etc., that are also associated with the use of debt (Warner 1977; Campbell, Hilscher et al. 2006). Even with better measures of potential bankruptcy and financial distress, it is argued that the tax shield benefits associated with using debt are substantially larger than the potential costs at existing rates of leverage (Miller 1977; Graham 2000). Based upon these historical models it appears that firms are not taking full advantage of debt-related tax shields and are not financing activities with the optimal amount of debt.

Figure 2.0 Dynamic trade-off theory (accounting for additional benefits, costs, and taxes associated with debt)



V_{max} occurs when marginal benefit of debt = marginal costs of debt.

Using the same trade-off theory framework, more recent models account for firm characteristics, industry fixed effects, debt holder ability to force a firm into bankruptcy, and sample changes that are a result of firm exit (Ju, Parrino et al. 2005; Lemmon, Roberts et al. 2006). While the more recent models do improve the operationalization of debt costs and have better explanatory power, the marginal benefits associated with debt usage continue to exceed the predicted marginal costs of debt at typical leverage ratios. Even with better measures of bankruptcy and financial distress, the existing measures of debt costs and benefits are insufficiently comprehensive to fully explain capital structure under the trade-off theory framework. Moreover, it is recognized that an "important factor is missing from existing specifications of leverage and that this factor contains a significant permanent or time-invariant component…"(Lemmon, Roberts et al. 2006).[21]

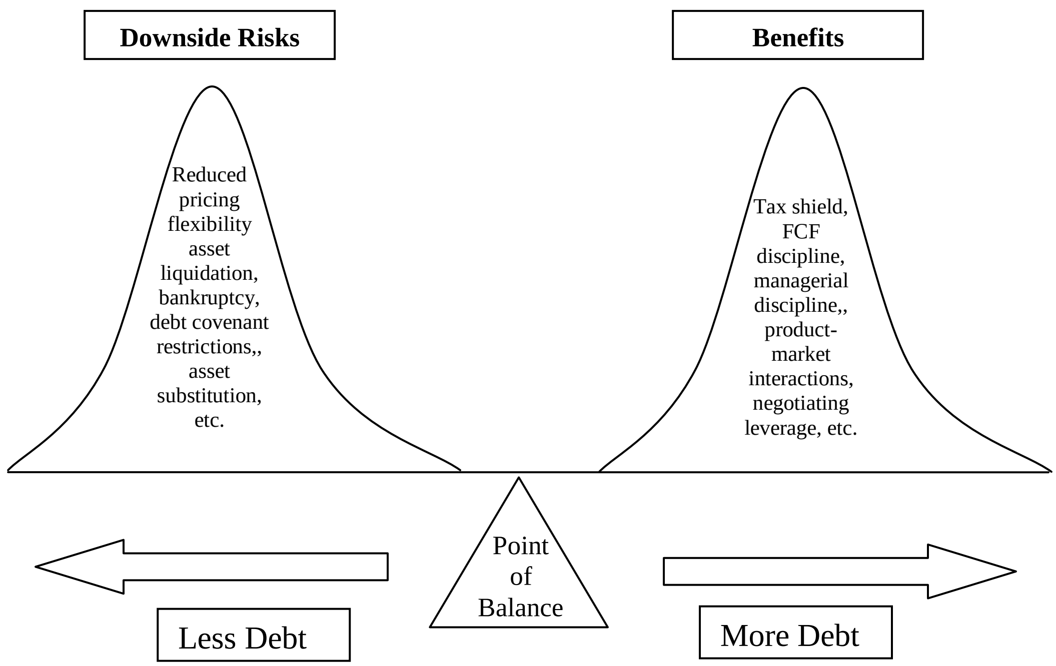
Some of the apparent underuse of debt can be attributed to how the costs and benefits of debt are measured. As illustrated by Figure 2.1 and enumerated in the previous chapter, the use of debt has multiple benefits and multiple costs to a firm. The magnitude of these costs and benefits are not only industry specific but they are firm specific. Each firm selects the point in their capitalization distribution that balances the downside risks with the upside benefits. Unfortunately, measurement of the upside benefits of debt has been largely limited to the tax shield associated with debt and the downside risk has been clustered around those activities that occur when a firm is in or near financial distress (i.e. bankruptcy and asset liquidation costs). While the tax shield benefit and financial distress costs are substantial components of the benefits and the downside risk, there are other debt effects that shift the point of balance towards the use of more or less debt.

To account for the risks associated with information asymmetries, agency costs, corporate control, and market interactions, the substantive contribution this chapter makes to the literature is the application of a more expansive measure of risk to predict

[21] Lemmon, Roberts, et al. recognize that in their analysis there is a time-invariant component missing from their analysis. They do not specifically identify that component.

the use of long-term debt. Moreover, the use of a two-part model to account for the substantial number of firms without leverage is also a novel approach.

Figure 2.1 Determination of Optimal Debt [22]



Theory & Hypothesis:

If the efficient market hypothesis (EMH) is correct and markets eventually reflect available information (Fama 1970), then reliance on the market and the CAPM should capture the investors' belief that the firm may have some risk exposure. The CAPM-

[22] The actual components and impact of those components on benefits and downside risk will have industry similarities but is ultimately firm specific. Industry fixed-effects may capture some idiosyncratic risk but their use does not capture all the unique risks associated with using debt for the firm.

based measure of risk captures the interest tax shield of debt as well as the other benefits of debt (i.e. reduced empire building, increased managerial discipline, etc.). It also captures other downside risks independent of bankruptcy that are associated with debt (i.e. asset substitution, sub-optimal investment behavior, overly conservative managerial oversight). In as much as it is aware, the market adjusts and the CAPM captures changes to the expected returns to reflect the cumulative risks to and benefits for a firm. The market associated nature of a CAPM-based measure is not limited to bankruptcy costs or one of the four factors noted in the previous chapter. The CAPM-derived measure more comprehensively captures risk and has the potential to explain the time-invariant determinant of capital structure identified by Lemmon and Roberts (2006).

As outlined in the previous chapter, firms face unique, market, and financial risks. Adjusting the CAPM's measure of risk by teasing apart financial risk from business risk (unique and market risk) allows one to quantify the cumulative risks a firm faces independent of its capital structure. The resulting measure of business risk is a wide-ranging measure that partially captures portions of the risk associated with the four existing areas of capital structure research. In addition, the adjusted risk measure introduces other factors faced by the firm (i.e. strategic position, legislative lobby, management turnover, etc.) that impact the profitability of the firm and its ability to secure and repay low-cost debt

Using unique and market risk (as measured by the CAPM and adjusted to remove the effect of financial risk) in the theoretical framework of the trade-off construct instead of the very specific measures of risk that have been employed should improve the trade-off theory's ability to predict capital structure. Not only does the CAPM-derived measure

(β_A) capture more of the benefits and costs associated with the use of debt but it also has the potential to explain time-invariant components and other factors that may impact leverage differences between sectors. The risk measure is examined alone and in tandem with existing determinants of leverage. By adding the CAPM-based measure of risk is to traditional determinants of leverage (Barclay, Smith et al. 1995; Baker and Wurgler 2002) one can ascertain if additional explanatory power is gained or if the CAPM-derived measure of risk is merely collinear with existing predictors of long-term debt.[23,24] The validity of using a market-associated, CAPM-derived measure of risk is examined for the entire market as well as by sector.

Conceptually, this dissertation is proposing that leverage is a function of long-term risk, short-term risk volatility, and the interaction between long-term and short-term risk volatility (Eq. 2.1). As long-term business risk (long-term risk or underlying risk) increases the use of debt will decrease. A result of the risk-reward relationship, lenders will charge firms a higher borrowing premium and/or place greater restrictions on the use of funds as the riskiness of borrowers increases. Higher risk premiums being extended to risky firms (and consequently a higher cost of debt financing), volatility in cash flows resulting from business risk, and debt-covenant restrictions make the use of debt for riskier firms less desirable.

[23] Traditional models have focused on financial distress costs and the tax-benefits of debt when predicting capital structure. Attempts to model leverage as a function of business risk have been restricted to the use of cash flow volatility and are not commonly used (Kale and Noe 1991).

[24] Business risk is commonly referred to as a factor that impacts the use of debt; however, few papers have attempted to use business risk as a predictor of leverage. The problem is that the investigators measured business risk as the volatility in realized cash flows. This retroactive perspective only captures the realized business risk instead of the business risk looking forward as ascertained by the market (Kale and Noe 1991, Titman and Wessels 1988, Flath and Knoebler 1890).

Leverage = f(long-term risk, short-term risk, and long/short-term interaction term) (2.1)

A similar scenario is played out for firms experiencing short-term volatility in business risk (short-term risk). These firms are likely to experience higher costs of debt financing due to uncertain cash flows, higher risk premiums, and restrictions on the use of funds. High volatility firms will also shy away from high cost debt obligations that may impede their ability to pursue optimal investment and operational activities.

The following hypotheses are proposed:

H_o: The use of a market-derived measure of risk is not associated with a firm's use of long-term debt.

H_{A1}: A market-derived measure of long-term or underlying risk is negatively correlated with the use of long-term debt.

H_{A2}: A market-derived measure of short-term risk is negatively correlated with the use of long-term debt.

H_{A3}: The interaction between a firm's short-term and long-term business risk is associated with the use of long-term debt. If the interaction term is negative, the impact of having both high underlying risk and high short-term risk is greater than the cumulative impacts of short and long-term risk considered separately. The converse also holds. If the interaction term is positive, the impact of having both high underlying risk and high short-term risk is less than the cumulative impacts of short and long-term risk considered separately.

Data & Descriptive Statistics

Three years (2005-2007) of full-year, audited data for firms currently traded on the AMEX, NASDAQ, NYSE, NYSE ARCA, Non-NASDAQ OTC Equity markets, and other OTC Bulletin Boards were used in this study. To be included in the study firms were required to be currently listed in the multi-sourced Global Industry Classification Standard (GICS) and traded in the United States.[25] A joint venture between Morgan Stanley and the Standard & Poor's, the GICS is broken into ten sectors: Consumer Discretionary, Consumer Staples, Energy, Financials, Health Care, Industrials, Information Technology, Materials, Telecommunication Services, and Utilities. These sectors are further broken down into industries and sub-industries. Additionally, firms were required to have market capitalization and total assets greater than 5 million and have an equity beta (β_e) for each of the three years in the study to be included in the sample.[26] Prior to the application of any of the above requirements the initial sample consisted of 5,819 firms; the final sample includes 4,547 firms.

The sample requirements appear to have a proportional impact with no one sector changing more than 1% relative to others as the restrictions are added by year. For analysis purposes all mutual funds, indices, and firms with missing market-based calculations of risk are excluded from the sample. The composition of the initial sample

[25] Over 85% of the firms in the sample are either traded on the NASDAQ or the NYSE. The AMEX accounts for 8.20% of the sample, with the remaining exchanges accounting for less the 5% respectively.
[26] Equity betas were gathered from Compustat and calculated by Barra (60-month Standard & Poor’s 500 Index calculation).

and the incremental impact of these requirements by year are reported in Table 2.0. Five firms are excluded from the 2005 sample due to missing risk calculations. The final sample composition, reported by GICS sector, is reported in Table 2.1.

Dependent Variable: Long-Term Debt Financing Ratio (LTDFR)

As one would expect, there is significant variation in the use of long-term debt within a sector as well as between sectors. Traditionally interpreted as loans and financial obligations that last greater than one year, long-term debt was gathered for each firm from their annual SEC filings using Compustat code FG_DEBT_LT_A(0). Following the example of Fama and French (2002) and Titman and Wessels (1988), the long-term debt was divided by the book value of each firm's assets (Compustat code FG_ASSETS_A(0)) to standardize reporting (Chaplinsky 1986; Titman and Wessels 1988; Rajan and Zingales 1995; Baker and Wurgler 2002; Fama and French 2002).[27] The result is a long-term debt financing ratio indicating the proportion of a firm's book value of assets that are financed with long-term debt. Depending upon the weighting of the sample, firms have an average of between 20-22% of their assets financed with long-term debt.[28] Table 2.2 reports the both the weighted and unweighted 2007 long-term debt financing ratio (LTDFR) and the three year average long-term debt financing ratio.

Due to the high transaction costs of issuing or retiring debt, seasoned equity offerings, and initial public offerings, changing capital structure can be very expensive

[27] Evidence is mixed on whether managers think of capital structure in term of book values or market values. As a result both book and market values of assets have been used to standardize debt levels in the literature. Given that the findings of this chapter will ultimately be applied to the not-for-profit sector, book values of assets were selected over the market value of equity approach.
[28] When the sample is weighted, it is weighted by the book value of assets.

Table 2.0 Sample composition by GICS Sector

	Initial Sample- No restrictions		2007 (with restrictions)		2006 (with restrictions)		2005 (with restrictions)	
Sector	**# of Firms**	**% of Sample**	**# of Firms**	**% of Sample**	**# of Firms**	**% of Sample**	**# of Firms**	**% of Sample**
Consumer Discretionary	853	14.66%	761	14.63%	726	14.83%	692	15.20%
Consumer Staples	216	3.71%	191	3.67%	190	3.88%	176	3.87%
Energy	379	6.51%	354	6.81%	318	6.50%	275	6.04%
Financials	1189	20.43%	1152	22.15%	1108	22.64%	1050	23.07%
Health Care	868	14.92%	744	14.31%	677	13.83%	615	13.51%
Industrials	736	12.65%	657	12.63%	635	12.98%	589	12.94%
Information Technology	1076	18.49%	910	17.50%	842	17.20%	790	17.36%
Materials	275	4.73%	231	4.44%	208	4.25%	186	4.09%
Telecommunication Services	106	1.82%	82	1.58%	76	1.55%	68	1.49%
Utilities	121	2.08%	118	2.27%	114	2.33%	111	2.44%
Sample	**5819**		**5200**		**4894**		**4552**	

Table 2.1 Final sample composition

	After removal of missing betas		Non-leveraged Firms		
Sector	**# of Firms**	**Percent**	**# of Firms**	**Percent of Sample**	**Percent of Sector**
Consumer Discretionary	692	15.22%	170	3.7%	24.57%
Consumer Staples	175	3.85%	32	0.7%	18.29%
Energy	275	6.05%	51	1.1%	18.55%
Financials	1049	23.07%	237	5.2%	22.59%
Health Care	614	13.50%	226	5.0%	36.81%
Industrials	588	12.93%	125	2.7%	21.26%
Information Technology	790	17.37%	399	8.8%	50.51%
Materials	186	4.09%	19	0.4%	10.22%
Telecommunication Services	67	1.47%	12	0.3%	17.91%
Utilities	111	2.44%	4	0.1%	3.60%
Sample	**4547**		**1275**		

for a firm. As a result firms are reluctant to frequently change capital structure (Leary and Roberts 2005). The long-term debt levels in the weighted sample support this contention with the 2007 long-term debt financing ratios (20.68%) closely resembling the three year averages (19.15%). The unweighted 2007 LTDFR are slightly higher than the unweighted three year averages. This reflects equal treatment of small and large firms and that small, start-up firms are often in the process of leveraging.

For various reasons firms may elect not to use long-term debt as a method of financing assets and operations. While 1,275 firms or 28% of the sample does not employ any long-term debt financing (Table 2.1), those that use this mechanism finance 20.7% (weighted by book value of assets) of their assets and operations through long-term debt.[29] The Information Technology Sector accounts for 399 firms or close to 25% of the non-leveraged firms. Fully equity financed firms are least common in the Telecommunication, Material, and Utilities Sectors. These sectors account for a combined total of 0.8% of the non-levered firms in the sample. Figure 2.2 illustrates the distribution of the long-term debt financing ratio across all sectors. If the 1,275 firms in the sample that do not use long-term debt are included, the average LTDFR for the sample is .1723. Figure 2.3 illustrates the average change in the use of long-term debt from 2005-2007. The mean is centered at .02 with roughly half the firms decreasing leverage over the two year period. Excluding firms with no long-term leverage in 2007 centers the distribution on .0132 meaning that firms increased their long-term debt financing ratio less than 1.3% on average over the three years 2005-2007. If all firms in the sample are included, there is an average increase of 2% in the long-term debt financing ratio over the three year period. The small changes lend support to Leary and

[29] The unweighted long-term debt financing ratio (excluding firms with no long-term debt) is .2394.

Roberts (2005) contention that capital structure is not actively manipulated from period to period. [30]

Table 2.2 Weighted and unweighted long-term debt financing ratios†

	Weighted		Unweighted	
Sector	**2007 LT Debt Financing Ratio**	**Three Year Average LT Debt Financing Ratio**	**2007 LT Debt Financing Ratio**	**Three Year Average LT Debt Financing Ratio**
Consumer Discretionary	0.3214	0.303	0.2777	0.2046
Consumer Staples	0.2136	0.2065	0.2446	0.1991
Energy	0.1753	0.1718	0.2569	0.2135
Financials	0.1859	0.1766	0.1695	0.1274
Health Care	0.1887	0.1646	0.2645	0.1602
Industrials	0.2912	0.2781	0.2065	0.1735
Information Technology	0.1513	0.1029	0.1914	0.088
Materials	0.2358	0.2365	0.2499	0.2227
Telecommunication Services	0.267	0.2534	0.4475	0.3627
Utilities	0.3027	0.3056	0.3005	0.2998
Sample	**0.2068**	**0.1951**	**0.2286**	**0.1622**

† Weighted by book value of assets

Explanatory Variables: Business Risk and the Volatility of Business Risk

To assess risk, the equity markets and researchers have turned to the capital asset pricing model (CAPM) (Novak 2007; Fernandez 2009). As previously outlined, Harry Markowitz's work on the CAPM determines equity specific returns based on risks and opportunities as assessed by equity investors. The CAPM measures the movement of a

[30] Capital structure is expensive to manipulate and is relatively stable over time. It has been demonstrated that as long as it remains within a managerially determined corridor firms do little active management of capital structure to influence the return to equity holders. The stability of leverage may also be due to the high persistence of idiosyncratic and market risk from period to period.

firm's stock price relative to the overall market and assigns the firm's equity a risk rating. The more a stock price fluctuates in relation to the overall market the greater the level of risk to the investor. As the trade volume of a given stock increases the accuracy and reliability of the market's assigned equity risk rating also increases.

The capital asset pricing model (Equation 2.2) holds that a firm's expected return in the period, $E(R_i)$, is a function of the risk free rate, R_F, the average equity risk premium in the market, (R_M-R_F), where R_M is the average return on all securities in the market, and the equity beta, β_E, the amount of risk that equity holders in a particular firm face relative to the average equity risk in the market.

$$E(R_i) = R_F + \beta_E(R_M - R_F) \tag{2.2}$$

Capturing the unique, market, and (to some degree) financial risk faced by a firm, β_E, can be thought of as the volatility of an asset relative to the typical market asset. A $\beta_E < 1$ is indicative of a firm less risky than average while a $\beta_E > 1$ indicates a more risky than average security. The equity beta is calculated by dividing the covariance of the firm's equity rate of return (R_i) and equity market return (R_M) by the variance of the equity market return (Equation 2.3).[31] Equity betas (β_E) were drawn from Compustat using a universal screening tool for each year in the study and is measured as the 52 week

[31] A β greater than one indicates the covariance between the firm's stock price and market return is greater than the variance in the market return. More intuitively, if beta is greater than one, then as the market goes up 2 percent the firm's stock price would go up by more than 2 percent. A firm whose stock price moves in lock step with the overall market has a β of one and those firms whose stock prices do not amplify market movements or does not move in lock with the market have a β of less than one.

Figure 2.2 Long-term debt financing ratio (Full Sample)

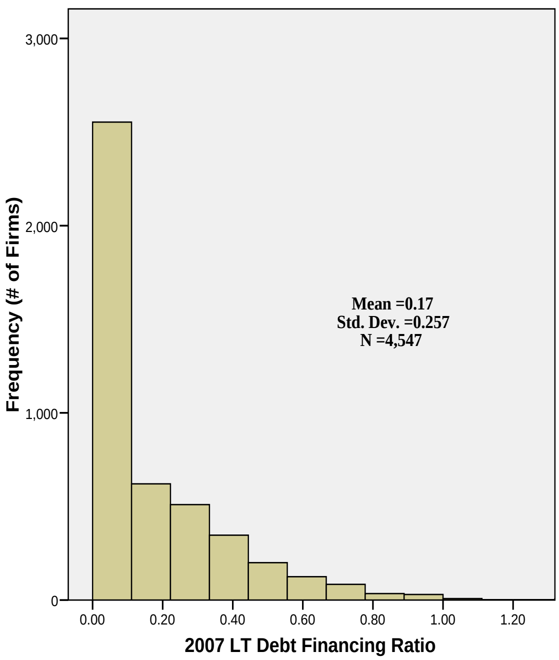
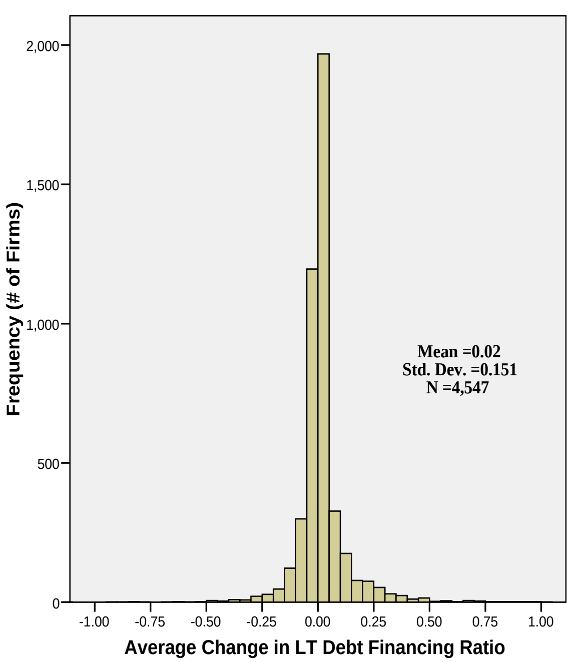


Figure 2.3 Average change in long-term debt ratio 2005-2007 (Full Sample)



covariance of a firm's stock return and the NYSE return over the variance of the NYSE return during the same period.[32]

$$\beta_E = \beta_{im} = \frac{Cov\,(R_i, R_m)}{Var\,(R_m)} \qquad (2.3)$$

The more volatile a firm's stock price relative to the market the greater the beta. The risk premium (R_M - R_F) is then applied to the beta such that firms more risky than the average security have a larger risk adjustment priced into their expected returns. A firm with the average cumulative risk (financial, market, and unique) receives the average risk premium adjustment (β_E =1) such that the expected return on the security equals the expected return for the entire market.

Unfortunately for those attempting to assess the business risk to an entire firm, the CAPM is a measurement of equity risk that overstates the risk faced by all the stakeholders of the firm by ignoring the risk to debt holders. Adjusting the analysis to reflect the capital structure of the firm is important since a firm's use of debt impacts the expected return to equity holders. As the proportion of debt increases the equity risk relative to the asset risk of the firm also increases (Brealey, Myers et al. 2008; Ross, Westerfield et al. 2008). More simply, as firms take on more debt (leverage up) the expected return to equity holders also increases (Modigliani and Miller 1963).[33, 34] Using

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[32] To account for outliers, β_A 's above the 95% confidence interval were set to the beta value associated with the outer limits of the 95% confidence interval.

[33] To reflect the additional equity risk, stock purchasers bid down the stock price when additional debt is issued. The lower stock price and unchanged earnings projection then reflect the higher required returns.

[34] Based on Modigliani and Miller proposition II, the cost of equity is a function of the firm's debt to equity ratio because of the higher risk involved for equity-holders in a company with debt. Due to seniority and subordination clauses, high amounts of leverage can also lead to the required return to debt increasing.

unadjusted CAPM beta estimates as measures of risk only accounts for that portion of the firm financed with equity. Since the required return on equity is always equal to or greater than the required return on assets, one introduces a bias that overstates the overall risk of the firm by not accounting for a firm's use of debt and just focusing on risks faced by equity holders.

To accurately account for the risk faced by the entire firm (debt and equity holders) one must unleverage, or remove the effect of capital structure on β_E. Risk to the entire firm, denoted by β_A, is the weighted average of the risk associated with the equity (β_E) of the firm and the risk associated with the debt (β_D) of the firm, where D is debt of the firm, E is the equity of the firm, and V is the value of both debt and equity (Equation 2.4).[35]

$$\beta_A = \beta_D\left(\frac{D}{V}\right) + \beta_E\left(\frac{E}{V}\right) \tag{2.4}$$

While either book or market equity and debt values can be used to unleverage β_E, the primary approach used in this chapter is to unleverage β_E using the book values of equity (however, the results of both methods are presented in the chapter).[36] The next chapter's prediction of long-term business risk, as approximated by the CAPM, allows for application of the model to the larger Healthcare Sector.[37] The lack of market values

[35] Results using market based equity values to unlever β_E are reported and are likely to be the subject of future research and papers.
[36] For example, the market value of CIGNA Healthcare's equity is \$9.1B and it has a β_E of 1.86. The book value of CIGNA's equity is close to \$5.4B with little/no difference between the market and book values of debt at \$37.5B. Using market values to unleverage β_E results in a β_A of .3632 ((9.1B/(9.1+37.5))*1.86) because β_D is assumed to be zero. Using book values of equity to unleverage β_E results in a β_A of .2155 ((5.4B/(5.4+37.5))*1.86).
[37] Moreover, using book values of equity to unlever equity betas produces more accurate predictions.

for not-for-profit firms in the sector would limit application of the unleveraging methodologies to publicly traded firms. Book values of assets and equity are reported for most of the sector and allow the model to be applied to the entirety of the sector.

The CAPM produces an estimate of equity risk, β_E , that is the covariance (stock return, return of market index) divided by the variance (return of market index). The risk associated with debt, β_D, can be similarly estimated as the covariance (return to debt holders, return of equity market index) divided by the variance (return of equity market index). As long as the value of the firm's assets is greater than the debt of the firm then the value of debt will not fluctuate with the market. If a firm with a sufficient asset base enters financial distress debt issuers can be reasonably assured that the assets of the firm can be liquidated and the debt repaid. [38] Liquidation values greater than debt obligations lead to the lack of fluctuation in debt values. Because the value of debt does not fluctuate with the market the covariance (debt value, market index) is 0. As is common practice, β_D can be set to 0 and β_E multiplied by the value of equity over the value of the firm to remove the effect of leverage and determine the business risk to the entire firm (β_A) (Bowman 1979).[39]

Economic and political forces work in different ways on different sectors. As the risk in the Energy Sector increases the risk in another sector may decrease. While there are relationships between sectors, one would anticipate differences in business risk between different segments of the market. The three year average business risk (long-term risk) to the entire firm (β_A), the risk to equity holders (β_E), and the volatility of that risk are reported in Table 2.3 by sector and for the entire sample. A result of equity

[38] There are 42 firms in the sample (0.97%) who have a LTDFR of greater than 1 in the sample.
[39] This assumption sets the covariance of the market or book value of debt and NYSE equal to 0. Consequently β_D equals 0.

holders having a claim on cash flows only after debt obligations have been met, risk to equity holders (β_E) is (and should be) greater than risk to the entire firm (β_A). Business risk is also consistently higher when market values of equity are used instead of book values of equity.[40] The Energy Sector, regardless of weighting and method of unleveraging β_E, carries the most business risk for the entire firm. Independent of the method of unleveraging and weighting of the sample, the Financial Sector carries the least amount of business risk as assessed by the market.[41,42]

Volatility of business risk, or short-term risk, is measured as the standard error of the mean unleveraged business risk (β_A) over the three year period of the sample and is reported in Table 2.3. The method of unleveraging β_E and whether the sample is weighted or not changes which sectors are the most volatile. Using market values of equity to derive business risk volatility, the Materials Sector is the most volatile (.1335) in the weighted sample while the Healthcare Sector (.6953) is the most volatile in the unweighted sample. When book values of equity are used to derive a firm's business risk, the Information Technology Sector (.0936) is the most volatile in the weighted sample and the Healthcare Sector (.4678) is the most volatile in the unweighted sample. Figures 2.5 and 2.6 present the distributions of market and book-derived business risk respectively. The market derived distribution of a firm's business risk is centered at .47

[40] The higher business risk is a result of market values of equity being greater than book values of equity. Because a firm's business risk is proportional to the percentages of debt and equity financing, market values of equity place greater weight on higher risk, equity financing.
[41] From 2005-2007. Volatility of the market (as measured by the S&P volatility index – VIX) during the 2005-2007 time frame is well within the cyclical variation experienced during the prior 20 years. After 2007, the markets did experience a sharp increase in volatility that peaked in late 2008 (October 2008); however, after the spike and since April 2009 the markets have returned to the normal cyclical variation experienced prior to the market correction. Because the CAPM measure of risk is measuring firm-specific variation relative to the market variation and not the absolute level of the market, changing the 2005-2007 time frame would likely have little impact on the estimates of long-term risk.
[42] Four and five year time periods were examined and found to not substantively impact estimates of long-term business risk.

(unweighted). Book-derived business risk is substantially lower at .35 (unweighted). Figures 2.7 and 2.8 present the volatility of business risk (short-term risk) using market and book values of equity to unlever β_E.[43]

Existing Explanatory Variables: Tobin's Q, Altman Z-Score, Intangibles, Fixed Assets, and Liquidity

The traditional determinants of leverage are included in this chapter for two reasons. First, inclusion validates prior research using the Duan two-part methodology. Prior capital structure research has modeled changes in debt financing on changes in explanatory variables, excluded firms with no financial leverage, or all-together ignored the limited dependent nature of the LTDFR (Titman and Wessels 1988; Shyam-Sunder and C. Myers 1999; Lemmon, Roberts et al. 2006). Second, it serves as an important reference point when ascertaining the validity of using business risk as a determinant of long-term debt financing. They are added to the business risk conceptual model (Eq 2.1) in an effort to determine if business risk is a unique predictor of capital structure or if it is merely collinear with the existing models of capital structure.

A number of models have been used to predict leverage using the trade-off theory of capital structure. Some of these models have included market-to-book ratios or Tobin's Q (Jae Hoon and Prather 2001), fixed assets, profitability, and size (Baker and Wurgler 2002), while others have used Altman's Z-Score, intangibles, and liquidity

[43] For the volatility between value weighted and the unweighted samples to remain similar the larger firms must experience the same proportional increase as the smaller firms. For example a firm with an equity value of $200M must experience a $20M shift in equity to be equivalent to a smaller firm that has a base equity value of $100M and an increase of $10M. On average, smaller do not experience the same equity returns as the larger firms. Smaller firms are more likely to experience bankruptcy and/or experience higher than average returns. The higher returns can be attributed to more investment/growth opportunities and increased firm nimbleness associated with being a smaller firm.

(Morellec 2001; Frank and Goyal 2003). Tobin's Q, Altman Z-score, intangibles, fixed assets and liquidity were selected as additional explanatory variables due their high prevalence in the literature and relative success in predicting the use of long-term debt. Tobin's Q is the ratio of the accounting value of assets (or the book value of the firm) to the sum of the market value of the firm's equity and book value of debt. It is thought to capture the market's assessment of future cash flows. When the ratio is small the market value of the firm (estimated present value of all future cash flows) is substantially larger than its current book value and indicates projected growth in assets. As the present value of future cash flows gets larger (and book-to-market ratios get smaller) firms are thought more capable of supporting debt. As demonstrated by Baker and Wurgler (2002), "market-to-book is not strongly related to retained earnings ... [which] rul[es] out the possibility that market-to-book affects leverage because it forecasts earnings." They go on to show market-to-book is "positively related to growth in assets, an effect that tends to increase leverage." As a result, smaller book-to-market ratios are often indicative of a higher LTDFR. The market value of the firm was drawn from Compustat using code Book_to_Market(0). The unweighted average ratio for all sectors is .282 and .633 when weighted by the book value of assets. Sector averages, both weighted and unweighted, are reported in Table 2.4 and 2.5.

The Altman Z-score, set forth by Edward Altman (1968), is a composite score measuring the working capital, retained earnings, earnings before interest and taxes, equity to liability ratios, and the sales of the firm.[44] It is intended to capture the probability of not being able to pay debt obligations as they become due with lower

[44] The weighted formula is Z-Score= ((1.2*working capital + 1.4*retained earnings + 3.3*operating income + sales)/total assets) +(.6*net worth)/total debt

scores indicating a higher probability of insolvency.[45] As the probability of default increases it becomes less likely that firms will be able to obtain or sustain long-term debt. The Z-score was gathered from Compustat using CA_ZSCORE_FY(0). The unweighted average for all sectors is 4.302 and 3.361 when weighted by the book value of assets. Sector averages, both weighted and unweighted, are reported in Table 2.4 and 2.5.

Intangible assets are non-monetary assets that are created through time and effort. When a firm enters into bankruptcy it is difficult to sell intangible assets since they normally do not have value outside of the firm and are related to human capital or other non-transferrable functions within the firm. Consequently, when firms enter bankruptcy and have to sell assets to meet debt obligations, the value of intangible assets are typically written down or lost as required by impairment testing accounting rules. As such, intangibles gathered from Compustat using FG_INTANG_A(0) are one potential cost to bankruptcy. As the potential costs of bankruptcy increase the use of long-term debt to finance assets and operations decreases (Morellec 2001). The measure is standardized by dividing the dollar value of intangibles by the book value of assets. The result is the percentage of the firm's assets that are intangible. The unweighted average for all sectors is .178 and .111 when weighted by the book value of assets. Sector averages, both weighted and unweighted, are reported in Table 2.4 and 2.5.

A company's assets can be either liquid (easily converted into cash) or fixed. Fixed assets are usually thought of as property, plant, and equipment and are not easily converted into cash. When firms enter into financial distress liquid assets have usually been converted to cash and paid out to meet liabilities. The fixed assets of the firm often

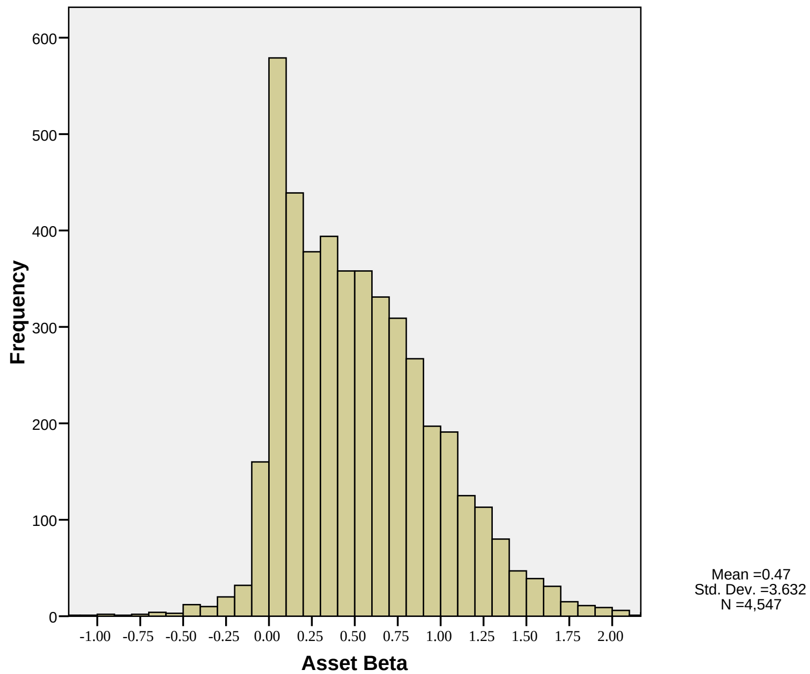
[45] A Z-score less than 1.8 = very high probability of insolvency, 1.8-2.7= high probability of insolvency, 2.7-3.0 = possible insolvency, and a score greater than 3 = insolvency not likely.

Table 2.3 Equity betas and volatility, market-derived asset betas, and book-derived asset betas

	Weighted by book value of assets					
	Equity		Asset (Unlevered with market values of equity)		Asset (Unlevered with book values of equity)	
Sector	**Beta**	**Volatility**	**Beta**	**Volatility**	**Beta**	**Volatility**
Consumer Discretionary	1.0765	0.2174	0.4466	0.0987	0.2859	0.0886
Consumer Staples	0.5831	0.1542	0.3703	0.0976	0.2304	0.0653
Energy	1.1897	0.1659	0.7999	0.1169	0.5567	0.0828
Financials	1.126	0.2591	0.1365	0.0201	0.0914	0.019
Health Care	0.6897	0.1771	0.4899	0.1313	0.3181	0.0918
Industrials	0.8723	0.1543	0.452	0.0716	0.2553	0.0481
Information Technology	0.9066	0.17	0.6829	0.1248	0.4863	0.0936
Materials	1.2414	0.2334	0.7279	0.1335	0.4653	0.087
Telecommunication Services	0.8882	0.1231	0.4592	0.0671	0.2918	0.0471
Utilities	0.7388	0.1061	0.3058	0.0473	0.1964	0.0295
Sample	**1.0551**	**0.2287**	**0.2663**	**0.0464**	**0.1746**	**0.0368**

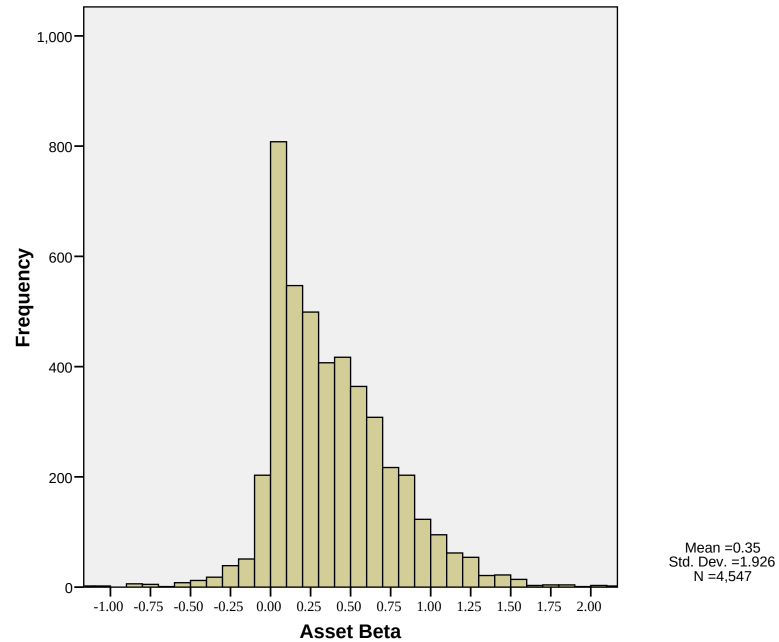
	Unweighted					
	Equity		Asset (Unlevered with market values of equity)		Asset (Unlevered with book values of equity)	
Sector	**Beta**	**Volatility**	**Beta**	**Volatility**	**Beta**	**Volatility**
Consumer Discretionary	0.8593	0.2897	0.5294	0.1736	0.3877	0.149
Consumer Staples	0.6345	0.2674	0.425	0.1843	0.2952	0.1385
Energy	1.061	0.3987	0.7573	0.3171	0.579	0.206
Financials	0.6385	0.1948	0.2001	0.0527	0.1445	0.0422
Health Care	0.4319	0.7823	0.2798	0.6953	0.2313	0.4678
Industrials	0.9633	0.297	0.6334	0.1988	0.456	0.1692
Information Technology	0.8579	0.3078	0.6757	0.2353	0.5307	0.2046
Materials	1.1607	0.2922	0.7278	0.189	0.5041	0.1461
Telecommunication Services	0.779	0.2979	0.4354	0.1701	0.2423	0.1466
Utilities	0.7208	0.1618	0.3295	0.0767	0.2212	0.0515
Sample	**0.7752**	**0.3412**	**0.4702**	**0.2374**	**0.3507**	**0.1802**

Figure 2.5 Business risk (β_A) distribution – Full sample (MV)



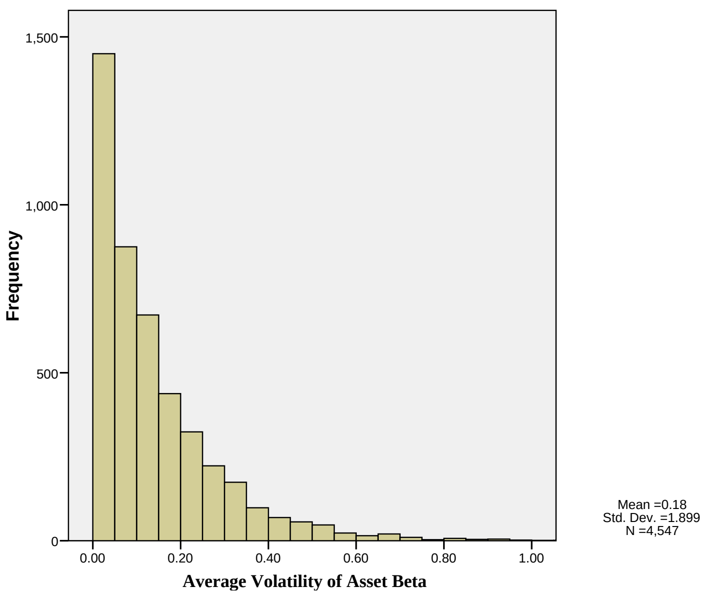
Market values used to unlever equity beta

Figure 2.6 Business risk (β_A) distribution – Full sample (BV)



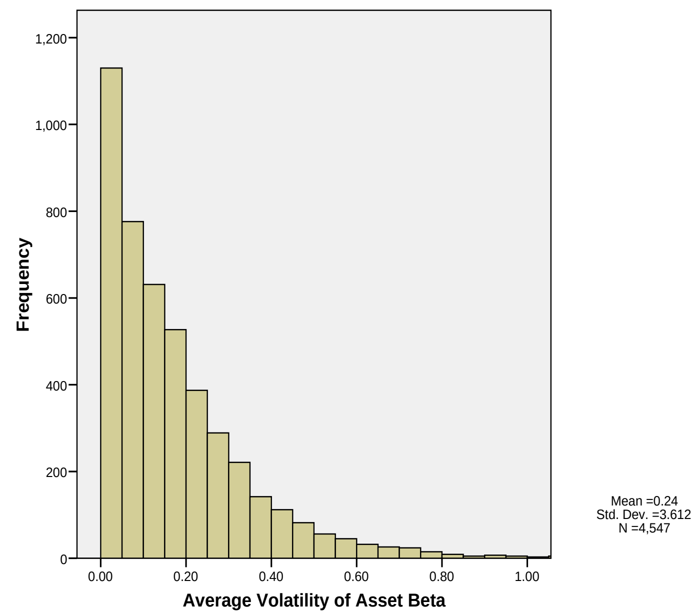
Book values used to unlever equity beta

Figure 2.7 Volatility of business risk (β_A) distribution- Full sample



Market-values of equity used to unleveraged β_E

Figure 2.8 Volatility of business risk (β_A) distribution- Full sample



Book-values of equity used to unleveraged β_E

remain. For lenders, fixed assets reduce the risk of lending by collateralizing debt obligations. If the borrowing firm cannot meet debt obligations (liquid assets are no longer available), the lender can seize the firm's remaining fixed assets, sell the assets in the market, and recoup the funds extended to the borrower. Firms with higher a higher percentage of fixed assets have the ability to collateralize more of their borrowing and are able to secure lower cost debt.[46] As a result, those firms with more physical or fixed assets use more debt to finance assets and operations (Baker and Wurgler 2002). Firm property, plant, and equipment was gathered from Compustat using code FG_PPE_NET_A(0) and divided by the total assets of the firm to arrive at the proportion of assets in the firm that are fixed. The unweighted, average fixed asset percentage for all sectors is .209 and .130 when weighted by the book value of assets. Sector averages, both weighted and unweighted, are reported in Table 2.4 and 2.5.

There are a number of potential measures of liquidity; the most frequently used is the current ratio. Measured as current assets over the current liabilities, the current ratio is a financial ratio used to determine if the firm has enough liquidity to meet financial obligations due within the next year. The more liquid the firm the easier it is for the firm to meet its liabilities. As a result, highly liquid firms find it easier to secure debt (Morellec 2001). The current ratio is gathered from Compustat using the FG_CURRENT_RATIO code. The unweighted average for all sectors is 3.457 and 1.564 when weighted by the book value of assets. Unweighted and weighted book-to-market

[46] Additional adjustments may be required to refine the use of fixed assets for the not-for-profit healthcare sector. Due to the existence of equity (net assets) that is limited as to use, only using PPE may systematically overstate the assets available to meet debt obligations (i.e. understate operational leverage).

ratios, Altman Z-score, bankruptcy costs, fixed asset percentage, and current ratio are reported in Tables 2.4 and 2.5 by sector and for the entire sample.

Empirical Models

The use of long-term debt is not normally distributed. It is skewed right and truncated at 0 (Fig. 2.2). While the weighted long-term leverage mean is .206 (.162 unweighted), 28% of the sample does not employ any long-term debt. The high prevalence of non-leveraged firms and the truncation of the dependent variable in the distribution warrants the use of a two-part, mixed model approach (Duan, Manning et al. 1983; Duan, Manning et al. 1984; Buntin and Zaslavsky 2004). A log transformation of the dependent variable is also employed to address the long tail in the distribution and reduce the impact of outliers in the sample.

Three mixed model, two-part approaches are used to explore the relationship between risk and the use of long-term debt. The first two-part model is limited to business risk, volatility of business risk, and the interaction between the two. Using the same approach, the second model uses the explanatory variables that are predominant in the existing leverage literature. The final model combines the business risk variables of the first model and the traditional determinants of capital structure of the second model using the same two-part model. Comparisons among the three models allow one to determine the relative explanatory power of business risk and its collinearity with existing leverage determinants.[47]

[47] The composite model will be applied to NFP providers and compared to IO providers in subsequent chapters.

Each of the three of the models is divided into two parts. The first part is intended to capture the probability of having leverage by using a probit model where the dependent variable is the log of the long-term debt financing ratio and the explanatory variables vary according to which of the three approaches are being explored (business risk, traditional, and the combined approach). The second part uses ordinary least square (OLS) methodology to predict leverage for all firms conditional on having leverage. The unconditional expected leverage for firms in the sample is then determined by multiplying the OLS prediction of part two by probability of having leverage (part one).

Model 1: Underlying (or long-term) business risk, short-term risk, interaction term

In the first model, the probability of a firm having long-term debt is a function of the three year average business risk (β_A), the volatility of risk (standard error of average three year β_A), and an interaction term between the average business risk and the volatility of the business risk (Equation 2.5).

$$PR\,(LTDFR_{2007}) = \chi_1\,\beta_{Assets} + \chi_2\,Volatility(\beta_{Assets}) + \chi_3\,(\beta_{Assets} * Volatility(\beta_{Assets})) + g \qquad (2.\,5)$$

$$Log(LTDFR_{2007}) = \chi_1\,\beta_{Assets} + \chi_2\,Volatility(\beta_{Assets}) + \chi_3\,(\beta_{Assets} * Volatility(\beta_{Assets})) + g \qquad (2.6)$$

The second part of the model uses OLS methodology to regress the same three explanatory variables (long-term business risk, volatility of business risk, and the interaction term) on all firms where leverage is greater than zero (Eq 2.6). The predicted log(LTDFR) from the OLS stage is saved and multiplied by the probability of having leverage derived in the first part of the model. The result is the expected (LTDFR) for each firm in the sample that has leverage greater than zero.[48][49]

The three year average asset beta is intended to capture the long-term underlying business risk faced by the firm. Using only the 2007 or 2006 asset beta to predict the LTDFR does not capture either the long-term business risk or its volatility. Point-in-time estimates of business risk are unable to tease apart risk that is fundamental to the firm and risk that is a result of a short-term shock or short-term fluctuations. By including multiple estimates of business risk one is able to capture both volatility and long-term, underlying risk. As underlying business risk increases, the costs of debt financing should increase yielding an inverse relationship between underlying risk and the LTDFR. Year to year volatility (movement around that long-term average) should also produce an inverse relationship with LTDFR. Substantial volatility of β_A can be considered short-term risk and makes both risk determination more difficult for lenders and the risk premium passed on to borrowers higher.[50]

Without the interaction term the predicted impact of having high (low) long-term risk and high (low) volatility on LTDFR may be overstated (understated). The impact of volatility and underlying business risk may not be strictly additive—if the interaction

---

[48] The predicted log (LTDFR) has values between -2.5 and 0 with values closer to 0 indicating a higher LTDFR. If the predicted log (LTDFR) is multiplied by the probability of having debt before being retransformed the application of probabilities will erroneously produce higher estimates of leverage because the expected values will be closer to 0. Retransformation of the log(LTDFR) must occur prior to the application of the stage one probabilities.

[49] The two part model allows for the same first stage variables to be used in the second stage without biasing the results.

[50] Lenders to a firm with constant risk and little to no variability in that risk can impose risk premium appropriate to that business with little fear that the borrower will experience a wild shift in its earnings. If lenders do not account for the volatility of a borrower's risk, the borrower may experience a large risk change and leave the lender exposed to a loan for which they have not imposed a large enough risk premium. The risk premium should account for the underlying risk as well as its volatility.

Table 2.4 Unweighted book-to-market, Altman Z-Score, intangibles, operating leverage, and liquidity

Sector	2007 Book-to-Market Ratio	Three Year Average Book-to-Market Ratio	2007 Altman Z-Score	Three Year Average Altman Z-Score	2007 Intagibles / Book Value of Assets	Three Year Average Intangibles / Book Value of Assets	2007 PPE / Book Value of Assets	Three Year Average PPE / Book Value of Assets	2007 Current Ratio	Three Year Average Current Ratio
Consumer Discretionary	-0.036	0.296	4.361	6.064	0.215	0.185	0.269	0.263	2.124	2.391
Consumer Staples	-0.402	0.15	4.887	5.222	0.225	0.193	0.285	0.29	2.947	2.739
Energy	0.436	0.459	5.127	7.281	0.099	0.06	0.609	0.592	2.015	2.805
Financials	1.24	0.71	7.369	8.418	0.044	0.031	0.134	0.134	6.008	5.306
Health Care	0.372	0.404	4.504	5.917	0.232	0.188	0.132	0.129	4.669	5.666
Industrials	-1.448	-0.269	4.213	4.857	0.239	0.19	0.227	0.225	2.468	2.636
Information Technology	0.481	0.409	3.964	4.807	0.26	0.206	0.098	0.097	3.722	3.858
Materials	0.534	0.476	5.236	5.749	0.165	0.129	0.355	0.353	2.87	3.324
Telecommunication Services	0.348	0.429	0.695	0.954	0.326	0.269	0.352	0.351	1.82	1.893
Utilities	0.606	0.507	1.892	1.765	0.059	0.056	0.193	0.18	1.625	1.772
Sample	**0.282**	**0.373**	**4.302**	**5.381**	**0.178**	**0.143**	**0.209**	**0.206**	**3.107**	**3.457**

Table 2.5 Weighted book-to-market, Altman Z-Score, intangibles, operating leverage, and liquidity

Sector	2007 Book-to-Market Ratio	Three Year Average Book-to-Market Ratio	2007 Altman Z-Score	Three Year Average Altman Z-Score	2007 Intagibles / Book Value of Assets	Three Year Average Intangibles / Book Value of Assets	2007 PPE / Book Value of Assets	Three Year Average PPE / Book Value of Assets	2007 Current Ratio	Three Year Average Current Ratio
Consumer Discretionary	-3.245	-0.916	2.627	2.891	0.269	0.257	0.276	0.263	1.318	1.396
Consumer Staples	0.226	0.378	3.924	4.018	0.407	0.326	0.293	0.298	1.14	1.166
Energy	0.397	0.437	3.944	3.91	0.128	0.092	0.587	0.578	1.235	1.32
Financials	1.129	0.672	2.913	4.549	0.037	0.029	0.034	0.035	2.132	2.211
Health Care	0.429	0.068	4.154	4.658	0.373	0.301	0.148	0.151	2.245	2.303
Industrials	0.048	0.21	3.137	3.162	0.234	0.192	0.224	0.224	1.564	1.555
Information Technology	0.374	0.316	5.749	6.563	0.271	0.211	0.119	0.12	2.201	2.394
Materials	0.557	0.434	2.881	2.991	0.268	0.168	0.383	0.382	1.765	1.874
Telecommunication Services	0.508	0.549	1.336	1.223	0.386	0.365	0.408	0.401	0.881	0.867
Utilities	0.575	0.545	1.29	1.201	0.06	0.062	0.148	0.14	0.966	1.012
Sample	**0.633**	**0.478**	**3.361**	**3.581**	**0.111**	**0.092**	**0.13**	**0.132**	**1.497**	**1.564**

term is greater than 0 then the impact of volatility and underlying risk is greater than the sum of impacts of χ_1 and χ_2 above. When the interaction term is negative, the impact of χ_1 and χ_2 is not additive and is something less than their sum. The results of the probit and OLS stages using market values of equity to derive asset betas and their volatility as well as models using book values of equity to arrive at asset betas are reported in Table 2.6 and Table 2.7.

Model 2: Traditional determinants of leverage (Tobin's Q, bankruptcy probability, bankruptcy cost, fixed assets, liquidity)

The second two-part model is limited to those factors in the literature most often cited as determinants of capital structure. Similar to the model outlined above, the first part of the two part model predicts the probability of having leverage. This probability of is based on Tobin's Q, the Altman Z-score, intangibles, fixed assets and the liquidity of the firm (Eq. 2.7).

$$PR\,(LTDFR_{2007}) = \chi_1\, Tobin's\,Q + \chi_2\, Altman's\ score + \chi_3\, \mathrm{int}\,angibles + \chi_4\, fixed\,assets + \chi_5\, liquidity + g \qquad \text{Eq. 2.7}$$

The second part of the model regresses the same explanatory variables on the log transformation of the LTDFR (Eq. 2.8) where leverage is greater than 0. The predicted log(LTDFR) from the OLS stage is saved, retransformed, and multiplied by the probability of having leverage derived in the first part of the model. The product is the unconditional, expected LTDFR for each firm in the sample.

$$
\begin{aligned}
Log(LTDFR_{2007}) = \\
& \chi_1\ Tobin's\ Q \quad + \quad \chi_2\ Altman's\ score \quad + \quad \chi_3\ \mathrm{int}\, angibles \\
+ \quad & \chi_4\ fixed\, assets\ + \quad \chi_5\ liquidity \quad + \quad g
\end{aligned}
\qquad \text{Eq. 2.8}
$$

Comparing the explanatory power from model 1 (business risk) to the expected values for model 2 (traditional determinants) provides insight into the fit of the two-part model and serves as a point of reference when interpreting business risk's ability to predict capital structure. The first and second stage coefficients and p-values (OLS results) are reported in Table 2.8.

Model 3: Combined Model (long-term business risk, short-term risk, interaction term, Tobin's Q, bankruptcy probability, bankruptcy cost, fixed assets, liquidity)

The final two-part model combines the prior two models. First, the probability of having leverage is determined by business risk factors (long-term, short-term, and interaction term) and by the traditional leverage explanatory variables (Tobin's Q, Altman Z-Score, intangibles, fixed assets, and firm liquidity) (Eq 2.9).

$$
\begin{aligned}
PR\ (LTDFR_{2007}) = \\
& \chi_1\ \beta_{Assets} \quad + \quad \chi_2\ Volatility(\beta_{Assets}) \quad + \quad \chi_3\ (\beta_{Assets} * Volatility(\beta_{Assets})) \\
+ \quad & \chi_4\ Tobin's\ Q \quad + \quad \chi_5\ Altman's\ score \quad + \quad \chi_6\ \mathrm{int}\, angibles \\
+ \quad & \chi_7\ fixed\, assets\ + \quad \chi_8\ liquidity \quad + \quad g
\end{aligned}
\qquad \text{Eq. 2.9}
$$

The second stage of the two part model regresses the same comprehensive list of variables on the log of the LTDFR (Eq 2.10) conditional on a firm having leverage. The predicted value from the OLS stage is saved, retransformed, and multiplied by the probability of having leverage determined in the first part of the model. The result is the expected LTDFR for each firm in the sample that is leveraged.

$$
\begin{aligned}
Log(LTDFR_{2007}) = & \\
& \chi_1\ \beta_{Assets} \quad + \quad \chi_2\ Volatility(\beta_{Assets}) \quad + \quad \chi_3\ (\beta_{Assets} * Volatility(\beta_{Assets})) \\
& + \quad \chi_4\ Tobin's\ Q \quad + \quad \chi_5\ Altman's\ score \quad + \quad \chi_6\ \text{int}\ angibles \\
& + \quad \chi_7\ fixed\ assets\ + \quad \chi_8\ liquidity \quad + \quad g
\end{aligned}
\qquad \text{Eq. 2.10}
$$

The primary reason the third model is included is to determine if business risk is collinear with the existing leverage determinants in the literature or if business risk (as measured by the CAPM) has some unique explanatory power. By adding business risk to the existing determinants of leverage and comparing the explanatory power of Model 3 to Model 2, one can quantify the unique explanatory power of business risk. The coefficients and p-values of the first and second models are reported in Table 2.9 and 2.10.

A correlation matrix (Appendix 1.0) is also included to determine if long-term risk, short-term risk, and the interaction term add unique explanatory power or if they are merely collinear with the traditional explanatory variables.

Sector Specific Models

Competition, maturity, growth potential and a number of other factors differ significantly between sectors and contribute to a sector's differential use of long-term debt. While inclusion of sector dummy variables does account for sector specific fixed effects it does not allow for differential sensitivity to long and short-term risk. Table 2.11 displays parameter estimates and p-values of both stages for the combined Model 3 that are sector specific. Sector specific models not only allow for unique sector intercepts but also for unique sensitivities to different types of business risks and accounting variables. The added flexibility of this fully interactive model generates intercepts and parameter estimates that reflect different sector sensitivities and vary substantially from one sector to another.

Sector specific stages one and two use Model 3 explanatory variables to predict both the probability of leverage as well as the level of leverage (conditional on firms having leverage). Similar to the preceding models, the firm's expected leverage is the product of the probability (stage or part 1) and the leverage predicted in the second stage of the two part model. Model fit by sector is reported by sector in Table 2.11

In addition to the two-part models, stepwise regressions were performed for equations 2.6, 2.8, 2.10 to determine the marginal explanatory power of each of the second part OLS regressors. The partial R^2 are reported in their respective tables. Healthcare sector-specific results for Models 1-3 are reported in Table 2.12.

Results and Discussion

Model 1: *Underlying business risk, short-term risk, interaction term*

Model 1 uses a two-part approach to determine the impact long-term business risk, short-term business risk, and the interaction between the two have on the capital structure of a firm. As evidenced by probit results (stage 1) in Tables 2.6 and 2.7, these business risk variables all have a negative impact on the probability of having long-term debt. This inverse relationship means that as risk increases the probability of having debt decreases. When book values of equity are used to derive asset betas, both the short-term and long-term variables are significant at the <.0001 level. The interaction term (book value of equity used to derive asset beta) has a very small negative impact on the probability of having leverage and is not significant at the p<.05 level.

Although the magnitude of the relationship changes when market values of equity are used to derive business risk variables, the story remains largely unchanged (Table 2.7). Both long-term and short-term business risk negatively impact the probability of having leverage (p<.002). However, the interaction term based on a market value of equity asset beta is also significant (p<.0001) albeit with a small impact.

In the second stage of the two part model, the business risk variables are regressed (OLS) on the log (LTDFR) for all firms where the LTDFR>0. The results of the OLS are presented in unweighted and weighted by size forms for all of the business risk variables. When book values of equity are used to unlever equity betas (Table 2.6) the OLS weighting substantially impacts parameter estimates and significance. When weighted by size, all business risk variables are significant at the p<.02 level with the majority of the explanatory power coming from short-term business risk (partial R^2 = .0112). Long-term business risk has a negative impact on the level of leverage as expected but short-term risk appears to have a positive correlation with the use of long-term debt. The interpretation of these results is difficult because the weighted OLS results have limited ability to explain variance. The second stage regressions explain only 2.1% of the variance. When the results of the first and second stage regressions are combined to form the expected LTDFR, the two-part model has the ability to explain less than 1% of the variance (R^2=.0055) in a sample where the OLS regression is weighted by size.

Combined and second stage results are substantially improved when the second stage OLS regressions are not weighted. Long-term risk and the interaction between long-term and short-term risk is significant at the $p<.0001$ level with long-term risk accounting for the majority of second stage explanatory power (partial R^2 = .0967) and the interaction term accounting for the balance (partial R^2=.0284). Long-term risk has the negative impact on leverage hypothesized but short-term risk is not significant in the second stage when regressed on the total sample. After OLS and probit results are combined to form the expected LTDFR, the unweighted, two part model accounts for 9.5% of the variance in the sample (R^2=.0949).[51]

When market values of equity are used to derive business risk both the second stage OLS regressions and the combined, expected LTDFR have limited explanatory power (Table 2.7). In the weighted OLS results short-term risk and the interaction term are significant ($p<.05$) but account for only .0088 of the variance. When combined with

[51] The predicted log (LTDFR) from the second stage was transformed back to the linear scale and multiplied by the probability determined in the first of the two stages. However, before the probabilities of having debt can be applied the predicted log (LTDFR) must be estimated and retransformed back to the linear scale. Failure to retransform the LTDFR before the application of probabilities will result in an inaccurate estimate of the expected LTDFR. The goodness of fit (R^2's) were determined by squaring the correlation between the expected LTDFR and the actual LTDFR.

the first stage probit results, the two stage model has an R^2 of .0063. Similar results are found when the OLS results are not weighted by size. All three business risk variables are significant but the OLS results account for only 2.8% of the variance. The explanatory power is further diminished as probit results are combined with the OLS regression to determine the expected LTDFR. The combined model (using market values of equity to determine asset betas and an unweighted second stage OLS regression) explains less than .1% of the variance (R^2=.0005).[52]

Using a two-part methodology to predict leverage, it is clear that business risk factors do have an impact on firm leverage. These factors either impact the probability of having debt, the actual level of leverage at the firm, or both. It is also clear that using book values of equity to unleverage equity betas produces superior results compared to the results using market values of equity to unleveraged equity betas. Long-term business risk has a consistent, negative impact on leverage while short-term business risk significance and direction of impact oscillates depending upon the OLS weighting in the full sample. Whether this is due to greater volatility in market values of equity, the reflection of realized vs. projected earnings in equity values, or some other factors the book vs. market unleveraging methodologies may be worth investigating in the future.

Model 2: Traditional determinants of leverage (Tobin's Q, bankruptcy probability, bankruptcy cost, fixed assets, liquidity)

[52] The difference between the weighted and unweighted R^2 is largely driven by AT&T, Conoco Phillilips, Proctor & Gamble, Time Warner, IBM, Comcast, Johnson & Johnson, Kraft, Sprint, Boeing, and Caterpillar. Even after controlling for size, the expected LTDFR is substantially lower than the actual LTDFR for these large firms.

Model 2 uses Tobin's Q, Altman's Z-Score, intangibles, fixed assets, liquidity and size to predict the probability of having leverage and the amount of that leverage. Similar to Model 1, the OLS results are reported in weighted and unweighted form. As reported in Table 2.8, all the traditional determinants significantly impact ($p<.0001$) the probability of having leverage (stage 1) with the exception of Tobin's Q.

When OLS results are weighted by firm size and the sample is restricted to firms that are leveraged, the traditional accounting variables account for 26% of variation in the sample ($R^2 = .2633$). All variables are significant at the $p<.002$ level with the exception of Tobin's Q which is not significant in the weighted sample. Altman's Z-Score and size account for the majority of the model's explanatory power (.15 and .0766 respectively). If the second stage OLS results are not weighted, all variables are significant at the $p<.0024$ level including Tobin's Q. Altman's Z-Score continues to account for the majority of the explanatory power (partial $R^2=.0479$) with size being the least explanatory (partial $R^2=.0052$). In the unweighted sample the traditional leverage determinants account for 12.94% of the variance among firms that have leverage.

As evidenced by the high explanatory power in the second stage OLS regressions, the specification of the accounting variables appears in line with previous literature. However, once the first stage probit results are combined with the OLS results to determine the expected LTDFR, the goodness of fit associated with these traditional accounting determinants significantly decreases. A weighted, OLS model that had described over 26% of variance is reduced to an R^2 of .054 when adjustments are made to accommodate the limited dependent variable. Likewise, second stage results decrease from an R^2 of .1294 to an overall R^2 of .0435 if the second stage OLS regressions remain unweighted by size.

The sample is composed of 4,547 firms that maintain varying levels of long-term leverage. For various political, operational, or managerial reasons 28% of the full sample has opted away from the use of any long-term debt. If firms without any long-term debt are excluded from the analysis one fails to account for the truncation of the dependant variable and consequently overstate the traditional determinants' ability to predict capital structure. Because previous research either restricted the sample to leveraged firms, been primarily concerned with changes in leverage as a result of changes in accounting variables, or ignored the limited dependent variable this two-part modeling of leverage is a substantial departure from existing practice and more accurately reflects the impact the traditional determinants have on a sample that includes zero-leveraged firms.

Model 3: Combined Model (underlying business risk, short-term risk, interaction term, Tobin's Q, bankruptcy probability, bankruptcy cost, fixed assets, liquidity)

In Model 3 business risk and the traditional determinants of leverage are used to predict both the probability of debt as well as firm leverage given the firm is leveraged. By comparing the results from Model 3 (Tables 2.9 and 2.10) to the two prior models one can determine that business risk does have unique explanatory power that predicts both the probability of having leverage as well as the level of that leverage.

In the probit regression (Stage 1) using book values of equity to unlever the equity beta, the magnitude and significance ($p<.0008$) of the traditional determinants remains virtually unchanged when business risk factors are added. Tobin's Q remains insignificant. There is some small attenuation in the magnitude of long and short-term business risk parameter estimates but the decrease is minimal. Both continue to have a negative impact on the probability of having long-term debt. As is also the case in Model 1, the business risk interaction term remains insignificant when the model is applied to the entire sample.

The OLS regressions (Stage 2) using book values of equity to unlever the equity beta see a marked improvement in explanatory power with the addition of business risk factors. Traditional leverage determinants can account for 12.94% of the variation when the sample is not weighted by size. The addition of business risk factors improves the OLS predictions 117% and generates an R^2 of .2818 in the unweighted sample. Similar to the probit results, the parameter estimates slightly attenuate with the addition of business risk factors. The significance of all factors remains largely unchanged with the exception of size which becomes more significant in the OLS stage of the combined model. Long-term business risk accounts for the majority of explanatory power (partial R^2=.1376) with Tobin's Q accounting for the least. Long-term risk continues to have a significant negative impact on the level of leverage and short-term business risk continues to lack significance.

When the two stages are combined to form the expected LTDFR the model explains 12.03% of the variation in the sample. Keeping in mind the traditional determinants (Model 2) account for 2.45% of the sample variance and business risk factors (Model 1) account for 9.5% of the variance in the unweighted samples, there appears to be little to no collinearity in their explanatory power. In fact, the addition of business risk may control for some unknown factors in Model 2 and produces a slightly better estimate of leverage than the sum of Models 1 and 2. Also reported in Table 2.10 are Model 3 results using market values of equity to derive asset betas as well results when the OLS regressions are weighted by size.[53]

The additional explanatory power gained by using these business risk factors may be due to how they are different from the majority of the traditional determinants. With the exception of Tobin's Q, the traditional determinants of leverage are largely realized or *ex post* ratios. Physical plants have been built, inventories purchased, and margins realized. Business risk is fundamentally different. Stock prices, while tied to what has happened in the past, are intrinsically forward looking. What are earnings going to be in the future? How are environmental factors or competitors going to impact the firm (and consequently stock price) moving forward? Book to market ratios or Tobin's Q do attempt to capture some forward looking risk but they are point in time estimates that do not account for fluctuations in that forward looking risk. This would also explain why Tobin's Q plays such a small role (partial R^2=.0093, Model 3 unweighted OLS, book value of equity) in explaining the capital structure of firms.

Sector Specific Models

There are substantial and significant differences between GICS Sectors. To account for these differences, each of the three prior two-part models is performed by sector. Rather than using a sector control variable, this fully interactive model allows

[53] Both the probit and OLS regressions were tested to determine if the movement to a sector specific model significantly improved the fit. This included a likelihood ratio test for the stage one probit regressions and F-test in the OLS stage. With the exception of the Information Technolgy Sector (Chi-Sq = 2.5 / p-value=.1109), all sector specific stage one likelihood tests had Chi-Squared values greater than 3.84 (p<.05). F-tests on the OLS regressions resulted in F-values ranging from a low of 2.95 in the Telecom Sector to a high of 10.38 in the Utilities Sector. All F-values were significant at the .05 level.

each of the ten sectors to have different responses and sensitivities to business risk and the traditional leverage determinants. A sector control or fixed effect makes one cumulative adjustment for the entire sector while this fully interactive model adjusts each parameter estimate to more accurately reflect the reality of that sector. Sector specific results for Model 1-3 are reported in Table 2.11.

When Model 1 is performed by sector substantial differences in explanatory power emerge. It is interesting to note that business risk has very limited ability to explain the capital structure of financial firms (R^2=.018) and utility firms (R^2=.047) during the 2004-2007 time frame. Alternatively, 20% or more of variance in the Energy, Healthcare, Materials, and Telecommunication Sectors can be explained by business risk factors after accounting for the limited dependent nature of leverage.

As one would expect with a fully interactive model, Model 2 results also improve when each regressor is allowed to be sector-specific. The R^2's from the combined model vary from a low of .0554 and .1072 in the Information Technology and Healthcare Sectors respectively to a high of .3467 in the Utilities Sector. Comparing the sector specific results to results that are not sector specific (Table 2.8), it becomes clear that sector-specfic adjustments should be made (either a fixed effect OLS regression in the second stage of the two-part model or, as is the case presented here, a sector specific OLS regression) to more accurately predict the use of leverage. Failure to account for differing parameter estimates substantially decreases Model 2's goodness of fit.

Interpretation of business risk and its impact on leverage is much more varied when examining sector-specific Model 3 results (Table 2.11). What can be determined is that the addition of business risk variables uniformly improves the goodness of fit. What varies is the degree of improvement. For example, Model 1 produces an R^2 of .1568 and Model 2 produces an R^2 of .2778 for the Consumer Staples Sector. Model 3, the combined model, explains 31.1% of the variance which is less than the sum of the prior two models. This would seem to indicate a certain amount of collinearity between business risk factors and the traditional determinants of leverage. This partial colinearity appears across all sectors.

Regardless of whether there appears to be sector-specific colinearity, business risk factors add unique explanatory power (H_o rejected). The R^2 gained by the inclusion of business risk is most substantial in the Utility, Industrials, and Energy Sectors with each realizing between a 10% - 229% improvement. Within the Healthcare Sector business risk variables improve the explanatory power of the existing determinants of leverage by over 110%.

It is also clear that business risk is negatively correlated with a firm's use of long-term debt. Regardless of how the sample is weighted and the derivation of business risk (market vs. book values of equity), probit and OLS results on Tables 2.6, 2.7, 2.9 and 2.10, indicate that long-term risk is negatively correlated the probability of having debt as well as being negatively correlated with the level of long-term debt (fail to reject H_{A1}). The impact of short-term business risk is mixed. It negatively impacts the probability of having debt in the probit results from Models 1 and 2 but it loses significance in a combined model when traditional determinants are added. In sector-specific Model 3 and Model 1, where short-term business risk is significant, the impact is opposite what was hypothesized (partial rejection of H_{A2}). In situations where it is significant short-term debt appears to be positively correlated with long-term debt.

Healthcare Sector

The healthcare specific results (Models1-3) in Table 2.12 support the larger sample findings. The presence of business risk has a negative impact on the probability of having leverage (Model 1 & 3- probit stage). Long-term risk is negatively correlated with the level of long-term debt (Models 1 & 3 – OLS stage) but short-term risk appears to be positively correlated with the presence of long-term debt when short-term risk is significant. When just business risk is considered, each variable has a negative impact on the probability of having debt (long and short-term business risk being significant at the $p<.0006$ level) and each factor is significant in the OLS stage of the model. Short-term business risk continues to have a positive correlation with the level of leverage ($p<.0005$) but a negative impact on the probability of leverage ($p<.0006$) and account for 3.52% of the variation while long-term business risk accounts for the majority of the model's explanatory power (partial R^2=.1881).

What is surprising is the limited number of variables that are significant when determining the probability of having debt in the healthcare sector. Of the nine variables considered in Model 3, only Altman's Z-Score, intangibles, fixed asset ratio, and size are significant in the first stage probit regression. Alternatively, almost all the variables with the exception of short-term risk are important predictors of the level of leverage ($p<.15$, stepwise). Long-term business risk remains the most important factor (partial R^2=.1959) while Altman's Z-Score is the least predictive in the Healthcare Sector (partial R^2=.0091) when considering a combined model (Model 3). Moreover, movement from a model that relies just on business risk (R^2=.2010) to a model that introduces the existing determinants of debt in addition to business risk (R^2=.2260) improves the predictive power of the model with business risk accounting for most of the variation.

The use of a two-part model to account for the use of long-term debt is a deviation from current practice in the capital structure literature. Traditional determinants of leverage have the ability to explain 26% of the variance among healthcare firms if the sample is limited to firms with leverage. However, failure to account for the probability of having debt may overstate the impact of the traditional variables. After accounting for the probability of having leverage, the traditional determinants of leverage can only account for between 2-10.7% of the variance (depending upon weighting and unleveraging of β_E technique). Business risk performs substantially better using the same models and can explain over 20% of the variance.

The impact of including business risk as a determinant of long-term debt usage is more telling when the models are allowed to be sector specific (Table 2.11). These more interactive models allow different industries to have different responses to both business risk and the traditional determinants of risk. Alone, business risk can explain substantial amounts of variation in a number of sectors. Together with the traditional determinants there is a substantive and significant improvement in the two-part estimations of the LTDFR. In fact, the business risk variables appear to be controlling for factors not previously accounted for in models of capital structure.[54]

Within the trade-off theory of capital structure firms balance the benefits of using debt with the costs of using debt. As evidenced by the findings of the two-part model on the IO sample, CAPM measured business risk captures a factor that was previously unaccounted for when the benefits were limited to tax shields and the costs were

[54] The findings would seem to support the findings of Leary and Roberts (2005).

primarily related to financial distress. Using business risk as a cumulative measure captures additional risk variables that impact the firm's capital structure decisions and allows one to more accurately predict the use of debt within the trade-off theory framework.[55]

[55] According to the Pecking Order firms will first seek to finance activities with retained earnings, move to the debt markets, and finally the equity markets. Determined by the ease of administration, the cost of capital, and the impact on existing equity holders, the Pecking Order theory could also benefit from the inclusion of business risk as a capital structure determining factor. A possible interpretation would be that as business risk increases the cost of debt also increases making the use of debt more costly to the firm. The increase in debt costs skews firms toward financing with retained earnings and away from debt because of the higher debt costs.

Table 2.6 Parameter estimates, standard error, and p-values for business risk using book values of equity to unlever the equity beta (Model 1)

	Full Sample						
	Business Risk Unlevereaged Using Book Values of Equity						
	Stage One: Probit			Stage Two: OLS *(Weighted by Size)*			
	Parameter	Standard Error	P> Chisq	Parameter	Standard Error	P-Value	Partial R^2
Intercept	0.8770	0.0294	<.0001	-1.5558	0.0168	<.0001	
Long -Term Risk (Asset Beta)	-0.4864	0.0500	<.0001	-0.3427	0.0749	<.0001	0.0089
Short-Term Risk (Volatility of Asset Beta)	-0.6206	0.0836	<.0001	2.0067	0.2965	<.0001	0.0112
Interaction Term	-0.0012	0.0009	0.1933	-0.5003	0.1997	0.0123	0.0028
	OLS R^2						0.0216
	Correlation between expected LTDFR and LTDFR						0.0741
	R^2 from Two Stage (Model 1)						0.0055

	Full Sample						
	Business Risk Unlevereaged Using Book Values of Equity						
	Stage One: Probit			Stage Two: OLS			
	Parameter	Standard Error	P> Chisq	Parameter	Standard Error	P-Value	Partial R^2
Intercept	0.8770	0.0294	<.0001	-1.0769	0.0207	<.0001	
Long -Term Risk (Asset Beta)	-0.4864	0.0500	<.0001	-0.7064	0.0413	<.0001	0.0967
Short-Term Risk (Volatility of Asset Beta)	-0.6206	0.0836	<.0001	0.0425	0.0664	0.5527	0.0000
Interaction Term	-0.0012	0.0009	0.1933	0.1806	0.0286	<.0001	0.0284
	OLS R^2						0.1251
	Correlation between expected LTDFR and LTDFR						0.3080
	R^2 from Two Stage (Model 1)						0.0949

Table 2.7 Parameter estimates, standard error, and p-values for business risk using market values of equity to unlever the equity beta (Model 1)

	Full Sample						
	Business Risk Unlevereaged Using Market Values of Equity						
	Stage One: Probit			Stage Two: OLS (Weighted by Size)			
	Parameter	Standard Error	P> Chisq	Parameter	Standard Error	P-Value	Partial R^2
Intercept	0.9273	0.034	<.0001	-1.5852	0.0201	<.0001	
Long -Term Risk (Asset Beta)	-0.1461	0.046	0.0015	-0.0284	0.0747	0.7039	
Short-Term Risk (Volatility of Asset Beta)	-1.3957	0.1147	<.0001	1.5357	0.3684	<.0001	0.0053
Interaction Term	-0.0052	0.0007	<.0001	-1.0120	0.4587	0.0275	0.0035
	OLS R^2						0.0088
	Correlation between expected LTDFR and LTDFR						-0.0793
	R^2 from Two Stage (Model 1)						0.0063

	Full Sample						
	Business Risk Unlevereaged Using Market Values of Equity						
	Stage One: Probit			Stage Two: OLS			
	Parameter	Standard Error	P> Chisq	Parameter	Standard Error	P-Value	Partial R^2
Intercept	0.9273	0.0340	<.0001	-1.1045	0.0276	<.0001	
Long -Term Risk (Asset Beta)	-0.1461	0.0460	0.0015	-0.3371	0.0488	<.0001	0.0197
Short-Term Risk (Volatility of Asset Beta)	-1.3957	0.1147	<.0001	-0.3527	0.1009	0.0005	0.0031
Interaction Term	-0.0052	0.0007	<.0001	0.4106	0.1047	<.0001	0.0054
	OLS R^2						0.0282
	Correlation between expected LTDFR and LTDFR						0.0222
	R^2 from Two Stage (Model 1)						0.0005

Table 2.8 Parameter estimates, standard error, and p-values for the traditional determinants of LTDFR (Model 2)

	Full Sample						
	Traditional Accounting Variables						
	Stage One: Probit			Stage Two: OLS (Weighted by Size)			
	Parameter	Standard Error	P> Chisq	Parameter	Standard Error	P-Value	Partial R^2
Intercept	-0.0836	0.0684	0.2219	-1.3574	0.0399	<.0001	
Tobin's Q	-0.0007	0.0038	0.8525	-0.0203	0.0134	0.1305	0.0011
Altman Z-Score	-0.0196	0.0030	<.0001	-0.1003	0.0053	<.0001	0.1500
Intangibles	1.7585	0.1624	<.0001	0.2715	0.0566	<.0001	0.0101
PPE	2.4219	0.1685	<.0001	0.4489	0.0540	<.0001	0.0202
Liquidity	-0.0452	0.0098	<.0001	0.0457	0.0140	0.0012	0.0052
Size	0.0001	0.0000	<.0001	0.0000	0.0000	<.0001	0.0766
	OLS R^2						0.2633
	Correlation between expected LTDFR and LTDFR						0.2329
	R^2 from Two Stage (Model 2)						0.0542

	Full Sample						
	Traditional Accounting Variables						
	Stage One: Probit			Stage Two: OLS			
	Parameter	Standard Error	P> Chisq	Parameter	Standard Error	P-Value	Partial R^2
Intercept	-0.0836	0.0684	0.2219	-1.6352	0.0445	<.0001	
Tobin's Q	-0.0007	0.0038	0.8525	-0.0968	0.0174	<.0001	0.0174
Altman Z-Score	-0.0196	0.0030	<.0001	-0.0258	0.0026	<.0001	0.0479
Intangibles	1.7585	0.1624	<.0001	0.6450	0.0787	<.0001	0.0254
PPE	2.4219	0.1685	<.0001	0.6333	0.0701	<.0001	0.0137
Liquidity	-0.0452	0.0098	<.0001	0.0458	0.0083	<.0001	0.0198
Size	0.0001	0.0000	<.0001	0.0000	0.0000	0.0024	0.0052
	OLS R^2						0.1294
	Correlation between expected LTDFR and LTDFR						0.2086
	R^2 from Two Stage (Model 2)						0.0435

Table 2.9 Parameter estimates, standard error, and p-values for a combined business risk and traditional leverage determinants model (Model 3). Book values of equity used to unleverage equity betas.

	Full Sample						
	Combined Model (Book Values of Equity Used to Unleverage Equity Beta)						
	Stage One: Probit			Stage Two: OLS (Weighted by Size)			
	Parameter	Standard Error	P> Chisq	Parameter	Standard Error	P-Value	Partial R^2
Intercept	0.1338	0.0749	0.0740	-1.3137	0.0367	<.0001	
Long -Term Risk (Asset Beta)	-0.4088	0.0684	<.0001	-1.0193	0.0591	<.0001	0.0668
Short-Term Risk (Volatility of Asset Beta)	-0.3682	0.1215	0.0024	-0.2368	0.1744	0.1746	
Interaction Term	0.0001	0.0013	0.9216	0.7233	0.1818	<.0001	0.0056
Tobin's Q	0.0004	0.0036	0.9184	0.0091	0.0123	0.4599	
Altman Z-Score	-0.0168	0.0030	<.0001	-0.0768	0.0050	<.0001	0.1500
Intangibles	1.7603	0.1647	<.0001	0.3436	0.0526	<.0001	0.0163
PPE	2.4509	0.1702	<.0001	0.7612	0.0535	<.0001	0.0492
Liquidity	-0.0325	0.0097	0.0008	0.1154	0.0139	<.0001	0.0260
Size	0.0001	0.0000	<.0001	0.0000	0.0000	<.0001	0.0766
	OLS R^2						0.3905
	Correlation between expected LTDFR and LTDFR						0.0236
	R^2 from Two Stage (Model 3)						0.0006

Table 2.9 Continued

	Full Sample: Combined Model (Book Values of Equity Used to Unleverage Equity Beta)						
	Stage One: Probit			Stage Two: OLS			
	Parameter	Standard Error	P> Chisq	Parameter	Standard Error	P-Value	Partial R^2
Intercept	0.1338	0.0749	0.0740	-1.4902	0.0427	<.0001	
Long -Term Risk (Asset Beta)	-0.4088	0.0684	<.0001	-0.8070	0.0449	<.0001	0.1376
Short-Term Risk (Volatility of Asset Beta)	-0.3682	0.1215	0.0024	-0.1138	0.0860	0.1857	
Interaction Term	0.0001	0.0013	0.9216	0.2133	0.0320	<.0001	0.0299
Tobin's Q	0.0004	0.0036	0.9184	-0.0723	0.0159	<.0001	0.0093
Altman Z-Score	-0.0168	0.0030	<.0001	-0.0155	0.0025	<.0001	0.0199
Intangibles	1.7603	0.1647	<.0001	0.7261	0.0718	<.0001	0.0301
PPE	2.4509	0.1702	<.0001	0.7865	0.0643	<.0001	0.0219
Liquidity	-0.0325	0.0097	0.0008	0.0679	0.0078	<.0001	0.0281
Size	0.0001	0.0000	<.0001	0.0000	0.0000	0.0008	0.0049
OLS R^2							0.2818
Correlation between expected LTDFR and LTDFR							0.3469
R^2 from Two Stage (Model 3)							0.1203

Table 2.10 Parameter estimates, standard error, and p-values for a combined business risk and traditional leverage determinants model (Model 3). Market values of equity used to unlever equity betas.

	Full Sample						
	Combined Model (Market Values of Equity Used to Unleverage Equity Beta)						
	Stage One: Probit			Stage Two: OLS (Weighted by Size)			
	Parameter	Standard Error	P> Chisq	Parameter	Standard Error	P-Value	Partial R^2
Intercept	0.1542	0.0824	0.0614	-1.1686	0.0433	<.0001	
Long -Term Risk (Asset Beta)	-0.1333	0.0624	0.0327	-0.6775	0.0630	<.0001	0.0353
Short-Term Risk (Volatility of Asset Beta)	-0.6751	0.1520	<.0001	-0.9957	0.2318	<.0001	0.0083
Interaction Term	-0.0023	0.0008	0.0062	1.5632	0.2801	<.0001	0.0057
Tobin's Q	-0.0004	0.0038	0.9076	-0.0142	0.0129	0.2718	
Altman Z-Score	-0.0194	0.0030	<.0001	-0.0829	0.0054	<.0001	0.1500
Intangibles	1.7013	0.1641	<.0001	0.2723	0.0552	<.0001	0.0088
PPE	2.4015	0.1691	<.0001	0.6440	0.0553	<.0001	0.0202
Liquidity	-0.0360	0.0098	0.0002	0.0874	0.0145	<.0001	0.0151
Size	0.0001	0.0000	<.0001	0.0000	0.0000	<.0001	0.0766
	OLS R^2						0.3199
	Correlation between expected LTDFR and LTDFR						0.2683
	R^2 from Two Stage (Model 3)						0.0720

Table 2.10 Continued

	Full Sample						
	Combined Model (Market Values of Equity Used to Unleverage Equity Beta)						
	Stage One: Probit			Stage Two: OLS			
	Parameter	Standard Error	P> Chisq	Parameter	Standard Error	P-Value	Partial R^2
Intercept	0.1542	0.0824	0.0614	-1.4364	0.0502	<.0001	
Long -Term Risk (Asset Beta)	-0.1333	0.0624	0.0327	-0.3888	0.0515	<.0001	0.0176
Short-Term Risk (Volatility of Asset Beta)	-0.6751	0.1520	<.0001	-0.3929	0.1065	<.0001	0.0074
Interaction Term	-0.0023	0.0008	0.0062	0.4281	0.1011	<.0001	0.0043
Tobin's Q	-0.0004	0.0038	0.9076	-0.0978	0.0170	<.0001	0.0179
Altman Z-Score	-0.0194	0.0030	<.0001	-0.0238	0.0026	<.0001	0.0479
Intangibles	1.7013	0.1641	<.0001	0.6292	0.0772	<.0001	0.0224
PPE	2.4015	0.1691	<.0001	0.6835	0.0690	<.0001	0.0168
Liquidity	-0.0360	0.0098	0.0002	0.0587	0.0084	<.0001	0.0277
Size	0.0001	0.0000	<.0001	0.0000	0.0000	0.0008	0.0055
	OLS R^2						0.1675
	Correlation between expected LTDFR and LTDFR						0.2227
	R^2 from Two Stage (Model 3)						0.0496

Table 2.11 Sector-specific correlation and R^2 results when Models 1-3 are run by sector.

	Model 1: Business Risk Unleveraged Using Book Values of Equity (Sector Specific)		Model 2: Traditional Accounting Determinants of LTDFR (Sector Specific)		Model 3: Combined Model (Sector Specific)		Additional Explanatory Power Gained with Risk Measures
GICS Sector	**Correlation**	**R^2**	**Correlation**	**R^2**	**Correlation**	**R^2**	**R^2**
Consumer Discretionary	0.4405	0.1940	0.4159	0.1730	0.5813	0.3379	0.1649
Consumer Staples	0.3960	0.1568	0.5270	0.2778	0.5577	0.3110	0.0332
Energy	0.4483	0.2010	0.4015	0.1612	0.5697	0.3246	0.1634
Finance	0.1358	0.0184	0.3959	0.1568	0.4289	0.1839	0.0272
Healthcare	0.4484	0.2010	0.3274	0.1072	0.4754	0.2260	0.1188
Industrials	0.4766	0.2271	0.3920	0.1537	0.6224	0.3874	0.2337
Information Technology	0.2999	0.0899	0.2354	0.0554	0.3888	0.1512	0.0958
Materials	0.5826	0.3394	0.5758	0.3316	0.6959	0.4843	0.1527
Telecommunication Services	0.6376	0.4066	0.4043	0.1635	0.7337	0.5383	0.3748
Utilities	0.2175	0.0473	0.5888	0.3467	0.6185	0.3825	0.0358

Table 2.12 Healthcare specific parameter estimates, standard error, and p-values for Models 1-3.

	Healthcare Sector Only						
	Business Risk Unlevereaged Using Book Values of Equity						
	Stage One: Probit			Stage Two: OLS			
	Parameter	Standard Error	P> Chisq	Parameter	Standard Error	P-Value	Partial R^2
Intercept	0.7759	0.0925	<.0001	-1.0486	0.0565	<.0001	
Long -Term Risk (Asset Beta)	-0.5597	0.1089	<.0001	-1.0753	0.1339	<.0001	0.1881
Short-Term Risk (Volatility of Asset Beta)	-0.7399	0.2156	0.0006	0.4985	0.1411	0.0005	0.0352
Interaction Term	-0.0016	0.0022	0.4683	0.6384	0.1278	<.0001	0.0457
	OLS R^2						0.2690
	Correlation between expected LTDFR and LTDFR						0.4483
	R^2 from Two Stage (Model 1)						0.2010

	Healthcare Sector Only						
	Traditional Accounting Variables						
	Stage One: Probit			Stage Two: OLS			
	Parameter	Standard Error	P> Chisq	Parameter	Standard Error	P-Value	Partial R^2
Intercept	-0.2854	0.1475	0.0530	-1.3155	0.1342	<.0001	
Tobin's Q	-0.1001	0.1280	0.4342	-0.1467	0.0525	0.0057	0.0172
Altman Z-Score	-0.0274	0.0067	<.0001	-0.0370	0.0066	<.0001	0.1308
Intangibles	1.5725	0.3383	<.0001	0.4137	0.2183	0.0594	
PPE	2.8475	0.5639	<.0001	0.0515	0.3016	0.8646	
Liquidity	0.0016	0.0131	0.8998	0.0337	0.0175	0.0549	
Size	0.0003	0.0001	<.0001	0.0000	0.0000	0.0246	0.0212
	OLS R^2						0.1692
	Correlation between expected LTDFR and LTDFR						0.3274
	R^2 from Two Stage (Model 2)						0.1072

Table 2.12 Continued

	Healthcare Sector Only						
	Combined Model (Book Values of Equity Used to Unleverage Equity Beta)						
	Stage One: Probit			Stage Two: OLS			
	Parameter	Standard Error	P> Chisq	Parameter	Standard Error	P-Value	Partial R^2
Intercept	-0.2362	0.1810	0.1920	-1.1976	0.1339	<.0001	
Long -Term Risk (Asset Beta)	-0.1306	0.1498	0.3834	-1.1013	0.1595	<.0001	0.1959
Short-Term Risk (Volatility of Asset Beta)	-0.0118	0.2956	0.9681	0.2033	0.1673	0.2254	
Interaction Term	0.0007	0.0032	0.8273	0.7529	0.1692	<.0001	0.0594
Tobin's Q	-0.0726	0.1329	0.5851	-0.0736	0.0489	0.1339	0.0074
Altman Z-Score	-0.0258	0.0071	0.0003	-0.0135	0.0075	0.0731	0.0091
Intangibles	1.5461	0.3430	<.0001	0.4448	0.2029	0.0294	0.0120
PPE	2.7996	0.5681	<.0001	0.0777	0.2780	0.7800	0.0219
Liquidity	-0.0026	0.0128	0.8400	0.0488	0.0161	0.0028	0.0331
Size	0.0003	0.0001	0.0003	0.0000	0.0000	0.0167	0.0200

OLS R^2 0.3368

Correlation between expected LTDFR and LTDFR 0.4754

R^2 from Two Stage (Model 3) 0.2260

Appendix 2.0 Correlation table using market values of equity to unleverage β_E

Market Unlevered Betas	Average Asset Beta	Volatility of Asset Beta	Interaction Term	Average Book-to-Market Ratio	Average Altman Z-Score	Average Current Ratio	Fixed Overhead	Average Intangibles
Average Asset Beta	1							
Volatility of Asset Beta	-0.9853 <.0001	1.0000						
Interaction Term	0.9892 <.0001	-0.9953 <.0001	1.0000					
Average Book-to-Market Ratio	0.0012 0.9376	-0.0001 0.9961	-0.0001 0.9961	1.0000				
Average Altman Z-Score	0.0028 0.8710	0.0120 0.4827	-0.0082 0.6320	0.0083 0.6470	1.0000			
Average Current Ratio	-0.0003 0.9862	0.0086 0.6112	-0.0047 0.7832	0.0100 0.5781	0.5257 <.0001	1.0000		
Fixed Overhead	0.0173 0.2526	-0.0035 0.8177	0.0032 0.8335	-0.0010 0.9525	-0.0352 0.0403	-0.1689 <.0001	1.0000	
Average Intangibles	0.0176 0.2439	-0.0074 0.6251	0.0103 0.4937	-0.0159 0.3194	-0.0763 <.0001	-0.1642 <.0001	-0.1937 <.0001	1.0000

Appendix 2.1 Correlation table using book values of equity to unleverage β_E

Book Unlevered Betas	Average Asset Beta	Volatility of Asset Beta	Interaction Term	Average Book-to-Market Ratio	Average Altman Z-Score	Average Current Ratio	Fixed Overhead	Average Intangibles
Average Asset Beta	1.0000							
Volatility of Asset Beta	-0.9549 <.0001	1.0000						
Interaction Term	0.9752 <.0001	-0.9902 <.0001	1.0000					
Average Book-to-Market Ratio	0.0095 0.5439	-0.0021 0.8942	-0.0001 0.9976	1.0000				
Average Altman Z-Score	0.0227 0.1848	0.0118 0.4891	-0.0081 0.6347	0.0083 0.6470	1.0000			
Average Current Ratio	0.0096 0.5712	0.0132 0.4373	-0.0047 0.7832	0.0100 0.5781	0.5257 <.0001	1.0000		
Fixed Overhead	0.0184 0.2223	-0.0047 0.7540	0.0032 0.8331	-0.0010 0.9525	-0.0352 0.0403	-0.1689 <.0001	1.0000	
Average Intangibles	0.0224 0.1385	-0.0082 0.5871	0.0104 0.4892	-0.0159 0.3194	-0.0763 <.0001	-0.1642 <.0001	-0.1937 <.0001	1.0000

CHAPTER III

The Development of a Business Risk Proxy

As demonstrated in the previous chapter, business risk is associated with both the probability of having long-term debt as well as the amount of that long-term debt. Using a two-part model that accounts for the truncation of the dependent variable (28% of firms have no long-term debt), business risk adds substantial value to the traditionally accepted predictors of capital structure within the healthcare sector. The challenge is that business risk, as measured by the capital asset pricing model (CAPM), is dependent upon a firm being publicly traded. Reliance on the market to assess risk excludes a huge portion of the healthcare sector.

Not-for-profit firms currently provide 70% of inpatient hospital days in acute care facilities, over 54% of the enrollment in health maintenance organizations, and close to 50% of mental health, home health, and nursing home care (Frank and Salkever 1994). As a result, not-for-profit firms, and the communities whose forgone taxes support them, have a difficult time assessing the risk being borne. Without the market's assessment of risk, not-for-profit firms are relegated to subjective guesses or 'pure-play' comparisons to estimate the business risk they face. This can translate into inaccurate costs of capital, under/overextension of municipal debt, and overly conservative managerial behavior.

Potentially very useful, relatively little work has been done to investigate financial or accounting indicators of business risk in the health care sector. A number of consulting houses have pulled together lists of managerial risks ranging from clinician shortages to unfunded mandates but financial indicators of risk in the healthcare sector have been largely ignored.[56] One of the few papers on the subject, Smith and Wheeler (1989) explored the possibility of using income (net income, funds flow, and free cash flow) to predict a CAPM assessment of risk. This chapter reexamines the use of income to predict risk and extends the analysis further by 1) examining the entire health sector 2) adjusting for capital structure to assess the risk to both debt and equity holders and 3) adding additional accounting variables thought to be correlated with market assessed risk. Although predictive models relying solely on income data may be informative for some sub-sectors of the health industry, including additional financial information greatly improves predictability of CAPM-derived, business risk. The inclusion of accounting variables also improves cost of capital estimates, and allows firms not publicly traded to more accurately assess risk by relying only on their own financial data.

This chapter will specifically address the following hypothesis:

H_{O1}: Income data (net income, funds flow, free cash flow) is not correlated with business risk as measured by the CAPM in the Healthcare Sector.

H_{O2}: Accounting variables and ratios are not correlated with business risk as measured by the CAPM in the Healthcare Sector.

[56] Health Leaders – Interstudy, Inc., KPMG, LLC.

H_{A1}: Income data is correlated with CAPM derived business risk and can be used in the development of a risk prediction.

H_{A2}: Accounting information is correlated with CAPM derived business risk and can be used in the development of a risk prediction.

The chapter begins with a brief review of the CAPM as well as an overview of sub-industry business risk.[57] The sample and data sources are discussed after the health sector business risk. Finally, the relationship between business risk and financial returns, predictors of bankruptcy, and financial management ratios are explored in a series of regression models. The chapter concludes with a comprehensive model that selects those financial return, bankruptcy and management measures that have the strongest relationship with business risk in the healthcare providers and services sub-sector.

Background

The risk – reward relationship is pervasive in markets. The greater the risk posed to investors the greater the required return. As detailed in Chapter One, the Capital Asset Pricing Model (equation 3.0) maintains the required return to equity holders (R_E) is a function of the underlying risk-free return in the market (R_F),[58] a relative measure of risk (β_E), and the difference in return between the market portfolio (R_M) and the risk-free rate:[59]

$$R_E = R_F + \underbrace{\beta_E} * \underbrace{(R_M - R_F)} \qquad (3.0)$$

[57] A more detailed discussion can be found in Chapter 1-2.
[58] The risk free rate of return is usually measured as the return on a one year treasury note.
[59] Equity beta is measured as the covariance (stock return, market index) / variance (market index).

Risk (relative to market)   Market risk premium

β_E, the risk to equity holders relative to the market, is adjusted by removing the effect of leverage (Bowman 1979) to arrive at a measure of risk that applies to both debt and equity holders in the firm (β_A) and is independent of its capital structure (for discussion see Chapter 2). B_A is a representation of the cumulative risks to debt and equity holders in the firm. As long as the markets have correctly priced information into equity prices, β_E (and subsequently β_A) captures the potential for bankruptcy, costs of bankruptcy, financing constraints (debt overhang), differential incentives between equity holders and managers, asset substitution and a host of other market and firm specific risks.

As illustrated in Table 3.0, approximately 18.1% of all for-profit (FP) healthcare assets are financed with long-term debt. Healthcare facilities are using the most long-term debt (53.7%) as a percentage of overall financing and healthcare distribution firms use the least (11.5%).[60] Adjusting for the capital structure of the firm is important since it affects the expected return to equity holders. The more debt being used, the greater the risk to equity holders (Brealey, Myers, Allen 2006; Ross, Westerfield, Jaffe 2008); as firms take on more debt (leverage up) the required return to equity holders also increases (Modigliani and Miller 1963).[61] Using leveraged CAPM beta estimates as measures of risk heavily skews the assessment of risk toward the risk being borne by equity holders. To account for the skewed assessment of risk and to more accurately portray the business risk faced by debt and equity holders one must unleverage, or remove the effect of capital

[60] Averages are weighted by book value of assets; the unweighted average debt as a percentage of overall financing is 23.01%.

[61] Derived from the weighted average cost of capital and based on Modigliani and Miller proposition II, the cost of equity is a linear function of the firm's debt to equity ratio because of the higher risk involved for equity-holders in a company with debt.

structure on, the CAPM assessment of equity risk.[62] Business risk to the entire firm denoted by β_A, is the weighted average of the risk associated with the equity (β_E) of the

Table 3.0 Percentage of assets financed by long-term debt. †

				% of Assets Financed w/ Long-Term Debt
Health Sector	**Pharmaceuticals, Biotechnology & Life Sciences**	Biotechnology	Biotechnology	18.7%
		Life Sciences Tools & Services	Life Sciences Tools & Services	15.5%
		Pharmaceuticals	Pharmaceuticals	15.6%
	Healthcare Equipment & Services	Healthcare Equipment & Supplies	HC Distributors	11.5%
			HC Equipment	19.1%
			HC Supplies	22.3%
		Healthcare Providers & Services	HC Facilities	53.7%
			HC Services	30.6%
			HC Managed Care	12.3%
		Healthcare Technology	HC Technology	28.2%
		All Firms		**18.1%**

† Weighted by firm size.

firm and the risk associated with the debt (β_D) of the firm, where D is debt of the firm, E is the equity of the firm, and V is the value of both debt and equity.[63]

$$\beta_A = \beta_D\left(\frac{D}{V}\right) + \beta_E\left(\frac{E}{V}\right) \tag{3.1}$$

[62] The adjustment is necessary because the presence of debt increases the CAPM assessment of risk by including financial risk into the market's assessment of a firm.
[63] Either book or market equity and debt values can be used to unlever beta.

The CAPM produces an estimate of equity risk, β_E, that is the covariance (stock price, market index) divided by the variance (market index). The risk associated with debt, β_D, can be similarly estimated as the covariance (debt value, market index) divided by the variance (market index). As long as the firm's assets are greater than the debt of the firm then the value of debt will not fluctuate with the market. When the value of debt does not fluctuate with the market the covariance (debt value, market index) is 0. β_D can be set to 0 and β_E multiplied by the value of equity over the value of the firm to remove the effect of leverage and determine β_A (Bowman 1979).[64, 65, 66] Book as well as market values of equity can be used to unlever β_E. The three year average β_A's unlevered using both market and book values of equity are reported in Table 3.1. Graphs 3.0 and 3.1 illustrate the distribution of β_A for the entire sector and for the Healthcare Provider & Services sub-sector.

In general, β_E's that are unlevered using the market values of equity produce higher β_A. This is not surprising since the market values of equity are usually greater than the book values of equity and the resulting value of (E/V) is closer to one (greater weight placed on equity returns). When book values are used to unlever β_E, equity accounts for a smaller percentage of the firm and the multiplier is farther away from one. When market values are used to unlever β_E in the provider and services sub-sector the resulting

---

[64] β_D = (Covariance of a firm's debt and NYSE) / Variance of the NYSE. Unless a firm enters financial distress the value of debt does not fluctuate with the market. This assumption sets the covariance of the market or book value of debt and NYSE equal to 0. Consequently β_D equals 0. As the LTDFR approaches 1 the market value of debt can decline and deviate from the book value of debt. By following convention and ignoring the decreases in market values of debt, the assessment of β_A may understate the business risk faced the firm.

[65] To account for outliers, β_A's above the 95% confidence interval were set to the beta value associated with the outer limits of the 95% confidence interval.

[66] Of the 614 firms in the sample, 15 (2.4%) have a LTDFR > 1. To transform these firms into the log scale and unleverage β_E the LTDFR was set to .99.

three-year average β_A is 0.3358. Market and book values for the categories comprising the sub-sector are reported in Table 3.2.

Table 3.1. Average betas, average market values, and average book values. Firm values reported in thousands †

				Three Year Average				
			Equity Beta	**Equity Beta**	**Market Unlevered Asset Beta**	**Book Unlevered Asset Beta**	**Average Book Value of Firm**	**Average Market Value of Firm**
Health Sector	**Pharmaceuticals, Biotechnology & Life Sciences**	Biotechnology	0.3932	0.7438	0.632	0.4158	$16,010	$41,061
		Life Sciences Tools & Services	0.5503	0.7844	0.6079	0.4709	$9,578	$14,848
		Pharmaceuticals	0.5874	0.7327	0.5729	0.3703	$60,289	$135,924
	Healthcare Equipment & Services	Healthcare Equipment & Supplies	0.5972	0.6489	0.5078	0.373	$12,990	$26,561
		Healthcare Providers & Services	0.554	0.6275	0.3358	0.1947	$28,192	$44,509
		Healthcare Technology	0.7594	0.8474	0.6622	0.3636	$1,291	$3,528
		Total	0.559	0.6897	0.4899	0.3181	$36,444	$75,362

† Weighted by firm size. The β_E were gathered from BARRA and were calculated as the covariance of the common stock price and 52-week NYSE over the variance of the 52-week NYSE. β_E 's were unlevered using Compustat files.

Figure 3.0 Three year average asset beta (entire Healthcare Sector). Book values of equity used to unleverage β_E.

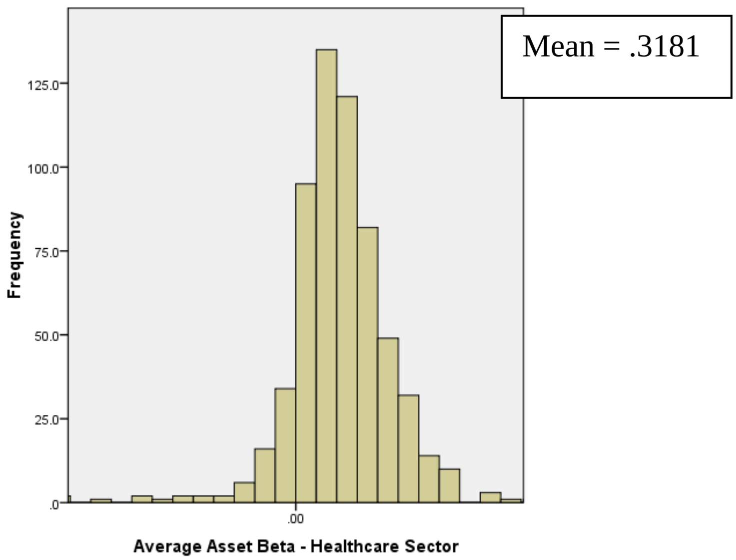


Figure 3.1 Three year average asset beta (healthcare provider & service firms). Book values of equity used to unleverage β_E.

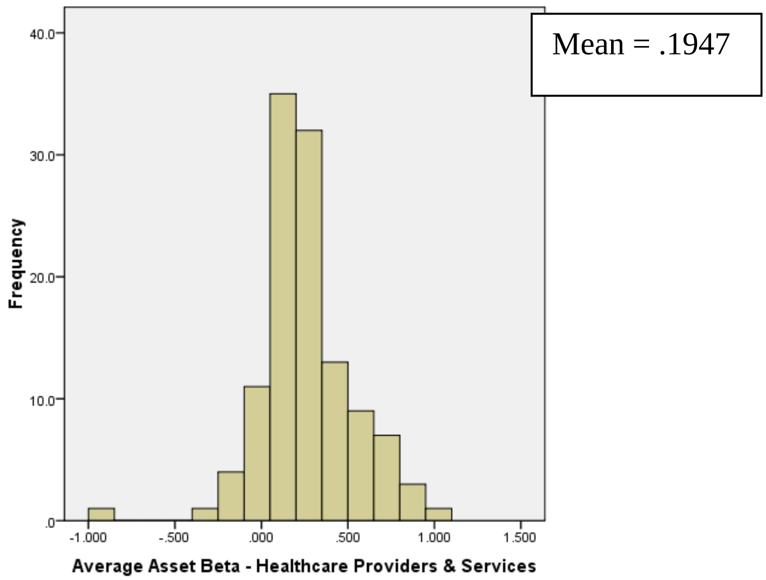


Table 3.2 Market and book values of equity for healthcare providers and services †

			2007	
		n= 117	**Market Value of Firm**	**Book Value of Firm**
Healthcare Providers & Services	**HC Facilities**	31	$2,260	$842
	HC Distributors	14	$15,551	$5,396
	HC Services	55	$10,844	$2,840
	HC Managed Care	17	$37,197	$13,053

† Weighted by firm size.

As evidenced in the prior chapter, business risk (β_A) unleveraged using book values of equity is a better predictor of LTDFR than β_A obtained through the use of market values of equity (see Chapter Two). β_A obtained through the use of book values of equity is used moving forward.[67] A correlation matrix including equity betas, the three year average asset betas (using both the market and book values of equity to unleveraged equity risk) is included in the appendices (See A1).

Data

Five years (2007-2003) of full-year, audited data for firms currently listed in the health sector of the multi-sourced Global Industry Classification Standard (GICS) and traded on the AMEX, NASDAQ, NYSE, NYSE ARCA, Non-NASDAQ OTC Equity markets, and other OTC Bulletin Boards were gathered using a universal screening tool.[68] A joint venture with Morgan Stanley and the Standard & Poor's, the GICS Health Sector is subdivided into health care distributors, equipment, facilities, services, supplies, technology, managed health care, biotechnology, pharmaceuticals, and life science tools & services.

[67] Furthermore, business risk is averaged over a three year period rather than looking individual years. This is done 1) to avoid any possible serial correlation and 2) to capture the underlying business risk. Using yearly data captures both the underlying business risk as well as the volatility of that risk. To avoid capturing volatility a three year average β_A is used. Additional look back periods were examined to determine fit but additional years neither added to the fit of the models nor did they significantly impact the average beta.

[68] Over 85% of the firms in the sample are either traded on the NASDAQ or the NYSE. The AMEX accounts for 8.20% of the sample, with the remaining exchanges accounting for less the 5% respectively.

Table 3.3 Sample composition

				# of Firms
Health Sector	**Pharmaceuticals, Biotechnology & Life Sciences**	Biotechnology	Biotechnology	177
		Life Sciences Tools & Services	Life Sciences Tools & Services	54
		Pharmaceuticals	Pharmaceuticals	83
	Health Care Equipment & Services	Health Care Equipment & Supplies	HC Equipment	124
			HC Supplies	32
		Health Care Providers & Services	HC Facilities	31
			HC Services	55
			HC Distributors	14
			HC Managed Care	17
		Health Care Technology	HC Technology	27
		Total		**614**

Firm data was arrayed both longitudinally, in panel data format and cross-sectionally using firm-year observations. Prior to the application of filters, there were 996 firms in the GICS Multisourced Health Sector. Firms were required to have been in existence for the entirety of the study frame (2005-2007), maintain positive total assets, and have market values greater than 0 for the study period. Of the 996 firms, only 733 firms had positive market and total assets values in 2007. Extending the filter to 2003 reduces the sample to 614 firms. Between the end of 2002 and the end of 2007, 134 of the 996 firms had an initial public offering and account for 35% of the observed reduction in the sample. Approximately 65% of the sample reduction is attributed to either being delisted from their respective exchanges or being removed from the GICS Multi-sourced Health Care Sector. The make-up of the final 614 firms in the sample is reported in Table 3.3.

Business Risk Factors

A number of income and accounting variables have been examined as potential predictors of business risk. Smith and Wheeler (1989) examined income measures, specifically, net income, funds flow, and free cash flow as predictors of risk to equity holders for four publically traded hospital management firms. Bildersee (1975) included other accounting measures such as growth, efficiency, and current ratio to predict business risk but focused only on the manufacturing sector. The bankruptcy literature is also suggestive of a relationship between the probability of bankruptcy, the costs of bankruptcy and risk as measured by the market. To explore these relationships in the healthcare sector three large classes of models are explored. First, financial returns (net income, funds flow, and free cash flow) are regressed on business risk using an OLS model with the belief that as net income, funds flow, and free cash flow increase so will the business risk (Smith and Wheeler 1989).[69] The second class of models will explore the relationship between business risk and the predictors of bankruptcy understanding that as the probability of bankruptcy increases so will business risk. The final class will mimic the prior two but will use accounting measures of management to predict business risk in a linear, OLS regression.

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[69] As risk increases the required return to equity holders also increases. Increases in net income, funds flow, and free cash flow are ex post measures that capture the realized return to equity holders and, consequently, the higher business risk.

Financial Returns – Net Income

Net income, or the "bottom line," is calculated by subtracting the cost of doing business (interest, taxes, depreciation, and other expenses) from the total revenues of the firm. To standardize net income, as defined by Compustat (FG_NET_INC_A(0)), the net income reported on annual financial statements was divided by the total book value of assets. The result is a net income-to-total assets ratio for each year in the sample. A three year net income to total assets average is used to predict the underlying business risk. A three year average vs. a single year observation is used to smooth net income and mitigate any excessive highs or lows associated with the instability of net income.[70] The resulting average net income ratio is then regressed using a traditional ordinary least squares (OLS) model on the three year average β_A.[71] The analysis was performed for the entire healthcare sector as well as by sub-sector. Sub-sector results are allowed to have different intercepts and differential sensitivity to net income. Parameter estimates, significance and the adjusted r-squared are reported in Table 3.4.

When the entire sector is examined, net income accounts for roughly 4.3% of the variance in the sample. At the sub-sector level, there are substantial differences among both the parameter estimates as well as the significance. Net income is not significantly related to β_A at the 5% level for the pharmaceutical, healthcare provider, or healthcare technology subsectors. The correlation between business risk and net income is highest in the Biotechnology (R^2=.0557) and Life Science Tools & Services (R^2=.0926). Despite

[70] Results do not substantially change when firm year observations are used instead of the three year average net income.
[71] Coefficients of variation were also explored for each of the financial return measures but no significant relationship was found with β_A.

the variance of parameter estimates and the lack of significance in certain sub-sectors, the parameter estimates are consistently positive as Smith et al posits.

Table 3.4 Parameter estimates, r-squared, and significance using net income, funds flow, and free cash flows as independent variable.

	Net Income						
	Sub Industry						
	Biotechnology	Healthcare Equipment & Supplies	Healthcare Providers & Services	Healthcare Technology	Life Science Tools & Services	Pharma-ceuticals	Total
Intercept	0.3572	0.3785	0.0041	0.3477	0.3430	0.3386	0.3236
Parameter Estimate	0.1633	0.2154	0.2066	0.3987	0.3657	0.0741	0.1576
R^2	0.0553	0.0251	0.0952	0.1170	0.0776	0.0069	0.0430
Significance	0.0018	0.0187	0.4954	0.0807	0.0434	0.4560	<.0001

	Funds Flow						
	Sub Industry						
	Biotechnology	Healthcare Equipment & Supplies	Healthcare Providers & Services	Healthcare Technology	Life Science Tools & Services	Pharma-ceuticals	Total
Intercept	0.3244	0.3707	0.2093	0.3256	0.3391	0.3294	0.3091
Parameter Estimate	0.1021	0.2233	-0.0292	0.2650	0.4006	0.0426	0.1037
R^2	0.0526	0.0329	0.0004	0.0604	0.1301	0.0030	0.0415
Significance	0.0025	0.0239	0.8315	0.2166	0.0086	0.6220	<.0001

Table 3.4 Continued

	Free Cash Flows						
	Sub Industry						
	Biotechnology	Healthcare Equipment & Supplies	Healthcare Providers & Services	Healthcare Technology	Life Science Tools & Services	Pharma-ceuticals	Total
Intercept	0.5218	0.3690	0.2107	0.3296	0.3222	0.3375	0.3338
Parameter Estimate	0.5829	0.1399	-0.0277	0.8603	0.3054	0.0905	0.2362
R^2	0.0492	0.0083	0.0002	0.0572	0.0247	0.0070	0.0179
Significance	0.0033	0.2610	0.8816	0.0195	0.2614	0.4509	0.0009

Financial Returns- Funds Flow

Depreciation and amortization are the largest non-cash expenses for healthcare firms. Funds flow is derived by adding depreciation and amortization (Compustat code FG_DEP_EXP_A(0)) to net income. Again, a ratio is determined by dividing funds flow by the total assets in the respective year to control for size. Three year averages are used to arrive at the underlying funds flow and avoid the highs and lows associated with year-to-year volatility that accompanies using firm-year observations. The resulting funds flow – to – total assets ratios are regressed (OLS) on β_A. Sub-sector results are allowed to have different intersects and differential sensitivity to funds flow. The parameter estimates, adjusted r-squared, and significance are reported in Table 3.4 for the entire Healthcare Sector and for each sub-sector. The inclusion of funds flow to debt holders was also examined by including interest and related expense (Compustat code XINT) in the calculation of the average funds flow. The parameter estimates, adjusted r-squared, and significance of the funds flow measure that includes interest and related expenses are reported in the Appendices (See A3).[72]

There is little difference in the explanatory power between net income and funds flow when all firms in the sector are included. Funds flow accounts for 4.15% of variance in the sample (net income R^2=.043) and, similar to net income, is not significant at the 5% level for the pharmaceutical, healthcare provider, or healthcare technology sub-sectors. The Life Science Tools & Services sub-sector has the strongest relationship with funds flow (R^2=.1301) while healthcare equipment and supply firms have the weakest, significant relationship (R^2=.0329). As evidenced by Table A.3, the inclusion of interest and related expenses in the funds flow measure consistently diminishes the fit of the model with the exception of healthcare provider and service firms. In this sub-sector the inclusion of interest payments in the funds flow measure improves the R^2 from .0004 to .0479 as well as making the relationship significant at the $P<.05$ level.

Financial Returns- Free Cash Flow

Free cash flow represents the money a firm generates after accounting for maintenance or growth of its asset structure. Gathered from Compustat (FG_CF_FREE_A(0)), it is calculated by subtracting changes in working capital and capital expenditures from the funds flow measure (net income and depreciation/amortization). Like net income and funds flow measures, three year averages are used to arrive at the average free cash flow and avoid measuring year to year volatility. Free cash flow - to - total asset ratios standardize the measure, are averaged over a three year period, and are regressed (OLS) on β_A. The parameter estimates,

[72] Addition of interest expense to funds flow reduces r-squared of model.

adjusted r-squared, and significance are reported in Table 3.4. The inclusion of payments to debt holders was also examined by including interest and related expense (Compustat code XINT) in the calculation of the average free cash flow. The parameter estimates, adjusted r-squared, and significance of the funds flow measure that includes interest and related expenses are reported in the Appendices (See A.3).

Of the three financial return measures, free cash flows are the least correlated with business risk. It is significant at the p=.05 level for the Biotechnology, Healthcare Technology, and Life Science Tools & Services sub-sectors and produces a marginal R^2 of .0179 when regressed on all firms in the sample. It is most significant and predictive in the Healthcare Technology Sub-Sector (R^2=.0572). Similar to the funds flow measure, the inclusion of interest and related expenses in the free cash flow measure diminishes the fit of the model with the exception of healthcare provider and service firms. In this sub-sector the payments the funds flow measure (including interest expense) improves the R^2 from .0002 to .0484 and measure becomes significant.

Bankruptcy Measures

There is an exhaustive list of potential bankruptcy measures; however, the Altman Z-score, the Piotroski score, and the value of intangibles capture multiple, sentinel events that may either lead to bankruptcy or quantify the costs once bankruptcy is entered. As the risk and costs of bankruptcy increase so should business risk. The Altman Z-score, set forth by Edward Altman (1968), is a composite score measuring the working capital, retained earnings, earnings before interest and taxes, equity to liability ratios, and the sales of the firm. The Z-score was gathered from Compustat using CA_ZSCORE_FY(0).

Similar to the Z-score, the Piotroski Score is a composite measure that examines the balance sheet, the income statement, and measures of efficiency. [73] Those firms with the highest Piotroski scores are the most likely to outperform the market while low-scorers perform poorly relative to the market and are considered potential bankruptcy candidates or acquisition targets. The Piotroski score was calculated using annual Compustat data.

Finally, intangible assets are non-monetary assets that are created through time and effort. When a firm enters into bankruptcy it is difficult to sell these assets since they often do not have value outside of the firm. Consequently, when firms enter bankruptcy and have to sell assets to meet debt obligations, the value of these assets are typically written down or lost. As such, intangibles gathered from Compustat using the FG_INTANG_A(0) code are one potential cost to bankruptcy.

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[73] Specifically, the 9-point scale awards a point for each of the following:
a. positive earnings, b. positive cash flow, c. year-to-year earnings growth, d. cash flow that exceeded earnings (a crude measure of accruals), e. if the ratio of long-term debt to total assets declined over the past year, f. if the current ratio improved (current assets divided by current liabilities) g. if the company didn't issue shares, h. an improvement in gross margins, i. an improvement in asset turnover (revenue divided by total assets)

Table 3.4 Results of stepwise regression of Z-score, Piotroski Score, and intangibles on average three year β_A .

	Bankruptcy											
	Sub Industry											
	Biotechnology			**Healthcare Equipment & Supplies**			**Healthcare Providers & Services**			**Healthcare Technology**		
	Parameter Estimate	Significance	Partial R^2 (Total R^2 in bold)	Parameter Estimate	Significance	Partial R^2 (Total R^2 in bold)	Parameter Estimate	Significance	Partial R^2 (Total R^2 in bold)	Parameter Estimate	Significance	Partial R^2 (Total R^2 in bold)
Intercept	0.5336	<.0001	***	0.4736	<.0001	***	0.2435	0.0157	***	0.2894	0.2613	***
Altman Z Score	0.0120	0.0004	0.0748	0.0147	<.0001	0.2514	0.0035	0.4390	***	0.0105	0.2443	0.1016
Piotroski Score	-0.0224	0.4894	***	-0.0179	0.1330	0.0116	0.0023	0.8862	***	0.0287	0.6250	***
Intangibles	-5.1E-06	0.9068	***	-7.E-06	0.5812	***	-5.E-06	0.5408	***	-0.0003	0.4731	***
Total Model R^2			0.0781			0.2645			0.0094			0.1234
Adjusted R^2			0.0606			0.2499			-0.0176			0.009

Table 3.4 Continued

	Bankruptcy								
	Sub Industry								
	Life Science Tools & Services			Pharmaceuticals			Total		
	Parameter Estimate	Significance	Partial R^2 (Total R^2 in bold)	Parameter Estimate	Significance	Partial R^2 (Total R^2 in bold)	Parameter Estimate	Significance	Partial R^2 (Total R^2 in bold)
Intercept	0.5393	<.0001	***	0.5569	<.0001	***	0.5198	<.0001	***
Altman Z Score	0.0087	0.0021	0.1725	0.0206	0.0004	0.1311	0.0123	<.0001	0.0947
Piotroski Score	-0.0248	0.2515	***	-0.0266	0.2679	***	-0.0291	0.0012	0.0174
Intangibles	9.E-06	0.6761	***	-4.E-06	0.5951	***	-4.E-06	0.5113	***
Total Model R^2			0.1952			0.151			0.1127
Adjusted R^2			0.1449			0.1187			0.1082

Table 3.4 Continued

	Bankruptcy (Weighted by firm size)											
	Sub Industry											
	Biotechnology			Healthcare Equipment & Supplies			Healthcare Providers & Services			Healthcare Technology		
	Parameter Estimate	Significance	Partial R^2 (Total R^2 in bold)	Parameter Estimate	Significance	Partial R^2 (Total R^2 in bold)	Parameter Estimate	Significance	Partial R^2 (Total R^2 in bold)	Parameter Estimate	Significance	Partial R^2 (Total R^2 in bold)
Intercept	0.5433	<.0001	***	0.5424	<.0001	***	0.1237	0.0306	***	0.7361	0.0015	***
Altman Z Score	0.0132	0.0038	0.0352	0.0204	<.0001	0.3411	0.0191	0.0005	0.1100	0.0024	0.8121	***
Piotroski Score	-0.0211	0.0887	0.0165	-0.0423	<.0001	0.1191	0.0037	0.6890	***	-0.0334	0.4440	***
Intangibles	-8.E-06	0.0358	0.0618	-4.E-06	0.0239	0.0180	-4.E-07	0.7460	***	-0.0006	0.0107	0.4134
Total Model R^2			0.1135			0.4782			0.1120			0.4306
Adjusted R^2			0.0966			0.4678			0.0877			0.3563

Table 3.4 Continued

	Bankruptcy (Weighted by firm size)								
	Sub Industry								
	Life Science Tools & Services			Pharmaceuticals			Total		
	Parameter Estimate	Significance	Partial R^2 (Total R^2 in bold)	Parameter Estimate	Significance	Partial R^2 (Total R^2 in bold)	Parameter Estimate	Significance	Partial R^2 (Total R^2 in bold)
Intercept	0.6683	<.0001	***	0.4343	<.0001	***	0.3348	<.0001	***
Altman Z Score	0.0070	0.0047	0.0967	-0.0113	0.2945	***	0.0170	<.0001	0.0821
Piotroski Score	-0.0462	0.0034	0.1352	-0.0150	0.2378	0.0293	-0.0186	0.0002	0.0200
Intangibles	1.E-05	0.0007	0.0838	4.E-06	0.0002	0.1733	3.E-06	<.0001	0.0481
Total Model R^2			0.2386			0.2137			0.1502
Adjusted R^2			0.1920			0.1838			0.1459

*** Only variables with a p-value < .15 were left in the stepwise regression.

The Altman Z-score, the Piotroski Score, and intangibles are regressed, using both a traditional and a stepwise OLS model, on the three year average asset beta. The regression is performed for the entire health care sector as well as for each of the sub-sectors using a traditional linear relationship. The parameter estimates, partial r-squared, and significance are reported in Table 3.4. Variables with a p-value $< .15$ were left in the stepwise.

Bankruptcy measures show a limited correlation with business risk if one examines the healthcare sector as a whole. At the sub-sector level, bankruptcy indicators among the healthcare equipment, technology, life science tools and services, and pharmaceutical firms are more strongly related to the average β_A. As evidenced by the partial R^2 results from the stepwise regressions, when business risk is significantly correlated with business risk it is largely driven by the Altman Z-score. The fit of these models can be further improved by weighting the observations by firm size. Weighted OLS results are reported in Table 3.4.

Management Measures

In studies that have examined the relationship between operational accounting information and market assessed risk, there appears to be three general categories of interest: profitability, liquidity, and efficiency (Bildersee 1975). In addition to these categories, this chapter includes operating leverage and size.

Profitability is measured by the three year, average return on assets and the three year, average return on equity. Both were gathered from Compustat using the FG_ROA

Table 3.5. Results of stepwise regression of operating leverage, return on assets, return on equity, efficiency, current ratio, asset turnover, and size on average three year β_A . * Only variables with a p-value < .15 were left in the stepwise regression.**

	Management											
	Sub Industry											
	Biotechnology			Healthcare Equipment & Supplies			Healthcare Providers & Services			Healthcare Technology		
	Parameter Estimate	Significance	Partial R^2 (Total R^2 in bold)	Parameter Estimate	Significance	Partial R^2 (Total R^2 in bold)	Parameter Estimate	Significance	Partial R^2 (Total R^2 in bold)	Parameter Estimate	Significance	Partial R^2 (Total R^2 in bold)
Intercept	1.0183	<.0001	***	0.5202	<.0001	***	0.4032	<.0001	***	0.3785	0.0414	***
Fixed Asset %	-0.3293	0.4202	***	-0.3045	0.2760	***	-0.3739	0.0155	0.0754	1.8792	0.0542	0.2729
ROA	0.0021	0.1665	***	0.0005	0.5869	***	-0.0009	0.5893	***	-0.0030	0.4507	***
ROE	0.0004	0.0263	0.0352	0.0001	0.6223	***	3.6E-05	0.0623	0.0256	0.0011	0.1223	0.0673
Efficiency	-0.0068	0.2533	***	-0.0093	0.7381	***	-0.0012	0.4312	***	-0.0833	0.6078	***
Current Ratio	-0.0202	0.0609	***	0.0272	0.0008	0.1481	-0.0041	0.8467	***	-0.0044	0.7439	***
Asset Turnover	-0.3825	0.0737	***	-0.0868	0.2570	***	-0.0022	0.9364	***	0.0953	0.7263	***
Size	-1.6E-05	0.2457	***	-8.4E-06	0.2811	***	-5.3E-06	0.1825	0.0225	-2.6E-05	0.8883	***
Total Model R^2			0.0841			0.1811			0.1321			0.3791
Adjusted R^2			0.0373			0.1412			0.0668			0.1234

Table 3.5 Continued

	Management								
	Sub Industry								
	Life Science Tools & Services			Pharmaceuticals			Total		
	Parameter Estimate	Significance	Partial R^2 (Total R^2 in bold)	Parameter Estimate	Significance	Partial R^2 (Total R^2 in bold)	Parameter Estimate	Significance	Partial R^2 (Total R^2 in bold)
Intercept	0.6336	<.0001	***	0.6178	<.0001	***	0.5742	<.0001	***
Fixed Asset %	-0.4763	0.1551	***	-0.2954	0.3664	***	-0.3599	0.0064	0.0148
ROA	0.0003	0.9009	***	0.0002	0.8813	***	0.0002	0.6350	***
ROE	0.0005	0.0536	***	0.0000	0.2321	***	2.7E-05	0.0474	0.0059
Efficiency	-0.1108	0.0309	***	-0.0307	0.2086	***	-0.0018	0.3174	***
Current Ratio	0.0236	0.0144	0.2759	0.0154	0.0909	0.1222	0.0130	0.0018	0.0572
Asset Turnover	0.0592	0.6875	***	-0.1063	0.5026	***	-0.0921	0.0005	0.0236
Size	-9.8E-06	0.4648	***	-2.1E-06	0.3754	***	-2.7E-06	0.1839	***
Total Model R^2			0.4033			0.1996			0.1065
Adjusted R^2			0.3014			0.1195			0.0949

Table 3.5 Continued

	Financial Management Ratios (Weighted by firm size)											
	Sub Industry											
	Biotechnology			Healthcare Equipment & Supplies			Healthcare Providers & Services			Healthcare Technology		
	Parameter Estimate	Significance	Partial R^2 (Total R^2 in bold)	Parameter Estimate	Significance	Partial R^2 (Total R^2 in bold)	Parameter Estimate	Significance	Partial R^2 (Total R^2 in bold)	Parameter Estimate	Significance	Partial R^2 (Total R^2 in bold)
Intercept	0.9060	<.0001	***	0.6082	<.0001	***	0.3635	<.0001	***	0.6739	0.0010	***
Fixed Asset %	-0.9624	0.0008	0.0711	-0.4520	0.0061	0.0341	-0.2636	0.0045	0.0674	1.3727	0.1937	0.1019
ROA	-0.0007	0.6120	***	-0.0019	0.3980	***	-0.0013	0.7009	***	-0.0053	0.2102	***
ROE	0.0004	0.1427	***	0.0010	0.1093	***	3.3E-05	0.0302	0.0370	0.0022	0.1130	***
Efficiency	-0.0081	0.0870	0.0142	-0.1563	<.0001	0.0800	-0.0008	0.0363	0.0722	-0.0852	0.2262	***
Current Ratio	-0.0059	0.5174	***	0.0289	0.0006	0.2287	-0.0009	0.9605	***	-0.0085	0.5311	***
Asset Turnover	-0.2773	0.1188	0.0203	0.0570	0.5508	***	-0.0167	0.0938	0.0246	-0.1111	0.6477	***
Size	-7.4E-06	<.0001	0.1919	-7.4E-06	<.0001	0.0895	-2.7E-06	0.0008	0.0698	-0.0001	0.3929	***
Total Model R^2			0.3094			0.4428			0.2722			0.3566
Adjusted R^2			0.2741			0.4157			0.2174			0.0916

Table 3.5 Continued

	Financial Management Ratios (Weighted by firm size)								
	Sub Industry								
	Life Science Tools & Services			Pharmaceuticals			Total		
	Parameter Estimate	Significance	Partial R^2 (Total R^2 in bold)	Parameter Estimate	Significance	Partial R^2 (Total R^2 in bold)	Parameter Estimate	Significance	Partial R^2 (Total R^2 in bold)
Intercept	0.3881	0.0045	***	0.5413	<.0001	***	0.3691	<.0001	***
Fixed Asset %	-0.1448	0.6971	***	-0.4828	0.0268	0.0963	-0.3518	<.0001	0.0724
ROA	-0.0082	0.0748	***	-0.0035	0.0726	***	-0.0036	<.0001	0.0227
ROE	0.0008	0.1305	***	3.1E-05	0.6351	***	3.5E-05	0.0431	0.0036
Efficiency	-0.1333	0.0367	0.1246	-0.0120	0.5965	***	-0.0009	0.0495	0.0046
Current Ratio	0.0216	0.0319	0.0660	0.0364	0.0006	0.0551	0.0372	<.0001	0.1804
Asset Turnover	0.3154	0.0681	***	-0.2911	0.0333	0.3843	-0.0479	<.0001	0.0517
Size	2.8E-06	0.4688	***	1.0E-06	0.0512	***	8.1E-07	<.0001	0.0196
Total Model R^2			0.2936			0.5649			0.3551
Adjusted R^2			0.1730			0.5213			0.3468

and FG_ROE codes respectively. The three year average current ratio is intended to capture the liquidity of the firm and was gathered using Compustat code FG_CURRENT_RATIO. Efficiency is measured as the net sales divided by the total equity in the firm and is then averaged over a three year period. Net annual sales were gathered using Compustat code FG_SALES_A(0) and equity is measured as the total book value of equity in the firm.[74] In addition, the asset turnover ratio measures how efficiently the overall assets of the firm are being employed to generate revenue and is measured annually using Compustat code FG_ASSET_TURN(0) and is then averaged over a three year period. Operating leverage is measured as the fixed assets of the firm divided by the total assets of the firm and is also averaged over a three year period. Fixed assets are measured by Compustat code FG_PPE_NET_A(0) and total assets by FG_ASSETS_A(0).

The seven financial management variables were regressed on the three year average beta of the firm using an OLS regression. The regression was performed for the entire health care sector as well as for each of the sub-sectors using a traditional linear relationship. In addition, a stepwise regression was performed using the same variables. Variables with a p-value < .15 were left in the stepwise. Results weighted by total asset size are also reported in Table 3.5.

The profitability, efficiency, and liquidity of a firm are correlated with business risk across all sub-sectors and for the Healthcare Sector as a whole. Financial management variables are most correlated with the life science tools and services sub-sector (adjusted R^2=.3014) and least correlated biotechnology firms (adjusted R^2=.0373).

[74] Book value of equity was measured as the total assets of the firm minus the total debt and liabilities of the firm.

It is interesting to note that the correlating factors seem to vary between sub-sectors. As is the case with bankruptcy measures, weighting the sector by firm size also significantly improves correlation (Table 3.5).

Results and Conclusion

The healthcare sector, although often grouped together by those outside of the industry, is incredibly diverse with multiple pressures and operational idiosyncrasies. What may be a common practice among heath care providers may be unthinkable to pharmaceutical firms. Each of the models examined has the potential to inform an estimation of a firm's β_A with the regressors highly dependent upon the sub-sector of the firm.

Reinforcing the findings of Smith and Wheeler (1989), net income, funds flow, and free cash flow do inform the level of business risk in some sub-sectors of the healthcare industry. With two exceptions, net income is the measure of financial earnings most correlated with business risk (excluding findings where $p>.05$). The two exceptions are the Life Science Tools & Services and Healthcare Equipment & Supplies sub-sectors. Within the Life Science Tools & Services sub-sector the funds flow measure performs best and accounts for 13.01% of the variation. The Healthcare Equipment & Supplies sub-sector has the strongest relationship with the free cash flow measure (R^2=.0329). The first null hypothesis (income measures are not correlated with the unleveraged, CAPM measurement of risk) can be rejected.

The relationship between bankruptcy and business risk also varies substantially between sub-sectors. Regardless of weighting, the bankruptcy measures of healthcare provider and service firms have the weakest relationship with business risk while the bankruptcy measures of healthcare equipment & supply firms and healthcare technology firms have the strongest correlation with business risk. Where bankruptcy is significant, the correlation is largely driven by the Altman Z-Score with additional factors becoming important when the sample is weighted by size.

Within the financial management ratios, the significance of any individual ratio is dependent upon the sub-sector examined. The ratios most significant across all sub-sectors are the operational leverage, returns on equity, and liquidity (current ratio). Additional factors do become significant when the sample is weighted by size and all variables are significant in the weighted, sector-wide regressions. Because both bankruptcy and financial management ratios are significant, the second null hypothesis (management and bankruptcy measures are not correlated with the unleveraged, CAPM measurement of risk) can be rejected.

To more accurately predict risk among firms in the healthcare sector, a composite model is derived from the financial returns, bankruptcy, and management models combining those elements most correlated with business risk. After excluding those variables that are insignificant or that have little explanatory power (partial $R^2 < .01$), the list of explanatory variables includes: Altman Z-score, operational leverage, current ratio, total asset turnover, net income, size, efficiency, and return on equity (Table 3.6). The reduced, composite model is then regressed (OLS) on the three year average β_A. Results of the composite model (parameter estimates, partial r-squared, and significance) are

Table 3.6 Composite model prior to removal of insignificant and low explanatory power variables. Weighted by size. * Only variables with a p-value < .15 were left in the stepwise regression.**

Healthcare Sector				
	OLS Results			
	Parameter Estimate	Standard Error	t Value	Pr > |t|
Intercept	0.3381	0.0506	6.68	<.0001
Fixed Asset %	-0.166	0.0774	-2.15	0.0331
ROA	-0.0018	0.0017	-1.08	0.2795
ROE	4.64E-05	1.80E-05	2.52	0.0124
Efficiency	-0.0011	0.0005	-2.4	0.0175
Currrent Ratio	0.0251	0.0057	4.44	<.0001
Asset Turnover	-0.0595	0.0106	-5.59	<.0001
Size	1.40E-06	8.30E-07	-1.67	0.0963
Altman Z-Score	0.028	0.0279	5.07	<.0001
Piotroski Score	-0.0059	0.0063	-0.92	0.3606
Intangibles	8.50E-07	2.20E-06	0.39	0.6998
Net Income	-0.4986	0.1988	-2.51	0.0129
		R^2		**0.434**

Table 3.7 Composite model after removal of insignificant variables or variables with limited explanatory power. Weighted by size.

Healthcare Sector (Weighted by Firm Size)					
	Stepwise Results				
	Parameter Estimate	Standard Error	F Value	Pr > F	Partial R^2
Intercept	0.3256	0.0281	134.13	<.0001	
Fixed Asset %	-0.1789	0.0656	7.44	0.0069	0.0632
ROE	5.18E-05	1.81E-05	8.2	0.0046	0.0282
Efficiency	-0.0011	0.0004	6.75	0.0100	0.0532
Current Ratio	0.0233	0.00526	19.72	<.0001	0.1684
Asset Turnover	-0.0581	0.0100	33.79	<.0001	0.0259
Size	-9.39E-07	3.76E-07	6.24	0.0132	0.0173
Altman Z-Score	0.0230	0.0047	23.23	<.0001	0.0160
Net Income	-0.7215	0.1328	29.5	<.0001	0.0528
			R^2		**0.42**

Table 3.8 Composite model after removal of insignificant variables or variables with limited explanatory power

Healthcare Sector					
	Stepwise Results				
	Parameter Estimate	Standard Error	F Value	Pr > F	Partial R^2
Intercept	0.45578	0.05437	70.28	<.0001	
Fixed Asset %	-0.36479	0.12883	8.02	0.0051	0.0278
ROE	5.44E-05	2.05E-05	7.05	0.0085	0.0165
Current Ratio	0.01671	0.00642	6.76	0.01	0.0988
Asset Turnover	-0.0794	0.02966	7.17	0.008	0.0281
Net Income	-0.20927	0.07753	7.29	0.0075	0.0438
			R^2		**0.22**

provided in Tables 3.7 -3.8 and point to a composite model that accounts for between 22% and 42.5% of the variance in the sector (depending on the weighting of the sample).

There is a significant improvement in β_A estimation when one includes the additional accounting information associated with bankruptcy and the financial management of the firm (H_{O1} and H_{O2} rejected). Using accounting data increases the fit of the model substantially due to reliance on multiple information points rather than a singular information point. A marginal fit using financial return variables to predict β_A, among healthcare firms improves drastically (R^2 moves from .04 to .42) for healthcare firms when the additional accounting variables are included.

While investor-owned firms have multiple stakeholders they must ultimately answer to those who have a residual claim on the assets of the firm – the shareholders. As such there is clear accountability among IO firms for the performance of the firm as well as how it finances activities. If the IO firm opts to finance activities with long-term debt there is direct increase in the equity risk premium and equity holders demand a higher return (Modigliani and Miller 1958; Modigliani and Miller 1963). NFP providers do not have the same clear accountability. They must satisfy the board of directors as well as cater to the needs and desires of patients, providers, and community in which they reside. Unlike their IO peers there are no clear equity holders. As NFP's finance more of their activities with long-term debt the equity risk premiums also increase but there are no clear or unified equity holders that demand higher returns to compensate for the increased risk. Without equity holders that appropriately adjust required returns for the impact debt has on risk premiums, NFP firms will likely overuse long-term debt.

Moving forward state regulatory boards and boards of directors must more accurately account for the risks faced by the firm. Failure to account for the risks will result in overuse of debt and a required return to equity holders that is untenable or inaccurate. In good times (when the return on assets is greater than the return on debt) the firm may not be earning a return on equity that matches the risk being borne by equity holders. In bad times (when the return on assets is less than the return on debt) the result will be the destruction of firm value. Equity destruction within the NFP providers has two direct impacts. First, negative returns on equity result in a direct decrease in the community benefit being provided by NFP providers. Second, when the returns on assets are lower than the returns on debt (and the firm is leveraged) the NFP provider must make the debt holders whole. To meet the debt obligations the NFP provider will draw down the existing net assets in the firm, increase operating margins (via cost control, aggressive contracting, or pursuit of high margin lines of business), or the provider will liquidate assets.

Estimation of business risk should examine additional accounting information and not just income measures. While far from perfect, the additional information does provide data points that account for the not only the health of the firm but also the amount of risk being borne by both debt and equity holders. As is the case with all studies that rely on accounting data, selection of the appropriate financial ratios and accounting data is difficult. Subsequent research should investigate the use of sub-sector specific ratios and information to predict business risk. This may include the role of Medicare and Medicaid revenues as a percentage of overall revenue for healthcare service and provider firms or the role of research and development in the biotechnology or pharmaceutical industries.

There are certainly a number of reasons to suspect different levels of risk between sectors. The differences in risk may be a result of a handful of factors that include political sensitivity, competition, regulation, or sector maturity. In addition to the absolute levels of risk being different between sectors, the response to the risk is also likely to be different. Some of the potential differences may be driven by behavioral finance factors and how management within a given sector responds to risk (excessive optimism on the part of sector managers, overconfidence about knowledge or ability, the existence of the confirmation bias, the illusion of control, the overweighting of available information, or the use of the affect heuristic to make decisions)(Shefrin 2007). Other factors that change how firms can respond to risk may include how easily risk can be passed on to other parties, elasticity of demand, the threat of substitutes, etc. An additional possibility is that not all risk is created equal. The CAPM is a cumulative measure of risk that is composed of multiple factors. If a firm is facing a great deal of regulatory risk but very little debt overhang would we expect the same response as if it was operating in an environment of substantial debt overhang and little regulatory risk? The firm may be facing the same absolute level of risk but the proportion or composition is different.[75]

Limitations:

1) One of the primary problems with using accounting data to predict CAPM risk is the differential time references. Accounting data is largely a reflection of environmental and managerial decisions that have occurred in the past. Moreover, accounting data captures both systematic and unsystematic risks (Bildersee 1975). The CAPM captures systematic risk the market foresees in the future. The result is a relationship between CAPM and accounting information that is not perfect but is informative.

[75] The differential response may also be due to the prevalence of factors in the sector not captured (but collinear with factors) in the predictive model.

2) Although the organizational and sociological literature is indicative of not-for-profit firms looking and behaving more like for-profit firms (Keeler 1999), there may be a different relationship between accounting variables and the business risk firms face in the not-for-profit sector.

Appendix 3.0 Correlation among equity risk, the three year average equity risk, and the three year asset risk unleveraged using book and market values of equity.

	Equity Beta	Three Year Average Equity Beta	Average β_A Unleveraged with Market Values of Equity	Average β_A Unleveraged with Book Values of Equity
Equity Beta	1			
Three Year Average Equity Beta	0.04937 0.2219	1		
Average β_A Unleveraged with Market Value of Equity	0.03941 0.3296	0.99975 <.0001	1	
Average β_A Unleveraged with Book Values of Equity	0.0331 0.413	0.99582 <.0001	0.99698 <.0001	1

Appendix 3.1 Correlation matrix of accounting and financial return measures.

	Operational Leverage	ROA	ROE	Efficiency	CR	Asset Turnover	Size	Altman Z-Score	Piotroski Score	Intangibles	Average Net Income
Operational Leverage	1										
ROA	0.12972	1									
	0.0014										
ROE	-0.06136	0.19071	1								
	0.1477	<.0001									
Efficiency	0.11999	0.0539	0.2691	1							
	0.003	0.1834	<.0001								
CR	-0.21859	0.03326	0.01653	-0.02751	1						
	<.0001	0.4153	0.6974	0.4995							
Asset Turnover	0.07089	0.37671	0.04961	0.10715	-0.17725	1					
	0.0815	<.0001	0.2399	0.0081	<.0001						
Size	0.04037	0.37671	0.02263	0.02924	-0.05275	0.06106	1				
	0.3199	<.0001	0.592	0.4695	0.1952	0.132					
Altman Z-Score	-0.06602	0.17326	0.04132	-0.01082	0.90576	-0.00307	-0.00277	1			
	0.1048	<.0001	0.3295	0.7899	<.0001	0.9398	0.9456				
Piotroski Score	0.21948	0.49232	0.06019	0.04787	-0.01537	0.39621	0.19309	0.11538	1		
	<.001	<.0001	0.1538	0.2363	0.706	<.0001	<.0001	0.0044			
Intangibles	0.00099	0.12194	0.01872	0.00868	-0.09527	0.04183	0.89627	0.00444	0.15461	1	
	0.9806	0.0028	0.6608	0.8314	0.0203	0.3071	<.0001	0.9137	0.0001		
Average Net Income	0.17162	0.36515	0.17987	0.02925	-0.00322	0.17584	0.08256	0.06008	0.27669	0.07137	1
	<.0001	<.0001	<.0001	0.4694	0.937	<.0001	0.0409	0.1387	<.0001	0.0802	

Appendix 3.2 Funds flow and free cash flow results with the inclusion of interest payments to debt holders

	Funds Flow						
	Sub Industry						
	Biotechnology	Healthcare Equipment & Supplies	Healthcare Provers & Services	Healthcare Technology	Life Science Tools & Services	Pharma-ceuticals	Total
Intercept	0.3094	0.3613	0.2306	0.3438	0.3154	0.3212	0.3072
Parameter Estimate	-0.0041	-0.0005	-0.0006	-0.0066	-0.0017	-0.0001	-0.0005
R^2	0.0066	0.0024	0.0479	0.0171	0.0041	0.0014	0.0033
Significance	0.2890	0.5487	0.0194	0.5152	0.6529	0.7325	0.1582

Appendix 3.2 Continued

	Free Cash Flows						
	Sub Industry						
	Biotechnology	Healthcare Equipment & Supplies	Healthcare Provers & Services	Healthcare Technology	Life Science Tools & Services	Pharma-ceuticals	Total
Intercept	0.3159	0.3613	0.2326	0.3451	0.3162	0.3212	0.3083
Parameter Estimate	-0.0052	-0.0005	-0.0006	-0.0071	-0.0021	-0.0001	-0.0005
R^2	0.0108	0.0024	0.0484	0.0196	0.0062	0.0014	0.0037
Significance	0.1725	0.5415	0.0182	0.4865	0.5738	0.7326	0.1346

CHAPTER IV

Application of Model & Proxy on IO Sample

In Chapter Two, it was demonstrated that business risk has a significant ability to predict the presence of long-term debt. It also has a substantive and significant ability to predict the level of that long-term debt. Unfortunately, using business risk to predict the use of debt in the Healthcare Sector is challenging. Because business risk, as measured by the Capital Asset Pricing Model (CAPM), is predicated on a firm being publicly traded, the high prevalence of not-for-profit (NFP) firms and lack of market data in the sector makes the calculation of business risk problematic. To address the challenge posed by the high prevalence of NFP firms, a prediction of risk (based on accounting ratios and values) was developed in Chapter Three. The purpose of this chapter is to determine the validity of the risk prediction by 1) predicting business risk using the accounting variables explored in Chapter Three and 2) using that risk estimation to predict capital structure for firms in the GICS Healthcare Sector.

While previous chapters remove reliance on market-derived data to predict the appropriate use of long-term debt, the validity of the business risk estimation in a two-part model needs to be established before it is applied to NFP firms (Chapter V). After establishing the validity of the business risk proxy the two-part model can be used by local, state, and federal governments supporting NFP healthcare firms to identify those entities over/underutilizing long-term debt.

This chapter will address the following hypotheses:

H_0: The business risk estimation in Chapter Three is not associated with a firm's use of long-term debt in the Healthcare Sector.

H_A: The business risk estimation developed in Chapter Three is correlated with the use of long-term debt in the Healthcare Sector.

The chapter begins by reviewing the business risk - capital structure relationship that was explored in Chapter Two. The business risk estimate detailed in Chapter Three is then calculated. The chapter concludes by utilizing the business risk estimation in the two-part model (Chapter Two) to predict the use of long-term debt for IO firms in the Healthcare Sector.

Background

As outlined in Chapter One, there are multiple factors that influence the use of long-term debt. The capital structure literature has identified agency costs, asymmetric information, product/input market interactions, and corporate control considerations as some of the factors that impact a firm's decision to use long-term debt. The relationship among these factors is complex and variable. The use of debt has the ability to increase firm value under some circumstances and decrease the value of the firm in response to others.

To better predict the use of debt and its relationship with risk, the corporate finance literature has used very specific measures such as the probability of bankruptcy or financial distress (Altman 1968; Piotroski 2000), the costs associated with being in bankruptcy or near bankruptcy, and other composite measures of distress (Warner 1977; Campbell, Hilscher et al. 2006) as a proxy for the costs of using debt. As the risk associated with these measures increases the required return to lenders increases and the use of debt decreases. Unfortunately, the specificity of these risk measures only partially captures the costs associated with debt and ignores many others (differential managerial incentives, asset substitution, debt overhang, etc.).[76] The benefits and costs of long-term debt are more than a single measure. The impact and interplay of debt and the firm span each of the four risk categories and are not adequately captured by such specific measures.

Reliance on a different method of determining risk is necessary if one is interested in a more comprehensive measure. To that end, Chapter Two used the CAPM to determine an inclusive measure of business risk. Adjustments were made to the measure to reflect risk to the entire firm (equity and debt holders). Finally, because of the high prevalence of firms without any long-term debt (truncated dependent variable) a two-part model was used to predict long-term debt usage using the adjusted business risk measurement. In the first stage, business risk was used to predict the probability of

[76] For example, the Altman Z-score is a composite measure used to predict insolvency. It examines five financial ratios ranging from sales/assets to working capital/assets. These ratios may be able to predict bankruptcy but they do little to account for costs associated with asset substitution, information asymmetries, or other downside risks that are associated with the use of debt.

having long-term debt. In the second stage business risk was used to predict the use of long-term debt conditional on having long-term debt. The firm's expected use of long-term debt was finally calculated by multiplying the two stages together. The two-stage model was run using the unleveraged CAPM-measurement of business risk in addition to a more inclusive model that added traditional predictors of long-term debt.

As illustrated by Chapter Two, in a combined model that includes business risk and traditional accounting variables (see Table 4.0 or 2.12), long-term business risk accounts for a large portion of the variation in the use of long-term debt among healthcare firms (partial R^2 = .1959 in second step of the two stage model). When significant, the other, substantial second stage predictive variables include the interaction term between short-term and long-term risk, liquidity, intangibles, and size.

Because business risk, as measured by the CAPM, is limited to firms publicly traded, a method of approximating the measure is needed if one is to use business risk as a predictor of long-term debt for NFP firms. In the previous chapter business risk was measured using the CAPM and unleveraged to remove financial risk and provide a measure independent of its capital structure (β_A). Income, bankruptcy, and management variables were then used to predict the long-term (three year average) unleveraged business risk (β_A) for firms within the GICS Healthcare Sector. A composite business risk estimatation model that combined income, bankruptcy, and management variables was derived to predict business risk for firms in the GICS Healthcare Sector (See Table 3.7).

Data

Five years (2007-2003) of full-year, audited data for firms currently listed in the health sector of the multi-sourced Global Industry Classification Standard (GICS) and traded on the AMEX, NASDAQ, NYSE, NYSE ARCA, Non-NASDAQ OTC Equity markets, and other OTC Bulletin Boards were included in the sample.[77] A joint venture with Morgan Stanley and the Standard & Poor's, the GICS Health Sector is subdivided into health care distributors, equipment, facilities, services, supplies, technology, managed health care, biotechnology, pharmaceuticals, and life science tools & services.

Firm data was arrayed both longitudinally, in panel data format and cross-sectionally using firm-year observations. Prior to the application of filters, there were 996 firms in the GICS Multisourced Health Sector. Firms were required to have been in existence for the entirety of the study frame (2003-2007), maintain positive total assets, and have market values greater than 0 for the study period. Of the 996 firms, only 733 firms had positive market and total assets values in 2007. Extending the filter to 2003 reduces the sample to 614 firms. Between the end of 2002 and the end of 2007, 134 of the 996 firms had an initial public offering and account for 35% of the observed reduction in the sample. Approximately 65% of the sample reduction is attributed to either being delisted from their respective exchanges or being removed from the GICS Multi-sourced Health Care Sector. The make-up of the final 614 firms in the Healthcare Sector is reported in Table 4.1.

[77] Over 85% of the firms in the sample are either traded on the NASDAQ or the NYSE. The AMEX accounts for 8.20% of the sample, with the remaining exchanges accounting for less the 5% respectively.

Table 4.1 Healthcare Sector sample composition

				# of Firms
Health Sector	**Pharmaceuticals, Biotechnology & Life Sciences**	Biotechnology	Biotechnology	177
		Life Sciences Tools & Services	Life Sciences Tools & Services	54
		Pharmaceuticals	Pharmaceuticals	83
	Health Care Equipment & Services	Health Care Equipment & Supplies	HC Equipment	124
			HC Supplies	32
		Health Care Providers & Services	HC Facilities	31
			HC Services	55
			HC Distributors	14
			HC Managed Care	17
		Health Care Technology	HC Technology	27
		Total		**614**

Prediction of Business Risk Variable

In Chapter Three income, bankruptcy, and management measures were used to predict the long-term business risk for the entire Healthcare Sector. Of the eleven measures considered, five are significant in the Healthcare Sector at a p>.05 level in a stepwise, OLS regression (Table 4.2). Using the significant, stepwise OLS parameter estimates the long-term business risk estimates can be calculated. As illustrated by equation 4.0, the risk prediction is composed of five variables and an intersect where X_1 is the fixed asset percentage of the firm (operational leverage), X_2 is the return on equity, X_3 is the liquidity of the firm (as measured by the current ratio), X_4 is efficiency (as measured by total asset turnover), and X_5 is the net income.[78]

Table 4.2 Income, bankruptcy, and management measures used to predict unleveraged, long-term business risk in the Healthcare Sector

Healthcare Sector					
	Stepwise Results				
	Parameter Estimate	Standard Error	F Value	Pr > F	Partial R2
Intercept	0.45578	0.05437	70.28	<.0001	
Fixed Asset %	-0.36479	0.12883	8.02	0.0051	0.0278
ROE	5.44E-05	2.05E-05	7.05	0.0085	0.0165
Current Ratio	0.01671	0.00642	6.76	0.01	0.0988
Asset Turnover	-0.0794	0.02966	7.17	0.008	0.0281
Net Income	-0.20927	0.07753	7.29	0.0075	0.0438
			R^2		**0.22**

$$\begin{aligned}\text{Long} - \text{Term Business Risk} = .45578 - .36479X_1 + .0000544X_2 + .01671X_3 \\ - .0794X_4 - .20927X_5\end{aligned} \quad \text{(Eq. 4.0)}$$

The distribution of long-term business risk (the unleveraged CAPM measurement of risk relative to the market (β_A)) has a mean of .318 and a standard deviation of .263

[78] For a full description of each variable see Chapter Three.

among healthcare firms (Figure 4.0). Using equation 4.0 above from the estimation of business risk variable in Chapter Three, the long-term business risk was calculated for the 614 firms in the Healthcare Sector. With a mean of .289 and a standard error of .394, Figure 4.1 illustrates distribution of the risk prediction in the sample.

Figure 4.0 Long-term business risk among healthcare firms

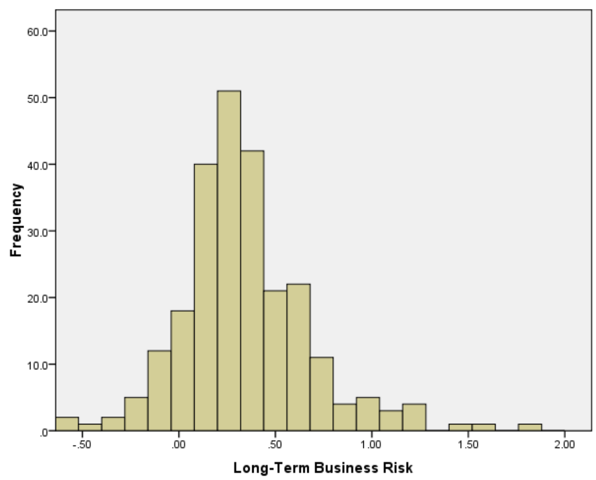
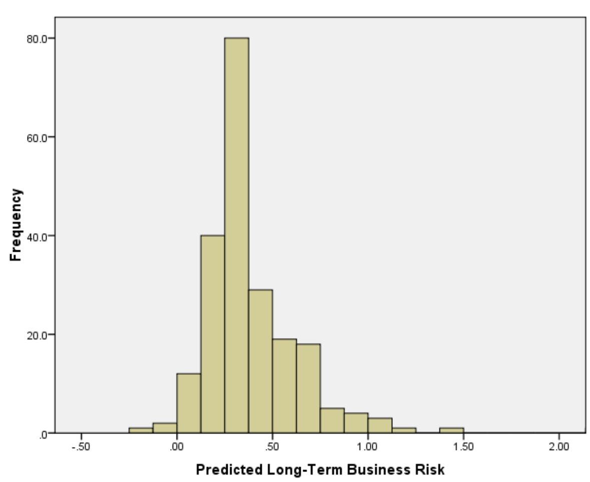


Figure 4.1 Predicted long-term business risk among healthcare firms



Prediction of Long-term Debt

Chapter Two used a two part model to predict the capital structure of firms by GICS Sector. In the first stage the probability of having debt was determined. In the second stage an OLS regression was run to determine the relationship business risk and a handful of additional variables had with the use of long-term debt (conditional on a firm having long-term debt).

After removing insignificant variables from the composite, two-part model, the probability of using long-term debt is largely determined by the Altman Z-Score, the operating leverage, and size. The recalibrated parameter estimates, standard error, and $P>Chi^2$ from the first-stage probit regressions are reported in Table 4.3. In the second stage OLS regressions long-term business risk is an important predictor of long-term debt usage. Also important is the size of the firm, its liquidity, and the intangible percentage of firm assets. The recalibrated, second-stage OLS parameter estimates, standard errors, p-values, and overall model fit are reported in Table 4.3.[79]

Using the recalibrated parameter estimates that reflect the inclusion of only those variables that are significant, the probability of having long-term debt is estimated by equation 4.1 where -.02832 is the intersect, X_1 is the Altman Z-Score, X_2 is the firm's operating leverage, X_3 is the percentage of the firm's assets that are intangible, and X_4 is the firm size.

$$\Pr(\text{Long}-\text{Term Debt}) = -0.2832 - .0282X_1 + 1.4788X_2 + 2.8605X_3 + 0.0003X_4 \qquad \text{(Eq. 4.1)}$$

[79] Treatment of zero-leveraged firms and the transformation of dependent variables is discussed in Chapter Two.

The second stage, OLS regressions are also recalibrated to reflect only those variables that are significant. Conditional on having long-term debt and a stage one probability of debt > 0, equation 4.2 estimates the log(long-term debt usage) where X_1 is the long-term risk (business risk proxy), X_2 is the liquidity of the firm, X_3 is the size of the firm, and X_4 is the Altman Z-Score.

$$\text{Log(Long} - \text{Term Debt)} = -1.2635 - .5013X_1 + .0481X_2 - .0000093X_3 - .0174X_4 \qquad \text{(Eq. 4.2)}$$

Having already developed the business risk proxy (Chapter Three), Equation 4.0 calculates a proxy measurement of long-term business risk that can be substituted for the market-based, CAPM measurement. That measurement is then used in the two-part model (specifically the second of the two stages – Eq. 4.2) to predict long-term debt usage conditional on having long-term debt.

The product of equations 4.1 and 4.2, the expected use of long-term debt accounts for the truncation of the dependent variable (high prevalence of zero-leveraged firms) in the sample.[80]

[80] The predicted log (LTDFR) has values between -2.5 and 0 with values closer to 0 indicating a higher LTDFR. If the probability is multiplied before the predicted log (LTDFR) is retransformed the application of probabilities will erroneously produce higher estimates of leverage because the expected values will be closer to 0.

Table 4.3 Refined parameter estimates, standard error, and significance from the two-stage model that only includes factors significant at the $p<.05$ level.

	Healthcare Sector					
	Combined Model (Book Values of Equity Used to Unleverage Equity Beta)					
	Stage One: Probit			Stage Two: OLS		
	Parameter	Standard Error	P> Chisq	Parameter	Standard Error	P-Value
Intercept	-0.2832	0.1055	0.0072	-1.2535	0.0845	<0.0001
Long -Term Risk (Asset Beta)				-0.5013	0.9189	<0.0001
Altman Z-Score	-0.0282	0.3020	<0.0001	-0.0174	0.0063	0.0062
Intangibles	1.4788	0.0060	<0.0001			
PPE	2.8605	0.5394	<0.0001			
Liquidity				0.0481	0.0139	0.0007
Size	0.0003	0.0001	<0.0001	-9.3E-6	4.3E-6	0.0317
R^2 from Composite, Two Stage Model						0.2039

Results & Discussion

Using a market assessment of business risk to predict the use of long-term debt among healthcare firms, one can account for roughly 22% of the variation of the LTDFR within the sector.[81] The sector is composed of a substantial number of NFP firms and the calculation of a CAPM-based measurement of business risk is difficult. To address the high prevalence of NFP firms and predict the use of debt using business risk as an independent variable a prediction of long-term business risk was developed using accounting ratios and values. Depending on the weighting of the sample, the predicted, unleveraged business risk captures between 22% and 42% of the business risk variation among healthcare firms.

The use of a accounting-based, prediction of risk (in lieu of the CAPM measurement of risk) combined with a two-part model accounts for 11.73% of the variation in the use of long-term debt in the healthcare sector (See Table 4.4). The reduction in model fit (22% to 11.73%) that occurs with the use of the business risk estimate can be attributed to1) a proxy that is not perfectly predictive of business risk and 2) a two-part model that has excluded non-significant factors. However, that portion of business risk that the business risk proxy does predict is predictive of LTDFR (H_O rejected). Had the proxy been 100% predictive of business risk there would be no degradation in the explanatory power in the composite, two-part LTDFR model.

As one would anticipate with a good proxy, the direction and significance of proxy is similar to that of the variable it is replacing. In the two-part model, business risk has a negative impact on the use of long-term debt and is significant at the $p<.005$ level

[81] 20% after removal of low-significance variables

(Tables 4.0 & 4.3). Had the proxy been positively associated with the use of long-term debt its insertion into Equation 4.2 would have likely resulted in a deterioration of predictive power below that of sector specific Model 2 in Chapter Two (Table 2.11). Moreover, additional second stage OLS regressions were performed with the business risk weighted and unweighted. In both instances the business risk estimate remains negative and significant at the $P<.05$ level.

Within the Healthcare Sector the majority of NFP firms are concentrated in the Healthcare Providers and Services Sub-Sector (healthcare facilities, services, distributors, and managed care). In the Healthcare Providers and Services Sub-Sector, using the business risk proxy in the two-stage model accounts for 33.45% of variance in the use of long-term debt (Table 4.4).

The explanatory power of the two-part model improves if the correlation between the expected LTDFR and the LTDFR is weighted by size. This occurs when either the predicted business risk or the realized business risk variable is used in the second OLS stage. The improvement is indicative of the model being more predictive among large firms. The one exception is among the healthcare provider and service firms sub-sector, the explanatory power declines from 33.45% to slightly less than 27% with weighting.

The substantial improvement associated with weighting can be attributed to a number of factors. First, small firms may be financing their growth through long-term debt and eventually "grow into" their capital structure. Second, the small firm, in need of cash, is willing to take on the additional risk associated with increased leverage. The benefits of growth financed by debt are greater than the costs associated with debt for the smaller firm. Another possible explanation is that both lenders to and managers at large firms have a better sense of the benefits and costs associated with debt and more accurately balance the costs of long-term debt with its benefits.

The use of business risk to predict the use of long-term debt is an important step to more accurately predicting capital structure. The current use of very specific measures of potential bankruptcy or costs of bankruptcy are important factors to consider when evaluating the firm's use of debt; however, their specificity fails to account for additional factors (both positive and negative) that impact the trade-off theory of capital structure. As a result, the prior trade-off models that have used specific measurements of the costs associated with debt are likely to underestimate the total costs of debt and overstate the benefits of long-term debt.

The use of a predictive measure that captures business risk allows for the extension of the business risk – long-term debt model into the NFP healthcare sector. The business risk estimation developed in the prior chapter is both significant and has the same directional impact as the variable it is intended to replace. Using the predicted business risk, it is now possible to determine a more appropriate level of long-term debt among all firms within the healthcare sector.

Table 4.4 R^2 of recalibrated, two-part model by healthcare sub-industry.

		Business Risk & Traditional Determinants	Business Risk Proxy & Traditional Determinants	
		Recalibrated Two-Part Model R^2	**Recalibrated Two-Part Model R^2**	**Recalibrated Two-part Model R^2 (Correlation weighted by firm size)**
Healthcare Sector	Biotechnology	0.1828	0.0860	0.4247
	Healthcare Equipment and Supplies	0.1336	0.0011	0.1845
	Healthcare Providers & Services	0.3417	0.3345	0.2698
	Healthcare Technology	0.0515	0.2843	0.2905
	Life Science Tools & Services	0.3561	0.0865	0.0378
	Pharmaceuticals	0.4082	0.2436	0.5002
	Total	**0.2039**	**0.1173**	**0.2392**

Appendix 4.0 Correlation table (proxy & components of two-Stage LTDFR model)

	Business Risk Proxy	Operating Leverage	ROA	ROE	Efficiency	Liquidity	Asset Turnover	Size	Altman Z Score	Piotroski Score	Intangibles	
Business Risk Proxy	1											
Operating Leverage	-0.29266	1										
	<.0001											
ROA	-0.75715	0.10177	1									
	<.0001	0.1049										
ROE	0.04117	-0.00903	0.09953	1								
	0.5473	0.8945	0.143									
Efficiency	-0.07279	0.13842	0.04453	0.49571	1							
	0.2869	0.0271	0.479	<.0001								
Liquidity	0.39152	-0.18336	0.02219	0.0319	-0.04683	1						
	<.0001	0.0035	0.7259	0.641	0.4592							
Asset Turnover	-0.52499	-0.03557	0.39056	0.03348	0.10899	-0.31239	1					
	<.0001	0.5719	<.0001	0.6229	0.0824	<.0001						
Size	-0.20924	-0.00428	0.18332	0.04351	0.01452	-0.11132	0.09356	1				
	0.002	0.9457	0.0033	0.5228	0.8175	0.0778	0.1362					
Altman Z Score	-0.37865	0.02373	0.63796	0.10386	-0.00348	0.11989	0.37547	0.17406	1			
	<.0001	0.7061	<.0001	0.1263	0.9559	0.0574	<.0001	0.0053				
Piotroski Score	-0.53281	0.1026	0.47026	0.05815	0.02248	-0.10605	0.39444	0.20995	0.42667	1		
	<.0001	0.1021	<.0001	0.3929	0.7209	0.093	<.0001	0.0007	<.0001			
Intangibles	-0.17862	-0.07638	0.15899	0.03852	-0.00926	-0.12301	0.06029	0.91411	0.14292	0.16503	1	
	0.0085	0.2242	0.011	0.5716	0.883	0.0511	0.3376	<.0001	0.0224	0.0083		
Average Net Income	-0.88116	0.15293	0.18972	0.14741	0.011	-0.06216	0.10035	0.06104	-0.01416	0.18163	0.05381	1
	<.0001	0.0145	0.0023	0.0296	0.8612	0.3257	0.1099	0.3316	0.822	0.0036	0.3921	

CHAPTER V

Application of Model & Proxy on NFP Sample

The United States spends 16% of the gross domestic product on healthcare and healthcare related services. While some of those expenditures go to individual providers and investor owned facilities, much of it is paid to not-for-profit (NFP) facilities. These NFP firms are exempt from federal and state taxes and have access low-rate municipal debt. Despite the substantial payments to (and high prevalence of) NFP firms, very little research has focused on NFP healthcare capitalization.

According to the trade-off theory originally set forth by Kraus and Litzenberger (1973), firms should balance the costs of using debt (potential bankruptcy, reduced pricing flexibility, asset substitution, etc.) with the benefits of debt financing (low cost capital, free cash flow discipline, negotiating leverage, etc.). The point at which the marginal cost of debt equals the marginal benefit of debt determines the optimal use of debt.[82] Prior research has focused on the marginal contributions of agency costs, asymmetric information, product/market interactions, and corporate control considerations under the trade-off theory framework but has lacked a forward looking, cumulative measure of risk.

To that end, the second chapter of this dissertation used the Capital Asset Pricing Model (CAPM) to predict risk to equity holders. Adjustments were then made such that

[82] A more full exploration of the theoretical framework can be found in Chapter Two.

the measure accurately reflected the risk faced by both the debt and equity holders in the firm. The result was a forward-looking, cumulative measure of business risk that captured the upside and downside risk. The more risk faced by a firm, the more the balance point shifted toward the use of less debt. When added to the traditional determinants of leverage, the business risk variables substantially improve explanatory power (48-820% by GICS Sector).

Moreover, the second chapter employed a two-part model to predict the usage of long-term debt. Not all firms are leveraged. In fact, over 27% of firms that are publicly traded do not use any long-term debt. To account for the high percentage of firms that do not carry any long-term debt and the truncation of the dependent variable, the prediction of debt use is divided into two stages. In the first stage the probability of using debt is determined. In the second stage, business risk and traditional accounting variables are used to explain the use of long-term debt conditional on the firm having long-term debt. The two stages are then combined to form the expected use of long-term debt for the firm. Using business risk and a two-part model to account for firms that do not finance assets with long-term debt, the expected use of long-term debt is a product of the probability of having debt and the predicted use of debt conditional on having long-term debt.[83]

Understanding that business risk, as measured by the CAPM, requires firms to be publicly traded, the third chapter developed an estimation of business risk that can be substituted for the market-derived measure of risk (β_A). Calculated using financial return, bankruptcy, and management ratios, the development of an business risk estimate allows

[83] A departure from how leverage is typically predicted, the use of a two part model and the introduction of business risk (CAPM measured) as an explanatory variable is a significant contribution to the field.

the two-part model to be applied to the not-for-profit (NFP) Healthcare Sector. However, before the estimate can be used to predict the use of long-term debt its validity in a two-part model needed to be established. The fourth chapter tested the business risk estimate in the two-part model to reaffirm its ability to predict the use of long-term debt.

This chapter builds upon the prior chapters, by applying the two-part model and risk estimate to a sample of NFP providers in the Healthcare Sector. Beginning by examining the use of long-term debt among investor-owned (IO) and NFP firms, this chapter will calculate the business risk estimate derived in Chapter Three specifically for the firms in the NFP sample. Next, the risk estimate will be used in the two-part model to predict the use of long-term debt for NFP healthcare firms.[84] Along the way, this chapter will specifically address the following hypothesis:

H_{O1}: There is no relationship between the long-term debt financing ratio (LTDFR) and the composite model (See Chapter Two – Model 3) in the NFP Healthcare Sector.

H_{A1}: There is a relationship between the LTDFR and composite risk in the NFP Healthcare sector.

H_{A2}: Not-for-profit healthcare firms are less sensitive to risk compared to their investor-owned counterparts when determining the appropriate use of debt. While investor-owned

[84] To determine if IO and NFP models would be the same if estimated separately the same two-part model explored in the prior chapters was estimated using the NFP hospital data. The first and second stages were compared to the IO sample using a likelihood ratio and F-test respectively. The likelihood ratio produced a Chi^2 of 1.95 (p=.1625) and the F-test produced an F-value of .3656 (p-value >.95). Based on the Chi^2 and F-test results one can reasonable assume the model does not produce substantively different estimates if the model is estimated using the NFP hospital data versus the IO healthcare sector data.

firms have multiple stakeholders they must ultimately answer to those who have a residual claim on the assets of the firm – the shareholders. As such there is clear accountability among IO firms for the performance of the firm as well as how it finances activities. If the IO firm opts to finance activities with long-term debt there is direct increase in the equity risk premium and equity holders demand a higher return (Modigliani and Miller 1958; Modigliani and Miller 1963). NFP providers do not have the same clear accountability. They must satisfy the board of directors as well as cater to the needs and desires of patients, providers, and community in which they reside. Unlike their IO peers there are no clear equity holders. As NFP's finance more of their activities with long-term debt the equity risk premiums also increase but there are no clear or unified equity holders that demand higher returns to compensate for the increased risk. Without equity holders that appropriately adjust required returns for the impact debt has on risk premiums, NFP firms will likely overuse long-term debt.

Data

A national sample of 3,258 NFP healthcare facilities was selected from information gathered by INGENIX, a subsidiary of UnitedHealth Group and a consulting operation that has assembled coding practices, substantial amounts of financial information, and benchmarks for healthcare firms. The sample of healthcare facilities include short-term, long-term, critical access, rehabilitation, and psychiatric hospital facilities. To be included in the sample the facility had to have at least $5M in assets. The sample includes privately owned, church owned, and other NFP hospitals from every state. The sample does not include government facilities. Of the initial sample, 326 hospitals were excluded due to missing financial data over the sample time frame (2007-2003). The final sample consists of 2,932 NFP hospitals.

Dependent Variable: Long-Term Debt Financing Ratio (LTDFR)

Similar to the use of long-term debt among IO firms, there is substantial variation in the use of long-term debt among NFP firms. The average 2007 long-term debt financing ratio among the 2,932 firms in the NFP sample is .3153 with a standard deviation of .2512 (Fig. 5.0). Within the sample 347 firms, or 11.8%, do not use any long-term debt. By way of comparison, the average LTDFR among IO healthcare provider and service firms is .2645 with a standard deviation of .2445 (See Table 3.0, Fig 5.1).[85] Not only do NFP firms use substantially more long-term debt but the prevalence of zero leveraged firms (11.8%) is substantially lower compared to the prevalence of zero leveraged firms in the IO sample (28%).

The use of long-term debt is not normally distributed in the NFP hospital sample. It is skewed right and truncated at 0 (Fig. 5.0). While the mean long-term leverage is .3153 (.3210 weighted), 11.8% of the sample does not employ any long-term debt. The high prevalence of non-leveraged firms and the truncation of the dependent variable in the distribution also warrants the use of the same two-part, mixed model approach employed in the second and third chapters (Duan, Manning et al. 1983; Duan, Manning et al. 1984; Buntin and Zaslavsky 2004). A log transformation of the dependent variable is also employed to address the long tail in the distribution and reduce the impact of outliers in the sample. Firms with LTDFR≥1 have their LTDFR set to .99.

[85] A full description of the investor-owned sample can be Chapter Two.

Figure 5.0 Long-term debt financing ratio for NFP sample

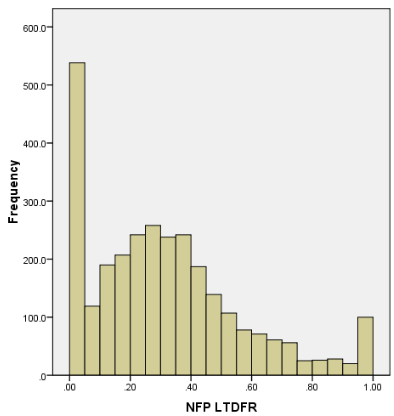
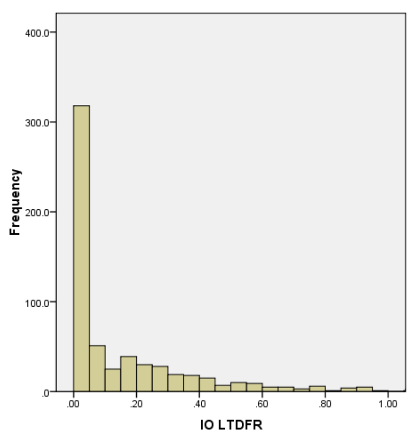


Figure 5.1 Long-term debt financing ratio for IO sample



The three most often cited reasons for IO firms avoiding long-term debt include financial flexibility, managerial entrenchment, and the use of non-debt tax shields (Marchica 2007; Devos, Dhillon et al. 2009; Dang 2010). While NFP firms do not necessarily benefit from non-debt tax shields (assuming limited for-profit subsidiaries), they can benefit from the added financial flexibility and managerial entrenchment that coincides with zero and ultra-low leverage. Moreover, NFP firms may have an added incentive to manage earnings to reduce community benefit obligations. It is generally argued that NFP firms have a responsibility to provide community benefits to their respective service areas equivalent to their tax liability if the firm were to pay taxes. By spreading facility losses or gains across the system rather than allowing the losses to pool at the facility level the system can reduce the amount of expected community benefit. Without understanding the national prevalence of NFP systems, their average size, or the frequency of their balance sheet/earnings management it is difficult to comment on the impact earnings management has on the findings.

Long-Term Business Risk & Other Determinants of the LTDFR

To assess risk, the equity markets have turned to the capital asset pricing model (CAPM). As previously outlined, Harry Markowitz's work on the CAPM determines equity specific returns based on risks and opportunities as assessed by equity investors. The CAPM measures the movement of a firm's stock price relative to the overall market and assigns the firm's equity a relative risk rating.

Unfortunately for those attempting to assess the business risk to an entire firm, the CAPM is a measurement of equity risk that overstates the risk faced by all the stakeholders of the firm by ignoring the risk to debt holders. Adjusting business risk to be independent of the capital structure of the firm is important since a firm's use of debt impacts the expected return to equity holders. As the proportion of debt increases the equity risk relative to the asset risk of the firm also increases (Brealey, Myers et al. 2008; Ross, Westerfield et al. 2008). As firms take on more debt (leverage up) the expected return to equity holders also increases (Modigliani and Miller 1963).[86, 87] Using CAPM beta estimates as measures of risk only accounts for that portion of the firm financed with equity. Since the required return on equity is always equal to or greater than the required return on assets, one introduces a bias that overstates the overall risk of the firm by not accounting for a firm's use of debt and just focusing on risks faced by equity holders.

To accurately account for the risk faced by the entire firm (debt and equity holders) one must unleverage, or remove the effect of capital structure on β_E. Risk to the entire firm, denoted by β_A, is the weighted average of the risk associated with the equity of the firm and the risk associated with the debt of the firm.[88] However, the use of the CAPM to assess the risk to equity holders can only be determined if the firm is publicly traded. To use long-term business risk as an explanatory variable among NFP firms a proxy was developed that estimates β_A.

As detailed in Chapter 4, the prediction of long-term business risk (β_A) is composed of five variables and an intersect where X_1 is the fixed asset percentage of the

[86] To reflect the additional equity risk, stock purchasers bid down the stock price when additional debt is issued. The lower stock price and unchanged earnings projection then reflect the higher required returns.

[87] Based on Modigliani and Miller proposition II, the cost of equity is a function of the firm's debt to equity ratio because of the higher risk involved for equity-holders in a company with debt. Due to seniority and subordination clauses, high amounts of leverage can also lead to the required return to debt increasing.

[88] The CAPM produces an estimate of equity risk, β_E , that is the covariance (stock return, return of market index) divided by the variance (return of market index). The risk associated with debt, β_D, can be similarly estimated as the covariance (return to debt holders, return of equity market index) divided by the variance (return of equity market index). As long as the value of the firm's assets is greater than the debt of the firm then the value of debt will not fluctuate with the market. If a firm with a sufficient asset base enters financial distress debt issuers can be reasonably assured that the assets of the firm can be liquidated and the debt repaid.[88] Liquidation values greater than debt obligations lead to the lack of fluctuation in debt values. Because the value of debt does not fluctuate with the market the covariance (debt value, market index) is 0. As is common practice, β_D can be set to 0 and β_E multiplied by the value of equity over the value of the firm to remove the effect of leverage and determine the business risk to the entire firm (β_A) (Bowman 1979).[88]

firm (operational leverage), X_2 is the return on equity, X_3 is liquidity (as measured by the current ratio), X_4 is the total asset turnover, and X_6 is net income.

$$\text{Long} - \text{Term Business Risk} = .45578 - .36479X_1 + .0000544X_2 + .01671X_3 - .0794X_4 - .20927X_5 \quad \text{(Eq. 5.0)}$$

Among the 2,932 NFP firms the predicted long-term business risk has a mean of .1834 (.2643 weighted) and standard deviation of .3033 (Fig. 5.2). The predicted long-term business risk among IO healthcare firms (using the same business risk proxy) is substantially higher with a mean of .4623 and a standard deviation of .1941 (Fig. 5.3).

Figure 5.2 Predicted long-term business risk among NFP Hospitals

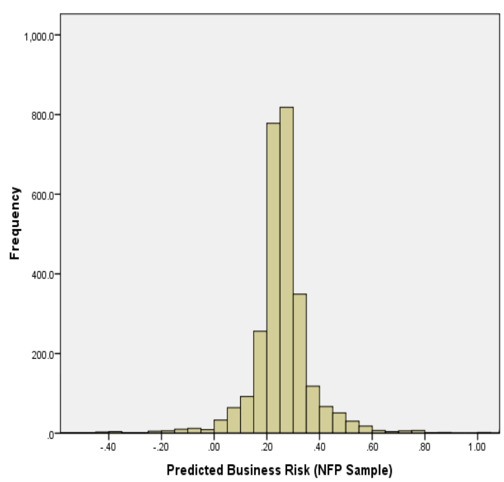
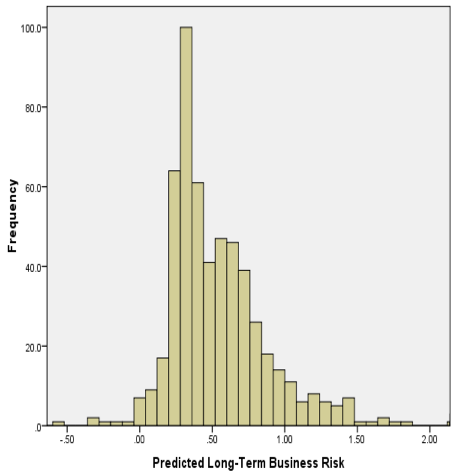


Figure 5.3 Predicted long-term business risk among IO firms in the Healthcare Sector



In addition to business risk, the refined two part model of Chapter 4 requires calculation of the fixed assets percentage (operating leverage), liquidity (current ratio), size, and the modified Altman Z-Score. Table 5.0 compares the above means of the 2,932 firms in the NFP sample to the means of those of the for-profit (FP) Healthcare Provider & Service firms in Chapter Three (n=117).[89]

Fixed Assets: A company's assets can be thought of as being either liquid (easily converted into cash) or fixed. Fixed assets are usually thought of as property, plant, and equipment and are not easily converted into cash. When firms enter into financial distress liquid assets have usually been converted to cash and paid out to meet liabilities. The fixed assets of the firm often remain. For lenders, fixed assets reduce the risk of lending by collateralizing debt obligations. If the borrowing firm cannot meet debt obligations (liquid assets are no longer available), the lender can seize the firm's remaining fixed

[89] See Tables 3.0-3.3.

assets, sell the assets in the market, and recoup the funds extended to the borrower. Firms with higher a higher percentage of fixed assets have the ability to collateralize more of their borrowing and are able to secure lower cost debt.[90] As a result, those firms with more physical or fixed assets use more debt to finance assets and operations (Baker and Wurgler 2002). A much higher percentage of a NFP firm (43%) is fixed when compared to their IO peers (17%) in the provider and services sub-sector. In other words, NFP firms have a higher operating leverage. The difference may be due to the relative size discrepancies between IO and NFP firms or it may be due to differing treatment of retained earnings.[91]

Liquidity: There are a number of potential measures of liquidity; the most frequently used is the current ratio. Measured as current assets over the current liabilities, the current ratio is a financial ratio used to determine if the firm has enough liquidity to meet financial obligations due within the next year. The more liquid the firm the easier it will be for the firm to meet its liabilities. As a result, highly liquid firms find it easier to secure debt (Morellec 2001). No substantial differences appear between the liquidity of NFP and IO firms. Both have current ratios around 2.9-3.0, meaning that they have three times more current assets than current liabilities.

[90] Additional adjustments may be required to refine the use of fixed assets for the non-for-profit healthcare sector. Due to the existence of equity (net assets) that is limited as to use, only using PPE may systematically overstate the assets available to meet debt obligations (i.e. understate operational leverage).
[91] Rather than returning equity to the community in the form of community benefit or lower rates the NFP hospitals may have an incentive to invest in property, plant, and equipment or other large capital expenditure projects.

Size: Measured as the total fund and liabilities balance, the size of the firm is thought to reflect on the firm's ability to meet debt obligations and, to some degree, its maturity (larger firms have more assets that can be liquidated to meet debt obligations). Posing a lower risk to lenders, the larger firms pay a lower risk premium to their lenders and consequently use more long-term debt. Moreover, the larger firms tend to be older, more established firms that have had more time to accumulate long-term debt. Within the NFP hospital sample, the average facility is worth $187.6M. Comparable firms from the IO sample are substantially larger ($3.2B). [92]

Altman Z-Score: The modified Altman Z-score, set forth by Edward Altman (1968, 1983, 2000) is a composite score measuring the working capital, retained earnings, earnings before interest and taxes, equity to liability ratios, and the sales of the firm.[93] It is intended to capture the probability of not being able to pay debt obligations as they become due with lower scores indicating a higher probability of insolvency.[94] As the probability of default increases it becomes less likely that firms will be able to obtain or sustain long-term debt. Evidenced in Table 5.0, the NFP hospitals are substantially less risky compared to their IO pears. The average Altman Z-Score in the NFP sample is 2.34 with a standard error of 1.46. Healthcare provider and service firms in the IO sample

[92] The NFP sample includes psychiatric and critical access facilities that are substantially smaller than their acute care counterparts. The IO sample is also composed of systems of hospitals whereas the NFP data is hospital specific.
[93] The modified, weighted formula is Z-Score= ((.717*working capital + .847*retained earnings + 3.107*EBIT)/total assets) +(.420*net worth)/total debt+.998*sales/total assets
[94] A Z-score less than 1.8 = very high probability of insolvency, 1.8-2.7= high probability of insolvency, 2.7-3.0 = possible insolvency, and a score greater than 3 = insolvency not likely.

Table 5.0 Comparison of Ingenix NFP sample means to IO Healthcare Provider & Services sample means from Chapter Two

	2007	
	NFP Hospital Sample	IO Provider & Service Firms (Chapter Two)
Altman Z-Score	2.349	1.509
Operating Leverage	0.438	0.167
Total Asset Turnover	1.154	0.847
Firm Size (Millions)	187.6	3,217.0
Current Ratio	2.969	3.060

save an average Z-score of 1.5, with lower score indicating a higher probability of bankruptcy.[95]

Prediction of Long-Term Debt

Chapter Three used a business risk estimate in a two part model to predict the use of long-term debt among publicly traded firms in the GICS Healthcare Sector. In the first stage the probability of having debt was determined. In the second stage business risk and a handful of additional accounting variables were used to predict the use of long-term debt (conditional on a firm having long-term debt). The final, expected use of long-term debt was estimated as the product of the first stage probability of having debt and the conditional estimation of the LTDFR. As demonstrated in the second and third chapter, within the composite, two-part model, the probability of using long-term debt is largely determined by the Altman Z-Score, operating leverage, and size. In the second stage

[95] The .84 difference in the average Altman Z-score is substantial and moves IO firms from the very high probability of bankruptcy (most at risk) where the average NFP provider operates to the high probability of bankruptcy (high risk) category.

long-term business risk is an important predictor of long-term debt usage. Also important is the size of the firm and its liquidity.

Using the parameter estimates derived in the previous chapter that reflect the inclusion of only those variables that are significant, the probability of having long-term debt is estimated by equation 5.1 where -.4591 is the intersect, X_1 is the Altman Z-Score, X_2 is the firm's proportion of assets that are intangible, and X_3 is the operating leverage, and X_4 is firm size.

$$\begin{aligned}\Pr(\text{Long}-\text{Term Debt}) = .4591 - .0789X_1 + 1.4171X_2 + 2.8666X_3 \\ + .0001X_4\end{aligned} \qquad \text{(Eq. 5.1)}$$

Conditional on having long-term debt and a stage one probability of debt > 0, equation 5.2 estimates the log(long-term debt usage) among healthcare firms where X_1 is the business risk proxy, X_2 is the liquidity of the firm, X_3 is the size of the firm, and X_4 is the Altman Z-Score. Because the Altman Z-Score requires a market value of equity to book value of liabilities ratio, the modified Z-Score (Altman 2000) for privately owned firms is used in lieu of Altman's original specification.

$$\begin{aligned}\text{Log}(\text{Long}-\text{Term Debt}) = -.9072 - .62271X_1 + .08599X_2 - .00001099X_3 \\ - .07621X_4\end{aligned} \qquad \text{(Eq. 5.2)}$$

The expected use of long-term debt is the product of equations 5.1 and 5.2. The predicted log (LTDFR) has values between -2.5 and 0 with values closer to 0 indicating a higher LTDFR.[96] If the probability is multiplied before the predicted log (LTDFR) is retransformed the application of probabilities will erroneously produce higher estimates of leverage because the expected values will be closer to 0. The product (Eq. 5.1 x retransformed Eq. 5.2) reflects the expected use of long-term debt while accounting for the 11% of firms that carry no long-term debt (truncation of the LTDFR variable).

Results & Discussion

It is important to recognize that the unit of observation between the IO and NFP samples is different. Within the IO sample the unit of observation is the firm which is often composed of multiple facilities. The financial information gathered from the IO sample reflects the cumulative asset, equity, and debt values across all facilities under the umbrella of the parent company. The NFP sample is restricted to facility level observations and is not grouped by ownership. While this is not a problem if NFP facility level data is not manipulated by a parent company it does open the possibility that parent companies (or healthcare systems) allocate portions of debt, equity, etc. to individual facilities to optimize financial performance. Of the 2,932 NFP facilities in the sample it is clear that at least 32 firms (5 long-term hospitals, 4 rehabilitation hospitals, and 23 short-term hospitals) have their capital structure manipulated at the system level.[97] Had system ownership variables been available the disparity could have been overcome by grouping NFP facilities by system or ownership. Without understanding the national prevalence of NFP systems, their average size, or the frequency of their balance

[96] Setting log (LTDFR) equal to -2.5 for non-leveraged firms is equivalent to a firm having a debt financing ratio of <.00316.

[97] As evidenced by negative long-term liability values.

sheet/earnings management it is difficult to comment on the impact the unit of observation has on the findings.

Prior to the application of probabilities to the second of the two stages, the OLS estimates from the prior chapter (Eq. 5.1) predict the NFP sample will have an average LTDFR of .2887. The NFP sample has an actual LTDFR of between 31-32% (depending on if the sample is weighted). However, after applying the probabilities of having debt (Eq. 5.2) to calculate the expected use of long-term debt, the average expected LTDFR is .1034. The NFP firm uses substantially more long-term debt than predicted by the composite, two part model.

Calculated by correlating the expected LTDFR and the 2007 LTDFR, the two-part model accounts for only 7.2% of the variance in the sample (Table 5.1). Yet, not all NFP hospitals face and react to the same pressures. To that end the sample was stratified by hospital type (children's, critical access, long-term, psychiatric, rehabilitation, short-term, and a catch-all category for those firms without a facility type designation) to determine if there are certain NFP facility categories where business risk and the traditional determinants of long-term debt predict relatively poorly (or well) the usage of long-term debt. Within the NFP sample, the expected LTDFR (generated using parameter estimates from a composite, two-stage model) has no significant correlation ($p<.05$) with children's, long-term, or psychiatric hospitals. The model does reasonably well for rehabilitation facilities (R^2=.198) and short-term hospitals (R^2=.132).

The hospital categories were further stratified by firm size to ascertain if there was differential predictive power dependent upon firm size. Regardless of firm size, there is no significant relationship between the expected and actual LTDFR for children's hospitals. The same holds true for long-term hospitals. In most cases stratification either makes the sample too small or there is insignificant correlation between the expected LTDFR and the 2007 LTDFR (Table 5.1). The three notable exceptions are for all short-term hospitals and for small critical access and psychiatric facilities. Amongst short-term hospitals (the bulk of the sample) the predictive power of the composite, two-part model is relatively stable accounting for between 9.4% and 15.8% of the sample variance (rejection of H_O).

Table 5.1 R^2 (derived from correlation between expected LTDFR and the 2007 LTDFR) by facility type and stratified by firm size. Grey cells indicate lack of significance (p>.05) or insufficient sample size.

NFP Facility Type	# of Firms	All Firms in Category	Firm Size Quartiles			
			1	2	3	4
Missing	87	0.099	0.282	0.049	0.000	0.085
Childrens	47	0.034	0.149	0.228	0.221	0.099
Critical Access	497	0.048	0.067	0.086	0.008	0.039
Long-Term	75	0.033	0.119	0.002	0.920	0.000
Psychiatric	79	0.052	0.152	0.002	0.089	0.487
Rehabilitation	51	0.198	0.211	0.159	0.243	0.031
Short-Term	2,096	0.132	0.094	0.146	0.158	0.120
Total	**2,932**	**0.072**	**0.090**	**0.083**	**0.057**	**0.086**

Having applied the business risk proxy and composite, two part model to a sample of IO firms in Chapter 4, risk (long-term business risk and accounting factors) can explain 11.73% of the long-term debt variation across all IO firms in the sector (Table 5.2). Examining the IO sample by sub-industry provides additional insight. The proxy and model account for between 0.1% to just over 33% of the variation depending upon healthcare sub-industry. Among IO firms the estimation is most accurate among healthcare provider & service firms (R^2=.3345) and least accurate for healthcare equipment and service firms. Among provider and service firms (of which hospitals are a part), the same prediction of business risk and a composite, two-part model produces substantially better LTDFR estimates in the investor owned sample (Table 4.4 & 5.2).

Among their IO peers in the Healthcare Providers and Services sub-industry the model and proxy account for more than 33% of the variation. The same model and risk prediction account for only 7.2% of the variation among NFP hospitals. This disparity between the IO and NFP estimations is slightly attenuated if the comparison is limited to just short-term hospitals (33% to 13%). However, the difference points to some fundamental differences between the two populations.

The predicted LTDFR among NFP firms is substantially lower than the actual LTDFR among NFP hospitals. If the theoretical model and measures hold, this finding is suggestive of NFP firms facing substantially higher risks than their IO peers *or* NFP firms deriving lower benefits from the use of debt compared to IO firms. In either case the NFP firms should be using less long-term debt than they currently do if they resemble their IO counterparts. To arrive at this conclusion, historical data was used to determine parameter estimates and intersects. As such, the research models the uses of long-term debt on what firms have done in past rather than how they should be leveraging either now or in the future. Using historical trends to predict optimal capital structure requires one to assume that historical behavior is 1) appropriate and 2) predictive of future behavior.

An additional consideration is that unlike IO firms, NFP entities do not have access to equity markets (Initial Public or Seasoned Equity Offerings) when raising capital. NFP's must generate financing through retained earnings, solicit philanthropy, or secure debt (taxable or non-taxable). As a result NFP firms have a unique capital financing constraint to which IO firms are not subject. On the other hand, NFP firms do have access to philanthropy and can benefit substantially from donations (Sloan, Hoerger et al. 1990; Haderlein 2006). Unfortunately little is known about the marginal benefits and costs of philanthropy relative to IPO and SEO equity financing. It is not clear that the financing constraints faced by NFP firms are substantively different that the financing constraints faced by IO firms.

Both NFP and IO firms have access to retained earnings and debt but only the publicly traded IO firm has access to the equity markets. Despite this access, SEO's are often avoided by management because of the poor market signals and effect on existing share holders (Armitage 1998). Moreover, philanthropy can be pursued continuously with minimal impact on the firm while IPO's can occur only once in the firm's lifetime and SEO's are pursued at infrequent intervals if at all.

While the composite, two-part model and risk estimate can produce estimates of the LTDFR that are significantly and substantially related to the actual LTDFR in the NFP sample, the difference in correlation between the IO and NFP entitites raises some critical issues. NFP hospitals are using substantially more debt than predicted given their prediction of risk and parameter estimates developed in the IO sample. Among NFP firms the LTDFR is 31% and among IO firms the LTDFR is 26%. More telling is the prevalence of zero leveraged firms- 28% of IO healthcare firms do not use any long-term debt while only 11.2% of NFP firms do not use any long-term debt. There are three possibilities that may explain some of the differences:

1) If the specification of the business risk estimate and two-part model is correct, the substantially poorer correlation of the expected and actual LTDFR suggests NFP firms are not adequately accounting for the risks (long-term business, bankruptcy, managerial, etc.) they face when making financing decisions. If the case, the proxy and composite two-part model proposed in this dissertation serve as an important estimation of the appropriate amount of long-term debt for NFP firms.
2) Given the poorer fit of the LTDFR estimates, either the proxy is not adequately predicting business risk or the parameter estimates do not translate to the NFP environment. In either case, there may be a 1) fundamental factor associated with being a NFP firm that is excluded from the LTDFR estimation (omitted variable bias) or 2) the factors included in the business risk estimate and model are correct but are not calibrated to reflect the risk to NFP facilities. However, for either the omitted variable or miscallibration argument to hold one has to conclude that NFP and IO firms operate in substantially different risk profiles. While they do have different stakeholders the behavior of NFP and IO healthcare facilities is increasingly similar. Facing shrinking margins, more aggressive contracting, labor shortages, reduced reimbursement, an appetite for new technology, and often competing against each other for market share, the behavior of NFP and IO firms is consistently seen as converging (Cutler and Horwitz 1998; Horwitz 2005).
3) A final possibility is that the benefits of long-term debt financing that accrue to NFP firms are greater than the benefits that accrue to IO firms. According to the trade-off

theory of capital structure, the greater NFP benefits would bias the NFP hospitals toward the use of more long-term debt.

Having established the validity of the business risk proxy and two-part approach in the prior chapters, the findings indicate that certain NFP hospitals (children's, long-term, and psychiatric) are not only unresponsive to long-term business risk but they are also unresponsive to the more traditional determinants of capital structure. The lack of responsiveness may be due to their service population, lack of competition, social or community need, or some other unknown factor. Regardless, these unique and specialized facilities appear to be operating outside of the trade-off theory of capital structure.

To some degree critical access hospitals (CAH) are insulated from risk. These hospitals receive a cost-based reimbursement that is intended to reduce the financial pressures under which they operate and guarantee hospital access.[98] These hospitals are responsive (R^2=.048) to a composite measure of risk (business, bankruptcy, managerial, etc) but are not as responsive as their rehabilitation and short-term, NFP peers (R^2=.198 and .132). This is likely a result of the government initiative to shield CAH from financial pressures that would result in a loss of service or facility closure.

For the 2,096 short-term hospitals, the proxy and two-part model account for 13% of the variation in the sample. Substantially better than critical access hospitals, the explanatory power of the proxy and model among short-term hospitals is still well below that of their for-profit peers. Although NFP hospitals may be behaving more like FP facilities, their different response to risk indicates that there still remains some fundamental differences between for-profit and not-for-profit firms. These differences

[98] Critical access legislation is intended to improve access for rural and vulnerable populations.

are impacting their use of leverage and response to the composite risk factors explored in the prior chapters. Moving forward, research should be focused on identifying if the differential response to risk is warranted.

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Table 5.2 Reproduction of Table 4.4 (R^2 of recalibrated, two-part model by healthcare sub-industry)

		Business Risk & Traditional Determinants	Business Risk Proxy & Traditional Determinants	
		Recalibrated Two-Part Model R^2	**Recalibrated Two-Part Model R^2**	**Recalibrated Two-part Model R^2 (Correlation weighted by firm size)**
Healthcare Sector	Biotechnology	0.1828	0.0860	0.4247
	Healthcare Equipment and Supplies	0.1336	0.0011	0.1845
	Healthcare Providers & Services	0.3417	0.3345	0.2698
	Healthcare Technology	0.0515	0.2843	0.2905
	Life Science Tools & Services	0.3561	0.0865	0.0378
	Pharmaceuticals	0.4082	0.2436	0.5002
	Total	**0.2039**	**0.1173**	**0.2392**

CHAPTER VI

Conclusion

The primary question this dissertation sought to answer was: What is the appropriate use of long-term debt for not-for-profit (NFP) healthcare providers? Healthcare expenditures account for close to 16% of the GDP and are projected to increase in the coming decades as the demographics of the country shift. Despite the already substantial expenditures in the sector, little is known about the appropriate financing of the highly prevalent NFP healthcare sector.

The first chapter of this dissertation provided a helpful primer of capital structure and healthcare finance literature. The theoretical framework of the trade-off theory that is used throughout the dissertation was presented before being expounded on in the second chapter.

In an effort to understand the appropriate capital structure for healthcare firms, Chapter II used a two-stage approach and the trade-off theory of capital structure to predict the use of long-term debt. The two-part model provides valuable insight into the traditional determinants of leverage. As evidenced by stage-two (OLS) results (Chapter II) that are limited to firms with leverage, the historical predictors of long-term debt can explain over 26% of the variation in the sample.[99] However, the high prevalence

[99] Sector-specific, second stage OLS results vary substantially but are uniformly higher than results that are not sector-specific.

low/non-leveraged firms truncates the dependent variable and requires adjustments to account for the probability of having leverage. After adjusting for the truncation of the dependent variable, the traditional determinants of debt account for less than 6% of the variation.

Business risk as an explanatory variable is also introduced in Chapter II. Business risk can improve estimates but the importance of using long-term risk to determine capital structure is not self-evident when examining business risk independently (business risk in the same, two-part model accounts for just over 9% of the variation in the sample). The benefits of using business risk are best realized when paired with the traditional determinants of debt. At the sector level, the pairing of business risk and traditional factors improved prediction substantially (10-229%).

Using business risk in tandem with other determinants of capital structure does improve predictive power in a two-part model. However, because of the frequency of NFP entities in the Healthcare Sector, a measure that approximates business risk is needed. Developed in Chapter III, income, bankruptcy, and management ratios were used to create an proxy that could be applied in the NFP sector.

Chapters IV and V used the two-part model and business risk proxy to predict the LTDFR in a sample of IO and NFP firms. Within the IO sample, a combined model (business risk and traditional determinants) that uses the business risk proxy explains over 33% of the variance in long-term debt usage among healthcare providers and service firms. The same business risk proxy and model explains 7.2% of the variance among NFP hospitals. The model does slightly better (R^2=.132) when the sample is limited to short-term NFP hospitals.

The substantially different results among the IO and NFP firms suggest that a) NFP firms are not adequately accounting for risk when determining their long-term debt usage, b) NFP healthcare facilities have a different response to risk relative to their IO counterparts, or c) the benefits of long-term debt financing that accrue to NFP firms are greater than the benefits that accrue to IO firms.

Directions for future research

While the results of this dissertation are informative, there are substantial opportunities to extend this research. Moving forward, exploration of why NFP and IO facilities have different sensitivities to risk is important. Are the different responses to risk warranted or are there benefits of debt financing that bias NFP firms to the use of more long-term debt? Moreover, do the traditional IO determinants of financial distress also indicate financial distress among NFP healthcare firms? Finally, do NFP firms experience financial distress and the costs of leverage in the same way as their IO peers?

Tangential research already underway has taken on two forms. The first is examining the impact of healthcare reform on the delivery infrastructure. If healthcare reimbursements stall or are reduced which providers are most impacted by the changes? The second tangential area is concerned with the provision of charity care and the required, IRS community benefit reporting. Who is providing care, what type, and can it be coordinated with existing delivery capacity to optimize the healthcare delivery/healthcare delivery infrastructure?

Overall, this dissertation makes an immediate and unique contribution to the field of healthcare finance by:

1) Using a two-part model to account for the large number of firms that opt not to use any long-term debt. Implementing a two-part model that predicts the expected long-term debt financing ratio by first predicting the probability of having debt and then making conditional predictions of leverage allows analysis to move beyond marginal or incremental analysis.
2) Using the Capital Asset Pricing Model (CAPM) to predict a forward-looking measure of business risk. Traditional determinants of leverage are measures of financial distress that have largely been realized. Both administrators and lenders must examine historical trends in addition to looking at risk that may or may not be realized in the future. Historical trends are reflections of realized risk while the forward looking CAPM measure of risk assesses risk that may occur.
3) Developing a prediction of risk that can be used to approximate a CAPM measurement of business risk. The predominance of not-for-profit (NFP) entities and coinciding lack of stock price variation in the Healthcare Sector requires that the measure of business risk be approximated with readily available accounting.
4) Applying long-term business risk measures in a two-part model to predict the use of long-term debt among both investor owned (IO) and NFP healthcare firms.

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