INTANGIBLE ASSETS AND DEFAULT RISK: AN EXAMINATION OF THE CREDIT DEFAULT SWAP MARKET

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ABSTRACT

In this study I examine the impact of intangible assets on default risk. Extant research primarily focuses on the relevancy of intangible assets in the equity markets, but the relevance of intangible assets in the credit markets has not been extensively explored. In fact, due to the differences between equity and debt, it is not apparent that the relevance of intangible assets would be the same for the equity and credit markets. Using data from the credit default swap (CDS) market, I provide evidence that both capitalized and uncapitalized intangible assets reduce default risk and that uncapitalized intangible assets are just as relevant to the CDS market as the items capitalized on the balance sheet. I also find that, uncapitalized intangible assets are more relevant for high default risk firms compared to low default risk firms and less relevant for high growth firms compared to low growth firms. Finally, I provide evidence of a market inefficiency for those firms with a low risk of default. Specifically, the CDS market appears to overreact to changes in debt but underreact to changes in uncapitalized intangible assets. This finding suggests that credit markets, similar to equity markets, would benefit from additional disclosures of intangible assets which are currently not capitalized.

DEDICATION

This dissertation is dedicated to my friends and family. Without their support this research would not have been possible.

LIST OF ABBREVIATIONS AND SYMBOLS

Coef	Coefficient
CRSP	The Center for Research in Security Prices
p-value	Probability associated with the occurrence under the null hypothesis of a value as extreme as or more extreme than the observed value
t-stat	Computed value of *t* test
CRSP	The Center for Research in Security Prices
U.S.	United States

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CHAPTER I

INTRODUCTION

In this paper I analyze the relation between credit default swap (CDS) spreads and intangible assets. Extant research provides evidence that, while intangible assets generate equity value (Ashton, 2005; Wyatt, 2008), equity markets fail to fully incorporate the value of these assets into market price (Chan, Lakonishok, & Sougiannis, 2001; Edmans, 2011; Lev & Sougiannis, 1996). This failure has prompted calls for accounting reform to improve the usefulness of financial statements by further capitalizing and/or disclosing intangible assets. However, the relevance of intangible assets in the credit markets has not been extensively explored. Because of the unique characteristics of debt relative to equity, the relevance of intangible assets in the credit markets is not a forgone conclusion. In this paper I first regress CDS spreads[1] on intangible assets and provide empirical evidence that both capitalized and uncapitalized intangible assets are relevant in the credit market by reducing default risk. Second, I provide evidence that the CDS market does not fully incorporate uncapitalized intangible assets into CDS spreads. These results suggest that the CDS market, similar to equity markets, may benefit from additional disclosures of intangible assets which are not currently capitalized.

Wyatt (2008) summarizes intangible assets as including technology resources (e.g., research and development), human resources (i.e., human capital) and production resources (e.g., brands and customer loyalty). These assets are increasingly important in driving firm value

[1] The CDS market is a derivatives market which trades specifically on firm default risk. The CDS spread is the price paid for the CDS, and it is calculated as a percentage of the respective debt’s face value. I discuss the CDS market in detail in Chapter II.

creation. Lev (2001) notes:

> Corporate profitability is often driven more by organizational capabilities than by control over physical resources, and even the value of physical goods is often due to such intangibles as technical innovations embodied in the products, brand appeal, creative presentation, or artistic content. (p. v)

Currently, GAAP allows the capitalization of intangible assets on the balance sheet only if they are acquired in external transactions and are specifically identifiable (i.e., have value on a stand-alone basis). This accounting treatment implies that there is a growing portion of firm value that is not captured on the balance sheet (Lev, 2001). The increasing importance of uncapitalized intangible assets has motivated a substantial amount of academic research on the valuation of these assets in financial markets (Ashton, 2005; Wyatt, 2008). However, this research has focused almost exclusively on equity markets.

Although the global bond markets are almost twice the size of the global stock market (Bank for International Settlements [BIS], 2012; World Federation of Exchanges [WFE], 2012), little is known about the relevance of intangible assets in the credit markets. As standard setters are pressured to capitalize additional intangible assets or increase related disclosure requirements, it is critical that academic research provide information addressing the relevance of these intangible value drivers on the credit markets. Unlike equity, the maximum payoff for debt is limited to the contractually obligated principal and interest payments. Bondholders are therefore less interested in firm growth and are more interested in whether the firm will default on its debt. As a result, it is not apparent that the relevance of intangible assets would be the same for the equity and credit markets. In fact, critics of accounting reform widely assume that intangible assets have minimal relevance in the credit markets (e.g., Holthausen & Watts, 2001; Skinner, 2008). Even though bondholders do not directly participate in a firm's growth, information about both capitalized and uncapitalized intangible assets can provide insight into future expectations for the firm that are relevant to assessing the probability of default.

The CDS market provides a rich data set in a novel environment which allows for testing the relevance of intangible assets on default risk. A CDS is a derivative whose underlying value is based on the default risk of a stated firm. The CDS market provides a better measure of default risk than bond yields or credit ratings because CDS spreads are less noisy[2] (Ericsson, Jacobs, & Oviedo, 2009; Hull, Predescu, & White, 2004) and updated more timely for changes in credit risk (Blanco, Brennan, & Marsh, 2005; Hull et al., 2004; Zhu 2006).

Using a changes model, I regress CDS spreads on capitalized and uncapitalized intangible assets. I use the market to book value of asset ratio, a common proxy for uncapitalized intangible assets (Villalonga, 2004), and I use instrumental variable (IV) estimation to control for the endogeneity between CDS spreads and uncapitalized intangible assets. Negative (positive) coefficients on capitalized and uncapitalized intangible assets imply that these assets reduce (increase) default risk.

Extant literature finds a positive relation between intangible assets and future growth in cash flows (Boujelben & Fedhila, 2011; Gruca & Rego, 2005), revenues (Hirschey & Weygandt, 1985; Ittner & Larcker, 1998; Kallapur & Trombley, 1999) and the book value of net assets (Kallapur & Trombley, 1999; Penman, 1996). Standard and Poors (2008) uses expected growth in cash flows as a positive indicator of a firm's credit worthiness. Intangible assets are associated with growth in future cash flows (Boujelben & Fedhila, 2011; Gruca & Rego, 2005), and should, therefore, reduce default risk. However, intangible assets also represent a source of cash flow uncertainty and stockholder/bondholder agency conflicts (i.e., underinvestment and

[2] Unlike bond yields which are impacted by multiple factors such as interest rate risk, liquidity risk and recovery rate, the CDS market separates default risk from all other uncertainty thereby providing a more precise measure of default risk.

asset substitution), which can increase default risk (Barnea, Haugen, & Senbet, 1985; Leland, 1998; Myers, 1977; Titman & Tsyplakov, 2007). As a result, the impact of intangible assets on default risk represents a trade-off between expected cash flow growth which reduces default risk and uncertainty and agency conflicts which increase default risk.

Extant research allows me to predict differences in the default risk / intangible asset relationship in certain sub-samples. My first sample partition is based on firm default risk. Due to the non-linear payoff structure of debt, credit markets are more sensitive to information about high default risk firms than low default risk firms (Callen, Livnat, & Segal, 2009; Easton, Monahan, & Vasvari, 2009; Ericsson et al., 2009). I therefore expect that as the firm's default risk increases, the relevance of intangible assets will increase. My second sample partition is based on the proportion of firm value attributable to growth opportunities. Agency conflicts intensify as the proportion of firm value attributable to growth opportunities increases (Moyer, Chatfield, & Sisneros, 1989; Myers, 1977) due to an increased opportunity for underinvestment and asset substitution and due to an increased information asymmetry. I hypothesize that, compared to low growth firms, intangible assets will be less relevant for high growth firms which are more susceptible to agency conflicts.

I find that intangible assets, both capitalized and uncapitalized, are relevant in the CDS market and reduce default risk. As expected, I find that uncapitalized intangible assets are more relevant (i.e., provide a greater reduction in default risk) for high default risk firms compared to low default risk firms. Critics of accounting reform for intangible assets argue that intangible assets have minimal relevance to the credit markets, particularly when a firm nears default (Holthausen & Watts, 2001; Skinner, 2008). My results are not consistent with this argument as it relates to the CDS market. Surprisingly I find that uncapitalized intangible assets are just as relevant to the CDS market as the items capitalized on the balance sheet. This finding contradicts the prevailing thought that balance sheet items are more useful to the credit market than uncapitalized intangible assets (Holthausen & Watts, 2001; Skinner, 2008). Lastly, I find, as expected, that uncapitalized intangible assets are less relevant (i.e., provide a lesser reduction in default risk) for high growth firms compared to low growth firms.

While not formally hypothesized, I also explore the efficiency with which the CDS market values intangible assets. If intangible assets are efficiently priced by the CDS market, then current CDS returns should be uncorrelated with past intangible values. By adding prior period levels of intangible assets to my regression model, I provide evidence that the CDS market underreacts to intangible assets that are not capitalized on the balance sheet. This finding suggests that additional disclosure and/or accounting recognition of intangible assets would be useful for the CDS market. However, when I perform this analysis separately for high default risk and low default risk firms, I find that the market inefficiency only exists for low default risk firms. That is, the CDS market efficiently prices uncapitalized intangible assets for high default risk firms. This finding is likely due to the heightened sensitivity of the CDS market for high default risk firms.

This study makes four contributions to the existing literature. First, I show that, on average, both capitalized and uncapitalized intangible assets reduce default risk. Then, by using the CDS spread to measure default risk, I extend our understanding of how accounting information impacts the growing CDS market. Next, I use cross sectional analysis to show that intangible assets are less relevant for high growth firms. Finally, I provide evidence on the efficiency of the CDS market in valuing intangible assets.

The remainder of this paper is organized as follows: I provide background and develop my hypotheses in Chapter II. I describe my empirical design in Chapter III. Chapter IV describes the sample. Chapter V discusses my empirical results, and Chapter VI summarizes the paper.

CHAPTER II

BACKGROUND AND HYPOTHESES DEVELOPMENT

The CDS Market

A CDS is a credit derivative whose value is based on the credit risk of a stated firm (i.e., the reference firm). In essence, a CDS works like an insurance contract designed to protect against default of the reference firm (see Figure 1). The buyer of the CDS pays premiums for this protection until a credit event (e.g., default) occurs to the reference firm or the CDS contract matures. The reference firm is not required to be a party to the CDS contract. The premiums are referred to as a spread and are calculated as a percentage of debt's face value. The seller of the CDS receives the spread and is contractually obligated to compensate the buyer if a credit event occurs. Larger (smaller) spreads indicate a higher (lower) default risk. As noted in Figure 1, an important distinction between a CDS and an insurance contract is that it is not necessary for the purchaser of the CDS to have an "insurable interest", that is the purchaser does not need to actually hold a bond of the reference firm. This feature allows for speculative trading which has fueled the growth in the market from outstanding notional value of $100 billion in 1998 to $30 trillion in 2010 (Intercontinental Exchange 2010).

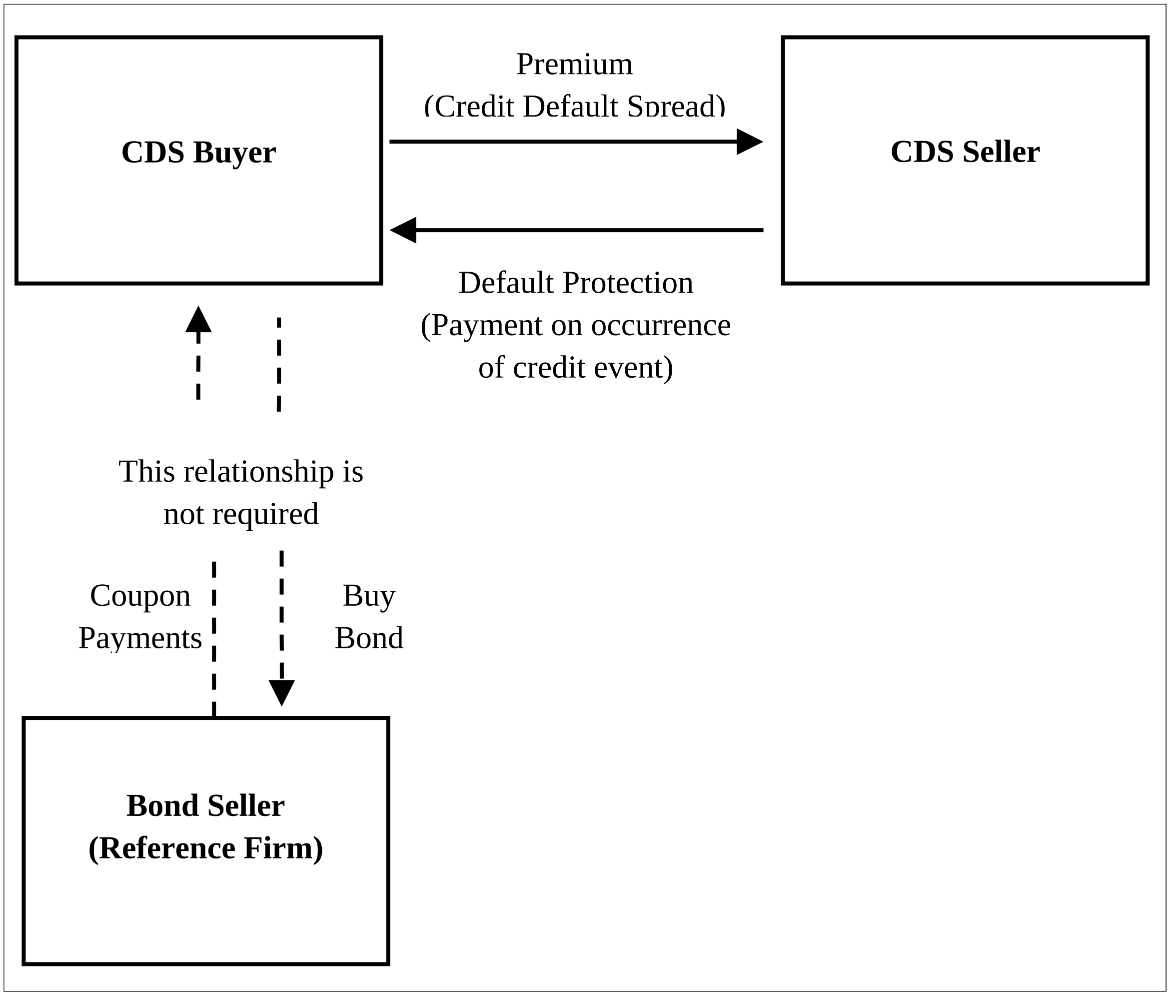

Figure 1. Credit Default Swaps

The CDS market provides a better measure of default risk than bond yields or credit ratings because CDS spreads are less noisy and updated more timely for changes in default risk. Unlike bond yields which are impacted by multiple factors such as interest rate risk, liquidity risk and recovery rate, the CDS market separates default risk from all other uncertainty thereby providing a more precise measure of default risk (Ericsson et al., 2009; Hull et al., 2004). Also the CDS market has been shown to respond more quickly to changes in credit risk than the bond market or credit ratings (Blanco et al., 2005; Hull et al., 2004; Zhu, 2006).

There is mixed evidence on whether the CDS market leads or lags the stock market in incorporating new information in prices (Fung, Sierra, & Zhang, 2008). There is also research evaluating whether financial information is incorporated in CDS pricing through public or private information (Batta, Qiu, & Yu, 2012). The purpose of this paper to evaluate the relevance of intangible assets in the CDS market, not to evaluate the means by which the CDS market incorporates information regarding intangible assets. Information regarding intangible assets could enter the CDS market directly (e.g., through financial reporting and/or insider information) or indirectly (e.g., through stock prices), and still be considered relevant for purposes of this paper. An evaluation of how intangible asset information is incorporated in CDS pricing is beyond the scope of this paper.

Intangible Assets and Default Risk

Research has shown that default risk is influenced by the risk free rate as well as a firm's leverage and volatility of its asset value (Duffee, 1999; Ericsson et al., 2009; Merton, 1974). Holding these variables constant, the anticipated impact of intangible assets on default risk is uncertain. It seems intuitive that a firm that is expected to experience revenue and cash flow growth will have increasing future cash flows available to fund its debt, resulting in a reduction in default risk. Extant literature finds a positive relation between intangible assets and future growth in cash flows (Boujelben & Fedhila, 2011; Gruca & Rego, 2005), revenues (Hirschey & Weygandt, 1985; Ittner & Larcker, 1998; Kallapur & Trombley, 1999) and the book value of net assets (Kallapur & Trombley, 1999; Penman 1996). In addition, Standard and Poors (2008) uses expected growth in cash flows as a positive indicator of a firm's credit worthiness.

While intangible assets, on average, lead to cash flow growth, these future cash flows are inherently uncertain, specifically for those intangible assets that are not capitalized on the balance sheet. Unlike tangible assets which are standardized and have a predictable cash flow stream, intangible assets have more a more uncertain cash flow stream and are typically subject to a long development period (Kothari, Laguerre, & Leone, 1999; Wyatt, 2008). As future cash flows become more uncertain, default risk increases (Duffee, 1999; Ericsson et al., 2009; Merton, 1974). Therefore, an investment in intangible assets increases both the expected value and the variance of future cash flows. Shi (2003) refers to these effects as the mean effect and the variance effect of intangible investment. The mean effect decreases default risk, while the variance effect increases default risk. Therefore the impact of intangible assets on default risk represents a tradeoff between this mean effect and variance effect.

A third factor influencing the relationship between intangible assets and default risk is the agency conflict between stockholders and bondholders regarding a firm's intangible investment. Academic research has widely studied these agency conflicts as it relates to a firm's growth opportunities. Growth opportunities are assets whose ultimate value depends on future discretionary investment by the firm (Myers, 1977). Most intangible assets, whether acquired or developed internally, represent growth opportunities because they drive economic growth and also require future investment to realize that growth (Ashton, 2005). For example, research and development (R&D), an intangible asset not capitalized on the balance sheet, is a growth opportunity for the firm whose ultimate value depends on additional expenditures, such as additional research and production costs. I apply the theories regarding agency conflicts and growth opportunities to develop my hypotheses regarding intangible assets and default risk.

Growth Opportunities

The total value of a firm, V, equals the value of a firm's debt, V_D, and the value of a firm's equity, $V_{E.}$ In addition, firm value, V, is the sum of the market value of both its assets in place, V_A, and its growth opportunities, V_G (Myers, 1977). Substituting these two definitions for total firm value yields the following equality:

$$V_D + V_E = V_A + V_G \qquad (1)$$

Growth opportunities can be viewed as call options on a real asset whereby the firm can purchase the rights to the assets' discounted cash flows at an exercise price equal to the investment needed to acquire the asset (McDonald & Siegel, 1986; Myers, 1977; Trigeorgis, 1996). Call options on common stock represent the right to purchase stock at a fixed exercise price while call options on a real asset represent the right to acquire a new business asset for a known investment. For example, a firm which has internally funded research or purchased a patent has the opportunity to produce the newly developed product. The cost of the research or patent represents the cost of the option and the decision to make the required investment to produce the new product represents a decision to exercise the real option.

Real options analysis has fundamentally changed the approach to capital investment decisions. The traditional approach to investment decisions, which is displayed in Figure 2, utilizes only the net present value (NPV) of an asset (i.e., the future cash flows discounted at a required rate of return less the cost of the initial investment). If the NPV is greater than (less than) zero, traditional finance theory suggests the investment should (not) be made. Evaluating a project based on its NPV is similar to evaluating an option based on its intrinsic value. If the NPV is greater than zero the option is "in the money" and the option's intrinsic value equals the

NPV. If the NPV is less than zero the option is “out of the money” and the option’s intrinsic value is zero.

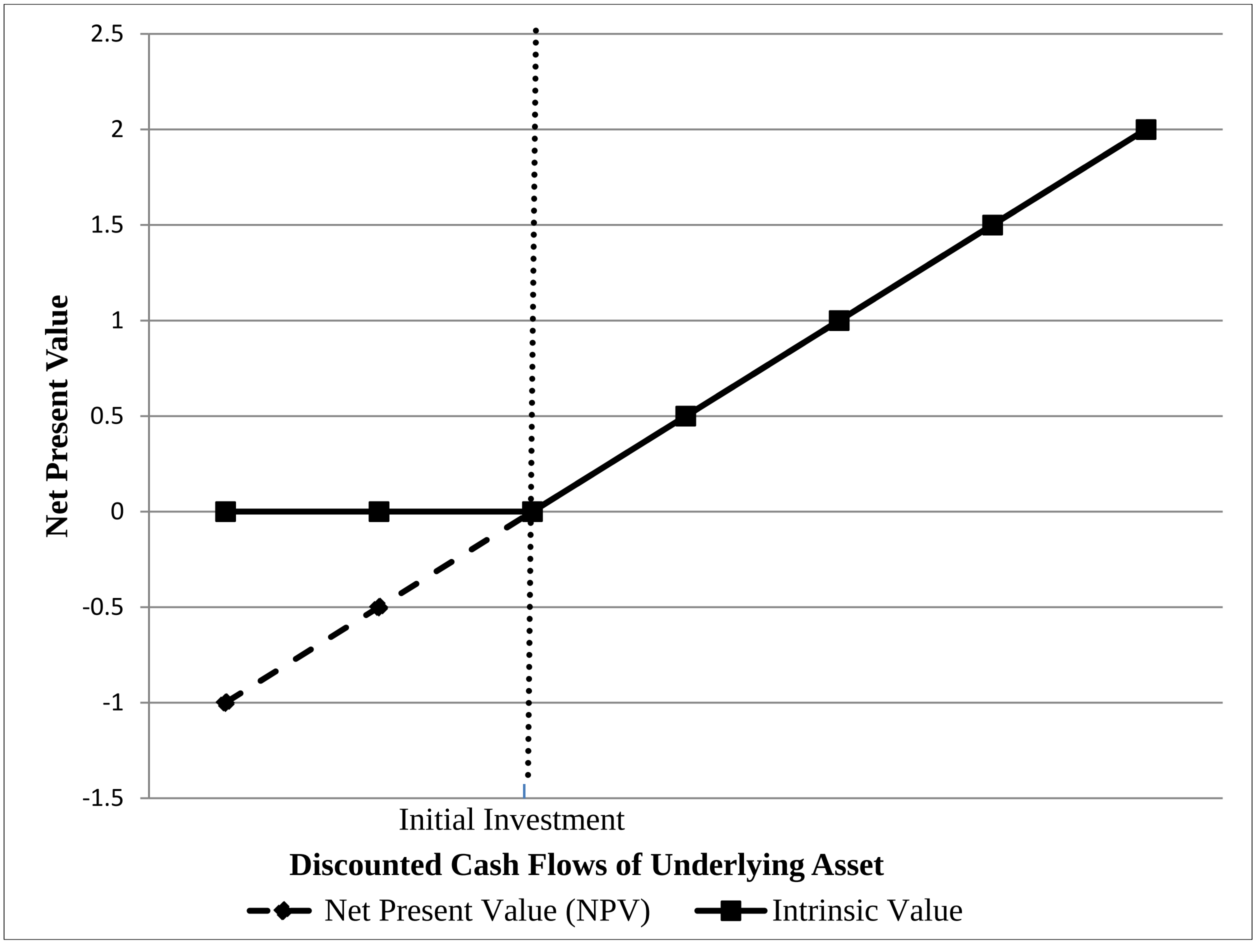

Figure 2. Traditional Capital Investment Analysis

Unlike the traditional NPV approach, real option analysis considers the uncertainty of the expected future cash flows and management’s flexibility in the timing of its investment decision. The difference between the option value and the intrinsic value is called the time value of the option, as shown in Figure 3. Time value represents the additional value of an option attributable to the option having more time to run (i.e., the investment decision can be delayed). In the unusual scenario where there is no uncertainty in the expected future cash flows or the investment decision cannot be delayed, then the option's time value is zero and the option value equals the intrinsic value. Alternatively, and more realistically, if the expected future cash flows are uncertain or if the option has time before it expires, then the option value is greater than the NPV of the underlying asset. For example, if the forecasted NPV of an asset is less than zero, the option on the asset can still have value because the project could become profitable before the option expires. The greater the uncertainty and period of time that the decision can be delayed, the greater the likelihood that the forecasted NPV will become positive before the option expires.

Upon exercise of a real option, the firm obtains the NPV of the underlying asset, but gives up the option to exercise the option in the future. In other words, if the time value of the option is greater than zero then the option itself is more valuable than the underlying asset. In essence, the firm loses value upon exercise of the option. In order to avoid this loss in value upon exercise of the option two conditions must be met. The first condition is the "value matching" condition which requires the value of the asset to be equal to the value of the option. The second condition is the "smooth pasting" condition which requires the slope of the asset value to equal to the slope of the option value. When the value matching and smooth pasting conditions are met there is no benefit to delaying the exercise of the option. Point A in Figure 3 represents the point where both of these conditions are met and the option is exercised.

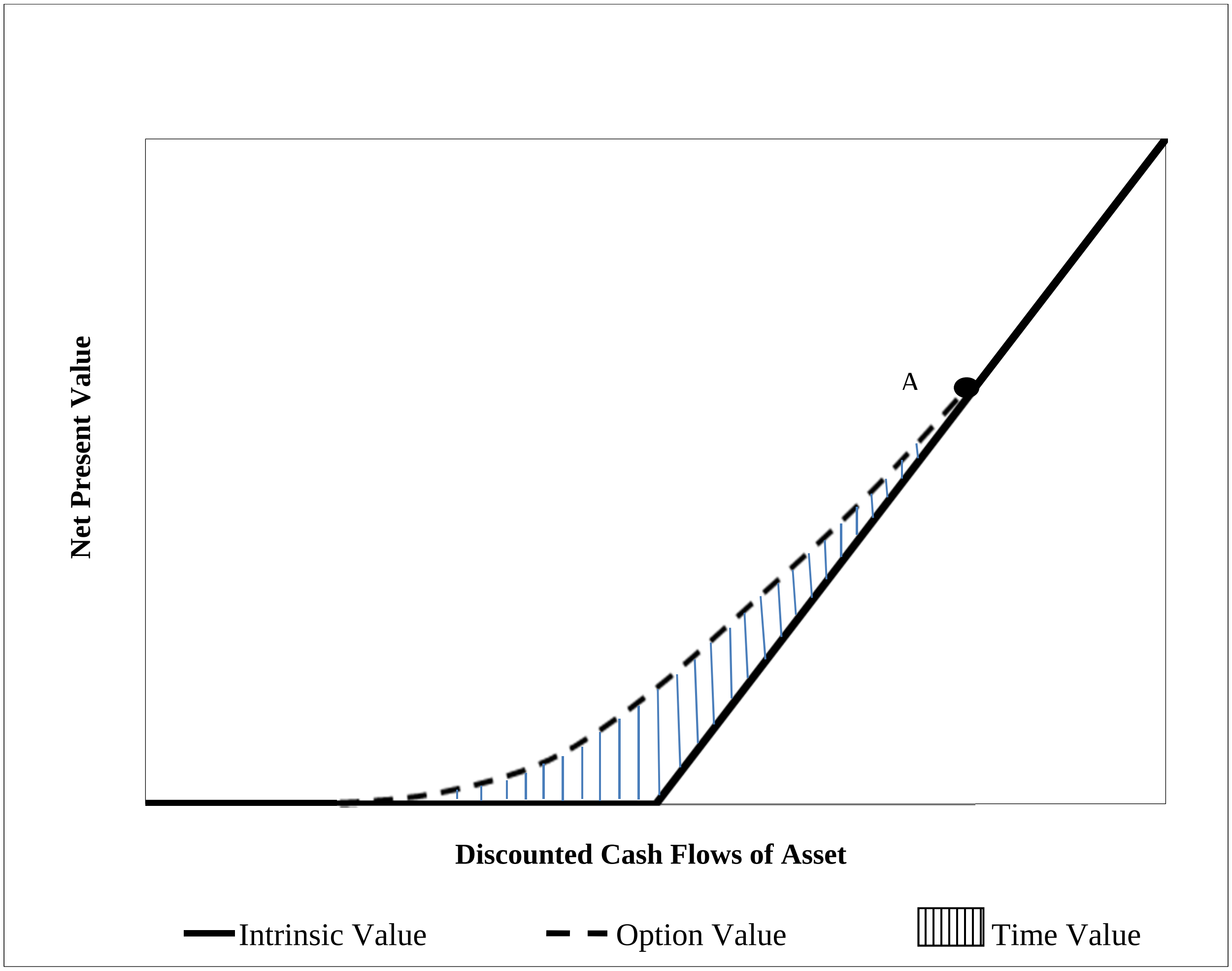

Figure 3. Option Value versus Intrinsic Value

The value of growth opportunities depends on future discretionary investment by the firm (Myers, 1977). Financing these opportunities with both debt and equity creates conflicts between stockholders and bondholders. Stockholders rely on management and the board of directors while bondholders utilize contracting mechanisms (e.g., debt covenants) to protect their individual interests. Research has shown that if management acts solely in the interests of stockholders, they have incentives to utilize growth opportunities to benefit stockholders at the expense of bondholders (Barnea et al., 1985; Long & Malitz, 1985; Myers, 1977). Specifically, management can either underinvest in its growth opportunities (Mauer & Ott, 2000; Myers,

1977) or use its growth opportunities to engage in asset substitution (Leland, 1998). Bondholders can use debt maturity or debt covenants to mitigate these incentives, but these contracting mechanisms will not completely eliminate these agency conflicts (Billett, King, & Mauer, 2007; Chava & Roberts, 2008). In this chapter I discuss how underinvestment and asset substitution may affect default risk.

Underinvestment

Underinvestment refers to an incentive to refrain from investing in growth opportunities because of the outstanding debt value (Mauer & Ott, 2000; Titman & Tsyplakov, 2007). In a frictionless environment where agency conflicts do not exist, firms would make investments in growth opportunities based on the project's expected return, regardless of the source of financing. Conversely, when agency conflicts exist, investment decisions are affected by the allocation of the project's return between stockholders and bondholders. Management of a leveraged firm, acting in the interests of stockholders, will require that the expected return on a growth project be large enough to cover the interest costs and still deliver the required rate of return to stockholders. If a firm refrains from investing in its growth opportunities solely because of interest costs, the firm is said to have underinvested in its growth opportunities.

To illustrate underinvestment, consider three firms with a total firm value of $100 that consists solely of growth opportunities that, if invested in, are expected to yield a 10% return to the firm. An example of this type of firm would be a leveraged firm that has performed research for a new pharmaceutical drug but has not made the necessary investments to begin production. The assumptions for these three firms are shown in Table 1. Firm A is financed entirely by equity, while firms B and C are financed by debt and equity. Firms B and C differ, however, in their interest rates. I assume that the management of these firms act in the interest of stockholders and that the bondholders are not able to control the investment decision (the use of contracting mechanisms is discussed later in this chapter). In addition, I assume the investment in the growth opportunity is financed by equity, thus holding the debt level constant[3].

Table 1

Underinvestment Example

	Firm A	Firm B	Firm C
Debt Value	0	90	90
Equity Value	100	10	10
Leverage	0.0%	900.0%	900.0%
Interest Rate	0.0%	9.5%	10.5%
Expected Return on Project	10.0%	10.0%	10.0%
Required Rate of Return on Equity	10.0%	10.0%	10.0%
Expected ROE	10.0%	14.5%	5.5%
Investment Decision	Invest	Invest	Do not invest

Comparing the expected return on equity (ROE) to the required rate of return provides the investment decisions for the three firms. I use the Dupont model to calculate expected ROE:

$$\text{ROE} = \text{RNOA} + [\text{FLEV} * (\text{RNOA} - \text{Interest})] \qquad (2)$$

where RNOA is the return on net operating assets, FLEV is financial leverage (debt divided by equity), and Interest is the firm interest rate. As noted in equation (2), if the expected return on

[3] For simplicity, I also hold the required rate of return on equity constant across all three firms. In reality, firm leverage increases firm risk which would increase the required rate of return for firm B and C's stockholders. Using a constant required return does not alter the conclusions drawn from this example.

the operating assets is less than the firm's interest rate, then the firm's leverage reduces the return stockholders receive.

Firm A, with no interest costs to consider, invests in the growth opportunity because it is expected to yield to stockholders their required rate of return. Firm B also invests in the growth opportunity because its interest rate (9.5%) is below the project's expected return, allowing the leverage to increase the expected ROE (14.5%) above the required return. Firms A and B invest in the growth opportunity because it is expected to provide to stockholders their required return. However, Firm C does not invest in the growth opportunity because of its cost of debt. Its cost of debt (10.5%) is greater than the project's expected return causing the expected ROE (5.5%) to fall below the required return. Firm C underinvests in its growth opportunities. Firm C could invest in the growth opportunity and the firm as a whole would yield 10% growth. However stockholders would have to share the benefits of the growth with bondholders and would not get their required return. To protect stockholder interests, Firm C will choose to forego the investment in the growth opportunity.

The preceding discussion is based on a firm with debt supported solely by growth opportunities (i.e., there are no assets in place). Underinvestment also occurs for firms with both assets in place and growth opportunities (Barnea et al., 1985; Mauer & Ott, 2000). For these firms, stockholders bear the full cost of investment[4] but share its benefits with debt holders. For instance, if the assets in place underperform, and the return on these assets is less than the cost of debt, then the proceeds from growth opportunities are available to bondholders to satisfy the debt obligations.

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[4] This discussion of underinvestment is based on the assumption that investments in growth opportunities are funded by equity holders. If, instead, these investments are funded by new debt financing, management then has incentives to over-invest in risky growth opportunities (i.e., asset substitution; Mauer and Sakar 2005). This asset substitution also increases default risk. Therefore whether the investment is funded by equity or debt, agency conflicts exist with increase default risk.

Applying the theory of underinvestment to intangible assets allows one to understand how this agency conflict may impact the association between intangible assets and default risk. Intangible assets require discretionary investment to transform value potential into realized value. That is, a firm must invest in its intangible assets in order to realize actual cash flow growth (Ashton, 2005). Underinvesting in its intangible assets will prevent the firm from maximizing its cash flow growth. As a result, the risk of underinvestment lowers expectations for the cash flows that intangible assets will generate. These lower expectations can neutralize the effect of intangible assets on default risk. Therefore, the risk of underinvestment can prevent intangible assets from reducing default risk.

Asset Substitution

Asset substitution represents another agency conflict associated with growth opportunities (e.g., Barnea et al., 1985; Jensen & Meckling, 1976; Leland, 1998). Asset substitution occurs when, after securing its debt financing, a firm increases its risk. The key to understanding asset substitution is to analyze how equity and debt value respond to risk (i.e., uncertainty in future cash flows). The equity value of a levered firm is similar to a European style stock option (Jensen & Meckling, 1976). When the debt matures, stockholders can buy the firm back from bondholders at an exercise price equal to the face value of the debt. Based on the Black Sholes (1973) option pricing model, option value (i.e., equity value) increases as firm risk increases. Debt value, on the other hand, declines as firm risk increases because cash flow uncertainty increases the probability of default (Merton, 1974). Since firm risk increases equity value and decreases debt value, management, acting in the interests of stockholders, has an incentive to increase firm risk.

If firm risk is increased before obtaining debt financing, bondholders will require a cost of debt commensurate with firm risk, and therefore no wealth is transferred from the bondholders to the stockholders. However a firm can increase its equity value by increasing firm risk after obtaining debt financing. If the increase in risk is great enough, a firm, acting in the interests of stockholders, would even be willing to invest in growth opportunities with negative net present values (Jensen & Meckling, 1976; Myers, 1977) to increase its equity value.

To understand asset substitution consider a firm with discounted future cash flows of $110 and outstanding debt of $100 which matures in three years. Also assume that the standard deviation of future cash flows is 0.20 and the risk free interest rate is 0.06. Treating equity value as an option to buy the firm from bondholders upon maturity (Jensen & Meckling, 1976) and using the Black Sholes option pricing model to value the equity results in equity value of 18.39. Now if the firm can increase its risk from 0.20 to 0.50, the equity value will increase from 18.39 to 39.68. Assuming that management acts in the interests of stockholders and that bondholders cannot control the risk level of the firm (the use of contracting mechanisms is discussed later in this paper), management will take on more risk to increase its equity value. A firm can increase its equity value even if the increase in risk requires a decline in discounted cash flows. For example, continue the assumption that a firm increases its risk from 0.20 to 0.50, but now assume that this change involves a decline in the discounted future cash flows to $90 (which is even below the outstanding debt value). Even though discounted future cash flows decline, equity value increases from 18.39 to 26.40.

Asset substitution, causing an increase in cash flow uncertainty, increases default risk (Leland, 1998). A firm can utilize its uncapitalized intangible assets to engage in asset substitution by: (1) investing in its high risk projects over its low risk projects (e.g., investing in the production of its product with the most uncertain demand), (2) replacing its current R&D activities with higher risk R&D activities (e.g., refocusing its research efforts on projects with a low probability of extremely high returns), and (3) shifting firm value from assets in place to growth opportunities (e.g., increase the spending on R&D).

Monitoring

Bondholders with rational expectations will anticipate the incentives for underinvestment and asset substitution and will increase the cost of debt. However, this change in debt pricing will not remove the effects of underinvestment and asset substitution on default risk. Bondholders can also add monitoring clauses to the debt contract to prevent or mitigate underinvestment and asset substitution. However, effective monitoring requires that the firm's investment opportunity set be transparent, which is not necessarily the case as discussed later in this chapter.

Prior Research

Two papers have analyzed the impact of R&D in the credit market. Using credit ratings to measure default risk, Shi (2003) finds that R&D investment increases default risk. These findings are based on using three different measures of R&D intensity all scaled by the market value of equity. Eberhart, Maxwell, & Siddique (2008) take issue with the use of market value of equity as a scalar for R&D intensity. They point out that if an R&D project yields a large equity value, then the scaled measure of R&D intensity could be relatively small due to the large denominator even though the firm has a high degree of R&D intensity. As an alternative, Eberhart et al. (2008) use both total sales and book value of assets to scale R&D intensity. Using this alternative measure of R&D investment and using distance to default to estimate default risk, they find that R&D investment decreases default risk.

In addition to using different variables for R&D investment and default risk, both Shi (2003) and Eberhart et al. (2008) have omitted variables which could be contributing to their opposing results. The direction of the bias caused by these variables is based on the correlation of the variable with the dependent variable, and the correlation of the variable with the variable of interest. Shi (2003) does not control for asset volatility. Asset volatility is positively correlated with both default risk (Duffee, 1999; Merton, 1974) and R&D investment (Chan et al., 2001). As a result, the omission of asset volatility biases the regression coefficient on R&D upward. Shi (2003) concludes that a positive coefficient on R&D is evidence that R&D intensity increases default risk, but this finding could be attributable to the omission of asset volatility in the regression. Eberhart et al. (2008) does not control for firm leverage and asset volatility. While the omission of asset volatility causes an upward bias on the R&D coefficient, the omission of firm leverage causes an opposing downward bias on the R&D coefficient. Leverage is positively correlated with default risk (Duffee, 1999; Merton, 1974) and negatively correlated with R&D investment (Long & Malitz, 1985). Since the omission of these two variables causes opposing biases on the R&D coefficient, it is unclear how these omitted variables influence the Eberhart et al. (2008) results

The mixed results presented by Shi (2003) and Eberhart et al. (2008) provide motivation for additional research in this area. Using a more comprehensive measure of uncapitalized intangible assets and a more rigorous empirical model, I seek to resolve this empirical question. By broadening the research question beyond R&D to all intangible assets, my results are unaffected by the choice of the R&D proxy. By including both asset volatility and leverage in my regression models, I avoid the bias caused by these omitted correlated variables.

Hypotheses

The impact of intangible assets on default risk can be characterized as a tradeoff between several factors. While expected growth in cash flows reduces default risk, an increase in the uncertainty of cash flows increases default risk. In addition, the intangible assets of a leveraged firm also represent a source of agency conflicts, specifically underinvestment and asset substitution. Underinvestment reduces the expected cash flow growth and can therefore prevent intangible assets from reducing default risk. Further, asset substitution increases firm risk thereby increasing default risk. I make no prediction on the direction of the overall influence of intangible assets on default risk. My first hypothesis, stated in the null form, is as follows:

> **H1:** The change in the quarter end CDS spread is unrelated to the change in the reference firm's capitalized and uncapitalized intangible assets.

Bondholder payoff cannot exceed but can fall below the contractually obligated principal and interest payments. Because of the asymmetric payoff distribution bondholders are more concerned with information that signals potential bankruptcy and less concerned about information that signals additional profits. In addition, bondholders are more sensitive to information about high default risk firms than low default risk firms. Research has shown that CDS spreads are more sensitive to leverage, asset volatility, interest rates and earnings for high default risk firms comparative to low default risk firms (Callen et al., 2009; Ericsson et al., 2009). The increased sensitivity of the CDS market for high default risk firms implies that intangible assets will have a greater impact on CDS spreads for high default risk firms compared to low default risk firms, leading to my second hypothesis:

> **H2:** The relation between the change in the CDS spread and the change in the reference firm's intangible assets is magnified when default risk is high.

As the proportion of firm value attributable to growth opportunities increases, management has more opportunities to underinvest and increase firm risk. As a result, agency conflicts intensify as the proportion of firm value attributable to growth opportunities increases (Moyer et al., 1989; Myers, 1977). In addition growth opportunities can be characterized as tangible (e.g., increasing plant capacity for existing product lines) or intangible (e.g., research to discover a new pharmaceutical product). Compared to tangible growth opportunities, intangible growth opportunities give rise to greater stockholder/bondholder agency conflicts (Long & Malitz, 1985) due to differences in information asymmetry. Creditors can more readily observe and monitor investment decisions involving tangible assets. Greater observability allows debt covenants or creditor monitoring to effectively minimize the underinvestment and asset substitution problems for tangible assets. Alternatively, intangible investment decisions, which are much more difficult to observe, give creditors less opportunity to monitor and influence a firm's incentives to underinvest and increase firm risk. High growth firms are typically intangible-intensive (Hirschey & Weygandt, 1985; Lev, 2001). Therefore high growth firms, compared to low growth firms, have greater stockholder/bondholder conflicts, leading to my third hypothesis:

> **H3:** The relation between the change in the CDS spread and the change in the reference firm's intangible assets is an increasing function of a firm's expected growth.

In order for intangible assets to be relevant for default risk, they must be measured reliably. Barth, Beaver, & Landsman (2001) note that in order for financial information to have a predicted significant relationship with market pricing, not only must it be relevant to the market, but it must also be measured with sufficient reliability. Intangible assets, specifically those that are not capitalized on the balance sheet, are inherently uncertain, and therefore whether or not they can be valued with sufficient reliability is questionable. I present my hypotheses and the results of this paper as a test of relevance of intangible assets. However, the tests of relevance and reliability are inextricably linked. Therefore, any test for relevance presented in this paper is actually a joint test of relevance and reliability.

CHAPTER III

EMPIRICAL DESIGN

Base Model

To evaluate the impact of intangible assets on default risk, I regress CDS spreads on capitalized and uncapitalized intangible assets in a changes model as follows:

$$\text{D\_CDSpread} = \beta_0 + \beta_1 \text{D\_Uncap\_Intang} + \beta_2 \text{D\_Cap\_Intang} + \beta_3 \text{D\_Controls} + \varepsilon \quad (3)$$

where D_CDSpread is the change in the log of the daily CDS spread[5], D_Uncap_Intang is the change in uncapitalized intangible assets, and D_Cap_Intang is the change in the book value of intangible assets, scaled by average total assets. I estimate uncapitalized intangibles with the market to book value of assets ratio calculated as follows:

$$\text{Uncapitalized Intangibles} = \frac{\text{MV Assets}}{\text{BV Assets}} = \frac{\begin{bmatrix}\text{Market Value of Common Stock} \\ + \text{ Book Value of Preferred Stock} \\ + \text{ Book Value of Total Liabilities}\end{bmatrix}}{\text{Book Value of Assets}} \quad (4)$$

This market to book value of assets is a common proxy for a firm's uncapitalized intangible resources (Villalonga, 2004) that has been shown to be correlated with investments in intangibles (e.g., Anderson, Banker, & Ravindran, 2006; Bharadwaj, Bharadwaj, & Konsynski, 1999; Connolly & Hirschey, 2005). If the coefficients on capitalized intangible assets (β_1) and uncapitalized intangible assets (β_2) are negative (positive) and significant, I can conclude that intangible assets are relevant for CDS spreads and reduce (increase) default risk.

[5] CDS spreads are expressed as a decimal and all are less than .01. To ensure that the log of the spread is non-negative first added one to the spread before taking the natural log.

Uncapitalized intangible assets are reflected in the market value of assets but not in the book value of assets. However, it is important to note that uncapitalized intangible assets are not the only factor causing differences between market and book asset values. For instance, differences can also be attributable to the stock market's assessment of a firm's future plans, opportunities and business risks (Lev, 2001). The market to book value of asset ratio, my proxy for uncapitalized intangible assets, is affected by all factors that are reflected in stock market prices that are not reflected on the balance sheet. As a result, coefficient β_2 is not solely related to uncapitalized intangible assets, which is a limitation of this study.

While CDS spreads and common stock prices are available daily, book values are only available on a quarterly basis. I therefore use only one daily observation per quarter. I select the first day following the quarterly earnings announcement because this is the first day that book value information becomes available[6]. The changes variables represent the change from one day after the prior quarter's earnings announcement to one day after the current quarter's earnings announcement. Compared to a levels regression model, the changes regression model restricts my sample size but it allows me to analyze variation in the CDS spreads. Also it is a more stringent test due to the noise in the data (Ericsson et al., 2009) as well as the inherent within-firm control for unobserved heterogeneity.

Control Variables

I include control variables in my regression analyses to control for the known determinants of default. These variables are collectively termed D_Controls in equation (3).

[6] A growing number of firms disclose a balance sheet as part of their quarterly earnings announcement (Chen et al. 2002). For those firms that don't disclose a balance sheet, some book value information can be inferred from the earnings release. My results are robust to using the day after the quarterly SEC filing date.

Structural models suggest that the theoretical determinants of default risk are firm asset volatility, the risk free interest rate, and firm debt. More specifically, the more volatile the firm's assets and the greater the firm debt, the greater the probability of default (Duffee, 1999; Merton, 1974). In contrast, as the risk free rate increases, firm wealth increases thus lowering default risk (Longstaff & Schwartz, 1995). Consistent with prior CDS research, I include the changes in these variables as explanatory variables for the changes in CDS spreads (Callen et al., 2009; Ericsson et al., 2009). I calculate asset volatility, Vol, as the standard deviation of daily stock returns over the previous three months. D_Vol is the change in this volatility measure from quarter t-1 to t. I calculate D_rf as the change in the five-year Treasury bill rate from quarter t-1 to t. I calculate D_Debt as the change in the sum of short term and long term debt from quarter t-1 to t, scaled by the average book value of assets. Many studies use the change in market leverage, where market leverage is debt scaled by the market value of assets. A market value measure of leverage would be problematic in my regression because the denominator reflects the market value of a firm's assets reflected in its stock price. Since the market value of assets is the numerator of my one of my variables of interest, D_Uncap_Intang, I want to exclude this market valuation from my control variable D_Debt to avoid collinearity issues. I therefore use average book value of assets instead of market value of assets to scale the change in debt.

In addition to these theoretical determinants of default risk, I also include the change in book value. Research shows that accounting information provides incremental value in explaining CDS spreads (e.g. Callen et al., 2009)[7]. I have already included as independent variables two components of the change in book value: the change in capitalized intangible

[7] Callen et al. (2009) find that firm earnings, by providing information about a firm's ability to repay its debt, are inversely related to CDS spreads. Because this study is focused on the balance sheet, I control for the change in book value instead of earnings. The mathematics behind the inclusion of the change in book value or earnings is similar. In fact the change in book value includes not only earnings, but also dividends and other comprehensive income.

assets and debt. To control for the remaining change in book value I add as additional control variables the change in property, plant and equipment (D_PPE) and the change in all remaining book value (D_BV_Other). I specifically identify property, plant and equipment because it, like intangible assets, is expected to generate cash flows over the long term. However, the future cash flow benefits of fixed assets are more certain than that of intangible assets (Wyatt, 2008), and there is no dispute on the relevance of tangible assets in the credit market. Fixed assets provide a useful measure with which to validate the specification of the model and analyze the impact of uncertainty due to intangibility of assets on default risk.

Endogeneity

The proxy for the change in uncapitalized intangible assets (D_Uncap_Intang) is likely endogenous in the regression model for two reasons. First, the use of the market value of equity in the calculation of a firm's uncapitalized intangible assets includes measurement error since research repeatedly shows that the market is not perfectly efficient (e.g., Malkiel, 2003; Basu, 1977). Further, Lakonishok, Shleifer, & Vishny (1994) suggests that firms with a high market to book ratio are overpriced in the equity market and firms with a low market to book ratio are underpriced in the equity market, suggesting that this measurement error is correlated with D_Uncap_Intang, thereby creating endogeneity. Second, the CDS market and the equity market are likely affected simultaneously by macroeconomic factors. This simultaneity causes endogeneity. The presence of an endogenous independent variable in an OLS regression results in biased regression coefficients. To control for endogeneity, I use IV estimation.

IV estimation requires the identification of variables, not included in the primary model, which are significant determinants of the endogenous variable (D_Uncap_Intang) and are exogenous to the dependent variable (D_CDSpread). My first IV is the growth in revenue from quarter t to t+4 (D_Revq). Uncapitalized intangible assets provide firms with a competitive advantage. As a result, a firm's changes in uncapitalized intangible assets are positively correlated with its future revenue growth (Hirschey & Weygandt, 1985; Kallapur & Trombley, 1999)[8]. My second IV is the change in the dividend ratio from quarter t-3 to t (D_Div_Ratio). Gelb and Siegel (2000) find that firms with significant levels of intangible assets use dividend increases to signal firm value, and the stock market responds positively to these signals. As a result, changes in a firm's uncapitalized intangible assets are positively correlated with changes in its dividend payout ratio.

I validate my selection of IVs by performing tests to ensure that the variables are sufficiently strong and not endogenous to my dependent variable. I also test the endogeneity of the change in uncapitalized intangible assets (D_Uncap_Intang) thereby confirming the need for IV estimation.

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[8] Earnings growth is an explanatory variable for the change in CDS spreads (D_CDSpread) (Callen et al., 2009), and therefore cannot be used as an IV. Revenue growth, on the other hand, is correlated with uncapitalized intangible assets (Hirschey & Weygandt, 1985; Kallapur & Trombley, 1999), yet is not an explanatory variable for CDS spreads.

CHAPTER IV

SAMPLE

I obtained CDS data for years 2001 to 2012 from Markit Group Limited. For each date and reference firm this database provides composite CDS spreads for multiple CDS maturities (0.5, 1, 2, 3, 4, 5, 7, 10, 15, 20, 25 and 30 years). The composite CDS spread is derived from at least two and up to 38 market quotes. For each composite CDS spread the database also provides the spread currency, the seniority of the debt (senior or subordinated) and the restructuring clause of the CDS (i.e., the level of protection the CDS provides for debt restructurings). I restrict my sample to only North American contracts denominated in U.S. dollars. The North American CDS contracts are most commonly associated with senior unsecured debt (99% of the contracts) and typically provide no protection for debt restructurings (85% of the contracts). I therefore exclude CDS contracts that are not associated with senior unsecured debt or that provide debt restructuring protection.

Because CDS data is available for multiple maturities, the same reference firm and date are listed multiple times. However, not all reference firms have CDS spread information for all possible maturities. As a result, a panel data test covering multiple maturities is susceptible to an overweighting of firms where CDS spread information is available for all of the possible maturities. To ensure that my data is balanced with respect to maturity I restrict my sample to the most common maturities (1, 3, 5, 7 and 10 years). 85% of the CDS contracts provide spread information for these maturities. I exclude firms from my sample that are missing CDS spread information for any of these maturities. The resulting CDS database has 1,421,534 daily CDS observations represented by 1,053 firms.

I obtain firm financial information from Compustat and stock price information from CRSP. I use firm name and ticker symbol to match firms from the CDS database to the Compustat and CRSP data. Due to availability of book value information on a quarterly basis, I use only one daily observation for each quarter. I select the first day following the current quarter earnings announcement, and I require that each observation have sufficient data to calculate the change in book value from the previous quarter (i.e., the day after the last earnings announcement). I also require that each observation have sufficient data to calculate the IVs (i.e., revenue growth from quarter t to quarter t+4 and change in dividend ratio from quarter t-3 to t). Based on my definition of uncapitalized intangible assets, a market value of assets less than the book value of assets implies negative intangible assets. While these firms would provide an interesting area of research, they are outside the scope of this paper. I therefore exclude all firms with market to book value of assets less than one. I also exclude firms with a negative net book value of assets (i.e., book value of total liabilities exceeding book value of total assets). All variables are trimmed at the 1st and 99th percentiles to control for the effect of outliers. These restrictions result in a final sample of 38,647 observations from 2001 to 2011 represented by 549 firms.

I classify my sample by industry based on the Fama-French 12 industry classifications. Table 2 presents the number of observations and the number of firms in each industry classification. This table shows that the sample is fairly evenly distributed by industry. The industry with the most (least) observations is manufacturing (consumer durables) with 6,202 (854) observations and 86 (14) firms. I do not specifically control for industry classification in the regressions results presented in Chapter V. However, my regression results are robust to the inclusion of industry fixed effects (untabulated).

Table 2

Sample by Industry

Industry	Number of Observations	Number of Firms
Consumer Nondurables	3,225	43
Consumer Durables	854	14
Manufacturing	6,202	86
Oil, Gas and Coal Extraction and Products	3,024	47
Chemicals and Allied Products	2,635	31
Business Equipment	3,063	44
Telephone and Television Transmission	1,435	28
Utilities	3,099	43
Wholesale, Retail and Some Services	4,738	54
Healthcare, Medical Equipment and Drugs	2,769	38
Finance	3,105	52
Other	4,498	69
Total	38,647	549

Table 3 presents the distribution of my sample by year, and Table 4 presents the distribution of my sample by fiscal quarter. Table 3 shows that my sample is concentrated primarily in the years 2002 through 2010. Table 4 shows that my sample is evenly distributed by fiscal quarter. I do not specifically control for year and fiscal quarter in the regressions presented in Chapter V. However, my regression results are robust to the inclusion of year and quarter fixed effects (untabulated).

Table 3

Sample by Year

Year	Number of Observations	Number of Firms
2000	15	2
2001	738	93
2002	2,000	162
2003	3,507	253
2004	4,849	333
2005	5,625	370
2006	5,959	399
2007	4,215	347
2008	3,532	292
2009	5,366	345
2010	2,836	317
2011	5	1

Table 4

Sample by Fiscal Quarter

Fiscal Quarter	Number of Observations	Number of Firms
1	10,211	510
2	9,760	498
3	9,608	495
4	9,068	489

Table 5 provides univariate statistics for my sample observations. The firms included in the CDS data base are large. The mean book value of assets is $35.2 billion. The size of these firms implies that the results of this study are likely not generalizable to smaller firms. On average, capitalized intangible assets are $4.3 billion, total assets are $35.2 billion, and the market value of assets is 1.68 times the book value of total assets. The medians of the difference variables suggest that most firms experience quarterly increases in capitalized intangibles, uncapitalized intangibles, fixed assets, and other book value, but experience quarterly decreases in asset volatility, debt and CDS spread.

Table 5

Univariate Statistics

Variable	Mean	Standard Deviation	Q1	Median	Q3
$CDSpread_t$[a]	0.970	1.283	0.269	0.538	1.116
$D\_CDSpread_t$[a]	-0.018	0.470	-0.098	-0.006	0.076
BV_Assets_t	35,200.600	98,896.720	5,832.900	12,611.760	26,795.600
MV_Assets_t	49,913.640	111,504.900	9,250.372	19,898.740	41,418.900
$Uncap\_Intang_t$	1.679	0.649	1.215	1.475	1.924
$D\_Uncap\_Intang_t$	0.001	0.148	-0.057	0.008	0.069
Cap_Intang_t	4,324.423	10,356.650	376.956	1,582.200	4,216.826
$D\_Cap\_Intang_t$	0.002	0.014	-0.001	0.000	0.002
D_Vol_t	-0.000	0.006	-0.003	-0.000	0.003
D_rf_t	-0.047	0.452	-0.330	0.020	0.250
$Debt_t$	11,725.440	49,836.720	1,343.920	3,092.000	7,145.954
D_Debt_t	0.002	0.025	-0.008	-0.000	0.008
D_PPE_t	0.004	0.013	-0.001	0.001	0.007
$D\_BV\_Other_t$	0.003	0.028	-0.011	0.003	0.017
D_Revq_{t+4}	0.059	0.158	-0.003	0.063	0.131
$D\_Div\_Ratio_t$	0.010	0.859	-0.037	0.000	0.052

[a] Variable values multiplied by 100.

The variables presented in Table 5 which have not been previously defined are as follows: $CDSpread_t$ is the log of the CDS spread plus one on the first day after the earnings announcement date; $Uncap\_Intang_t$ is MV_Assets as of the first day after the earnings announcement for quarter t divided by BV_Assets at the end of quarter t; $Debt_t$ is the book value of long term debt plus the book value of debt in current liabilities at the end of quarter t.

Table 6 presents Pearson correlation coefficients for the primary regression variables. This table shows that, as expected, the change in the CDS spread (D_CDSpread) is positively correlated to the changes in volatility (D_Vol) and debt (D_Debt), and negatively correlated with changes in uncapitalized intangible assets (D_Uncap_Intang) and other book value (D_BV_Other). Surprisingly, the changes in capitalized intangible assets (D_Cap_Intang) and property, plant and equipment (D_PPE) are positively correlated with changes in the CDS spread (D_CDSpread). One potential explanation for this finding is that firms that invest in capitalized intangible assets and property plant and equipment utilize debt to fund these investments, and the change in debt causes an increase in default risk. Capitalized intangible assets (D_Cap_Intang) and property, plant and equipment (D_PPE) are both positively correlated with debt (0.237 and 0.195, respectively), and these correlations are statistically significant with *p*-values less than 0.01.

Table 6 also suggests that many of my regression variables are correlated with each other. Significant correlation can create multicollinearity issues. However, the variance inflation factors for my regression results presented in Chapter V (untabulated) are less than 10, suggesting that multicollinearity is not a significant concern for my regressions.

Table 6

Pearson Correlation Matrix

	$D\_CDSpread_t$	$D\_Uncap\_Intang_t$	$D\_Cap\_Intang_t$	D_Vol_t	D_rf_t	D_Debt_t	D_PPE_t
$D\_Uncap\_Intang_t$	(0.199) **						
$D\_Cap\_Intang_t$	0.014 **	(0.071) **					
D_Vol_t	0.253 **	(0.148) **	(0.021) **				
D_rf_t	(0.208) **	0.187 **	0.002 **	(0.318) **			
D_Debt_t	0.029 **	(0.072) **	0.237 **	0.025 **	(0.014) **		
D_PPE_t	0.020 **	(0.054) **	0.116 **	0.009	(0.008)	0.195 **	
$D\_BV\_Other_t$	(0.029) **	(0.082) **	(0.232) **	(0.053) **	0.044 **	0.493 **	(0.176) **

** two-tailed *p*-value < 0.01; * two-tailed *p*-value < 0.05

CHAPTER V

RESULTS

In this chapter I present my regression results. Larcker and Rusticus (2010) suggest that, when presenting regression results using IV estimation, researchers should show the OLS regression results and the first stage IV regression results in addition to the second stage IV regression results. As a result, for each estimation equation, I present three sets of results: the OLS regression, the first stage IV regression and the second stage IV regression. Since my sample includes multiple observations for each firm, all of my regression results are estimated using clustered standard errors, which are White (1984) standard errors adjusted to account for possible correlation within a cluster (Petersen, 2009). All regression variables are defined throughout the text in Chapter IV, and, for convenience, in the Appendix.

Table 7 presents results of the estimation of equation (3) using OLS estimation. In the OLS model, the coefficient on the change in uncapitalized intangible assets (D_Uncap_Intang) is negative and significant. However, the coefficient on capitalized intangible assets (D_Cap_Intang) is insignificant. While the coefficients for volatility (D_Vol), risk free rate (D_rf), debt (D_Debt) and other book value (D_BV_Other) are all in the predicted direction, the coefficient for property, plant and equipment (D_PPE) is insignificant.

There is no dispute that property, plant and equipment is relevant to the credit market, yet the coefficient is insignificant. The lack of statistically significant results for property, plant and equipment (D_PPE) provides some insight into the potential cause for an insignificant coefficient for capitalized intangibles assets (D_Cap_Intang). As shown in Table 5, both of these variables have low variability. D_PPE and D_Cap_Intang have standard deviations of 0.013 and 0.014, respectively. This lower variability reduces the power of the statistical test of the coefficient's significance.

Table 7

Full Sample: OLS Estimation

Variable	Predicted Sign	Coef	*t*-Stat
$D\_Uncap\_Intang_t$	?	-0.005	-11.15**
$D\_Cap\_Intang_t$	?	-0.005	-1.33
D_Vol_t	+	0.145	9.53**
D_rf_t	-	-0.001	-10.42**
D_Debt_t	+	0.008	2.73**
D_PPE_t	-	-0.002	-0.66
$D\_BV\_Other_t$	-	-0.008	-3.16**
Maturity Fixed Effects		Yes	
Observations		38,647	
R^2		0.1059	

**two-tailed *p*-value < 0.01; *two-tailed *p*-value < 0.05

As explained earlier, the change in uncapitalized intangible assets is potentially endogenous to the dependent variable, which biases the coefficients in the OLS model. IV estimation is designed to control for this endogeneity. Table 8 presents results of the estimation of equation (3) using IV estimation. Consistent with the standard IV approach, the first stage regression consists of a regression of the endogenous variable, change in uncapitalized intangible assets (D_Uncap_Intang), on the other independent variables in the model as well as my previously discussed IVs, change in revenue (D_Revq) and change in dividend ratio (D_Div_Ratio). As expected, the coefficients for both of the IVs are positive, however only the coefficient on the change in the revenue (D_Revq) is significant.

Table 8

Full Sample: IV Estimation

		First Stage		Second Stage	
	Predicted Sign	Dependent = $D\_Uncap\_Intang_t$		Dependent = $D\_CDSpread_t$	
Variable	(applicable for 2nd stage IV)	Coef	*t*-Stat	Coef	*t*-Stat
$D\_Uncap\_Intang_t$	?			-0.016	-6.26**
$D\_Cap\_Intang_t$	?	-1.269	-9.48**	-0.018	-3.68**
D_Vol_t	+	-2.362	-7.55**	0.116	7.15**
D_rf_t	-	0.053	13.67**	-0.001	-3.59**
D_Debt_t	+	0.341	3.34**	0.011	3.38**
D_PPE_t	-	-1.031	-7.52**	-0.012	-2.64**
$D\_BV\_Other_t$	-	-0.901	-8.92**	-0.018	-4.85**
Instrumental Variables:					
D_Revq_{t+4}		0.132	11.26**		
$D\_Div\_Ratio_t$		0.001	0.36		
Maturity Fixed Effects		Yes			
Observations		38,647		38,647	
R^2		0.0873			
Pseudo R^2				0.0757	
Instrumental Variable Validation:					
Weak instrument test (Partial *F*-statistic)				63.62 (*p*=0.00)	
Over-identifying restrictions test (Hansen *J*-statistic)				0.74 (*p*=0.39)	
Endogeneity test (Sargan-Hansen *C*-statistic)				19.92 (*p*=0.00)	

**two-tailed *p*-value < 0.01; *two-tailed *p*-value < 0.05

To validate my selection of IVs I need to reject (fail to reject) the null hypothesis that the IVs are weak (exogenous). The partial F-statistic of 64.75 (p-value < 0.01) allows me to reject the null hypothesis that my IVs are weak. Likewise the Hansen (1982) *J*-statistic of 0.60 (p-value of 0.44) allows me to fail to reject the null hypothesis that my IVs are exogenous.

I use the predicted value of D_Uncap_Intang from the first stage regression in my second stage regression. My second stage regression results show that uncapitalized and capitalized intangible assets reduce default risk (coefficients = -0.016 and -0.018, *t*-statistic = 6.26 and 3.68, respectively), allowing me to reject H1. In addition, the coefficients on my control variables are all statistically significant in the predicted direction.

I compare the coefficient on uncapitalized intangible assets to the coefficient for each of the balance sheets items (untabulated) and find no statistical difference, suggesting that uncapitalized intangible assets are just as relevant to the CDS market as the items capitalized on the balance sheet. Critics of accounting reform for intangible assets argue that assets which satisfy the GAAP criteria for capitalization are more useful to the credit market than uncapitalized intangible assets (Holthausen & Watts, 2001; Skinner, 2008). My results are not consistent with this argument as it relates to the CDS market.

To confirm that IV estimation is an improvement over the OLS model (i.e., to show that the change in uncapitalized intangible assets is, in fact, endogenous), I perform the Sargan-Hansen *C*-test (Hayashi 2000). Unlike the more common Hausman test, the *C*-statistic is robust to the presence of heteroskedasticity. The *C*-statistic of 30.00 (p-value < 0.01) allows me to reject the null hypothesis that the change in uncapitalized intangible assets is exogenous, thereby justifying the use of IV estimation over OLS. Unlike an OLS regression, the R-square of an IV regression is not bounded between zero and one and is an inappropriate measure of fit (Pesaran

& Smith, 1994). While goodness of fit is not my objective in this paper, I calculate pseudo R-square, the squared correlation between the actual and predicted dependent variable, to provide a measure of goodness of fit.

High Default Risk versus Low Default Risk Firms

H2 predicts that, because of the non-linear payoff structure of debt, CDS spreads will be more sensitive to changes in intangible assets for high default risk firms, compared to low default risk firms. I test H2 by including an indicator variable for high default risk firms (Hi_Default) and interacting this variable with each of my independent variables as follows:

$$\begin{aligned} D\_CDSpread = {} & \Gamma_0 + \Gamma_1\, D\_Uncap\_Intang + \Gamma_2\, D\_Cap\_Intang + \Gamma_3\, D\_Controls \\ & + \Gamma_4\, Hi\_Default + \Gamma_5\, D\_Uncap\_Intang * Hi\_Default \\ & + \Gamma_6\, D\_Cap\_Intang * Hi\_Default + \Gamma_7\, D\_Controls * Hi\_Default + \varepsilon \end{aligned} \qquad (5)$$

where Hi_Default equals 1 for firms with a CDS spread greater than 0.01 at the beginning of quarter t, and 0 otherwise. I have previously shown that intangible assets reduce default risk. The coefficients on the interactions of intangible assets and Hi_Default (Γ_5 and Γ_6) indicate the difference in the CDS spread / intangible asset relation for high default risk firms compared to low default risk firms. Negative (positive) coefficients on these interaction terms indicate that intangible assets provide a greater (lesser) reduction in the CDS spread for high default risk firms compared to low default risk firms. H2 predicts that intangible assets are more relevant for high default risk firms (i.e., Γ_5 and Γ_6 are negative and significant).

Equation (5) represents a threshold model which I estimate using the value of the lagged level CDS spread as my threshold. The hypothesized relationship between the change in default risk and the change in intangible assets is hypothesized to be stronger above the threshold compared to below the threshold. I select the 0.01 CDS spread as my threshold based on the distribution of lagged CDS spreads. Figure 4 presents a histogram of lagged CDS spread values. As shown in Figure 4 these values have a skewed distribution with the majority of the sample having low CDS spreads (i.e., low default risk). I select a threshold of 0.01 in an effort to classify the firms in the right tail as high default risk firms. I analyze the sensitivity of the results presented in this paper to my selection of threshold value in two ways. First, I use credit ratings, a more noisy default risk measure, to identify investment grade (i.e., low default risk) and speculative grade (i.e., high default risk) firms. These results, untabulated, are quantitatively and qualitatively similar to the results presented herein. Second, H2 suggests that as I increase (decrease) my threshold value, the coefficients on the interaction terms (Γ_5 and Γ_6) will become more negative (closer to zero). In untabulated tests, I find that shifting the threshold value has the predicted result.

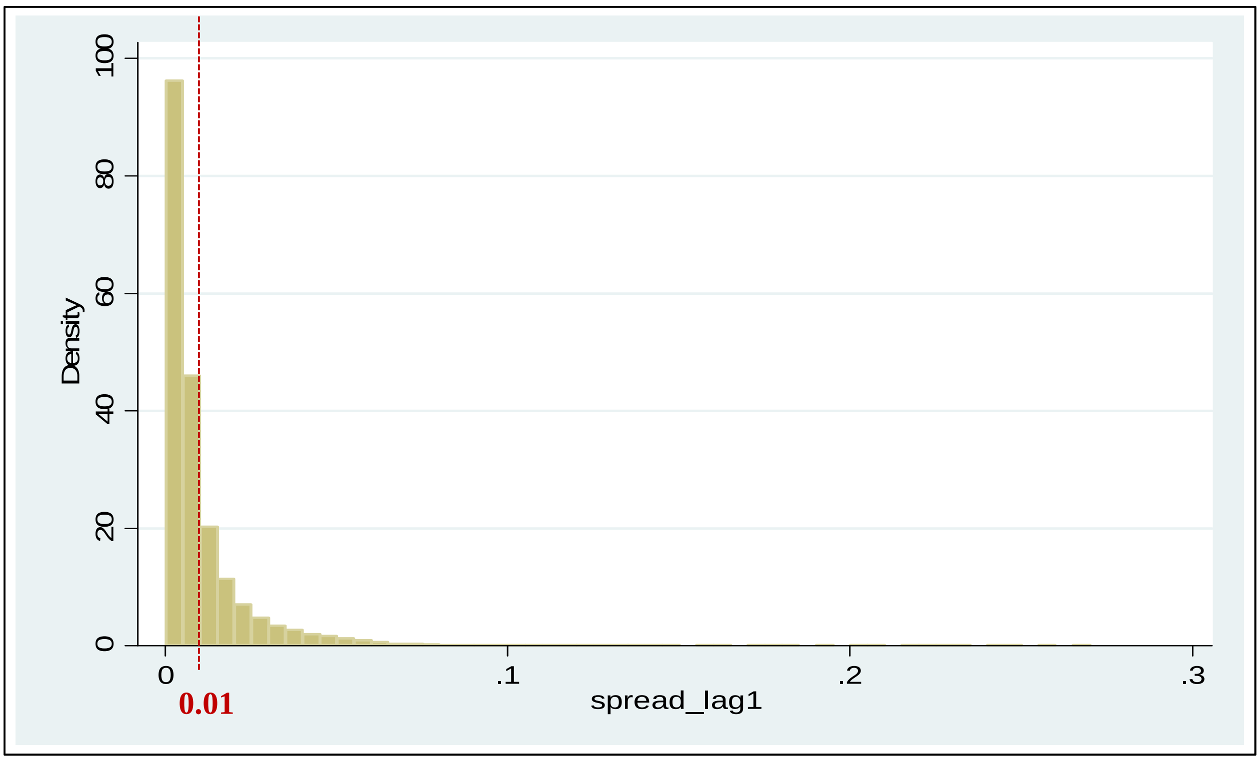

Figure 4. Distribution of Lagged CDS Spreads

Table 9 presents results of the estimation of equation (5) using OLS estimation. A coefficient on the interaction term in the same (opposite) direction as the coefficient on the corresponding original slope term indicates an increase (decrease) in relevance for high default risk firms compared to low default risk firms. The coefficient on the change in uncapitalized intangible assets (D_Uncap_Intang) is -0.002 (*t*-statistic = -11.44) suggesting that uncapitalized intangible assets reduce default risk for low default risk firms. The coefficient on the corresponding interaction term (D_Uncap_Intang * Hi_Default) is also negative (coefficient = -0.014, t-statistic = -9.03) suggesting that uncapitalized intangible assets cause an even greater reduction in default risk for high default risk firms.

The coefficient on the change in capitalized intangible assets (D_Cap_Intang) is -0.003 (*t*-statistic = -2.43) indicating the capitalized intangible assets reduce default risk for low default risk firms. However, the coefficient on the corresponding interaction term (D_Cap_Intang * Hi_Default) is insignificant suggesting that there is no difference in the relevance of capitalized intangible assets between high and low default risk firms.

Table 9 also presents the summed coefficients (i.e., the sum of the slope and the slope shift coefficients) to provide the total impact of intangible assets on high default risk firms. These summed coefficients suggest that uncapitalized (capitalized) intangible assets reduce (do not reduce) default risk for high default risk firms.

Table 9

Low Default Risk versus High Default Risk Firms: OLS Regression

	Variable	Predicted Sign	Coef	*t*-Stat
Γ_1	$D\_Uncap\_Intang_t$	-	-0.002	-11.44**
Γ_2	$D\_Cap\_Intang_t$	-	-0.003	-2.43*
	D_Vol_t	+	0.052	10.82**
	D_rf_t	-	-0.001	-15.81**
	D_Debt_t	+	0.003	3.17**
	D_PPE_t	-	-0.005	-3.45**
	$D\_BV\_Other_t$	-	-0.004	-4.38**
	Hi_Default	+	-0.001	-8.22**
Γ_5	$D\_Uncap\_Intang * Hi\_Default_t$	-	-0.014	-9.03**
Γ_6	$D\_Cap\_Intang * Hi\_Default_t$	-	-0.009	-0.90
	$D\_Vol * Hi\_Default_t$	+	0.106	4.15**
	$D\_rf * Hi\_Default_t$	-	-0.002	-5.30**
	$D\_Debt * Hi\_Default_t$	+	0.018	2.40*
	$D\_PPE * Hi\_Default_t$	-	-0.010	-1.11
	$D\_BV\_Other * Hi\_Default_t$	-	-0.016	-2.29*
	Summed Coefficients:			
	Uncapitalized Intangible Assets ($\Gamma_1 + \Gamma_5$)		-0.016	-10.13**
	Capitalized Intangible Assets ($\Gamma_2 + \Gamma_6$)		-0.013	-1.24
	Maturity Fixed Effects		Yes	
	Observations		38,647	
	R^2		0.1787	

** two-tailed *p*-value < 0.01; * two-tailed *p*-value < 0.05

Since the change in uncapitalized intangible assets (D_Uncap_Intang) is endogenous, the interaction term of this variable with an indicator variable is also endogenous. As a result the OLS estimation of equation (5) yields biased coefficients. I use IV estimation to control for this endogeneity. An IV estimation equation with two endogenous variables requires two first stage regressions. Additionally, in order to perform the overidentifying restrictions test which tests for the exogeneity of the IVs, the number of IVs must be greater than the number of endogenous regressors. In addition to my original two IVs, I create a third IV by interacting my strongest IV, the growth in revenue (D_Revq), with the high default risk indicator variable (Hi_Default).

Table 10 presents the first stage IV estimation results for equation (5). I present two first stage regressions: one for each endogenous regressor. The purpose of showing first stage regression results is to provide evidence for the conclusion that the IVs are sufficiently related to the endogenous variables. The Table 10 results at least one IV in each of the first stage regressions has a *p*-value of less than 0.01. In addition, the weak instrument test allows me to reject the null hypothesis that my IVs are weak (*F*-statistics of 45.10 and 21.99).

Table 10

Low Default Risk versus High Default Risk Firms: First Stage IV Regression

	Dependent = D_Uncap_Intang$_t$		Dependent = D_Uncap_Intang *_Hi_Default$_t$	
Variable	Coef	*t*-Stat	Coef	*t*-Stat
D_Cap_Intang$_t$	-1.426	-8.41**	0.000	0.38
D_Vol$_t$	-2.973	-5.55**	0.000	0.33
D_rf$_t$	0.053	10.75**	0.000	0.21
D_Debt$_t$	0.342	2.43*	-0.000	-0.04
D_PPE$_t$	-1.078	-6.80**	0.000	0.38
D_BV_Other$_t$	-1.021	-7.40**	0.000	0.17
Hi_Default	0.011	3.69**	0.012	5.09**
D_Cap_Intang * Hi_Default$_t$	0.574	2.65**	-0.852	-5.40**
D_Vol * Hi_Default$_t$	1.249	2.24*	-1.726	-5.99**
D_rf * Hi_Default$_t$	-0.001	-0.19	0.051	9.73**
D_Debt * Hi_Default$_t$	0.017	0.09	0.359	2.78**
D_PPE * Hi_Default$_t$	0.132	0.51	-0.947	-4.32**
D_BV_Other * Hi_Default$_t$	0.362	2.14*	-0.659	-5.98**
Instrumental Variables:				
D_Revq$_{t+4}$	0.140	9.36**	0.000	0.14
D_Revq * Hi_Default$_{t+4}$	-0.017	0.84	0.123	7.89**
D_Div_Ratio$_t$	0.001	0.39	0.000	0.11
Maturity Fixed Effects	Yes		Yes	
Observations	38,647		38,647	
R^2	0.0906		0.1155	
Instrumental Variable Validation:				
Weak instrument test (Partial *F*-statistic)	45.10 (*p*=0.00)		21.99 (*p*=0.00)	

** two-tailed *p*-value < 0.01; * two-tailed *p*-value < 0.05

Table 11 presents the second stage IV estimation results for equation (5). These second stage regression results show the coefficients on intangible assets are negative (-0.008 and

-0.013) and significant (two-tailed *p*-values < 0.01), indicating that intangible assets reduce default risk for low default risk firms. As predicted in H2 the coefficient on the interaction term for uncapitalized intangible assets (D_Uncap_Intang * Hi_Default*)* is negative and significant (coefficient = -0.023, *t*-statistic =-3.69), suggesting that uncapitalized intangible assets are more relevant for high default risk firms compared to low default risk firms. However, the coefficient on the interaction term for capitalized intangible assets (D_Cap_Intang * Hi_Default) is insignificant indicating no statistical difference in the relevance of capitalized intangible assets between high default risk and low default risk firms.

The coefficients for all other interaction terms, other than property, plant and equipment, are significant in the expected direction. These results suggest that, as a firm nears default, the CDS market becomes more sensitive to all determinants of default, other than capitalized intangible assets and fixed assets. The lack of significance for capitalized intangible assets and fixed assets is potentially due to the lack of variability in these values from one quarter to the next, and therefore a lack of statistical power. The summed coefficients results show that uncapitalized and capitalized intangible assets reduce default risk (coefficients = -0.032 and -0.026, *t*-statistic = -5.15 and -2.25, respectively) for high default risk firms.

To confirm my use of an IV estimation model and my selection of IVs I use the over-identifying restrictions test and an endogeneity test. The results of these tests are also presented in Table 11. I fail to reject the null hypothesis that my IVs are exogenous (*J*-statistic of 0.58), and reject the null hypothesis that D_Uncap_Intang and D_Uncap_Intang * Hi_Default are exogenous (*C*-statistic of 52.53). These results allow me to draw the conclusions that IV estimation is preferred over OLS and that my IVs are valid.

Table 11

Low Default Risk versus High Default Risk Firms: Second Stage IV Regression

	Variable	Predicted Sign	Coef	*t*-Stat
Γ_1	$D\_Uncap\_Intang_t$	-	-0.008	-7.19**
Γ_2	$D\_Cap\_Intang_t$	-	-0.013	-4.97**
	D_Vol_t	+	0.029	4.30**
	D_rf_t	-	-0.000	-4.19**
	D_Debt_t	+	0.005	3.29**
	D_PPE_t	-	-0.011	-5.15**
	$D\_BV\_Other_t$	-	-0.011	-5.46**
	Hi_Default	?	-0.001	-4.97**
Γ_5	$D\_Uncap\_Intang * Hi\_Default_t$	-	-0.023	-3.69**
Γ_6	$D\_Cap\_Intang * Hi\_Default_t$	-	-0.012	-1.07
	$D\_Vol * Hi\_Default_t$	+	0.096	3.37**
	$D\_rf * Hi\_Default_t$	-	-0.001	-2.74**
	$D\_Debt * Hi\_Default_t$	+	0.021	2.61**
	$D\_PPE * Hi\_Default_t$	-	-0.018	-1.66
	$D\_BV\_Other * Hi\_Default_t$	-	-0.019	-2.42*
	Summed Coefficients:			
	Uncapitalized Intangible Assets ($\Gamma_1 + \Gamma_5$)		-0.032	-5.15**
	Capitalized Intangible Assets ($\Gamma_2 + \Gamma_6$)		-0.026	-2.25*
	Maturity Fixed Effects		Yes	
	Observations		38,647	
	Pseudo R^2		0.1465	
	Instrumental Variable Validation:			
	Over-identifying restrictions test (Hansen *J*-statistic)		0.58 (*p*=0.44)	
	Endogeneity test (Sargan-Hansen *C*-statistic)		52.53 (*p*=0.00)	

** two-tailed *p*-value < 0.01; * two-tailed *p*-value < 0.05

High Growth versus Low Growth Firms

Agency conflicts intensify as the proportion of firm value attributable to growth opportunities increases (Moyer et al., 1989; Myers, 1977). H3 predicts that the relevance of intangible assets for CDS spreads will be less for high growth firms than low growth firms. I test H3 by including an indicator variable for high growth firms (Hi_Growth) and interacting this variable with each of my independent variables as follows:

$$\begin{aligned} D\_CDSpread = \; & \Omega_0 + \Omega_1 \, D\_Uncap\_Intang + \Omega_2 \, D\_Cap\_Intang + \Omega_3 \, D\_Controls \\ & + \Omega_4 \, Hi\_Growth + \Omega_5 \, D\_Uncap\_Intang * Hi\_Growth \\ & + \Omega_6 \, D\_Cap\_Intang * Hi\_Growth + \Omega_7 \, D\_Controls * Hi\_Growth + \varepsilon \end{aligned} \quad (6)$$

where Hi_Growth equals 1 for firms with a market to book value of assets ratio above the annual median[9] at the beginning of quarter t, and 0 otherwise. The coefficients on the interactions of intangible assets and Hi_Growth (Ω_5 and Ω_6) indicate the difference in the CDS spread / intangible asset relation for high growth firms compared to low growth firms. Negative (positive) coefficients on these interaction terms indicate that intangible assets provide a greater (lesser) reduction in the CDS spread for high growth firms compared to low growth firms. H3 predicts that intangible assets are less relevant for high growth firms (i.e., Ω_5 and Ω_6 are positive and significant).

Table 12 presents results of the estimation of equation (6) using OLS estimation. These results show that uncapitalized intangible assets reduce default risk for low growth firms (coefficient = -0.022, *t*-statistic = -11.14) and are less relevant for high growth firms (coefficient = -0.003, *t*-statistic = -9.72). Furthermore I find no statistical difference between the relevance

[9] My results are robust to excluding firms with a market to book value of assets around the median. Specifically, if I define low (high) growth firms as firms with a market to book value of assets below (above) the 60 (40) percentile, my results are quantitatively similar.

of capitalized intangible assets for high growth and low growth firms (coefficient = -0.001, *t*-statistic = -0.09).

Table 12

Low Growth versus High Growth Firms: OLS Regression

	Variable	Predicted Sign	Coef	*t*-Stat
Ω_1	$D\_Uncap\_Intang_t$	-	-0.022	-11.14**
Ω_2	$D\_Cap\_Intang_t$	-	-0.005	-0.49
	D_Vol_t	+	0.142	6.12**
	D_rf_t	-	-0.002	-7.52**
	D_Debt_t	+	0.015	2.10*
	D_PPE_t	-	-0.018	-2.48*
	$D\_BV\_Other_t$	-	-0.016	-2.57*
	Hi_Growth	?	-0.000	-0.10
Ω_5	$D\_Uncap\_Intang * Hi\_Growth_t$	+	0.019	9.59**
Ω_6	$D\_Cap\_Intang * Hi\_Growth_t$	+	-0.001	-0.09
	$D\_Vol * Hi\_Growth_t$	?	-0.015	-0.56
	$D\_rf * Hi\_Growth_t$	?	0.001	3.88**
	$D\_Debt * Hi\_Growth_t$	?	-0.008	-1.07
	$D\_PPE * Hi\_Growth_t$	?	0.019	2.21*
	$D\_BV\_Other * Hi\_Growth_t$	?	0.008	1.16
	Summed Coefficients:			
	Uncapitalized Intangible Assets ($\Omega_1 + \Omega_5$)		-0.003	-9.72**
	Capitalized Intangible Assets ($\Omega_2 + \Omega_6$)		-0.006	-2.23*
	Maturity Fixed Effects		Yes	
	Observations		38,647	
	R^2		0.1437	

** two-tailed *p*-value < 0.01; * two-tailed *p*-value < 0.05

Similar to equation (5), equation (6) contains two endogenous regressors and, therefore, requires IV estimation to provide unbiased estimates. To perform the overidentifying restrictions test I need at least three IVs. In addition to my original two IVs, I create a third IV by interacting my strongest IV, the growth in revenue (D_Revq), with the high growth firm indicator variable (Hi_Growth). Table 13 presents the first stage regression results for equation (6) as well as the results of the weak instrument test.

I present two first stage regressions: one for each endogenous regressor. As noted earlier, the purpose of presenting the first stage IV regression is to demonstrate that the IVs are sufficiently related to the endogenous regressors. For the first stage regression on the change in uncapitalized intangible assets (D_Uncap_Intang) two IVs are statistically significant in the predicted direction: the change in revenue (D_Revq) and the change in revenue interacted with the high growth indicator variable (D_Revq * Hi_Growth). The weak instrument test for this regression allows me to reject the null hypothesis that my IVs are weak (*F*-statistic of 57.09). For the first stage regression on D_Uncap_Intang * Hi_Growth, one IV is statistically significant in the predicted direction (D_Revq * Hi_Growth). Furthermore, the weak instrument test for this regression allows me to reject the null hypothesis that my IVs are weak (*F*-statistic of 30.86). Based on the results presented in Table 13, I conclude that my IVs are sufficiently related to the endogenous regressors such that they can yield unbiased estimates in the second stage IV estimation.

Table 13

Low Growth versus High Growth Firms: First Stage IV Regression

	Dependent = $D\_Uncap\_Intang_t$		Dependent = $D\_Uncap\_Intang * Hi\_Growth_t$	
Variable	Coef	*t*-Stat	Coef	*t*-Stat
$D\_Cap\_Intang_t$	-0.758	-5.53**	-0.000	-0.01
D_Vol_t	-1.141	-6.04**	0.000	0.15
D_rf_t	0.030	10.41**	0.000	0.15
D_Debt_t	0.318	3.92**	-0.000	-0.16
D_PPE_t	-0.733	-6.77**	0.000	0.15
$D\_BV\_Other_t$	-0.564	-7.71**	0.000	0.16
Hi_Growth	-0.019	-5.33**	-0.007	-2.17*
$D\_Cap\_Intang * Hi\_Growth_t$	-0.567	-2.63**	-1.325	-7.69**
$D\_Vol * Hi\_Growth_t$	-2.669	-3.96**	-3.810	-5.96**
$D\_rf * Hi\_Growth_t$	0.040	5.64**	0.070	10.78**
$D\_Debt * Hi\_Growth_t$	-0.004	-0.02	0.314	2.15*
$D\_PPE * Hi\_Growth_t$	-0.524	-2.19*	-1.257	-5.57**
$D\_BV\_Other * Hi\_Growth_t$	-0.486	-2.90**	-1.051	-7.15**
Instrumental Variables:				
D_Revq_{t+4}	0.071	9.05**	0.000	0.14
$D\_Revq * Hi\_Growth_{t+4}$	0.149	6.18**	0.220	9.60**
$D\_Div\_Ratio_t$	0.001	0.36	-0.000	-0.15
Maturity Fixed Effects	Yes		Yes	
Observations	38,647		38,647	
R^2	0.1069		0.1028	
Instrumental Variable Validation:				
Weak instrument test (Partial *F*-statistic)	57.09 (*p*=0.00)		30.86 (*p*=0.00)	

** two-tailed *p*-value < 0.01; * two-tailed *p*-value < 0.05

Table 14 presents the second stage regression results for equation (6). The second stage regression results show that the impact of uncapitalized intangible assets falls from -0.030 for low growth firms to -0.009 for high growth firms (the coefficient on D_Uncap_Intang * Hi_Growth = 0.021, *t*-statistic = 3.15). As predicted, these results imply that uncapitalized intangible assets reduce default risk for low growth firms, and become less relevant for high growth firms. Alternatively, the impact of capitalized intangible assets is insignificant for low growth firms and is -0.014 (two-tailed *p*-value <0.01) for high growth firms.

H3 predicts that capitalized intangible assets will be less relevant for high growth firms, yet my results show that the difference in relevance between high growth and low growth firms is insignificant (coefficient = -0.002, *t*-statistic = -0.18). I develop my prediction for H3 by suggesting that high growth firms have greater stockholder/bondholder agency conflicts due to differences in information asymmetry. As noted earlier, intangible assets which meet the threshold of capitalization are acquired in external transactions and are specifically identifiable. A potential explanation for the lack of predicted findings for capitalized intangible assets is that these assets are not susceptible to agency conflicts to the same extent as uncapitalized intangible assets. This explanation is supported by the statistically insignificant coefficients on the other balance sheet items (i.e., debt, fixed assets and all other book value) which are also not as susceptible to stockholder/bondholder agency conflicts.

The summed coefficients presented in Table 14 indicate that both uncapitalized and capitalized intangible assets reduce default risk for high growth firms (coefficients = -0.009 and -0.014, *t*-statistics = -6.07 and -3.85, respectively). It is important to note that, while uncapitalized intangible assets are less relevant for high growth firms compared to low growth firms, they are not irrelevant for high growth firms.

Table 14

Low Growth versus High Growth Firms: Second Stage IV Regression

	Variable	Predicted Sign	Coef	*t*-Stat
Ω_1	$D\_Uncap\_Intang_t$	-	-0.030	-4.69**
Ω_2	$D\_Cap\_Intang_t$	-	-0.012	-0.95
	D_Vol_t	+	0.131	5.36**
	D_rf_t	-	-0.001	-4.58**
	D_Debt_t	+	0.018	2.39*
	D_PPE_t	-	-0.024	-2.79**
	$D\_BV\_Other_t$	-	-0.021	-2.96**
	Hi_Growth	?	-0.000	-0.66
Ω_5	$D\_Uncap\_Intang * Hi\_Growth_t$	+	0.021	3.15**
Ω_6	$D\_Cap\_Intang * Hi\_Growth_t$	+	-0.002	-0.18
	$D\_Vol * Hi\_Growth_t$	?	-0.030	-1.07
	$D\_rf * Hi\_Growth_t$	?	0.001	3.32**
	$D\_Debt * Hi\_Growth_t$	?	-0.009	-1.17
	$D\_PPE * Hi\_Growth_t$	?	0.018	1.87
	$D\_BV\_Other * Hi\_Growth_t$	?	0.007	0.84
	Summed Coefficients:			
	Uncapitalized Intangible Assets ($\Omega_1 + \Omega_5$)		-0.009	-6.07**
	Capitalized Intangible Assets ($\Omega_2 + \Omega_6$)		-0.014	-3.85**
	Maturity Fixed Effects		Yes	
	Observations		38,647	
	Pseudo R^2		0.1261	
	Instrumental Variable Validation:			
	Over-identifying restrictions test (Hansen *J*-statistic)		1.14 (*p*=0.29)	
	Endogeneity test (Sargan-Hansen *C*-statistic)		20.80 (*p*=0.00)	

** two-tailed *p*-value < 0.01; * two-tailed *p*-value < 0.05

To confirm my use of IV estimation and my selection of IVs, I use the over-identifying restrictions test and an endogeneity test. These results of these tests are also presented in Table 14. I fail to reject the null hypothesis that my IVs are exogenous (*J*-statistic of 1.14), and reject the null hypothesis that D_Uncap_Intang and D_Uncap_Intang * Hi_Growth are exogenous (*C*-statistic of 20.80). These results allow me to draw the conclusions that IV estimation is preferred over OLS and that my IVs are valid.

Sensitivity Analyses

My data consists of multiple CDS maturities. I include fixed effects to control for the different maturities. However, it is possible that CDS maturity affects more than just the regression intercepts. That is, the maturity of the CDS contract could influence the relevance of intangible assets. For instance, the agency conflicts associated with longer maturities could cause intangible assets to lose their relevance for long term CDS contracts. I re-estimate my analyses separately for each CDS maturity. In Tables 15, 16 and 17, I present the OLS, first stage IV and second stage IV regression results, respectively, of equation (3). In Tables 18 and 19 I present the second stage IV regression results showing low default risk versus high default risk firms and low growth versus high growth firms, respectively. These results show that for each maturity, the relation between uncapitalized and capitalized intangible assets and default risk is similar to the results presented which combine all maturities.

Table 15

By Maturity: OLS Regression

Variable	Predicted Sign	Maturity = 1 year Coef	*t*-Stat	Maturity = 3 years Coef	*t*-Stat	Maturity = 5 years Coef	*t*-Stat	Maturity = 7 years Coef	*t*-Stat	Maturity = 10 years Coef	*t*-Stat
$D\_Uncap\_Intang_t$	?	-0.004	-9.11**	-0.005	-9.80**	-0.005	-11.00**	-0.005	-10.94**	-0.005	-11.20**
$D\_Cap\_Intang_t$	?	-0.003	-0.84	-0.006	-1.65	-0.007	-1.79	-0.004	-1.20	-0.002	-0.63
D_Vol_t	+	0.213	11.22**	0.157	9.20**	0.136	8.41**	0.115	7.55**	0.101	6.85**
D_rf_t	-	-0.001	-8.05**	-0.001	-10.16**	-0.001	-11.18**	-0.001	-10.05**	-0.001	-8.99**
D_Debt_t	+	0.007	2.11*	0.010	3.06**	0.008	2.50*	0.008	2.53*	0.007	2.44*
D_PPE_t	-	0.002	0.44	-0.001	-0.28	-0.003	-0.67	-0.004	-1.06	-0.005	-1.42
$D\_BV\_Other_t$	-	-0.011	-3.53**	-0.010	-3.26**	-0.009	-3.06**	-0.007	-2.47*	-0.006	-2.15*
Observations		7,730		7,779		7,713		7,709		7,716	
R^2		0.1242		0.1139		0.1132		0.0984		0.0855	

**two-tailed *p*-value < 0.01; *two-tailed *p*-value < 0.05

Table 16

By Maturity: First Stage IV Regression

	Dependent Variable = D_Uncap_Intang$_t$									
	Maturity = 1 year		Maturity = 3 years		Maturity = 5 years		Maturity = 7 years		Maturity = 10 years	
Variable	Coef	*t*-Stat	Coef	*t*-Stat	Coef	*t*-Stat	Coef	*t*-Stat	Coef	*t*-Stat
D_Cap_Intang$_t$	-1.306	-9.13**	-1.230	-8.90**	-1.280	-9.58**	-1.299	-9.64**	-1.236	-8.94**
D_Vol$_t$	-2.414	-7.52**	-2.369	-7.01**	-2.292	-7.14**	-2.326	-7.06**	-2.416	-7.22**
D_rf$_t$	0.051	13.37**	0.054	13.50**	0.052	13.06**	0.053	13.39**	0.053	13.41**
D_Debt$_t$	0.300	2.73**	0.255	2.39*	0.386	3.80**	0.388	3.74**	0.376	3.66**
D_PPE$_t$	-1.118	-7.03**	-1.007	-7.22**	-1.030	-7.38**	-0.970	-6.83**	-1.032	-7.32**
D_BV_Other$_t$	-0.904	-8.44**	-0.879	-8.53**	-0.921	-9.16**	-0.907	-9.02**	-0.894	-8.49**
Instrumental Variables:										
D_Revq$_{t+4}$	0.128	10.42**	0.139	10.79	0.130	11.08**	0.129	10.82**	0.132	10.96**
D_Div_Ratio$_t$	0.001	0.57	0.001	0.82	0.001	0.66	0.000	0.24	-0.001	-0.59
Observations	7,730		7,779		7,713		7,709		7,716	
R^2	0.0879		0.0892		0.0864		0.0864		0.0872	
Instrumental Variable Validation:										
Weak instrument test (Partial *F*-statistic)	54.79 (*p*=0.00)		59.07 (*p*=0.00)		61.84 (*p*=0.00)		58.60 (*p*=0.00)		60.18 (*p*=0.00)	

**two-tailed *p*-value < 0.01; *two-tailed *p*-value < 0.05

Table 17

By Maturity: Second Stage IV Regression

Variable	Predicted Sign	Maturity = 1 year		Maturity = 3 years		Maturity = 5 years		Maturity = 7 years		Maturity = 10 years	
		Coef	*t*-Stat	Coef	*t*-Stat	Coef	*t*-Stat	Coef	*t*-Stat	Coef	*t*-Stat
$D\_Uncap\_Intang_t$	?	-0.016	-5.38**	-0.016	-5.55**	-0.017	-5.73**	-0.017	-6.09**	-0.014	-5.44**
$D\_Cap\_Intang_t$	?	-0.018	-3.24**	-0.018	-3.53**	-0.020	-3.76**	-0.019	-3.69**	-0.014	-2.67**
D_Vol_t	+	0.181	8.79**	0.181	7.00**	0.107	6.27**	0.084	5.25**	0.075	4.90**
D_rf_t	-	-0.000	-1.73	-0.000	-3.97**	-0.001	-4.39**	-0.001	-3.16**	-0.001	-3.22**
D_Debt_t	+	0.010	2.71**	0.010	3.43**	0.012	3.25**	0.012	3.37**	0.011	3.10**
D_PPE_t	-	-0.010	-1.73	-0.010	-1.95	-0.013	-2.44*	-0.015	-2.93**	-0.014	-3.01**
$D\_BV\_Other_t$	-	-0.021	-4.86**	-0.021	-4.57**	-0.019	-4.53**	-0.017	-4.60**	-0.014	-3.81**
Observations		7,730		7,779		7,713		7,709		7,716	
Pseudo R^2		0.0815		0.0791		0.0746		0.0672		0.0691	
Instrumental Variable Validation:											
Over-identifying restrictions test (Hansen J-statistic)		0.93 (*p*=0.33)		1.40 (*p*=0.24)		0.79 (*p*=0.37)		0.39 (*p*=0.53)		0.15 (*p*=0.70)	
Endogeneity test (Sargan-Hansen C-statistic)		18.87 (*p*=0.00)		15.34 (*p*=0.00)		14.88 (*p*=0.00)		19.33 (*p*=0.00)		12.88 (*p*=0.00)	

**two-tailed *p*-value < 0.01; *two-tailed *p*-value < 0.05

Table 18

By Maturity: Second Stage IV Regression for Low Default Risk versus High Default Risk Firms

Variable	Predicted Sign	Maturity = 1 year		Maturity = 3 years		Maturity = 5 years		Maturity = 7 years		Maturity = 10 years	
		Coef	*t*-Stat	Coef	*t*-Stat	Coef	*t*-Stat	Coef	*t*-Stat	Coef	*t*-Stat
$D\_Uncap\_Intang_t$	?	-0.009	-6.81**	-0.008	-6.61**	-0.009	-6.36**	-0.010	-6.39**	-0.009	-6.12**
$D\_Cap\_Intang_t$	?	-0.014	-5.19**	-0.011	-4.47**	-0.014	-4.56**	-0.014	-4.20**	-0.013	-3.83**
D_Vol_t	+	0.043	5.96**	0.033	4.42**	0.031	4.12**	0.021	2.53*	0.009	1.06
D_rf_t	-	-0.001	-4.02**	-0.001	-5.52**	-0.001	-4.27**	-0.000	-2.52*	-0.000	-2.18*
D_Debt_t	+	0.005	3.27**	0.005	3.28**	0.006	3.13**	0.006	2.81**	0.005	2.70**
D_PPE_t	-	-0.010	-4.44**	-0.011	-5.00**	-0.012	-4.36**	-0.012	-4.43**	-0.012	-4.14**
$D\_BV\_Other_t$	-	-0.011	-5.89**	-0.010	-5.42**	-0.011	-4.76**	-0.011	-4.48**	-0.011	-4.51**
Hi_Default	?	-0.002	-3.60**	-0.001	-4.22**	-0.001	-3.58**	-0.001	-3.29**	-0.001	-4.35**
$D\_Uncap\_Intang * Hi\_Default_t$	-	-0.037	-2.31*	-0.025	-2.67**	-0.024	-3.12**	-0.021	-3.42**	-0.014	-2.71**
$D\_Cap\_Intang * Hi\_Default_t$	-	-0.031	-1.14	-0.025	-1.43	-0.012	-0.98	-0.011	-0.97	0.000	0.01
$D\_Vol * Hi\_Default_t$	+	0.187	3.93**	0.111	3.07**	0.071	2.29*	0.060	2.17*	0.070	2.73**
$D\_rf * Hi\_Default_t$	-	-0.002	-1.56	-0.002	-2.76**	-0.001	-2.81**	-0.001	-2.53*	-0.001	-2.75**
$D\_Debt * Hi\_Default_t$	+	0.029	1.78	0.029	2.80**	0.020	2.22*	0.019	2.41*	0.015	2.11*
$D\_PPE * Hi\_Default_t$	-	-0.050	-1.64	-0.021	-1.33	-0.015	-1.22	-0.016	-1.55	-0.010	-1.11
$D\_BV\_Other * Hi\_Default_t$	-	-0.051	-2.90**	-0.031	-2.68**	-0.018	-2.09*	-0.012	-1.63	-0.005	-0.71
Observations		7,730		7,779		7,713		7,709		7,716	
Pseudo R^2		0.1550		0.1545		0.1418		0.1308		0.1285	
Instrumental Variable Validation:											
Weak instrument test ($D\_Uncap\_Intang_t$)		37.74 (*p*=0.00)		40.83 (*p*=0.00)		43.19 (*p*=0.00)		41.64 (*p*=0.00)		43.56 (*p*=0.00)	
Weak instrument test ($D\_Uncap\_Intang * Hi\_Default_t$)		5.56 (*p*=0.00)		9.42 (*p*=0.00)		15.24 (*p*=0.00)		19.91 (*p*=0.00)		25.71 (*p*=0.00)	
Over-identifying restrictions test (Hansen *J*-statistic)		0.78 (*p*=0.38)		1.41 (*p*=0.24)		0.72 (*p*=0.39)		0.29 (*p*=0.59)		0.06 (*p*=0.81)	
Endogeneity test (Sargan-Hansen *C*-statistic)		41.90 (*p*=0.00)		40.55 (*p*=0.00)		40.54 (*p*=0.00)		45.16 (*p*=0.00)		35.20 (*p*=0.00)	

** two-tailed *p*-value < 0.01; * two-tailed *p*-value < 0.05

Table 19

By Maturity: Second Stage IV Regression for Low Growth versus High Growth Firms

Variable	Predicted Sign	Maturity = 1 year		Maturity = 3 years		Maturity = 5 years		Maturity = 7 years		Maturity = 10 years	
		Coef	*t*-Stat	Coef	*t*-Stat	Coef	*t*-Stat	Coef	*t*-Stat	Coef	*t*-Stat
$D\_Uncap\_Intang_t$	-	-0.031	-4.18**	-0.032	-4.11**	-0.030	-4.01**	-0.033	-4.72**	-0.024	-3.56**
$D\_Cap\_Intang_t$	-	-0.022	-1.63	-0.017	-1.26	-0.012	-0.85	-0.012	-0.91	0.003	0.24
D_Vol_t	+	0.221	7.25**	0.145	5.40**	0.120	4.56**	0.087	3.51**	0.081	3.43**
D_rf_t	-	-0.001	-2.79**	-0.002	-4.56**	-0.002	-5.10**	-0.001	-4.21**	-0.001	-4.25**
D_Debt_t	+	0.020	2.23*	0.021	2.43*	0.018	2.20*	0.018	2.34*	0.014	1.86
D_PPE_t	-	-0.022	-2.06*	-0.023	-2.17*	-0.025	-2.54*	-0.028	-3.24**	-0.022	-2.85**
$D\_BV\_Other_t$	-	-0.030	-3.30**	-0.025	-2.98**	-0.022	-2.70**	-0.018	-2.56*	-0.011	-1.64
Hi_Growth	?	0.000	0.04	-0.000	-0.26	-0.000	-0.88	-0.000	-1.35	-0.000	-0.56
$D\_Uncap\_Intang * Hi\_Growth_t$	+	0.023	2.98**	0.023	2.89**	0.020	2.56*	0.023	3.21**	0.015	2.10*
$D\_Cap\_Intang * Hi\_Growth_t$	+	0.010	0.73	0.003	0.22	-0.005	-0.34	-0.003	-0.22	-0.017	-1.26
$D\_Vol * Hi\_Growth_t$	?	-0.088	-2.56*	-0.030	-0.94	-0.024	-0.79	-0.001	-0.05	-0.006	-0.23
$D\_rf * Hi\_Growth_t$	?	0.001	2.21*	0.001	3.18**	0.001	3.48**	0.001	2.95**	0.001	3.29**
$D\_Debt * Hi\_Growth_t$	?	-0.013	-1.33	-0.011	-1.25	-0.009	-1.06	-0.009	-1.08	-0.005	-0.62
$D\_PPE * Hi\_Growth_t$	?	0.014	1.23	0.017	1.48	0.019	1.82	0.023	2.33*	0.015	1.58
$D\_BV\_Other * Hi\_Growth_t$	?	0.015	1.53	0.011	1.27	0.006	0.74	0.003	0.36	-0.003	-0.38
Observations		7,730		7,779		7,713		7,709		7,716	
Pseudo R^2		0.1304		0.1307		0.1224		0.1184		0.1124	
Instrumental Variable Validation:											
Weak instrument test ($D\_Uncap\_Intang_t$)		49.48 (*p*=0.00)		54.95 (*p*=0.00)		53.48 (*p*=0.00)		52.74 (*p*=0.00)		55.01 (*p*=0.00)	
Weak instrument test ($D\_Uncap\_Intang * Hi\_Growth_t$)		26.39 (*p*=0.00)		27.69 (*p*=0.00)		28.56 (*p*=0.00)		27.57 (*p*=0.00)		29.86 (*p*=0.00)	
Over-identifying restrictions test (Hansen *J*-statistic)		1.45 (*p*=0.23)		2.30 (*p*=0.13)		1.31 (*p*=0.25)		0.47 (*p*=0.49)		0.21 (*p*=0.65)	
Endogeneity test (Sargan-Hansen *C*-statistic)		17.60 (*p*=0.00)		14.04 (*p*=0.00)		18.30 (*p*=0.00)		16.68 (*p*=0.00)		17.15 (*p*=0.00)	

**two-tailed *p*-value < 0.01; *two-tailed *p*-value < 0.05

As discussed earlier, Shi (2003) and Eberhart et al. (2008) find mixed results when evaluating the relationship between R&D intensity and default risk. This paper more broadly studies all uncapitalized intangible assets, not just R&D. However, it is possible that my results are strictly attributable to R&D. To assess the sensitivity of my results to R&D, I re-estimate my analyses eliminating all firms with R&D expenditures in the current quarter. The results of this additional test, not tabulated, are quantitatively and qualitatively identical to the results presented in this paper.

CDS Market Efficiency

The previous analyses consistently show that uncapitalized intangible assets are relevant to the CDS market. The majority of the results, although mixed, also show that capitalized intangible assets are relevant to the CDS market. These results motivate the follow-up research question: Is the value of intangible assets fully incorporated into CDS spreads? The Mishkin (1986) test is widely used to test the rational pricing of accounting numbers. However, Kraft, Leone, & Wasley (2007) demonstrate that this test is susceptible to improper inferences caused by omitted variables. They further show that a simpler, and asymptotically equivalent, alternative is to directly regress future returns on the accounting variable of interest. Testing rational pricing of intangible assets with this alternative approach simply requires modifying equation (3) to include lagged intangibles as follows:

$$\text{D\_CDSpread} = \delta_0 + \delta_1 \text{D\_Uncap\_Intang} + \delta_2 \text{D\_Cap\_Intang} + \delta_3 \text{Uncap\_Intang}_{t-1} + \delta_4 \text{Cap\_Intang}_{t-1} + \delta_5 \text{D\_Controls} + \varepsilon \quad (7)$$

where $\text{Uncap\_Intang}_{t-1}$ is the market to book value of asset ratio at the end of quarter *t-1* and Cap_Intang_{t-1} is the book value of intangible assets at the end of quarter *t-1* scaled by average total assets. If intangible assets are priced rationally by the CDS market then there should be no unexploited profit opportunities related to past intangible balances in the CDS market. In other words, the change in the CDS spread from quarter t-1 to quarter t should be unrelated to the level of uncapitalized and capitalized intangible assets that exist at the end of quarter t-1. I also include in this model the lagged values of the remaining balance sheet items (i.e., debt; property, plant and equipment; and other book value). The inclusion of these variables allows me to compare capitalized intangible assets to other items reported on the balance sheet and analyze the impact of intangibility on rational pricing.

An initial CDS market overreaction (underreaction) is evidenced by a statistically significant coefficient on the lagged variables in the opposite (same) direction of the coefficient on the change variable. For example, since uncapitalized intangible assets reduce default risk (i.e., δ_1 is negative), a positive (negative) coefficient on lagged uncapitalized intangible assets is evidence that the CDS market initially overreacts (underreacts) to uncapitalized intangible assets. On the other hand, since debt increases default risk (i.e., there is a positive coefficient on the change in debt), a positive (negative) coefficient on lagged debt is evidence that the CDS market initially underreacts (overreacts) to debt.

Table 20 presents the univariate statistics for the variables which I am adding to the model. These statistics show that uncapitalized intangible assets at period t-1 ($Uncap\_Intang_{t-1}$) appear very similar the uncapitalized intangible assets at period t-2 ($Uncap\_Intang_{t-2}$), which I use as an IV. I expect that $Uncap\_Intang_{t-2}$ will be a strong IV for $Uncap\_Intang_{t-1}$.

Table 20

Univariate Statistics- Rational Pricing Variables

Variable	Mean	Standard Deviation	Q1	Median	Q3
$Uncap\_Intang_{t-1}$	1.679	0.656	1.208	1.470	1.922
Cap_Intang_{t-1}	0.189	0.176	0.034	0.146	0.313
$Debt_{t-1}$	0.288	0.148	0.177	0.271	0.385
PPE_{t-1}	0.326	0.232	0.127	0.277	0.522
BV_Other_{t-1}	0.125	0.196	-0.009	0.091	0.222
$Uncap\_Intang_{t-2}$	1.678	0.670	1.201	1.468	1.918

The variables presented in Table 20 which have not been previously defined are as follows: $Debt_{t-1}$ is the book value of the long term debt plus the book value of debt in current liabilities at the end of quarter t-1 scaled by the average book value of total assets; PPE_{t-1} is the book value of property plant and equipment at the end of quarter t-1 scaled by the average book value of total assets; BV_Other_{t-1} is the book value of all other assets (total assets – intangible assets – PP&E – debt) at the end of quarter t-1 scaled by the average book value of total assets; $Uncap\_Intang_{t-2}$ is MV_Assets as of the first day after the earnings announcement for quarter t-2 divided by BV_Assets at the end of quarter t-2.

Table 21 presents results of the estimation of equation (7) using OLS estimation for the full sample. The coefficients on lagged intangibles are insignificant suggesting that the CDS market efficiently prices intangibles. On the other hand, the coefficient on lagged debt is negative and significant (p-value < 0.05), suggesting that the CDS market overreacts to debt.

Table 21

Test of Rational Pricing for Full Sample: OLS Regression

Variable	Predicted Sign	Coef	*t*-Stat
$D\_Uncap\_Intang_t$	-	-0.005	-11.03**
$D\_Cap\_Intang_t$	-	-0.005	-1.69
D_Vol_t	+	0.144	9.43**
D_rf_t	-	-0.001	-10.43**
D_Debt_t	+	0.008	2.83**
D_PPE_t	-	-0.001	-0.48
$D\_BV\_Other_t$	-	-0.009	-3.35**
$Uncap\_Intang_{t-1}$	?	0.000	1.18
Cap_Intang_{t-1}	?	0.000	0.60
$Debt_{t-1}$	?	-0.001	-2.19*
PPE_{t-1}	?	-0.000	-0.22
BV_Other_{t-1}	?	0.000	0.06
Maturity Fixed Effects		Yes	
Observations		38,647	
R^2		0.1067	

** two-tailed *p*-value < 0.01; * two-tailed *p*-value < 0.05

As noted earlier, the coefficients in the OLS model are biased due to endogeneity. I therefore also perform this rational pricing analysis using IV estimation. Similar to the change in uncapitalized intangible assets, the lagged value of uncapitalized intangible assets is likely endogenous in equation (7). Since I am adding an endogenous regressor to equation (3), I also need to add an IV. I select the value of uncapitalized intangible assets at period t-2 ($Uncap\_Intang_{t-2}$) as my additional IV. I expect that this IV is positively correlated to the value of uncapitalized intangible assets at period t-1 and has no explanatory power for the change in CDS spreads from period t-1 to t.

Table 22 presents the first stage regression results for equation (7) as well as the results of the weak instrument test. With two endogenous variables, I present two first stage regressions. The partial F-statistics of 56.41 (*p*-value < 0.01) and 6,005.64 (*p*-value < 0.01) allow me to reject the null hypothesis that my IVs are weak.

Table 22

Test of Rational Pricing for Full Sample: First Stage IV Regression

Variable	Dependent = $D\_Uncap\_Intang_t$		Dependent = $Uncap\_Intang_{t-1}$	
	Coef	*t*-Stat	Coef	*t*-Stat
$D\_Cap\_Intang_t$	-1.127	-8.20**	1.025	5.85**
D_Vol_t	-2.132	-6.84**	-2.118	-5.27**
D_rf_t	0.052	13.57**	0.028	6.19**
D_Debt_t	0.355	3.43**	-0.925	-5.79**
D_PPE_t	-1.032	-6.72**	0.536	2.28*
$D\_BV\_Other_t$	-0.860	-8.28**	1.019	6.60**
Cap_Intang_{t-1}	0.018	1.17	0.025	1.27
$Debt_{t-1}$	-0.032	-2.39*	-0.067	-3.47**
PPE_{t-1}	0.028	1.82	0.040	2.07*
BV_Other_{t-1}	0.013	0.76	0.026	1.15
Instrumental Variables:				
D_Revq_{t+4}	0.131	11.25**	0.091	7.45**
$D\_Div\_Ratio_t$	0.000	0.32	-0.000	-0.32
$Uncap\_Intang_{t-2}$	-0.028	-6.49**	0.940	113.82**
Maturity Fixed Effects	Yes		Yes	
Observations	38,647		38,647	
R^2	0.1021		0.9304	
Instrumental Variable Validation:				
Weak instrument test (Partial *F*-statistic)	56.41 (*p*=0.00)		6,005.64 (*p*=0.00)	

** two-tailed *p*-value < 0.01; * two-tailed *p*-value < 0.05

Table 23 presents the second stage regression results for equation (7). My second stage regression results suggest that the CDS market underreacts to uncapitalized intangible assets and overreacts to debt. All other balance sheet items appear to be rationally priced. These results provide some initial evidence that, like the equity market, the CDS market might benefit from additional recognition or disclosure of uncapitalized intangible assets. In Table 23, I also present the results of the over-identifying restrictions test and test for the presence of endogeneity. The Hansen (1982) *J*-statistic of 0.71 (*p*-value of 0.40) allows me to fail to reject the null hypothesis that my IVs are exogenous. The Sargan-Hansen *C*-test (Hayashi, 2000) confirms the presence of endogeneity in the OLS model, thereby confirming the need for IV estimation.

Table 23

Test of Rational Pricing for Full Sample: Second Stage IV Regression

Variable	Predicted Sign	Dependent = D_CDSpread	
		Coef	*t*-Stat
$D\_Uncap\_Intang_t$	-	-0.016	-6.35**
$D\_Cap\_Intang_t$	-	-0.018	-3.73**
D_Vol_t	+	0.116	7.25**
D_rf_t	-	-0.001	-3.60**
D_Debt_t	+	0.012	3.46**
D_PPE_t	-	-0.013	-2.46*
$D\_BV\_Other_t$	-	-0.018	-4.96**
$Uncap\_Intang_{t-1}$	?	-0.001	-2.43*
Cap_Intang_{t-1}	?	0.000	1.24
$Debt_{t-1}$	?	-0.001	-3.10**
PPE_{t-1}	?	0.000	1.06
BV_Other_{t-1}	?	0.000	0.64
Maturity Fixed Effects		Yes	
Observations		38,647	
Pseudo R^2		0.0760	
Instrumental Variable Validation:			
Over-identifying restrictions test (Hansen *J*-statistic)		0.71 (*p*=0.40)	
Endogeneity test (Sargan-Hansen *C*-statistic)		21.48 (*p*=0.00)	

** two-tailed *p*-value < 0.01; * two-tailed *p*-value < 0.05

As noted previously, the CDS market is more responsive for high default risk firms compared to low default risk firms. Therefore the efficiency of the CDS market might vary based on the default risk of the firm. I explore this idea in Tables 24, 25, 26 and 27 by partitioning my sample on default risk. Low (high) default risk firms are firms with a CDS spread less than or equal to (greater than) 0.01 at the beginning of quarter t.

Table 24 presents the results of the OLS rational pricing model for low default risk firms and high default risk firms. These results indicate a market underreaction to uncapitalized intangible assets for low default risk firms (coefficient = -0.001, *t*-statistic = -6.57) and a market overreaction to uncapitalized intangible assets for high default risk firms (coefficient = 0.001, *t*-statistic = 1.97).

Table 24

Test of Rational Pricing for Low Default Risk versus High Default Risk Firms: OLS Regression

		Low Default Risk		High Default Risk	
Variable	Predicted Sign	Coef	*t*-Stat	Coef	*t*-Stat
$D\_Uncap\_Intang_t$	-	-0.002	-12.14**	-0.015	-10.08**
$D\_Cap\_Intang_t$	-	-0.003	-1.96	-0.016	-1.56
D_Vol_t	+	0.052	10.90**	0.155	6.08**
D_rf_t	-	-0.001	-15.85**	-0.002	-7.73**
D_Debt_t	+	0.003	3.11**	0.021	2.94**
D_PPE_t	-	-0.004	-2.84**	-0.016	-1.70
$D\_BV\_Other_t$	-	-0.004	-4.03**	-0.021	-2.96**
$Uncap\_Intang_{t-1}$	?	-0.001	-6.57**	0.001	1.97*
Cap_Intang_{t-1}	?	0.000	0.92	-0.000	-0.26
$Debt_{t-1}$	?	0.000	0.04	0.001	1.03
PPE_{t-1}	?	0.000	0.68	-0.001	-0.57
BV_Other_{t-1}	?	0.000	0.68	-0.000	-0.33
Maturity Fixed Effects		Yes		Yes	
Observations		27,393		11,254	
R^2		0.1320		0.1719	

** two-tailed *p*-value < 0.01; * two-tailed *p*-value < 0.05

Due to the endogeneity of both uncapitalized intangible assets ($D\_Uncap\_Intang_t$) and the lagged value of uncapitalized intangible assets ($Uncap\_Intang_{t-1}$), I perform this same analysis using IV estimation. Tables 25 and 26 provide the first stage IV regressions for low default risk and high default risk firms, respectively. For low default risk firms, the partial F-statistics for the two first stage regressions are 42.75 and 5,455.29 (p-values < 0.01). For the high default risk firms, the partial F-statistics for the two first stage regressions are 19.30 and 584.43 (p-values < 0.01). Collectively, these results indicate that the IVs are sufficiently related to the endogenous regressors for both low and high default risk firms such that they can yield unbiased estimates in the second stage regressions.

Table 25

Test of Rational Pricing for Low Default Risk Firms: First Stage IV Regression

Variable	Dependent = D_Uncap_Intang$_t$		Dependent = Uncap_Intang$_{t-1}$	
	Coef	*t*-Stat	Coef	*t*-Stat
D_Cap_Intang$_t$	-1.266	-7.19**	0.843	4.15**
D_Vol$_t$	-2.774	-5.17**	-2.278	-3.33**
D_rf$_t$	0.051	10.52**	0.025	4.79**
D_Debt$_t$	0.361	2.52*	-0.882	-4.12**
D_PPE$_t$	-1.143	-5.60**	0.575	2.02*
D_BV_Other$_t$	-0.973	-6.85**	1.006	4.94**
Cap_Intang$_{t-1}$	0.019	1.03	0.028	1.33
Debt$_{t-1}$	-0.020	-1.14	-0.056	-2.34*
PPE$_{t-1}$	0.030	1.63	0.043	2.03*
BV_Other$_{t-1}$	0.011	0.51	0.030	1.15
Instrumental Variables:				
D_Revq$_{t+4}$	0.139	9.39**	0.093	6.35**
D_Div_Ratio$_t$	0.001	0.37	-0.005	-2.16*
Uncap_Intang$_{t-2}$	-0.028	-6.21**	0.945	127.74**
Maturity Fixed Effects	Yes		Yes	
Observations	27,393		27,393	
R^2	0.0987		0.9378	
Instrumental Variable Validation:				
Weak instrument test (Partial *F*-statistic)	42.75 (*p*=0.00)		5,455.29 (*p*=0.00)	

** two-tailed *p*-value < 0.01; * two-tailed *p*-value < 0.05

Table 26

Test of Rational Pricing for High Default Risk Firms: First Stage IV Regression

Variable	Dependent = $D\_Uncap\_Intang_t$		Dependent = $Uncap\_Intang_{t-1}$	
	Coef	*t*-Stat	Coef	*t*-Stat
$D\_Cap\_Intang_t$	-0.805	-5.22**	1.486	4.75**
D_Vol_t	-1.650	-5.56**	-1.937	-4.27**
D_rf_t	0.051	9.54**	0.031	5.22**
D_Debt_t	0.353	2.74**	-1.021	4.64**
D_PPE_t	-0.930	-4.59**	0.737	2.57*
$D\_BV\_Other_t$	-0.661	-6.13**	1.079	5.58**
Cap_Intang_{t-1}	0.019	0.89	0.016	0.44
$Debt_{t-1}$	-0.061	-3.49**	-0.006	0.22
PPE_{t-1}	0.028	1.31	0.007	0.19
BV_Other_{t-1}	0.023	1.19	-0.005	-0.16
Instrumental Variables:				
D_Revq_{t+4}	0.120	7.56**	0.080	4.17**
$D\_Div\_Ratio_t$	0.000	0.14	0.002	1.23
$Uncap\_Intang_{t-2}$	-0.015	-1.50	0.846	41.53**
Maturity Fixed Effects	Yes		Yes	
Observations	11,254		11,254	
R^2	0.1153		0.8264	
Instrumental Variable Validation:				
Weak instrument test (Partial *F*-statistic)	19.30 (*p*=0.00)		584.43 (*p*=0.00)	

** two-tailed *p*-value < 0.01; * two-tailed *p*-value < 0.05

Table 27 presents the second stage regression results for the rational pricing model for both low and high default risk firms. The results for this partitioned sample show that the market inefficiency for uncapitalized intangible assets identified in Table 23 only relate to low default risk firms. The CDS market appears to underreact to changes in uncapitalized intangible assets (coefficient = -0.001, *t*-statistic = -5.75) and overreact to changes in property, plant and equipment (coefficient = 0.001, *t*-statistic = 2.00) for low default risk firms. For high default risk firms, uncapitalized intangible assets and balance sheet items appear to be rationally priced.

Table 27

Test of Rational Pricing for Low Default Risk versus High Default Risk Firms: Second Stage IV Regression

		Low Default Risk		High Default Risk	
Variable	Predicted Sign	Coef	*t*-Stat	Coef	*t*-Stat
$D\_Uncap\_Intang_t$	-	-0.009	-7.25**	-0.032	-5.08**
$D\_Cap\_Intang_t$	-	-0.011	-4.38**	-0.028	-2.50*
D_Vol_t	+	0.031	4.69**	0.121	4.35**
D_rf_t	-	-0.001	-4.46**	-0.001	-3.52**
D_Debt_t	+	0.005	3.21**	0.027	3.41**
D_PPE_t	-	-0.011	-4.52**	-0.032	-2.83**
$D\_BV\_Other_t$	-	-0.010	-5.05**	-0.031	-4.09**
$Uncap\_Intang_t$	?	-0.001	-5.75**	0.000	0.87
Cap_Intang_{t-1}	?	0.000	1.52	0.000	0.15
$Debt_{t-1}$	?	-0.000	0.97	-0.000	-0.19
PPE_{t-1}	?	0.001	2.00*	0.000	0.17
BV_Other_{t-1}	?	0.000	1.14	0.000	0.14
Maturity Fixed Effects		Yes		Yes	
Observations		27,393		11,254	
Pseudo R^2		0.0621		0.0670	
Instrumental Variable Validation:					
Over-identifying restrictions test (Hansen *J*-statistic)		2.01 (p=0.16)		0.26 (p=0.61)	
Endogeneity test (Sargan-Hansen *C*-statistic)		48.96 (p=0.00)		6.81 (p=0.03)	

** two-tailed p-value < 0.01; * two-tailed p-value < 0.05

These results provide evidence that intangible assets are relevant to the CDS market, and that the CDS market might benefit from additional recognition or disclosure of uncapitalized intangible assets. However, any additional recognition or disclosure would likely only benefit the pricing of low default risk firms.

CHAPTER VI

DISCUSSION

The purpose of this study is to provide empirical evidence on the impact of intangible assets on the CDS market. The accounting and disclosure requirements of intangible assets have been the subject of much debate. Despite the significance of the credit markets as users of financial statements, academic research on intangible assets has focused exclusively on firm and equity market performance. This study extends the intangible assets research by evaluating relevance of intangible assets to one component of debt pricing, namely default risk.

The findings from this study suggest that the CDS market would benefit from recognition and/or disclosure of intangible assets that are currently not being capitalized. However it is important to recognize that the purpose of this study is not to provide a basis for specific policy recommendations (for several reasons). First, I purposefully select a broad definition of intangible assets, rather than identifying the specific intangible value drivers (i.e., human capital, customer loyalty, etc.) that the CDS market finds relevant. Second, I do not address the critical issue of measurement. Quantifying intangible value drivers in a way that is relevant and reliable is a significant obstacle for accounting reform in this area. Third, the firms represented in my sample are large firms. The results are not necessarily generalizable to smaller firms. Finally, default risk is only one component of debt pricing. This study focuses explicitly on the CDS market and ignores the effect of intangible assets on other credit markets which are influenced by other factors in addition to default risk. Standard setters and regulators face trade-offs between the users of financial statements. An accounting standard/policy that might be useful to one set of users might not be useful, or might even be detrimental, to another set of users.

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APPENDIX

The variables used in the regressions presented in this paper are as follows (in alphabetical order):

BV_Assets_t	=	book value of total assets at the end of quarter t;
BV_Other_{t-1}	=	book value of all other assets (total assets – intangible assets – PP&E – debt) at the end of quarter t-1 scaled by the average book value of total assets;
Cap_Intang_t	=	book value of intangible assets;
Cap_Intang_{t-1}	=	book value of intangible assets at the end of quarter t-1 scaled by the average book value of total assets;
$CDSpread_t$	=	log of (CDS spread plus one) on the first day after the earnings announcement date;
$D\_BV\_Other_t$	=	change in the book value of all other assets (total assets – intangible assets – PP&E – debt) from quarter t-1 to quarter t scaled by the average book value of total assets;
$D\_Cap\_Intang_t$	=	change in Cap_Intang from quarter t-1 to quarter t scaled by the average book value of total assets;
$D\_CDSpread_t$	=	change in CDSpread from quarter t-1 to quarter t;
D_Debt_t	=	change in Debt from quarter t-1 to quarter t scaled by the average book value of total assets;
$D\_Div\_Ratio_t$	=	change in the dividend ratio (dividends per share divided by earnings before extraordinary items per share) from quarter t-3 to quarter t;
D_PPE_t	=	change in the book value of property, plant and equipment from quarter t-1 to quarter t scaled by the average book value of total assets;
D_Revq_{t+4}	=	change in the log of revenue from quarter t to quarter t+4;
$D\_Uncap\_Intang_t$	=	change in Uncap_Intang from quarter t-1 to quarter t;

D_rf_t = change in five-year treasury bill rate from the first day after the previous earnings announcement date to the first day after the current earnings announcement date;

D_Vol_t = the standard deviation of daily stock returns for the three months prior to the first day after the earnings announcement date;

$Debt_t$ = book value of the long term debt plus the book value of debt in current liabilities;

$Debt_{t-1}$ = book value of the long term debt plus the book value of debt in current liabilities at the end of quarter t-1 scaled by the average book value of total assets;

Hi_Default = 1 for firms with a CDS spread greater than 0.01 at the beginning of quarter t, and 0 otherwise;

Hi_Growth = 1 for firms with a market to book value of assets ratio above the annual median at the beginning of quarter t, and 0 otherwise;

MV_Assets_t = market value of total assets calculated as the market value of equity on the first day after the earnings announcement date (stock price * common shares outstanding) plus book value of total liabilities at the end of quarter t + book value of preferred stock at the end of quarter t;

PPE_{t-1} = book value of property plant and equipment at the end of quarter t-1 scaled by the average book value of total assets;

$Uncap\_Intang_t$ = MV_Assets as of the first day after the earnings announcement for quarter t divided by BV_Assets at the end of quarter t;

$Uncap\_Intang_{t-1}$ = MV_Assets as of the first day after the earnings announcement for quarter t-1 divided by BV_Assets at the end of quarter t-1;

$Uncap\_Intang_{t-2}$ = MV_Assets as of the first day after the earnings announcement for quarter t-2 divided by BV_Assets at the end of quarter t-2.