Uncertainty and Valuations*

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ABSTRACT

The idea that uncertainty about a firm's long-run profitability could increase its stock valuation has been proposed by Pastor and Veronesi (2003) to explain a number of phenomena in financial markets. We further examine this idea by analyzing a simple valuation model for both stocks and bonds, in contrast to the existing studies focusing on stocks only. Unless a firm is deeply in debt, our model implies that uncertainty about a firm's profitability increases its stock valuation and decreases its bond valuation, where uncertainty's impact is stronger if the firm's leverage is higher. Using a number of existing uncertainty proxies in the literature and controlling for volatility, we empirically test these predictions. Consistent with the existing literature, our empirical evidence generally supports the positive association of stock valuation and uncertainty for most but not all uncertainty proxies. However, our empirical evidence generally does not support the negative association between uncertainty and bond valuations using existing uncertainty proxies, particularly firm age. These results point to a number directions for further examination.

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I. Introduction

Much progress has been made recently in exploring the idea that investors face uncertainty about parameter values in their model. In a recent survey paper, Pastor and Veronesi (2009) note that "many financial market phenomena that appear puzzling at first sight are easier to understand once we recognize that parameters in financial models are uncertain and subject to learning." A prominent idea in this literature is that the uncertainty about a firm's long-run profitability increases its stock valuation. This follows directly from the premise that the firm's future earnings are a convex function of the growth rate of its earnings. Due to Jensen's inequality, higher uncertainty in the growth rate implies higher expected future earnings, and so leads to higher stock valuations. Pastor and Veronesi (2003) provide strong supportive empirical evidence that firms with high uncertainty (using firm age as a proxy) tend to have high market to book ratios. This argument may also have important implications for the "technology bubble" in late 1990s. Pastor and Veronesi (2006) argue that there was not necessarily a bubble, since in their calibrations a plausible amount of uncertainty about the profitability of the technology firms is sufficient to generate the high valuations observed at the peak of the "bubble" period. This argument offers a sharp contrast to the previously widely held view that the valuations of technology stocks were driven by irrational exuberance (see, e.g., Shiller 2000).

Given the significant attention and success of this uncertainty-convexity argument, the goal of our paper is to further evaluate it both theoretically and empirically. The main idea is as follows. The main intuition of the uncertainty-convexity argument of Pastor and Veronesi (2003) is that large uncertainty about the profitability of a firm means it might be the next Google (i.e., very profitable), or it might be very unprofitable. If the firm's future earnings are a convex function of the growth rate, the impact of the prospects of being the next Google dominates and hence uncertainty increases the stock valuation. It is important to note that one should not treat the above argument (uncertainty increases the stock valuation) as a mathematical identity: it may not be true if the above assumptions are violated. For example, if one takes the idea from ambiguity aversion (e.g., Gilboa and Schmeidler (1989)), higher uncertainty *reduces* the stock valuation since an ambiguity-averse investor makes decisions based on the worst-case-scenario. It is, of course, an empirical question to evaluate the validity of this idea in Pastor and Veronesi (2003). This motivates us to introduce corporate bonds into our analysis.

In this paper, we argue that the corporate bond market provides a great opportunity for an additional litmus test for this idea, as the above intuition leads to an immediate implication for corporate bonds: While equity holders capture the upside benefit in case the firm is indeed the 'next Google,' the upside for corporate bond holders is limited by the full repayment of the notional amount of the bond. However, bond holders would still suffer from the downside when the firm turns out to be very unprofitable. As a result, a straightforward extension of the above uncertainty-convexity argument to include corporate bonds implies that bond prices should decrease with uncertainty.

We formalize this in a simple one-period model. A firm is a claim to some asset at the end of the period. Following Pastor and Veronesi (2003), the asset value is assumed to be a convex function of the growth rate, which investors are uncertainty about. The firm is financed by both equity and a bond. At the end of the period, if the firm's asset is worth more than the notional value of the bond, the bond holders receive the bond's notional amount and the equity holders will get the residual value. If the firm's asset is worth less than the notional amount of the bond, however, the bond holders will get the whole firm and the equity holders receive nothing. Obtaining stock and bond prices in closed-form, the model leads to the following four implications.

First, the uncertainty about the firm's earning growth rate increases its stock valuation. This is similar to the main point in Pastor and Veronesi (2003), who consider a model without leverage. Due to Jensen's inequality, the uncertainty in the growth rate of the profitability increases the expected profit of a firm and so increases the firm's value. The same intuition also works in our model with leverage: Since the equity is a levered position in the firm's underlying asset, uncertainty increases the firm value and so increases the stock price. This naturally leads to our second implication: the positive association of uncertainty and stock valuation tends to be stronger for firms with higher leverage.[1]

The third implication is that the uncertainty about the firm's earnings growth rate decreases a firm's debt valuation, except in the extreme situation where the firm is very deeply in debt. The intuition is the following. A higher uncertainty implies that the firm may turn out to be extremely profitable or very unprofitable. Although the prospects of being extremely profitable greatly benefit the equity value, it does not increase the debt value as much since the debt holders don't benefit much from the upside: At the maximum, the debt holders receive the notional amount of the bond. If the firm turns out to be unprofitable, however, the debt holders may suffer from default. As a result, greater uncertainty tends to hurt debt value. In the extreme case where the firm is deeply in debt, however, this result is reversed. If the firm is very close to bankruptcy and most of the firm value belongs to debt holders, an increase in uncertainty increases the firm value and so increases the debt value. In other words, debt holders essentially own the firm and debt trades analogous to equity.[2] Again, this extreme situation is less relevant in our later empirical analysis given that the corporate bonds in our sample all have investment grade ratings.

The negative association between uncertainty and bond values offers potentially an opportunity to distinguish the two main competing viewpoints on the technology 'bubble' and subsequent crash. Shiller (2000) argues it was a bubble driven by an excess of optimism that

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[1] The exception is the extreme case where firms are very deeply in debt. Intuitively, if a firm is almost surely to go bankrupt, the equity value is close to zero and its sensitivity to uncertainty fades away when further debt is added. This extreme situation is not relevant in our empirical analysis, where we only focus on bonds with investment grade credit ratings.

[2] This is similar to the intuition in the classical debt overhang problem in Myers (1977).

subsequently evaporated. If it is optimism that drives up stock prices, it should also drive up bond prices. On the other hand, if it is convexity in expected earnings growth rates combined with uncertainty that drives up stock prices, as proposed in Pastor and Veronesi (2006), it should *decrease* bond prices. It is important to note that one should not view this as a "horse race" between two theories. On the one hand, Pastor and Veronesi (2006) offer a structured model with further implications on top of the high valuations for technology firms, while on the other hand, the view in Shiller (2000) has not yet been developed into structural and thus potentially refutable models. Nevertheless, the qualitatively different implications from these two alternative views offer a valuable set-up for empirical analyses.

The fourth implication from the model is that, unless the firm is deeply in debt, an increase of leverage increases the sensitivity of debt value to uncertainty (i.e., for firms with higher leverage, an increase in uncertainty decreases their debt value even more). To see the intuition, let's first consider the limit case where the firm has very little debt. In this case, it is almost certain that the firm is going to be able to pay back the debt. Hence, the debt value is very insensitive to the uncertainty. This sensitivity naturally increases when the firm has more debt.

We test these implications using data on equity and bond prices from 1994 – 2006. For the equity valuation measure, we use the (log of the) ratio of the market value over the book value of equity from CRSP and Compustat, as in Pastor and Veronesi (2003). For the bond valuation measure, we use credit spreads based on bond transactions data from the National Association of Insurance Commissioners (NAIC) database matched to the Fixed Income Securities Database (FISD), which contains bond issue and issuer characteristics. Given the holding restrictions of insurance companies, this database essentially only includes investment grade corporate bonds.

To take the model to the data, the main challenge is empirically measuring uncertainty. Our strategy here is to adopt a large number of different uncertainty proxies used in the literature, discussing the pros and cons of each measure. In our baseline regressions, we adopt the proxy for uncertainty originally proposed by Pastor and Veronesi (2003): minus the reciprocal of one plus firm age. The motivation is that investors learn about a firm's profitability over time. As a result, uncertainty over the earnings growth rate decreases over time, such that firm age and uncertainty are negatively associated. They propose this specific functional form (of minus the reciprocal of one plus firm age) based on their model of a Bayesian investor.

Using firm age as the uncertainty proxy, we first replicate the main empirical result in Pastor and Veronesi (2003) that firms with greater uncertainty (i.e., younger firms) tend to have higher stock valuations. However, our empirical results based on this uncertainty measure are contradictory to all of the other implications of our model. In particular, we find that greater uncertainty is associated with higher bond prices (or smaller credit spreads).

All our empirical results are derived from pooled panel regressions with both firm- and time-fixed effects and standard errors clustered by firm. We test the model's first implication by regressing the log of market-to-book-ratios on the measure of uncertainty (i.e., firm age) with standard firm-level controls. The coefficient for firm age is -2.71 with a t-statistic of 5.03. Consistent with the evidence in Pastor and Veronesi (2003), this result implies that younger firms, with presumably higher uncertainty, tend to have higher market-to-book ratios. Next, we test the second implication by interacting the uncertainty proxy with leverage. We find that the association of firm age with stock valuation comes mainly from firms with low leverage, contradictory to the model implication that uncertainty should increase high leverage firms' valuation more strongly.[3] In general, the negative association between stock valuation and firm age is largely driven by technology firms. For example, if we remove all technology firms from our sample (about 13% of observations), the M/B regressions no longer show any (significant) association with age (while remaining significant though using log(M/B)).

For the third implication, we regress credit spreads on the measure of uncertainty, with firm- and issue-level controls, firm fixed effects and time fixed effects. We consider two bond samples as in Campbell and Taksler (2003). The first sample only uses bond issues with longer maturity (at least 5 years) and the second sample only uses bond issues with shorter maturity (at least 1 year but less than 5 years). For the long maturity sample, the coefficient for firm age is 9.35 (t-statistic of 2.44), implying that higher uncertainty (i.e., lower age) is associated with lower credit spreads and so higher bond prices, contradictory to the third implication of our model. The results from the short maturity sample are almost the same: the coefficient for firm age is 9.76 (t-statistic of 2.24). Finally, we test the fourth implication in credit spread regressions with interactions of the uncertainty measure with leverage and find that all the coefficients for the 'firm age x leverage' interaction terms are insignificant. The results across the two bond maturity samples are again almost the same.

However, firm age is arguably an imperfect proxy for uncertainty about the future growth rate of profitability. By design, firm age as a proxy for uncertainty implies that uncertainty always decreases over time. In practice, however, the uncertainty of a firm's profitability does not necessarily have to decrease over time. A negative shock to the economy can easily increase firms' uncertainty, as seen, for example, in the current financial crisis. Or, investors may indeed learn over time about the profitability of different firms, but may do so a very different speeds, depending on a firm's and its industry's life cycle (see e.g. Gort and Klepper (1982), Klepper and Graddy (1990) and Jovanovic and MacDonald (1994) for discussion of such industry dynamics). In addition, Chun, Kim, Morck and Yeung (2008) mention a further alternative interpretation of firm age being related to creative destruction such that younger firms can grow faster, going back to Schumpeter (1912), where "new,

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[3] It is worth noting that there is no robust empirical association between firm age and leverage.

[6] There is some evidence of limited and costly arbitrage between corporate bonds and credit default swaps (see e.g. Blanco, Brennan and Marsh (2005)) and between bond and equity markets (see e.g. Mitchell, Pedersen and Pulvino (2007), Yu (2006)), but it is unclear whether this would be enough to explain our results. On the other hand, there is also widespread evidence that information contained in equity and derivate prices is useful for bond valuation (see e.g. Collin-Dufresne et al. (2001), Cremers et al. (2008), and Ericsson, Jacobs and Oviedo (2005)). Furthermore, recent papers indicate that more elaborate models seem to be able to reconcile equity, bond (and derivative) prices (see e.g. Bhamra, Kuehn and Strebulaev (2009), Chen, Collin-Dufresne and Goldstein (2008), and Cremers, Driessen and Maenhout (2008)).

initially small, firms are better able to explore and exploit the opportunities brought about by new technology because innovators can better protect their property rights over their innovations by organizing their own firms. King and Levine (1993), Fogel, Morck, and Yeung (2008), and others provide empirical support for this view. This alternative interpretation could potentially also explain the higher market-to-book ratios and higher bond prices for younger firms. However, a full exploration of the interpretation of the firm age results falls outside the scope of this paper.

Given the potential drawback in firm age as a proxy for uncertainty, we also examine the robustness of our results by adopting various alternative proxies of uncertainty. We first redo our analysis using log of one plus age as the uncertainty measure and the results are very similar to those in our baseline regressions. Second, one might suspect that firm age may be more likely to pick up the variation in uncertainty for firms in more uncertain industries. Hence, we attempt to examine our model implications for more uncertain industries, but do not find evidence consistent with this conjecture. Third, we also adopt two new measures of uncertainty introduced by Pastor, Taylor and Veronesi (2009) that are based on stock market reactions to earnings announcement surprises. The results based on these two measures are generally insignificant in most stock and bond valuation regressions and/or have opposite signs.

Fourth, we repeat our analysis based on the uncertainty measures obtained in Korteweg and Polson (2008), who calibrate the Leland (1994) model to stock and bond prices to obtain the implied parameter uncertainty for firm asset value and for asset volatility, which we denote as Sigma1 and Sigma2 respectively. Although these two uncertainty measures are not designed to capture the uncertainty about the long-run profitability, they are likely to be positively correlated with such uncertainty and hence could be useful proxies. Indeed, the results based on one of the measures, Sigma1, are broadly consistent with our model implications. In particular, the results based on both measures are consistent with first two implications from our model: Higher uncertainty, as measured by either greater posterior parameter uncertainty about asset value and asset volatility, is associated with higher stock valuation and this association is stronger among firms with higher leverage. In our panel regressions with firm-fixed effects, these two proxies are insignificantly associated with corporate bond yield spreads. If one includes industry-fixed effect rather than firm-fixed effect in the regressions, these two proxies become significant for the sample of bonds with maturities over 5 years, but have opposite signs, with only the sign of Sigma1 being consistent with the model prediction.

Fifth and finally, we consider two proxies of uncertainty based on analyst forecasts of the quarterly earnings-per-share, namely analyst forecast dispersion (i.e., the normalized standard errors of the earnings-per-share) and analyst forecast error (i.e., the difference between the median forecast and the actual earnings-per-share). Guntay and Hackbarth (2010) find that analyst forecast dispersion is positively associated with credit spreads. In our sample, we indeed find that both analyst uncertainty proxies have positive relation with credit spreads, consistent with our model. However, neither the analyst forecast dispersion nor the analyst forecast error variables are positively associated with equity valuation. The coefficient of analyst forecast dispersion is strongly negative, both statistically and economically, in the stock valuation regressions. Analyst forecast errors are unrelated to stock valuation in our sample.

In conclusion, despite the impressive success of the idea of uncertainty and convexity on both empirical and theoretical fronts, our analysis shows that it also faces a number of challenges, and so points to directions for future research. The existing evidence and validation of the idea of uncertainty and convexity is focused on the equity market. We perform a kind of "out-of-sample" test by an extension to the corporate bond market using a plethora of uncertainty proxies, where the empirical evidence appears to be generally strongly contradictory to the model predictions. There are two broad possibilities: either our uncertainty proxies are failing to pick up uncertainty about the earnings growth rate, or our uncertainty proxies are fine but the model is rejected. As our empirical work by necessity tests a joint hypothesis about both our model and what each proxy measures, we are unable to reach a clear conclusion between these two options.

First, it might be that our results demonstrate the difficulty in reliably measuring uncertainty about the earnings growth rate. We consider 8 different proxies, and the only proxy for which the model's implications and thus the uncertainty-convexity idea are not clearly rejected is Sigma1 (i.e., the implied parameter uncertainty for firm asset value). Of course, it is possible that among all the different uncertainty proxies we have adopted, Sigma1 might be the most effective proxy. However, even for Sigma1, the results using leverage interactions are at best ambivalent. Therefore, our paper poses a challenge to the empirical literature to search for better measures of uncertainty about the earnings growth rate.

As a result, a related important contribution of this paper is to give a warning to be cautious in interpreting uncertainty proxies currently used in the literature, particularly firm age. For example, after Pastor and Veronesi (2003) many subsequent papers have used firm age as a proxy for uncertainty about growth prospects, see e.g. Wei and Zhang (2006), Gaspar and Massa (2006), Nishad and Kapadia (2007), and Cao, Simin and Zhao (2008). Other papers like Adrian and Rosenberg (2008) employ Pastor and Veronesi's intuition linking firm age and higher uncertainty. Given our results and assuming the plausibility that increased uncertainty would be associated with lower bond prices, our paper is an important reminder to researchers that firm age could proxy for various different firm characteristics.

Second, if the right interpretation of our results is that the model fails, one reason could be that equity and bond markets are not fully integrated. If so, it would be fruitful to search for the frictions preventing the force of arbitrage.[6] Further, one might speculate that firm age might pick up optimism if one takes the view that investors tend to be optimistic about young firms from the IPO short-term overpricing literature.[7] If optimism drives up young firms' stock valuation, it would then be natural that these young firms' debt should also have high valuation and low credit spreads. While this conjecture appears feasible, it is still far from a conclusive explanation, for which one would seem to have to reliably identify optimism and its variation across firms and over time, which falls outside the scope of this paper. Moreover, this behavioral interpretation also has to face further challenges, for example to account for the observation that high valuations are often closely linked to high volatility and turnover.

Besides the large literature on asset valuation, our paper is also broadly related to the literature that attempts to document and explain the technology bubble, see, e.g., Abreu and Brunnermeier (2003), Allen, Morris and Shin (2006), Brunnermeier and Nagel (2004), Scheinkman and Xiong (2003), Cochrane (2003), Cooper, Dimitrov and Rau (2001), Hong, Scheinkman and Xiong (2006, 2008), Lamont and Thaler (2003), Ljungqvist and Wilhelm (2003), Ofek and Richardson (2003), Pastor and Veronesi (2006, 2008), and Schultz and Zaman (2001), among others. Our paper adds to this literature by demonstrating the empirical challenges faced by one of the leading explanations, and so points to directions for improvement. Finally, our paper is related to the literature linking uncertainty to debt values, see e.g. Duffie and Lando (2001) and David (2008). For example, Yu (2005) finds lower credit spreads for firms with better accounting disclosure, especially for short-term bonds, but does not consider equity valuation. Guntay and Hackbarth (2010) use analyst forecast dispersion to consider credit spreads and Korteweg and Polson (2008) analyze the impact of parameter uncertainty on corporate bonds. Among other things, their focus is on the parameter uncertainty on firm value but stay away from the issue that firm value is a convex function of the earnings growth rate, which is the main focus in Pastor and Veronesi (2003), as well as our paper.

The rest of the paper is organized as follows. Section II presents a simple model of stock and bond valuations. The empirical tests of the implications of the model are in Section III and Section IV concludes. All proofs are provided in the Appendix.

II. Model

In this section, we first provide a simple valuation model to capture the convexity argument in Pastor and Veronesi (2003). We first simplify the continuous-time model in Pastor and Veronesi (2003) into a one-period model, so that we can still keep the model tractable even after introducing a corporate bond into the model to study the impact of uncertainty on both stock and bond valuations. This extension allows us to empirically test the "convexity argument" based on data from both the stock and corporate bond markets, thereby providing further evidence to fortify or reject this convexity argument.

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[7] See Ljungqvist, Nanda, and Singh (2006) for a model where some sentiment investors hold optimistic beliefs about the future prospects for the IPO company that leads to long-run negative IPO returns as documented in Ritter (1991).

A. Uncertainty and the Convexity Argument

Let's consider a one-period model (t=0, 1). There is a firm whose asset in place at t=0 has a value of V_0 >0. The firm is financed only by equity and will be liquidated at t=1. So the stock is a claim to the firm's liquidation value V_1 at t=1:

$$\ln V_1 - \ln V_0 = u + \varepsilon, \tag{1}$$

where u is the mean growth rate of the firm and ε is normally distributed,

$$\varepsilon \sim N(0, \sigma_\varepsilon^2). \tag{2}$$

Note that in (1), we intentionally set the firm's liquidation value V_1 as a convex function of the mean growth rate u. This is intended to capture the main insights from Pastor and Veronesi (2003), which notes that a firm's cash flows in the long run are naturally a convex function of the mean growth rate in profitability.

To see the uncertainty effect in Pastor and Veronesi (2003), we first look at the case without uncertainty, i.e., when investors know the true value of u. To simplify the calculation, we set the riskless interest rate at zero and assume that investors are risk-neutral. Neither of the two assumptions is crucial for our later analysis.

It is straightforward to calculate the stock price at t=0,

$$S_0 = E\left[V_1\right] = V_0 e^{u + \frac{1}{2}\sigma_\varepsilon^2}. \tag{3}$$

The above expression for stock price shows that a higher mean earnings growth rate u naturally leads to a higher stock valuation. Moreover, a higher volatility in realized earnings σ_ε, due to Jensen's inequality, increases the expected dividend and hence also increases stock valuation.

We now introduce uncertainty about the mean growth rate u: Investors don't know its true value but have a belief that

$$u \sim N(\bar{u}, \sigma_u^2), \tag{4}$$

where $\bar{u}$ and σ_u are constants. Investors' uncertainty about the mean growth rate is captured by σ_u. The higher σ_u, the higher the uncertainty. It is important to note that uncertainty and volatility are *not* the same in our model and one *can* empirically identify σ_ε and σ_u separately. One can measure σ_ε by estimating the volatility of a firm's realized earnings, e.g., the standard deviation of return on assets. The measurement for σ_u is much more difficult and we will attempt to measure it using various proxies in the literature in our empirical analysis in Section III.

In this case with uncertainty, the stock price is given by

$$S_0 = E\left[V_0 e^{u + \frac{1}{2}\sigma_\varepsilon^2}\right] = V_0 e^{\bar{u} + \frac{1}{2}\sigma_u^2 + \frac{1}{2}\sigma_\varepsilon^2}. \tag{5}$$

The above expression shows that the stock price also increases in the uncertainty σ_u. This is one of the main results in Pastor and Veronesi (2003, 2006): Due to the higher uncertainty in the growth rate of profitability, young firms and technology firms have higher stock valuations.

As shown in (3), the stock valuation is convex in u: The increase in valuation caused by an increase in u by Δ is larger than the decrease in valuation caused by a decrease in u by Δ. As a result, the uncertainty in u increases the stock valuation. Intuitively, when the profitability of a firm is highly uncertain, it might be the next Google (i.e., very profitable), or might be very unprofitable. The convexity in (3) implies that the impact of the prospects of being the next Google dominates and hence uncertainty increases the stock valuation.

It is worth pointing out that one should not treat the above argument (uncertainty increases the stock valuation) as a mathematical identity: it may not be true if the above assumptions are violated. For example, if one takes the idea from ambiguity aversion (e.g., Gilboa and Schmeidler (1989)), higher uncertainty *reduces* the stock valuation since an ambiguity-averse investor makes decisions based on the worst-case-scenario. It is, of course, an empirical question to evaluate the validity of the idea in Pastor and Veronesi (2003). This motivates us to introduce corporate bonds into our analysis.

B. Corporate Bonds

The above insight has been shown to be important in understanding a number of intriguing empirical facts in the stock market (e.g., Pastor and Veronesi (2003, 2006, 2008), and Johnson (2004)). In this paper, we argue that the corporate bond market provides a great opportunity for another test for this convexity argument. The idea is that the above convexity argument leads to an immediate implication for corporate bond valuation: Although equity holders can benefit from the prospects that the firm might be the next Google, the upside for corporate bond holders is capped by the notional amount of the bond. On the other hand, bondholders would still suffer from the downside when the firm turns out to be very unprofitable. Hence, bond value would seem to tend to decrease with uncertainty about the growth rate of profitability. Next, we formalize this idea by introducing a corporate bond into the baseline model.

Identical to the model in Section II.A, the asset of the firm V_1 and the investors' perceptions are given by equations (1), (2), and (4). However, the firm is now financed by both equity and a zero-coupon bond. The debt has a principle value of B and matures at t=1. Hence, the equity claim receives $\max\left(V_1 - B, 0\right)$.

The firm value at t=0, denoted as F_0, is

$$F_0 = E\left[V_1\right] = V_0 e^{\bar{u} + \frac{1}{2}\sigma_u^2 + \frac{1}{2}\sigma_\varepsilon^2}. \qquad (6)$$

The stock price is given by $S_0 = E\left[\max\left(V_1 - B, 0\right)\right]$. Simply by taking the expectation, we obtain

$$S_0 = e^{\bar{u}+\frac{1}{2}\left(\sigma_u^2+\sigma_\varepsilon^2\right)} V_0 N(d_1) - BN(d_2), \tag{7}$$

where $N(\cdot)$ is the cumulative distribution function for a standard normal random variable, and

$$d_1 = \frac{\ln\frac{V_0}{B} + \bar{u} + \sigma_u^2 + \sigma_\varepsilon^2}{\sqrt{\sigma_u^2 + \sigma_\varepsilon^2}}, \tag{8}$$

$$d_2 = d_1 - \sqrt{\sigma_u^2 + \sigma_\varepsilon^2}. \tag{9}$$

Then, the debt value is

$$D_0 = F_0 - S_0. \tag{10}$$

For the ease of discussion, we now introduce two notations, B^* and B^{**}, where

$$B^* \equiv V_0 e^{\bar{u}}, \tag{11}$$

and B^{**} refers to the unique solution to following equation

$$N(d_1)\sqrt{\sigma_u^2 + \sigma_\varepsilon^2} + n(d_1) = \sqrt{\sigma_u^2 + \sigma_\varepsilon^2}, \tag{12}$$

where $n(\cdot)$ is the probability density function of a standard normal distribution. It is straightforward to verify that $0 < B^* < B^{**}$. Note that from (11), B^* is the debt level such that if the firm grows at the expected rate $\bar{u}$ it will have just enough to pay back the debt and the equity is worth zero at t=1. As will become clear in the appendix, B^{**} is the debt level such that $\partial D_0 / \partial \sigma_u = 0$. The following proposition summarizes the results on the impact of uncertainty on stock and bond valuations.

Proposition 1. The impacts of uncertainty on stock and bond valuations can be summarized as follows:

1. $\frac{\partial S_0}{\partial \sigma_u} > 0$. That is, an increase in uncertainty increases the stock price.

2. $\frac{\partial^2 S_0}{\partial \sigma_u \partial B} > 0$ if $B < B^*$ and $\frac{\partial^2 S_0}{\partial \sigma_u \partial B} < 0$ if $B > B^*$. That is, the impact of uncertainty on the stock price increases with leverage for firms with less than B^* debt, but it decreases with leverage for firms with more than B^* debt.

3. $\frac{\partial D_0}{\partial \sigma_u} < 0$ if $B < B^{**}$ and $\frac{\partial D_0}{\partial \sigma_u} > 0$ if $B > B^{**}$. That is, an increase in uncertainty decreases the debt value for firms with less than B^{**} debt, but increases the debt value for firms with more than B^{**} debt.

4. $\frac{\partial^2 D_0}{\partial \sigma_u \partial B} < 0$ if $B < B^*$ and $\frac{\partial^2 D_0}{\partial \sigma_u \partial B} > 0$ if $B > B^*$. That is, the marginal impact of uncertainty on debt value (i.e., $\partial D_0 / \partial \sigma_u$) decreases with leverage for firms with less than B^* debt but it increases with leverage for firms with more than B^* debt.

Proof: See the Appendix.

Result 1 is similar the main point in Pastor and Veronesi (2003), who consider a model of an all-equity firm without leverage. Due to Jensen's inequality, the uncertainty in the growth rate of the profitability increases the expected profit of a firm and so increases the firm's value. The same intuition also works in our model with leverage: Since equity is a levered position in the firm's underlying asset, uncertainty increases firm value and thus increases the stock price. This naturally leads to result 2: The impact of uncertainty on the stock price tends to be stronger when the leverage is higher. The exception is the extreme case where the firm is deeply in debt ($B > B^*$). This is intuitive: Suppose the firm is very deeply in debt and almost surely will default. Then, the equity value is close to zero and its sensitivity to uncertainty fades away when further debt is added.

Result 3 is our main theoretical result, which implies that as long as the firm's debt is less than B^{**}, an increase in uncertainty about the growth rate of profitability decreases the debt value. The intuition is the following. Having a high uncertainty implies that the firm may turn out to be extremely profitable or very unprofitable. Note that relative to equity holders, debt holders benefit much less from the prospect of the firm being extremely profitable: At the maximum, the debt holders receive the bond's notional amount. If the firm turns out to be unprofitable, however, the debt holders will suffer from default. As a result, uncertainty tends to hurt debt value. In the extreme case where the firm is deeply in debt ($B > B^{**}$), however, this result is reversed. Since in this case most of the firm value belongs to debt holders and the equity is basically worthless, an increase in uncertainty increases the firm value and so increases the debt value.

The impact of uncertainty on debt value varies with leverage, as summarized in result 4. When the firm's debt is less than B^*, an increase of leverage increases the sensitivity of debt value to uncertainty (i.e., $\partial D_0 / \partial \sigma_u$ becomes more negative). To see the intuition, let's first consider the limit case where the firm has very little debt (B is close to zero). In this case, it is almost certain that the firm is going to be able to pay back the debt. Hence, the debt value is very insensitive to the uncertainty ($\partial D_0 / \partial \sigma_u$ is close to 0). This sensitivity increases when the firm has more debt ($\partial D_0 / \partial \sigma_u$ becomes more negative). In the other extreme where the firm's debt is more than B^{**}, as noted in result 3, $\partial D_0 / \partial \sigma_u$ becomes positive. As a result, $\partial D_0 / \partial \sigma_u$ increases with leverage when the firm is deep in debt.

It is worth clarifying that there are two different convexities in our model. The first one is that the firm's payoff V_1 is a convex function of the mean growth rate u. The second one is the convexity in the payoff from equity. The first convexity is the focus in Pastor and Veronesi (2003), while the second one, the convexity in equity's payoff and hence the concavity in debt's payoff, offers a useful set-up for further examining the implications from the convexity studied in Pastor and Veronesi (2003). For example, if one believes high stock valuations at certain time are driven by optimism, one should also observe high valuations for corporate bonds. Result 3, however, implies that if the high stock valuations are caused by high uncertainty, one should instead observe lower bond valuations, unless the firm is deeply in debt.

III. Empirical Analysis

This section tests the four implications in Proposition 1. It is important to point out that although results 2 through 4 depend on the debt level, the more empirically relevant cases are those where $B < B^*$ and $B < B^{**}$. Note that $B^* < B^{**}$ and that, from (11), B^* is the debt level such that if the firm grows at the expected rate $\bar{u}$ it will have just enough to pay back the debt and the equity is worth zero at t=1. Such firms will most likely have credit ratings indicating a very high likelihood of default and surely be below investment grade. As explained in more detail below, our bond data do not contain such bond issues.

In the rest of this section, we will thus test the four implications from proposition 1 for the case where $B < B^*$ and $B < B^{**}$: (i) uncertainty increases stock valuation, (ii), the impact of uncertainty on the stock valuation is stronger if the firm's leverage is higher, (iii), uncertainty decreases bond valuation, (iv), the impact of uncertainty on the bond valuation is stronger if the firm's leverage it higher.

A. Data

The stock prices and accounting data are from CRSP and Compustat. We use all common stocks listed in the U.S. The variable definitions closely follow those in Pastor, Taylor and Veronesi (2009). Market value of equity equals the stock price at the end of the calendar quarter times the number of common stocks outstanding. Book value of equity follows Fama and French (1993) and equals stockholders' equity book value plus deferred taxes minus book value of preferred stock (the latter two are set at zero if missing).

We use the following firm-level controls. Stdev(Ret) is the standard deviation of daily firm returns in the previous 180 days, the same interval as in Campbell and Taksler (2003). ROE is return on equity and equals income before extraordinary items available for common stock plus deferred taxes, divided by the book value of equity. Std(ROE) equals the standard deviation of ROE based on the previous 12 quarters (if available, a minimum of 4 quarters is required). Assets measures the book value of total assets. Capex/Assets is the ratio of capital expenditures over the book value of total assets, set to zero if missing. Leverage is the ratio of the book value of long-term debt over total assets. R&D/Assets is the book value of research and development expenses over the book value of total assets, set to zero if missing. PPE/Assets equals property, plant and equipment book value divided by total assets. Dividend Paying is a dummy equal to one if the firm paid a cash dividend that period. We use quarterly observations, as Compustat data is updated in that frequency. We choose the sample period 1994-2006 to match with our corporate bond data.

Our corporate bond data come from the National Association of Insurance Commissioners (NAIC) transactions database. We match the NAIC database to the Fixed Investment Securities Database (FISD), CRSP and Compustat. The FISD database contains issue- and issuer-specific information such as the offering date, amount and whether the bond issue is enhanced, redeemable, putable or convertable. The NAIC database consists of all transactions by life insurance companies, property and casualty insurance companies, and Health Maintenance Organizations (HMOs).

For the sample that could be matched to FISD, CRSP and Compustat, we apply various data screens, largely similar to Campbell and Taksler (2003) with some notable exceptions. We only consider fixed-rate U.S. dollar bonds that are non-puttable, non-convertible and non-asset-backed. We also discard all bonds that are exchangeable, or pay-in-kind, that have a non-fixed coupon, that are subordinated, secured or guaranteed or are zero coupon bonds. Different from Campbell and Taksler (2003), we do not remove redeemable (or enhanced) bonds as this would remove over half of our sample and we want to make sure our bond sample is as representative as possible, while controlling for this feature in our regressions. Further, we only use issues whose average credit rating is between AA and BBB, using ratings from S&P and Moody's.[8]

Next, we create two samples of bond issues, one sample with longer maturity (5 years or more) and another sample with shorter maturity bonds (maturity of no more than 5 years but at least one year). For each bond sample and in order to reduce the effect of over-representation of very liquid bonds, we make quarterly observations by only recording for each issue the last available daily average credit spread of every quarter. Finally, we make sure that each firm-quarter combination is unique by choosing the issue with the largest offering amount if there are multiple issues per firm in a quarter for a given sample.

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[8] As Campbell and Taksler (2003) discuss, bond issues with AAA ratings appear problematic and are also removed by them, as they are by Elton et al. (2001). Non-investment grade issues are also eliminated, because insurance companies rarely purchase such issues, as they are often prohibited to do so. As a result, such transactions are unlikely to be representative of the overall bond market transactions for those issues.

For all bond trades in our sample, we calculate yields and credit spreads. The benchmark rate that is used to construct credit spreads is based on an interpolation of the yields of the two on-the-run government bonds bracketing the corporate bond with respect to duration. To avoid very small coefficients, we multiply the credit spreads by 100, such that all credit spreads are in percentage points.

The credit spread regressions have these additional firm- and issue-level controls relative to the market-to-book regressions. ROA is the return on assets, calculated as the ratio of net income over book value of total assets. Log Maturity is the logarithm of maturity in months and (Log Maturity)^2 is the square of Log Maturity. Log Offering Amount is the logarithm of the total notional amount sold. Enhanced is a dummy equal to one if there are any credit-enhancement features, and Redeemable is a dummy equal to one if the issue can be called back by the firm under some circumstance.[9]

To take the model to the data, one has to confront the difficulty in measuring uncertainty about the growth rate of profitability. Our strategy here is to adopt a number of proxies in the literature and be careful about the pros and cons of each measure. In our baseline regressions, following Pastor and Veronesi (2003), we adopt -Inv(1+Age), i.e., minus the inverse of 1 + Age, as our main proxy for uncertainty. Here, Age is the number of years since the firm first appears on CRSP. The motivation is that the uncertainty about a firm's profitability might be resolved and thus decrease over time as investors learn about the firm. This specific functional form is taken from their model with a simple Bayesian learning structure. As we will show, results remain similar if we repeat the analysis using log(1+Age) as the proxy for uncertainty.

It is important to note the drawbacks of the measures based on firm age. It clearly is not always the case that firms' uncertainty always decreases over time. One of the main reasons that we adopt his measure is to make it comparable to existing studies. Understanding the imperfection of these measures, however, we need to take it into account when interpreting our empirical results. Moreover, we also attempt to complement our baseline regressions by adopting a number of other proxies of uncertainty.

As the first set of two alternative measures for uncertainty, we use Erc(1)+ and Erc(2)-as proposed by Pastor, Taylor and Veronesi (2009). The idea is that if investors are uncertain about the firm's profitability, i.e., if they have flatter priors about future earnings, they would respond more strongly to earnings surprises. Erc(1)+ and Erc(2)- are essentially earnings response coefficients: Erc(1)+ is the average of the firm's previous 12 stock price reactions to quarterly earnings surprises, excluding negative values. Erc(2)- is minus the regression slope of the firm's last 12 quarterly earnings surprises on its abnormal stock returns around earnings announcements, excluding positive

[9] Results are robust to adding further controls, such as the age of the bond (i.e. time since the offering date), the square of the age of the bond, and stock returns. We also tried using or adding the square of -Inv(1+Age), which has a -85% correlation with -Inv(1+Age), but it is insignificant and does not change any results. The square of log(1+Age) has a correlation of 98% with log(1+Age) and adding it again does not change results, though causing multicollinearity concerns.

values. Although these two measures are intuitive, they are not ideal for our tests either, since they are 'contaminated' by the volatility of earnings. A higher volatility in profitability reduces these two uncertainty measures. Intuitively, if realized earnings are very noisy measures of the mean earnings growth rate, investors would respond less to earnings surprises, leading to lower values for Erc(1)+ and Erc(2)-.[10] That is, a higher value of these two measures means either high uncertainty or low volatility. Note that high uncertainty and low volatility have opposite impacts on the valuations of stocks and bonds. This means that these two measures are not ideal for our tests as any results may potentially be driven by not perfectly controlling for the volatility of earnings. With this concern in mind, we redo the analysis based on these two measures for comparison.

Next, we also adopt two measures of uncertainty from Korteweg and Polson (2008), who calibrate the Leland (1994) model to stock and bond prices to obtain the implied parameter uncertainty at the end of each year for 1994 to 2006. We use Sigma1 to denote the posterior standard deviation of firm's asset value, and Sigma2 to denote the posterior standard deviation of firm's asset volatility. Although Sigma1 and Sigma2 are not the same as the uncertainty of the long run profitability, they are likely to be positively correlated with it and hence may serve as useful proxies.

Our final uncertainty proxies are from the analyst forecast literature, see e.g. Diether, Malloy and Scherbina (2002) and Guntay and Hackbarth (2010), from the IBES database. Analyst Dispersion is the standard deviation across all IBES analyst of their next-quarter earnings-per-share forecast, normalized (i.e., divided) by the end-of-quarter stock price. Analyst Error is the difference between the median next-quarter earnings-per-share forecast and the actual earnings-per-share.

Table 1 presents descriptive statistics for the market-to-book (M/B) sample as well as the combined (longer and shorter maturity) credit spread sample. Means and standard deviations are given in Panel A, and pair-wise correlations of the prime variables of interest in Panel B. -Inv(1+Age) has a standard deviation of 0.036, Log(1+Age) of 0.62 and their pair-wise correlation with each other equals 94%. Both Erc(1)+ and Erc(2)- have a small but positive correlations with -Inv(1+Age) and Log(1+Age), i.e., those correlations have the 'wrong' sign since higher Erc(1)+ and Erc(2)- mean to reflect higher uncertainty while higher -Inv(1+Age) and Log(1+Age) mean to reflect low uncertainty. However, in unreported results of pooled panel regressions of either Erc(1)+ or Erc(2)- on -Inv(1+Age) plus controls, the coefficient of -Inv(1+Age) is indeed negative and statistically significant, with or without firm fixed effects, and similarly for Log(1+Age). In addition, the pair-wise correlation of Erc(1)+ and Erc(2)- equals 27%, which is very close to their correlation as reported in Pastor, Taylor and Veronesi (2009). Finally Sigma1 and Sigma2 are negatively correlated with the -Inv(1+Age) and Log(1+Age), i.e., these uncertainty measures have the 'right' correlation. Notably, the correlation between Sigma2 and the age-based measures is much weaker.

[10] See Pastor, Taylor and Veronesi (2009) for further discussions on these two measures.

B. Results

To test the first implication of our model, we regress log(M/B) on the measure of uncertainty in pooled panel regressions with standard firm-level controls, firm fixed effects and time fixed effects. The results are summarized in column 1 of Table 2A. The coefficient of the uncertainty proxy, -Inv(1+Age), is -2.71. The t-statistic based on robust standard errors clustered by firm is 5.03. This implies that firms with higher uncertainty (i.e., lower values of -Inv(1+Age)) tend to have higher market-to-book ratios, consistent with the evidence in Pastor and Veronesi (2003) that uncertainty increases stock valuations.

Next, we test the model's second implication by interacting the uncertainty measure with dummies indicating whether the firm has low or high leverage. Specifically, we create a dummy Low (High) Leverage which equals one if the firm's leverage is in the lowest (highest) quartile that quarter. As shown in column 2 of Table 2A, the association of uncertainty with stock valuation comes mainly from firms with low leverage: the coefficient for -Inv(1+Age) x Low Lev equals -1.10 (with a t-statistic of 3.02). On the other hand, the coefficient for -Inv(1+Age) x High Lev is 1.08 with a t-statistic of 3.10. As a result, relative to the group of high-leverage firms, the association between log(M/B) and the uncertainty proxy is about two times as strong for the group of low leverage firms. This evidence is inconsistent with the second implication that uncertainty should increase high leverage firms' valuation more strongly.

We also run the above regressions of log(M/B) on three subsamples, with the results presented in Table 3A. The first subsample is for technology firms (i.e., 48 Fama-French industry groups #35, #36 and #37). In this 'High-Tech' subsample, uncertainty also has a significant impact on stock valuations: The coefficient for -Inv(1+Age) equals -4.21 (t-statistic of 2.44). The second subsample is the full sample without the technology firms. While the coefficient for -Inv(1+Age) is clearly reduced at -2.23, its statistical significance is stronger (t-statistic of 3.99). The third and final subsample considered is a 'Credit-Spread' subsample, including only firms for which we have corporate bond data, and only using those quarters for which we have credit spreads data in our sample. In this subsample, however, the coefficient for -Inv(1+Age) is no longer significant and has the opposite sign (with a positive coefficient of 1.94 and a t-statistic of 0.77). Note that from Table 1, firms in this Credit-Spread subsample tend to have higher leverage, and that from Table 2A, the impact of uncertainty (as measured by firm age) decreases with leverage. Hence, it is not very surprising that the uncertainty impact disappears in this Credit-Spread subsample.[11]

Implication 3 suggests that high uncertainty leads to low bond prices and so high credit spreads. We test this implication by regressing credit spreads on the uncertainty proxies, with firm-level controls, firm fixed effects and time fixed effects. The results are reported in Table 4. The

[11] The lack of robustness of a negative association between –inv(1+Age) and both log(M/B) and M/B in the credit spread sample also suggests that firm age may not be a proxy for uncertainty per se, unless one would assume that firms that issue bonds have no cross-sectional or time series differences in uncertainty.

regressions are run on two samples. The first sample only uses bond issues with long maturity (at least 5 years). The second sample only uses bond issues with short maturity (at least 1 year but less than 5 years). For the long maturity sample, the coefficient for -Inv(1+Age) equals 9.35 (t-statistic of 2.44). This implies that younger firms, with presumably higher uncertainty, tend to have smaller credit spreads or higher bond prices, contradictory to implication 3. The results from the short maturity sample are almost the same: the coefficient for -Inv(1+Age) equals 9.76 (t-statistic of 2.24). The economic significance of the association between uncertainty and credit spreads is considerable. For example, a one standard deviation shock to -Inv(1+Age) is associated with a change in credit spreads of about 20 basis points (e.g., 9.76×0.02). For comparison, the average credit spread is 178 basis points.

Finally, we test implication 4 by interacting the uncertainty measure with the Low and High Leverage dummies. The results are reported in Table 5. For the long maturity sample, the coefficient for -Inv(1+Age) equals 9.89, (t-statistic of 2.54), and all the coefficients for the interaction terms are insignificant. The results for the short maturity sample are almost the same. While we do not report their coefficients, all specifications in Table 5 include all firm- and issue-level controls also included in Table 4, as well as firm and time fixed effects.

In summary, we test the uncertainty-convexity argument in Tables 2 through 5. Consistent with the existing evidence, our proxy for uncertainty increases stock valuations. However, contradictory to the uncertainty-convexity argument, we find this impact is stronger for firms with low leverage. Also contradictory to our extension of the Pastor and Veronesi learning about profitability model, we find that higher uncertainty leads to lower credit spreads and thus higher bond prices, rather than lower bond prices as predicted by the model.

C. Robustness

We redo our analysis and find our previous results are robust to the following specifications. First, instead of clustering standard errors by firm, we also cluster standard errors by both firm and time and the results remain the same. Second, instead of using the log of the market-to-book ratio as the stock valuation measure, we also obtain similar results (reported in Tables 2B and 3B) by using the market-to-book ratio directly. Third, we use Log(1+Age) as the proxy for uncertainty. Motivated by their learning model, Pastor and Veronesi (2003) propose the uncertainty measure -Inv(1+Age), and prefer it over the measure Log(1+Age). Nevertheless, as a robustness check we also redo the analysis using Log(1+Age) as the uncertainty measure. As shown in Tables 2A, 2B, 3A, 3B, 4 and 5, the main results remain the same. Moreover, the economic impact of uncertainty on credit spreads implied by the coefficient on Log(1+Age) are even larger than the economic impact using -Inv(1+Age). For example, a one standard deviation shock to Log(1+Age) is associated with a change in credit spreads of about 48 basis points (0.87×0.55).

An important exception is that the subsample analysis in Table 3B shows that the negative relationship between M/B and Log(1+Age) and between M/B and –Inv(1+Age) are both completely driven by the technology firms. For example, while the coefficient on Log(1+Age) in the M/B regressions equals -0.37 (t-statistic of 2.56) in the full sample in Table 2B, its coefficients is about five times larger (equal to -1.93 with a t-statistic of 3.63) in the sample of technology firms in Table 3B, and is insignificant (coefficient of -0.12 and a t-statistic of 0.88) in the sample without technology firms. Similarly, -Inv(1+Age) is insignificant in Table 3B after the technology firms (only about 13% of the sample) are taken out (coefficient of -0.40 with a t-statistic of 0.53). While the coefficient of both Log(1+Age) and -Inv(1+Age) remain significant in the subsample without technology firms using the log of M/B, combined with the insignificance in both log(M/B) and M/B regressions of both -Inv(1+Age) and Log(1+Age) in the subsample of firms with credit spreads, this raises serious robustness concerns for the basic Pastor and Veronesi (2003) results.[14]

One might suspect that the uncertainty impact in Pastor and Veronesi (2003) is mainly driven by very young firms, and that the firms in our Credit Spread subsample tend to be older. Hence, we examine the firm age distribution for our overall sample and the Credit Spread subsample. While firms issuing bond tend to be older, the firm age distributions for very young firms (where uncertainty may matter most) across these two samples are quite similar. Figure 1 plots the cumulative distribution function of firm age for our overall sample, and the Credit Spread subsample. It shows the age distributions for very young firms are similar across the subsamples: For our overall sample (labeled as M/B Sample in the plot), 12% of the observations are from firms that are five years old or younger; for the high (low) duration Credit Spread subsample, those firms contribute 11%(8%) of the observations.

Another related concern is that firms' capital structure choice is endogenous. To the extent that this choice is related to uncertainty, it might affect our regression results. For example, suppose firms with high uncertainty choose to issue less debt. This makes its corporate debt safer and so leads to lower credit spreads. Therefore, firms with high uncertainty may have low credit spreads as we observe in the tests for implication 3 (Table 4). Moreover, this also implies that firms with low leverage tend to be firms with high uncertainty, or that are younger. Hence, we may observe that low leverage firms have higher market-to-book ratios, as in our tests of implication 2 (Table 3). To

[14] Note that the correlation between Log(M/B) and M/B equals 74%. Another exception is that in Table 2A and 2B, the coefficients for Log(1+Age) x High Lev and Log(1+Age) x Low Lev are no longer significant. That is, leverage does not have a significant impact on the association between the stock valuation and uncertainty.

address the above concern, we run a panel regression of leverage on our uncertainty measure -Inv(1+Age), with firm fixed effects. It shows that firms with higher uncertainty (lower -Inv(1+Age)) tend to have higher leverage, which goes against the above concern on endogeneity.[15]

Due to different business environments, some industries are inherently more uncertain than others. Hence, a feasible conjecture is that the age-based measures may fail to capture the variation in uncertainty in our pooled panel regressions, and that those measures might be better at capturing uncertainty for those industries with high uncertainty in the first place. To examine this conjecture, we repeat our analysis on a subsample of firms in more uncertainty industries. We adopt three proxies for the uncertainty of industries: The industries with below median firm age, below median asset size, and above median stock return volatility are indentified as those with higher uncertainty. In general, there is no or opposite evidence for this conjecture and that results on the subsample of more uncertain industries are inconsistent with the model predictions either.[9]

D. Alternative Uncertainty Proxies

Given the difficulty and importance of measuring uncertainty, we also try to use other uncertainty proxies proposed in the literature. In particular, Pastor, Taylor and Veronesi (2009) propose two measures for uncertainty, labelled Erc(1)+ and Erc(2)-. However, as noted in Section III.A, these two proxies are also contaminated by volatility of the profitability. A higher volatility in profitability reduces these two uncertainty measures. That is, a higher value of these two measures means either high uncertainty or low volatility. Note that high uncertainty and low volatility have opposite impacts on the valuations of stocks and bonds. Therefore, these two measures are not ideal for our tests. With this concern in mind, we redo the analysis based on these two measures and report the results in Tables 6-9.

Overall, these two measures' impacts are often insignificant and have opposite signs. For example, in the first two columns of Table 6, the two uncertainty measures have insignificant impacts on the stock valuation measure log(M/B) with opposite signs. The results are the same if we restrict our sample to the High-Tech firms (Table 7). In the tests of implication 3 (Table 8), these two measures have insignificant impacts on credit spreads for all specifications except Erc(2)-, which has negative and marginally significant coefficient for the shorter maturity sample. However, the coefficient of Erc(2)- for the longer maturity sample is positive and insignificant. Similarly, these two measures are insignificant for all specifications in the regressions with the interactions of uncertainty and leverage (Table 9).

One possibility for the poor performance of Erc(1)+ and Erc(2)- is that both exhibit only limited time series variation. Both proxies are based on earnings announcement stock market reactions in the past 12 quarters, resulting by construction in large persistence. Indeed, using industry

[15] We acknowledge that this entails only a very preliminary analysis of endogeneity of leverage, which is a very difficult problem for which good instruments are lacking. The details of these results are omitted for brevity and to save space, and are available upon request.

rather than firm fixed effects (not reported) somewhat improves their results. While their coefficients remain insignificant for log(M/B), in particular Erc(2)- then has a negative and significant coefficient for both shorter and long maturity bonds, albeit only marginally significantly so in the latter.

Next, we adopt the measures of uncertainty from Korteweg and Polson (2008), who calibrate the Leland (1994) model to stock and bond prices to obtain the implied posterior standard deviation for the asset value and for asset value volatility (Sigma1 and Sigma2) at the end of each year during 1994 to 2006. We use these two measures as proxies for uncertainty since they are likely to be positively correlated with the uncertainty about the long run profitability. We combine these measures with our stock and bond prices and firm level controls to repeat our analysis.[16]

We run market-to-book regressions similar to those in Tables 2 and 3, using the two new uncertainty proxies Sigma1 and Sigma2. As shown in Table 10 for the market-to-book regressions, the coefficients of Sigma1 and Sigma2 are significantly positive. This is consistent with the first implication from our model that firms with higher uncertainty tend to have higher market-to-book ratios. Interestingly, as shown in Table 11, we also find that the stock valuation increases with these two uncertainty proxies in the credit spread subsample.[17] This is in contrast with the results based on firm age measures in Table 3, perhaps suggesting that these two measures from Korteweg and Polson (2008) are more effective at capturing uncertainty than the firm age-based measures. Moreover, as shown in Table 11, the coefficients for the interaction term of uncertainty and High Lev are significantly positive, consistent with the second implication that the uncertainty impact is stronger for firms with higher leverage.

However, our evidence from the bond markets is more mixed. As reported in Table 12, the association between these two proxies, Sigma1 and Sigma2, and corporate bond yields is insignificant if we include firm-fixed effects in our panel regressions. If one includes industry- rather than firm-fixed effects in the regressions, these two proxies become significant only for the sample of bonds with maturities over five years, but with opposite signs. In particular, the coefficient of Sigma1 is positive, consistent with the model implication that higher uncertainty leads to higher bond yield spreads, but the coefficient of Sigma2 is significantly negative. In unreported credit spread regressions, we also interact these two uncertainty proxies with leverage and the coefficients for the interaction terms are insignificant. Finally, since leverage might not be effective in capturing the default probability, we also repeat the analysis using "Better (Worse) Rating" dummies to replace the High (Low) Lev" dummies. The "Better (Worse) Rating" dummy equals one if the firm's credit rating is in the top (bottom) quartile in that year.[18] As shown in Table 13, the coefficients for

[16] As the posterior volatility measures are estimated using data over the whole calendar year, we employ annual observations in these regressions, as opposed to quarterly observations everywhere else in the paper.

[17] While both Sigma1 and Sigma2 are only calculated for firms with bonds that are included in the same NAIC database, Korteweg and Poulsen (2008) are considerably more inclusive in their data screens. This explains why the sample of all firms for which their proxies are available (Table 10) is considerably larger than the sample of all firms for which their proxies are available that also survives our bond data screens (Table 11).

[18] For the other uncertainty proxies, results using the leverage and rating dummies-interactions are typically quite similar.

"Sigma1 x Worse Rating" are significantly positive, consistent with the implications from our model. The coefficients for "Sigma2 x Worse Rating" are also significantly positive, although their magnitude is quite small relative to the coefficients for Sigma2.

Finally, we consider uncertainty proxies based on analyst forecast of quarterly earnings-per-share, Analyst Dispersion and Analyst Error. While both are proxies for the general information environment, it seems reasonable to expect that either would be increasing in uncertainty about the growth rate of future earnings. Indeed, Guntay and Hackbarth (2010) argue that Analyst Dispersion proxies for future cash flow uncertainty, and consistent with their interpretation and our model, find a positive association between Analyst Dispersion and credit spreads.

However, Table 14 shows that Analyst Dispersion is negatively related to Log(M/B) and M/B, while the coefficient of Analyst Error is insignificant. According to our model, this would be inconsistent with interpreting analyst disagreement (or analyst forecast errors) as proxies for the uncertainty of the earnings growth rate. Finally, in Panel A of Table 15 we can replicate the positive association between Analyst Dispersion and credit spreads documented in Guntay and Hackbarth (2010). We also find that Analyst Error has generally a positive and significant coefficient. However, the interactions in Panel B of Table 15 are consistently economically insignificant, and generally statistically insignificant as well.

In summary, among all the proxies, the implied posterior standard deviation for the asset value (Sigma1) appears most consistent with the model: A higher Sigma1 leads to higher stock valuation and lower bond valuation, especially with industry- rather than firm-fixed effects. There is also some evidence that these two effects are stronger for firms with higher leverage (or worse credit ratings).

IV. Conclusion

We have developed a simple valuation model for both stocks and bonds, where the firm's future earnings are a convex function of the growth rate of earnings. The model has four implications for firms that are not highly distressed. First, uncertainty about a firm's earning growth rate increases its stock price. Second, this impact is stronger for firms with higher leverage ratios. Third, higher uncertainty decreases the firm's bond price. Fourth, the impact on bond prices is stronger if the firm's leverage is higher. We first test these four implications using the measure for uncertainty originally proposed by Pastor and Veronesi (2003) based on firm age. Consistent with the existing evidence in the literature, our empirical results support the first implication. However, the other three implications are shown to be inconsistent with our empirical evidence. In particular, we find strong evidence that younger firms tend to have lower credit spreads. Therefore, an important contribution of our paper is to caution future researchers against using firm age as generally a good proxy for uncertainty about the firm's earnings growth rate.

Due to the drawbacks of the firm age based measure (particularly, its implication that uncertainty always goes down over time), we also adopt a number of alternative proxies for uncertainty used in the literature. However, the evidence based on these measures is generally inconsistent with each other.

Various interpretations of our results point to different directions for future research. For example, if one believes that the uncertainty-convexity idea is valid but uncertainty is poorly measured, it would be fruitful to search for better measures. This may also help to better understand what the firm age-based measure is capturing in the regressions. On the other hand, if one believes that it is optimism that pushes up the valuations for the stocks and bonds of younger firms, then it calls for attempts to measure optimism both across firms and over time, using more direct proxies for optimism than firm age. More importantly, this behavioral interpretation also has to face further challenges, for example to account for the observation that high valuations are often closely linked to high volatility and turnover.[20]

[20] See Hong and Stein (2009) for a summary of recent attempts based on disagreement and short sales constraints.

APPENDIX

A. Proof of Proposition 1

Define

$$\sigma^2 \equiv \sigma_u^2 + \sigma_\varepsilon^2. \tag{13}$$

Substituting (13) into (7) and differentiating S_0 with respect to σ, after some algebra, we obtain

$$\frac{\partial S_0}{\partial \sigma} = V_0 e^{\bar{u}+\frac{\sigma^2}{2}}\left(N(d_1)\sigma + n(d_1)\right) > 0, \tag{14}$$

which implies result 1: $\partial S_0 / \partial \sigma_u > 0$.

Differentiate (14) with respect to B and, after some algebra, we obtain result 2.

Substituting (6), (7) and (13) into (10), and differentiating D_0 with respect to σ, we obtain

$$\frac{\partial D_0}{\partial \sigma} = V_0 e^{\bar{u}+\frac{\sigma^2}{2}} f, \tag{15}$$

where

$$f \equiv \sigma - N(d_1)\sigma - n(d_1). \tag{16}$$

As a result, the sign of $\partial D_0 / \partial \sigma$ is the same as that of f. From (16), we obtain that

$$\lim_{B\to\infty} f = \sigma > 0, \tag{17}$$

$$\lim_{B\to 0} f = 0. \tag{18}$$

$$\frac{\partial f}{\partial B} = -n\left(d_1\right)\frac{\ln V_0 - \ln B + \bar{u}}{B\sigma^2}. \tag{19}$$

Therefore, we have

$$\partial f / \partial B < 0 \quad \text{if } B \in [0, B^*), \tag{20}$$

$$\partial f / \partial B > 0 \quad \text{if } B \in [B^*, \infty). \tag{21}$$

Equations (18) and (20) imply

$$f(B) < 0, \quad \text{if } B \in [0, B^*). \tag{22}$$

Since f is continuous and monotonically increasing in B if $B \in [B^*, \infty)$ (see (21)), together with equations (17) and (22), this implies that there exists a unique value $B^{**} \in [B^*, \infty)$, such that $f(B^*) = 0$, and $f < 0$ if $B < B^{**}$ and $f > 0$ if $B > B^{**}$. Hence, equation (15) implies that $\partial D_0 / \partial \sigma < 0$ if $B < B^{**}$ and $\partial D_0 / \partial \sigma > 0$ if $B > B^{**}$. Note that $f(B^*) = 0$ is equivalent to (12) , and that the sign of $\partial D_0 / \partial \sigma_u$ is the same as that of $\partial D_0 / \partial \sigma$. This proves result 3. Note also that the sign of $\frac{\partial^2 D_0}{\partial \sigma_u \partial B}$ is the same as that of $\partial f / \partial B$. Hence, equations (20) and (21) lead to result 4.

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Table 1. Descriptive Statistics

This table presents the descriptive statistics for both the sample for the M/B regressions and the Credit Spread regressions. Panel A reports the mean and standard deviations (Stdev) for both dependent variables and all relevant firm and bond issue level controls. Panel B reports the pair-wise correlations between M/B, Credit Spread, four uncertainty proxies and two volatility proxies. M/B is the market-to-book ratio. Log(1+Age) is the log of one plus firm age, -Inv(1+Age) is minus the reciprocal of one plus firm age. Erc(1)+ is the average of the firm's previous 12 stock price reactions to earnings surprises, excluding negative values. Erc(2)- is minus the regression slope of the firm's last 12 earnings surprises on its abnormal stock returns around earnings announcements, excluding positive values. Sigma1 and Sigma2 are the estimates of parameter uncertainty from Korteweg and Polson (2008). Sigma1 is the posterior standard deviation of a firm's asset value, and Sigma2 is the posterior standard deviation of a firm's asset value volatility. Analyst Dispersion is the standard deviation across all IBES analyst of their next-quarter earnings-per-share forecast, normalized (i.e., divided) by the end-of-quarter stock price. Analyst Error is the difference between the median next-quarter earnings-per-share forecast and the actual earnings-per-share. Log(Assets) is the log of the book value of assets in millions. ROE is return on equity. Capex is capital expenditures. Leverage is book value of long-term debt over book value of total assets. R&D/Assets is research and development expenditures. PPE is plant, property and equipment expenditures. Credit Spread is the difference between the yield on the (long maturity) bond in excess of the yield of a duration-matched Treasury bond. ROA is return on assets. Maturity is the bond issue's maturity in months. Enhanced is a dummy equal to 1 if the bond issue includes special features making the bond safer. Redeemable is a dummy equal to 1 if the bond issue is redeemable.

Panel A. Means and Standard Deviations

	Full Sample		*Credit Spread Sample*	
	Mean	Stdev	Mean	Stdev
MB	1.15535	1.756986	1.037006	1.27544
Log(1+Age)	3.116436	0.624015	3.552595	0.546936
-Inv(1+Age)	-0.05376	0.035513	-0.0335	0.020571
Erc(1) +	6.96622	5.520539	7.112371	5.605849
Erc(2) -	-0.06213	0.056133	-0.05245	0.051115
Sigma1	0.05150	0.01600	0.042721	0.008563
Sigma2	0.04744	0.08695	0.051764	0.015595
Analyst Dispersion	0.00175	0.00382		
Analyst Error	0.00160	0.76301		
Stdev(Ret)	0.026692	0.013611	0.020732	0.009263
Std(ROE)	0.086591	2.190707	0.048113	0.197091
Log(Assets)	6.898615	1.836477	8.870677	1.337479
ROE	0.02187	0.078108	0.033949	0.06621
Capex/Assets	0.038548	0.041716	0.034607	0.036592
Capex missing	0.013308	0.114593	0.019487	0.138237
Leverage	0.182192	0.155242	0.238748	0.128629
R&D/Assets	0.008526	0.021817	0.003917	0.009131
R&D missing	0.579324	0.493673	0.638949	0.480334
PPE/Assets	0.307448	0.227548	0.342085	0.235669
Dividend Paying	0.623693	0.484464	0.852094	0.355028
Credit Spread			0.017764	0.015675
ROA			0.011155	0.017415
Log Maturity			4.829621	0.570775
(Log Maturity)^2			23.65099	5.862269
Log Offering Amount			12.22142	1.055126
Enhanced			0.097212	0.296262
Redeemable			0.554358	0.497062

Panel B. Pair-wise Correlations

	M/B	Log(Age)	-Inv(1+Age)	Erc(1)+	Erc(2)-	Stdev(Ret)	Std(ROE)	Credit Spread	Sigma1	Sigma2	Analyst Disp.
Log(Age)	-0.0021	1									
-Inv(1+Age)	-0.0162	0.9447	1								
Erc(1)+	-0.085	-0.0392	-0.0082	1							
Erc(2)-	-0.0558	-0.0708	-0.0374	0.2702	1						
Stdev(Ret)	0.2003	-0.2087	-0.2067	-0.0069	0.0149	1					
Std(ROE)	0.3708	0.0068	-0.0258	-0.0685	-0.0349	0.0394	1				
Credit Spread	-0.0131	-0.1275	-0.1274	-0.01	0.0399	0.5476	0.0568	1			
Sigma1	0.1374	-0.0308	-0.0432	-0.0163	-0.0009	0.2525	-0.0196	-0.1554	1		
Sigma2	0.0082	0.0261	0.0132	-0.0102	-0.0175	0.0514	-0.0028	0.0035	0.2325	1	
Analyst Disp.	-0.0381	-0.0467	-0.0658	-0.0769	-0.0583	0.2835	0.0498	0.4228	-0.1024	0.0212	1
Analyst Error	0.0327	0.0089	0.0092	-0.0064	-0.0256	0.0557	0.0172	0.0593	-0.0122	0.0082	0.0415

Table 2A. Log(M/B) and Uncertainty

This table presents the results from pooled panel regressions of log(M/B) on proxies for uncertainty and firm-level controls. The data is quarterly from 1994-2006, and all specifications include time fixed effects and firm fixed effects. T-statistics based on robust standard errors clustered by firm are given between parentheses. Log(1+Age) is the log of one plus firm age. -Inv(1+Age) is minus the reciprocal of one plus firm age. 'Low (High) Lev' is a dummy equal to one if the firm's leverage is in the lowest (highest) 25% in the sample that year and 0 otherwise. For descriptions of the firm controls, see Table 1. N is the number of observations and R^2 is percentage of explained variation.

-Inv(1+Age) x Low Lev		-1.098		
		(-3.02)		
-Inv(1+Age)	-2.708	-2.487		
	(-5.03)	(-4.54)		
-Inv(1+Age) x High Lev		1.078		
		(3.10)		
Log(1+Age) x Low Lev				0.0179
				(1.77)
Log(1+Age)			-0.576	-0.584
			(-6.28)	(-6.35)
Log(1+Age) x High Lev				0.00422
				(0.57)
Stdev(Ret)	6.765	6.773	6.591	6.588
	(7.86)	(7.87)	(7.67)	(7.67)
Log(Assets)	0.0589	0.0603	0.0708	0.0713
	(2.32)	(2.38)	(2.77)	(2.79)
ROE	0.708	0.710	0.694	0.698
	(8.40)	(8.44)	(8.24)	(8.28)
Capex/Assets	3.469	3.472	3.439	3.435
	(19.44)	(19.58)	(19.21)	(19.21)
Capex missing	-0.486	-0.486	-0.485	-0.490
	(-4.56)	(-4.59)	(-4.52)	(-4.56)
Leverage	0.253	0.497	0.235	0.278
	(2.56)	(4.39)	(2.37)	(2.25)
R&D/Assets	2.265	2.256	2.259	2.261
	(5.74)	(5.74)	(5.73)	(5.73)
R&D missing	0.0639	0.0644	0.0628	0.0631
	(2.71)	(2.73)	(2.67)	(2.69)
PPE/Assets	-1.391	-1.343	-1.356	-1.335
	(-8.67)	(-8.36)	(-8.42)	(-8.30)
Dividend Paying	0.0460	0.0495	0.0501	0.0502
	(1.40)	(1.51)	(1.53)	(1.53)
N	225,233	225,233	225,233	225,233
R^2	66%	66%	66%	66%

Table 2B. M/B and Uncertainty

This table presents the results from pooled panel regressions of M/B on proxies for uncertainty and firm-level controls. The data is quarterly from 1994-2006, and all specifications include time fixed effects and firm fixed effects. T-statistics based on robust standard errors clustered by firm are given between parentheses. Log(1+Age) is the log of one plus firm age. -Inv(1+Age) is minus the reciprocal of one plus firm age. 'Low (High) Lev' is a dummy equal to one if the firm's leverage is in the lowest (highest) 25% in the sample that year and 0 otherwise. For descriptions of the firm controls, see Table 1. N is the number of observations and R^2 is percentage of explained variation.

-Inv(1+Age) x Low Lev		-1.126		
		(-1.70)		
-Inv(1+Age)	-1.575	-1.241		
	(-1.95)	(-1.51)		
-Inv(1+Age) x High Lev		0.582		
		(1.20)		
Log(1+Age) x Low Lev				0.0347
				(2.02)
Log(1+Age)			-0.370	-0.386
			(-2.56)	(-2.67)
Log(1+Age) x High Lev				0.0158
				(1.33)
Stdev(Ret)	16.26	16.27	16.13	16.12
	(11.99)	(12.01)	(11.91)	(11.91)
Log(Assets)	-0.0264	-0.0254	-0.0176	-0.0165
	(-0.55)	(-0.53)	(-0.37)	(-0.35)
ROE	1.315	1.317	1.305	1.311
	(6.95)	(6.96)	(6.91)	(6.94)
Capex/Assets	3.717	3.718	3.693	3.686
	(13.26)	(13.29)	(13.23)	(13.22)
Capex missing	-0.374	-0.375	-0.374	-0.384
	(-4.31)	(-4.34)	(-4.29)	(-4.40)
Leverage	0.966	1.147	0.953	0.986
	(5.40)	(5.36)	(5.32)	(4.75)
R&D/Assets	3.983	3.977	3.979	3.981
	(4.19)	(4.19)	(4.18)	(4.18)
R&D missing	0.0779	0.0782	0.0770	0.0775
	(2.28)	(2.29)	(2.26)	(2.28)
PPE/Assets	-1.493	-1.446	-1.466	-1.423
	(-5.71)	(-5.57)	(-5.59)	(-5.45)
Dividend Paying	-0.0249	-0.0220	-0.0216	-0.0212
	(-0.45)	(-0.40)	(-0.40)	(-0.39)
N	225,233	225,233	225,233	225,233
R^2	0.521	0.522	0.522	0.522

Table 3A. Log(M/B) and Uncertainty in Subsamples

This table presents the results from pooled panel regressions of log(M/B) on proxies for uncertainty and firm-level controls using subsamples. The first subsample only considers "High Tech Sample" firms (i.e., using 48 Fama-French industry groups #35, #36 and #37 only, or 329 firms). The second "Credit Spread Sample" uses only firms for which our credit spread sample contains data for that same quarter (667 firms). The data is quarterly from 1994-2006, and all specifications include time fixed effects and firm fixed effects. T-statistics based on robust standard errors clustered by firm are given between parentheses. Log(1+Age) is the log of one plus firm age. -Inv(1+Age) is minus the reciprocal of one plus firm age. For descriptions of the firm controls, see Table 1. The other controls included but now shown to save space are ROE, Capex/Assets, Capex missing, Log(Assets), R&D/Assets, R&D missing, PPE/Assets, and Dividend Paying. N is the number of observations and R^2 is percentage of explained variation.

	High-Tech Sample firms only				Without High-Tech Sample firms				Credit Spread Sample firms only			
-Inv(1+Age) x Low Lev		-0.960				-0.958				-1.020		
		(-1.23)				(-2.40)				(-0.93)		
-Inv(1+Age)	-4.213	-3.992			-2.233	-2.170			1.944	1.908		
	(-2.44)	(-2.36)			(-3.99)	(-3.83)			(0.77)	(0.77)		
-Inv(1+Age) x High Lev		0.525				1.131				1.164		
		(0.57)				(3.07)				(1.07)		
Log(1+Age) x Low Lev				0.0155				0.0185				-0.0119
				(0.50)				(1.81)				(-1.14)
Log(1+Age)			-1.226	-1.239			-0.443	-0.449			0.140	0.188
			(-5.21)	(-5.24)			(-4.60)	(-4.65)			(0.57)	(0.80)
Log(1+Age) x High Lev				0.0208				-0.0007				0.0243
				(0.99)				(-0.08)				(2.15)
Stdev(Ret)	3.956	3.956	3.811	3.844	6.571	6.560	6.435	6.427	11.62	11.27	11.61	11.52
	(1.91)	(1.91)	(1.84)	(1.86)	(6.97)	(6.96)	(6.83)	(6.83)	(3.56)	(3.73)	(3.55)	(3.81)
Leverage	0.763	0.938	0.768	0.660	0.202	0.436	0.187	0.268	0.202	0.449	0.204	-0.0250
	(3.05)	(3.01)	(3.13)	(1.96)	(1.91)	(3.61)	(1.77)	(2.04)	(0.90)	(1.75)	(0.92)	(-0.09)
N	28,641	28,641	28,641	28,641	196,592	196,592	196,592	196,592	34,571	37,166	34,571	37,166
Other Controls Included	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
R^2	63%	64%	64%	64%	65%	65%	65%	65%	72%	72%	72%	72%

Table 3B. M/B and Uncertainty in Subsamples

This table presents the results from pooled panel regressions of M/B on proxies for uncertainty and firm-level controls using subsamples. The first subsample only considers "High Tech Sample" firms (i.e., using 48 Fama-French industry groups #35, #36 and #37 only, or 329 firms). The second "Credit Spread Sample" uses only firms for which our credit spread sample contains data for that same quarter (667 firms). The data is quarterly from 1994-2006, and all specifications include time fixed effects and firm fixed effects. T-statistics based on robust standard errors clustered by firm are given between parentheses. Log(1+Age) is the log of one plus firm age. -Inv(1+Age) is minus the reciprocal of one plus firm age. For descriptions of the firm controls, see Table 1. The other controls included but now shown to save space are ROE, Capex/Assets, Capex missing, Log(Assets), R&D/Assets, R&D missing, PPE/Assets, and Dividend Paying. N is the number of observations and R^2 is percentage of explained variation.

	High-Tech Sample firms only				Without High-Tech Sample firms				Credit Spread Sample firms only			
-Inv(1+Age) x Low Lev		-1.370				-0.845				-6.236		
		(-0.70)				(-1.25)				(-2.99)		
-Inv(1+Age)	-6.756	-6.449			-0.395	-0.233			-0.0346	-0.936		
	(-2.12)	(-2.09)			(-0.53)	(-0.30)			(-0.01)	(-0.22)		
-Inv(1+Age) x High Lev		0.906				0.547				1.858		
		(0.49)				(1.18)				(1.07)		
Log(1+Age) x Low Lev				0.00287				0.0350				0.00832
				(0.04)				(2.19)				(0.42)
Log(1+Age)			-1.925	-1.927			-0.120	-0.134			-0.279	-0.310
			(-3.63)	(-3.62)			(-0.88)	(-0.97)			(-0.62)	(-0.72)
Log(1+Age) x High Lev				0.00139				0.0135				0.0404
				(0.03)				(1.12)				(1.83)
Stdev(Ret)	19.80	19.79	19.55	19.56	14.48	14.47	14.42	14.39	20.99	21.25	20.87	21.77
	(4.78)	(4.79)	(4.72)	(4.72)	(10.54)	(10.53)	(10.51)	(10.50)	(5.04)	(5.18)	(5.03)	(5.26)
Leverage	2.198	2.476	2.206	2.205	0.843	0.991	0.837	0.890	1.180	1.762	1.169	0.902
	(3.75)	(3.30)	(3.80)	(2.85)	(4.59)	(4.56)	(4.56)	(4.18)	(2.52)	(3.16)	(2.51)	(1.66)
N	28,641	28,641	28,641	28,641	196,592	196,592	196,592	196,592	34,571	37,166	34,571	37,166
Other Controls Included	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
R^2	54%	54%	54%	54%	49%	49%	49%	49%	57%	59%	57%	59%

Table 4. Credit Spreads and Uncertainty

This table presents the results from pooled panel regressions of credit spreads on proxies for uncertainty and firm-level and bond issue-level controls, using two samples. The first sample only uses bond issues with maturity of at least 5 years. The second sample only uses bond issues with maturity of at least 1 year and less than 5 years. The data is quarterly from 1994-2006, and all specifications include time fixed effects and firm fixed effects. T-statistics based on robust standard errors clustered by firm are given between parentheses. The uncertainty proxies are Log(1+Age) and -Inv(1+Age). Also included but not reported to save space are the following controls: ROE, Stdev(ROE), Log(Assets), Capex Missing, Log Offering Amount, and Enhanced dummy. For descriptions of the uncertainty proxies and the firm and bond issue-level controls, see Table 1. N is the number of observations and R^2 is percentage of explained variation.

	Maturity over 60 months		*Maturity between 12 and 60 months*	
-Inv(1+Age)	9.35		9.76	
	(2.44)		(2.24)	
Log(1+Age)		0.88		0.87
		(2.67)		(2.31)
Stdev(Ret)	53.60	53.69	94.58	94.63
	(12.40)	(12.42)	(9.10)	(9.11)
Log Market Cap	-0.43	-0.44	-0.63	-0.63
	(12.70)	(12.76)	(9.71)	(9.70)
Leverage	0.38	0.40	0.60	0.62
	(1.37)	(1.44)	(1.56)	(1.59)
ROA	-4.17	-4.15	-5.19	-5.17
	(4.92)	(4.90)	(2.98)	(2.97)
Capex/Assets	-0.17	-0.20	0.73	0.70
	(0.54)	(0.61)	(0.86)	(0.82)
R&D/Assets	-2.36	-2.63	-5.90	-6.17
	(1.32)	(1.48)	(2.45)	(2.59)
R&D missing	-0.11	-0.12	-0.11	-0.12
	(4.15)	(4.31)	(2.54)	(2.76)
PPE/Assets	-0.58	-0.60	-1.12	-1.14
	(1.56)	(1.62)	(1.91)	(1.94)
Dividend Paying	-0.22	-0.22	-0.12	-0.12
	(2.39)	(2.45)	(0.60)	(0.61)
Log Maturity	0.47	0.48	0.20	0.20
	(1.64)	(1.64)	(0.27)	(0.27)
(Log Maturity)^2	-0.03	-0.03	-0.02	-0.02
	(0.91)	(0.92)	(0.18)	(0.18)
Redeemable	0.19	0.19	0.21	0.22
	(3.57)	(3.56)	(3.01)	(3.04)
N	11,584	11,584	8,182	8,182
R^2	69%	69%	65%	65%

Table 5. Credit Spreads and Uncertainty Interacted with Leverage

This table presents the results from pooled panel regressions of credit spreads on proxies for uncertainty and firm-level and bond issue-level controls, using two samples. The first sample only uses bond issues with maturity of at least 5 years. The second sample only uses bond issues with maturity of at least 1 year and less than 5 years. The data is quarterly from 1994-2006, and all specifications include time fixed effects and firm fixed effects. T-statistics based on robust standard errors clustered by firm are given between parentheses. The uncertainty proxies, Log(1+Age) and -Inv(1+Age), are interacted 'Low (High) Lev,' a dummy equal to one if the firm's leverage is in the lowest (highest) 25% in the sample that year and 0 otherwise. All specifications also include all of the firm and issue-level controls in Tables 4. For descriptions of the uncertainty proxies and the firm and bond issue-level controls, see Table 1. N is the number of observations and R^2 is percentage of explained variation.

	Maturity over 60 months		*Maturity between 12 and 60 months*	
-Inv(1+Age) x Low Lev	-2.58		-2.65	
	(1.78)		(1.34)	
-Inv(1+Age)	9.89		10.67	
	(2.54)		(2.33)	
-Inv(1+Age) x High Lev	-0.05		-0.06	
	(0.04)		(0.03)	
Log(1+Age) x Low Lev		0.02		0.04
		(1.42)		(2.10)
Log(1+Age)		0.88		0.89
		(2.67)		(2.36)
Log(1+Age) x High Lev		0.01		0.01
		(0.36)		(0.55)
N	11,584	11,584	8,182	8,182
R^2	69%	69%	65%	65%

Table 6. log(M/B), M/B and Erc

This table presents the results from pooled panel regressions of log(M/B) (first two columns) and M/B (last two columns) on proxies for uncertainty and firm-level controls, using the alternative uncertainty proxies Erc(1)+ and Erc(2)-. Erc(1)+ is the average of the firm's previous 12 stock price reactions to earnings surprises, excluding negative values, and Erc(2)- is minus the regression slope of the firm's last 12 earnings surprises on its abnormal stock returns around earnings announcements, excluding positive values. The data is quarterly from 1994-2006, and all specifications include time fixed effects and firm fixed effects. T-statistics based on robust standard errors clustered by firm are given between parentheses. For descriptions of the firm controls, see Table 1. N is the number of observations and R^2 is percentage of explained variation.

Dependent:	*Log(M/B)*		*M/B*	
Erc(1)+	0.04		-0.55	
	(0.25)		(2.24)	
Erc(2)-		-0.43		-1.23
		(1.72)		(2.96)
Stdev(Ret)	12.26	13.71	20.63	22.74
	(9.96)	(10.66)	(10.60)	(11.25)
Std(ROE)	0.00	0.00	0.01	0.01
	(1.15)	(0.96)	(0.97)	(0.60)
Log(Assets)	-0.02	-0.06	-0.07	-0.16
	(0.64)	(1.65)	(1.03)	(2.18)
ROE	0.83	0.77	2.74	2.78
	(8.75)	(8.14)	(10.45)	(10.47)
Capex/Assets	3.31	3.14	3.43	3.33
	(16.13)	(15.73)	(11.43)	(10.56)
Capex missing	-0.35	-0.29	-0.28	-0.20
	(4.37)	(3.91)	(2.59)	(2.36)
Leverage	0.21	0.22	0.88	1.02
	(1.82)	(1.90)	(4.34)	(4.70)
R&D/Assets	2.04	2.12	4.41	4.18
	(3.39)	(3.27)	(3.01)	(2.41)
R&D missing	0.05	0.06	0.09	0.09
	(1.94)	(2.06)	(2.20)	(1.93)
PPE/Assets	-1.32	-1.26	-1.51	-1.25
	(6.88)	(6.04)	(5.01)	(3.56)
Dividend Paying	0.04	0.07	-0.05	0.04
	(0.94)	(1.69)	(0.68)	(0.55)
N	43,032	42,755	43,032	42,755
R^2	70%	71%	57%	58%

Table 7. log(M/B), M/B and Erc for High-Tech Firms

This table presents the results from pooled panel regressions of M/B (first two columns) and log(M/B) (last two columns) on proxies for uncertainty and firm-level controls, using the alternative uncertainty proxies Erc(1)+ and Erc(2)-, using only "High Tech Sample" firms (i.e., using 48 Fama-French industry groups #35, #36 and #37 only). Erc(1)+ is the average of the firm's previous 12 stock price reactions to earnings surprises, excluding negative values, and Erc(2)- is minus the regression slope of the firm's last 12 earnings surprises on its abnormal stock returns around earnings announcements, excluding positive values. The data is quarterly from 1994-2006, and all specifications include time fixed effects and firm fixed effects. T-statistics based on robust standard errors clustered by firm are given between parentheses. For descriptions of the firm controls, see Table 1. N is the number of observations and R^2 is percentage of explained variation.

Dependent:	*Log(M/B), High-Tech Firms*		*M/B, High-Tech Firms*	
Erc(1)+	0.97		0.89	
	(2.02)		(0.88)	
Erc(2)-		-0.81		-3.19
		(1.01)		(1.77)
Stdev(Ret)	11.44	14.23	27.90	33.38
	(4.26)	(5.22)	(5.24)	(5.93)
Std(ROE)	0.17	0.10	0.29	0.21
	(8.75)	(3.39)	(4.57)	(2.65)
Log(Assets)	-0.06	-0.03	-0.21	-0.26
	(0.81)	(0.43)	(1.09)	(1.26)
ROE	0.60	0.68	3.46	4.02
	(3.34)	(4.15)	(5.59)	(6.28)
Capex/Assets	3.41	2.57	6.61	5.81
	(5.11)	(4.03)	(4.60)	(4.14)
Capex missing	-0.49	-0.41	-1.89	-1.67
	(0.98)	(1.47)	(1.33)	(1.83)
Leverage	0.80	0.89	2.25	2.33
	(2.92)	(3.12)	(3.36)	(3.45)
R&D/Assets	1.22	1.42	3.37	4.68
	(2.44)	(1.94)	(2.55)	(2.14)
R&D missing	0.14	0.17	0.21	0.29
	(1.48)	(1.79)	(1.35)	(1.75)
PPE/Assets	-3.00	-2.61	-4.59	-4.37
	(6.16)	(4.94)	(4.58)	(3.70)
Dividend Paying	0.17	0.18	0.16	0.12
	(1.58)	(1.62)	(0.56)	(0.39)
N	5,476	5,273	5,476	5,273
R^2	70%	71%	61%	62%

Table 8. Credit Spreads and Erc

This table presents the results from pooled panel regressions of credit spreads on proxies for uncertainty and firm-level and bond issue-level controls, using two samples. The first sample only uses bond issues with maturity of at least 5 years. The second sample only uses bond issues with maturity of at least 1 year and less than 5 years. The data is quarterly from 1994-2006, and all specifications include time fixed effects and firm fixed effects. T-statistics based on robust standard errors clustered by firm are given between parentheses. The alternative uncertainty proxies are Erc(1)+, the average of the firm's previous 12 stock price reactions to earnings surprises, excluding negative values, and Erc(2)-, minus the regression slope of the firm's last 12 earnings surprises on its abnormal stock returns around earnings announcements, excluding positive values. Also included but not reported to save space are the following controls: ROE, Stdev(ROE), Log(Assets), Capex Missing, Log Offering Amount, Log Maturity^2 and Enhanced dummy. For descriptions of the uncertainty proxies and the firm and bond issue-level controls, see Table 1. N is the number of observations and R^2 is percentage of explained variation.

	Maturity over 60 months				*Maturity between 12 and 60 months*			
Erc(1)+	-0.52	0.25			-0.43	0.23		
	(1.40)	(0.76)			(0.77)	(0.35)		
Erc(2)-			-1.74	-1.07			-1.15	0.16
			(3.33)	(1.92)			(1.83)	(0.23)
Stdev(Ret)	73.93	57.80	67.87	49.85	105.52	94.91	97.80	80.27
	(14.77)	(12.36)	(16.81)	(13.28)	(10.55)	(7.06)	(12.79)	(7.73)
Log Market Cap	-0.45	-0.44	-0.43	-0.41	-0.52	-0.59	-0.57	-0.57
	(12.37)	(11.61)	(12.85)	(11.34)	(10.54)	(8.29)	(9.61)	(8.22)
Leverage	1.03	0.25	1.15	0.17	0.85	0.55	0.89	0.29
	(3.79)	(0.72)	(4.28)	(0.53)	(2.69)	(1.16)	(2.70)	(0.67)
ROA	-5.07	-4.54	-5.41	-4.52	-5.49	-3.11	-5.45	-4.67
	(3.71)	(3.77)	(4.95)	(4.94)	(3.60)	(2.10)	(3.99)	(3.73)
Capex/Assets	-1.10	0.09	-1.74	0.06	-1.24	1.46	-2.03	1.31
	(2.02)	(0.22)	(3.40)	(0.18)	(1.06)	(1.25)	(2.12)	(1.45)
R&D	-1.13	-1.82	-2.55	-1.83	-5.27	-8.20	-4.94	-5.62
	(0.46)	(0.83)	(1.09)	(1.05)	(1.67)	(2.59)	(1.71)	(2.35)
R&D missing	-0.04	-0.11	0.00	-0.11	-0.09	-0.13	-0.03	-0.11
	(0.96)	(3.87)	(0.12)	(3.74)	(1.66)	(2.48)	(0.47)	(2.25)
PPE/Assets	-0.31	-0.44	0.06	-0.34	-0.10	-0.88	0.20	-0.69
	(1.39)	(0.91)	(0.33)	(1.08)	(0.33)	(1.18)	(0.71)	(1.72)
Dividend Paying	-0.22	-0.19	-0.28	-0.20	-0.24	-0.05	-0.27	-0.12
	(2.65)	(1.65)	(3.41)	(1.69)	(1.72)	(0.19)	(1.94)	(0.50)
Log Maturity	0.37	0.63	0.26	0.67	1.65	1.08	1.00	0.59
	(1.05)	(2.17)	(0.74)	(1.99)	(1.92)	(1.31)	(1.23)	(0.77)
Redeemable	0.26	0.18	0.22	0.19	0.27	0.23	0.27	0.19
	(4.47)	(3.47)	(4.06)	(3.27)	(3.49)	(2.89)	(3.90)	(2.90)
Firm F.E.	No	Yes	No	Yes	No	Yes	No	Yes
48 Industry F.E.	Yes	No	Yes	No	Yes	No	Yes	No
N	8,767	8,767	9,649	9,649	6,220	6,220	6,804	6,804
R^2	52%	68%	54%	70%	52%	63%	53%	66%

Table 9. Credit Spreads and Erc Interacted with Leverage

This table presents the results from pooled panel regressions of credit spreads on proxies for uncertainty and firm-level and bond issue-level controls, using two samples. The first sample only uses bond issues with maturity of at least 5 years. The second sample only uses bond issues with maturity of at least 1 year and less than 5 years. The data is quarterly from 1994-2006, and all specifications include time fixed effects and firm- or industry-fixed effects. T-statistics based on robust standard errors clustered by firm are given between parentheses. The uncertainty proxies, Erc(1)+ and Erc(2)-, are interacted 'Low (High) Lev,' a dummy equal to one if the firm's leverage is in the lowest (highest) 25% in the sample that year and 0 otherwise. The alternative uncertainty proxies are Erc(1)+, the average of the firm's previous 12 stock price reactions to earnings surprises, excluding negative values, and Erc(2)-, minus the regression slope of the firm's last 12 earnings surprises on its abnormal stock returns around earnings announcements, excluding positive values. All specifications also include all of the firm and issue-level controls in Tables 4. For descriptions of the uncertainty proxies and the firm and bond issue-level controls, see Table 1. N is the number of observations and R^2 is percentage of explained variation.

	Maturity over 60 months				*Maturity between 12 and 60 months*			
Erc(1)+ x Low Lev	0.01	0.005			0.01	0.01		
	(1.51)	(0.87)			(1.83)	(1.13)		
Erc(1)+	-0.63	0.17			-0.77	-0.07		
	(1.41)	(0.43)			(1.19)	(0.09)		
Erc(1)+ x High Lev	-0.01	0.00			0.00	0.00		
	(0.69)	(0.27)			(0.05)	(0.34)		
Erc(2)- x Low Lev			0.31	0.23			-0.84	-0.52
			(0.43)	(0.31)			(0.88)	(0.60)
Erc(2)-			-1.62	-0.97			-0.82	0.51
			(2.80)	(1.70)			(1.22)	(0.75)
Erc(2)- x High Lev			-0.76	-0.57			-0.35	-0.92
			(0.84)	(0.69)			(0.29)	(0.66)
Firm F.E.	No	Yes	No	Yes	No	Yes	No	Yes
48 Industry F.E.	Yes	No	Yes	No	Yes	No	Yes	No
N	11,584	11,584	11,584	11,584	8,182	8,182	8,182	8,182
R^2	54%	69%	54%	69%	55%	65%	55%	65%

Table 10. log(M/B), M/B and Sigma

This table presents the results from pooled panel regressions of log(M/B) (first two columns) and M/B (last two columns) on proxies for uncertainty and firm-level controls, using the alternative uncertainty proxies Sigma1 and Sigma2, which are defined in Table 1. The uncertainty proxies, Sigma1 and Sigma2, are interacted 'Low (High) Lev,' a dummy equal to one if the firm's leverage is in the lowest (highest) 25% in the sample that year and 0 otherwise. The data is annual from 1994-2006, and all specifications include time fixed effects and firm fixed effects. T-statistics based on robust standard errors clustered by firm are given between parentheses. All specifications also include all of the firm and issue-level controls in Tables 2. For descriptions of the firm controls, see Table 1. N is the number of observations and R^2 is percentage of explained variation.

Dependent	Log(M/B)				M/B			
Sigma1 x Low Lev		0.03				3.25		
		(0.02)				(0.72)		
Sigma1	6.13	6.27			8.51	8.84		
	(4.95)	(4.76)			(2.44)	(2.46)		
Sigma1 x High Lev		-0.43				-1.29		
		(0.42)				(0.51)		
Sigma2 x Low Lev				-0.42				1.52
				(0.17)				(0.37)
Sigma2			8.06	8.39			5.51	5.70
			(3.89)	(4.06)			(2.92)	(2.61)
Sigma2 x High Lev				-1.07				-0.56
				(0.85)				(0.28)
N	2,611	2,611	2,651	2,651	2,611	2,611	2,651	2,651
R^2	79%	79%	79%	79%	69%	69%	69%	69%

Table 11. log(M/B) and M/B and Sigma in Credit Spread Sample

This table presents the results from pooled panel regressions of log (M/B) and M/B on Sigma1 and Sigma2 and firm-level controls using the "Credit Spread Sample" which uses only firms for which our credit spread sample contains data for that same quarter. The data is annual from 1994-2006, and all specifications include time fixed effects and firm fixed effects. T-statistics based on robust standard errors clustered by firm are given between parentheses. All specifications also include all of the firm and issue-level controls in Tables 3. For descriptions of the firm controls, see Table 1. N is the number of observations and R^2 is percentage of explained variation.

Dependent	log(M/B)				M/B			
Sigma1 x Low Lev		-0.06				6.03		
		(0.06)				(2.10)		
Sigma1	5.37	5.02			12.45	9.91		
	(3.82)	(3.54)			(2.95)	(2.56)		
Sigma1 x High Lev		1.84				3.30		
		(1.59)				(1.11)		
Sigma2 x Low Lev				-0.11				3.82
				(0.08)				(1.95)
Sigma2			7.46	7.16			5.47	3.82
			(3.47)	(3.45)			(2.59)	(1.78)
Sigma2 x High Lev				2.69				2.50
				(1.77)				(1.08)
N	1,629	1,629	1,663	1,662	1,629	1,629	1,663	1,662
R^2	81%	81%	80%	80%	69%	70%	69%	69%

Table 12. Credit Spreads and Sigma

This table presents the results from pooled panel regressions of credit spreads on proxies for uncertainty and firm-level and bond issue-level controls, using two samples. The first sample only uses bond issues with maturity of at least 5 years. The second sample only uses bond issues with maturity of at least 1 year and less than 5 years. The data is annual from 1994-2006, and all specifications include time fixed effects and firm- or industry-fixed effects. T-statistics based on robust standard errors clustered by firm are given between parentheses. The alternative uncertainty proxies are Sigma1 and Sigma2, which are defined in Table 1. All specifications also include all of the firm and issue-level controls in Tables 4. For descriptions of the uncertainty proxies and the firm and bond issue-level controls, see Table 1. N is the number of observations and R^2 is percentage of explained variation.

	Maturity over 60 months				Maturity between 12 and 60 months			
Sigma1	8.74	2.37			-3.19	-8.62		
	(1.92)	(0.56)			(0.41)	(1.09)		
Sigma2			-450.85	33.32			-585.49	-28.76
			(1.94)	(0.14)			(1.61)	(0.08)
Firm F.E.	No	Yes	No	Yes	No	Yes	No	Yes
48 Industry F.E.	Yes	No	Yes	No	Yes	No	Yes	No
N	1,299	1,299	1,320	1,320	902	902	916	916
R^2	60%	78%	60%	78%	62%	81%	62%	81%

Table 13. Credit Spreads and Sigma Interacted with Ratings

This table presents the results from pooled panel regressions of credit spreads on proxies for uncertainty and firm-level and bond issue-level controls, using two samples. The first sample only uses bond issues with maturity of at least 5 years. The second sample only uses bond issues with maturity of at least 1 year and less than 5 years. The data is quarterly from 1994-2006, and all specifications include time fixed effects and firm- or industry-fixed effects. T-statistics based on robust standard errors clustered by firm are given between parentheses. The uncertainty proxies, Sigma1 and Sigma2, are interacted with 'Better (Worse) Rating,' a dummy equal to one if the firm's credit rating is in the top (bottom) quartile in each year. The uncertainty proxies, Sigma1 and Sigma2, are defined in Table 1. All specifications also include all of the firm and issue-level controls in Tables 4. For descriptions of the uncertainty proxies and the firm and bond issue-level controls, see Table 1. N is the number of observations and R^2 is percentage of explained variation.

	Maturity over 60 months				*Maturity between 12 and 60 months*			
Sigma1 x Better Rating			-3.54	-2.39			-5.16	-8.39
			(2.44)	(1.09)			(2.28)	(2.75)
Sigma1			-5.39	-3.24			-15.21	-9.55
			(1.13)	(0.75)			(1.98)	(1.23)
Sigma1 x Worse Rating			18.77	13.74			16.8	7.14
			(9.18)	(5.2)			(2.17)	(5.64)
Sigma2 x Better Rating	-0.83	-0.99			-1.12	-5.27		
	(0.71)	(0.59)			(0.6)	(2.24)		
Sigma2	-788.78	-251.62			-794.89	95.88		
	(3.25)	(1.07)			(2.03)	(0.24)		
Sigma2 x Worse Rating	13.15	9.78			11.83	3.94		
	(7.99)	(4.52)			(4.8)	(1.33)		
Firm F.E.	No	Yes	No	Yes	No	Yes	No	Yes
48 Industry F.E.	Yes	No	Yes	No	Yes	No	Yes	No
N	1,320	1,320	1,299	1,299	916	916	902	902
R^2	63%	79%	65%	79%	64%	81%	65%	81%

Table 14. log(M/B), M/B and Analyst Uncertainty

This table presents the results from pooled panel regressions of log(M/B) (first two columns) and M/B (last two columns) on proxies for uncertainty and firm-level controls, using the alternative uncertainty proxies Analyst Dispersion and Analyst Error, which are defined in Table 1. The uncertainty proxies, Analyst Dispersion and Analyst Error, are interacted 'Low (High) Lev,' a dummy equal to one if the firm's leverage is in the lowest (highest) 25% in the sample that year and 0 otherwise. The data is annual from 1994-2006, and all specifications include time fixed effects and firm fixed effects. T-statistics based on robust standard errors clustered by firm are given between parentheses. All specifications also include all of the firm and issue-level controls in Tables 2. For descriptions of the firm controls, see Table 1. N is the number of observations and R^2 is percentage of explained variation.

Dependent	Log(M/B)				M/B			
Analyst Dispersion x Low Lev		-2.279				-21.12		
		(-0.47)				(-2.19)		
Analyst Dispersion	-46.60	-50.45			-57.03	-60.32		
	(-20.67)	(-15.23)			(-14.24)	(-10.37)		
Analyst Dispersion x High Lev		11.65				21.15		
		(2.72)				(3.05)		
Analyst Error x Low Lev				-0.0232				-0.00257
				(-1.88)				(-0.13)
Analyst Error			-0.00542	0.000554			0.00248	0.00535
			(-1.14)	(0.09)			(0.34)	(0.58)
Analyst Error x High Lev				-0.00272				-0.00762
				(-0.25)				(-0.50)
N	160,254	160,254	194,909	194,909	160,254	160,254	194,909	194,909
R^2	71%	71%	69%	69%	59%	59%	56%	56%

Table 15. Credit Spreads and Analyst Uncertainty

This table presents the results from pooled panel regressions of credit spreads on proxies for uncertainty and firm-level and bond issue-level controls, using two samples. The first sample only uses bond issues with maturity of at least 5 years. The second sample only uses bond issues with maturity of at least 1 year and less than 5 years. The data is annual from 1994-2006, and all specifications include time fixed effects and firm- or industry-fixed effects. T-statistics based on robust standard errors clustered by firm are given between parentheses. The alternative uncertainty proxies are Analyst Dispersion and Analyst Error, which are defined in Table 1. All specifications also include all of the firm and issue-level controls in Tables 4. For descriptions of the uncertainty proxies and the firm and bond issue-level controls, see Table 1. N is the number of observations and R^2 is percentage of explained variation.

Panel A.	*Maturity over 60 months*				*Maturity between 12 and 60 months*			
Analyst Dispersion	189.77	106.09			160.72	107.41		
	(6.55)	(4.44)			(10.49)	(7.22)		
Analyst Error			0.158	0.0965			0.0793	0.0356
			(3.29)	(2.16)			(2.67)	(1.47)
Firm F.E.	No	Yes	No	Yes	No	Yes	No	Yes
48 Industry F.E.	Yes	No	Yes	No	Yes	No	Yes	No
N	21,189	21,189	21,738	21,738	29,582	29,582	30,500	30,500
R^2	55%	65%	55%	66%	56%	70%	54%	69%

Panel B.	*Maturity over 60 months*				*Maturity between 12 and 60 months*			
Analyst Dispersion x Low Lev	-0.7879	-0.6812			-0.0251	-0.1558		
	(-1.09)	(-1.65)			(-0.63)	(-0.38)		
Analyst Dispersion	213.98	116.61			148.97	95.21		
	(4.94)	(3.59)			(7.32)	(4.42)		
Analyst Dispersion x High Lev	-0.2394	0.0255			0.3676	0.3679		
	(-0.52)	(0.06)			(1.23)	(1.18)		
Analyst Error x Low Lev			0.0768	0.0217			-0.153	-0.137
			(0.50)	(0.22)			(-2.01)	(-2.15)
Analyst Error			0.157	0.106			0.129	0.0802
			(2.10)	(1.41)			(3.21)	(2.34)
Analyst Error x High Lev			-0.0252	-0.0309			-0.0596	-0.0546
			(-0.24)	(-0.29)			(-0.96)	(-1.01)
Firm F.E.	No	Yes	No	Yes	No	Yes	No	Yes
48 Industry F.E.	Yes	No	Yes	No	Yes	No	Yes	No
N	21,189	21,189	21,738	21,738	29,582	29,582	30,500	30,500
R^2	0.552	0.654	0.545	0.664	0.560	0.695	0.539	0.692

Figure 1. Firm Age Distribution

This figure plots the cumulative distribution function of firm age for our samples. M/B Sample is our full sample, "CS Sample, High Dur" is our credit Spread Sample of bonds with a maturity of 12 to 60 months, "CS Sample, Low Dur" is our credit Spread Sample of bonds with a maturity of less than 12 months.