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Uncertainty, Major Investments, and Capital Structure Dynamics

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ABSTRACT

This study examines the effects of uncertainty on firms' capital structure dynamics. We find that high-uncertainty firms have substantially lower target leverage while those firms' leverage adjustment speeds increase only if they are over-levered. We show that when facing large investment needs, over-levered firms with high uncertainty converge to their targets substantially faster to avoid bankruptcy whereas those with low uncertainty tend to deviate from their targets due to the transitory debt financing of the investments, thereby reconciling two opposing leverage dynamics documented in the literature. On the other hand, under-levered firms with high uncertainty converge to their targets more slowly than those with low uncertainty due to the increased value of the option to wait and see. Further investigation of the leverage adjustment behavior of over- and under-levered firms in relation to uncertainty provides evidence that bankruptcy threat, agency costs, and real option channels account for various aspects of leverage dynamics.

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Uncertainty affects various aspects of firms' business activities. A rich body of literature has shown that uncertainty has material effects on firms' decision-making—particularly on their investment decisions. Emphasizing the existence of market frictions such as capital irreversibility, financial constraints, and fixed costs, early studies in this line centered around the question, "How does uncertainty affect corporate investment?" For example, Bernanke (1983), using a Bayesian learning framework, shows that uncertainty related to investment increases the value of real options to the firm, causing it to wait for additional information to invest. This real option insight for explaining the relation between a firm's investment decision and uncertainty has been further explored and buttressed to produce a multitude of subsequent studies proposing other probable causes of the effect of uncertainty on corporate investment.[1] The asset pricing literature also has a long tradition of asking how stock-return volatility, a commonly used uncertainty measure, is related to stock returns at both aggregate and individual firm levels.[2]

On the financing side, however, the effects of uncertainty on a firm's capital structure rebalancing behavior have been little explored, although a large number of studies following the seminal work by Modigliani and Miller (1958) have endeavored to grasp firms' financing behaviors in different contexts and frameworks. Given that uncertainty affects firms' business activities including major investments and financing decisions both directly and indirectly, the relative scarcity of research on this subject is quite puzzling.[3]

In so far as the value of debt and capital structure are interrelated and to the extent that uncertainty affects firms' investment and financing decisions, a careful examination of the effect of uncertainty on capital structure dynamics will contribute to a better understanding of a firm's financing behavior in a dynamic context and its implications for firm value.

The purpose of this paper is to investigate how a firm responds to the uncertainty it is faced with so as to optimize its capital structure decisions. Specifically, we address the following issues:

(i) how uncertainty affects a firm's target capital structure;[4]

(ii) whether uncertainty increases a firm's leverage adjustment speed; and

(iii) in the presence of major investment, how uncertainty affects leverage adjustment speed.

[1]See, for example, Abel and Eberly (1994, 1996), Bertola and Caballero (1994), Bloom (2000), Bloom (2009), Veracierto (2002), and Bloom, Bond, and Van Reenen (2007) for subsequent studies in this vein.

[2]See, among numerous others, Black (1978), Christie (1982), McDonald and Siegel (1985), French, Schwert, and Stambaugh (1987), Campbell and Hantschel (1992), Duffee (1995), Campbell, Lettau, Malkiel, and Xu (2001), Ang, Hodrick, Xing, and Zhang (2006, 2009), and Grullon, Lyandres, and Zhdanov (2012) for studies in this area.

[3]As a few exceptions, see Frank and Goyal (2009), who test whether stock-return volatility affects firms' leverage ratios, although stock-return volatility is not confirmed to be significant. Kale, Noe, and Ramírez (1991) examine the effect of business risk on corporate capital structure. Colak, Flannery, and Öztekin (2014) find that political uncertainty raises financial intermediation costs, and slows down firms' adjustments toward their optimal capital structure.

[4]The underlying rationale for the existence of target leverage is provided by the dynamic trade-off theory. As long as markets are frictionless, firms would have no reason to deviate from their target leverage. The theory postulates, however, that firms attain their target debt levels as firms trade-off tax benefits of debt financing against financial distress costs, which often include default-related agency costs in a broadly interpreted framework.

In an effort to capture all relevant uncertainty factors using a single measure, we follow the approach proposed by Leahy and Whited (1996) to use the standard deviation of daily stock returns for individual firms to examine the effects of uncertainty on firms' leverage decisions. Past literature has well documented the benefits of using stock return volatility as a proxy to capture uncertainty facing a firm. In so far as asset returns, particularly stock returns, reflect the prospect of firms' future business environment reasonably well, we expect the impact of different sources of uncertainty to be adequately incorporated into the returns. We can, therefore, consider stock return volatility a forward-looking measure of uncertainty that correctly weighs the relative impact of different sources of uncertainty on the firm value.[5] Also, it has been shown that firm-level stock return volatility is significantly correlated with a variety of alternative uncertainty proxies, thereby lending credence to its use as a comprehensive uncertainty measure (e.g. Bloom, Bond, and Van Reenen (2007)).[6]

By incorporating uncertainty into leverage dynamics, our study offers substantially different and richer interpretations of firms' dynamic capital structure decisions than have been documented in the existing literature. First, we find that uncertainty has a strong negative effect on firms' target leverage levels. The coefficient estimates of uncertainty on target leverage are all significantly negative in the various model specifications tested. A further investigation of the underlying mechanisms suggests that uncertainty increases potential financial distress costs and exacerbates shareholder–debtholder conflicts, thereby leading to a lower optimal leverage ratio.

Second, the effect of uncertainty on leverage adjustment speeds depends on whether a firm is over-levered or under-levered. In particular, uncertainty increases firms' adjustment speeds significantly only when firms are over-levered. This might arise from the fact that an over-levered firm facing higher uncertainty has greater adjustment benefits, lower adjustment costs, or both. We test two possible mechanisms linking uncertainty and leverage adjustment speeds, finding that an over-levered firm with higher uncertainty enjoys greater adjustment benefits as well as lower adjustment costs incurred by bond retirement.

Finally, the effect of uncertainty on financing behavior at the time of investment shocks also depends on whether the firm is over-levered or under-levered. Our findings suggest that over-levered firms voluntarily deviate from leverage targets during investment spikes when faced with low uncertainty, whereas they adjust leverage toward targets even faster when faced with high uncertainty. Under-levered firms, on the other hand, converge to the targets regardless of their leverage standing, though the adjustment speed for high-uncertainty firms is faster.

We identify two possible mechanisms that might contribute to this finding. First, uncertainty creates a higher value of the option to wait and see, leading to a delayed investment decision in

[5]Another attractive feature of using a stock-return-based measure of uncertainty is that the data are reported at sufficiently high frequencies.

[6]The proxies in their study include sale growth volatility and within-year variability of analysts' earnings forecasts. Bond, Moessner, Mumtaz, and Syed (2005) also report similar results.

a high uncertainty situation (Bloom, Bond, and Van Reenen , 2007). This is particularly the case for over-levered firms. Second, a firm tends to rely mostly on debt to finance its major investment opportunities (Mayer and Sussman, 2005; Bond, Klemm, and Marinescue, 2006; DeAngelo, DeAngelo, and Whited, 2011), so an over-levered firm will seize the opportunity and issue debt to finance the investment project when given a major investment opportunity as long as the benefits of doing so are expected to outweigh the costs, which may well be the case when the firm is faced with a relatively low level of uncertainty. Faced with major investment shocks, an under-levered firm is more likely to take the opportunities with debt financing because issuing debt is cost-efficient given the relatively low sunk adjustment costs in this case (Faulkender, Flannery, Hankins, and Smith, 2012), and an under-levered firm faces a lower level of default risk compared with its over-levered counterpart.

It is noteworthy that existing studies fail to reach a consensus on firms' leverage adjustment behavior around major investments. Elsas, Flannery, and Garfinkel (2014), for instance, find that firms tend to move toward the estimated leverage target faster when they have major investments whereas in DeAngelo, DeAngelo, and Whited (2011) firms purposefully but temporarily move away from permanent leverage targets by issuing transitory debt to fund large investments. Our study reconciles the two seemingly contradictory findings by incorporating the effects of uncertainty on the capital structure dynamics, especially for over-levered firms. If a major investment relies mostly on debt financing, over-levered firms will deviate from targets when uncertainty is low whereas they will converge to leverage much faster when uncertainty is high.

To address the potential endogeneity problem arising from the reverse causality, we employ a difference-in-differences (DiD) approach using two large exogenous uncertainty shocks during our sample period, namely the Dot-com Bubble Crash and the Global Financial Crisis.[7] We find that large increases in uncertainty induced by those exogenous shocks lowered the target leverage ratios of treatment firms—more so than for control firms. In addition, the exogenous shocks accelerated the speed of leverage adjustment for over-levered firms.

[Insert Figure 1 Here]

Our paper contributes to the dynamic capital structure literature in three ways. First, this paper proposes firm-level uncertainty as a new significant determinant of target capital structure. In the dynamic trade-off framework, leverage targets are driven by several forces such as debt tax shields, potential financial distress costs, and agency benefits and costs related to debt (Harris and Raviv, 1991; Fama and French, 2002; Frank and Goyal, 2009). Most of the empirical dynamic capital structure studies such as Fama and French (2002), Flannery and Rangan (2006), Antoniou, Gunny, and Paudyal (2008) model target leverage as a linear function of firm fixed effects as

[7]Figure 1 demonstrates that the Dot-com Bubble Crash and the Global Financial Crisis, in fact, increased market-wide uncertainty substantially.

well as a set of firm characteristics such as firm size, profitability, asset tangibility, investment opportunities, and R&D intensity. To the best of our knowledge, our study is the first in the literature to propose firm-level uncertainty as an important determinant of target leverage. We find that uncertainty lowers target or optimal leverage ratios by increasing potential financial distress costs and exacerbating shareholder–debtholder conflicts (e.g. underinvestment and risk-shifting problems). Furthermore, we show that the uncertainty effect on leverage targets is greater than the effects of firm size, market-to-book, asset tangibility, R&D intensity, and industry median leverage, making uncertainty the most important determinant among all time-varying determinants of market leverage targets.

Second, this paper is also the first to show that firm-level uncertainty is a major determinant of the capital structure adjustment speed. Fischer, Heinkel, and Zechner (1989) and Hovakiminan, Opler, and Titman (2001), among others, show that the adjustment speed is determined by the costs of being off the target as well as the costs of adjusting toward the target. In this spirit, a series of empirical studies have investigated how quickly firms converge to their leverage targets (Fama and French, 2002; Leary and Roberts, 2005; Flannery and Rangan, 2006; Huang and Ritter, 2009; Frank and Goyal, 2009) and recent literature has shown that the speed of leverage adjustment is influenced by various forces including macroeconomic factors (Cook and Tang, 2010), the gap between cash flows and investment opportunities (Faulkender, Flannery, Hankins, and Smith, 2012), and institutional differences across countries (Öztekin and Flannery, 2012). We show that over-levered firms' adjustment speeds significantly increase with uncertainty, while under-levered firm's adjustment speeds are not affected by uncertainty. Furthermore, we show that over-levered firms facing higher uncertainty enjoy greater adjustment benefits (i.e., avoidance of bankruptcy threats), while facing lower adjustment costs (i.e., bond retirement costs).

Finally, we add to the literature on the real effects of uncertainty by linking uncertainty, major investments (or investment spikes), and capital structure dynamics. Unlike routine investment periods in which adjustment benefits and costs solely determine adjustment speeds, they are no longer the main driving forces when a firm is given major investment opportunities. Whether the firm grabs the investment opportunities (the investment channel) and how investment spikes are funded (the financing channel) will have a material effect on the capital structure adjustment speed. Although it is well documented that investment spikes are largely funded by debt and firms tend to repay debt in the subsequent periods (Mayer and Sussman, 2005; DeAngelo, DeAngelo, and Whited, 2011; Elsas, Flannery, and Garfinkel, 2014; Im, Mayer, and Sussman, 2016), it is unclear whether the adjustment speed is positive or negative around investment spikes. Note that Elsas, Flannery, and Garfinkel (2014) find evidence for an even higher adjustment speed, while DeAngelo, DeAngelo, and Whited (2011) document purposeful deviations from leverage targets, suggesting a negative speed of leverage adjustment. By incorporating uncertainty into the firm's dynamic capital structure decisions, our analysis nests and reconciles conflicting results documented in past studies of firms' financing behavior around major investments. Our findings demonstrate that both the temporary deviations from the target leverage in DeAngelo, DeAngelo, and Whited (2011) and the opposite tendency in Elsas, Flannery, and Garfinkel (2014) can be comfortably accommodated in our empirical specification, thereby offering deeper insight into the factors underlying a firm's dynamic capital structure decision. Furthermore, we show that firms with higher uncertainty tend to invest more cautiously given investment opportunities (Bernanke, 1983; Bloom, Bond, and Van Reenen, 2007; Bloom, 2009), and to use less debt than the firms with lower uncertainty, providing evidence supporting both investment and financing channels.

The remainder of the paper is organized as follows. In Section I, we first derive predictions about the effects of uncertainty on capital structure dynamics based on the existing literature on capital structure dynamics, uncertainty and investment dynamics, and corporate financing around major investments. We then present our empirical framework. Section II describes the sample, measurement of variables, and descriptive statistics. In Section III, we present our main results. In Section IV, we examine mechanisms through which uncertainty affects firms' target-setting and adjustment behaviors. Section V concludes.

I. Theoretical Predictions and Empirical Framework

A. Theoretical Predictions

In the dynamic trade-off model, leverage targets are driven by several forces such as debt tax shields, potential financial distress costs, and agency benefits and costs related to debt (Harris and Raviv, 1991; Fama and French, 2002; Frank and Goyal, 2009). According to Fischer, Heinkel, and Zechner (1989) and Hovakimian, Opler, and Titman (2001), adjustment speeds are determined by the costs of being off the target determined by the marginal benefits and costs of leverage as well as adjustment costs. In this section, we analyze existing literature on the determinants of leverage targets and adjustment speeds, the effects of uncertainty on various variables of interests such as investment, financing constraints, profitability, and financing modes, and derive testable predictions on the effects of uncertainty on leverage targets and adjustment speeds.

A.1. Effects of Uncertainty on Leverage Targets

Uncertainty affects target leverage ratios through four channels: debt tax shields, potential financial distress costs, the agency benefits of debt, and the agency costs of debt. First, the effects of uncertainty on target leverage ratios through debt tax shields can be positive or negative depending on the magnitude of two conflicting effects. The *positive* effect is concerned with non-debt tax shields (DeAngelo and Masulis, 1980). A firm faced with higher uncertainty is less likely to benefit from non-debt tax shields arising from lower R&D expenditures and depreciation expenses due to the reduction in capital expenditures, as is evidenced by Bloom, Bond, and Van Reenen (2007) and Gulen and Ion (2016). Non-debt tax shields do not directly influence leverage level, but the reduction in non-debt tax shields implies a lower chance of having no taxable income. Thus, a high-uncertainty firm has a smaller chance of having no taxable income, and consequently its expected tax rate will be higher, and its expected payoff from interest tax shields will be higher given the amount of debt. Therefore, the effects of uncertainty on target leverage ratios through debt tax shields can be positive. The *negative* effect is related to the effect of uncertainty on the magnitude and volatility of earnings. A high-uncertainty firm is more likely to have lower and more volatile earnings. As a result, it is expected to have a higher chance of having no taxable income, and consequently its expected tax rate will be lower and its expected payoff from interest tax shields will be lower. Thus, the effects of uncertainty on target leverage ratios through debt tax shields can be negative.

Second, the effects of uncertainty on target leverage ratios through potential financial distress costs are expected to be *negative*. A firm faced with higher uncertainty tends to have higher expected bankruptcy costs because it is likely to have a higher probability of bankruptcy and face higher indirect bankruptcy costs given bankruptcy. A high-uncertainty firm is likely to be less profitable and have more volatile earnings. Consequently, the probability of bankruptcy increases. When uncertainty is higher, those indirect costs are likely to be higher, in that suppliers may withdraw trade credits, customers may turn to competitors, and even some key employees may leave firms.[8] Thus, *ceteris paribus*, uncertainty is positively associated with bankruptcy costs, and consequently has a negative effect on target leverage ratios.

Third, the effects of uncertainty on target leverage through the agency benefits of debt can be either *positive* or *negative*. In the agency models of Jensen and Meckling (1976), Easterbrook (1984), Jensen (1986), and Stulz (1990), the interests of managers are not aligned with those of shareholders, and managers tend to waste free cash flows on perquisites such as corporate jets, plush offices, and building empires, as well as on bad investments. Jensen (1986) shows that agency costs increase with free cash flows. However, debt may reduce the free cash flow agency problem by ensuring that managers are disciplined, make efficient investment decisions, and do not pursue private benefits as this increases bankruptcy risk (Jensen, 1986; Stulz, 1990).

The direction of the effect of uncertainty on target leverage through agency benefits arising from the disciplining role of debt depends on the composition of a firm's earnings from the assets it has in place and the size of its profitable investments among its free cash flow, given that a firm's free cash flow is defined as its earnings from assets in place less the size of its profitable investments (Jensen, 1986). Given profitability from assets in place, a firm with more future investment opportunities has a lower sensitivity of investment to Tobin's Q when it is faced with a

[8] The indirect costs of financial distress—identified as reduction in valuable capital expenditures, losses of key customers and losses of important suppliers etc.—are known to be much bigger than the direct costs of financial distress (Andrade and Kaplan, 1998).

high level of uncertainty. A high-uncertainty firm has a higher value of the real option to wait and see, and thus it is more likely to choose to delay investment and save cash in the current period (Bloom, Bond, and Van Reenen, 2007; Gulen and Ion, 2016). This leads to a higher level of free cash flow and the firm will face more severe agency problems, as Jensen (1986) and Stulz (1990) predict. Thus, a high-uncertainty firm will get more benefits from the disciplinary role of debt, leading to a *higher* optimal leverage ratio. However, a firm with more profitable assets in place, given profitable investment opportunities, has lower profitability from assets in place when it is faced with high uncertainty. This leads to lower free cash flows and the agency problems between managers and shareholders get less severe. Thus, the value of debt as a disciplining device gets lower, leading to a *lower* optimal leverage ratio.

Finally, the effects of uncertainty on target leverage through shareholder–debtholder agency problems are predicted to be *negative*. Those agency problems such as asset substitution and underinvestment problems arise when shareholders' interests are not aligned with debtholders' interests (Fama and Miller, 1972; Jensen and Meckling, 1976; Myers, 1977). A high-uncertainty firm, compared with a low-uncertainty firm, is likely to face more severe underinvestment and asset substitution problems, because high uncertainty will make both assets in place and investment projects riskier. As a result, its debt will become riskier. Therefore, a high-uncertainty firm has a stronger incentive to control shareholder–debtholder conflicts, and will have a lower optimal leverage ratio.

To sum up, although the effects of uncertainty on target leverage ratios through potential financial distress costs and shareholder–debtholder agency conflicts are expected to be *negative*, the effects through debt tax shields and agency benefits of debt can be either *positive* or *negative*. Therefore, whether uncertainty will increase or decrease target leverage ratios is an empirical question. Although the magnitude of total effects may not be very large if one force offsets another, understanding which forces are working more strongly than other sheds light on how uncertainty influences a firm's capital structure dynamics. Figure 2 depicts the hypothetical relationship between leverage, benefits and costs of leverage, and firm value according to the level of uncertainty. This figure is based on the most likely scenario: *i)* tax benefits linearly increase with leverage and marginal tax benefits are minimally smaller for high-uncertainty firms; *ii)* leverage level and costs of leverage have a convex relation and marginal costs of leverage are higher for high-uncertainty firms.[9] Under this scenario, a firm with higher uncertainty is likely to have a lower target leverage ratio. In Section IV.A, we further investigate the mechanisms through which uncertainty affects leverage targets.

[Insert Figure 2 Here]

[9]The value of an unlevered firm could be negatively affected by uncertainty, because a high-uncertainty firm may delay its investments even when its leverage ratio is zero. However, the inclusion of this effect does not affect the target leverage ratios of either a high- or a low-uncertainty firm.

A.2. Effects of Uncertainty on Adjustment Speeds

Recent studies such as Fama and French (2002), Leary and Roberts (2005), Flannery and Rangan (2006), Huang and Ritter (2009), and Frank and Goyal (2009) have investigated how quickly firms converge to their leverage targets. While Welch (2004) is the obvious exception, almost all research in this arena concludes that firms do have targets, but that the speed with which these targets are reached is unexpectedly slow. This has motivated the literature to search for the sources of adjustment costs. For example, Fischer, Heinkel, and Zechner (1989) argue that firms will adjust leverage only if the benefits of doing so exceed the costs of reducing the firm's deviation from target leverage. Altınkılıç and Hansen (2000) present estimates of security issuance costs. Korajczyk and Levy (2003), Strebulaev (2007), and Shivdasani and Stefanescu (2010) have modeled the impact of transaction costs on observed leverage patterns. Leary and Roberts (2005) derive optimal leverage adjustments when transaction costs have fixed or variable components. Cook and Tang (2010) investigate the impact of several macroeconomic factors on the speed of capital structure adjustment toward target leverage ratios, and find evidence that firms adjust their leverage toward target faster in good macroeconomic states relative to bad states. Faulkender, Flannery, Hankins, and Smith (2012) investigate the role played by adjustment costs in firms' adjusting back toward their leverage targets and find higher adjustment speed when adjustment costs are sunk relative to when these costs are incremental. Öztekin and Flannery (2012) investigate whether institutional differences help explain the variance in estimated adjustment speeds by comparing firms' capital structure adjustments across countries, finding that institutional features relate to adjustment speeds, consistent with the hypothesis that better institutions lower the transaction costs associated with adjusting a firm's leverage.

Despite the substantial literature developed in the field of capital structure, little attention has been paid to the impact of uncertainty on capital structure adjustment speeds. Marginal adjustment benefits and costs are likely to be significantly affected by the level of uncertainty that a firm faces, and the effects of uncertainty on marginal adjustment benefits and costs are likely to be fundamentally different between over-levered and under-levered firms. In particular, relevant adjustment methods are likely to be different depending on whether firms are over-levered or under-levered, and thus the effects of uncertainty on marginal adjustment costs are also likely to be different.

On the one hand, uncertainty might have differential effects on marginal adjustment benefits between over-levered and under-levered firms, because the costs related to financial distress and agency conflicts between debtholders and shareholders will dominate for over-levered firms, and debt tax shields and the agency benefits arising from the disciplining role of debt will dominate for under-levered firms. First, consider over-levered firms. The costs related to potential financial distress, asset substitution and underinvestment problems are likely to increase faster when they face higher levels of uncertainty. Thus, the marginal benefits arising from the reduction of excess leverage are likely to be higher when they face higher levels of uncertainty.[10] Now consider under-levered firms. The marginal benefits arising from the convergence toward target leverage are not likely to be affected by the level of uncertainty. Although it is possible to develop some arguments supporting differential marginal benefits, the difference in marginal benefits according to uncertainty may not be economically significant.

Figure 3 depicts the hypothetical relationship between uncertainty and the marginal benefits of leverage adjustment. An over-levered (under-levered) firm facing high uncertainty will have a firm-value increase of $e-g$ ($h-j$) when the firm fully closes the deviation of d, while an over-levered firm facing low uncertainty will have a firm-value increase of $e-f$ ($h-i$) when the firm fully closes the deviation of d. Thus, the difference in (average) adjustment benefits between high- and low-uncertainty firms should be greater when firms are over-levered ($f-g$) than when firms are under-levered ($i-j$). Precisely speaking, marginal adjustment benefits are equal to the slopes of each curve evaluated at d.

[Insert Figure 3 Here]

On the other hand, marginal adjustment costs are also likely to be affected by uncertainty. First, consider over-levered firms. They adjust their leverage toward targets by issuing new shares or repaying debt. Altınkılıç and Hansen (2000) show that uncertainty has a significantly positive impact on the cost of equity issuance. Thus, equity issuance costs will be higher if uncertainty is higher. The costs of retiring public debt are mostly related to illiquid secondary debt markets that trade the firms' public debts (Chen, Lesmond, and Wei, 2007). Higher uncertainty may increase the volatility of noise trading and in turn bond liquidity, lowering the costs of retiring bonds. The costs of retiring privately placed debt include penalties, renegotiation costs, and other fees during the retirement process (Leary and Roberts, 2005). It is possible that debtholders of high-uncertainty firms would welcome early repayment of debt, thus lowering renegotiation costs. Therefore, in the cases of both public and private debts, high-uncertainty firms are likely to face lower debt retirement costs. Overall, over-levered firms facing high uncertainty will have higher marginal adjustment costs if the adjustment involves equity issuance, but lower marginal adjustment costs if it involves debt retirement.

Now consider under-levered firms. They adjust their leverage toward targets by raising debt capital or repurchasing shares. As their leverage ratios are below their optimal leverage ratios, uncertainty may not affect the costs of raising debt significantly. If anything, uncertainty will increase the costs of raising debt to some extent. The costs of repurchasing shares, however, are largely related to the illiquidity of shares. Higher uncertainty may increase the volatility of

[10]The relationship between leverage and bankruptcy costs is convex, and thus with high bankruptcy costs, firms tend to rely more on internal financing or switch to more equity financing to significantly reduce their chances of default (Aysun and Honig, 2011).

noise trading in the stock market, lowering stock liquidity and the costs of repurchasing shares. Overall, under-levered firms facing high uncertainty will face higher marginal adjustment costs if the adjustment involves debt issuance, but face lower marginal adjustment costs if it involves share repurchasing. However, the effect of uncertainty in this case is likely to be quite small.

To sum up, although it is likely that the marginal adjustment benefits of over-levered firms increase with uncertainty and those of under-levered firms do not vary with uncertainty, the effects of uncertainty on marginal adjustment costs depend on whether firms are over-levered and what adjustment methods are used. Thus, whether over-levered firms or under-levered firms facing high uncertainty adjust their leverage toward their targets significantly faster than their low-uncertainty counterparts is an open question, although we expect that the effects of uncertainty on marginal adjustment benefits are greater than the effects on marginal adjustment costs. In Section IV.B, we further investigate the mechanisms through which uncertainty affects capital structure adjustment speeds.

A.3. Effects of Uncertainty on Adjustment Speeds During Major Investments

Corporate financing behavior for large investment opportunities has recently attracted researchers' attention for two reasons. First, episodes of major investment provide valuable opportunities to gain insights into the firms' capital structure decision because major investments entail external financing most of the time as opposed to retained-earnings-dependent financing patterns for routine, replacement investments (Mayer and Sussman, 2005). Second, the heavy reliance of major investments on external financing is likely to reveal managers' attitude toward leverage and firms' capital structure adjustment dynamics more prominently (DeAngelo, DeAngelo, and Whited, 2011; Elsas, Flannery, and Garfinkel, 2014). Interestingly, two recent studies (i.e., DeAngelo, DeAngelo, and Whited (2011) and Elsas, Flannery, and Garfinkel (2014)) offer somewhat contrary results regarding firms' leverage decisions around major investments. Elsas, Flannery, and Garfinkel (2014) find that firms tend to move toward the estimated leverage target faster when they have major investments, whereas in DeAngelo, DeAngelo, and Whited (2011) firms purposefully but temporarily move away from permanent leverage targets by issuing transitory debt to fund large investments.

In normal periods, the trade-off of adjustment benefits and costs will determine adjustment speeds as discussed in Section I.B. However, if a firm is faced with major investment opportunities, adjustment benefits and costs are no longer the main driving forces. Whether the firm grabs the investment opportunities and how investment spikes are funded will have drastic effects on capital structure dynamics. Although it is well documented that investment spikes are largely funded by debt and firms tend to repay debt in the subsequent period (Mayer and Sussman, 2005; DeAngelo, DeAngelo, and Whited, 2011; Elsas, Flannery, and Garfinkel, 2014; Im, Mayer, and Sussman, 2016), it is unclear whether the speed of adjustment is positive or negative around investment spikes. Note that Elsas, Flannery, and Garfinkel (2014) find evidence for an even higher speed of leverage adjustment, while DeAngelo, DeAngelo, and Whited (2011) find evidence for an intentional deviation from the target, meaning a negative speed of leverage adjustment. If investment spikes are mainly funded by debt regardless of whether the firm is over-levered or under-levered, the impact of major investments on the speed of adjustment will be opposite: the increase in leverage due to mainly-debt-financed major investments will lower the adjustment speed for over-levered firms, while it will increase the adjustment speed for under-levered firms.

How uncertainty influences a typical firm's speed of leverage adjustment during investment spikes also depends on whether the firm is over-levered or under-levered. If an investment spike relies mostly on debt financing, as is reported in Mayer and Sussman (2005) and DeAngelo, DeAngelo, and Whited (2011), over-levered firms facing low uncertainty will deviate from targets over the investment spike period. For those firms, the net present value (NPV) of the new investment project is likely to be greater than the benefits arising from adjusting their leverage toward targets. However, over-levered firms facing high uncertainty may adjust their leverage back to leverage targets. For those firms, the adjustment benefits are likely to be greater than the NPV of the new investment project. On the contrary, under-levered firms will converge to their targets with varying speeds depending on the severity of the uncertainty they are faced with. Those facing higher uncertainty are likely to converge at a lower speed than those facing lower uncertainty, as those facing higher uncertainty tend to place a higher value on the option to wait and see, making their investment decisions more cautious (Bloom, Bond, and Van Reenen, 2007). In Section IV.C, we further investigate the mechanisms through which uncertainty affects capital structure adjustment speeds during investment spikes.

B. Empirical Framework

To investigate the impact of uncertainty on capital structure dynamics—both leverage targets and adjustment speeds—we extend Flannery and Rangan's (2006) partial adjustment framework as stated below:

$$L_{i,t} - L_{i,t-1} = \lambda(L^{\star}_{i,t} - L_{i,t-1}) + \kappa_t + \upsilon_{i,t}, \tag{1}$$

where $L_{i,t}$ is firm i's current leverage, $L^{\star}_{i,t}$ is firm i's target leverage ratio, κ_t is an error component reflecting year fixed effects, and $\upsilon_{i,t}$ is a white-noise error term.[11] $L_{i,t} - L_{i,t-1}$ measures actual

[11]The partial adjustment model of capital structure is one of the most frequently employed workhorse models in empirical dynamic capital structure research. Dynamic trade-off models, such as Fischer, Heinkel, and Zechner (1989), maintain that market imperfections such as taxes, bankruptcy costs, agency benefits, and agency costs generate a link between capital structure and firm value, but firms allow their leverage to diverge from their optimal leverage most of the time, and only take actions to offset deviations from their optimal leverage if it gets too far out of line. According to the survey by Graham and Harvey (2001), 81% of firms consider a target debt ratio or range when making their capital structure decisions. The speed at which firms adjust toward target leverage ratios depends on the costs and benefits of adjusting leverage. With zero adjustment costs, the dynamic trade-off theory implies that firms should stick

change in leverage, or leverage adjustment, and $L^{\star}_{i,t} - L_{i,t-1}$ measures deviation from the target leverage ratio. The speed of adjustment parameter, λ, measures how fast a typical firm's actual leverage adjusts to its target leverage. It is expected to lie between 0 and 1 with a higher λ indicating a faster speed of adjustment. Each year, a typical firm closes a proportion λ of the gap between where it stands ($L_{i,t-1}$) and where it hopes to be ($L^{\star}_{i,t}$). As leverage measures ($L_{i,t}$), we consider both book leverage ratio ($BDR_{i,t}$) and market leverage ratio ($MDR_{i,t}$). The book leverage ratio is defined as total debt divided by the book value of total assets, while the market leverage ratio is defined as total debt divided by the sum of total debt and the market value of equity. Detailed variable definitions are described in Panel A of Table I.

B.1. Identifying the Effects of Uncertainty on Leverage Targets

To examine if firms take uncertainty into account when they set their leverage targets, we model target leverage $L^{\star}_{i,t}$ as a linear function of uncertainty, as well as a set of firm characteristics and firm fixed effects:

$$L^{\star}_{i,t} = \alpha + \eta^{\star}_{i} + \beta UNC_{i,t-1} + \gamma X_{i,t-1}, \tag{2}$$

where $\eta^{\star}_{i}$ is an error component reflecting firm fixed effects in target leverage, $UNC_{i,t-1}$ is the level of uncertainty facing the firm i in year t,[12], and $X_{i,t-1}$ is a set of firm characteristics used in recent dynamic capital structure studies including Fama and French (2002), Flannery and Rangan (2006), Antoniou, Guney, and Paudyal (2008), Faulkender, Flannery, Hankins, and Smith (2012), and Elsas, Flannery, and Garfinkel (2014).

Substituting $L^{\star}_{i,t}$ in Equation (2) into Equation (1), we obtain the following equation:

$$L_{i,t} = \lambda\alpha + \lambda\eta^{\star}_{i} + (1-\lambda)L_{i,t-1} + \lambda\beta UNC_{i,t-1} + \lambda\gamma X_{i,t-1} + \kappa_t + \upsilon_{i,t}. \tag{3}$$

Equation (3) can be re-written as the following standard dynamic panel regression model, which will serve as our main econometric framework:[13]

to their optimal leverage at all times. However, if adjustment costs are very high, firms are more likely to be reluctant to adjust toward their optimal leverage. Flannery and Rangan (2006) proposed a partial adjustment model in which firms partially or incompletely adjust toward their target leverage ratios, which depend on firm characteristics.

[12] The firm-level uncertainty measure used in this study will be explained in the next section.

[13] Considering the increasingly important role of the estimation of dynamic panel data models in corporate finance research, there is a need to resolve several key estimation issues arising from fixed effects and lagged dependent variables. For instance, the Ordinary Least Squares (OLS) and within groups (WG) estimates of the coefficient of the lagged dependent variable tend to be biased upwards and downwards, respectively. This is particularly true when the data have a short panel length (Nickell, 1981; Bond, 2002). Therefore, the coefficients of $UNC_{i,t-1}$ in Equation (2) and Equation (4) are also likely to be biased. Using simulated panel data, Flannery and Hankins (2013) show that the estimation performance of various econometric methodologies varies substantially depending on data complications, such as fixed effects, the persistence of the dependent variable, endogenous independent variables, and error term autocorrelations. They find that the LSDVC estimator proposed by Bruno (2005) performs the best in the absence of endogenous independent variables whereas the System GMM estimator (Arellano and Bover, 1995; Blundell and Bond, 1998) appears to be the best choice in the presence of endogeneity and even second-order serial correlation if

$$L_{i,t} = b_0 + b_1 L_{i,t-1} + b_2 UNC_{i,t-1} + b_3 X_{i,t-1} + \kappa_t + \eta_i + \upsilon_{i,t}, \tag{4}$$

where $b_0 = \lambda\alpha$, $b_1 = (1-\lambda)$, $b_2 = \lambda\beta$, $b_3 = \lambda\gamma$, and $\eta_i = \lambda\eta_i^{\star}$. We include year dummies to control for year fixed effects (κ_t).[14] The speed of adjustment can be estimated as $\widehat{\lambda} = 1 - \widehat{b}_1$. Once we have obtained $\widehat{\lambda}$, it is straightforward to obtain $\widehat{\alpha}$, $\widehat{\beta}$, $\widehat{\gamma}$, $\widehat{\eta}_i^{\star}$, and target leverage estimates.[15] We employ the four econometric methodologies described in the footnote below to ensure that the estimated effect of uncertainty on target leverage is not due to the choice of estimation methods or instrument sets, although more weight will be given to System Generalized Methods of Moments (System GMM) and Least Squares Dummy Variables with a bias correction (LSDVC) results.

B.2. Identifying the Effects of Uncertainty on the Speed of Adjustment

Once they have deviated from their leverage targets, firms tend to adjust their leverage back to the targets gradually. Note that λ in Equation (1) represents the proportion of the gross leverage gap closed per period. Considering that a firm's leverage is mechanically adjusted to net income at each fiscal year's end, the leverage gap in Equation (1) can be decomposed into *i*) the gap to be closed by net income-induced involuntary adjustment, and *ii*) the remaining gap to be filled by the firm's voluntary, or active, leverage adjustment (Faulkender, Flannery, Hankins, and Smith, 2012).

To estimate the speed at which active adjustment is made, we first calculate firm *i*'s hypothetical book leverage, $BDR^p_{i,t-1}$, as the proportion between $D_{i,t-1}$ and the sum of $A_{i,t-1}$ and $NI_{i,t}$.[16] Thus, $BDR^p_{i,t-1}$ is what a firm's leverage is expected to be at the end of time t if the firm engages in no net capital market activities. We decompose the change in book leverage $BDR_{i,t} - BDR_{i,t-1}$ (denoted $\Delta BDR_{i,t}$) into two parts: passive adjustment due to net income accounting ($BDR^p_{i,t-1} - BDR_{i,t-1}$) and active adjustment arising from active financial decisions ($BDR_{i,t} - BDR^p_{i,t-1}$ or $\Delta BDR^p_{i,t}$). We then estimate a typical firm's active adjustment speed using the following models:

$$\Delta BDR^p_{i,t} = Constant + \lambda BDEV^p_{i,t} + \varepsilon_{i,t}, \tag{5}$$

the dataset includes shorter panels.

[14] If we replace year fixed effects with year dummies, caution is required. To restore $\widehat{\lambda}\widehat{\alpha}$, we need to adjust $\widehat{b}_0$ by adding a constant to ensure that the mean of year effects estimated using year dummies is zero. The adjusted $\widehat{b}_0$, or $\widehat{b}_0^{\star}$, should be equal to $\widehat{\lambda}\widehat{\alpha}$.

[15] Given the residual of the regression (i.e., $\widehat{\varepsilon}_{it} = \widehat{\eta}_i + \widehat{\upsilon}_{i,t}$), the fixed effects in leverage ($\widehat{\eta}_i$) can be estimated by calculating within-firm average residuals. The fixed effects in target leverage ($\widehat{\eta}_i^{\star}$) can be estimated by dividing the fixed effects in leverage ($\widehat{\eta}_i$) by the speed of adjustment estimate ($\widehat{\lambda}$). The target book leverage ratio and target market leverage ratio are denoted $BDR^{\star}$ and $MDR^{\star}$, respectively. If uncertainty has a substantial impact on a typical firm's target leverage ratio, the coefficient of the uncertainty measure $UNC_{i,t-1}$ in Equation (2), β, is expected to be significantly different from zero for both leverage measures.

[16] $D_{i,t-1}$ and $A_{i,t-1}$ denote firm *i*'s total debt and book total assets in year $t-1$, respectively. Similarly, $NI_{i,t}$ denotes its net income during year t.

and

$$\Delta MDR_{i,t} = Constant + \lambda MDEV_{i,t} + \varepsilon_{i,t}, \tag{6}$$

where $BDEV^{p}_{i,t} = BDR^{\star}_{i,t} - BDR^{p}_{i,t-1}$, $MDEV_{i,t} = MDR^{\star}_{i,t} - MDR_{i,t-1}$, and λ captures the active adjustment speed.[17]

To examine if the heterogeneity in the active adjustment speed is driven by firm-year-specific uncertainty, we model λ in Equations (5) and (6) as a function of a firm's uncertainty:

$$\lambda = \lambda_0 + \lambda_1 UNC_{i,t-1}, \tag{7}$$

or

$$\lambda = \lambda_0 + \lambda_1 D\_HighUNC_{i,t-1}. \tag{8}$$

By substituting Equation (7) or (8) into Equations (5) and (6), we obtain empirical specifications allowing us to test whether uncertainty determines a typical firm's leverage adjustment speed. A non-trivial coefficient, λ_1, for the interaction term between current leverage deviation ($BDEV^{p}_{i,t}$ or $MDEV_{i,t}$) and an uncertainty-related variable ($UNC_{i,t-1}$ or $D\_HighUNC_{i,t-1}$) will attest to the adjustment speed being influenced by uncertainty. To gain further insight, we also look into the sub-sample behavior of over-levered and under-levered firms, separately.

B.3. Identifying the Effects of Uncertainty on the Speed of Adjustment during Investment Spikes

Major investments might be one major channel through which uncertainty affects the speed of leverage adjustment. That is, uncertainty could play a differential role in relation to firms' leverage rebalancing behavior conditional on whether they are faced with major investment opportunities or not. To investigate the joint effect of uncertainty and major investments, we build the following model for the speed of leverage adjustment:

$$\lambda = \lambda_0 + \lambda_1 D\_HighUNC_{i,t-1} + \lambda_2 D\_Spike_{i,t} + \lambda_3 D\_HighUNC_{i,t-1} \times D\_Spike_{i,t}, \tag{9}$$

where $D\_Spike_{i,t}$ is a dummy for investment spikes, which equals one if firm i experiences an investment spike at time t and zero otherwise. We then establish the following models of book and market leverage dynamics by substituting Equation (12) into Equations (5) and (6):

$$\begin{aligned} \Delta BDR^{p}_{i,t} = {} & Constant + \lambda_0 BDEV^{p}_{i,t} + \lambda_1 BDEV^{p}_{i,t} \times D\_HighUNC_{i,t-1} + \lambda_2 BDEV^{p}_{i,t} \times D\_Spike_{i,t} \\ & + \lambda_3 BDEV^{p}_{i,t} \times D\_HighUNC_{i,t-1} \times D\_Spike_{i,t} + \varepsilon_{i,t}, \end{aligned} \tag{10}$$

[17] We do not make any net-income-related adjustment for market leverage because we assume that the market value of a firm's equity (and possibly debt) will properly reflect the firm's net income.

and

$$\Delta MDR_{i,t} = Constant + \lambda_0 MDEV_{i,t} + \lambda_1 MDEV_{i,t} \times D\_HighUNC_{i,t-1} + \lambda_2 MDEV_{i,t} \times D\_Spike_{i,t} + \lambda_3 MDEV_{i,t} \times D\_HighUNC_{i,t-1} \times D\_Spike_{i,t} + \varepsilon_{i,t}. \quad (11)$$

Detailed variable definitions are presented in Table I. Based on the analysis provided in Section I.A.3, we expect a non-trivial coefficient (λ_3) for the interaction term, $BDEV^p_{i,t}$ ($MDEV_{i,t}$) $\times$ $D\_HighUNC_{i,t-1} \times D\_Spike_{i,t}$.

II. Sample Selection, Variable Measurement, and Descriptive Statistics

A. Sample Selection

The data used in our empirical analysis come from the CRSP/Compustat Merged (CCM) database for annual financial statements data, the Center for Research in Security Prices (CRSP) database for daily stock return data, the Compustat database for credit rating data, and the United Nations (UN) database for GDP deflator data from 1988 to 2014. The data start from 1988 because data from cash flow statements are needed to analyze financing patterns around major investments. Note that in that year the Financial Accounting Standards Boards (FASB) #5 replaced "cash statements by sources and uses of fund" with cash flow statements. Our dataset consists of all manufacturing firms with the two-digit North American Industry Classification System (NAICS) sector codes of 31, 32, or 33. We require that each firm has at least 10 years of uninterrupted observations. We exclude firms with missing or negative total assets, negative book equity, or whose stock are not traded on the three major stock exchanges in the U.S. (i.e., NYSE, NASDAQ, and AMEX). We keep the firm-year observation if variables other than total assets and book equity are missing. The final sample is an unbalanced panel of 29,546 firm-year observations corresponding to 1,909 firms.

B. Variable Measurement

B.1. Measuring Uncertainty

To measure uncertainty, we use the standard deviation of a firm's daily stock returns for each fiscal year suggested by Leahy and Whited (1996) and Bloom, Bond, and Van Reenen (2007). Our uncertainty measure is defined as:

$$UNC\_RAW_{i,t} = \sqrt{\frac{1}{D_t - 1}\sum_{d=1}^{D_t}(r_{i,t,d} - \bar{r}_{i,t})^2}, \quad (12)$$

where D_t is the number of trading days in year t, $r_{i,t,d}$ is firm i's stock return on day d in year t, and $\bar{r}_{i,t}$ is the annual average of firm i's daily stock returns in year t. Our main variable of interest, $UNC_{i,t}$, is constructed by standardizing the firm-year-specific uncertainty measure specified in Equation (9). We also construct a dummy variable for high uncertainty level, $D\_HighUNC_{i,t}$, which equals one if the uncertainty measure is higher than its sample median and zero otherwise.

The stock returns-based measure of uncertainty is very attractive for the following reasons. First, this measure is a forward-looking indicator that implicitly weighs the relative value impact of different sources of uncertainty, such as demand, productivity, technological change, inflation, interest rates, regulation, and policy changes (Bloom, Bond, and Van Reenen, 2007).[18] Second, this measure utilizes stock returns measured at a sufficiently high frequency. Our sampling frequency for daily stock returns is on average 245 observations per year, producing low sample variance. Consequently, movements in the uncertainty measure are likely to reflect a change in the underlying process or fundamentals rather than pure noise (see Bloom, Bond, and Van Reenen, 2007). Third, as Bond, Moessner, Mumtaz, and Syed (2005) and Bloom, Bond, and Van Reenen (2007) indicate, this stock returns-based measure is highly correlated with other possible proxies for uncertainty, such as the within-year variability of analysts' earnings forecasts and the cross-sectional dispersion across forecasts made by different analysts for the same firm. Finally, this measure varies across firms and over time, allowing us to evaluate if high-uncertainty firms have leverage dynamics that are significantly different from those of low-uncertainty firms in general, and more specifically during major investments.

B.2. Measuring Control Variables

Following the dynamic capital structure literature, such as Fama and French (2002), Flannery and Rangan (2006), Faulkender, Flannery, Hankins, and Smith (2012), and Elsas, Flannery, and Garfinkel (2014), we control for a vector of firm and industry characteristics that may affect a firm's target capital structure. All variables are computed for firm i over its fiscal year t. In the dynamic panel data regressions used to estimate target leverage, the control variables include firm size, $LnTA_{i,t-1}$, measured by the natural logarithm of book total assets denominated in year-2000 dollars; investment opportunities, $MV\_BV_{i,t-1}$, measured by the sum of the book value of debt and the market value of equity divided by the book value of total assets; profitability, $EBIT\_TA_{i,t-1}$, measured by the ratio of earnings before interests and taxes (EBIT) to total assets; asset tangibility, $FA\_TA_{i,t-1}$, measured by the ratio of net property, plant, and equipment (PP&E) to total assets; depreciation and amortization, $DEP\_TA_{i,t-1}$, measured by the ratio of depreciation and amortization to total assets; R&D intensity, $RD\_TA_{i,t-1}$, measured by research and development (R&D)

[18]In so far as stock returns reflect the prospect of firms' future performance and business environment reasonably well, we expect the impact of different sources of uncertainty to be adequately incorporated into the returns. Therefore, stock return volatility correctly weighs the relative impact of different sources of uncertainty on the firm value.

expenses as a proportion of total assets; R&D dummy, $D\_RD_{i,t-1}$, measured by a dummy variable for positive R&D expenses; debt-rating dummy, $D\_Rated_{i,t-1}$, measured by a dummy variable for long-term debt-rating availability in Compustat; and industry median book (or market) leverages, $\overline{BDR}_{j,t}$ (or $\overline{MDR}_{j,t}$), as measured by industry median book (or market) leverage ratios based on Fama and French's (1997) 48 industries. Detailed variable definitions are described in Panel A of Table I.

C. Descriptive Statistics

To minimize the effect of outliers, we winsorize all variables at the top and bottom 1% of each variable's distribution. Panel B of Table I provides summary statistics for the main variables used in this study. On average, a firm in our final sample has a book (market) leverage ratio of 18.6% (18.4%) and a book (market) target leverage ratio of 18.7% (18.9%). Also, an average firm in our sample has a positive active book (market) deviation of 0.002 (0.005). These statistics are consistent with existing literature that find that over half of firms are under-levered (e.g. Faulkender, Flannery, Hankins, and Smith (2012)). This table also report summary statistics for other leverage-related variables such as leverage adjustments ($\Delta BDR^{p}_{i,t}$ or $\Delta MDR_{i,t}$) and deviations from leverage targets ($BDEV^{p}_{i,t}$ or $MDEV_{i,t}$). The uncertainty measure $UNC\_RAW_{i,t}$ has a mean value of 0.035 and a median value of 0.030. Panel B also reports summary statistics for the control variables. In our sample, an average firm has book total assets of $234 million, a market-to-book ratio of of 1.67, EBIT scaled by total assets of 3.6%, PP&E scaled by total assets of 24.1%, depreciation expenses scaled by total assets of 4.2%, and R&D expenses scaled by total assets of 6.1%. Panel C shows that an average firm in our sample has investment expenditures scaled by total assets of 8.9%, and on average 2.8% of firm-year observations are categorized as investment spikes or major investments.

[Insert Table I Here]

III. Empirical Results

A. Does Uncertainty Lower Leverage Targets?

To examine whether uncertainty increases (or decreases) a typical firm's target leverage ratio, we first estimate the dynamic panel regression model specified in Equation (4). Panel A and Panel B of Table II present the estimation results for book and market leverage ratios, respectively. The four columns in each panel report estimation results based on OLS, WG, LSDVC, and System GMM estimators. We include firm fixed effects to control for unobserved time-invariant firm-specific characteristics in all estimation methods save OLS, while we incorporate year fixed effects to account for temporal variations in all four specifications. System GMM appears to perform slightly better than LSDVC in that *i)* the goodness-of-fit scores with System GMM model (0.735 and 0.743 in Panels A and B, respectively) are higher than LSDVC model (0.732 and 0.709 in Panels A and B, respectively), and *ii)* LSDVC estimates are reported to be the most accurate only in the absence of endogenous independent variables. So we use the Blundell and Bond's (1998) System GMM estimators for target leverage estimation and other analyses in the rest of the paper.

[Insert Table II Here]

As the results based on market and book leverage ratios are qualitatively similar to each other, the following analyses will be based on Panel A. As predicted by Nickell (1981) and Bond (2002), the coefficients of the lagged dependent variable estimated by System GMM ($\widehat{b}_1^{GMM} = 0.748$) and LSDVC ($\widehat{b}_1^{LSDVC} = 0.744$) comfortably fall between the OLS ($\widehat{b}_1^{OLS} = 0.829$) and WG ($\widehat{b}_1^{WG} = 0.641$) estimates.[19] System GMM results in Column (4) indicate that overall book adjustment speed is around 25.2% per annum. The sensitivity of book targets to uncertainty is estimated to be -0.015. That is, one standard deviation increase in uncertainty leads to a 1.5% decrease in book target leverage. The coefficients of control variables are comparable to previous findings (Flannery and Rangan, 2006; Elsas, Flannery, and Garfinkel, 2014). For example, target leverage increases with assets tangibility and industry median leverage, and decreases with profitability and non-debt tax shields. We have similar results in Panel B for market leverage models. The System GMM estimate of overall market adjustment speed is around 23.3%, which is comparable to the literature. The System GMM estimate of the target-uncertainty sensitivity remains significant at the 1% level, with the sensitivity being -0.061—suggesting that one standard deviation increase in uncertainty leads to a 6.1% decrease in market target leverage.

As discussed in Section I.A.1, the effects of uncertainty through debt tax shields and agency benefits of debt cannot be determined *a priori*, although the effects of uncertainty through potential financial distress costs and shareholder-bondholder agency conflicts are expected to be *negative*. The ultimate effect of uncertainty on target leverage, therefore, depends on which forces dominate. That the sensitivity of firms' target leverage ratios to uncertainty is negative and both economically and statistically significant based on both System GMM and LSDVC estimates suggests that either the effects of uncertainty through potential financial distress costs and shareholder-bondholder agency conflicts offset the opposite effects through debt tax shields and disciplinary role of debt, or effects of uncertainty through debt tax shields and/or agency benefits of debt are also played in

[19] The GMM-style instruments used in the fourth column include the second and all available further lags of a leverage measure (*BDR* and *MDR* in Panels A and B, respectively), the first to eighth lags of standardized uncertainty (*UNC*), and the second to eighth lags of all control variables for first difference equations. In addition, the first lags of the changes in leverage, standardized uncertainty, and all control variables are used as instruments for level equations. The Sargan-Hansen test of over-identifying restrictions does not reject this specification (p-value=0.920), which supports the validity of our choice of instruments. The Arellano-Bond's (1991) serial correlation tests find no significant evidence of second-order serial correlation in the first-differenced residuals (p-value=0.863).

the direction of lowering target leverage ratios. We further analyze the mechanisms through which uncertainty lowers target leverage ratios in Section IV.

Having provided evidence about the marginal effects of uncertainty on target leverage ratios, we proceed to gain further insight by examining the contribution made by firm fixed effects on the leverage targets and comparing target leverage ratios between high-uncertainty and low-uncertainty firms. Table III, Panel A, presents the summary statistics for target leverage ratios with and without firm fixed effects. That is, we decompose target leverage estimates with firm fixed effects into *i)* firm fixed effects ($\widehat{\eta}_i^{\star}$) and *ii)* leverage targets net of the effects. It can be shown that the mean (median) proportion of firm fixed effects on the target leverage ratios is 37.2% (33.1%) for book targets, and 41.7% (38.8%) for market targets. Thus, firm fixed effects constitute significant parts in both book and market target leverage ratios. Table III, Panel A, also shows that firm fixed effects, whether positive or negative, are consistently prominent across the distribution. The 5-th and 95-th percentiles of the firm fixed effects in book targets (market targets) are -17.4% (-20.4%) and 23.9% (32.1%), respectively.

[Insert Table III Here]

In addition, we compare target leverage ratios with firm fixed effects of high-uncertainty firms and low-uncertainty firms. Consistent with the analyses of the marginal effects of uncertainty on target leverage ratios, high-uncertainty firms tend to have significantly lower target leverage ratios than low-uncertainty firms. The upper part in Panel A shows that the mean (median) difference in book target leverage ratios between high-uncertainty and low-uncertainty firms is -4.6% (-7.1%), while the lower part in Panel A shows that mean (median) difference in market target leverage ratios is -4.2% (-6.1%). Using Student's t-test and the Wilcoxon rank-sum test, we show that the mean and median differences in both book targets and market targets are statistically significant at the 1% level. The differences are also economically significant, especially given that we define high-uncertainty and low-uncertainty firms based on the median of our uncertainty measure. The differences are even greater if terciles are used to group firms into high-uncertainty and low-uncertainty firms. This confirms our main results regarding the negative sensitivity of leverage targets to uncertainty reported in Table II.A.

Furthermore, we implement the analysis of covariance (ANCOVA) to further examine the relative importance of various determinants in capturing the variation in target leverage ratios, following Lemmon, Roberts, and Zender (2008) who carry out the ANCOVA for actual leverage ratios. Table III, Panel B, presents the results of the variance decompositions for several specifications. Each column in the table corresponds to a different model specification for target leverage ratios. The numbers in the body of the table, excluding the last two rows, correspond to the fraction of the total partial sum of squares for a particular model. That is, we normalize each effect by dividing the partial sum of squares for each effect by the aggregate partial sum of squares across all effects in the model so that the columns sum to one. First, the ANCOVA results reported in Columns (6) and (12) show that the total variation of market targets explained by uncertainty is 4%, while the total variation of book targets explained by uncertainty is 0.4%. This suggests that the uncertainty effects in both book targets and market targets are greater than the effects of firm size, market-to-book, asset tangibility, R&D intensity, and industry median leverage. In particular, uncertainty is the most important determinant of market target leverage ratios among all time-varying determinants. Second, the ANCOVA results show that time-invariant firm-specific effects are the major source of the total variation. The total variation of market targets explained by all time-varying determinants is only 8.7%, while the total variation of book targets explained by all time-varying determinants is only 7.2%. In other words, 91.3% and 92.8% of the total variations in market targets and book targets are explained by time-invariant firm-fixed effects. Intuitively, this suggests that much of the explanatory power of existing target leverage determinants comes from the cross-sectional, as opposed to time-series, variation.

B. Does Uncertainty Increase Leverage Adjustment Speeds?

To examine whether uncertainty increases a firm's active capital structure adjustment speed, we model the adjustment speed as a function of a firm's uncertainty. Table IV presents our main results for the relationship between uncertainty and active adjustment speeds. We also conduct subsample analyses for over-levered and under-levered firms to gain further insight into potentially asymmetric effects of uncertainty on capital structure dynamics. We use the leverage-deviation sorted top and bottom terciles as the under-levered and over-levered samples, respectively.[20]

[Insert Table IV Here]

Before investigating the effects of uncertainty on capital structure adjustment speeds, we examine if over-levered firms have faster adjustment speeds than under-levered firms. For the full sample, 35.6% (29.3%) of the book (market) leverage deviation from target is closed per period, which is in line with the existing literature.[21] In addition, we find that over-levered firms tend to actively adjust leverage toward the targets faster than under-levered counterparts, consistent with Hovakimian (2004) and Faulkender, Flannery, Hankins, and Smith (2012). A typical over-levered firm actively decreases its book (market) leverage toward the target by 46.9% (36.0%) of the gap on average, while a typical under-levered firm increases its book (market) leverage toward the target by 40.5% (24.6%).

[20]Overall, 46.03% of firms in our sample are over-levered in terms of book leverage, and 44.28% in terms of market leverage. Characteristics and investment and financing behaviors of over-levered and under-levered firms differ substantially (Faulkender, Flannery, Hankins, and Smith, 2012).

[21]See, for instance, Fama and French, 2002; Flannery and Rangan, 2006; Lemmon, Roberts, and Zender, 2008, DeAngelo, DeAngelo, and Whited, 2011.

Concerning the effect of uncertainty on the active adjustment speed, the significantly positive signs of the interaction terms $BDEV^{p}_{i,t} \times UNC_{i,t-1}$ and $MDEV_{i,t} \times UNC_{i,t-1}$ in the full sample regressions suggest that uncertainty accelerates adjustment toward the target. Results remain unchanged when we replace the standardized uncertainty measure with the high-uncertainty dummy. The full sample analysis shows that the book (market) adjustment speed of high-uncertainty firms is 9.6% (4.7%) higher than that of low-uncertainty firms. However, sub-sample analysis suggests that the results are mostly driven by over-levered firms as the coefficients of the interaction terms remain significantly positive in the over-levered firm sample, whereas they are insignificant for under-levered firms. Overall, over-levered firms facing high uncertainty tend to adjust book leverage 12.9% faster and market leverage 5.2% faster than those facing low uncertainty.

Figure 4 summarizes our findings. The figure on the left-hand side compares book adjustment speeds of high-uncertainty over-levered (under-levered) firms and low-uncertainty over-levered (under-levered) firms, while the figure on the right-hand side compares market adjustment speeds of high-uncertainty over-levered (under-levered) firms and low-uncertainty over-levered (under-levered) firms. This figure clearly shows that over-levered firms' adjustment speeds significantly increase with uncertainty while under-levered firms' adjustment speeds are not significantly affected by uncertainty. In Section IV.B, we further analyze the mechanisms through which uncertainty increases over-levered firms' leverage adjustment speeds but does not significantly influence under-levered firms' adjustment speeds.

[Insert Figure 4 Here]

C. The Diff-in-Diff Analyses using the Global Financial Crisis and the Dot-Com Crash

One major concern in using the stock return-based measure of uncertainty is the potential endogeneity problem due to the reverse causality running from capital structure to stock prices. To address this concern in establishing the causal effect of uncertainty on capital structure dynamics, namely target leverage and speed of leverage adjustment, we execute a DiD analysis similarly to Lin and Flannery's (2013) and Fang, Tian, and Tice's (2014) studies.[22] A DiD analysis allows us to compare the firms with relatively large uncertainty increases to the firms with small increases due to the exogenous shocks (i.e., the Global Financial Crisis and the Dot-com Crash) to establish the causal effect of uncertainty on leverage dynamics. For both quasi-natural experiments, we first construct a treatment group and a control group using a propensity score matching procedure. This matching procedure is indispensable since a key assumption of the DiD technique is parallel trends of the two groups' leverage targets or adjustment speeds in the absence of the exogenous shock.

We use the following empirical specifications, which incorporate the DiD technique, to identify

[22] Refer to Fang, Tian, and Tice (2014) for a discussion of the advantages of the DiD analyses.

the effects of exogenous shocks to uncertainty on leverage targets and adjustment speeds:

$$\begin{aligned} MDR_{i,t} &= Constant + (1-\lambda)MDR_{i,t-1} + \lambda\gamma X_{i,t-1} + \lambda\beta_1 D\_Treatment_i + \lambda\beta_2 D\_Post_{t-1} \\ &\quad + \lambda\beta_3 D\_Treatment_i \times D\_Post_{t-1} + \varepsilon_{i,t}, \end{aligned} \tag{13}$$

and

$$\begin{aligned} \Delta MDR_{i,t} &= Constant + \lambda_0 MDEV_{i,t} + \lambda_1 MDEV_{i,t} \times D\_Treatment_i + \lambda_2 MDEV_{i,t} \times D\_Post_t \\ &\quad + \lambda_3 MDEV_{i,t} \times D\_Treatment_i \times D\_Post_t + \varepsilon_{i,t}, \end{aligned} \tag{14}$$

where $D\_Treatment_i$ is a dummy variable that equals one if firm i belongs to the treatment group and zero otherwise, and D_Post_t is a dummy variable that equals one if year $t \geq 2008$ (1999) for the Global Financial Crisis (the Dot-com Crash) and zero otherwise. Note that the regressions are estimated using the data of the matched pairs over a seven-year window surrounding each shock.

C.1. DiD Analysis Which Makes Use of the Global Financial Crisis

Figure 1 depicts the average level of uncertainty in monthly and annual frequency over the full sample period. An inspection of this figure suggests that uncertainty peaked during the Global Financial Crisis. The Crisis serves as a good exogenous shock for the following reasons. First, uncertainty increased dramatically between 2007 and 2008—by almost one standard deviation of the full-sample uncertainty distribution.[23] In addition, the increase in uncertainty during this period exhibits cross-sectional variation across firms. Second, the dramatic change in uncertainty concurrent with the Crisis is unlikely to be triggered by firms' target leverage ratios or leverage adjustment speeds.[24] Finally, in spite of some potential problems, the Global Financial Crisis is often regarded as an exogenous uncertainty shock in various studies in the literature, such as Bloom (2009), and how firms responded to the Crisis in terms of setting target leverage ratios and adjusting their leverage ratios toward their leverage targets is in itself an interesting question.

To implement the propensity score matching, we first define the top tercile of firms whose uncertainty increased the most surrounding the Crisis as the treatment group, and the bottom tercile as the control group. Specifically, we calculate average annual firm-level uncertainty for the pre-Crisis year (2006) and for the post-Crisis year (2008) and calculate the difference as individual firms' uncertainty changes induced by the Crisis. Our sample consists of 972 firms at the time of shock, with 321 firms being assigned to the treatment group and the control group each. We then

[23]Baker, Bloom, and Davis' (2016) text-based economic policy uncertainty index also confirms the rising uncertainty between 2007 and 2008. See their website for details: http://www.policyuncertainty.com/index.html.

[24]However, we cannot argue that firms' leverage adjustment speeds do not affect the uncertainty change during the Crisis at all. For example, low adjustment speeds for over-levered firms could increase uncertainty more significantly during the Crisis period. Thus, we consider additional exogenous shocks to firms' uncertainty levels.

estimate a probit model, in which the dependent variable is a dummy variable that equals one if a firm belongs to the treatment group and zero if it belongs to the control group. We use the same set of explanatory variables as in the target leverage estimation. Because the Global Financial Crisis had a substantial impact on a firm's market value of equity, we use market leverage ratio as our main measurement in the DiD analysis.

Table V reports the DiD results. Column (1) in Panel A shows the pre-matching regression results. A pseudo-R^2 of 18.5% and a χ^2 statistic of 156.9 suggest that the specification is well defined. We then perform one-to-one propensity score matching using the propensity scores, i.e., the predicted probabilities of being assigned to treatment group. We keep all pairs of firms with the smallest distance in propensity scores, thus obtaining 127 pairs in the final sample. In Column (2) of Panel A, we use the matched sample to run the probit model again as a diagnostic check.[25] If the 127 pair of firms are well matched then we expect the coefficients of independent variables to be statistically insignificant. Panel A shows that none of the independent variables are statistically significant.

[Insert Table V Here]

We conduct a series of additional diagnostic tests similar to Fang, Tian, and Tice (2014) to further confirm that the parallel trends assumption is satisfied in our setting. First, Panel B presents the estimated propensity score distribution for the treatment and control groups. It shows that differences in propensity scores between the two groups across distance percentiles are all trivial and statistically insignificant.[26] Second, we compare the differences in the pre-Crisis characteristics of the two groups using a univariate test. The t-statistics reported in Panel C show that differences in the average values of independent variables between the two groups, including the uncertainty measure, are all insignificant. Note that both groups of firms had almost the same uncertainty level right before the Crisis, although their capital structure decisions were affected by the Financial Crisis in different manners.

Panel D presents the results from estimating the impact of the exogenous shock on target leverage ratios. We estimate target leverage ratio using two different models: namely, OLS and System GMM.[27] The negative coefficients (-0.014 and -0.034) of D_Post_t for OLS and System GMM in Panel D suggest that the Global Financial Crisis indeed had a negative impact on a typical firm's target leverage. More importantly, the coefficients on $D\_Treatment_i \times D\_Post_t$ remain significant

[25] Four observations are dropped in this model. Since the industries corresponding to those four observations have only treatment firm (or firms), their industry dummies predict the success perfectly.

[26] Although not reported in the table, the t-statistic of the mean difference between the two groups is -0.089.

[27] GMM-style instrumental variables used in the System GMM are the second to all lags of market leverage ratios, and second to third lags of all firm-specific control variables for the first-differenced equations. Similarly, the first lags of changes in market leverage and all firm-specific control variables are used for the level equations. Treatment dummy, post dummy, and their interactions are used as standard IVs in level equations only.

at the 1% level for both OLS (-0.078) and System GMM (-0.036), indicating that the impact was substantially greater for firms whose uncertainty jumps during the Crisis were relatively higher.

Panel E reports the results showing the effect of the exogenous shock on leverage adjustment speeds.[28] Similar to its effect on the firm's target leverage, the Financial Crisis had a positive impact on adjustment speeds, as indicated by the coefficients of $MDEV_{i,t} \times D\_Post_t$, with 11.6% for the whole sample and 20.9% for the over-levered sample, indicating positive impacts of the shock on leverage adjustment speeds in the full sample and the over-levered sample. Meanwhile, the coefficients of $MDEV_{i,t} \times D\_Treatment_i \times D\_Post_t$ are 15.0% for the whole sample and 51.6% for the over-levered sample, and are significant at the 5% and 1% levels, respectively. We find little evidence, however, for uncertainty effects of the exogenous shock among the under-levered firms. Thus, over-levered firms that experienced higher uncertainty jumps tend to adjust their leverage faster, confirming our main results reported in Section III.B for adjustment speeds.

These trends can be seen more clearly in Figure 5. This figure depicts the market leverage adjustment rate for the over-levered treatment groups and over-levered control groups over a seven-year period centered on the year in which the Global Financial Crisis started (i.e., 2007).[29] As shown, the two lines representing the trend for the the adjustment rates for the treatment group and control group are closely in parallel in the three years leading up to 2007. After 2007, the difference in adjustment rates between the treatment group and the control group starts to increase, indicating a positive causal effect of uncertainty on the adjustment speeds of over-levered firms.

[Insert Figure 5 Here]

C.2. DiD Analysis Which Makes Use of the Dot-com Crash

To further confirm the causal effect of uncertainty on the capital structure dynamics, we conduct an additional DiD analysis using another uncertainty shock brought about by the Dot-com Crash. The results are presented in Table IA.I in the Internet Appendix. We employ the same methodology and variables as for the Global Financial Crisis. Setting the year 1998 as the shock year (τ=0), we use the data from the seven-year period 1995–2001 (τ =-3 to +3). Treatment (control) firms are those whose uncertainty increased the most (the least) during 1997 to 1999 (τ = -1 to +1). Among the 1,305 firms present in 1998, 430 firms in the top and bottom terciles are selected, respectively, as treatment and control groups. We then repeat the propensity score matching to obtain 202 pairs of matched firms. The diagnostic tests reported in Panels A, B, and C show that they are overall well matched. Again, we show that *i*) the post-diagnostic regression has a very low χ^2 statistic

[28] Deviation from the target is estimated with the initial results of Table II, not with the results of Panel D of Table V. Note that we categorize a firm as over-levered (under-levered) if both its leverage and its matched firm's leverage are greater (smaller) than their targets.

[29] The figure tracks all matched pairs of firms that are over-levered at the end of 2007.

(p-value of 99.8%) and pseudo R-squared (2.4%), and no significant coefficients for independent variables; *ii*) the propensity score distributions of treatment and control groups are very similar, with a maximum difference of only 0.44%; and *iii*) most of the means of the characteristics of matched firms are not statistically different from one to the other, but R&D expenses for treatment firms are marginally higher than those for control firms, at the 10% significance level.

With these well matched firms, we conduct the GMM estimation of targets using data from 1995–2001 (τ =-3 to +3). Panel D shows that the coefficients of D_Post_t (the general effect of the uncertainty shock on leverage targets) are not statistically different from zero, but the coefficients for $D\_Treatment_i \times D\_Post_{t-1}$ (the additional effect for those whose uncertainty increased more during the shock) are significantly negative, implying that the increase in uncertainty pulls down the target only for those whose uncertainty increased more during the shock. Panel E shows that the coefficients of $MDEV_{i,t} \times D\_Post_t$ are insignificant in all three samples, but the coefficients of $MDEV_{i,t} \times D\_Treatment_i \times D\_Post_t$ are significantly positive, except for the under-levered sample, implying that only over-levered firms whose uncertainty increased more during the Dot-com Crash increased their adjustment speeds significantly: under-levered counterparts did not. Overall, the results are quite similar to those based on the Global Financial Crisis.

D. How Does Uncertainty Affect Leverage Adjustment Speeds During Major Investments?

To investigate how uncertainty affects a typical firm's active capital structure adjustment speed in normal periods and in investment "spike" periods, we estimate a model presented in Section I.B.3.[30] Table VI presents the results for the effects of uncertainty, an investment shock, and their interaction on a typical firm's speed of adjustment with respect to book leverage (Panel A) and market leverage (Panel B). Before discussing the main results in relation to uncertainty, we investigate whether the adjustment speed is higher or lower during investment spikes. The full sample results reported in Column (1) in Panel A suggest that firms adjust their leverage much faster during investment spike periods. However, there are significant differences in the two subsamples. Over-levered firms facing investment spikes have lower book adjustment speeds than those not facing spikes (5.9% (=28.1%-22.2%) vs. 28.1% for book leverage; 5.5% (=27.4%-21.9%) vs. 27.4% for market leverage), while under-levered firms facing investment spikes have much higher adjustment speeds than those not facing spikes (103.1% (=19.7%+83.4%) vs. 19.7% for book leverage; 68.1% (=14.5%+53.6%) vs. 14.5% for market leverage). The results for over-levered firms are consistent

[30] An investment spike in this paper is defined similarly to the way it is defined in Elsas, Flannery, and Garfinkel's (2014) work. However, while they study built-in investments and acquired investments separately, we identify investment spikes based on the sum of those two types of expenditures. Specifically, a firm is considered to have an investment spike if its investment rate in a given fiscal year exceeds both 200% of its previous three-year-average investment rate and 30% of its previous year's total assets. The investment rate is calculated as the ratio of the sum of capital expenditures and cash used for acquisitions to total assets at the prior fiscal year's end. We identify 794 investment spikes in our sample, or, equivalently, 2.82% of firm-year observations, comparable to 3.39% of Elsas, Flannery, and Garfinkel (2014).

with DeAngelo, DeAngelo, and Whited (2011), while the results for under-levered firms are in line with Elsas, Flannery, and Garfinkel (2014) and Faulkender, Flannery, Hankins, and Smith (2012).

[Insert Table VI Here]

We then investigate how differently uncertainty (measured by the high uncertainty dummy) affects adjustment speeds of firms with different combinations of investment regime (measured by the investment spike dummy) and leverage status (measured by the over-levered firm dummy). The results are reported in Columns (4) and (6) of Table VI. Consistent with our predictions, over-levered and under-levered firms have opposite reactions to investment spikes. While over-levered firms tend to temporarily deviate from their target leverage ratios during investment spikes, with slower or even *negative* speeds of adjustment depending on the severity of uncertainty facing them, under-levered firms tend to fully adjust or even over-adjust their leverages. More specifically, over-levered firms with low uncertainty deviate from the targets during spikes with a negative speed of adjustment (-24.0% for book leverage; -23.5% for market leverage) whereas over-levered firms with high uncertainty adjust toward the target leverage ratios with a positive speed of adjustment (23.0% for book leverage; 15.8% for market leverage). For under-levered firms, the difference between low uncertainty and high uncertainty groups is smaller but still significant. In the under-levered firm sample, the speed of adjustment during spikes for low uncertainty group is 105.2% (i.e., overshooting) for book leverage and 74.7% for market leverage, whereas the speed of adjustment during spikes for high-uncertainty firms is 100.6% (i.e., overshooting) for book leverage and 57.9% for market leverage. Figure 6 depicts adjustment speeds for subgroups based on uncertainty, investment regime, and leverage status. At first sight, it is noticeable that uncertainty plays a much more important role in investment spike periods, particularly for over-levered firms. Over-levered firms' adjustment speeds are positive when they are faced with high uncertainty while over-levered firm's adjustment speeds are negative when they are faced with low uncertainty.

[Insert Figure 6 Here]

As mentioned earlier, existing studies fail to reach a consensus on firms' leverage adjustment behavior around major investments. Introducing the notion of *intentional temporary deviation* from target leverage, DeAngelo, DeAngelo, and Whited (2011) argue that the apparent slow leverage adjustment can be accounted for by this intentional deviation arising from the issue of *transitory debt* for major investments. While their simulation-based study offers rich insights into firms' spike financing behavior, it is also the case that somewhat different accounts are offered by other researchers. In particular, Elsas, Flannery, and Garfinkel (2014) find that firms tend to move faster toward estimated targets on average when they have major investment opportunities. As evidenced above, these two seemingly contrary arguments, particularly for over-levered firms, can be reconciled by taking uncertainty into account in explaining leverage adjustment process.

When an over-levered firm is given a major investment opportunity, it will grab the opportunity—primarily issuing debt—as long as the benefits of doing so are expected to outweigh the costs, which may well be the case when the firm is faced with a relatively low level of uncertainty. Consequently, the firm may want to voluntarily deviate from the leverage targets at a time of an investment spike. This is consistent with the findings of DeAngelo, DeAngelo, and Whited (2011). If uncertainty is high, on the other hand, over-levered firms would want to delay taking the investment and/or repay debt to ensure future borrowing capacity, if, in particular, high uncertainty creates a high enough value of the *option of waiting and seeing*. Alternatively, they would probably issue equity rather than debt to finance potential investment projects because high uncertainty and excessive leverage together may quickly expose the firms to a higher default risk. As a result, they will adjust their leverages toward the targets more rapidly when they are faced with investment spikes. This is consistent with the findings of Elsas, Flannery, and Garfinkel (2014). Under-levered firms, on the other hand, are likely to take the major investment opportunity, mainly via debt financing, as those firms are relatively better shielded from default risk. In addition, adjusting toward target leverage by funding major investments by issuing debt is a cost-efficient method because of *sunk adjustment costs* in this case (Faulkender, Flannery, Hankins, and Smith, 2012). Hence, they will increase leverage toward the target, making the adjustment faster when they are faced with investment spikes. We further analyze the mechanisms through which uncertainty influences leverage adjustment speeds during investment spikes in Section IV.C.

IV. Mechanisms Through Which Uncertainty Influences Capital Structure Dynamics

A. *Mechanisms Through Which Uncertainty Lowers Leverage Targets*

In Section I.A.1, we have identified four potential mechanisms through which uncertainty affects target leverage ratios, i.e., debt tax shields, financial distress costs, agency benefits of debt, and agency costs of debt. The effects of uncertainty on leverage targets through financial distress costs and shareholder–debtholder agency conflicts are expected to be negative, but the effects through debt tax shields and agency benefits of debt can be either positive or negative. Thus, we have investigated whether uncertainty increases or decreases leverage targets in Section III.A. We found that uncertainty lowers target leverage ratios. In this section, we examine through which mechanisms uncertainty influences leverage targets. The results are presented in Table VII. The analyses reported below show evidence supporting the financial distress cost channel and the shareholder–debtholder conflict channel. The results suggest that uncertainty increases potential financial distress costs and exacerbates shareholder–debtholder conflicts (e.g. underinvestment and risk-shifting problems), thereby leading to a lower optimal leverage ratio.

A.1. Through Debt Tax Shields

The effects of uncertainty on target leverage ratios through debt tax shields can be positive due to the reduction in non-debt tax shields followed by a lower chance of having no taxable income and consequently a higher expected tax rate when uncertainty is high, or negative due to lower and more volatile earnings followed by a higher chance of having no taxable income and consequently a lower expected tax rate when uncertainty is high. In other words, the effect of uncertainty on target leverage could be either stronger or weaker when the value of tax shields is greater. To test whether the effect is stronger or weaker, we add an interaction term between the value of tax shields and uncertainty to Equation (4). To test all the other channels, we simply replace the proxy for the value of tax shields with proxies for expected financial distress costs, agency benefits of debt, and agency costs of debt. To estimate debt tax shields, we first calculate tax rate, τ, as corporate tax divided by pretax income. Under the assumption of perpetual debt, the value of tax shields is derived as tax-deductible debt (here we use the sum of long-term debt and short-term debt) multiplied by the tax rate (τ). We then scale the value of tax shields by total assets to obtain our measure of debt tax shields, $TXSHLD$. The result is presented in the first column of Table VII. The coefficient of the interaction of uncertainty and the value of tax shields, $UNC \times TXSHLD$, is not significant, implying that the two conflicting effects of tax shields might offset each other.

A.2. Through Financial Distress Costs

As a firm faced with higher uncertainty tends to have higher expected bankruptcy costs, the effects of uncertainty on target leverage ratios through potential financial distress costs are expected to be *negative*. This means that the effects of uncertainty on target leverage could be higher when bankruptcy costs are higher, implying that the interaction of uncertainty and bankruptcy costs is expected to be significantly negative. We use two proxies for bankruptcy costs, i.e., costs of debt (*COD*) and Altman Z-score (*Z*) (Altman, 1968; Altman, 2000).[31] The cost of debt measure is calculated as coupon spread and is positively related to bankruptcy costs while Altman Z-score is negatively related to bankruptcy costs. Thus, the interaction of uncertainty and costs of debt, $UNC \times COD$, is expected to be negative, while that of uncertainty and Z-score, $UNC \times Z$, is expected to be positive. Columns (2) and (3) of Table VII give the results, which are consistent with the bankruptcy cost mechanism, indicating that when bankruptcy costs are higher, uncertainty lowers leverage targets more significantly.

[31] Specifically, Z-score is estimated as: Z = 1.2X1 + 1.4X2 + 3.3X3 + 0.6X4 +X5, where X1 = working capital/total assets; X2 = retained earnings/total assets; X3 = earnings before interest and taxes/total assets; X4 = market value equity/book value of total liabilities; X5 = sales/total assets.

A.3. Through Agency Benefits of Debt

When there is a higher (lower) level of free cash flows, agency conflicts between shareholders and managers will be more (less) severe, and consequently agency benefits arising from the disciplining role of debt are higher (lower). The effect of uncertainty on target leverage ratios through agency benefits of debt is not clear-cut, in that it can be *positive* due to a higher value of the real option of waiting and seeing regarding new investment projects, and consequently more free cash flows available in current period when uncertainty is high, or it could be *negative* due to lower profitability from assets in place and consequently less free cash flows when uncertainty is high. In other words, the effect of uncertainty on target leverage could be either higher or lower when agency conflicts between shareholders and managers are more severe and thus agency benefits of debt are greater. The percentage of shares held by all blockholders, $SUMBLKS$, and the percentage of shares held by all affiliated blockholders, $SUMAFLIN$, are inversely related to the degree of agency conflicts. The data are from Dlugosz, Fahlenbrach, Gompers, and Metrick (2006).[32] The results are presented in Column (4) and Column (5) of Table VII. The coefficients of the interaction of uncertainty and the percentage of shares by blockholders are not significant, suggesting that the two conflicting effects of agency benefits might offset each other.

A.4. Through Agency Costs of Debt

High uncertainty makes both assets in place and investment projects riskier, followed by more severe underinvestment and asset substitution problems. To resolve the shareholder–debtholder agency conflicts, a firm is likely to choose a *lower* optimal/target leverage ratio. This means that uncertainty lowers leverage targets more significantly when agency conflicts between shareholders and debtholders are higher, implying that the interaction of uncertainty and shareholder–debtholder agency costs is expected to be significantly negative. Following Nini, Smith, and Sufi (2009), as a proxy for shareholder–debtholder agency conflicts we utilize covenant violation, $VIOLYR$, which is a dummy variable that equals one if a firm reports a loan covenant violation in an SEC 10-K or 10-Q filing for a given year, and zero otherwise.[33] The interaction of uncertainty and shareholder–debtholder agency conflicts, $UNC \times VIOLYR$, is expected to be negative. Column (6) of Table VII reports the result, which is consistent with the shareholder–debtholder agency cost mechanism, indicating that when shareholder–debtholder agency conflicts are more severe, the effect of uncertainty on target leverage is stronger.

[32] Data regarding blockholders' shareholdings are available at Professor Andrew Metrick's website: http://faculty.som.yale.edu/andrewmetrick/data.html.

[33] Data regarding loan covenant violations are available at Professor Amir Sufi's website: http://faculty.chicagobooth.edu/amir.sufi/data.html. We construct an annualized loan covenant violation measure by modifying an original quarterly measure. Our firm-year specific loan covenant violation measure equals one if there is at least one violation across four quarters in that year, and zero otherwise.

B. Mechanisms Through Which Uncertainty Increases Adjustment Speeds

In Section I.A.2 we identified two potential mechanisms through which uncertainty influences adjustment speeds, i.e., marginal adjustment benefits and marginal adjustment costs. The marginal adjustment benefits of over-levered firms increase with uncertainty and those of under-levered firms do not vary with uncertainty, while the effects of uncertainty on marginal adjustment costs depend on whether whether firms are over-levered and on what adjustment method is used. Thus, we have investigated whether uncertainty increases or decreases adjustment speeds in Section III.B. We found that uncertainty increases over-levered firms' adjustment speeds significantly, whereas the effect of uncertainty on under-levered firms' adjustment speeds is insignificant. As a firm would adjust its capital structure only when the adjustment benefits outweigh the adjustment costs, it is possible for an over-levered firm facing higher uncertainty to have greater adjustment benefits, lower adjustment costs, or both. In this section, we study whether the adjustment benefits and costs differ among firms facing different degrees of uncertainty separately for over-levered firms and under-levered firms. The results are presented in Table IX and Table VIII. The analyses presented below suggest that an over-levered firm facing higher uncertainty does not only enjoy greater adjustment benefits (i.e., avoidance of bankruptcy threats), but also faces lower adjustment costs (i.e., bond retirement costs).

B.1. Uncertainty and Marginal Adjustment Benefits

In this section, we examine whether uncertainty increases firms' adjustment benefits—particularly for over-levered firms. The trade-off theory suggests that firms would enjoy benefits from adjusting their capital structure by an amount equal to the value changes due to changes in debt tax shields benefits, direct/indirect financial distress costs, and agency benefits/costs. As discussed in Section I.A, marginal adjustment benefits would be determined by the shape of the leverage-firm value curve, as depicted in Figures 2 and 3. The steeper the curve, the greater the adjustment benefits. It is quite likely that the curves for high-uncertainty firms are steeper than the curves for low-uncertainty firms. For example, firms facing higher uncertainty would have a higher probability of being financially distressed, and financial distress costs are likely to increase more sensitively given the same increase in leverage—and thus the curves are more likely to be steeper.

Before examining the effect of uncertainty on the curvature of the leverage-value curve, we investigate if uncertainty magnifies bankruptcy threat, as measured by the likelihood of credit ratings being downgraded, as we suspect that major benefits that over-levered firms enjoy by lowering their leverage would be related to the reduction in bankruptcy threats. Table VIII reports the descriptive statistics and z-test results showing whether uncertainty increases the proportions of firms facing a downgrade in their credit ratings for over-levered firms (Panel A) and under-levered firms (Panel B). The results are striking. First, for over-levered and under-levered firms alike, the proportion of firms assigned to each credit rating in the investment grade category (i.e., BBB or above) is higher with the low-uncertainty group. And the exact opposite is true for the non-investment category (i.e., BB or below).[34] Second, but more importantly, uncertainty is shown to have a clear link to credit rating change. High-uncertainty firms tend to suffer 4.49% (2.81%) more credit rating downgrades in the over-levered firm sample (under-levered firm sample). Note that the difference between high-uncertainty and low-uncertainty firms in the over-levered sample is greater than in the under-levered sample. Of particular interest is the relative proportion of firms falling from the investment grade to the speculative grade. For the over-levered (under-levered) sample, 4.09% (4.85%) of high-uncertainty firms experience this fall, whereas 0.92% (0.81%) of low-uncertainty firms do so. These results suggest that firms facing higher uncertainty would enjoy greater benefits from adjusting their leverage toward targets in the sense that they can avoid threats from bankruptcy that are more likely to happen.

[Insert Table VIII Here]

To investigate whether high-uncertainty firms have greater adjustment benefits (i.e., have a steeper leverage-value curve than low-uncertainty firms) we regress raw returns ($r_{i,t}$) or returns in excess of industry mean returns ($r_{i,t} - r_{j,t}$) on *i)* net debt issuance in excess of net equity issuance scaled by market capitalization at the end of the previous fiscal year ($D_{i,t} - E_{i,t}$), *ii)* its interaction with the high-uncertainty firm dummy ($(D_{i,t} - E_{i,t}) \times D\_HighUNC_{i,t-1}$), and *iii)* a set of control variables similar to those in Faulkender and Wang (2006). The control variables include the changes in earnings, changes in total assets, changes in R&D expenses, changes in dividends, total external finance, changes in interest expenses, natural logarithm of lagged total assets, and lagged market-to-book ratios, as well as firm and year fixed effects.[35] The results are presented in Table IX, Panel A. Two findings emerge. First, we find that adjustment benefits exist, as evidenced by the negative coefficient of $D_{i,t} - E_{i,t}$ for over-levered firms and the positive coefficient for under-levered firms.[36] Second, but more importantly, the coefficients of the interaction term, $(D_{i,t} - E_{i,t}) \times D\_HighUNC_{i,t-1}$, for over-levered firms are negative and statistically significant at the 5% level, while those for under-levered firms are not statistically significant. Our results suggest that over-levered firms facing high uncertainty adjust their leverage more promptly because they have greater adjustment benefits, such as the avoidance of bankruptcy threats, compared to their low-uncertainty counterparts.

[34] An immediate corollary of this finding is that firms with higher uncertainty are more likely to be graded as speculative. The results show that the high-uncertainty group consists of a significantly lower proportion of investment-grade firms and a higher proportion of speculative-grade firms.

[35] Size and value factors are also included as the excess returns are defined over industry average returns rather than over Fama and French research portfolio returns. The ratios of debt to market capitalization are not included, in order to make sure that our key measure, net debt issuance over net equity issuance, captures all effects caused by corporate financing decisions.

[36] Note also that adjustment benefits for over-levered firms are greater than those for under-levered firms, as depicted in Figure 3.

[Insert Table IX Here]

B.2. Uncertainty and Marginal Adjustment Costs

As mentioned above, it is possible that an over-levered firm facing high uncertainty adjusts its leverage faster than a low-uncertainty counterpart due to lower adjustment costs. In this section, we study whether the adjustment costs differ among firms facing different degrees of uncertainty separately for over-levered firms and under-levered firms. We consider four types of adjustment costs: the issuance cost of debt, the retirement cost of debt, the issuance cost of equity, and the retirement cost of equity. The relevant adjustment costs are the issuance costs of equity and the retirement costs of debt for over-levered firms, and the issuance costs of debt and the retirement costs of equity for under-levered firms. As a proxy for the issuance costs of equity/debt, we use the gross equity/debt underwriter spread. The underwriter spread represents the costs of underwriting the offer if the investment banking competition is sufficient (Altınkılıç and Hansen, 2000). As a proxy for the retirement costs of equity, we use a firm's daily average trading volume scaled by market capitalization at the end of the fiscal year.[37] The proxy is appropriate since the U.S. Securities and Exchange Commission (SEC) has instituted Rule 10b-18 that restricts the timing and amount of equity retirement on any given day (Leary and Roberts, 2005). This provision is designed to protect investors from stock price manipulation: it imposes the rule that limits any non-block purchases for a day cannot exceed the greater of one round lot and the number of round lots closest to 25% of the security's trading volume. Thus, a firm with a higher daily trading volume may have lower retirement costs for equity. As a proxy for the retirement costs of debt, we use the annual trading volume of public bonds scaled by the amounts outstanding, since the retirement costs of public bonds are associated with illiquid secondary public bond markets (Chen, Lesmond, and Wei, 2007).

To examine whether uncertainty raises or lowers adjustment costs, we regress the proxies of adjustment costs on lagged uncertainty and a set of control variables. To construct underwriter spread measures, we use the security issuance data contained in the SDC Platinum database.[38] To construct the trading volume of equity and debt, we use the CRSP daily security database and TRACE Enhanced Bond Trades database. The control variables include firm characteristics that we use in the target leverage estimation, issue characteristics, year fixed effects, and industry fixed

[37] Our results are consistent when we use the maximum daily trading volume instead of the average daily trading volume as in Leary and Roberts (2005).

[38] We download all US issues of equity and debt, then we restrict our sample to those issues of seasoned equity offerings of common shares and all non-convertible debt issues whose issuers are listed in AMEX, NYSE, and NASDAQ. After matching with the manufacturing firms in our sample, we have 1,780 issues of equity issued by 773 unique firms, and 2,986 issues of debt issued by 338 unique firms. Since relevant adjustment costs for the two groups are different, we further narrow down the sample to under- and over-levered firms. Finally, we have 487 (537) equity issues issued by book (market) over-levered firms and 852 (742) debt issues issued by book (market) under-levered firms.

effects.[39] The results are presented in Table IX, Panel B. Statistically insignificant coefficients of uncertainty in the regression models for equity issuance costs and debt issuance costs reported in Columns (1) and (3) suggest that uncertainty does not have a substantial impact on issuance costs when controlling for firm and issue characteristics. However, uncertainty tends to lower the retirement costs of equity and debt, supported by significantly positive coefficients of uncertainty on trading volumes. Uncertainty increases uninformed trading (i.e., noise trader volatility in Kyle's (1985) model) and increases the liquidity of firms' securities. Consistent with this prediction, our results suggest that uncertainty tends to lower the costs of retirement for both equity and debt. Thus, we cannot reject the possibility that high-uncertainty over-levered firms tend to adjust their capital structure more quickly due to lower adjustment costs.

C. Mechanisms Through Which Uncertainty Increases Adjustment Speeds During Investment Spikes

In this section, we investigate two possible channels through which uncertainty affects a typical firm's capital structure adjustment speeds in spike periods as well as in normal periods, as reported in Section III.D. One possible channel on the *extensive margin* is that uncertainty might hinder firms' investment decisions. Uncertainty can push firms to invest less when they are faced with major investment opportunities, or even delay investments altogether as Bloom, Bond, and Van Reenen (2007) suggest. Given that investment spikes are financed by debt in general (Im, Mayer, and Sussman, 2016), a firm facing high uncertainty would use lower amounts of debt, thereby incurring a smaller increase in leverage at the time of the investment shock. The other channel on the *intensive margin* is that firms facing higher uncertainty may have different financing patterns at the time of investment shocks. In other words, it may be the case that firms with different levels of uncertainty still make similar investment decisions, but their modes of financing are different. In this case, firms with high uncertainty do not delay the investments while using different proportions of debt for financing. We expect that the results in Table VI arise through either or both of the two channels just described. In this subsection, we examine the two channels separately.

C.1. Investment Channel

First, we provide an empirical test of the first channel using the model employed in Bloom, Bond, and Van Reenen (2007). Specifically, we use the sales growth of each individual firm as a proxy for demand shock to capture the investment opportunity in the investment-rate regression specified

[39]The issue characteristics include a ratio of principals to total assets and a ratio of closed price to offer price for equity issues, and a ratio of principals to total assets and yield to maturity for debt issues. We also control for the remaining years to maturity in the model for the retirement costs of debt.

below:

$$
\begin{aligned}
I_{i,t}/K_{i,t-1} \quad = \quad & Constant + \beta_1 \Delta y_{i,t} + \beta_2 C_{i,t}/K_{i,t-1} + \beta_3 C_{i,t-1}/K_{i,t-2} \\
& + \beta_4 (y-k)_{i,t-1} + \beta_5 (\Delta y_{i,t})^2 + \beta_6 \Delta UNC_{i,t} + \beta_7 UNC_{i,t-1} \\
& + \beta_8 UNC_{i,t} * \Delta y_{i,t} + Year\ Dummies + \varepsilon_{i,t},
\end{aligned} \tag{15}
$$

where $I_{i,t}/K_{i,t-1}$ is the ratio of investment ($INV_{i,t}$) to capital stock at the prior year's end ($K_{i,t-1}$), and $C_{i,t}/K_{i,t-1}$ is the ratio of cash flow ($C_{i,t}$) to capital stock at the prior year's end ($K_{i,t-1}$), y is measured as the natural log of a firm's annual sales, k is the natural log of capital stock (K), and $UNC_{i,t}$ is the standardized uncertainty used in the paper.[40] We interpret the coefficient for the term interacting uncertainty with demand shock, β_8, as the marginal effect of uncertainty on a firm's investment responsiveness to the demand shock. If uncertainty has a substantial adverse effect on a firm's propensity to invest when it is faced with (major) investment opportunities, β_8 should be negative. The demand shock proxy used in our model is an *ex ante* investment shock measure, which is also used in Bloom, Bond, and Van Reenen's (2007) model.

Table X reports the estimation results. We estimate the model using System GMM and report one-step GMM coefficients and standard errors robust to autocorrelation and heteroscedasticity as in Bloom, Bond, and Van Reenen (2007). GMM-style instrumental variables used in the System GMM estimation include the second to eighth lags of $I_{i,t}/K_{i,t-1}$, $\Delta y_{i,t}$, $(y-k)_{i,t}$, $C_{i,t}/K_{i,t-1}$, and $UNC_{i,t}$ for first difference equations, and the second to eighth lags of $\Delta(I_{i,t}/K_{i,t-1})$, $\Delta\Delta y_{i,t}$, $\Delta(y-k)_{i,t}$, $\Delta(C_{i,t}/K_{i,t-1})$, and $\Delta UNC_{i,t}$, for level equations. Note that year dummies are treated as IV-style instruments for the equations in levels only. The Sargan-Hansen tests of over-identifying restrictions do not reject the specifications reported in Table X, and there is no evidence of second-order serial correlation in the first-differenced residuals in all those specifications. The goodness-of-fit scores are also reported. Our estimation results closely resemble the findings in Bloom, Bond, and Van Reenen's (2007) study based on UK data in a different period. In particular, the coefficients of the interaction term between uncertainty and sales growth, β_8, is negative and statistically significant at the 5% level in Column (3) and 1% in Columns (4) and (5). That is, firms with higher levels of uncertainty tend to respond more cautiously to given investment opportunities, suggesting that the *investment* channel is at work.

[Insert Table X Here]

[40] Investment (INV) is the sum of capital and acquisition expenditures, cash flow (C) is the sum of income before extraordinary items and depreciation and amortization expenses, and capital stock (K) is estimated using the perpetual inventory method.

C.2. Financing Channel

Second, we also examine whether firms' financing patterns during investment spikes differ by their uncertainty levels. To classify the different financing methods of each firm, we first construct financing variables by calculating debt financing, equity financing, cash flow financing, and other financing as proportions of lagged total assets.[41] Then we estimate a system of equations as follows:

$$\begin{aligned}
DEBT_TA_{i,t} &= Constant + \beta_D INT_TA_{i,t} + Controls + Year\ Dummies + \varepsilon^D_{i,t}, &(16)\\
EQUITY_TA_{i,t} &= Constant + \beta_E INT_TA_{i,t} + Controls + Year\ Dummies + \varepsilon^E_{i,t}, &(17)\\
CF_TA_{i,t} &= Constant + \beta_C INT_TA_{i,t} + Controls + Year\ Dummies + \varepsilon^C_{i,t}, &(18)\\
OTHER_TA_{i,t} &= Constant + \beta_O INT_TA_{i,t} + Controls + Year\ Dummies + \varepsilon^O_{i,t}, &(19)
\end{aligned}$$

where $INT\_TA_{i,t}$ is the ratio of a firm's investment to its lagged total assets, and $Controls$ include $LnTA_{i,t-1}$, $MV\_BV_{i,t-1}$, $EBIT\_TA_{i,t-1}$, $FA\_TA_{i,t-1}$, $DEP\_TA_{i,t-1}$, $RD\_TA_{i,t-1}$, $D\_RD_{i,t-1}$, $\overline{MDR}_{j,t-1}$, and $D\_Rated_{i,t-1}$.[42] Note that β_D is the proportion of debt used to finance the investment at the time of the investment shock. (β_E, β_C, and β_O are defined likewise). Those four proportions should sum to 1, so we estimate the system of the four seemingly unrelated regressions equations (*SURE*) with the constraint:

$$\beta_D + \beta_E + \beta_C + \beta_O = 1. \tag{20}$$

The estimation results explain how a typical firm finances its investment spike. To further test if uncertainty plays an important role in firms' financing patterns at the time of an investment shock, we split our sample into high- and low-uncertainty groups. Firm-year observations categorized as investment spikes are divided into either high-uncertainty or low-uncertainty groups depending on whether uncertainty at the previous year-end is higher or lower than the full sample median uncertainty. The results are presented in Table XI. The finding reported in the previous section that high uncertainty causes firms to delay their investment decisions is confirmed by the smaller number of investment spikes assigned to the high-uncertainty group (292 spikes) compared to the low-uncertainty group (496 spikes). Table XI shows that debt is the major financing source for firms during investment spikes. The overall proportion of debt financing is 84.7% in the full sample. These results correspond to Im, Mayer, and Sussman's (2016) study, which shows that firms tend to use debt as their major financing source at the time of major investments. Although debt is still the major financing source for high-uncertainty firms at investment spikes (76.9%), their debt reliance is much weaker than those of low-uncertainty firms (91.7%). These findings

[41] We calculate other financing sources as the residual investment amount after deducting debt, equity, and cash flow financing sources from the total investment.

[42] Detailed descriptions of the control variables are presented in Table I.

support what we term the *financing* channel, illustrating that firms with higher uncertainty tend to fund their investments with lower proportions of debt. Our results are robust to using industry median book leverage ratios as a control variable, and to estimating the system of equations without control variables.

[Insert Table XI Here]

Overall, the results reported in Table X and Table XI suggest that the two channels considered so far—the investment channel and the financing channel—jointly affect firms' capital structure dynamics during major investments. More specifically, firms facing higher uncertainty tend to respond more cautiously to their investment opportunities, leading to them investing smaller amounts. Meanwhile, they also tend to fund their investments with relatively lower proportions of debt. These two mechanisms together tend to increase the gap between high- and low- uncertainty firms' capital structure adjustment speeds at the time of investment shocks.

V. Conclusion

This study investigates how uncertainty affects firms' capital structure dynamics using a panel data set of U.S. public manufacturers between 1988 and 2014. Using the individual stock return volatility as a collective measure of uncertainty, we find that uncertainty affects firms' target leverage ratios, speeds of leverage adjustment, as well as financing behaviors around major investments. We demonstrate that uncertainty, on average, affects leverage targets across all of the firms considered. This uncertainty effect extends to the speeds at which firms adjust their leverage ratios toward the targets—although asymmetrically, depending on whether they are over-levered or under-levered. Furthermore, we confirm that the seemingly conflicting results related to leverage decisions around investment spikes documented in the past research can be reconciled by introducing the interplay between uncertainty and firms' current leverage ratios in relation to their target leverage ratios.

Specifically, we demonstrate first that uncertainty has substantial effects on both firms' target leverage ratios and their adjustment speeds. A one standard deviation increase in uncertainty generally results in a 1.5% (6.1%) decrease in the target book (market) leverage ratio, implying that the negative effects of uncertainty through financial distress costs and agency conflicts between shareholders and bondholders dominate the positive effect through tax shields and the disciplinary role of debt. Second, we then show that uncertainty only affects the adjustment speeds of over-levered firms: it has an insignificant effect on under-levered firms. In the over-levered firm sample, the firms facing high uncertainty tend to adjust their capital structure 12.9% (5.2%) faster than low-uncertainty firms, as measured by book (market) adjustment speed. The uncertainty effect disappears in the under-levered firm sample. We also analyze the robustness of our results using the Global Financial Crisis and Dot-com Bubble Crash as large exogenous uncertainty shocks. We show that the two events both did, in fact, increase the market-wide uncertainty substantially, and had significant impacts on the capital structure dynamics. The DiD analyses confirm that both uncertainty shocks lowered the target leverage ratios of treatment firms, and more so than control group, and accelerated the speed of leverage adjustment for over-levered firms. Thus, our robustness tests, overall, confirm and support the main findings of our study.

Large investments, or investment spikes, are mostly financed externally, and hence the heavy reliance of major investments on external financing is likely to reveal the managers' attitudes toward leverage and firms' capital structure adjustment dynamics more prominently. We find that over-levered and under-levered firms have opposite reactions to investment spikes in terms of their financing behavior. Over-levered firms tend to temporarily deviate from their target leverage ratios at a time of investment spikes, with slower or even negative speeds of adjustment depending on the severity of uncertainty facing them. On the other hand, under-levered firms tend to fully adjust or even over-adjust their leverage ratios toward the targets. Overall, uncertainty plays significant, yet opposite, roles in both groups of firms, with its impact on the over-levered sample being greater in magnitude. Therefore, our study demonstrates that the seemingly conflicting results documented in DeAngelo, DeAngelo, and Whited (2011) and Elsas, Flannery, and Garfinkel (2014), particularly for over-levered firms, can be reconciled and comfortably nested in our empirical specifications by incorporating the effects of uncertainty on capital structure dynamics.

This paper also explores several possible mechanisms through which uncertainty could influence target leverage ratios by empirically testing the effects of uncertainty on tax shields, financial distress costs, agency benefits, and agency costs. Our results suggest that uncertainty is likely to increase potential financial distress costs and exacerbate shareholder–debtholder conflicts, thereby leading to a lower optimal leverage ratio. In addition, greater adjustment benefits and lower adjustment costs are the key contributing factors for the faster leverage adjustment of over-levered firms facing higher uncertainty. Finally, we also shed light on the mechanisms through which uncertainty affects firms' financing at the time of investment spikes by identifying two possible channels: namely, the investment channel and the financing channel. Our results show that firms with higher uncertainty tend to invest more cautiously given investment opportunities, and they use less debt than the firms with lower uncertainty.

References

Abel, A. B., and Eberly, J. C., 1994, "A unified model of investment under uncertainty," *American Economic Review*, 84, 1369–1384.

Abel, A. B., and Eberly, J. C., 1996, "Optimal investment with costly reversibility," *Review of Economic Studies*, 63, 581–593.

Altınkılıç, O., and Hansen, R. S., 2000, "Are there economies of scale in underwriting fees? Evidence of rising external financing costs," *Review of Financial Studies*, 13, 191–218.

Altman E. I., 1968, "Financial ratios, discriminant analysis and the prediction of corporate bankruptcy," *Journal of Finance*, 23, 589–609.

Altman E. I., 2000, "Predicting financial distress of companies: Revisiting the Z-score and ZETA models," *Stern School of Business, New York University*, 9–12.

Andrade, G. and Kaplan, S. N., 1998, "How costly is financial (not economic) distress? Evidence from highly leveraged transactions that became distressed," *Journal of Finance*, 53, 1443–1493.

Ang, A., Hodrick, R. J., Xing, Y., and Zhang, X., 2006, "The cross-section of volatility and expected returns," *Journal of Finance*, 61, 259–299.

Ang, A., Hodrick, R. J., Xing, Y., and Zhang, X., 2009, "High idiosyncratic volatility and low returns: International and further US evidence," *Journal of Financial Economics*, 91, 1–23.

Antoniou, A., Guney, Y., and Paudyal, K., 2008, "The determinants of capital structure: Capital market-oriented versus bank-oriented institutions," *Journal of Financial and Quantitative Analysis*, 43, 59–92.

Arellano, M. and Bond, S. R., 1991, "Some tests of specification for panel data: Monte Carlo evidence and an application to employment equations," *Review of Economic Studies*, 58: 277–297.

Arellano, M. and Bover, O., 1995, "Another look at the instrumental variable estimation of error-components models," *Journal of Econometrics*, 68, 29–52.

Aysun, U. and Honig, A., 2011, "Bankruptcy costs, liability dollarization, and vulnerability to sudden stops," *Journal of Development Economics*, 95, 201–211.

Baker, S.R., Bloom, N., and Davis, S.J., 2016, "Measuring economic policy uncertainty," *Quarterly Journal of Economics*, Forthcoming.

Bernanke, B. S., 1983, "Nonmonetary effects of the financial crisis in the propagation of the great depression," *American Economic Review*, 73, 257–276.

Bertola, G., and Caballero, R. J., 1994, "Irreversibility and aggregate investment," *Review of Economic Studies*, 61, 223–246.

Black, E., 1978, *Rhetorical Criticism: A Study in Method*. University of Wisconsin Press.

Bloom, N., 2000, "The dynamic effects of real options and irreversibility on investment and labor demand," Working paper, In stitute for Fiscal Studies.

Bloom, N., 2009, "The impact of uncertainty shocks," *Econometrica*, 77, 623–685.

Bloom, N., Bond, S., and Van Reenen, J., 2007, "Uncertainty and investment dynamics," *Review of Economic Studies*, 74, 391–415.

Blundell, R., and Bond, S., 1998, "Initial conditions and moment restrictions in dynamic panel data models," *Journal of Econometrics*, 87, 115–143.

Bond, S. R., 2002, "Dynamic panel data models: A guide to micro data methods and practice," *Cemmap working paper CWP 09/02*, Institute for Fiscal Studies, London.

Bond, S., Klemm, A., and Marinescu, I., 2006, "Technology and the financing of investment spikes," Working paper, Institute for Fiscal Studies.

Bond, S., Moessner, R., Mumtaz, H., and Syed, M., 2005, "Microeconometric evidence on uncertainty and investment," Working paper, Institute for Fiscal Studies.

Bruno, G. S., 2005, "Approximating the bias of the LSDV estimator for dynamic unbalanced panel data models," *Economics Letters*, 87, 361–366.

Chen, H., Wang, H., and Zhou, H., 2014, "Stock return volatility and capital structure decisions," available at SSRN: http://ssrn.com/abstract=2346642 or http://dx.doi.org/10.2139/ssrn.2346642

Christie, A. A., 1982, "The stochastic behavior of common stock variances: Value, leverage and interest rate effects," *Journal of Financial Economics*, 10, 407–432.

Colak, G., Flannery, M. J., and Öztekin, Ö., 2014, "Political uncertainty, transaction Costs, and leverage adjustments: An international perspective," Working paper.

Campbell, J. Y., and Hentschel, L., 1992, "No news is good news: An asymmetric model of changing volatility in stock returns," *Journal of Financial Economics*, 31, 281–318.

Campbell, J. Y., Lettau, M., Malkiel, B. G., and Xu, Y., 2001, "Have individual stocks become more volatile? An empirical exploration of idiosyncratic risk," *Journal of Finance*, 56, 1–43.

Cook, D. O., and Tang, T., 2010, "Macroeconomic conditions and capital structure adjustment speed," *Journal of Corporate Finance*, 16, 73–87.

DeAngelo, H., DeAngelo, L., and Whited, T. M., 2011, "Capital structure dynamics and transitory debt," *Journal of Financial Economics*, 99, 235–261.

DeAngelo, H., and Masulis, R. W., 1980, "Optimal capital structure under corporate and personal taxation," *Journal of Financial Economics*, 8, 3–29.

Duffee, G. R., 1995, "Stock returns and volatility a firm-level analysis," *Journal of Financial Economics*, 37, 399–420.

Dlugosz, J., Fahlenbrach, R., Gompers, P., and Andrew Metrick, 2006, "Large blocks of stock: Prevalence, size, and measurement," *Journal of Corporate Finance*, 12(3), 594–618.

Elsas, R., Flannery, M. J., and Garfinkel, J. A., 2014, "Financing major investments: Information about capital structure decisions," *Review of Finance*, 18, 1341–1386.

Easterbrook, F. H., 1984, "Two agency-cost explanations of dividends," *The American Economic Review*, 74, 650–659.

Fama, E. F. and French, K. R., 1997, "Industry costs of equity," *Journal of Financial Economics*, 43, 153–193.

Fama, E. and French, K., 2002, "Testing trade-off and pecking order predictions about dividends and debt," *Review of Financial Studies* 15, 1–34.

Fama, E. F. and Miller, M. H., 1972, *The Theory of Finance: Vol. 3*. Dryden Press, Hinsdale.

Fang, V. W., Tian, X., and Tice, S., 2014, "Does stock liquidity enhance or impede firm innovation?" *Journal of Finance*, 69, 2085–2125.

Faulkender, M., Flannery, M. J., Hankins, K. W., and Smith, J. M., 2012, "Cash flows and leverage adjustments," *Journal of Financial Economics*, 103, 632–646.

Faulkender, M., and Wang, R., 2006, "Corporate financial policy and the value of cash," *Journal of Finance*, 61, 1957–1990.

Fischer, E., Heinkel, R., and Zechner, J., 1989, "Dynamic capital structure choice: Theory and tests," *Journal of Finance*, 44, 19–40.

Flannery, M. J., and Rangan, K. P., 2006, "Partial adjustment toward target capital structures," *Journal of Financial Economics*, 79, 469–506.

Flannery, M. J., and Hankins, K. W., 2013, "Estimating dynamic panel models in corporate finance," *Journal of Corporate Finance*, 19, 1–19.

Frank, M. Z., and Goyal, V. K., 2009, "Capital structure decisions: Which factors are reliably important?" *Financial Management*, 38, 1–37.

French, K. R., Schwert, G. W., and Stambaugh, R. F., 1987, "Expected stock returns and volatility," *Journal of Financial Economics*, 19, 3–29.

Graham, J. R., and Harvey, C. R., 2001, "The theory and practice of corporate finance: Evidence from the field," *Journal of Financial Economics*, 60, 187–243.

Grullon, G., Lyandres, E., and Zhdanov, A., 2012, "Real options, volatility, and stock returns," *Journal of Finance*, 67, 1499–1537.

Gulen, H., and Ion, M., 2016, "Policy uncertainty and corporate investment," *Review of Financial Studies*, 29, 523–564.

Harris, M., and Raviv, A., 1991, “The theory of capital structure,” *Journal of Finance*, 46, 297–355.

Hovakimian, A., 2004, “The role of target leverage in security issues and repurchases,” *Journal of Business*, 77, 1041–1072.

Hovakimian, A., Opler, T., and Titman, S., 2001, “The debt-equity choice,” *Journal of Financial and Quantitative Analysis*, 36, 1–24.

Huang, R., and Ritter, J. R., 2009, “Testing theories of capital structure and estimating the speed of adjustment,” *Journal of Financial and Quantitative Analysis*, 44, 237–271.

Im, H. J., Mayer, C., and Sussman, O., 2016, “Investment spike financing,” Working Paper, University of Oxford and Peking University.

Jensen, M. C., 1986, “Agency cost of free cash flow, corporate finance, and takeovers,” *American Economic Review*, 76, 323–329.

Jensen, M. C., and Meckling, W. H., 1976, “Theory of the firm: Managerial behavior, agency costs and ownership structure,” *Journal of Financial Economics*, 3, 305–360.

Kale, J. R., Noe, T. H., and Ramí, G. G., 1991, “The effect of business risk on corporate capital structure: Theory and evidence,” *Journal of Finance*, 46, 1693–1715.

Korajczyk, R. A., and Levy, A., 2003, “Capital structure choice: Macroeconomic conditions and financial constraints,” *Journal of Financial Economics*, 68, 75–109.

Kyle, A. S., 1985, “Continuous auctions and insider trading.,” *Econometrica* 53, 1315–1335.

Leary, M. T., and Roberts, M. R., 2005, “Do firms rebalance their capital structures?” *Journal of Finance*, 60, 2575–2619.

Leahy, J. V., and Whited, T. M., 1996, “The effect of uncertainty on investment: Some stylized facts,” *Journal of Money, Credit and Banking*, 28, 64–83.

Lemmon, M. L., Roberts, M. R., and Zender, J. F., 2008, “Back to the beginning: Persistence and the cross-section of corporate capital structure,” *Journal of Finance*, 63, 1575–1608.

Lin, L., and Flannery, M. J., 2013, “Do personal taxes affect capital structure? Evidence from the 2003 tax cut,” *Journal of Financial Economics*, 109, 549–565.

Mayer, C., and Sussman, O., 2005, “Financing investment: A new test of capital structure,” Working Paper, University of Oxford.

McDonald, R. L., and Siegel, D. R., 1985, “Investment and the valuation of firms when there is an option to shut down,” *International Economic Review*, 26, 331–349.

Modigliani, F., and Miller, M. H., 1958, “The cost of capital, corporation finance and the theory of investment,” *American Economic Review*, 48, 261–297.

Myers, S. C., 1977, “Determinants of corporate borrowing,” *Journal of Financial Economics*, 5, 147–175.

Nickell, S., 1981, “Biases in dynamic models with fixed effects,” *Econometrica*, 49, 1417–1426.

Nini, G., Smith D. C., Sufi A., 2009, “Creditor control rights and firm investment policy,” *Journal of Financial Economics*,92(3), 400–420.

Öztekin, Ö., and Flannery, M. J., 2012, “Institutional determinants of capital structure adjustment speeds,” *Journal of Financial Economics*, 103, 88–112.

Stefanescu, I., and Shivdasani, A., 2010, “How do pensions affect capital structure decisions?” *Review of Financial Studies*, 23, 1287–1323.

Standard and Poor’s, 2015, 2014 Annual U.S. corporate default study and rating transitions, available at https://www.globalcreditportal.com/ratingsdirect

Strebulaev, I. A., 2007, “Do tests of capital structure theory mean what they say?” *Journal of Finance*, 62, 1747–1787.

Stulz, R, 1990, “Managerial discretion and optimal financing policies,” *Journal of Financial Economics*, 26, 3–27.

Veracierto, M. L., 2002, “Plant-level irreversible investment and equilibrium business cycles,” *American Economic Review*, 92, 181–197.

Welch, I., 2004, “Capital structure and stock returns,” *Journal of Political Economy*, 112, 106–132.

Table I
Variable Definitions and Summary Statistics

This table shows definitions of, and summary statistics for, the variables used in this study. Panel A provides definitions of the main variables. The italicized codes in brackets ([]) represent item codes in CRSP/Compustat Merged Database. Panel B reports summary statistics for variables constructed using a sample of U.S. public firms in the manufacturing industry from 1988 to 2014. The sample consists of firms which have at least 10 years of uninterrupted observations. All variables are winsorized at the first and 99th percentiles.

Panel A. Variable Definitions

Abbreviation	Definition	Calculation
Leverage-related variables		
$BDR_{i,t}$	Book leverage	Total debt ([*dltt*]+[*dlc*]) over book total assets [*at*]
$BDR^p_{i,t-1}$	Book leverage before active adjustment	Total debt ([*dltt*]+[*dlc*]) at the beginning of year t over the sum of book total assets [*at*] at the beginning of year t and net income [*ni*] during year t
$MDR_{i,t}$	Market leverage	Total debt ([*dltt*]+[*dlc*]) over market value of total assets ([*dltt*]+[*dlc*]+[*cshpri*]*[*prcc_f*])
$BDR^\star_{i,t}$	Book target	Target book leverage ratio estimated using System GMM in Table 2, Panel A
$MDR^\star_{i,t}$	Market target	Target market leverage ratio estimated using System GMM in Table 2, Panel B
$\Delta BDR^p_{i,t}$	Active book adjustment	Change in book leverage from the book leverage before active adjustment ($BDR_{i,t} - BDR^p_{i,t-1}$)
$\Delta MDR_{i,t}$	Market adjustment	Change in market leverage during year t ($MDR_{i,t} - MDR_{i,t-1}$)
$BDEV^p_{i,t}$	Active book deviation	Deviation of book leverage before active adjustment from book target at the beginning of year t ($BDR^\star_{i,t} - BDR^p_{i,t-1}$)
$MDEV_{i,t}$	Market deviation	Deviation of market leverage from market target at the beginning of year t ($MDR^\star_{i,t} - MDR_{i,t-1}$)
$BADJ^p_{i,t}$	Active book adjustment rate	Active book adjustment ($\Delta BDR^p_{i,t}$) divided by active book deviation ($BDEV^p_{i,t}$)
$MADJ_{i,t}$	Market adjustment rate	Market adjustment ($\Delta MDR_{i,t}$) divided by market deviation ($MDEV_{i,t}$)
Uncertainty-related variables		
$UNC\_RAW_{i,t}$	Raw uncertainty measure	Standard deviation of firm i's daily stock returns available for fiscal year t
$UNC_{i,t}$	Standardized uncertainty measure	$\frac{UNC\_RAW_{i,t} - \overline{UNC\_RAW_{i,t}}}{\sigma(UNC\_RAW_{i,t})}$, where $\overline{UNC\_RAW_{i,t}}$ and $\sigma(UNC\_RAW_{i,t})$ are the mean and standard deviation of $UNC\_RAW_{i,t}$
$D\_HighUNC_{i,t}$	High-uncertainty dummy	Dummy variable, which equals one if a firm's uncertainty ($UNC\_RAW_{i,t}$) is higher than its sample median, and zero otherwise.
Control variables		
$LnTA_{i,t}$	Firm size	Natural logarithm of total assets denominated in year-2000 dollars
$MV\_BV_{i,t}$	Market-to-book ratio	Market total assets ([*dlc*] + [*dltt*] + [*cshrpi*] * [*prcc_f*]) to book total assets ([*at*])
$EBIT\_TA_{i,t}$	Profitability	Earnings before interests and taxes ([*ib*]+[*xint*]+[*txt*]) over total assets ([*at*])
$FA\_TA_{i,t}$	Tangibility	Total property, plant and equipment net of accumulated depreciation ([*ppent*]) over total assets ([*at*])
$DEP\_TA_{i,t}$	Depreciation	Depreciation and amortization ([*dp*]) over total assets ([*at*])
$RD\_TA_{i,t}$	R&D intensity	R&D expenses ([*xrd*]) over total assets ([*at*]) (0 if missing)
$D\_RD_{i,t}$	R&D dummy	Dummy variable, which equals one if a firm does not report R&D expenses in year t, and zero otherwise.
$\overline{BDR}_{j,t}$	Industry median book leverage	Industry median book leverage, where industry is defined following Fama and French (1997)
$\overline{MDR}_{j,t}$	Industry median market leverage	Industry median market leverage, where industry defined following Fama and French (1997)
Investment-related variables		
$INV\_TA_{i,t}$	Investment rate	Sum of capital and acquisition expenditures ([*capx*]+[*aqc*]) over total assets ([*at*]) measured at the beginning of year t
$D\_Spike_{i,t}$	Investment-spike dummy	Dummy variable, which equals one if a firm has experienced an investment spike in year t, and zero otherwise.

Panel B. Summary Statistics

Variables	Obs.	Mean	S.D.	P01	P25	Median	P75	P99
Leverage-related variables								
$BDR_{i,t}$	29,546	0.186	0.159	0.000	0.032	0.168	0.294	0.480
$MDR_{i,t}$	29,546	0.184	0.193	0.000	0.018	0.127	0.286	0.597
$BDR^{*}_{i,t}$	29,546	0.187	0.134	0.000	0.078	0.176	0.274	0.429
$MDR^{*}_{i,t}$	29,546	0.189	0.165	0.000	0.060	0.151	0.277	0.524
$\Delta BDR^{p}_{i,t}$	29,546	0.001	0.084	-0.122	-0.025	0.000	0.024	0.140
$\Delta MDR_{i,t}$	29,546	0.001	0.098	-0.162	-0.036	0.000	0.031	0.177
$BDEV^{p}_{i,t}$	29,546	0.002	0.122	-0.219	-0.054	0.009	0.071	0.188
$MDEV_{i,t}$	29,546	0.005	0.144	-0.265	-0.058	0.009	0.083	0.235
$BADJ^{p}_{i,t}$	28,544	0.321	2.755	-2.220	-0.100	0.106	0.735	3.343
$MADJ_{i,t}$	28,352	0.208	3.107	-2.840	-0.154	0.107	0.768	3.469
Uncertainty-related variables								
$UNC\_RAW_{i,t}$	29,546	0.035	0.020	0.013	0.021	0.030	0.044	0.075
$UNC_{i,t}$	29,546	-0.011	0.999	-1.133	-0.743	-0.253	0.450	1.980
$D\_HighUNC_{i,t}$	29,546	0.495	0.500	0.000	0.000	0.000	1.000	1.000
Control variables								
$LnTA_{i,t}$	29,546	5.455	2.062	2.293	3.924	5.324	6.843	9.175
$MV\_BV_{i,t}$	29,546	1.669	1.434	0.522	0.831	1.203	1.922	4.497
$EBIT\_TA_{i,t}$	29,546	0.036	0.192	-0.352	0.008	0.080	0.135	0.237
$FA\_TA_{i,t}$	29,546	0.241	0.162	0.034	0.115	0.208	0.335	0.564
$DEP\_TA_{i,t}$	29,546	0.042	0.022	0.012	0.026	0.038	0.053	0.084
$RD\_TA_{i,t}$	29,546	0.061	0.097	0.000	0.000	0.024	0.079	0.249
$D\_RD_{i,t}$	29,546	0.255	0.436	0.000	0.000	0.000	1.000	1.000
$\overline{BDR}_{j,t}$	29,546	0.161	0.084	0.043	0.083	0.158	0.226	0.294
$\overline{MDR}_{j,t}$	29,546	0.136	0.098	0.018	0.052	0.125	0.203	0.313
Investment-related variables								
$INV\_TA_{i,t}$	28,170	0.089	0.146	0.006	0.024	0.051	0.100	0.287
$D\_Spike_{i,t}$	28,170	0.028	0.166	0.000	0.000	0.000	0.000	0.000

Table II

Estimation of the Sensitivity of Leverage Targets to Uncertainty

This table reports the results of the target leverage estimation regressions using OLS, WG, LSDVC, and System GMM estimators. The empirical model used is: $L_{i,t} = Constant + (1-\lambda)L_{i,t-1} + \lambda\beta UNC_{i,t-1} + \lambda\gamma X_{i,t-1} + Year\ Dummies + \eta_i + \upsilon_{i,t}$. The dependent variables are book leverage (*BDR*) and market leverage (*MDR*) in Panels A and B, respectively. Details for variables included in the models are provided in Table I. In OLS and WG estimators, standard errors are clustered by firm and displayed in parentheses below. In LSDVC models, Blundell-Bond estimators are chosen as an initial estimator. We calculated a bootstrap variance-covariance matrix for corrected LSDV using 50 repetitions. In System GMM, we report two-step GMM coefficients and standard errors that are asymptotically robust to both heteroskedasticity and serial correlation, and which use the finite-sample correction proposed by Windmeijer (2005). Instrument variables used in System GMM are the first to eighth lags of standardized uncertainty, the second to all available lags of leverage (*BDR* and *MDR* in Panel A and B), and the second to eighth lags of firm-specific control variables for the equations in first-differences, and the change of standardized uncertainty, the first lag of change in leverage, and the first lag of change in all firm-specific control variables for level equations. Note that year dummies are treated as instruments for the equations in levels only. m1 and m2 represent the test statistics of Arellano-Bond tests for first-order and second-order serial correlations in first-differenced residuals, respectively. Sargan/Hansen represents the J stats for overidentifying restrictions. Overall goodness-of-fit scores are reported for OLS, WG, LSDVC, and System GMM. *, **, and *** indicate statistical significance at the 10%, 5%, and 1% levels, respectively.

Panel A. Book Leverage Ratios

Variables	(1) OLS $BDR_{i,t}$	(2) WG $BDR_{i,t}$	(3) LSDVC $BDR_{i,t}$	(4) System GMM $BDR_{i,t}$
$BDR_{i,t-1}$	0.829***	0.641***	0.744***	0.748***
	(0.005)	(0.008)	(0.006)	(0.010)
$UNC_{i,t-1}$	-0.001	-0.003***	-0.004***	-0.004***
	(0.001)	(0.001)	(0.001)	(0.001)
$LnTA_{i,t-1}$	0.003***	0.011***	0.009***	0.003***
	(0.000)	(0.001)	(0.001)	(0.001)
$MV\_BV_{i,t-1}$	-0.001**	-0.001**	-0.001***	-0.001
	(0.000)	(0.001)	(0.001)	(0.001)
$EBIT\_TA_{i,t-1}$	-0.013***	-0.025***	-0.024***	-0.016**
	(0.004)	(0.006)	(0.005)	(0.007)
$FA\_TA_{i,t-1}$	0.029***	0.056***	0.048***	0.085***
	(0.005)	(0.010)	(0.009)	(0.014)
$DEP\_TA_{i,t-1}$	-0.168***	-0.212***	-0.235***	-0.472***
	(0.030)	(0.051)	(0.048)	(0.064)
$RD\_TA_{i,t-1}$	-0.016*	-0.010	-0.009	-0.009
	(0.009)	(0.016)	(0.017)	(0.019)
$D\_RD_{i,t-1}$	0.005***	0.007**	0.006*	0.016***
	(0.001)	(0.004)	(0.004)	(0.005)
$\overline{BDR}_{j,t-1}$	0.049***	0.072***	0.050***	0.038**
	(0.008)	(0.016)	(0.017)	(0.019)
$Constant$	0.026***	0.017*		0.037***
	(0.004)	(0.009)		(0.008)
Firm fixed effects	No	Yes	Yes	Yes
Year fixed effects	Yes	Yes	Yes	Yes
Number of observations	29,546	29,546	29,546	29,546
Number of firms	1,909	1,909	1,909	1,909
Goodness of fit—$Corr(BDR_{i,t}, \widehat{BDR}_{i,t})^2$	0.740	0.721	0.732	0.735
m1				-23.150
(*p*-value)				0.000
m2				-0.170
(*p*-value)				0.863
Sargan/Hansen				1,889
(*p*-value)				0.920
Speed of adjustment ($\widehat{\lambda}$)	0.171***	0 .359***	0.256***	0.252***
	(0.005)	(0.008)	(0.006)	(0.010)
Target-uncertainty sensitivity ($\widehat{\beta}$)	-0.005	-0.009***	-0.014***	-0.015***
	(0.004)	(0.003)	(0.003)	(0.005)

Panel B. Market Leverage Ratios

Variables	(1) OLS $MDR_{i,t}$	(2) WG $MDR_{i,t}$	(3) LSDVC $MDR_{i,t}$	(4) System GMM $MDR_{i,t}$
$MDR_{i,t-1}$	0.832***	0.630***	0.739***	0.767***
	(0.005)	(0.008)	(0.006)	(0.009)
$UNC_{i,t-1}$	-0.005***	-0.008***	-0.009***	-0.014***
	(0.001)	(0.001)	(0.001)	(0.001)
$LnTA_{i,t-1}$	0.000	0.019***	0.017***	-0.002*
	(0.000)	(0.002)	(0.001)	(0.001)
$MV\_BV_{i,t-1}$	-0.002***	-0.001**	-0.001	-0.002***
	(0.000)	(0.000)	(0.001)	(0.001)
$EBIT\_TA_{i,t-1}$	-0.012***	-0.029***	-0.028***	-0.014*
	(0.004)	(0.006)	(0.006)	(0.008)
$FA\_TA_{i,t-1}$	0.031***	0.066***	0.057***	0.067***
	(0.005)	(0.012)	(0.010)	(0.015)
$DEP\_TA_{i,t-1}$	-0.229***	-0.224***	-0.241***	-0.524***
	(0.033)	(0.055)	(0.057)	(0.072)
$RD\_TA_{i,t-1}$	-0.032***	-0.011	-0.007	-0.031*
	(0.008)	(0.014)	(0.020)	(0.017)
$D\_RD_{i,t-1}$	0.010***	0.010**	0.008*	0.018***
	(0.002)	(0.005)	(0.004)	(0.006)
$\overline{MDR}_{j,t-1}$	0.055***	0.115***	0.093***	0.049***
	(0.009)	(0.017)	(0.016)	(0.017)
$Constant$	0.041***	-0.033***		0.068***
	(0.004)	(0.009)		(0.008)
Firm fixed effects	No	Yes	Yes	Yes
Year fixed effects	Yes	Yes	Yes	Yes
Observations	29,546	29,546	29,546	29,546
Number of firms	1,909	1,909	1,909	1,909
Goodness of fit—$Corr(MDR_{i,t}, \widehat{MDR}_{i,t})^2$	0.747	0.686	0.709	0.743
m1				-24.030
(p-value)				0.000
m2				-1.469
(p-value)				0.142
Sargan/Hansen				1,886
(p-value)				0.929
Speed of adjustment ($\widehat{\lambda}$)	0.168***	0.370***	0.261***	0.233***
	(0.005)	(0.008)	(0.006)	(0.009)
Target-uncertainty sensitivity ($\widehat{\beta}$)	-0.029***	-0.022***	-0.033***	-0.061***
	(0.006)	(0.003)	(0.004)	(0.007)

Table III
Comparison of Target Leverage Ratios by the Level of Uncertainty

Panel A reports summary statistics for target leverage ratios, both with and without firm fixed effects. It further shows the summary statistics for high and low uncertainty groups. The difference in the mean and median between the two groups are reported with t-stat/z-stat (of Wilcoxon rank-sum test) at the bottom. Panel B presents the variance decomposition of the target leverage ratios for several different model specifications, with R-squares at the bottom. The results for book target leverage ratios and market target leverage ratios are presented in column (1) to (6) and column (7) to (12), respectively. Variable definitions are provided in Table I.

Panel A. Target leverage by uncertainty

Variables	Obs.	Mean	S.D.	P05	P25	Median	P75	P95
				Book leverage				
Book target without firm fixed effect	29,546	0.185	0.082	0.056	0.127	0.181	0.238	0.327
Firm fixed effect in book target ($\widehat{\eta}_i^*$)	1,909	0.007	0.131	-0.174	-0.086	-0.011	0.081	0.239
Proportion of fixed effect in book target	1,357	0.372	0.246	0.040	0.171	0.331	0.534	0.838
Book target with firm fixed effect	29,546	0.187	0.134	0.000	0.078	0.176	0.274	0.429
High-uncertainty firms	14,773	0.164	0.139	0.000	0.049	0.137	0.250	0.433
Low-uncertainty firms	14,773	0.210	0.125	0.013	0.117	0.208	0.289	0.427
Difference		*-0.046*				*-0.071*		
t-stat/z-stat		*-30.14*				*-35.09*		
				Market leverage				
Market target without firm fixed effect	29,546	0.186	0.097	0.002	0.119	0.186	0.253	0.346
Firm fixed effect in market target ($\widehat{\eta}_i^*$)	1,909	0.011	0.160	-0.204	-0.087	-0.012	0.085	0.321
Proportion of fixed effect in market target	1,263	0.417	0.265	0.036	0.202	0.388	0.605	0.909
Market target with firm fixed effect	29,546	0.189	0.165	0.000	0.060	0.151	0.277	0.524
High-uncertainty firms	14,773	0.168	0.172	0.000	0.026	0.118	0.255	0.523
Low-uncertainty firms	14,773	0.209	0.154	0.012	0.096	0.179	0.292	0.524
Difference		*-0.042*				*-0.061*		
t-stat/z-stat		*-21.99*				*-32.48*		

Panel B. Variance decomposition of target leverage

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)
Variables	Book target leverage						Market target leverage					
Firm fixed effects	0.994		0.993	0.924		0.928	0.960		0.960	0.903		0.913
Year fixed effects		0.210	0.001		0.047	0.000		0.525	0.004		0.123	0.000
$UNC_{i,t-1}$	0.006	0.790	0.006	0.005	0.020	0.004	0.040	0.475	0.036	0.047	0.003	0.040
$LnTA_{i,t-1}$				0.003	0.311	0.002				0.001	0.015	0.001
$MV\_BV_{i,t-1}$				0.001	0.031	0.001				0.002	0.236	0.002
$EBIT\_TA_{i,t-1}$				0.003	0.078	0.003				0.001	0.093	0.002
$FA\_TA_{i,t-1}$				0.028	0.193	0.027				0.012	0.114	0.011
$DEP\_TA_{i,t-1}$				0.028	0.117	0.028				0.022	0.127	0.023
$RD\_TA_{i,t-1}$				0.000	0.027	0.000				0.001	0.046	0.001
$D\_RD_{i,t-1}$				0.007	0.034	0.007				0.007	0.093	0.007
$\overline{BDR}_{j,t-1}$				0.002	0.142	0.001						
$\overline{MDR}_{j,t-1}$										0.004	0.150	0.003
Observations	29,546	29,546	29,546	29,546	29,546	29,546	29,546	29,546	29,546	29,546	29,546	29,546
R-squared	0.952	0.033	0.953	0.997	0.267	0.997	0.956	0.044	0.960	0.991	0.305	0.991

Table IV

Effects of Uncertainty on Leverage Adjustment Speeds

This table reports the results of regression analyses examining how uncertainty affects the speed of adjustment. Panel A reports the regression results with respect to book leverage ratios. The first columns of each sample present results from the regression model: $\Delta BDR_{i,t}^{p} = Constant + \lambda BDEV_{i,t}^{p} + \varepsilon_{i,t}$. In the second and third columns of each sample, λ is modelled as $\lambda_0 + \lambda_1 UNC_{i,t-1}$ or $\lambda_0 + \lambda_1 D\_HighUNC_{i,t-1}$. The results for full sample, over-levered sample, and under-levered sample are reported in column (1) to (3), column (4) to (6), and column (7) to (9), respectively. In Panel B, the results for market leverage ratios are presented. Details for variables included in the models are provided in Table I. Bootstrapped standard errors are reported in parentheses. *, **, and *** indicate statistical significance at the 10%, 5%, and 1% levels, respectively.

Panel A. Book Adjustment Speeds

	Full sample			Over-levered firms			Under-levered firms		
Variables	(1) $\Delta BDR_{i,t}^{p}$	(2) $\Delta BDR_{i,t}^{p}$	(3) $\Delta BDR_{i,t}^{p}$	(4) $\Delta BDR_{i,t}^{p}$	(5) $\Delta BDR_{i,t}^{p}$	(6) $\Delta BDR_{i,t}^{p}$	(7) $\Delta BDR_{i,t}^{p}$	(8) $\Delta BDR_{i,t}^{p}$	(9) $\Delta BDR_{i,t}^{p}$
$BDEV_{i,t}^{p}$	0.356***	0.335***	0.294***	0.469***	0.414***	0.356***	0.405***	0.405***	0.421***
	(0.005)	(0.005)	(0.007)	(0.012)	(0.014)	(0.018)	(0.018)	(0.019)	(0.015)
$BDEV_{i,t}^{p} \times UNC_{i,t-1}$		0.054***			0.053***			-0.002	
		(0.004)			(0.007)			(0.008)	
$BDEV_{i,t}^{p} \times D\_HighUNC_{i,t-1}$			0.096***			0.129***			-0.025
			(0.011)			(0.016)			(0.017)
Constant	0.000	0.002***	0.001***	0.021***	0.016***	0.017***	-0.013***	-0.014***	-0.014***
	(0.000)	(0.000)	(0.000)	(0.001)	(0.001)	(0.001)	(0.002)	(0.002)	(0.001)
Observations	29,546	29,546	29,546	9,750	9,750	9,750	9,750	9,750	9,750
R-squared	0.269	0.277	0.273	0.289	0.300	0.298	0.118	0.118	0.119

Panel B. Market Adjustment Speeds

	Full sample			Over-levered firms			Under-levered firms		
Variables	(1) $\Delta MDR_{i,t}$	(2) $\Delta MDR_{i,t}$	(3) $\Delta MDR_{i,t}$	(4) $\Delta MDR_{i,t}$	(5) $\Delta MDR_{i,t}$	(6) $\Delta MDR_{i,t}$	(7) $\Delta MDR_{i,t}$	(8) $\Delta MDR_{i,t}$	(9) $\Delta MDR_{i,t}$
$MDEV_{i,t}$	0.293***	0.280***	0.263***	0.360***	0.323***	0.313***	0.246***	0.246***	0.242***
	(0.005)	(0.004)	(0.009)	(0.010)	(0.011)	(0.016)	(0.016)	(0.012)	(0.013)
$MDEV_{i,t} \times UNC_{i,t-1}$		0.036***			0.030***			0.015	
		(0.004)			(0.005)			(0.010)	
$MDEV_{i,t} \times D\_HighUNC_{i,t-1}$			0.047***			0.052***			0.007
			(0.011)			(0.016)			(0.015)
Constant	-0.001*	0.000	-0.000	0.009***	0.005***	0.007***	0.002	0.003*	0.003
	(0.000)	(0.000)	(0.001)	(0.002)	(0.001)	(0.001)	(0.002)	(0.002)	(0.002)
Observations	29,546	29,546	29,546	9,750	9,750	9,750	9,750	9,750	9,750
R-squared	0.186	0.190	0.187	0.129	0.132	0.130	0.047	0.048	0.047

Table V

DiD Analysis—Global Financial Crisis

This table presents a DiD analysis of how uncertainty changes due to the exogenous shock of Global Financial Crisis affect firms' capital structure dynamics, i.e., target leverage and speed of adjustment toward the target. Panel A provides prematch propensity score regression and postmatch diagnostic regression. Both regressions are based on a probit model and the dependent variable is a dummy variable, which equals one if a firm belongs to the treatment group and zero otherwise. We identify the treatment group and control group by calculating uncertainty changes between the pre-Crisis year (2006) and the post-Crisis year (2008) as the change in uncertainty for each firm due to the Crisis. We then define the top tercile of firms whose uncertainty increased the most at the time of the Crisis (2007) as the treatment group and the bottom tercile as the control group. We use the same set of explanatory variables as the one in the target leverage estimation. Note that we perform one-to-one propensity score matching, where we retain the pair of firms with the smallest distance in propensity scores. Panel B reports the distributions of estimated propensity scores for treatment group, control group, and the differences in propensity scores between the two groups. Panel C presents the differences in characteristics of the two groups using univariate t-tests. Panel D provides the estimation results for the impact of the exogenous shock on the target leverage ratios. $D\_Treatment_i$ is a dummy variable which equals one if a firm belongs to the treatment group and zero otherwise. D_Post_{t-1} is a dummy variable which equals one for the period 2008-2010 and zero otherwise (2004-2007). Firm-clustered standard errors and two-step GMM standard errors with Windmeijer (2005) correction are presented in parentheses for OLS and System GMM, respectively. Panel E provides the estimation results for the impact of exogenous shock on the speed of adjustments. Note that over-levered (under-levered) high-uncertainty firms are matched to over-levered (under-levered) low-uncertainty firms. Bootstrapped standard errors are reported in parentheses. Details for variables included in the models are provided in Table I. In all panels, standard errors are reported in parentheses. *, **, and *** denote statistical significance at the 10%, 5%, and 1% levels, respectively.

Panel A. Prematch Propensity Score Regression and Postmatch Diagnostic Regression

	Dummy=1 if in treatment group; 0 if control group	
Variables	Prematch	Postmatch
$UNC_{i,t-1}$	-0.724***	0.333
	(0.137)	(0.219)
$MDR_{i,t-1}$	1.434***	-0.116
	(0.516)	(0.845)
$LnTA_{i,t-1}$	-0.179***	0.049
	(0.039)	(0.065)
$MV\_BV_{i,t-1}$	-0.082*	0.018
	(0.050)	(0.072)
$EBIT\_TA_{i,t-1}$	-2.029***	0.255
	(0.418)	(0.744)
$FA\_TA_{i,t-1}$	1.384**	-0.408
	(0.618)	(0.945)
$DEP\_TA_{i,t-1}$	-5.060	4.095
	(3.898)	(5.904)
$RD\_TA_{i,t-1}$	-0.517	-0.287
	(0.890)	(1.565)
$D\_RD_{i,t-1}$	0.191	-0.281
	(0.172)	(0.299)
$\overline{MDR}_{j,t-1}$	-0.704	20.585
	(3.868)	(13.194)
Constant	-0.321	-3.367
	(0.743)	(2.265)
Industry fixed effects	Yes	Yes
Observations	613	250
χ^2	156.9	15.91
p-value of χ^2	0.000	0.955
Pseudo R^2	0.185	0.046

Panel B. Estimated Propensity Score Distributions

Propensity Scores	Obs.	Mean	Min	P5	P25	P50	P75	P95	Max
Treatment	127	0.494	0.112	0.177	0.478	0.494	0.206	0.855	0.983
Control	127	0.494	0.112	0.179	0.477	0.494	0.206	0.854	0.996
Difference	-	0.001	0.000	0.000	0.001	0.001	0.002	0.003	0.014

Panel C. Differences in Pre-shock Characteristics

	Treatment	Control	Difference	t-statistic
$UNC_{i,t-1}$	-0.446	-0.488	0.042	0.713
$MDR_{i,t-1}$	0.130	0.122	0.008	0.524
$LnTA_{i,t-1}$	5.694	5.637	0.058	0.260
$MV\_BV_{i,t-1}$	1.841	1.892	-0.051	-0.308
$EBIT\_TA_{i,t-1}$	0.031	0.025	0.007	0.285
$FA\_TA_{i,t-1}$	0.197	0.197	0.000	-0.004
$DEP\_TA_{i,t-1}$	0.037	0.035	0.002	0.878
$RD\_TA_{i,t-1}$	0.067	0.072	-0.006	-0.469
$D\_RD_{i,t-1}$	0.165	0.213	-0.047	-0.973
$\overline{MDR}_{j,t-1}$	0.090	0.082	0.008	1.001

Panel D. Target Leverage Ratios

Variables	OLS $MDR_{i,t}$	System GMM $MDR_{i,t}$
$MDR_{i,t-1}$	0.766***	0.646***
	(0.024)	(0.044)
D_Post_{t-1}	-0.014**	-0.034***
	(0.006)	(0.009)
$D\_Treatment_i$	0.031***	0.027***
	(0.006)	(0.008)
$D\_Treatment_i \times D\_Post_{t-1}$	-0.078***	-0.036***
	(0.011)	(0.014)
$LnTA_{i,t-1}$	0.005***	0.015**
	(0.001)	(0.007)
$MV\_BV_{i,t-1}$	-0.003**	-0.006**
	(0.001)	(0.003)
$EBIT\_TA_{i,t-1}$	0.022	-0.003
	(0.017)	(0.030)
$FA\_TA_{i,t-1}$	0.021	-0.048
	(0.026)	(0.078)
$DEP\_TA_{i,t-1}$	0.048	-0.650**
	(0.152)	(0.314)
$RD\_TA_{i,t-1}$	-0.013	-0.019
	(0.029)	(0.059)
$D\_RD_{i,t-1}$	0.017*	-0.001
	(0.009)	(0.030)
$\overline{MDR}_{j,t-1}$	0.015	0.135*
	(0.040)	(0.077)
Constant	-0.002	-0.000
	(0.009)	(0.039)
Observations	1,699	1,699
Number of firms	254	254
Goodness of fit—$Corr(MDR_{i,t}, \widehat{MDR}_{i,t})^2$	0.655	0.616
m1 (p-value)		0.000
m2 (p-value)		0.624
Sargan/Hansen (p-value)		0.730

Panel E. Speed of Adjustment

Variables	Full sample $\Delta MDR_{i,t}$	Over-levered $\Delta MDR_{i,t}$	Under-levered $\Delta MDR_{i,t}$
$MDEV_{i,t}$	0.219***	0.072	0.388***
	(0.035)	(0.050)	(0.110)
$MDEV_{i,t} \times D\_Post_t$	0.116**	0.209**	-0.022
	(0.052)	(0.083)	(0.100)
$MDEV_{i,t} \times D\_Treatment_i$	0.011	0.029	-0.121
	(0.052)	(0.070)	(0.205)
$MDEV_{i,t} \times D\_Treatment_i \times D\_Post_t$	0.150**	0.516***	0.244
	(0.069)	(0.161)	(0.248)
Constant	0.001	0.004	0.012
	(0.002)	(0.005)	(0.009)
Observations	1,699	622	310
R-squared	0.263	0.160	0.265

Table VI
Uncertainty, Major Investments, and Adjustment Speeds

This table reports the results of regression analyses examining how uncertainty affects the speed of adjustment when firms face major investments. Panel A reports the regression results with respect to book leverage ratios. The first columns of each sample present results from the regression model $\Delta BDR^p_{i,t} = Constant + \lambda BDEV^p_{i,t} + \varepsilon_{i,t}$, in which λ is modelled as $\lambda_0 + \lambda_2 D\_Spike_{i,t}$. The second columns of each sample present results from the regression model $\Delta BDR^p_{i,t} = Constant + \lambda BDEV^p_{i,t} + \varepsilon_{i,t}$, in which λ is modelled as $\lambda_0 + \lambda_1 D\_HighUNC_{i,t-1} + \lambda_2 D\_Spike_{i,t} + \lambda_3 D\_HighUNC_{i,t-1} \times D\_Spike_{i,t}$. $D\_Spike_{i,t}$ is a dummy variable which equals 1 if firm i experiences an investment spike in year t and zero otherwise. We treat firm i's investment in year t as an investment spike if firm i's investment rate exceeds its previous 3-year-average investment rate and is greater than 30% of its total assets at the beginning of year t following Elsas, Flannery, and Garfinkel (2014). $D\_HighUNC_{i,t-1}$ is a dummy variable which equals one if the firm i's uncertainty is higher than the sample median and zero otherwise. The results for full sample, over-levered sample, and under-levered sample are reported in column (1) to (2), column (3) to (4), and column (5) to (6), respectively. In Panel B, the results for market leverage ratios are reported. A detailed description of the variables included in the models is provided in Table I. Bootstrapped standard errors are reported in parentheses. *, **, and *** indicate statistical significance at the 10%, 5%, and 1% levels, respectively.

Panel A. Book Adjustment Speeds

	Full sample		Over-levered firms		Under-levered firms	
Variables	(1) $\Delta BDR^p_{i,t}$	(2) $\Delta BDR^p_{i,t}$	(3) $\Delta BDR^p_{i,t}$	(4) $\Delta BDR^p_{i,t}$	(5) $\Delta BDR^p_{i,t}$	(6) $\Delta BDR^p_{i,t}$
$BDEV^p_{i,t}$	0.243***	0.220***	0.281***	0.206***	0.197***	0.220***
	(0.004)	(0.005)	(0.010)	(0.015)	(0.016)	(0.016)
$BDEV^p_{i,t} \times D\_HighUNC_{i,t-1}$		0.038***		0.089***		-0.040***
		(0.008)		(0.014)		(0.011)
$BDEV^p_{i,t} \times D\_Spike_{i,t}$	0.652***	0.722***	-0.222***	-0.445***	0.834***	0.832***
	(0.039)	(0.048)	(0.082)	(0.120)	(0.038)	(0.048)
$BDEV^p_{i,t} \times D\_HighUNC_{i,t-1} \times D\_Spike_{i,t}$		-0.152**		0.380**		-0.007
		(0.075)		(0.161)		(0.076)
Constant	-0.001***	-0.001*	0.002	-0.001	0.000	-0.000
	(0.000)	(0.000)	(0.001)	(0.001)	(0.002)	(0.002)
Observations	27,334	27,334	8,967	8,967	8,877	8,877
R-squared	0.201	0.202	0.107	0.115	0.162	0.163

Panel B. Market Adjustment Speeds

	Full sample		Over-levered firms		Under-levered firms	
Variables	(1) $\Delta MDR_{i,t}$	(2) $\Delta MDR_{i,t}$	(3) $\Delta MDR_{i,t}$	(4) $\Delta MDR_{i,t}$	(5) $\Delta MDR_{i,t}$	(6) $\Delta MDR_{i,t}$
$MDEV_{i,t}$	0.230***	0.216***	0.274***	0.266***	0.145***	0.140***
	(0.004)	(0.007)	(0.011)	(0.019)	(0.012)	(0.013)
$MDEV_{i,t} \times D\_HighUNC_{i,t-1}$		0.023**		0.008		0.011
		(0.011)		(0.015)		(0.012)
$MDEV_{i,t} \times D\_Spike_{i,t}$	0.435***	0.543***	-0.219**	-0.502***	0.536***	0.607***
	(0.029)	(0.039)	(0.109)	(0.179)	(0.027)	(0.050)
$MDEV_{i,t} \times D\_HighUNC_{i,t-1} \times D\_Spike_{i,t}$		-0.242***		0.386*		-0.178***
		(0.073)		(0.228)		(0.062)
Constant	-0.002***	-0.002***	0.000	-0.000	0.007***	0.006***
	(0.000)	(0.000)	(0.002)	(0.002)	(0.001)	(0.001)
Observations	27,131	27,131	8,755	8,755	8,897	8,897
R-squared	0.145	0.146	0.069	0.069	0.079	0.080

Table VII
Mechanisms Through Which Uncertainty Affects Target Leverage

This table reports the results of the regression analyses used to examine the mechanisms through which uncertainty affects target leverage. To measure the value of tax shields scaled by total assets ($TXSHLD$), we estimate the value of the tax shield as the tax-deductible debt (sum of long-term debt and short-term debt) multiplied by the tax rate. To measure the costs of debt (COD), we use all-fees-in spread for syndicated loans from the Thomson Reuters DealScan database. To calculate Altman's (1968) Z-score (Z), we use the following formula: $Z = 1.2X_1 + 1.4X_2 + 3.3X_3 + 0.6X_4 + X_5$, where X_1 is a ratio of working capital to total assets, X_2 is a ratio of retained earnings to total assets, X_3 is a ratio of earnings before interest and taxes to total assets, X_4 is a ratio of market value of equity to book value of total liabilities, and X_5 is a ratio of sales to total assets. $SUMBLKS$ is the percentage of shares held by all blockholders, while $SUMAFLIN$ is the percentage of shares held by all affiliated blockholders. $VIOLYR$ is a dummy variable, which is equal to one if a firm reports a loan covenant violation in an SEC 10-K or 10-Q filing for a given year and zero otherwise. $Controls$ is the set of control variables used in Table II. Two-step GMM standard errors with Windmeijer (2005) correction are reported in parentheses. *, **, and *** denote statistical significance at the 10%, 5%, and 1% level, respectively.

Variables	(1) $MDR_{i,t}$	(2) $MDR_{i,t}$	(3) $MDR_{i,t}$	(4) $MDR_{i,t}$	(5) $MDR_{i,t}$	(6) $MDR_{i,t}$
$MDR_{i,t-1}$	0.753***	0.744***	0.759***	0.834***	0.825***	0.768***
	(0.011)	(0.023)	(0.010)	(0.029)	(0.026)	(0.015)
$UNC_{i,t-1}$	-0.016***	0.002	-0.014***	0.007	0.002	-0.007***
	(0.002)	(0.009)	(0.002)	(0.010)	(0.007)	(0.002)
$TXSHLD_{i,t-1}$	0.022*					
	(0.012)					
$UNC \times TXSHLD_{i,t-1}$	0.017					
	(0.013)					
$COD_{i,t-1}$		0.001				
		(0.004)				
$UNC \times COD_{i,t-1}$		-0.007***				
		(0.003)				
$Z_{i,t-1}$			-0.000			
			(0.000)			
$UNC \times Z_{i,t-1}$			0.000***			
			(0.000)			
$SUMBLKS_{i,t-1}$				-0.000		
				(0.000)		
$UNC \times SUMBLKS_{i,t-1}$				-0.000		
				(0.000)		
$SUMAFLIN_{i,t-1}$					0.000	
					(0.001)	
$UNC \times SUMAFLIN_{i,t-1}$					-0.000	
					(0.001)	
$VIOLYR_{i,t-1}$						-0.006
						(0.004)
$UNC \times VIOLYR_{i,t-1}$						-0.015***
						(0.004)
Control variables	Yes	Yes	Yes	Yes	Yes	Yes
Firm fixed effects	Yes	Yes	Yes	Yes	Yes	Yes
Year fixed effects	Yes	Yes	Yes	Yes	Yes	Yes
Observations	25,882	6,116	29,166	2,499	2,499	14,618
Number of firms	1,840	1,363	1,903	588	588	1,840
Goodness of fit—$Corr(MDR_{i,t}, \widehat{MDR}_{i,t})^2$	0.739	0.730	0.739	0.751	0.749	0.730
m1	-22.260	-7.282	-23.870	-7.501	-7.545	-17.32
(p-value)	0.000	0.000	0.000	0.000	0.000	0.000
m2	-0.782	2.719	-1.540	0.057	0.007	-1.211
(p-value)	0.434	0.007	0.124	0.955	0.995	0.226
Sargan/Hansen	1,750	994	1,880	515	516	1,735
(p-value)	0.210	0.278	0.998	0.304	0.293	0.909

Table VIII
Uncertainty and Credit Ratings Transition Frequency Matrix

This table reports the relationship between uncertainty and credit ratings. Panel A shows the results of the over-levered firm sample and Panel B shows the results of the under-levered firm sample. S&P domestic long term issuer credit rating is used for categorizing credit rating, we have merged minor categories into broader ones. For example, credit ratings such as AA+, AA, and AA- are all categorized into AA. Each row represents the initial credit rating of a firm (at the fiscal end of last year) and each column represents the credit rating at the fiscal year end. Proportion of each credit ratings and proportion of downgrades events are reported. Differences in proportions of each credit and their z-statistics are reported in the bottom rows, and differences in proportions of downgrade events and their z-statistics are reported in the last two columns.

Panel A. Over-levered Firms

		Rating at year end (frequency)												
Sample	Initial rating	AAA	AA	A	BBB	BB	B	CCC/CC	D	Total	Down	Prop.(%)	*Diff.(%)*	*z-stat*
High uncertainty	AAA	8	1	0	0	0	0	0	0	9	1	11.11	*8.67*	*1.202*
	AA	0	23	6	1	0	0	0	0	30	7	23.33	*16.41*	*2.701*
	A	0	1	243	28	0	0	0	1	273	29	10.62	*7.00*	*4.054*
	BBB	0	0	10	452	28	3	1	0	494	32	6.48	*4.31*	*3.474*
	BB	0	0	1	23	594	61	3	0	682	64	9.38	*8.22*	*4.372*
	B	0	0	0	1	35	405	10	1	452	11	2.43	*2.43*	*0.973*
	CCC/C	0	0	0	0	0	6	10	0	16	0	0.00	n.a.	n.a.
	D	0	0	0	0	0	0	0	0	0	n.a.	n.a.	n.a.	
	Total	8	25	260	505	657	475	24	2	1956	144	7.36	*4.49*	*5.919*
	Prop. (%)	0.41	1.28	13.29	25.82	33.59	24.28	1.23	0.10	100.00				
Low uncertainty	AAA	40	1	0	0	0	0	0	0	41	1	2.44		
	AA	0	121	9	0	0	0	0	0	130	9	6.92		
	A	0	5	553	21	0	0	0	0	579	21	3.63		
	BBB	0	0	12	530	12	0	0	0	554	12	2.17		
	BB	0	0	0	20	235	3	0	0	258	3	1.16		
	B	0	0	0	1	2	35	0	0	38	0	0.00		
	CCC/C	0	0	0	0	0	0	0	0	0	n.a.	n.a.		
	D	0	0	0	0	0	0	0	0	0	n.a.	n.a.		
	Total	40	127	574	572	249	38	0	0	1600	46	2.88		
	Prop. (%)	2.50	7.94	35.88	35.75	15.56	2.38	0.00	0.00	100.00				
Diff. in proportions	*Diff. (%)*	*-2.09*	*-6.66*	*-22.58*	*-9.93*	*18.03*	*21.91*	*1.23*	*0.10*					
	z-stat	*-5.376*	*-9.767*	*-15.811*	*-6.412*	*12.273*	*18.499*	*4.446*	*1.279*					

Panel B. Under-levered Firms

Sample	Initial rating	Rating at year end (frequency) AAA	AA	A	BBB	BB	B	CCC/CC	D	Total	Down	Prop.(%)	*Diff.(%)*	*z-stat*
High uncertainty	AAA	9	1	0	0	0	0	0	0	10	1	10.00	*3.55*	*0.424*
	AA	0	52	4	0	0	0	0	0	56	4	7.14	*2.24*	*0.676*
	A	0	0	234	19	3	0	0	0	256	22	8.59	*4.38*	*2.704*
	BBB	0	0	11	416	33	2	0	0	462	35	7.58	*5.85*	*4.774*
	BB	0	0	0	18	390	19	1	0	428	20	4.67	*4.17*	*2.685*
	B	0	0	0	0	28	157	1	0	186	1	0.54	*0.54*	*0.320*
	CCC/C	0	0	0	0	0	2	1	1	4	1	25.00	n.a.	
	D	0	0	0	0	0	0	0	0	0	n.a.	n.a.	n.a.	
	Total	9	53	249	453	454	180	3	1	1402	84	5.99	*2.81*	*3.935*
	Prop. (%)	0.64	3.78	17.76	32.31	32.38	12.84	0.21	0.07	100.00				
Low uncertainty	AAA	87	5	1	0	0	0	0	0	93	6	6.45		
	AA	1	232	12	0	0	0	0	0	245	12	4.90		
	A	0	7	721	29	3	0	0	0	760	32	4.21		
	BBB	0	0	26	599	11	0	0	0	636	11	1.73		
	BB	0	0	0	25	171	1	0	0	197	1	0.51		
	B	0	0	0	0	5	14	0	0	19	0	0.00		
	CCC/C	0	0	0	0	0	0	0	0	0	0	n.a.		
	D	0	0	0	0	0	0	0	0	0	n.a.	n.a.		
	Total	88	244	760	653	190	15	0	0	1950	62	3.18		
	Prop. (%)	4.51	12.51	38.97	33.49	9.74	0.77	0.00	0.00	100.00				
Diff. in proportions	*Diff. (%)*	*-3.87*	*-8.73*	*-21.21*	*-1.18*	*22.64*	*12.07*	*0.21*	*0.07*					
	z-stat	*-6.595*	*-8.776*	*-13.208*	*-0.714*	*16.411*	*14.726*	*2.044*	*1.18*					

Table IX
Uncertainty and Adjustment Benefits and Costs

This table reports the results of the regression analyses designed to examine the impacts of uncertainty on firms' adjustment benefits and costs. Panel A reports the results for the following model: $r_{i,t}(\text{or } r_{i,t} - r_{j,t}) = Constant + \beta_0(D_{i,t} - E_{i,t}) + \beta_1(D_{i,t} - E_{i,t}) \times D\_HighUNC_{i,t-1} + Controls + \varepsilon_{i,t}$. The dependent variable is raw returns ($r_{i,t}$) or returns in excess of industry mean returns ($r_{i,t} - r_{j,t}$). The independent variables include *i)* net debt issuance in excess of net equity issuance scaled by market capitalization at the end of previous fiscal year ($D_{i,t} - E_{i,t}$), and *ii)* its interaction with high-uncertainty firm dummy ($(D_{i,t} - E_{i,t}) \times D\_HighUNC_{i,t-1}$). The control variables include the changes in earnings, changes in total assets, changes in R&D expenses, changes in dividends, total external finance, changes in interest expenses, natural logarithm of lagged total assets, and lagged market-to-book ratios, as well as firm and year fixed effects. Columns (1) and (2) report the results for the over-levered firm sample, and Columns (3) and (4) report the results for the under-levered firm sample. Panel B reports the results for the following model: $Proxy_{i,t} = Constant + \beta_0 UNC_{i,t-1} + Controls + \varepsilon_{i,t}$. Relevant adjustment cost proxies ($Proxy_{i,t}$) are the underwriter spread of equity and the annual trading volume of bond for over-levered firms, and the underwriter spread of debt and the average daily trading volume of equity for under-levered firms. Control variables include all the control variables used in the target estimation, security characteristics, such as issuance amounts, a ratio of closed price to offer price, yield to maturity, credit ratings, and years to maturity, as well as industry and year fixed effects. Columns (2) and (3) include rating fixed effects. Columns (1) and (2) present the results for over-levered firms, Columns (3) and (4) those for under-levered firms. In both panels, firm-clustered standard errors are reported in parentheses. *, **, and *** denote statistical significance at the 10%, 5%, and 1% level, respectively.

Panel B. Adjustment benefits

Sample	Over-levered firms		Under-levered firms	
	(1)	(2)	(3)	(4)
Variables	$r_{i,t}$	$r_{i,t} - r_{j,t}$	$r_{i,t}$	$r_{i,t} - r_{j,t}$
$(D_{i,t} - E_{i,t})$	-0.352***	-0.351***	0.186***	0.186***
	(0.059)	(0.059)	(0.071)	(0.071)
$(D_{i,t} - E_{i,t}) \times D\_HighUNC_{i,t-1}$	-0.055**	-0.054**	-0.045	-0.044
	(0.022)	(0.022)	(0.057)	(0.057)
Firm Characteristics	Yes	Yes	Yes	Yes
Firm Fixed Effects	Yes	Yes	Yes	Yes
Year Fixed Effects	Yes	Yes	Yes	Yes
Observations	4,481	4,481	3,432	3,432
R-squared	0.279	0.278	0.325	0.326

Panel B. Adjustment costs

Sample	Over-levered firms		Under-levered firms	
	(1)	(2)	(3)	(4)
Variables	Underwriter spread of equity	Annual trading volume of bond	Underwriter spread of debt	Average daily trading volume of equity
$UNC_{i,t-1}$	0.061	0.681**	0.031	0.004***
	(0.085)	(0.266)	(0.066)	(0.000)
Firm Characteristics	Yes	Yes	Yes	Yes
Issue Characteristics	Yes	Yes	Yes	N/A
Year Fixed Effects	Yes	Yes	Yes	Yes
Industry Fixed Effects	Yes	Yes	Yes	Yes
Rating Fixed Effects	N/A	Yes	Yes	N/A
Observations	487	2,080	852	15,614
R-squared	0.603	0.149	0.617	0.291

Table X

Effects of Uncertainty on the Responsiveness of a Firm's Investment to a Demand Shock

This table reports the results of the regressions estimating the impact of uncertainty on a firm's responsiveness to a demand shock. The variables used are defined following Bloom, Bond, and Van Reenen (2007). Specifically, investment rate ($I_{i,t}/K_{i,t-1}$) is the ratio of investment ($INV_{i,t}$) to its lagged capital stock ($K_{i,t-1}$), and cash flow ($C_{i,t}/K_{i,t-1}$) is the ratio of cash flow (C) to its lagged capital stock. Investment (INV) is the sum of capital and acquisition expenditures (*capx* and *aqc*), and capital stock (K) is estimated using perpetual inventory method, sales growth ($\Delta y_{i,t}$) is measured as the natural logarithm of a firm's annual sales (*sale*), cash flow (C) is the sum of income before extraordinary items (*ib*) and depreciation and amortization expenses (*dp*). The small k stands for the natural logarithm of capital stock (K) and UNC is our standardized uncertainty measure. We report one-step coefficients and standard errors robust to autocorrelation and heteroscedasticity. GMM-style instrumental variables used in the System GMM estimation include the second to eighth lags of $I_{i,t}/K_{i,t-1}$, $\Delta y_{i,t}$, $(y-k)_{i,t}$, $C_{i,t}/K_{i,t-1}$, and $UNC_{i,t}$ for first difference equations, and the second to eighth lags of $\Delta(I_{i,t}/K_{i,t-1})$, $\Delta\Delta y_{i,t}$, $\Delta(y-k)_{i,t}$, $\Delta(C_{i,t}/K_{i,t-1})$, and $\Delta UNC_{i,t}$, for level equations. Note that year dummies are treated as IV-style instruments for the equations in levels only. m1 and m2 represent the test statistics of the Arellano-Bond test for first-order and second-order serial correlations in the first-differenced residuals, respectively. Sargan/Hansen represents the J stats for overidentifying restrictions. The goodness-of-fit measure is the squared correlation coefficient between actual and predicted levels of the dependent variable. *, **, and *** denote statistical significance at the 10%, 5%, and 1%, respectively.

Variables	(1) $I_{i,t}/K_{i,t-1}$	(2) $I_{i,t}/K_{i,t-1}$	(3) $I_{i,t}/K_{i,t-1}$	(4) $I_{i,t}/K_{i,t-1}$	(5) $I_{i,t}/K_{i,t-1}$
Sales growth ($\Delta y_{i,t}$)	0.514***	0.478***	0.535***	0.542***	0.548***
	(0.038)	(0.036)	(0.045)	(0.044)	(0.044)
Cash flow ($C_{i,t}/K_{i,t-1}$)	-0.061***	-0.056***	-0.057***	-0.057***	-0.056***
	(0.011)	(0.011)	(0.011)	(0.011)	(0.011)
Lagged cash flow ($C_{i,t-1}/K_{i,t-2}$)	0.023***	0.024***	0.024***	0.024***	0.024***
	(0.007)	(0.007)	(0.007)	(0.007)	(0.007)
Error correction term ($(y-k)_{i,t-1}$)	0.179***	0.188***	0.187***	0.187***	0.188***
	(0.015)	(0.016)	(0.016)	(0.016)	(0.016)
Sales growth squared ($(\Delta y_{i,t})^2$)		0.122***	0.124***	0.117***	0.115***
		(0.035)	(0.036)	(0.035)	(0.035)
Change in uncertainty ($\Delta UNC_{i,t}$)			0.013	0.024**	
			(0.016)	(0.011)	
Lagged uncertainty ($UNC_{i,t-1}$)			-0.010		
			(0.010)		
Uncertainty × sales growth ($UNC_{i,t} * \Delta y_{i,t}$)			-0.105**	-0.111***	-0.115***
			(0.041)	(0.041)	(0.040)
Constant	0.034*	0.020	-0.026	-0.024	0.015
	(0.018)	(0.019)	(0.023)	(0.023)	(0.019)
Firm fixed effects	Yes	Yes	Yes	Yes	Yes
Year fixed effects	Yes	Yes	Yes	Yes	Yes
Observations	25,835	25,835	25,835	25,835	25,835
Number of firms	1,888	1,888	1,888	1,888	1,888
Goodness of fit—$Corr(I_{i,t}/K_{i,t-1}, \widehat{I_{i,t}/K_{i,t-1}})^2$	0.134	0.145	0.150	0.149	0.150
m1	-18.36	-18.31	-18.29	-18.31	-18.31
(p-value)	0	0	0	0	0
m2	-0.966	-0.870	-0.753	-0.764	-0.740
(p-value)	0.334	0.385	0.451	0.445	0.459
Sargan/Hansen	1481	1481	1488	1495	1489
(p-value)	0.189	0.186	0.138	0.117	0.142

Table XI

Effects of Uncertainty on Financing Sources During Investment Shocks

This table reports the results of the regressions estimating the impact of uncertainty on the financing patterns at the time of investment shocks. For each sample, we estimate the system of equations: $F_{i,t} = Constant + \beta INV\_TA_{i,t} + Controls + \varepsilon_{i,t}$, with the restriction that four coefficients of $INV\_TA_{i,t}$ on each financing sources sum to 1. Dependent variables ($F_{i,t}$) are ratios of debt financing, equity financing, cashflow financing, and other financing source to its lagged total assets, with each denoted $DEBT\_TA_{i,t}$, $EQUITY\_TA_{i,t}$, $CF\_TA_{i,t}$, and $OTHER\_TA_{i,t}$, respectively. $INV\_TA_{i,t}$ is a ratio of investment to its lagged total assets. Details for other independent variables used in the models are provided in Table I. The results using full sample, high-uncertainty sample, and low-uncertainty sample are presented in columns (1) to (4), column (5) to (8), and column (9) to (12), respectively. Firm-year observations categorized as investment spikes are divided into either high-uncertainty or low-uncertainty group depending on whether the uncertainty level at the previous year end is higher or lower than the sample median of uncertainty level. Standard errors are reported in parentheses. *, **, and *** denote statistical significance at the 10%, 5%, and 1%, respectively.

	Full sample				High-uncertainty sample				Low-uncertainty sample			
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)
Variables	$DEBT\_TA_{i,t}$	$EQUITY\_TA_{i,t}$	$CF\_TA_{i,t}$	$OTHER\_TA_{i,t}$	$DEBT\_TA_{i,t}$	$EQUITY\_TA_{i,t}$	$CF\_TA_{i,t}$	$OTHER\_TA_{i,t}$	$DEBT\_TA_{i,t}$	$EQUITY\_TA_{i,t}$	$CF\_TA_{i,t}$	$OTHER\_TA_{i,t}$
$INV\_TA_{i,t}$	0.847***	0.142***	-0.007	0.018	0.769***	0.245***	0.005	-0.019	0.917***	0.085***	-0.018	0.016
	(0.019)	(0.022)	(0.018)	(0.019)	(0.040)	(0.050)	(0.041)	(0.039)	(0.018)	(0.015)	(0.015)	(0.016)
$LnTA_{i,t-1}$	0.012*	-0.019***	0.005	0.006	0.029**	-0.041***	0.023*	-0.007	-0.000	-0.003	-0.003	0.006
	(0.006)	(0.006)	(0.005)	(0.005)	(0.014)	(0.016)	(0.013)	(0.012)	(0.006)	(0.005)	(0.005)	(0.006)
$MV\_BV_{i,t-1}$	-0.044***	0.050***	-0.006	-0.024***	-0.058***	0.056***	-0.005	-0.030***	-0.030***	0.021***	0.005	0.001
	(0.006)	(0.007)	(0.005)	(0.006)	(0.011)	(0.012)	(0.010)	(0.010)	(0.008)	(0.006)	(0.006)	(0.007)
$EBIT\_TA_{i,t-1}$	0.108	-0.791***	0.942***	0.081	0.095	-0.708***	1.026***	0.079	0.083	-0.385***	0.546***	-0.205**
	(0.067)	(0.068)	(0.056)	(0.057)	(0.113)	(0.123)	(0.102)	(0.096)	(0.096)	(0.073)	(0.075)	(0.082)
$FA\_TA_{i,t-1}$	0.229***	-0.005	-0.199***	0.043	0.397***	-0.092	-0.264*	0.198	0.100	0.011	-0.094*	-0.019
	(0.073)	(0.075)	(0.062)	(0.063)	(0.150)	(0.165)	(0.137)	(0.128)	(0.069)	(0.052)	(0.054)	(0.059)
$DEP\_TA_{i,t-1}$	-0.910*	0.301	1.131***	-0.312	-2.401**	1.763*	1.609*	-1.025	0.314	-0.624	0.397	-0.007
	(0.516)	(0.523)	(0.434)	(0.442)	(0.950)	(1.039)	(0.861)	(0.805)	(0.517)	(0.391)	(0.400)	(0.439)
$RD\_TA_{i,t-1}$	0.449**	0.542***	-0.871***	0.247	0.730**	0.944***	-0.901***	-0.068	-0.010	-0.498***	-0.774***	1.259***
	(0.176)	(0.178)	(0.148)	(0.151)	(0.294)	(0.323)	(0.267)	(0.250)	(0.215)	(0.163)	(0.167)	(0.183)
$D\_RD_{i,t-1}$	0.013	0.018	-0.021	-0.007	0.063	0.052	-0.014	-0.084**	-0.012	-0.022	-0.022	0.054***
	(0.020)	(0.021)	(0.017)	(0.017)	(0.045)	(0.049)	(0.041)	(0.038)	(0.018)	(0.014)	(0.014)	(0.015)
$\overline{MDR}_{j,t-1}$	0.215**	-0.111	0.041	-0.124	0.402*	-0.426*	0.065	0.013	0.059	-0.114	0.057	-0.006
	(0.108)	(0.110)	(0.091)	(0.093)	(0.230)	(0.252)	(0.209)	(0.195)	(0.102)	(0.077)	(0.079)	(0.087)
$D\_Rated_{i,t-1}$	-0.023	0.037	-0.042*	0.017	0.009	-0.015	-0.111	0.109	0.005	-0.002	-0.019	0.020
	(0.026)	(0.027)	(0.022)	(0.022)	(0.084)	(0.091)	(0.076)	(0.071)	(0.022)	(0.016)	(0.017)	(0.018)
Constant	-0.291***	0.089	0.072	-0.032	-0.294***	0.002	-0.018	0.040	-0.209***	0.127**	0.143***	-0.062
	(0.061)	(0.062)	(0.052)	(0.053)	(0.110)	(0.122)	(0.101)	(0.095)	(0.066)	(0.050)	(0.051)	(0.056)
Year fixed effects	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Observations	788	788	788	788	292	292	292	292	496	496	496	496
R-squared	0.616	0.448	0.494	0.092	0.431	0.530	0.561	0.166	0.804	0.190	0.251	0.234

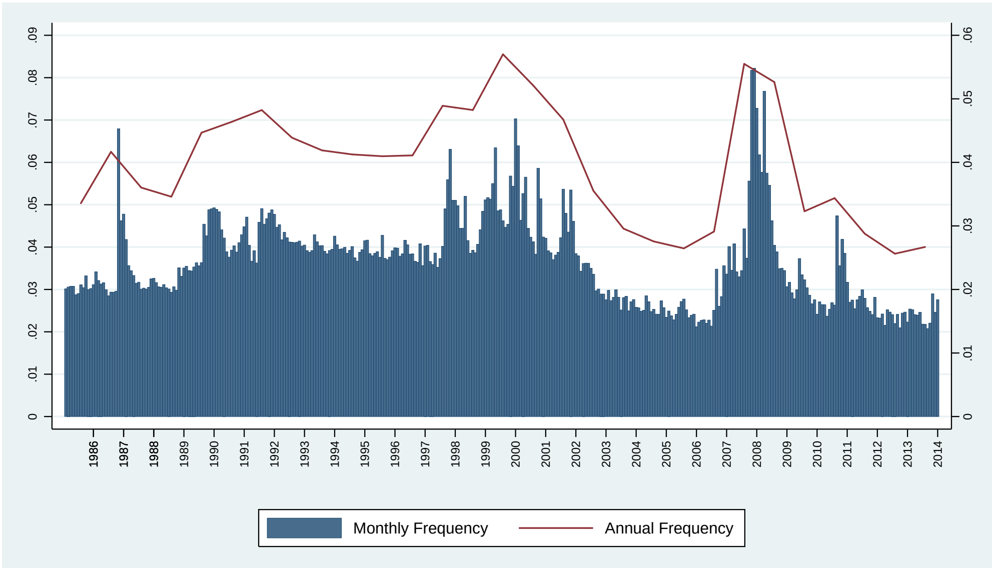
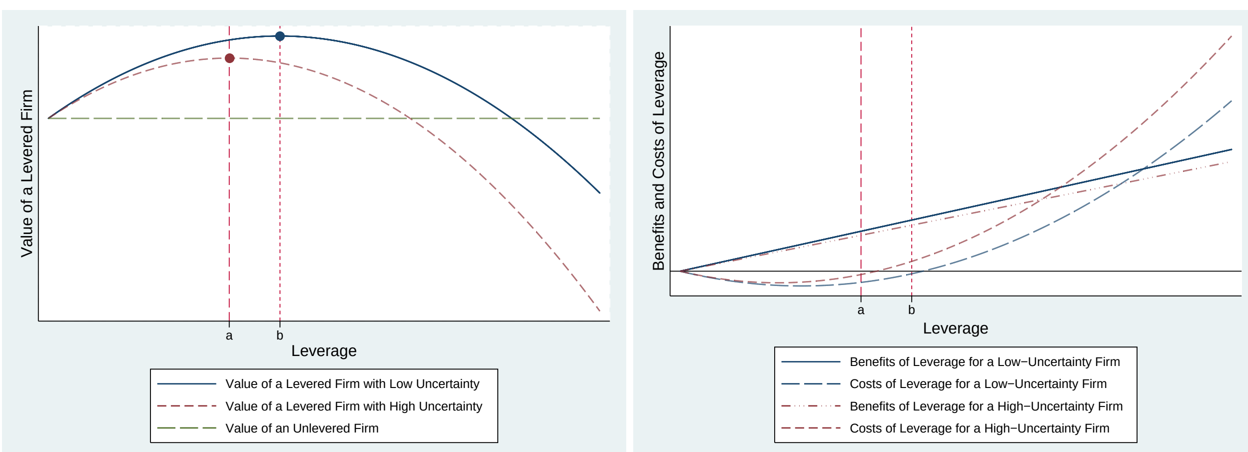


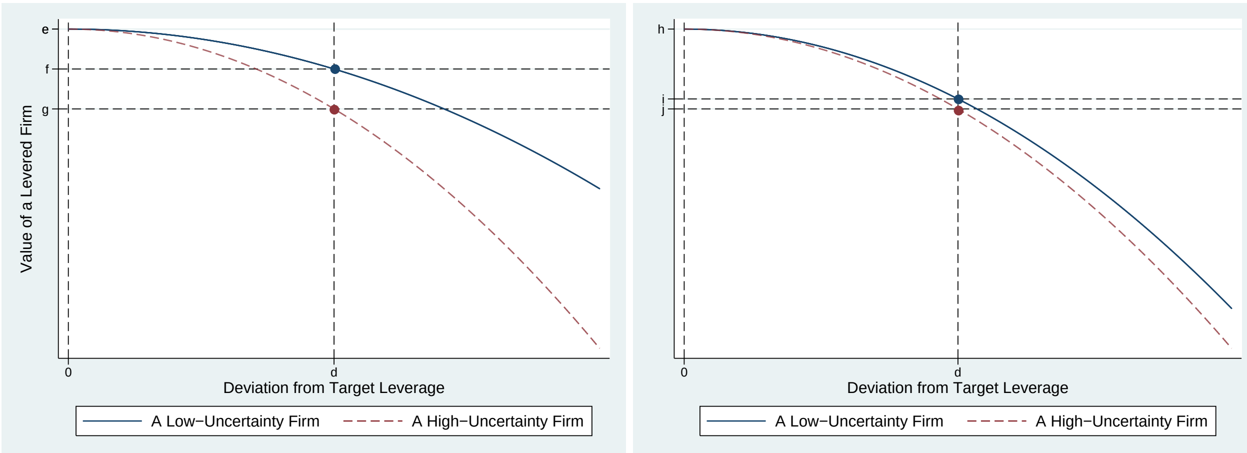
Figure 1. Monthly and annual uncertainty measured as the standard deviation of stock returns. This figure depicts the geometric mean of the monthly and annual uncertainty of firms in the CRSP universe from January 1986 to December 2014. The blue bar represents the monthly uncertainty measured by the standard deviation of daily stock returns during the specific month. The red line represents the annual uncertainty measured by the standard deviation of daily stock returns during the calendar year.



(a) Leverage and Firm Value

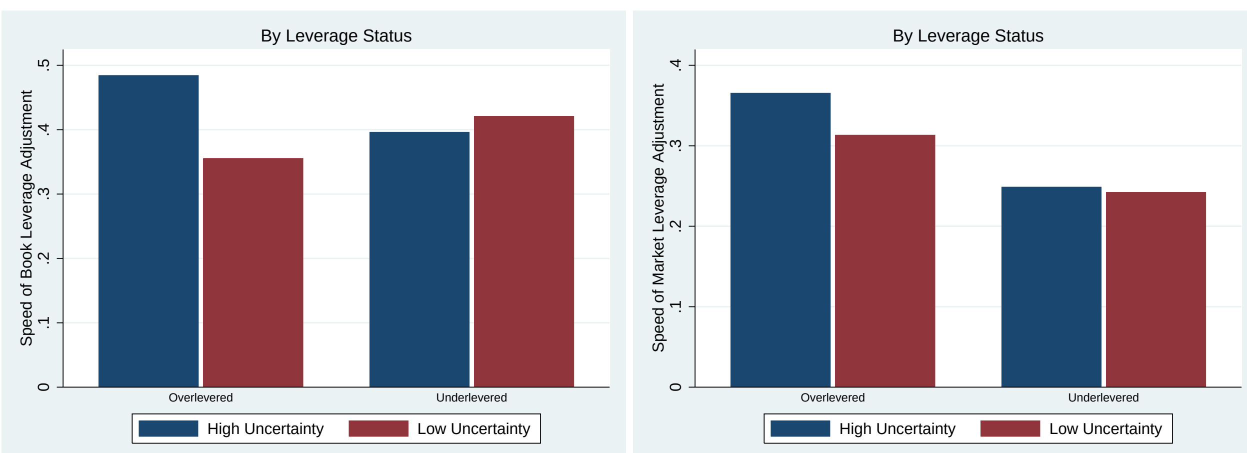
(b) Leverage and Benefits and Costs of Leverage

Figure 2. Hypothetical relationship between leverage, benefits and costs of leverage, and firm value. Panel (a) depicts the hypothetical relationship between leverage and firm value. The lines in the panel stand for the value of a levered firm with low uncertainty (blue solid line), the value of a levered firm with high uncertainty (red dashed line), and the value of an unlevered firm (green long-dashed line). Panel (b) presents the hypothetical relationship between leverage, benefits and costs of leverage. The lines in Panel (b) represent the benefits of leverage for a low-uncertainty firm (blue solid line), the costs of leverage for a low-uncertainty firm (blue long-dashed line), the benefits of leverage for a high-uncertainty firm (red dash-dotted line), and the costs of leverage for a high-uncertainty firm (red dashed line).



(a) Over-levered Firms (b) Under-levered Firms

Figure 3. Effects of uncertainty on marginal benefits of leverage adjustment. This figure depicts the hypothetical relationship between uncertainty and marginal benefits of leverage adjustment. Panel (a) compares over-levered firms facing high uncertainty and those facing low uncertainty, and Panel (b) compares under-levered firms facing high uncertainty and those facing low uncertainty. The (full) adjustment benefits are equal to the difference between the firm value evaluated at zero and the firm value evaluated at a given deviation of d. Marginal adjustment benefits are equal to the slopes of each curve evaluated at d. In both panels, the blue solid line stands for a low-uncertainty firm, and the red dashed line stands for a high-uncertainty firm.



(a) Book Adjustment Speeds (b) Market Adjustment Speeds

Figure 4. Comparison of adjustment speeds by leverage status: high-uncertainty firms vs. low-uncertainty firms. This figure shows the adjustment speeds estimated using the coefficients reported in Table IV. Book adjustment speeds and market adjustment speeds are presented in Panel (a) and Panel (b), respectively. In each panel, the blue bar depicts the adjustment speeds for high-uncertainty firms and the red bar depicts the adjustment speeds for low-uncertainty firms. The adjustment speeds of the over-levered firms (under-levered firms) are presented to the left (right).

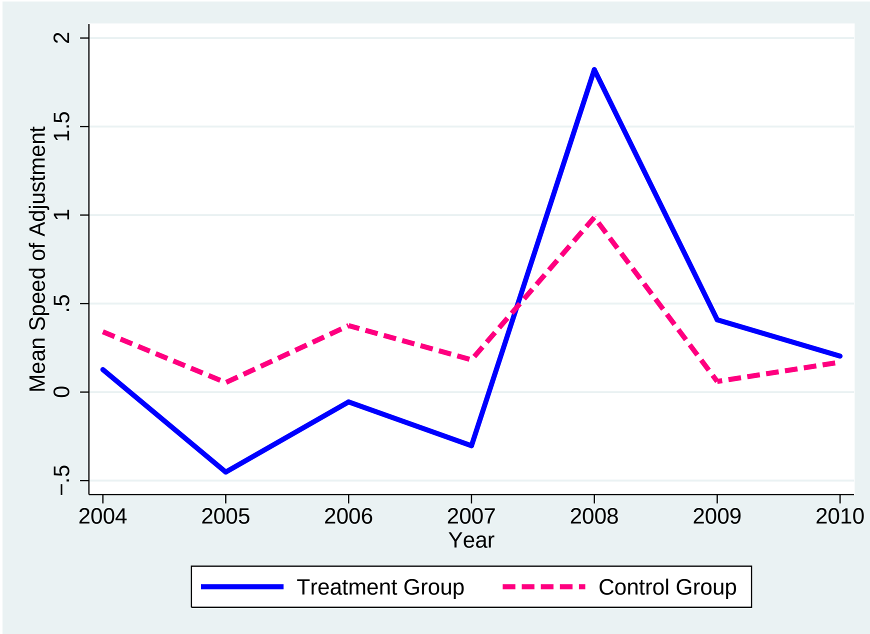
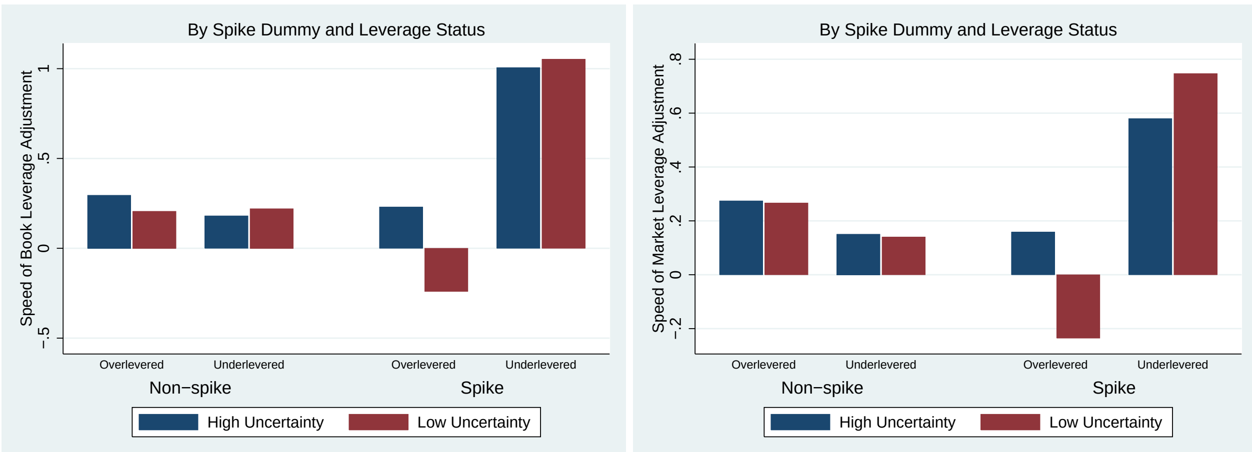


Figure 5. Adjustment speeds around the 2007–2008 Global Financial Crisis. This figure shows the adjustment speeds of over-levered firms around the Global Financial Crisis. The blue solid line presents the average adjustment speeds of treatment firms, and the red dashed line presents the average adjustment speeds of control firms. Treatment firms and control firms are identified using a propensity score matching procedure described in Section III.C.1.



(a) Book Adjustment Speeds

(b) Market Adjustment Speeds

Figure 6. Comparison of adjustment speeds by spike dummy and leverage status: high-uncertainty firms vs. low-uncertainty firms. This figure shows the adjustment speeds estimated using the coefficients reported in Table VI. Book adjustment speeds and market adjustment speeds are presented in Panel (a) and Panel (b), respectively. In each panel, blue bar depicts the adjustment speeds for high-uncertainty firms and red bar depicts the adjustment speeds for low-uncertainty firms. The adjustment speeds in the non-spike sample and the spike sample are both presented in each panel.