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The Response of Firms' Leverage to Uncertainty: Evidence from UK Public *versus* Non-Public Firms *

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Abstract

This paper empirically investigates the effects of uncertainty on firms' leverage. The analysis is carried out for a large panel of public and non-public UK manufacturing firms over 1999-2008. The empirical results provide evidence that firms use less short-term debt as they go through periods of high uncertainty. The leverage of non-public firms is more sensitive to idiosyncratic uncertainty in comparison to their public counterparts, yet macroeconomic uncertainty affects both types of firms similarly. We finally end our investigation showing that the total impact of either type of uncertainty on firms' leverage is related to the amount of the cash buffer each firm carries.

Keywords: Cash holdings; Leverage; Public *versus* Non-public firms; Idiosyncratic *versus* Macroeconomic uncertainty; Spillover effects; System-GMM
JEL classification: C23, D81, G32

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1 Introduction

Since the seminal work of Modigliani and Miller (1958), researchers have been scrutinizing the factors that affect firms' financing decisions. While proposed theories including the agency theory (Jensen and Meckling (1976)), the capital signalling theory (Ross (1977)), pecking order theory (Myers (1984)), the free cash flow theory (Jensen (1986)), organizational behavior (Myers (1993)), market timing theory (Baker and Wurgler (2002)), managerial overoptimism (Heaton (2002)) and inertia theory (Welch (2004)) help us to understand the role of firm-specific factors such as profitability, firm size, the effective tax rate, firm growth, tangible assets, stock returns and non-debt tax shields in the determination of firms' leverage, less attention is paid to the role of variations in firm-specific and macroeconomic factors.[1] For instance, we do not know to what extent firms readjust their capital structure when faced with macroeconomic or firm-specific (idiosyncratic) uncertainty. We know even less about how public *versus* non-public (private) firms' leverage responds to macroeconomic and idiosyncratic uncertainty and neither do we know if there is a difference between the response of each type of firm.

There are several papers in the existing empirical literature which scrutinize the role of macroeconomic conditions on firms' borrowing behavior. Research shows that managers, in consideration of the financial strength of the firm, design the capital structure of the firm in alignment with the state of the economy to minimize the adverse effects of business-cycles.[2] However, there is little research on the effects of macroeconomic uncertainty on firms' capital structure. To our knowledge, there are only two studies, Baum, Stephan, and Talavera (2009) and Hatzinikolaou, Katsimbris, and Noulas (2002), which examine the impact of macroeconomic uncertainty on firms' leverage. These studies focus solely on publicly traded firms and show that an increase in macroeconomic uncertainty would lead to a decrease in firm borrowing. In contrast, when we review the literature on the impact of idiosyncratic uncertainty on firms' capital structure, we observe that while some studies provide evidence that idiosyncratic uncertainty exerts a negative impact on leverage, others suggest that the effect is positive. Nevertheless, none of these studies investigate the behavior of non-public firms under uncertainty as their main focus is on publicly traded US companies.

In this study we differ from the earlier research in several distinct ways. In contrast to the

[1]Several researchers provide evidence on the empirical validity of these theories. See, for instance, among others, Harris and Raviv (1991), Myers (2001), Hovakimian, Opler, and Titman (2001), Fama and French (2002), Hennessy and Whited (2005) and Abor and Biekpe (2009). Also see Kolasinski (2009) for an excellent survey of the empirical literature on capital structure.

[2]See, for instance, among others, Levy and Hennessy (2007), Hackbarth, Miao, and Morellec (2006), Korajczyk and Levy (2003), Suarez and Sussman (1999) and Gertler and Hubbard (1993).

existing research, we use a large panel of UK manufacturing firms and examine the uncertainty-leverage relationship for public *versus* non-public firms as our dataset enables us to differentiate the firms by their legal form. Our initial inspection of the data shows that non-public firms are relatively small in size and significantly differ from their public counterparts in the context of their access to the capital markets. It is generally accepted that non-public firms have less potential to absorb the negative business shocks and they have to overcome more hurdles to access outside sources of finance as there are substantial informational asymmetries between managers of non-public firms and the outside creditors. As a consequence, banks would be more cautious to lend to them in an environment where uncertainty is high as these firms possibly face shortfalls in their expected cash flows. Furthermore, in our investigation we explore the effects of both idiosyncratic and macroeconomic uncertainty on firms' leverage. Hence, this study provides answers to questions such as whether a firm's leverage decision is more sensitive to idiosyncratic or macroeconomic uncertainty and whether the effects of uncertainty on leverage are different for public *versus* non-public firms.

Research has also shown that uncertainty not only affects firm behavior on its own but also in conjunction with various firm-specific variables. For instance as Baum, Caglayan, and Talavera (2010) suggest, when uncertainty varies over time, lenders may fail to evaluate the creditworthiness of a firm and render the firm credit constrained by raising the liquidity premium required to provide funds. In such circumstances, firm managers will be more dependent on firms' retained earnings or liquid assets to overcome the difficulties that which the firm has to go through. In this case, Baum, Caglayan, and Talavera (2010) show that the impact of uncertainty on a firm's fixed capital investment can also be gauged through its effects on the firm's retained earnings (spillover effects) in addition to the own effects of uncertainty. Therefore, in this paper, we explore whether uncertainty has spillover effects on leverage through other firm-specific variables in addition to its own effects. In particular, we consider those movements in firms' liquid assets and examine to what extent the effects of uncertainty spill over the firm's leverage as the liquid assets of the firm evolve with the movements in idiosyncratic and macroeconomic volatility. In doing so, we present evidence on the indirect effects (spillover effects) of uncertainty, an issue that has not been examined earlier, in addition to the direct (own) effects of uncertainty. Overall, our investigation helps us to lay out a more complete picture of how idiosyncratic and macroeconomic variations on their own or in conjunction with movements in firms' liquid assets affect public *versus* non-public firms' leverage decisions.

We begin our analysis by separately estimating the effects of macroeconomic and idiosyncratic uncertainty on the target leverage of public and non-public manufacturing firms. We then incorporate both types of uncertainty in the same model to scrutinize whether these measures are jointly operational. Once we establish the role of each type of uncertainty on firms' leverage, we introduce an interaction term between our measures of uncertainty and the cash stock of the firm to examine how the impact of uncertainty on leverage changes as cash holdings of the company vary over time—the spillover effect. Our empirical investigation makes use of three different measures to capture the impact of both firm-specific and macroeconomic uncertainty on public *versus* non-public firms' leverage while controlling for several firm-specific variables. The data on public and non-public UK manufacturing firms are extracted from the FAME database and cover the period 1999-2008.

Our findings can be summarized as follows. Using the System-GMM estimator we find that the effects of firm-specific variables such as investment-to-total assets ratio, sales-to-total assets ratio, cash-to-total assets ratio on leverage are generally similar to earlier empirical findings.[3] Therefore, throughout the discussion of our findings we do not place too much emphasis on the role of firm-specific determinants on leverage. Instead, we mainly focus on the impact of time-varying idiosyncratic and macroeconomic uncertainty on firms' leverage, and whether the leverage of public *versus* non-public firms behaves differently in response to either sources of uncertainty and whether firms' cash holdings affect the marginal impact of uncertainty on leverage.

When we examine the effects of uncertainty, we find that an increase in idiosyncratic uncertainty causes firms to lower their leverage. The negative effect of idiosyncratic uncertainty is consistent with the findings of Titman and Wessels (1988) and MacKie-Mason (1990) who show that a firm's leverage is significantly negatively correlated with its earnings volatility.[4] We also find that the leverage of non-public firms exhibits a greater sensitivity to idiosyncratic uncertainty as compared to their public counterparts. This finding is consistent with the view that the financing policy of non-public firms depends more on their in-house performance as external finance is expected to diminish during periods of volatility due to the presence of frictions.

We next turn to investigate the effects of macroeconomic uncertainty. We find that an increase in macroeconomic uncertainty also leads to both public and non-public firms to use less short-term debt in their capital structure. Yet we find no evidence that the impact is different across each category. This indicates that during periods of macroeconomic turmoil

[3]See for instance Titman and Wessels (1988), Fama and French (2002) and Brav (2009).

[4]This is in contrast to Myers (1977) who argues that large business risk may reduce the agency cost of debt leading to an increase in the firm's debt.

debt becomes an unattractive source of finance for either type of firm. When we re-estimate the model incorporating both idiosyncratic and macroeconomic uncertainty along with the firm-specific variables, we observe that the coefficients associated with both uncertainty types maintain their signs and significance indicating the robustness of our results.

Last but not least, we examine the spillover effects of uncertainty on leverage through firms' cash holdings. We show that both types of uncertainty have significant spillover effects on public firms' leverage, yet we find no such significant effects for non-public firms. A follow up investigation which considers both direct and spillover effects of uncertainty provides evidence that leverage of both public and non-public firms are negatively and significantly affected as uncertainty increases. More interestingly, we find that while the overall impact of idiosyncratic uncertainty on leverage is negative, this negative effect becomes stronger as the firm holds more cash stocks. In other words, we show that during periods of higher idiosyncratic uncertainty, firms with higher levels of cash holdings have a larger propensity to reduce their leverage relative to those firms that hold lower levels of cash stocks. In contrast, the total impact of macroeconomic uncertainty on leverage is stronger when firms' cash holding is low. Furthermore, the negative effect of macroeconomic uncertainty becomes weaker and, in fact, insignificant as firms accumulate a stockpile of cash.

The remainder of the study proceeds as follows. Section 2 lays out the effects of macroeconomic and idiosyncratic uncertainty on a firm's financing behavior. Section 3 provides a description of datasets and explains the construction of variables in conjunction with summary statistics. Section 4 discusses the empirical models. Section 5 presents the empirical results. Section 6 concludes the study.

2 The Link between Uncertainty and Leverage

In what follows below, we provide a brief discussion on the role of macroeconomic and firm-specific uncertainty in determining a firm's leverage.

2.1 Macroeconomic Uncertainty and Firm Leverage

There is an extensive empirical literature which investigates how macroeconomic uncertainty affects firms' behavior. Several researchers, including Leahy and Whited (1996), Ghosal and Loungani (1996), and Baum, Caglayan, and Talavera (2010) indicate that firms significantly reduce their fixed investment expenditures during periods of high uncertainty.[5] Bartram (2002)

[5]Also see Aizenman and Marion (1999), Beaudry, Caglayan, and Schiantarelli (2001), Bloom, Bond, and Reenen (2007) who present evidence on the adverse effects of uncertainty on fixed investment.

presents evidence that the measures of firm liquidity is significantly associated with interest rate exposure. Studies, among others, Almeida, Campello, and Weisbach (2004) and Baum, Caglayan, Stephan, and Talavera (2008), find that firms increase their demand for liquid assets in response to an increase in macroeconomic uncertainty. Collectively, these empirical findings indicate that managers fine tune the fixed investment behavior and liquid assets of their firms to shield the firm against the adverse effects of uncertainty associated with the aggregate economic activities.

Unfortunately, there is not much empirical research that investigates the impact of macroeconomic uncertainty on a firm's debt structure. Gertler and Hubbard (1993) discuss how firms face both idiosyncratic and macroeconomic uncertainty in their production and financial decisions. According to them, although firms can mitigate the effect of the first one, they are not able to manipulate the effects of macroeconomic uncertainty. Therefore, firms opt for equity rather than debt to shift (at least some of) the business-cycle risk to their lenders during periods of higher macroeconomic uncertainty. In this context, the effect of macroeconomic uncertainty on the leverage ratio is expected to be negative.

To our knowledge, only two studies empirically examine the link between leverage and uncertainty. Baum, Stephan, and Talavera (2009) show for a set of large U.S. nonfinancial firms drawn from COMPUSTAT that an increase in macroeconomic uncertainty leads to a significant decrease in firms' optimal short-term leverage. In addition, splitting their sample by liquidity and leverage they provide evidence that the impact of macroeconomic uncertainty is stronger for high-liquidity firms and low leveraged firms. Hatzinikolaou, Katsimbris, and Noulas (2002) examine the impact of inflation uncertainty on firms' debt-equity ratios for the firms included in the Dow Jones Industrial Index and they find that inflation uncertainty has a significant negative effect on a firm's debt-equity ratio.

Given the lack of empirical evidence on the effects of macroeconomic uncertainty on leverage, it is of particular interest to investigate to what extent macroeconomic uncertainty affects the target leverage of firms. It must be noted that this issue is not only relevant for public companies but more so for non-public companies whose main source of financing is bank debt. Especially, it is well documented that the firms in each group face different financial constraints due to the presence of asymmetric information when it comes to raising funds to finance their daily activities as well as their capital investment projects.[6] All together, empirical evidence on public and non-public firms' capital structures will help us to enhance our understanding of

[6] In Whited (1992), one of the fundamental predictions of the asymmetric information theory is that small firms have limited access to debt markets due to the lack of the collateral necessary to back up their loans.

macroeconomic uncertainty–leverage linkages.

2.2 Firm-Specific Uncertainty and Firm Leverage

When we review the literature we find that while some researchers report a negative impact of idiosyncratic uncertainty on leverage others find no or positive effects. The trade-off theory of capital structure predicts an inverse link between firm-specific uncertainty and firms' optimal debt levels. The rationale for this prediction is that higher business risk as measured by an increase in the volatility of cash flows heightens the probability of bankruptcy. Therefore, due to the presence of positive bankruptcy costs, firms use less debt in their capital structure when there is a large variation in their earnings. To that end Bradley, Jarrell, and Kim (1984) present a single period corporate capital structure model and show the presence of a negative association between firm volatility and its optimal debt. Subsequently, Titman and Wessels (1988) report a negative association between earnings volatility and leverage. Baum, Stephan, and Talavera (2009) report a significant and negative impact of idiosyncratic uncertainty on the optimal short-term leverage for US non-financial public firms.[7] Wald (1999) investigates how earnings volatility affects the target leverage by examining the determinants of capital structure in France, Germany, Japan, the US and the UK. They find a significant negative effect of firm-level risk on the debt-to-assets ratio for firms established in the US and Germany. For the remaining countries, however, they do not find any significant association between firms' business risk and their leverage.[8] Overall similar findings are reported in Baxter (1967), Ferri and Jones (1979), Friend and Lang (1988) and MacKie-Mason (1990), indicating the presence of a significant and negative impact of firm-level risk on leverage.

In contrast, Myers (1977) predicts a positive relationship between risk and debt. He argues that large business risk may reduce the agency cost of debt and thus firms use more debt in their capital structure. Jaffe and Westerfield (1987) also derive a positive association between risk and the optimal debt level. Several other empirical studies, including Auerbach (1985), Kim and Sorensen (1986) and Chu, Wu, and Chiou (1992), report a significant and positive impact of firm-level risk on leverage. Earlier, Toy, Stonehill, Remmers, and Wright (1974) report the presence of a significant and positive effect of earnings volatility on the debt ratio of manufacturing firms in Japan, Norway and the US. Kale, Noe, and Ramirez (1991) examine the impact of business risk on the optimal debt level by developing a model similar to DeAngelo

[7] In addition, they show that highly leveraged firms and small firms are more sensitive to firm-specific uncertainly as compared to relatively low leveraged or large firms.

[8] Flath and Knoeber (1980) also show that the firm's earning volatility does not have any significant impact on leverage in 38 major industries over the period 1957-1972 using a dataset drawn form the IRS Statistics of Income, Corporate Income Tax Returns database.

and Musulis (1980). They predict that the relationship is approximately U-shaped. Using the annual COMPUSTAT data, they show that an increase in business risk initially leads to a decline in debt. However, once the firm's debt exceeds a certain limit, they use more debt in their capital structure as business risk increases.

Overall, we observe that both theoretical and empirical research lead to conflicting conclusions on the association between idiosyncratic risk and leverage. In the case of theoretical models, results are related to the underlying assumptions and in the case of empirical studies, results differ based on the sample and measure of uncertainty used in the investigation. In addition, none of the studies cited above examines this relationship for non-public companies. Since non-public firms' financing options significantly differ from that of public firms' as they are not legally allowed to issue debt instruments, it is important to investigate how non-public firms' leverage evolves under uncertainty. In this paper, we therefore test how firm-specific uncertainty affects non-public firms' leverage, as compared to that of publicly traded firms using UK firm-level data.

3 Data, Variable Construction and Measuring Uncertainty

To carry out our investigation we construct an annual panel dataset for public and non-public manufacturing firms using the FAME database which is made available by Bureau van Dijk (BvD) Electronic Publishing. We generate three different measures of macroeconomic uncertainty based on gross domestic product (GDP), the consumer price index (CPI) and Treasury bill rates (T-bill rates). The data on macroeconomic variables are extracted from the International Financial Statistics (IFS), an International Monetary Fund (IMF) database. The dataset covers a ten-year period from 1999 to 2008.

3.1 Public *versus* Non-Public Company Definition

Under the UK Companies Act, all limited liability companies register themselves with the Companies House as either public or non-public companies. Companies House is basically an executive agency of the United Kingdom Department for Business, Innovation and Skills (BIS). The fundamental functions of the Companies House are to incorporate and dissolve limited liability companies, accumulate and scrutinize company information and make this information available to the public.[9]

According to the Companies Act of 1967, in the United Kingdom, all public and non-public companies must submit their annual financial statements to the Register of Companies House.

[9] For more information about Companies House, see http://www.companieshouse.gov.uk/.

However, the Companies Act of 1981 modified the 1967 Act allowing small firms to file an abbreviated balance sheet without a profit and loss statement and medium sized companies to submit an abbreviated financial statement.[10] Currently, both public and non-public companies must file their financial statements within a period of ten and seven months respectively of their accounting year-end date.

It should be noted that all accounting statements are compiled according to the UK accounting standards. Both non-public and public companies' financial statements must be audited by a professional and a qualified auditing firm if the company's annual turnover is more than one million pounds. However, public firms should provide some additional information to the general public to be listed at the London Stock Exchange. Hence, firm-specific information compiled from this source is compatible across public and non-public firms.

3.2 The FAME Database

As mentioned earlier, according to the UK Companies Act, all limited liability companies must submit their annual financial statements to Companies House during a specific period of time from the year-end date. Once a company files its accounting statements, Companies House carefully investigates and checks this information and makes it available to the general public. Jordans, one of the leading providers of legal information in the UK, collects this data from Companies House. Finally, BvD collects the data from Jordans and makes it available through the FAME database.

The FAME database provides information on both active and inactive public/non-public limited liability companies in the UK up to a maximum of a 10-year period. The data coverage may vary in terms of the number of observations for a given company as there may be entry or exit from the dataset. The main advantage of the FAME database is that it includes both balance-sheet and off-balance sheet information, such as income statements, cash flows statements, profit and loss accounts and ownership information.

Firms in the database operate in a wide range of industrial sectors including agriculture, forestry and mining, manufacturing, construction, retail and wholesale, hotels and restaurants, the financial sector, the public sector and the regulated utility industry. FAME contains data for both non-public and public limited companies and over 99% of the companies in the database are small and not traded on the stock exchange. Hence, our dataset gives us a unique opportunity

[10] According to the Companies Act, a company to be classified into "medium" ("small") category based on execution of any two of the following criteria for at least two consecutive years: (i) annual sales should not be more than 11.2 (2.8) million pounds, (ii) book value of total assets should not be more than 5.6 (1.4) million pounds, and (iii) the number of workers should not be more than 250 (50).

to investigate the behavior of non-public *versus* public limited companies.

The FAME database reports two sorts of variables in the form of static and annual observations. An annual variable is a variable whose values are reported for each end of accounting year. Whereas, in the case of a static variable (a "header" variable), such as ownership information, company type (public or non-public, listed or unlisted, etc), date of incorporation, registration number, SIC primary and secondary codes, only the previous year's reported value exists. The FAME database that we use for this study contained information for 1999-2008 on both static variables and annual financial statements for approximately 4 million public and non-public companies in the UK. All incorporated entities are classified by the 2003 Standard Industrial Classification (SIC) codes.

3.3 Sample Selection Criteria and Initial Screening

In this paper we only focus on the manufacturing firms and exclude companies that have changed the date of their accounting year-end by more than a few weeks. The dataset refers to 12-month accounting periods for all companies. As an initial screening, we exclude companies that have less than 3 years of consecutive data on debt, investment, cash and equivalence, or sales. Second, we set all negative values for all variables in the sample as missing.

After the initial screening, our dataset contains a total of 120,337 firm-year observations over a ten-year period from 1999 to 2008. The dataset has an unbalanced panel structure where each firm contributes between 3 to 10 years of observations. Since there is both entry and exit to the panel over the sample period, possible selection and survivorship bias is to some extent extenuated. We flag each firm as either public or non-public based on their "Company Type" as provided by FAME. In the next subsection, we describe the construction of our firm-specific and macroeconomic conditioning variables in detail.

3.4 Variable Construction

We construct leverage as the book value of the short-term debt to total assets ratio as we aim to understand the behavior of public and non-public firms' short-term debt as uncertainty evolves over time.[11] We should note that Titman and Wessels (1988) also use the ratio of short-term debt to total assets as one of the proxies for firm leverage and several other researchers including Marsh (1982), Fama and French (2002), Rajan and Zingales (1995) and Leary and Roberts (2005), define leverage as a ratio of the book value of debt to total assets.

[11] It should be noted that the market value of debt is not available for non-public firms.

Following the previous empirical studies, we include a number of firm-specific control variables in our empirical model. We define investment as expenditure by the firm on the purchase of fixed tangible assets during a year. Cash is set equal to cash and equivalents. Sales are defined as the total turnover of the company during an accounting year period. To control for the potential influence of outliers in our empirical analysis, all variables that enter into our model in ratios are winsorized at the lower and upper one-percentile to purge the impact of outliers and reporting errors on the data.[12] Further details on the variables are given in the Appendix.

3.5 Generating Firm-Specific Uncertainty

Researchers implement different methods to generate a proxy for firm-specific uncertainty. For instance, Huizinga (1993) uses the conditional variance obtained from a GARCH-type specification on wage and materials cost. Pindyck and Solimano (1993) and Caballero and Pindyck (1996) use a geometric Brownian model to derive the variance of the marginal revenue product of capital. Ghosal and Loungani (2000) measure the firm-level risk by the standard deviation of the firm's unpredictable profit. Bo (2002) constructs an AR(1) model for sales and then uses the cumulative standard deviation of the residuals obtained from the model for each year as a measure of uncertainty. Bo and Lensink (2005) use stock price volatility as well as the volatility of the number of employees to measure firm-level uncertainty. They compute stock price volatility as the difference between the highest and lowest stock price for each underlying firm normalized by the lowest price. To construct volatility based on employees, they use the coefficient of variance over a seven-year period. Baum, Stephan, and Talavera (2009) estimate firm-level uncertainty by calculating the standard deviation of the closing price of the firm's shares.

Most of the measures described above are well-suited for cases where the focus is on large publicly traded firms as these methods may introduce a bias into the constructed measure of uncertainty for small firms.[13] Given that the focus of our paper is on the behavior of public *versus* non-public firms, and non-public firms are much smaller than the public firms, we follow Morgan, Rime, and Strahan (2004) and compute two separate time-varying measures of firm-specific uncertainty. Their approach requires us to run a simple model on firm sales scaled by total assets (S_{it}) using firm fixed-effects (f_i) and year fixed-effects (f_t):

$$S_{it} = f_i + f_t + \psi_{it} \tag{1}$$

[12] See, for instance, Brav (2009) who applied similar screening methods.

[13] For more details on this issue, see Comin and Philippon (2005).

where i and t denote firm and year, respectively and ψ_{it} is the white-noise error term. The absolute value of these residuals, $\sigma_{it}^{level} = |\psi_{it}|$, is then used as a proxy for firm-specific uncertainty. f_i and f_t stand for firm-specific fixed and time effects, respectively.

Our second measure of uncertainty is constructed by estimating a similar model on the growth of firm sales (ΔlnS_{it}). More specifically, we estimate the following model:

$$\Delta lnS_{it} = f_i^{'} + f_t^{'} + \psi_{it}^{'} \tag{2}$$

where i and t are as defined above. $\psi_{it}^{'}$ is the error term with zero mean and finite variance. In particular, the absolute value of the residuals obtained from Equation (2), $\sigma_{it}^{growth} = |\psi_{it}^{'}|$, represents the fluctuations with respect to both the cross-firm and the cross-year average growth of sales. Similar to the above model, f_i' and f_t' stand for firm-specific fixed and time effects, respectively. The interpretation of Equation (1) based on the level of firm sales is similar. Thus, $\sigma_{it}^{level} = |\psi_{it}|$ represents the fluctuations regarding the cross-firm and the cross-year average of the level of firm sales.

We construct a third proxy based on Bo (2002) using sales. To do that we estimate an AR(1) model for sales normalized by total assets. Using the one-period ahead residuals, we compute the cumulative-volatility in sales, $\sigma_{it}^{cumulative}$. Specifically, the uncertainty proxy for 2000 is constructed by calculating the standard deviation of the residuals obtained from the AR(1) model of sales that uses data for 2000 and 1999. Similarly, the uncertainty measure for 2001 is constructed calculating the standard deviation of the residuals obtained from the same model using the data for 2001, 2000 and 1999. The process is repeated similarly.[14] The downside of this approach is the loss of one observation per firm.

3.6 Computing Macroeconomic Uncertainty

Similar to the case of generating firm-specific uncertainty, researchers use different methodologies to construct measures of macroeconomic uncertainty. For instance, Aizenman and Marion (1999) use conditional variances obtained from government expenditures as a share of GDP, nominal money growth and the real exchange rate to proxy for macroeconomic uncertainty. Driver, Temple, and Urga (2005) construct a proxy for macroeconomic uncertainty from the conditional variance of manufacturing output obtained from a GARCH model. Baum, Stephan, and Talavera (2009) fit a generalized ARCH model to derive the conditional variance of the index of leading macroeconomic indicators as a proxy for the macro-level uncertainty.[15]

[14] For more details see Bo (2002).
[15] Byrne and Davis (2005) also employ the same methodology to proxy for macro-level uncertainty.

In contrast to the researchers above, Ghosal and Loungani (2000) use the moving standard deviation of energy prices and the Federal Fund Rate (FFR) to proxy for macroeconomic fluctuations. Korajczyk and Levy (2003) use two-year aggregate domestic nonfinancial corporate profit growth, and two-year equity market returns. Several other researchers, including Kaufmann, Mehrez, and Schmukler (2005) and Graham and Harvey (2001), utilize survey-based methods based on the dispersion of forecasts, which are collected from firm or bank managers, as a measure of macroeconomic uncertainty.

In our investigation we follow the ARCH/GARCH methodology to measure macroeconomic uncertainty. To generate macroeconomic uncertainty, given that companies tend to consider their production as well as financing decisions, we use monthly observations for the CPI and T-bill rates and quarterly observations for GDP for the period between 1996 and 2008. Once the conditional variances for each series are obtained, we annualize the monthly or quarterly conditional variances to match the frequency of our uncertainty measure with that of the panel data.[16] Two measures of uncertainty based on GDP (σ_t^{GDP}) and T-bill rates (σ_t^{T-bill}) are directly used as proxies for macroeconomic uncertainty. In addition, we compute the equal weighted conditional variance index (σ_t^{Index}) using the conditional variance of GDP, CPI and T-bill rates as a third measure of macroeconomic uncertainty.

3.7 Summary Statistics

Table 1 provides the descriptive statistics for our variables for the full sample, and split by public and non-public firms. We apply nonparametric equality tests to examine if the means, medians and standard deviations of those variables that we employ in our models differ across public and non-public firms.

We observe that the mean value of leverage for non-public firms is significantly higher than their public counterparts over our sample period. This difference implies that the non-public firms in our dataset depend more on short-term debt to finance their activities in comparison to the public firms. This observation makes sense as debt financing is the only means for non-public firms to raise funds. This observation is also in line with that of Brav (2009) who shows that non-public firms use relatively more debt to finance their fixed capital investments than public firms. We also observe that the leverage of non-public firms is more volatile as compared to that of public firms. Similarly, there is a significant difference between non-public and public firms' sales-to-total assets ratios. The mean value of the sales-to-total assets ratio is 1.60 for

[16]Table 5 in the appendix presents the estimated ARCH/GARCH specifications. As the table reveals, the estimates on diagnostic tests provide evidence that our models are well-specified and there is no remaining ARCH effect in the residuals.

non-public firms, whereas, it is 1.08 for the public firms. This ratio is also more volatile for the non-public firms as compared to that of public firms.

The estimates on cash and equivalent do not show any significant difference between the two groups. Non-public firms have a cash and equivalent-to-total assets ratio of 12.2% on average, whereas, this figure is 11.1% for public firms. We should also note that, on average, public firms have higher investment normalized by total assets as compared to their non-public counterparts. The mean value of the investment to asset ratio is 15% and 18% for non-public firms and public firms, respectively. This differential is statistically significant for the mean and median values. The size of the standard deviation for this variable provides evidence that public firms' investment rates are slightly more variable than that of non-public firms over the period under consideration.

Insert Table 1 about here

Table 2 presents summary statistics of our macroeconomic and idiosyncratic uncertainty measures. The table reports the means, standard deviations, as well as the 25th, 50th and 75th percentiles of these proxies. There are several considerable differences along with a few common characteristics across our measures of idiosyncratic and macroeconomic uncertainty. We find that the standard deviation of the uncertainty measure based on the level of sales is higher than that based on the growth of sales. The conditional variance of the gross domestic product is also more volatile as compared to the conditional variance of Treasury bill rates. To investigate whether our uncertainty proxies gauge similar movements in the business and macroeconomic environment, we investigate the correlations between our measures of uncertainty. The estimates reported in Table 3 show that the correlation coefficients are very low and they are not significant at any reasonable level of significance. Hence, we conclude that each of our measures captures a different aspect of the uncertainty in the environment that firms operate in.

Insert Table 2 and 3 about here

In Table 4 we report simple correlation coefficients between our main variables and leverage for non-public and public firms in two separate panels. For both types of firms (public and non-public), leverage has a negative correlation with the sales to total asset ratio. This association is weaker and statistically insignificant in the case of public firms, reflecting that the optimal leverage may be more sensitive to sales for non-public firms as compared to public firms. The level of cash and equivalent is significantly and negatively correlated with leverage for both non-public and public firms. This correlation suggests that cash rich firms borrow less.

We also find that the correlation between leverage and the investment rate is significant and positive for both groups. The intensity of this relationship is considerably higher for public firms as the magnitude of the correlation coefficient is 0.45, while, for non-public firms, this magnitude is only 0.17. This evidence suggests that public firms use relatively more short-term debt to finance their investment opportunities than the non-public firms.

Regarding the correlation between uncertainty and leverage, the table provides some important linkages. In fact, Table 4 provides preliminary evidence on the association between uncertainty and firms' leverage. From the table, we can observe that there is a significant negative association between leverage and two firm-specific uncertainty measures—one measure based on level and the other based on cumulative sales. In contrast, the measure of volatility based on growth of sales is positively correlated with firm leverage. When we inspect the correlations between macroeconomic uncertainty and firm leverage we find for both public and non-public firms that uncertainty measures based on Treasury bill rates and gross domestic product and leverage are negatively correlated. In summary, these observations suggest that the leverage of UK non-public and public manufacturing firms has a negative relation with macroeconomic uncertainty. However, to properly examine the causal effects of both types of uncertainty, we need to have a well-specified model which incorporates the relevant firm-specific variables while considering the leverage dynamics.

Insert Table 4 about here

4 Econometric Framework

4.1 Specification of the Baseline Empirical Model

To examine the association between uncertainty and leverage we estimate separately and jointly several models for public and non-public firms. We formulate our baseline model by augmenting a standard model that examines leverage with measures of uncertainty. Our model, among others similar to Brav (2009), Baum, Stephan, and Talavera (2009) and Auerbach (1985), contains the lagged leverage ratio (lagged dependant variable) to control for the persistence of debt holdings. Specifically, we express the model in the following form:

$$Lev_{it} = \lambda_0 + \lambda_1 Lev_{it-1} + \lambda_2 Sales_{it} + \lambda_3 Cash_{it} + \lambda_4 Invt_{it} + \lambda_5 \sigma_{it-1}^{firm} + \lambda_6 \sigma_{t-1}^{macro} + f_i + \varepsilon_{it} \quad (3)$$

where subscript i and t denote firms and years, respectively. Lev_{it} is the leverage ratio in year t for firm i and is defined as the ratio of short-term debt to total assets. $Sales_{it}$, $Cash_{it}$ and $Invt_{it}$ denote sales, cash and equivalents and fixed investment, correspondingly, and each variable is normalized by total assets to remove scale effects. In this model we investigate the impact of the beginning of the period uncertainty on leverage. Hence, uncertainty enters the model with a lag. σ_{it-1}^{firm} is one of our time-varying firm-specific uncertainty measures for firm i in year t. σ_{t-1}^{macro} denotes one of our time-varying macroeconomic uncertainty measures. f_i denotes firm-specific fixed effects, and ε_{it} is the error term. All estimations are carried out for the period 1999-2008. The key coefficients of interest are λ_5 and λ_6 which capture the effects of firm-specific and macroeconomic uncertainty on the firm's leverage, respectively. Particularly, we are interested to see if these coefficients attain a negative or a positive sign so that we can determine the effect of uncertainty on the leverage of public and non-public manufacturing firms.

4.2 Differential Effects of Uncertainty

Whilst estimating the effects of uncertainty on the firm's short-term leverage, Equation (3) does not enable us to test whether the impact of uncertainty on public firms is statistically different from that of non-public firms. To scrutinize this issue, we extend our basic model so that all variables of interest can assume a different coefficient across public and non-public firms within the same framework. To achieve our goal we generate two sets of dummies that allow us to separate public firms from non-public firms and interact them with all variables in the model. Specifically, we generate a public-firm dummy (D_i^{public}) which is equal to one if the firm is categorized as a public firm and zero otherwise. We then generate a dummy for non-public firms ($D_i^{nonpublic}$) which is equal to $(1 - D_i^{public})$. In particular, the extended model takes the following form:

$$
\begin{aligned}
Lev_{it} = \phi_0 &+ \phi_1 Lev_{i,t-1} D_i^{public} + \phi_2 Lev_{it-1} D_i^{nonpublic} + \phi_3 Sales_{it} D_i^{public} + \phi_4 Sales_{it} D_i^{nonpublic} \\
&+ \phi_5 Cash_{it} D_i^{public} + \phi_6 Cash_{it} D_i^{nonpublic} + \phi_7 Invt_{it} D_i^{public} + \phi_8 Invt_{it} D_i^{nonpublic} \\
&+ \phi_9 \sigma_{it-1}^{firm} D_i^{public} + \phi_{10} \sigma_{it-1}^{firm} D_i^{nonpublic} + \phi_{11} \sigma_{t-1}^{macro} D_i^{public} \\
&+ \phi_{12} \sigma_{i,t-1}^{macro} D_i^{nonpublic} + f_i + \varepsilon_{it} \qquad (4)
\end{aligned}
$$

The rest of the variables are the same as above. We prefer this approach over estimating leverage models on separate sub-samples of public and non-public firms owing to the following two reasons. First, our approach allows us to work with higher degrees of freedom. Second, our approach allows us to properly test the differential effects of uncertainty on leverage for both groups of firms.[17] More specifically, we test the following two hypotheses:

H_0^1 : The impact of σ_{it-1}^{firm} on Lev_{it} is the same across firm-years for public and non-public firms.

H_0^2 : The impact of σ_{t-1}^{macro} on Lev_{it} is the same across firm-years for public and non-public firms.

4.3 Spillover Effects of Uncertainty

Baum, Caglayan, Stephan, and Talavera (2008) develop a partial equilibrium model of precautionary demand for liquid assets to examine how macroeconomic uncertainty and idiosyncratic uncertainty affect firms' cash holdings. Their empirical results indicate that uncertainty has a significant impact on the non-financial US firms' optimal liquidity and firms increase their demand for liquid assets in response to an increase in either macroeconomic uncertainty or firm-specific uncertainty.[18] Since a firm's financing policy markedly depends on the firm's investment opportunities and availability of internal funds, uncertainty is likely to have indirect (spillover) effects, possibly through its impact on cash holdings, as well while directly affecting firms' capital investment or borrowing behavior.

In fact Baum, Caglayan, and Talavera (2010) provide evidence that uncertainty affects firms' capital investments on its own (the direct effect of uncertainty) and through its impact on those firms' cash holdings (the indirect effect of uncertainty). To see whether the effects of uncertainty spill over to firms' leverage behavior through its effects on firms' cash holdings, we augment our basic specification by incorporating cash-holding-uncertainty interactions. In particular, we estimate the following augmented model:

$$\begin{aligned}
Lev_{it} = {} & \beta_1 Lev_{it-1} D_i^{public} + \beta_2 Lev_{it-1} D_i^{nonpublic} + \beta_3 Sales_{it} D_i^{public} + \beta_4 Sales_{it} D_i^{nonpublic} \\
& + \beta_5 Cash_{it} D_i^{public} + \beta_6 Cash_{it} D_i^{nonpublic} + \beta_7 Invt_{it} D_i^{public} + \beta_8 Invt_{it} D_i^{nonpublic} \\
& + \beta_9 \sigma_{it-1}^{firm} D_i^{public} + \beta_{10} \sigma_{it-1}^{firm} D_i^{nonpublic} + \beta_{11} \sigma_{t-1}^{macro} D_i^{public} + \beta_{12} \sigma_{i,t-1}^{firm} D_i^{nonpublic} \\
& + \beta_{13} Cash_{it} \sigma_{it-1}^{firm} D_i^{public} + \beta_{14} Cash_{it} \sigma_{it-1}^{firm} D_i^{nonpublic} + \beta_{15} Cach_{it} \sigma_{t-1}^{macro} D_i^{public} \\
& + \beta_{16} Cash_{it} \sigma_{t-1}^{macro} D_i^{nonpublic} \\
& + \beta_0 + f_i + \varepsilon_{it} \qquad (5)
\end{aligned}$$

We assess the spillover effects of idiosyncratic uncertainty on the firm's leverage by investigating

[17] This approach also allows one to test the differential effects of the remaining variables across public *versus* non-public firms. Nevertheless, we leave this step to the interested reader to save space and concentrate on the effects of uncertainty on firms' leverage.

[18] Almeida, Campello, and Weisbach (2004) also show that macroeconomic conditions have a significant impact on financially constrained firms' cash holdings.

the significance of β_{13} and β_{14} in Equation (5):

H_0^1 : $\beta_{13} = 0$, for public firms.

H_0^2 : $\beta_{14} = 0$, for non-public firms.

To examine the spillover impact of macroeconomic uncertainty on leverage, we test the significance of β_{15} and β_{16} in Equation (5):

H_0^3 : $\beta_{15} = 0$, for public firms.

H_0^4 : $\beta_{16} = 0$, for non-public firms.

The null hypotheses suggest that idiosyncratic volatility as well as macroeconomic volatility affect leverage in conjunction with movements in firms' cash holdings. If the presumptions are incorrect, the hypotheses will be rejected.

4.4 Estimation Procedure

The endogeneity problem in the data requires us to use an instrumental variable (IV) approach. Hence we use a robust two-step system dynamic panel data (DPD) estimator (system GMM approach) developed by Blundell and Bond (1998) to estimate our models. While implementing this methodology, fixed effects are removed by design as the model is estimated in first-differences. The estimation procedure combines equations in differences of the variables with equations in levels and controls for possible endogeneity problems by using the lagged values of the regressors as instruments. Finally, this approach is quite flexible and allows the researcher to make use of different instruments with different lag structure for both the levels and the first-differenced equations. To test for the validity of the instruments we use the *J-statistic* of Hansen (1982). This statistic is asymptotically distributed as χ^2 with degrees of freedom equal to the number of overidentifying restrictions (i.e., the number of instruments less the number of estimated parameters). Under the null hypothesis, the instruments are orthogonal to the errors.

To examine the presence of serial correlation in the error terms, we employ the Arellano and Bond (1991) test for autocorrelation. Under the null of no serial correlation, the test asymptotically follows a standard normal distribution. It also provides a further check on the correct specification of the System-GMM process. In a dynamic panel data context, the first-order serial correlation is likely to be present, but the residuals should not exhibit the second-order serial correlation if the instruments are strictly exogenous.

The estimates from the J test are reported in each table that we present below. These estimates indicate that the instruments used in the System GMM estimations are appropriate and satisfy the orthogonality conditions. The Arellano-Bond AR(2) tests do not provide any evidence for the presence of second-order serial correlation in the residuals. This indicates the use of our instruments are appropriate. Hence, for brevity, we do not make any further comments on those aspects when we discuss our results.

5 Empirical Findings

We commence our empirical analysis estimating the effects of idiosyncratic uncertainty on leverage using three different measures. Then we carry out the same exercise with macroeconomic uncertainty. Once we establish the effects of each type of uncertainty separately, we incorporate both types of uncertainty measures into our model as in Equation (3). Using a similar approach, we next investigate whether uncertainty has a differential impact on the leverage of non-public *versus* public firms as Equation (4) depicts. Last but not least, we estimate Equation (5) to examine if the effects of uncertainty spill-over to leverage through its impact on the cash holdings of the firms, followed by a discussion on the total impact of uncertainty on firms' leverage.

5.1 The Impact of Uncertainty on Leverage

5.1.1 The Role of Firm-specific Uncertainty

Table 6, Panel A, presents our results on the impact of idiosyncratic uncertainty on leverage. In addition to measures of uncertainty, the regression model includes lagged leverage, sales, cash and investment to total asset ratios as firm-specific explanatory variables. Lagged leverage attains a positive sign providing evidence on the persistence of leverage: firms that borrowed in the previous period continue to use debt financing. Coefficients of $Sales$ and $Cash$ to total asset ratios are significant and negative as expected implying that an improvement in sales and cash holdings enables firms to borrow less funds. The investment rate is positive suggesting that increases in capital investment lead to an increase in the short-term debt of firms. Our findings for the firm-specific variables are generally consistent with the previous empirical work including that of Titman and Wessels (1988), Fama and French (2002), Rajan and Zingales (1995) and Brav (2009). Hence, we do not further discuss the sign and significance of these variables, instead, we concentrate on the effects of uncertainty on leverage. All these variables in the remaining tables attain similar signs and significance as in Table 6.

Table 6 displays the impact of three different measures of firm-specific uncertainty on leverage. Model 1 considers the impact of uncertainty based on the level of sales. Model 2 implements the impact of volatility based on the growth of sales and Model 3 estimates the impact of cumulative volatility constructed as in Bo (2002) based on the level of sales. Given the correlations depicted in Table 3, we believe that each measure captures a different aspect of uncertainty in the business environment yet we expect to find that an increase in uncertainty would adversely affect leverage. That is, as uncertainty in firm's operations increase, we should expect to see a reduction in the use of short-term debt causing a decline in firms' leverage. Our rationale behind this prediction is that a higher business risk increases the chance of bankruptcy and, as a result firms use less debt. Equally, it is possible that banks or other financial institutions do not lend to those firms that experience higher business risk to protect themselves from potential losses.

The key finding emerging from Table 6 is that there is a significant negative association between idiosyncratic uncertainty and leverage. For each model depicted in the table, we observe that uncertainty attains a significant and negative coefficient. Overall, our findings are consistent with Titman and Wessels (1988), MacKie-Mason (1990), Wald (1999) and Baum, Stephan, and Talavera (2009) that firm-level risk has a negative and significant impact on leverage.

5.1.2 The Role of Macroeconomic Uncertainty

Panel A, Table 7, provides the estimates of a model similar to Table 6 except that we now concentrate on the effects of macroeconomic uncertainty on firms' leverage. Here, too, we implement three different measures of uncertainty to capture the turmoil in macroeconomy. In particular, Models 1 and 2 use uncertainty measures based on gross domestic product, and Treasury bill rates, respectively. Model 3 uses a weighted uncertainty index based on gross domestic product, Treasury bill rates and the consumer price index.

We expect that there is a negative relationship between macroeconomic volatility and firms' borrowing behavior. This can be rationalized as follows. Higher macroeconomic uncertainty raising the firm's business risk deteriorates the corporate tax shelter and increases the chance of insolvency. In such an uncertain state of the economy, firms' managers would generally be more cautious about the costs of financial distress and they therefore reduce the level of debt as debt makes their firms more exposed to macroeconomic risk. In all three models, we observe that macroeconomic uncertainty has a significant and negative impact on firms' leverage. Although, the intensity of the estimated effects of macroeconomic uncertainty on leverage depends on the uncertainty measure used, the negative link is apparent.

Overall, our findings suggest that firms use considerably less debt in their capital structure when the macroeconomic climate is volatile. The negative macroeconomic uncertainty-leverage relationship is in line with our prediction that firms reduce their short-term debt financing during an uncertain state of the economy as debt makes them more exposed to macroeconomic risks. Our observations are consistent with the findings of Hatzinikolaou, Katsimbris, and Noulas (2002) and Baum, Stephan, and Talavera (2009) who report a negative association between macroeconomic uncertainty and the leverage of US non-financial firms.

5.1.3 The Impact of Uncertainty

Having established the negative effects of both types of uncertainty on firm leverage, we estimate one more model to cover Equation 3 where both types of uncertainty are considered in the same model. This attempt may be observed as a robustness check of those findings reported in Tables 6 and 7. Alternatively this step can be rationalized noting that firms do not operate only under macroeconomic risk or firm-specific risk as these risks are available for firms at any point in time. Hence, we present a new set of results in Table 8 where we discuss the behavior of firm leverage as both types of uncertainty are operational. The first and second models use our measures of uncertainty based on GDP in conjunction with the volatility in level of sales and the cumulative volatility in sales, correspondingly. In our third and fourth models we use the uncertainty measure based on T-bill rates while firm-specific uncertainties are same as before.[19] Observing the coefficients of the uncertainty measures for each model, we see that both macroeconomic and firm-specific uncertainty attain negative and significant signs.[20] These findings provide evidence that our results are not only similar across different measures of uncertainty but they are robust when we implement different pairs of macroeconomic and idiosyncratic uncertainty.

To summarize our findings so far, we can say that our regression results provide support to the claim that manufacturing firms in the UK use less short-term debt in their capital structure when there is an increase in either macroeconomic or firm-specific uncertainty. These results hold for each proxy that we use for either types of uncertainty. Nevertheless, these results are too general and do not allow us to comment on whether uncertainty affects public *versus* non-public firms differently. This is an important question as there are significant differences between the two types of firms. In particular, non-public firms are relatively small in size and they differ in terms of their ability to access the capital markets. Furthermore, they have generally less potential to absorb negative business shocks which leads to banks acting more cautiously towards non-public firms. Last but not least, non-public firms exhibit relatively a high leverage ratio. We therefore continue our investigation and test if uncertainty affects

[19] We also run the regressions with volatility in growth of sales and equal weighted volatility index in conjunction, respectively, with other macroeconomic and idiosyncratic uncertainty measures. The results are generally similar to those reported in Table 8 and are available upon request.

[20] As the results in Panel A, Table 8, indicate, the estimates of firm-specific variables are generally similar to the findings of previous empirical studies on capital structure.

leverage across public and non-public firms differently.

5.2 The Differential Impact of Uncertainty across Public and Non-Public Firms

5.2.1 The Differential Impact of Firm-specific Uncertainty

Given the results presented in earlier tables, we next seek to find out if uncertainty has differential effects across public and non-public firms. In Table 9, we replicate the model that we present in Table 6, where now all firm-specific variables and our uncertainty measures are interacted with *Public* and *Non-public* dummies to properly test for the differential effects. The *Public* dummy is set to one if the firm is public and zero otherwise. The *Non-public* dummy is equal to $(1 - Public)$. In all three cases, lagged leverage attains a positive and significant sign for both types of firms. However, the size of the coefficient for non-public firms is significantly larger than that of public firms showing that non-public firms' leverage has a greater persistence than that of public firms. This is expected as non-public firms depend on short-term debt to carry out their daily business activities while public firms have a wider choice to finance theirs. Sales and cash to total assets ratios also exhibit significant and negative effects on leverage. This effect is significantly greater in absolute value for public firms, once more signalling the fact that non-public firms cannot reduce their dependence on short-term borrowing as much as public firms when their sales and cash holdings improve.

We also find that the effect of investment on leverage is insignificant for non-public firms and significant only at the 10% level for public firms.[21] All of these variables for the remaining tables attain the same signs as in Table 8 and we do not make further comments on them.[22] Overall, our results regarding firm-specific variables are generally in line with the earlier findings.

When we turn to the effect of idiosyncratic uncertainty on public *versus* non-public firms we observe the following findings. Here, the first model estimates the impact of volatility based on the level of sales on leverage. The second model estimates the effects of volatility based on growth of sales on leverage and the third model estimates that of cumulative-volatility as in Bo (2002). Table 9 shows that all three measures of idiosyncratic uncertainty attain a significantly negative coefficient regardless of firm type. This suggests that both public and non-public firms use less short-term debt in their financing during a high-risk business climate. Equality tests reported in Panel B of Table 9 significantly reject the hypothesis that the impact of uncertainty

[21] It is possible that the insignificance of the investment ratio for non-public firms is due to the fact that they have on average significantly less expenditure on capital investment as compared to their public counterparts (see Table 1).

[22] To our knowledge, the impact of firm-specific variables on leverage, which we provide here for public *versus* non-public firms, has not been studied in the literature with the exception of Brav (2009).

is the same across the two types of firms in two out of three uncertainty measures; volatility based on the level and the cumulative-volatility of sales. The coefficient of uncertainty based on the growth of sales is highly significant and negative for non-public firms yet the difference between the public and non-public firms is marginal (at 10%). These findings suggest that the leverage of non-public firms is considerably more sensitive to idiosyncratic uncertainty as compared to their public counterparts. The greater sensitivity of leverage for small firms is in accordance with our expectations. In summary, idiosyncratic uncertainty has a relatively strong effect on non-public firms' leverage compared to public firms.

5.2.2 The Differential Impact of Macroeconomic Uncertainty

To proceed the story further, we evaluate whether the sensitivity of leverage to macroeconomic uncertainty differs across non-public and public firms. The next set of results we document in Table 10 is obtained from a model constructed in spirit to that presented in Table 7. Here, we interact all variables and measures of macroeconomic uncertainty with *Public* and *Non-public* dummies. Models 1 and 2 estimate the impact of uncertainty on leverage that is based on GDP and Treasury bill rates, respectively and model 3 estimates that of the effect of an equally weighted uncertainty measure.

Focusing on the effects of uncertainty, we observe that the coefficients associated with all three measures of macroeconomic uncertainty are significantly negative for both public and non-public firms. This suggests that both groups of firms significantly reduce the use of short-term debt in their business activities during states of economic turmoil. However, when we test for differential effects, we cannot reject the hypothesis that the impact of macroeconomic uncertainty across the two groups is similar.

5.2.3 The Differential Impact of Uncertainty

Next, to check for the robustness of our results presented in Tables 9 and 10, we examine the differential effects of macroeconomic and idiosyncratic uncertainty simultaneously, i.e. we run Equation 4 in Section 4.2. We estimate four dynamic models. Similar to Table 8, Models 1 and 2 use volatility based on GDP and that based on the level of sales and the cumulative-volatility measure, respectively. Models 3 and 4, use uncertainty proxies based on Treasury bill rates along with the above two types of firm-specific volatility measures. Table 11, Panel A, reports our results estimated from these four models. In all four cases, our results regarding firms-specific variables for both public and non-public firms are similar to that in Panel A of Tables 9 and 10. Hence, we do not further comment on them.

Table 11 shows that both macroeconomic and idiosyncratic uncertainty have significant and negative associations with leverage. Public and non-public firms significantly decrease their short-term leverage when macroeconomic uncertainty or idiosyncratic uncertainty increases. The point estimates show that the former firms are highly sensitive to the variations of idiosyncratic uncertainty, while the latter firms display a significantly smaller sensitivity. Equality test results, shown in Panel B of the table, indicate that the equality of coefficients is strongly rejected in all four models for idiosyncratic uncertainty. As expected, this confirms that non-public firms' leverage is more sensitive to idiosyncratic uncertainty as compared to public firms. In contrast, the magnitude of the estimates on macroeconomic uncertainty is larger for public firms in comparison to that of non-public firms, yet they are not statistically different from that of non-public firms. This suggests that both groups of firms experience negative effects due to macroeconomic uncertainty with a similar intensity.

In summary, the results presented in Tables 9-11 indicate that both groups of firms exhibit a negative sensitivity to idiosyncratic and macroeconomic uncertainty. Our results also suggest that, in general, the leverage of non-public firms is relatively more sensitive to idiosyncratic uncertainty than that of public firms. The greater sensitivity of non-public firms to idiosyncratic uncertainty is in line with our predictions. Since non-public firms are more informationally opaque to their external financiers, and since banks are likely to be more cautious about adverse selection and moral hazard problems in an environment where uncertainty is high, non-public firms will be unable to attract external financing in periods of heightened uncertainty. Hence, they use less debt in their capital structure.

5.3 The Spillover Effects of Uncertainty: Does Uncertainty Affect Firm's Leverage through Cash Holdings?

Having established the impacts of both types of uncertainty on leverage and the differential effects of uncertainty across public *versus* non-public firms' leverage, we next turn to investigate whether uncertainty affects firm leverage through its cash holdings as shown in Equation 5. In other words, we would like to find out whether the affect of uncertainty on leverage changes as the amount of the cash holdings of the firms evolve over time. We therefore introduce an interaction term between uncertainty and cash holdings. This term captures the 'spillover effect' of uncertainty on leverage through firms' cash holdings. Table 12 presents the results for three models. Models 1 and 2 respectively quantify the spillover effects of idiosyncratic uncertainty and macroeconomic uncertainty separately and Model 3 presents our results when both types of uncertainty are present in the environment.[23] We should note prior to discussing the interaction terms that the own effect of uncertainty in this set of regressions is similar to those reported earlier. The only difference is that the coefficient of firm-specific uncertainty is insignificant for public firms for models 1 and 3. However, this finding does not necessarily mean that firm-specific uncertainty in not operational for the case of public firms, which we will come back to later when we discuss the interaction terms.

Table 12 shows that the coefficient on the idiosyncratic uncertainty-cash holdings interaction is negative for both public and non-public firms. However, the coefficient is statistically significant only for the public firms. This implies that when (public) firms experience idiosyncratic uncertainty, an increase in cash holdings will lead firms to further reduce their debt holdings. In contrast, the estimates on the interaction of macroeconomic uncertainty and cash holdings are positive for both groups of firms. Yet, this coefficient is statistically significant only for the public firms. The positive coefficient on the interaction term suggests that an increase in cash holdings will motivate the manager to increase the firms' leverage in times of high macroeconomic uncertainty. In other words, in times of macroeconomic uncertainty the manager of the (public) firm can convince the lenders to extend more credit in the short run, given that the firm's cash stocks are increasing. Furthermore, if these firms are successful in their businesses, the fact that there is higher macroeconomic risk should not affect such firms to borrow more funds in the short run when they are rich in cash holdings. An alternative rationale is that during uncertain states of the economy, firms are more likely to face unexpected variations in their retained earnings. As a result, they would prefer to hold more cash and use short-term debt in financing rather than internal funds.

5.4 The Full Impact of Uncertainty on Leverage

Now that we have established the impact of own and spillover effects of uncertainty on leverage, we can compute the full effects of either type of uncertainty. To gauge the full impact of uncertainty at a particular level of cash holdings, we must compute the total derivative of leverage with respect to idiosyncratic and macroeconomic uncertainty as shown in the equations below

$$\frac{\partial Lev}{\partial \sigma_{firm}} = \hat{\Psi}_{\sigma_{firm}} + \hat{\Psi}_{\sigma_{firmCash}} \times Cash^* \tag{6}$$

[23] The results from other combinations are qualitatively similar to those in Table 12 and are available from the authors on request.

$$\frac{\partial Lev}{\partial \sigma_{macro}} = \hat{\Psi}_{\sigma_{macro}} + \hat{\Psi}_{\sigma_{macroCash}} \times Cash^* \tag{7}$$

where $\hat{\Psi}_{\sigma_{firm}}$, $\hat{\Psi}_{\sigma_{firmCash}}$ refer to the estimated coefficients for the effects of idiosyncratic uncertainty and the interaction of idiosyncratic uncertainty with cash holdings, respectively. Similarly, $\hat{\Psi}_{\sigma_{macro}}$ and $\hat{\Psi}_{\sigma_{macroCash}}$ denote the coefficients associated with macroeconomic uncertainty and the interaction of macroeconomic uncertainty with cash holdings. $Cash^*$ refers to a particular level of cash and equivalent holdings which we compute at the 10th, 25th, 50th, 75th, 80th and 90th percentiles. The results of these total derivatives are reported in Tables 13 and 14 for public and non-public firms separately while we plot these values in Figures 1-4 along with the 95% confidence interval.

Panel A of Table 13 lays out the total derivatives with respect to idiosyncratic uncertainty for public firms. These values are negative and significantly different from zero at all levels of cash holdings apart from the 10th percentile. It is interesting to note that the negative effect of idiosyncratic uncertainty on leverage significantly differs across different percentiles of cash holding and becomes stronger as the cash stocks of firm accumulate. These estimates indicate that the negative aggregate effect of idiosyncratic uncertainty on leverage increases as the firm increases its cash holdings.

In Panel B, Table 13, we present the estimates of total derivatives of leverage with respect to macroeconomic uncertainty for public firms. While the estimates are negative and significant, they are different in comparison to that of idiosyncratic uncertainty.[24] In particular, the effect of macroeconomic uncertainty on leverage is weaker at higher percentiles of cash holdings. This suggests that those firms which hold more cash during uncertain states of the economy tend to reduce their leverage relatively by a lesser amount in response to an increase in macroeconomic volatility. This finding is the opposite to that for the case of idiosyncratic uncertainty.

Next we calculate the same set of derivatives for non-public firms. The estimates are reported in Panels A and B of Table 14. As in the case of public firms, Panel A of Table 14 shows that the aggregate effect of idiosyncratic uncertainty is negative and significant at all levels of cash holdings. Indeed, this effect increases as firms stockpile more cash. This implies that in response to higher business-risk, those firms that hold more cash tend to reduce their leverage by a relatively greater amount as compared to those firms which have relatively lower levels of cash holdings.

[24]Nevertheless, the total derivative with respect to macroeconomic uncertainty becomes positive at or above the 90th percentile of cash holdings.

Looking at Panel B of Table 14 we see that the total derivative of leverage with respective to macroeconomic uncertainty is negative and significant when firms' cash holdings are around the 50th percentile of cash holdings. This effect becomes insignificant at or above the 75th percentile of firms' cash holdings and eventually becomes positive, though not significant, at or above the 90th percentile—the opposite of what we observe in Panel A which displays the total effects of idiosyncratic uncertainty on leverage. These observations are in line with what we expect and similar to that of public firms but more pronounced. Given these figures, we can claim that the leverage of the firms which hold more cash is relatively less sensitive to macroeconomic risk.

Comparing the estimates of the total derivatives with respective to either type of uncertainty for public *versus* non-public firms we observe that while the signs and the statistical significance of the estimates for non-public firms are quite similar to the results for public firms, the size of the total effects of uncertainty on leverage considerably differ at each level of cash-holdings for both groups.

Figures 1 to 4 depict the findings that we report in Tables 13 and 14. For both groups of firms, we see that idiosyncratic uncertainty, shown in Figures 1 and 3, exerts a negative effect on firm leverage and this effect strengthens as firms' cash holdings improve. That is firms tend to borrow less when idiosyncratic uncertainty increases and more so when firms hold more cash. However, the response of firms and the impact of uncertainty on leverage differ at different levels of cash holdings for each type of firm. First of all, non-public firms are always affected more than public firms under idiosyncratic uncertainty. For instance, public firms are not significantly hampered by idiosyncratic risk when their cash holdings are low. Perhaps banks find it advantageous to renegotiate with firms that are in financial distress and extend new credit rather than let the firm file for bankruptcy. However, non-public firms do not have such a luxury; in periods of high idiosyncratic uncertainty they can only borrow less due to financial frictions. This separation lessens, although non-public firms are more affected than public firms, when both types of firm carry more cash. This is perhaps due to both types of firms relying on their own resources to overcome periods of internal unrest to avoid the risk premium demanded by the lenders.

When we turn to compare the impact of macroeconomic uncertainty as shown in Figures 2 and 4, we see that they are almost identical except the scales. The effect of macroeconomic uncertainty on both types of firms is negative but the impact is much higher for public firms, yet the effect for both types of firms weakens as firms' cash stocks improve. One reason why public firms are more affected in times of uncertainty than non-public firms can be due to the fact that banks in times of turmoil reconsider their lending policies and call in their risky loans. In contrast, since public firms can issue longer term debt instruments in the market, it is likely that they can afford to reduce their short-term borrowing. Also as the cash holding of companies improves, lenders start to extend more credit to both types of firms reducing the overall impact of uncertainty on leverage as the figure shows.

Overall, the most striking finding of the spillover effects analysis is that in response to an increase in idiosyncratic uncertainty, a firm with more cash holdings has a tendency to reduce short-term debt financing by a larger amount relative to a firm with a low level of cash holdings, whereas this observation is reversed for the case of macroeconomic uncertainty. These observations strongly indicate that models that do not take into account the interaction between uncertainty and firms' cash holdings are likely to produce inaccurate conclusions regarding the effect of uncertainty on leverage. Our results indicate that the effect of uncertainty on leverage depends on the type of uncertainty and how firms' cash holdings evolve over time.

6 Conclusions

Implementing a dynamic panel data methodology, we investigate the roles of idiosyncratic and macroeconomic uncertainty in determining the level of non-public and public manufacturing firms' short-term leverage in the United Kingdom. Our dataset is collected from the FAME database and covers the period between 1999-2008. To quantify the effects of volatility we employ three different proxies for both firm-specific and macroeconomic uncertainty. In each model, along with a measure of uncertainty, we use several firm-specific factors that have been used in prior empirical research. The effects of these firm-specific variables on leverage are similar to those reported in earlier research including Titman and Wessels (1988), Fama and French (2002), Rajan and Zingales (1995) and Brav (2009).

Our findings on the impact of uncertainty on firm leverage can be summarized as follows. First, we show that there is a significant negative association between idiosyncratic uncertainty and the leverage of firms. However, non-public firms' leverage exhibits a greater sensitivity to idiosyncratic uncertainty as compared to their public counterparts. This observation is in line with the idea that an increase in business uncertainty leads to non-public firms depend more on their in house performance as external finance is restricted due to the presence of financial frictions. Our investigation also shows that both types of firms exhibit a negative and significant sensitivity to macroeconomic uncertainty while the sensitivity of each type of firm is similar. It appears that firms in each category become cautious about the cost of financial distress during periods of macroeconomic uncertainty and carry less short-term debt. These results hold true for different proxies for either type of uncertainty.

We next investigate the presence of spillover effects of uncertainty on leverage through firms' cash holdings and show that the spillover effect is more pronounced for public firms. Furthermore, an investigation of the total impact of uncertainty on leverage provides evidence that the effects of uncertainty on leverage change as the amount of the cash holdings of the companies evolves over time. In particular, it turns out that during periods of higher firm-specific (macroeconomic) uncertainty, firms are more (less) likely to reduce their leverage if they hold a relatively higher (lower) level of cash balances. This is an interesting finding and provides evidence that the total effect of uncertainty on leverage varies with respect to its source and the amount of cash each firm holds.

Our findings suggest that researchers should consider the effects of both macroeconomic and idiosyncratic sources of uncertainty while studying firms' optimal leverage over and above the other factors that have been investigated in the literature. While doing this, the possibility of spillover effects should also be considered. When we evaluate our findings along with some of the recent research, a reduction in leverage due to increased uncertainty may also be taken as a signal that firms are decreasing their investment expenditures in times of higher economic volatility. If so, as almost all countries are riding through heightened uncertainty due to the 2008-2009 financial crises, it is not a far fetched conjecture that recessionary pressures will not ease that easily. Especially, in those countries where governments are taking severe measures to reduce the debt problem, such as the UK, the possibility of observing a second dip into recessionary phase is quite likely.

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Table 1: Descriptive Statistics of Firm-Specific Variables for Public *versus* Non-Public Firms

The table reports the summary statistics for the full sample as well as for public and non-public firms separately. The sample covers the period from 1999 to 2008. We categorize a firm as public if it is listed on any stock exchange of the country and non-public if otherwise. Reported in the third column of the table is the number of firm-year observations that belong to public and non-public firms. The dependent variable, leverage, is defined as the ratio of the short-term debt to total assets. Definitions of the firm-specific independent variables are given in the Appendix. The table also reports the difference between the means, medians and standard deviation of public and non-public firms. Nonparametric tests are applied to test the equality. * denotes statistical significance at the 1% level of significance.

Variables	Firms	Statistics			
		Obs.	Mean	Median	Std.Dev.
Short-term debt-to-total assets ratio	Non-public	114976	0.198	0.119	0.225
	Public	5361	0.138	0.067	0.183
	Full Sample	120337	0.196	0.116	0.223
	Difference		0.060*	0.052*	0.042*
Sales-to-total assets ratio	Non-public	99946	1.600	1.469	0.869
	Public	5060	1.085	1.019	0.631
	Full Sample	105006	1.575	1.443	0.892
	Difference		0.515*	0.450*	0.238*
Cash & equivalent-to-assets ratio	Non-public	135067	0.122	0.057	0.156
	Public	5477	0.111	0.054	0.146
	Full Sample	140544	0.121	0.057	0.555
	Difference		0.011*	0.003	0.010*
Investment-to-total assets ratio	Non-public	53699	0.152	0.026	0.263
	Public	4292	0.184	0.041	0.283
	Full Sample	57991	0.155	0.028	0.265
	Difference		- 0.032*	-0.015*	-0.020*

Table 2: Summary Statistics of Proxies for Uncertainty

The table presents summary statistics of the uncertainty measures. We construct three time-varying proxies for firm-specific uncertainties which are based on sales, σ_{it}^{level}, σ_{it}^{growth} and $\sigma_{it}^{cumulative}$. Note that $\sigma_{it}^{cumulative}$ is cumulative volatility in level of sales. Similarly, we compute three time-varying proxies for macroeconomic uncertainty based on the conditional variance of T-bills rates (σ_t^{T-bill}) and GPD (σ_t^{GDP}). Our third measure, (σ_t^{Index}), gives equal weight to the conditional variances obtained from GDP, CPI and $T-bill\ rates$ (see the text for further explanation on measuring volatility).

Statistics	**Firm-Specific Uncertainty**			**Macroeconomic Uncertainty**		
	σ_{it}^{level}	σ_{it}^{growth}	$\sigma_{it}^{cumulative}$	σ_t^{T-bill}	σ_t^{GDP}	σ_t^{Index}
Mean	0.240	0.216	0.500	0.033	4.475	1.538
Std. Dev.	2.023	0.443	7.707	0.046	3.142	1.061
P25	0.033	0.044	0.007	0.011	1.988	0.701
P50	0.069	0.044	0.024	0.011	1.988	0.701
P75	0.185	0.221	0.087	0.026	8.017	2.709

Table 3: Correlations of Idiosyncratic and Macroeconomic Uncertainty Proxies

The table presents the coefficients of correlation for macroeconomic and idiosyncratic uncertainty measures. We construct three time-varying proxies for firm-specific uncertainties which are based on sales, σ_{it}^{level}, σ_{it}^{growth} and $\sigma_{it}^{cumulative}$. Note that $\sigma_{it}^{cumulative}$ is cumulative volatility in level of sales. Similarly, we compute three time-varying proxies for macroeconomic uncertainty based on the conditional variance of T-bills rates (σ_t^{T-bill}) and GPD (σ_t^{GDP}). Our third measure, (σ_t^{Index}), gives equal weight to the conditional variances obtained from GDP, CPI and $T-bill\ rates$ (see the text for further explanation on measuring volatility).

		Firm-Specific Uncertainty		
		σ_{it}^{level}	σ_{it}^{growth}	$\sigma_{it}^{cumulative}$
Macroeconomic Uncertainty	σ_t^{GDP}	0.024	-0.001	0.001
	σ_t^{T-bill}	0.022	0.004	0.011
	σ_t^{Index}	0.011	0.003	0.011

Table 4: Correlation of Uncertainty and Firm-Specific Variables with Leverage
The table presents correlations between firm leverage and the remaining variables in the model. The sample covers the period from 1999 to 2008. We categorize a firm as public if it is listed in the stock exchange and as non-public if it is not. The leverage is defined as the ratio of the short-term debt to total assets. The methodology of measuring volatility and definitions of the firm-specific independent variables are given in the Appendix. ** denotes statistical significance at the 5% level.

Variables	**Firms**	**Leverage**	
		Non-public	Public
Sales-to-total assets ratio	Non-public	-0.007**	
	Public		-0.015
Cash & equivalent-to-total assets ratio	Non-public	-0.117**	
	Public		-0.182**
Investment-to-total assets ratio	Non-public	0.172**	
	Public		0.446**
Volatility in level of sales	Non-public	-0.008**	
	Public		-0.035**
Volatility in growth of sales	Non-public	0.058**	
	Public		0.130**
Cumulative-volatility in sales	Non-public	-0.025**	
	Public		-0.021**
T-bills rate volatility	Non-public	-0.012**	
	Public		-0.002**
GDP volatility	Non-public	-0.009**	
	Public		0.037**

Table 5: ARCH/GARCH Estimates for Macroeconomic Uncertainty

This table reports the estimates obtained by estimating a generalized ARCH (GARCH) model for Treasury bill rates (TBR), the consumer price index (CPI) and gross domestic product (GDP). X denotes the dependent variable in ARCH/GARCH specifications. The figures given in parentheses are standard errors. The estimates on log-likelihood and Q-statistics to test for the remaining ARCH/GACRH effects in the model are given in the lower panel. Statistical significance at the 1%, 5% and 10% levels is indicated by one, two and three asterisks, correspondingly.

Regressors	ΔTBR		ΔCPI		ΔGDP	
	Coeff.	Std.Err.	Coeff.	Std.Err.	Coeff.	Std.Err.
ΔX_{t-1}	-0.120	(0.271)	-0.724	(0.112)**	0.232	(0.112)**
ΔX_{t-2}	0.353	(0.187)*	0.129	(0.124)	-0.001	(0.147)
Constant	0.013	(0.006)**	0.400	(0.096)***	2.789	(0.917)***
MA(1)	0.577	(0.274)**	0.958	(0.049)***		
ARCH(1)	0.724	(0.164)***	0.259	(0.146)*	0.859	(0.368)**
GARCH(1)	0.271	(0.128)**	0.512	(0.269)*		
Constant	0.005	(0.001)***	0.031	(0.012)***	1.281	(0.420)***

Diagnostic tests for remaining GARCH effects

	ΔTBR	ΔCPI	ΔGDP
Log-likelihood	92.569	-52.868	-103.101
Observations	148.000	148.000	51.000
LM-test(4)	0.140	2.010	2.510
P-value	0.997	0.733	0.643
Q(8)	3.274	4.936	11.225
P-value	0.916	0.764	0.189
Q(15)	3.865	18.999	16.009
P-value	0.998	0.213	0.381

Table 6: Robust Two-step System-GMM Estimates for Firm-Specific Uncertainty Effect on Leverage

Panel A of the table reports the estimates obtained from robust two-step System-GMM estimations for firm-specific uncertainty effects on firms' leverage. The figures given in parentheses are standard errors and they are asymptotically robust to heteroskedasticity. The dependent variable is leverage, defined as the short-term debt scaled by total assets. The analysis covers the period 1999-2008 for a panel of UK public and non-public firms. Model 1 estimates the impact of volatility in level of sales on leverage. Model 2 estimates the impact of volatility in growth of sales and Model 3 estimates the impact of cumulative volatility in level of sales on firm's leverage. In all three models, the one period lagged values of the first difference of the right-hand side variables are used as instruments for the equations in levels. The instruments for differenced equations are the second to fourth lags, the first to sixth lags and the second to sixth lags of the right-hand side variables for Model 1, 2 and 3, respectively. Business cycle effects are controlled by including year dummies (not reported). The methodology of measuring volatility and definitions of the remaining independent variables are given in the appendix. Panel B reports the J statistics, which is a test of the over identifying restrictions and distributed as chi-squared under the null of instrument validity and Arellano-Bond, AR(2), test of second-order autocorrelation in the first-differenced residuals. *** denotes statistical significance at the 1% level of significance. ** indicates statistical significance at the 5% level. * indicates statistical significance at the 10% level.

Panel A: Estimation results						
Regressors	**Model 1**		**Model 2**		**Model 3**	
	Coeff.	Std.Err.	Coeff.	Std.Err.	Coeff.	Std.Err.
Lev_{it-1}	0.338	(0.098)***	0.361	(0.100)***	0.437	(0.112)***
$Sales_{it}$	-0.014	(0.002)***	-0.015	(0.002)***	-0.012	(0.002)***
$Cash_{it}$	-0.062	(0.025)***	-0.087	(0.035)***	-0.107	(0.039)***
$Invt_{it}$	0.053	(0.017)***	0.057	(0.018)***	0.041	(0.018)**
σ_{it-1}^{level}	-0.021	(0.007)***				
σ_{it-1}^{growth}			-0.047	(0.026)**		
$\sigma_{it-1}^{cumulative}$					-0.012	(0.003)***
Constant	0.146	(0.018)***	0.153	(0.020)***	0.127	(0.021)***
Panel B: Diagnostic tests						
Firm-years	23,487		19,741		21,001	
Firm	5,436		4,944		5,301	
AR(2)	-1.202		-1.034		-0.558	
p-value	0.229		0.301		0.576	
J-statistic	37.470		48.290		32.030	
p-value	0.164		0.173		0.778	

Table 7: Robust Two-step System-GMM Estimates for Macroeconomic Uncertainty Effect on Leverage

Panel A of the table reports the estimates obtained from robust two-step System-GMM estimations for macroeconomic uncertainty effects on firms' leverage. The figures given in parentheses are standard errors which are asymptotically robust to the presence of heteroskedasticity and serial correlation within panels. The dependent variable is leverage, defined as the short-term debt scaled by total assets. The analysis covers the span 1999-2008 for a panel of UK public and non-public firms. Model 1 estimates the impact of volatility in GDP on leverage. Model 2 estimates the impact of volatility in T-bills rates on leverage and Model 3 estimates the impact of equal weighed volatility index on firm's leverage. In all three models, the one period lagged values of first difference of the right-hand side variables are used as instruments for the equations in levels. The instruments for differenced equations are the second and third lags of the right-hand side variables for all three models. Business cycle effects are controlled by including year dummies (not reported). The methodology of measuring volatility and definitions of the remaining independent variables are given in the appendix. Panel B of the table reports the J statistics, which is a test of the over identifying restrictions and distributed as chi-squared under the null of instrument validity and Arellano-Bond, AR(2), test of second-order autocorrelation in the first-differenced residuals. *** denotes statistical significance at the 1% level of significance. ** indicates statistical significance at the 5% level. * indicates statistical significance at the 10% level.

Panel A: Estimation results						
Regressors	**Model 1**		**Model 2**		**Model 3**	
	Coeff.	Std.Err.	Coeff.	Std.Err.	Coeff.	Std.Err.
Lev_{it-1}	0.318	(0.127)**	0.327	(0.128)***	0.317	(0.127)**
$Sales_{it}$	-0.014	(0.002)***	-0.015	(0.002)***	-0.014	(0.001)***
$Cash_{it}$	-0.115	(0.041)***	-0.123	(0.041)***	-0.116	(0.041)***
$Invt_{it}$	0.047	(0.019)**	0.044	(0.019)**	0.047	(0.020)**
σ^{GDP}_{t-1}	-0.010	(0.003)***				
σ^{T-bill}_{t-1}			-0.460	(0.159)***		
σ^{Index}_{t-1}					-0.040	(0.010)***
Constant	0.157	(0.024)***	0.162	(0.025)***	0.156	(0.024)***
Panel B: Diagnostic tests						
Firm-years	24394		24394		24394	
Firm	5713		5713		5713	
AR(2)	-1.129		-1.066		-1.130	
p-value	0.259		0.286		0.258	
J-statistic	14.080		12.550		14.130	
p-value	0.779		0.562		0.776	

Table 8: Robust Two-step System-GMM Estimates for Combined Effects of Macroeconomic and Firm-Specific Uncertainty on Leverage

Panel A of the table reports the estimates obtained from robust two-step System-GMM estimations for combined effects of macroeconomic uncertainty and firm-specific uncertainty on firms' leverage. The figures given in parentheses are standard errors which are are asymptotically robust to the presence of heteroskedasticity and serial correlation within panels. The dependent variable is leverage, defined as the ratio of short-term debt to total assets. The analysis covers the period 1999-2008 for panel of UK public and non-public firms. Model 1 estimates the joint impact of volatility in GDP and volatility in level of sales on leverage. Model 2 estimates the joint impact of volatility in GDP and accumulative volatility in sales on leverage. Model 3 estimates the joint impact of volatility in T-bills rates and volatility in level of sales on firm's leverage. Model 4 estimates the joint impact of volatility in T-bills rates and cumulative volatility in sales on leverage. In all four models, the one period lagged values of the first difference of the right-hand side variables are used as instruments for the equations in levels. The instruments for differenced equations are the first and second lags for Model 1, 2 and 3. For Model 4, the second to fourth lags of the right-hand variables are used as instruments for first differenced equations. Business cycle effects are controlled by including year dummies (not reported). The methodology of measuring volatility and definitions of the remaining independent variables are given in the appendix. Panel C of the table reports the J statistics, which is a test of the over identifying restrictions and distributed as chi-squared under the null of instrument validity and Arellano-Bond, AR(2), test of second-order autocorrelation in the first-differenced residuals. *** denotes statistical significance at the 1% level of significance. ** indicates statistical significance at the 5% level. * indicates statistical significance at the 10% level.

Panel A: Estimation results				
Regressors	**Model 1**	**Model 2**	**Model 3**	**Model 4**
	Coeff. Std.Err.	Coeff. Std.Err.	Coeff. Std.Err.	Coeff. Std.Err.
Lev_{it-1}	0.358 (0.134)***	0.316 (0.156)***	0.339 (0.127)***	0.439 (0.148)***
$Sales_{it}$	-0.015 (0.002)***	-0.014 (0.002)***	-0.016 (0.002)***	-0.017 (0.003)***
$Cash_{it}$	-0.113 (0.041)***	-0.116 (0.041)***	-0.126 (0.042)***	-0.127 (0.042)***
$Invt_{it}$	0.044 (0.020)**	0.049 (0.021)**	0.045 (0.020)**	0.043 (0.025)*
σ_{t-1}^{GDP}	-0.010 (0.002)***	-0.010 (0.002)***		
σ_{t-1}^{T-bill}		-0.453 (0.159)***	-0.844 (0.233)***	
σ_{it-1}^{level}	-0.022 (0.008)***		-0.023 (0.009)***	
$\sigma_{it-1}^{cumulative}$		-0.029 (0.012)**		-0.069 (0.002)***
Constant	0.153 (0.026)***	0.157 (0.029)***	0.164 (0.025)***	0.156 (0.031)***
Panel B: Diagnostic tests				
Firm-years	23487	21001	23487	21001
Firm	5436	5301	5436	5301
AR(2)	-1.010	-1.011	-1.140	-0.14
p-value	0.310	0.311	0.254	0.889
J-statistic	12.77	10.86	12.29	9.04
p-value	0.850	0.828	0.583	0.433

Table 9: Robust Two-step System-GMM Estimates for a Differential Effect of Firm-Specific Uncertainty on the Leverage of Public Firms and Non-public

Panel A reports the estimates obtained from robust two-step System-GMM estimations. The figures given in parentheses are standard errors which are asymptotically robust to the presence of heteroskedasticity and serial correlation within panels. To examine the differential impact of uncertainty across both groups of firms, we construct $D_i^{nonpublic}$.X (D_i^{public}.X) as the explanatory variable X interacted with a dummy equal to one (zero) if the firm is non-public and zero (one) if the firm is public. The dependent variable is leverage, defined as the ratio of short-term debt to total assets. The analysis covers the period 1999-2008 for a panel of UK non-public and public firms. Model 1 estimates the impact of volatility in level of sales on leverage. Model 2 estimates the impact of volatility in growth of sales and Model 3 estimates the impact of cumulative volatility in level of sales on firm's leverage. In all three models, the one period lagged values of the first difference of the right-hand side variables are used as instruments for the equations in levels. The instruments for differenced equations are the second to fourth lags of the right-hand side variables for all models. Business cycle effects are controlled by including year dummies (not reported). The methodology of measuring volatility and definitions of the remaining independent variables are given in the appendix. Panel B of the table reports the test statistics along with its p-values for testing a differential effect of idiosyncratic uncertainty. Panel C reports the J statistics, which is a test of the over identifying restrictions and distributed as chi-squared under the null of instrument validity and Arellano-Bond, AR(2), test of second-order autocorrelation in the first-differenced residuals. ***, ** and * denote statistical significance at the 1%, 5% and 10% level, respectively.

Panel A: Estimation results			
Regressors	**Model 1** Coeff. Std.Err.	**Model 2** Coeff. Std.Err.	**Model 3** Coeff. Std.Err.
$D_i^{nonpublic}.Lev_{it-1}$	0.624 (0.048)***	0.694 (0.050)***	0.629 (0.052)***
$D_i^{public}.Lev_{it-1}$	0.338 (0.181)**	0.393 (0.188)**	0.348 (0.189)*
$D_i^{nonpublic}.Sales_{it}$	-0.015 (0.001)***	-0.017 (0.002)***	-0.015 (0.002)***
$D_i^{public}.Sales_{it}$	-0.027 (0.010)***	-0.026 (0.010)***	-0.027 (0.010)***
$D_i^{nonpublic}.Cash_{it}$	-0.076 (0.012)***	-0.066 (0.012)***	-0.079 (0.013)***
$D_i^{public}.Cash_{it}$	-0.119 (0.037)***	-0.091 (0.040)**	-0.108 (0.039)***
$D_i^{nonpublic}.Invt_{it}$	0.010 (0.011)	0.012 (0.012)	0.011 (0.012)
$D_i^{public}.Invt_{it}$	0.127 (0.074)*	0.158 (0.087)*	0.126 (0.075)*
$D_i^{nonpublic}.\sigma_{it-1}^{level}$	-0.035 (0.007)***		
$D_i^{public}.\sigma_{it-1}^{level}$	-0.006 (0.002)**		
$D_i^{nonpublic}.\sigma_{it-1}^{growth}$		-0.048 (0.014)***	
$D_i^{public}.\sigma_{it-1}^{growth}$		-0.044 (0.023)*	
$D_i^{nonpublic}.\sigma_{it-1}^{cumulative}$			-0.076 (0.016)***
$D_i^{public}.\sigma_{it-1}^{cumulative}$			-0.007 (0.003)**
Constant	0.104 (0.010)***	0.097 (0.012)***	0.099 (0.011)***
Panel B: Tests for differential effects of uncertainty			
$\sigma_{firm}^{public} = \sigma_{firm}^{nonpublic}$	14.370	10.030	18.070
p-value	0.000	0.113	0.000
Panel C: Diagnostic tests			
Firm-years	23,487	19,741	21,001
Firm	5,436	4,944	5,301
AR(2)	-0.080	-0.300	-0.220
p-value	0.936	0.766	0.826
J-statistic	22.560	28.990	15.060
p-value	0.546	0.220	0.591

Table 10: Robust Two-step System-GMM Estimates for a Differential Effect of Macroeconomic Uncertainty on the Leverage of Public and Non-public Firms

Panel A of the table reports the estimates obtained from robust two-step System-GMM estimations for the effects of macroeconomic uncertainty on firms' leverage, separately for non-public and public firms. The figures given in parentheses are standard errors which are asymptotically robust to the presence of heteroskedasticity and serial correlation within panels. To examine the differential impact of uncertainty across both groups of firms, we construct $D_i^{nonpublic}$.X (D_i^{public}.X) as the explanatory variable X interacted with a dummy equal to one (zero) if the firm is non-public and zero (one) if the firm is public. The dependent variable is leverage, defined as the ratio of short-term debt to total assets. The analysis covers the period 1999-2008 for a panel of UK non-public and public firms. Model 1 estimates the impact of volatility in GDP on leverage. Model 2 estimates the impact of volatility in T-bills rates on leverage and Model 3 estimates the impact of equal weighed volatility index on firm's leverage. In all three models, the one period lagged values of the first difference of the right-hand side variables are used as instruments for the equations in levels. The instruments for differenced equations are the second and the third lags of the right-hand side variables for Model 1 and 2. For Model 3, the third and fourth lags of the right-hand side variables (excluding uncertainty) are used as instruments in first differenced equations. Business cycle effects are controlled by including year dummies (not reported). The methodology of measuring volatility and definitions of the remaining independent variables are given in the appendix. Panel B of the table reports the test statistics along with its p-values for testing a differential effect of macroeconomic uncertainty. Panel C of the table reports the J statistics, which is a test of the over identifying restrictions and distributed as chi-squared under the null of instrument validity and Arellano-Bond, AR(2), test of second-order autocorrelation in the first-differenced residuals. ***, ** and * denote statistical significance at the 1%, 5% and 10% level, respectively.

Panel A: Estimation results			
Regressors	**Model 1**	**Model 2**	**Model 3**
	Coeff. Std.Err.	Coeff. Std.Err.	Coeff. Std.Err.
$D_i^{nonpublic}.Lev_{it-1}$	0.617 (0.048)***	0.675 (0.064)***	0.617 (0.048)***
$D_i^{public}.Lev_{it-1}$	0.409 (0.192)**	0.242 (0.136)*	0.413 (0.192)**
$D_i^{nonpublic}.Sales_{it}$	-0.015 (0.002)***	-0.016 (0.001)***	-0.014 (0.001)***
$D_i^{public}.Sales_{it}$	-0.029 (0.009)***	-0.014 (0.008)*	-0.029 (0.009)***
$D_i^{nonpublic}.Cash_{it}$	-0.076 (0.012)***	-0.071 (0.013)***	-0.077 (0.012)***
$D_i^{public}.Cash_{it}$	-0.113 (0.030)***	-0.090 (0.038)**	-0.112 (0.036)***
$D_i^{nonpublic}.Invt_{it}$	0.011 (0.012)	0.003 (0.011)	0.011 (0.013)
$D_i^{public}.Invt_{it}$	0.123 (0.064)*	0.151 (0.059)**	0.122 (0.064)*
$D_i^{nonpublic}.\sigma_{t-1}^{GDP}$	-0.010 (0.002)***		
$D_i^{public}.\sigma_{t-1}^{GDP}$	-0.021 (0.008)***		
$D_i^{nonpublic}.\sigma_{t-1}^{T-bill}$		-0.596 (0.278)**	
$D_i^{public}.\sigma_{t-1}^{T-bill}$		-0.992 (0.383)***	
$D_i^{nonpublic}.\sigma_{t-1}^{Index}$			-0.029 (0.008)***
$D_i^{public}.\sigma_{t-1}^{Index}$			-0.067 (0.025)***
Constant	0.105 (0.010)***	0.102 (0.014)***	0.105 (0.011)***
Panel B: Tests for differential effects of uncertainty			
$\sigma_{macro}^{public} = \sigma_{macro}^{nonpublic}$	1.670	0.680	1.820
p-value	0.195	0.414	0.177
Panel C: Diagnostic tests			
Firm-years	24,394	24,394	24,394
Firm	5,713	5,713	5,713
AR(2)	0.120	0.200	0.120
p-value	0.904	0.840	0.903
J-statistic	25.680	35.010	25.670
p-value	0.370	0.170	0.370

Table 11: Robust Two-step System-GMM Estimates for Differential Effects of Firm-Specific and Macroeconomic Uncertainty on the Leverage of Public and Non-public Firms

Panel A reports the estimates obtained from robust two-step System-GMM estimations for the effects of macroeconomic and firm-specific uncertainty on firms' leverage, separately for non-public and public firms. The figures given in parentheses are standard errors which are asymptotically robust to the presence of heteroskedasticity and serial correlation within panels. To examine the differential impact of uncertainty across both groups of firms, we construct $D_i^{nonpublic}$.X (D_i^{public}.X) as the explanatory variable X interacted with a dummy equal to one (zero) if the firm is non-public and zero (one) if the firm is public. The dependent variable is leverage, defined as the short-term debt scaled by total assets. The analysis covers the period 1999-2008 for a panel of UK non-public and public firms. Model 1 estimates the joint impact of volatility in GDP and volatility in level of sales on leverage. Model 2 estimates the joint impact of volatility in GDP and cumulative volatility in sales on leverage. Model 3 estimates the joint impact of volatility in T-bills rates and volatility in level of sales on firm's leverage. Model 4 estimates the joint impact of volatility in T-bills rates and cumulative volatility in sales on leverage. Business cycle effects are controlled by including year dummies (not reported). The methodology of measuring volatility and definitions of the remaining independent variables are given in the appendix. Panel B of the table reports the test statistics along with its p-values for testing a differential effect of uncertainty. Panel C reports the J statistics, which is a test of the over identifying restrictions and distributed as chi-squared under the null of instrument validity and Arellano-Bond, AR(2), test of second-order autocorrelation in the first-differenced residuals. ***, **, and * denote statistical significance at the 1%, 5% and 10% level, respectively.

	Panel A: Estimation results			
Regressors	**Model 1**	**Model 2**	**Model 3**	**Model 4**
	Coeff. Std.Err.	Coeff. Std.Err.	Coeff. Std.Err.	Coeff. Std.Err.
$D_i^{nonpublic}.Lev_{it-1}$	0.759 (0.026)***	0.761 (0.031)***	0.775 (0.026)***	0.768 (0.033)***
$D_i^{public}.Lev_{it-1}$	0.528 (0.162)*	0.639 (0.184)*	0.340 (0.138)***	0.395 (0.135)*
$D_i^{nonpublic}.Sales_{it}$	-0.015 (0.002)***	-0.014 (0.002)***	-0.016 (0.001)***	-0.015 (0.002)***
$D_i^{public}.Sales_{it}$	-0.019 (0.007)***	-0.025 (0.009)***	-0.027 (0.010)***	-0.012 (0.006)*
$D_i^{nonpublic}.Cash_{it}$	-0.054 (0.009)***	-0.061 (0.011)***	-0.056 (0.009)***	-0.061 (0.012)***
$D_i^{public}.Cash_{it}$	-0.090 (0.028)***	-0.081 (0.027)***	-0.076 (0.035)***	-0.058 (0.028)***
$D_i^{nonpublic}.Invt_{it}$	0.001 (0.009)	0.002 (0.011)	0.003 (0.010)	0.001 (0.011)
$D_i^{public}.Invt_{it}$	0.111 (0.061)*	0.117 (0.058)**	0.146 (0.059)**	0.136 (0.059)***
$D_i^{nonpublic}.\sigma_{t-1}^{GDP}$	-0.009 (0.003)***	-0.007 (0.003)**		
$D_i^{public}.\sigma_{t-1}^{GDP}$	-0.016 (0.007)**	-0.015 (0.008)*		
$D_i^{nonpublic}.\sigma_{t-1}^{T-bill}$		-0.621 (0.294)**	-0.926 (0.328)***	
$D_i^{public}.\sigma_{t-1}^{T-bill}$		-0.922 (0.418)**	-1.093 (0.461)**	
$D_i^{nonpublic}.\sigma_{it-1}^{level}$	-0.025 (0.005)***		-0.027 (0.005)***	
$D_i^{public}.\sigma_{it-1}^{level}$	-0.004 (0.002)**		-0.005 (0.002)**	
$D_i^{nonpublic}.\sigma_{it-1}^{cumulative}$		-0.050 (0.013)***		-0.056 (0.013)***
$D_i^{public}.\sigma_{it-1}^{cumulative}$		-0.004 (0.002)**		-0.007 (0.002)***
Constant	0.078 (0.006)***	0.074 (0.007)***	0.085 (0.008)***	0.086 (0.008)***
	Panel B: Tests for differential effects of uncertainty			
$\sigma_{firm}^{public} = \sigma_{firm}^{nonpublic}$	15.410	11.010	16.290	13.170
p-value	0.000	0.000	0.000	0.000
$\sigma_{macro}^{public} = \sigma_{macro}^{nonpublic}$	0.530	0.580	0.330	0.090
p-value	0.467	0.445	0.565	0.760
	Panel C: Diagnostic tests			
Firm-years	23,487	21,001	23,487	21,001
Firm	5,436	5,301	5,436	5,301
AR(2)	0.210	-0.003	0.170	-0.160
p-value	0.837	0.998	0.869	0.873
J-statistic	39.210	42.370	40.080	28.640
p-value	0.211	0.127	0.113	0.156

Table 12: Robust Two-step System-GMM Estimates for Spillover Effects of Firm-Specific and Macroeconomic Uncertainty on the Leverage of Non-public and Public Firms

Panel A reports the estimates obtained from robust two-step System-GMM estimations for the spillover effects of macroeconomic and firm-specific uncertainty on firms' leverage, separately for non-public and public firms. The figures given in parentheses are standard errors which are asymptotically robust to the presence of heteroskedasticity and serial correlation within panels. To examine the differential impact of uncertainty across both groups of firms, we construct $D_i^{nonpublic}$.X (D_i^{public}.X) as the explanatory variable X interacted with a dummy equal to one (zero) if the firm is non-public and zero (one) if the firm is public. The dependent variable is leverage, defined as the ratio of short-term debt to total assets. The analysis covers the period 1999-2008 for a panel of UK non-public and public firms. Model 1 estimates the spillover effect of firm-specific uncertainty on leverage. Model 2 estimates the spillover effect of macroeconomic uncertainty on leverage and Model 3 estimates the spillover effects of both macroeconomic and firm-specific uncertainty on firm leverage jointly. Business cycle effects are controlled by including year dummies (not reported). The methodology of measuring volatility and definitions of the remaining independent variables are given in the appendix. Panel B of the table reports the J statistics, which is a test of the over identifying restrictions and distributed as chi-squared under the null of instrument validity and Arellano-Bond, AR(2), test of second-order autocorrelation in the first-differenced residuals. ***, ** and * denote statistical significance at the 1%, 5% and 10% level, respectively.

Regressors	Model 1	Model 2	Model 3
	Coeff. Std.Err.	Coeff. Std.Err.	Coeff. Std.Err.
Panel A: Estimation results			
$D_i^{nonpublic}.Lev_{it-1}$	0.636 (0.049)***	0.584 (0.032)***	0.588 (0.032)***
$D_i^{public}.Lev_{it-1}$	0.348 (0.184)*	0.418 (0.132)***	0.420 (0.132)***
$D_i^{nonpublic}.Sales_{it}$	-0.016 (0.001)***	-0.015 (0.001)***	-0.015 (0.002)***
$D_i^{public}.Sales_{it}$	-0.024 (0.009)***	-0.031 (0.007)***	-0.030 (0.007)***
$D_i^{nonpublic}.Cash_{it}$	-0.076 (0.012)***	-0.099 (0.014)***	-0.098 (0.015)***
$D_i^{public}.Cash_{it}$	-0.096 (0.040)***	-0.167 (0.046)***	-0.156 (0.046)***
$D_i^{nonpublic}.Invt_{it}$	0.007 (0.012)	0.014 (0.012)	0.015 (0.012)
$D_i^{public}.Invt_{it}$	0.155 (0.069)**	0.121 (0.059)**	0.122 (0.059)**
$D_i^{nonpublic}.\sigma_{t-1}^{GDP}$	-0.009 (0.003)***	-0.011 (0.003)***	-0.012 (0.003)***
$D_i^{public}.\sigma_{t-1}^{GDP}$	-0.017 (0.008)**	-0.029 (0.010)***	-0.029 (0.010)***
$D_i^{nonpublic}.\sigma_{it-1}^{level}$	-0.032 (0.009)***	-0.038 (0.007)***	-0.035 (0.009)***
$D_i^{public}.\sigma_{it-1}^{level}$	-0.002 (0.002)	-0.006 (0.002)**	-0.001 (0.002)
$D_i^{nonpublic}.Cash_{it}.\sigma_{it-1}^{level}$	-0.037 (0.093)		-0.056 (0.099)
$D_i^{public}.Cash_{it}.\sigma_{it-1}^{level}$	-0.164 (0.075)**		-0.165 (0.078)**
$D_i^{nonpublic}.Cash_{it}.\sigma_{t-1}^{GDP}$		0.033 (0.025)	0.034 (0.025)
$D_i^{public}.Cash_{it}.\sigma_{t-1}^{GDP}$		0.119 (0.069)*	0.117 (0.069)*
Constant	0.106 (0.011)***	0.115 (0.007)***	0.114 (0.008)***
Panel B: Diagnostic tests			
Firm-years	23,487	23,487	23,487
Firm	5,436	5,436	5,436
AR(2)	-0.060	-0.180	-0.170
p-value	0.954	0.858	0.869
J-statistic	52.360	65.960	87.500
p-value	0.309	0.195	0.118

Table 13: Sensitivity of Public Firms' Leverage to Uncertainty and Cash Holdings
Panel A reports the percentiles of the cash-to-total assets ratio, estimates of the elasticities of leverage (Lev) with respective to idiosyncratic uncertainty (σ_{firm}) at particular levels of cash holdings, standard errors and p-values associated with the test of significance of the estimates. Panel B reports the percentiles of the cash-to-total assets ratio, estimates of the elasticities of leverage (Lev) with respective to macroeconomic uncertainty (σ_{macro}) at particular levels of cash holdings, standard errors and p-values associated with the test of significance of the estimates.

Panel A: Idiosyncratic Uncertainty Effects and Cash/Assets Holdings						
	P10	**P25**	**P50**	**P75**	**P80**	**P90**
Cash/assets	2.1E-03	1.6E-02	5.4E-02	1.5E-01	1.8E-01	3.1E-01
$\frac{\partial Lev}{\partial \sigma_{firm}}$	-0.002	-0.004	-0.010	-0.025	-0.031	-0.051
Std. Err.	0.003	0.002	0.003	0.010	0.013	0.020
p-value	0.508	0.069	0.004	0.013	0.016	0.022
Panel B: Macroeconomic Uncertainty Effects and Cash/Assets Holdings						
Cash/assets	2.1E-03	1.6E-02	5.4E-02	1.5E-01	1.8E-01	3.1E-01
$\frac{\partial Lev}{\partial \sigma_{macro}}$	-0.029	-0.027	-0.023	-0.012	-0.008	0.007
Std. Err.	0.010	0.009	0.008	0.007	0.009	0.016
p-value	0.004	0.003	0.003	0.102	0.331	0.673

Table 14: Sensitivity of Non-Public Firms' Leverage to Uncertainty and Cash Holdings
Panel A reports the percentiles of the cash-to-total assets ratio, estimates of the elasticities of leverage (Lev) with respective to idiosyncratic uncertainty (σ_{firm}) at particular levels of cash holdings, standard errors and p-values associated with the test of significance of the estimates. Panel B reports the percentiles of the cash-to-total assets ratio, estimates of the elasticities of leverage (Lev) with respective to macroeconomic uncertainty (σ_{macro}) at particular levels of cash holdings, standard errors and p-values associated with the test of significance of the estimates.

Panel A: Idiosyncratic Uncertainty Effects and Cash/Assets Holdings						
	P10	**P25**	**P50**	**P75**	**P80**	**P90**
Cash/assets	4.3E-04	9.2E-03	5.7E-02	1.7E-01	2.2E-01	3.5E-01
$\frac{\partial Lev}{\partial \sigma_{firm}}$	-0.034	-0.035	-0.038	-0.044	-0.047	-0.054
Std. Err.	0.009	0.008	0.007	0.013	0.017	0.029
p-value	0.000	0.000	0.000	0.001	0.008	0.069
Panel B: Macroeconomic Uncertainty Effects and Cash/Assets Holdings						
Cash/assets	4.3E-04	9.2E-03	5.7E-02	1.7E-01	2.2E-01	3.5E-01
$\frac{\partial Lev}{\partial \sigma_{macro}}$	-0.012	-0.011	-0.009	-0.005	-0.004	0.000
Std. Err.	0.004	0.003	0.003	0.004	0.004	0.007
p-value	0.003	0.003	0.002	0.114	0.325	0.967

Appendix
Symbol and Definitions of Variables

Symbol	Variable	Definition
Lev_{it}	Sort-term debt/total assets	Short-term debt at the end of this year divided by total assets
$Sales_{it}$	Sales/total assets	Total turnover during a year divided by total assets
$Invt_{it}$	Investment/total assets	Aggregate investment divided by total assets
$Cash_{it}$	Cash/ total assets	Cash and Equivalent divided by total assets
$D_i^{nonpublic}$	Non-public dummy	Non-public is a dummy equal to one if the firm is non-public and zero if the firm is public
D_i^{public}	Public dummy	Public is a dummy equal to one if the firm is public and zero if the firm is non-public
σ_{it}^{level}	Volatility in level of sales as proxy for firm-specific uncertainty	It is the size of the deviation from average sales of the firm over the period from 1999 to 2008 and from average sales for all firms in a given year.
σ_{it}^{growth}	Volatility in growth of sales as proxy for firm-specific uncertainty	For a given firm-year, it is measured by the size of the deviation from average growth of sales of the firm over the period 1999 to 2008 and from average growth for all firms in that year.
$\sigma_{it}^{cumulative}$	Cumulative-volatility in sales as proxy for firm-specific uncertainty	To measure the cumulative-volatility in sales for the year 2000, we compute the standard deviation of the residuals obtained from the state space model of sales for years 2000, 1999; similarly for year 2001, the residuals in 2001, 2000 and 1999 are used.
σ_t^{GDP}	Conditional variance for gross domestic product (GDP)	ARCH/GARCH specifications are used for GDP to obtain the conditional variance as proxy for macroeconomic uncertainty.
σ_t^{TBR}	Conditional variance for Treasury bill rates (T-bill rates)	ARCH/GARCH models are estimated for T-bill rates to proxy for macroeconomic uncertainty.
σ_t^{Index}	Conditional variance index	We compute an equal weighted index using the conditional variance obtained from ARCH/GARCH specifications for GDP, CPI and T-bill rates.

Figure 1

Marginal Effects of Idiosyncratic Uncertainty on Public Firms' Leverage

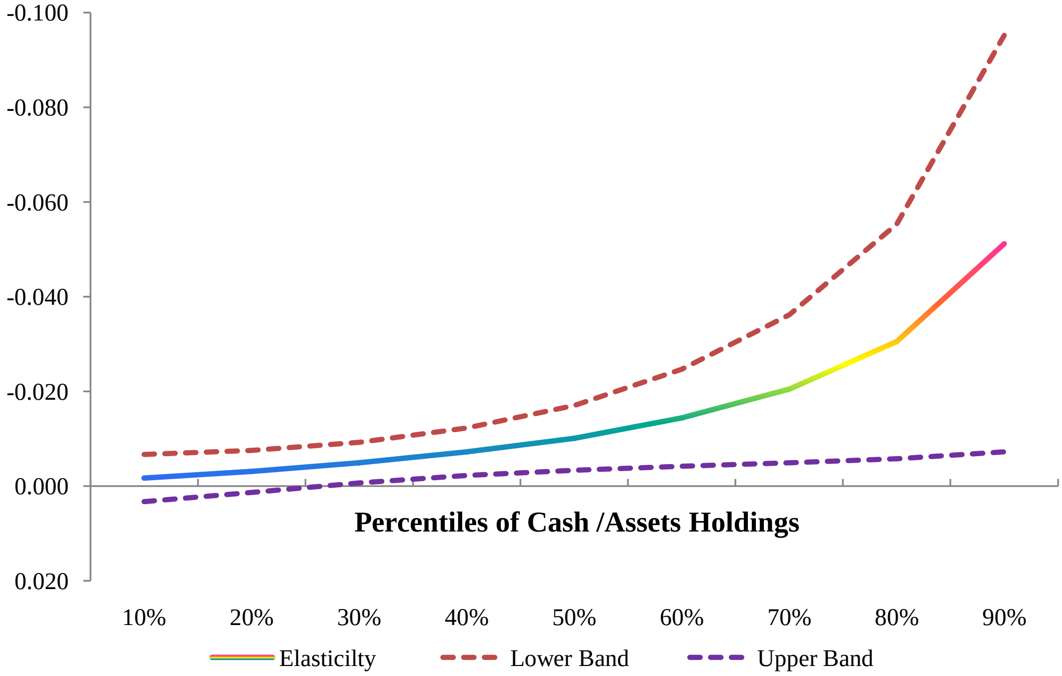

Figure 2

Marginal Effects of Macroeconomic Uncertainty on Public Firms' Leverage

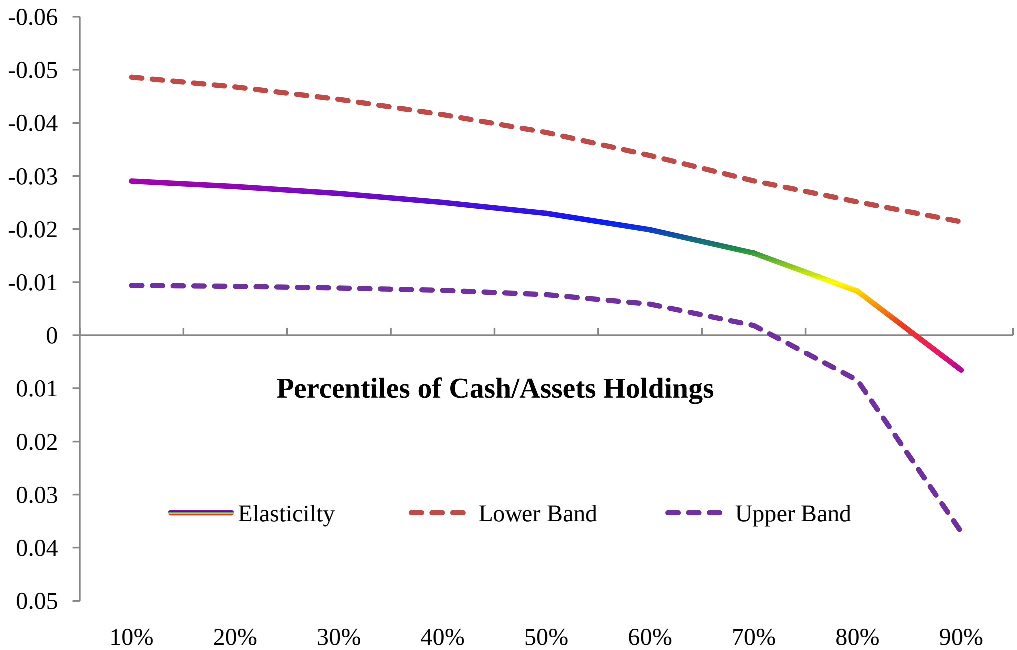

Figure 3
Marginal Effects of Idiosyncratic Uncertainty on Non-public Firms' Leverage

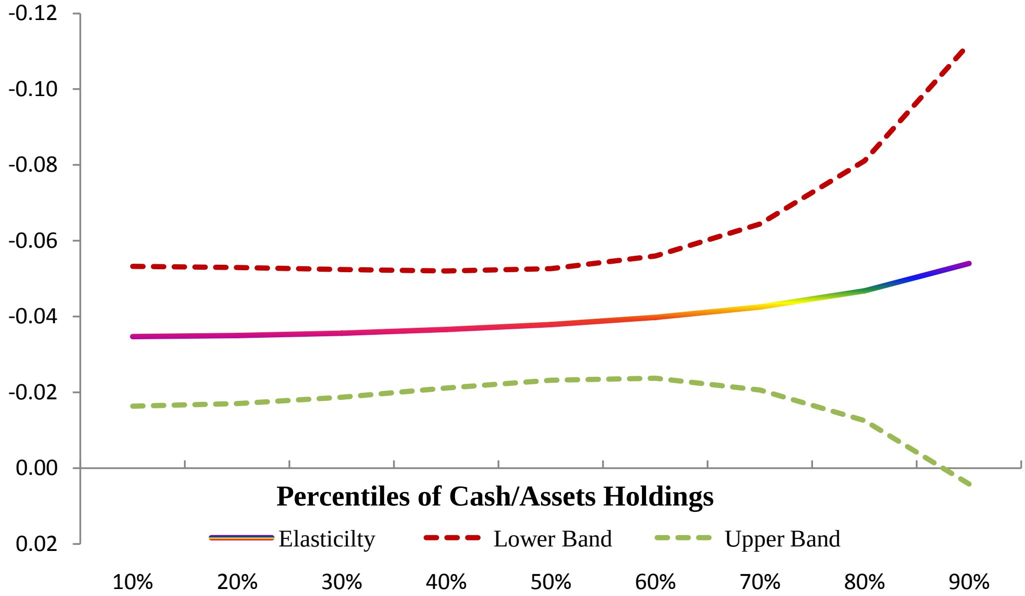

Figure 4
Marginal Effects of Macroeconomic Uncertainty on Non-public Firms' Leverage