Strategic Debt: Evidence from Bertrand and Cournot Competition

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Abstract

We investigate how competitive behavior affects the capital structure of a firm. Theory predicts that the impact of different types of output market uncertainty (in particular, unanticipated shocks in demand and costs) on a firm's leverage depends on the type of competition in an industry. We test these predictions in a sample of U.S. manufacturing firms by classifying firms into Cournot competition (strategic substitutes), and Bertrand competition (strategic complements). We show that demand uncertainty is positively related to leverage for firms in both the Cournot and the Bertrand sample. Cost uncertainty has a significantly positive impact on the leverage of Cournot firms, but plays a negligible role for Bertrand firms. Our results support the strategic use of debt and highlight the role of firms' competitive behavior in the product market in their capital structure decisions.

Key words: Strategic debt, Cournot competition, Bertrand competition, demand and cost uncertainty, leverage

JEL classification: G32, L10, L60

1. Introduction

Financing and output decisions are closely linked. Several theoretical studies (e.g., Brander and Lewis, 1986; Maksimovic, 1988; Bolton and Scharfstein, 1990; Showalter, 1995; Dasgupta and Titman, 1998; Faure-Grimaud, 2000; Wanzenried, 2003) emphasize the strategic role of debt in a firm's competitive strategy in the output market. An important feature of these theoretical models is that the strategic role of debt depends on the firm's competitive environment. In particular, the link between a firm's capital structure and its output market decisions is different in Cournot and Bertrand competition.

Brander and Lewis (1986) introduce a Cournot competition model to link the choice of debt level and output decisions. Because of limited liability, the equity holders of a firm that take on debt optimize their output strategy over non-bankruptcy states of the world. When the firm faces uncertainty in the output market (e.g., uncertainty about future demand or costs), equity holders ignore the bad states of demand or costs in which debt holders would suffer. Therefore, they have an incentive to gain a strategic advantage in the output market by competing more aggressively. In short, Brander and Lewis (1986) predict that Cournot firms subject to demand and/or cost uncertainty have an incentive to commit to a large output by using a highly leveraged capital structure. In a model of Bertrand competition, Showalter (1995) shows that different sources of output market uncertainty have a different effect on a firm's capital structure. When demand is uncertain, debt carries a strategic advantage. However, when costs are uncertain, Bertrand firms have an incentive to reduce their debt level.

The models of Brander and Lewis (1986) and Showalter (1995) thus produce testable hypotheses that depend on the type of competition. In Cournot competition, higher demand uncertainty leads to higher debt levels, and cost uncertainty also encourages firms

to have a high leverage. In Bertrand competition, higher demand uncertainty induces higher debt, while higher cost uncertainty induces firms to choose lower debt levels.

Empirical research on the link between debt and product market competition is scarce. Chevalier (1995a, 1995b), Phillips (1995), and Kovenock and Phillips (1997) focus on a small number of industries in which some firms experience sharp changes in their capital structure. Lyandres (2006) presents a model that describes how the extent of competitive interaction among firms influences the role of strategic debt. He tests the predictions of the model on a large sample of U.S. manufacturing companies.

To our knowledge, Showalter (1999) is the only study that conducts an empirical test of the effect of demand and cost uncertainty on capital structure choice. Showalter shows that U.S. manufacturing firms increase debt as demand uncertainty becomes more important, but reduce debt as costs become more uncertain. He concludes that his findings are consistent with the predictions of models on Bertrand competition, and thus with the hypothesis that the firms in his sample engage in Bertrand competition.

Despite the clear distinction that theoretical models make between Cournot and Bertrand competition, empirical studies to date do not attempt to take the type of competitive behavior into account. The aim of our study is to test the theoretical predictions of Brander and Lewis (1986) and Showalter (1995) and explicitly investigate the different implications these models have for firms in Bertrand and Cournot competition. We use the competitive strategy measure of Sundaram, John and John (1996) to characterize the competitive behavior of firms in different industries. This approach allows us to identify industries in which the competitive environment can be categorized as either Cournot or Bertrand competition. For the samples of Cournot and Bertrand firms, we estimate a capital

structure model with conventional determinants of leverage and measures of cost and demand uncertainty as explanatory variables.

For Cournot firms, we find that both demand uncertainty and cost uncertainty are significantly positively associated with leverage. The effects are statistically significant across several different measures of leverage and proxies of uncertainty. For Bertrand firms, demand uncertainty has a significantly positive impact on leverage, but cost uncertainty does not have a significant effect on capital structure. The impact of different sources of uncertainty clearly differs in our two samples of Cournot and Bertrand firms.

Our findings are consistent with the theoretical predictions of Brander and Lewis (1986) that higher demand and cost uncertainty induce Cournot firms to increase debt levels. Our evidence also supports the positive impact of demand uncertainty on Bertrand firms' leverage, as predicted by Showalter (1995), but there is no evidence for the role of cost uncertainty among these firms. Our analysis underlines the role of strategic debt and shows that distinguishing firms according to their competitive behavior is important. Whether firms are competing in Cournot or Bertrand affects the way their capital structure choice is influenced by output market uncertainty.

2. Literature

In this section, we briefly review the theoretical and empirical literature on the relation between leverage and product market competition.

Brander and Lewis (1986) analyze a two-stage Cournot model. In Cournot competition, firms compete by setting the quantities they produce. With locally linear demand curves, Cournot firms compete as strategic substitutes (Bulow, Geanakoplos and Klemperer, 1985). In the first stage of the model, firms decide on the amount of debt. In the

second stage, they compete in the output market. In this framework, debt commits the equity holders of a firm to pursue a more aggressive product market strategy by raising the quantity to produce. Because of the limited liability effect, the equity holders of firms that take on debt optimize only over non-bankruptcy states of the world. If the firm goes bankrupt, the equity holders' losses are limited by the value of their initially contributed investment, which is assumed to be zero in this model. Debt holders suffer in the case of a shortage of the firm's returns. A higher dispersion in anticipated levels of either demand or costs increases the uncertainty that the firm faces. And higher uncertainty induces equity holders in Cournot firms to compete more aggressively by producing more. As a result, higher uncertainty, regardless of whether the source is demand or costs, leads to higher levels of both output and debt. Debt is always of strategic advantage when Cournot firms face demand or cost uncertainty.

Showalter (1995) modifies Brander and Lewis' (1986) model to the case of Bertrand competition in which rival firms compete by setting prices. With non-increasing marginal costs, Bertrand firms compete as strategic complements (Bulow et al., 1985). Showalter shows that in this type of competition, the source of output market uncertainty plays a crucial role in determining the optimal debt level. With Bertrand competition, debt brings about a strategic advantage only when demand is uncertain. When this type of uncertainty is large, high prices are encouraged through high debt levels. By increasing its debt, a firm optimizes over good states of the world (i.e., high demand states) and therefore chooses a higher equilibrium price. Rival firms react by raising their prices, thus increasing the expected profit of the leveraged firms. However, when costs are uncertain, firms that take on debt place emphasis on low cost states, and therefore choose a lower equilibrium price. The commitment to a lower price induces rival firms to decrease their price, reducing

the expected profit of the leveraged firm. As a result, Bertrand firms facing high cost uncertainty have no incentive to hold debt. Showalter (1999) argues that in a more general model where debt has other advantages, higher cost uncertainty induces Bertrand firms to reduce leverage below the optimal debt level that firms would hold in the absence of any strategic motive.

Wanzenried (2003) shows that demand uncertainty (or volatility) also raises a firm's optimal debt level in models of both Cournot and Bertrand competition in the presence of differentiated products. She does not take uncertainty on the cost side into account. Haan and Toolsema (2007) present a numerical analysis of strategic debt using Wanzenried's (2003) two-stage differentiated goods model with a correction in solving the second stage of the model. In contrast to the result of Wanzenried, they find that the equilibrium debt level decreases for both Bertrand and Cournot firms as demand becomes more volatile.

Showalter (1999) is the only empirical study we know that empirically investigates the role of demand and cost uncertainty in determining a firm's capital structure. Showalter analyzes a sample of U.S. manufacturing firms over the period 1975-1994 and examines the relation between leverage and the demand/cost uncertainty that firms face in product markets. To measure demand and cost uncertainty, Showalter (1999) proposes an approach that uses trend regressions. Demand (cost) uncertainty is calculated as the natural logarithm of the standard error of regressions of sales (costs of good sold over sales) on linear and non-linear trends. His empirical results are in line with Showalter (1995). There is a positive relation between leverage and demand uncertainty and a negative relation between leverage and cost uncertainty. Showalter (1999) concludes that price competition is the prevalent competitive behavior in U.S. manufacturing.

The type of competitive behavior plays a crucial role in theoretical models of the link between competition and leverage. We are not aware of any studies that explicitly allow for the type of competition affecting this link. We contribute to the literature by directly testing the predictions of models of Cournot and Bertrand competition on the relation between output market uncertainty and capital structure. To that end, we classify firms in our empirical analysis into different types of strategic interaction in their industries. The hypotheses that we aim to test are as follows. Under Bertrand competition:

(*H1*) firms use more debt when demand is more uncertain;

(*H2*) firms use less debt when costs are more uncertain.

Under Cournot competition:

(*H3*) firms use more debt when demand is more uncertain;

(*H4*) firms use more debt when costs are more uncertain.

3. Methodology and data

3.1. Strategic competition measures: complements vs. substitutes

Sundaram et al. (1996) argue that whether competition occurs in strategic substitutes (SS) or strategic complements (SC) depends on the effects of a firm's moves on its competitor's marginal profits. Suppose two duopolistic firms, A and B, are in an initial equilibrium, i.e., both firms have set marginal revenues equal to marginal costs. If firm A changes its strategy due to an exogenous shock, this change affects its own as well as firm B's marginal profits. To reach a new equilibrium, both firms re-optimize based on the expected consequences for their marginal profits. If firm B re-optimizes by competing in SS, then its marginal profits must be decreasing. On the contrary, if firm B re-optimizes by competing in SC, then its marginal profits must be increasing. Thus, competition in SC and SS can be

distinguished by examining the sign of the second derivative of firm A's profits with respect to its own and firm B's strategic variable.

Sundaram et al. (1996) provide an empirical measure of the type of competition by constructing a proxy for the second derivative in the context of R&D competition. Their competitive strategy measure (*CSM*) is the coefficient of correlation between $\Delta\pi^f/\Delta S^f$ and ΔS^c, where $\Delta\pi^f/\Delta S^f$ is the change in a firm's profit margin (which is the change in net income over the change in net sales), and ΔS^c is the change in the competitors' output.[1] If *CSM* is smaller than zero, then competition is in SS; if *CSM* is greater than zero, then competition is in SC. In the empirical implementation, Sundaram et al. use cutoff points of -0.05 and +0.05 to define the sample of SS and SC firms. Lyandres (2006) provides a mathematical proof for the validity of this *CSM* measure as a proxy for the nature of product market competition, under the assumption that the firm's value function remains constant in the short-run. In the long-run, an industry-wide shock might change a firm's value function and introduce noise in the relation between the firm's marginal profit and its rivals' sales. Lyandres (2006) develops a model in which a firm's leverage is positively related to the extent of competitive interaction within its industry. He uses the absolute value of *CSM* as a measure of the extent of interaction.

We follow the approach of Sundaram et al. (1996) to measure the type of strategic competition. We argue that competitive behavior may change over time when firms face industry shocks or changes in demand functions. Therefore, we estimate *CSM* based on

[1] Sundaram et al. (1996) include all firms with the same 4-digit SIC except the firm in question in the set of competitors.

quarterly data during a relatively short period of time: we require 20 consecutive quarters of sales (Compustat data *ITEM#*2, quarterly database) and profits (*ITEM#*8).[2]

We use a narrow definition of industries based on their 4-digit SIC. Therefore, we argue that it is reasonable to assume that competitive behavior is consistent across firms in each industry-year. We derive a measure representative for each industry-year's competition type. After obtaining the *CSM* measures for each firm-year, we calculate the mean and the standard deviation of the *CSM* for each industry in each year. We use the following measures of competitive behavior: (i) *SSDUM* is a dummy that takes a value of one if the industry-year mean of *CSM* is significantly positive, and a value of zero otherwise; (ii) *SCDUM* takes a value of one if the industry-year mean of *CSM* is significantly negative, and a value of zero otherwise. We use a 10% significance level. This procedure is consistent with Lyandres (2006), although he does not take into account the statistical significance. Our approach results in the identification of three separate samples of firms: Cournot firms, Bertrand firms, and unidentified firms.[3]

3.2. Measures of demand and cost uncertainty

Following Showalter (1999), we define three demand uncertainty proxies (*DEM1*, *DEM2*, and *DEM3*) as the natural logarithm of the standard error of the following trend regressions:

$$Y_t = \beta_0 + \beta_1 t + e_t \tag{1}$$

$$Y_t = \gamma_0 + \gamma_1 t + \gamma_2 t^2 + u_t \tag{2}$$

$$Y_t = \lambda_0 + \lambda_1 t + \lambda_2 t^2 + \lambda_3 t^3 + v_t \tag{3}$$

[2] Sundaram et al. (1996) use 40 quarters in the empirical estimation of *CSM*. Lyandres (2006) uses annual data for 10 years or more to estimate the extent of strategic interaction.

[3] The unidentified firms have an industry-year *CSM* which is not significantly different from zero. The sample of unidentified firms is not further analyzed in our study.

where Y_t is either sales or costs of goods sold divided by sales at time *t*. Showalter's (1999) assumption behind this approach is that a firm's sales and costs grow or decline in a fairly predictable pattern. Deviations from the anticipated trends represent unanticipated shocks to demand or costs. We scale the demand uncertainty proxies by sales to prevent larger firms from having a larger uncertainty measure by definition. Our three cost uncertainty proxies (*COST1, COST2,* and *COST3*) are taken from the same regressions, but with the costs of goods sold (*ITEM#*30) divided by sales in quarter *t* as dependent variable.

Showalter (1999) assumes that demand and cost uncertainty are stable over a long period of time and he estimates the regressions over his whole sample period, from 1975 to 1994. We argue that a firm's demand or cost uncertainty may exhibit important changes over time. Therefore, we use quarterly data for five consecutive years in estimating demand and cost uncertainty. In addition, we control for predictable seasonal effects in the estimation by adding three quarter dummies to regressions (1), (2), and (3).

3.3. Leverage measures

To facilitate a comparison with Showalter's (1999) study, we stay close to his choice of measures for capital structure and other variables. As *CSM* and the output market uncertainty measures are based on five consecutive years of data, we compute the average of a firm's leverage and the firm-specific capital structure determinants over five consecutive years as well. We use four measures of leverage, two of which are based on book values and two on market values. The book value of the long-term debt ratio (*LDEBTBV*) is defined as the average of total long-term debt (Compustat data *ITEM#*9, annual database) over five consecutive years divided by the average of total assets (*ITEM* #6). The market value of the long-term debt ratio (*LDEBTMV*) is calculated as the average

of total long-term debt divided by the average market value of total assets.[4] The book value of the total debt ratio (*TDEBTBV*) is average total debt (*ITEM* #9 + *ITEM* #34) divided by average total assets. The market value of the total debt ratio (*TDEBTMV*) is defined as average total debt divided by the average market value of total assets.

3.4. Capital structure determinants

Empirical capital structure research uses variables related to static trade-off, agency, and information asymmetry considerations to explain leverage. In the static trade-off framework, the firm is viewed as setting a target debt-to-assets ratio and moving towards it. A firm's capital structure is determined by the trade-off between tax advantages and bankruptcy-related costs. DeAngelo and Masulis (1980) argue that the tax advantage of debt diminishes as other tax reductions, such as tax and investment tax credits, increase. Because these variables act as a tax shield substitute for debt, a negative relation between leverage and these non-debt tax shields is expected. The proxy for non-debt tax shields used in this study (*NDTS*) is defined as the ratio of average depreciation (*ITEM#125*) and investment tax credit (*ITEM#208*) to average total assets. With respect to bankruptcy costs, we use the following variables: asset tangibility (higher tangibility of assets indicates lower risk for the lender as well as reduced direct costs of bankruptcy), firm risk (higher risk indicates higher volatility of earnings and higher probability of bankruptcy), and firm size (an inverse proxy for the probability of bankruptcy; larger firms are less likely to face financial distress). We measure tangibility (*TANG*) as the ratio of average net fixed assets (*ITEM#8*) to average total assets; firm risk (*RISK*) as the standard deviation of the ratio of

[4] The measure market value of total assets is calculated as (Total debt + Market value of equity + Preferred stock – Deferred taxes and investment credits) = *ITEM #9 + ITEM #34 + (ITEM #199*ITEM #54) + ITEM #10 – ITEM #35.*

operating income before depreciation (*ITEM#13*) to total assets; and firm size (*SIZE*) as the natural logarithm of average total assets.

Agency conflicts between equity holders and debt holders arise from asset-substitution and underinvestment. To minimize these conflicts, firms with high growth opportunities have a preference for a low leverage, thus seeking equity financing for their new projects instead of debt financing. Agency theory predicts that growth opportunities are negatively associated with leverage. We use the market-to-book ratio (*MTB*), defined as the average market value of total assets over the average book value of total assets, as a proxy for growth opportunities. If debt is not collateralized, equity holders have incentives to expropriate wealth from debt holders (Myers, 1977). Creditors may also demand a higher interest rate, forcing firms to choose equity instead. Our measure of tangibility can be used as a proxy for collateralization, which is expected to be positively related to leverage.

The pecking-order theory suggests that firms follow a specific hierarchy in financing: they prefer internal over external financing. If external financing is required, a firm issues the safest security first. That is, it first issues debt, then hybrid securities such as convertible bonds, and equity only as the last resort. It is common to use profitability to test the pecking-order theory: more profitable firms are likely to have less leverage as they make use of the internally generated fund first. We measure profitability (*PROFIT*) as the average operating income before depreciation divided by the average total assets.

From the asymmetric information viewpoint, bigger firms are likely to provide better information to the market and are expected to have better access to credit. Hence, firm size is expected to be positively correlated with debt levels. Liquidity is another variable that determines the capital structure choice of firms. The agency theory and pecking-order theory both predict a negative relation between liquidity and leverage. We

measure liquidity (*LIQUID*) as the ratio of average cash and short-term investments (*ITEM#1*) to average total assets. In addition, we use 2-digit SIC industry dummies in our regression models to capture the unobservable influences of industry characteristics on leverage choice of firms with common product lines.[5]

3.5. Data

We obtain firm-level data from the COMPUSTAT North America database for the period 1985 to 2004. We collect data at two different frequencies: annually and quarterly. At the annual frequency, we take all manufacturing firms' relevant financial information such as total assets, tangible assets, profits, debt levels, etc. At the quarterly frequency, we collect sales, profits, and costs of goods sold, all of which are needed to estimate *CSM* and demand/cost uncertainty.

We define competitors as all firms in the COMPUSTAT data base with the same 4-digit SIC code (*ITEM#*324) in each particular year. Therefore, we drop the observations that do not have records of 4-digit historical SIC. As we focus on U.S. manufacturing firms only, we omit observations with historical SIC below 2000 or above 3999. We exclude firms in industries concerned with miscellaneous items.[6] Competition within industries is the main focus of our study, so the identification of the relevant competitors within the same industry is essential. We require firms to have both total assets and sales greater than 1 million USD. We discard firms without quarterly data for sales, profits, and costs of

[5] We conduct robustness checks by using alternative measures of leverage and capital structure determinants. For example, we also measure *LDEBTBV* as the average ratio of long-term debt to the book value of total assets (instead of the ratio of the of average long-term debt to the average book value of total assets), *LDEBTMV* as the average ratio of long-term debt to the market value of assets, *TANG* as the average ratio of fixed assets to total assets, *PROFIT* as the average ratio of operating income to total assets, etc. The results are similar.

[6] We do not take these industries as the last 2 digits of the 4-digit SIC code ending with 99 as in MacKay and Phillips (2005), but check these industries manually to make sure of the correct definitions. This procedure is in line with Clarke (1989) and Campello (2006).

goods sold. We follow MacKay and Phillips (2005) and drop observations with negative sales or assets for either annual or quarterly records.

The data screens yield a final sample of 126 industries, consisting of 14,007 firm-years and 2,660 distinct firms. We analyze data in three consecutive five-year periods to avoid that we use overlapping data for calculating *CSM*, demand and cost uncertainty, and the other variables. We present results that are based on the periods 1989-1994, 1995-1999, and 2000-2004.[7] After applying Sundaram et al.'s (1996) approach to measure strategic competition, we obtain a sample of Bertrand firms that includes 954 observations (the "Bertrand sample"), and a sample of Cournot firms that includes 633 observations (the "Cournot sample").

We estimate panel data models with firm random effects to investigate the relation between output market uncertainty and leverage.[8] We use time dummies (for three different periods) and White standard errors to correct for heteroskedasticity. The basic regression model is as follows:

$$LEV_{it} = \beta_0 + \sum_{i=1}^{19} \beta_i INDUSTRY_i + \beta_{20} TANG_{it} + \beta_{21} SIZE_{it} + \beta_{22} RISK_{it} + \beta_{23} NDTS_{it} +$$

$$+ \beta_{24} PROFIT_{it} + \beta_{25} MTB_{it} + \beta_{26} LIQUID_{it} + \beta_{27} DEM_{it} + \beta_{28} COST_{it} + \varepsilon_{it} \qquad (4)$$

where *LEV* is the proxy for leverage; $INDUSTRY_i$ are the industry dummies for 2-digit SIC industries; *DEM* and *COST* represent the demand and cost uncertainty proxies *DEM1*, *DEM2*, *DEM3* and *COST1*, *COST2*, *COST3*, respectively. The other explanatory variables are described above. In a robustness check, we include a measure of competition intensity,

[7] Other combinations of 3 consecutive periods are used for robustness checks: (i) 1987-1991, 1992-1996, and 1997-2001; (ii) 1988-1992, 1993-1997, and 1998-2002; and (iii) 1989-1993, 1994-1998, and 1999-2003. We find similar results.

[8] A Hausman test shows that the differences between the coefficients in the fixed and random effects panel models are not statistically significant.

the absolute value of industry-average *CSM*, as an additional explanatory variable as suggested by Lyandres (2006).

4. Empirical analysis of the link between leverage and demand/cost uncertainty

Table 1 presents summary statistics of firm characteristics in the Bertrand and Cournot samples. Many firm characteristics differ significantly across both samples. Generally, firms competing as strategic substitutes are smaller, less prone to business risk, and more profitable, and have smaller fixed assets, fewer growth opportunities, and less liquidity. Average demand and cost uncertainty are lower for firms in the Cournot sample compared to the Bertrand sample.

Table 2 presents correlations between the variables in the Bertrand sample (Panel A) and the Cournot sample (Panel B). Similar to Showalter (1999), we observe that the highest correlations between the explanatory variables are those between *PROFIT* and *DEM*/*COST* in both samples. The relatively high and negative correlations between profitability and both sources of uncertainty indicate that firms that experience less cost and demand uncertainty on average have higher profits. A potential explanation is that under predictable output market conditions, firms are better able to anticipate optimal capacity and inventory levels. Liquidity has a large, positive correlation with both *DEM* and *COST* in the Bertrand sample, while in the Cournot sample only the correlation between *LIQUID* and *COST* is relatively high. This may be explained by the fact that firms facing high output market uncertainty have a greater need for liquid assets in order to be well prepared for poor states of the world.

In Table 3, we report the averages of the leverage and the demand and cost uncertainty measures for the industries included in the Bertrand and Cournot samples. The

Bertrand (Cournot) sample consists of 24 (21) 4-digit SIC industries. Within each sample, industries are presented in order of descending long-term debt ratios based on book values. The table also shows the rank order for each of the variables, with 1 as the highest value.

Within the Bertrand sample, the industries with the highest average leverage ratios correspond to those characterized by low demand and cost uncertainty. The low leverage industries generally have relatively high demand and cost uncertainty. The industries that we classify as Bertrand and that have the highest debt levels include plastics (SIC 3081, 3086), alcohol (SIC 2084), and fabrics (SIC 2211); the lowest average leverage is observed in the semiconductor service (SIC 3674), telegraph apparatus (SIC 3661), and biological diagnostics (SIC 2836) industries.

Within the Cournot sample, we observe high average debt ratios in the paperboard (SIC 2631), aluminum (SIC 3334), steel works (SIC 3321), and insulating nonferrous wire (SIC 3357) industries; and low leverage in the electro-medical apparatus (SIC 3845), lab analytical instruments (SIC 3826), and magnetic optical recording (SIC 3695) industries. The industries competing in Cournot with the highest leverage appear to have medium or relatively high levels of uncertainty in both demand and costs. Clearly, the association between *DEM/COST* and leverage varies systematically across the two samples with different competitive behavior.

Table 4 reports the estimation results of our capital structure regressions. For each sample, and for each of the four measures of leverage, we estimate three panel models with three different proxies of demand and cost uncertainty as independent variables (in addition to the conventional determinants of capital structure used in previous studies). The results are consistent across different leverage proxies, but the statistical significance is somewhat stronger when market-value measures of leverage are used.

The regressions based on the Bertrand sample (see Panel A) support hypothesis *H1*, which states that Bertrand firms facing higher demand uncertainty use more debt. The results show that demand uncertainty indeed has a positive impact on the debt ratio of Bertrand firms, consistent with the theoretical models of Showalter (1995) and Wanzenried (2003). The coefficient of the *DEM* measures is significantly positive for all leverage proxies, except for *LDEBTBV*. The economic impact of demand uncertainty is substantial. For example, a one standard deviation increase in *DEM1* is associated with a 10.2% increase in the average *TDEBTMV* of Bertrand firms.

Showalter (1995, 1999) contends that cost uncertainty is negatively associated with debt within Bertrand competition. However, the regressions for Bertrand firms indicate that none of the cost uncertainty proxies has a statistically significant effect on leverage. Coefficients are also not consistently negative across the panel models and they are generally very close to zero. We find no support for hypothesis *H2*.

With regard to the control variables in our Bertrand sample regressions, *TANG, SIZE, PROFIT, MTB*, and *LIQUID* show significant coefficients with the correct signs as predicted in the capital structure literature. The effect of the other variables is not significant, although they have the expected sign in most cases.

In the Cournot sample, the results show a positive and statistically significant effect of both demand and cost uncertainty on leverage in all 12 regression models (see Panel B). Hence, we find evidence that both demand uncertainty and cost uncertainty encourage Cournot firms to use strategic debt, consistent with hypotheses *H3* and *H4*. These results are in line with the argument of Brander and Lewis (1986) that in the presence of output market uncertainty, firms have an incentive to have a high leverage to commit to aggressive competition. This aggressiveness induces their rival firms to reduce output, and raises the

expected profit of the leveraged firms. These effects are also significant from an economic point of view. A one standard deviation increase in *DEM1* (*COST1*) is associated with a 14.3% (13.3%) increase in the average *TDEBTMV* of Cournot firms. The coefficients on the control variables in the regressions based on the Cournot sample are in line with the capital structure literature.

To investigate whether the coefficients of the demand and cost uncertainty measures and the control variables differ significantly across the Bertrand and Cournot samples, we run regressions with the same specification as in Table 4, but based on all observations in the two samples together and including interaction terms of all variables with *SSDUM*.[9] The results indicate that the coefficients of the cost uncertainty measures are significantly larger for Cournot firms than for Bertrand firms. Demand uncertainty does not significantly differ in terms of its impact on leverage across these two types of firms. The results are consistent with our main finding that demand uncertainty affects the leverage of all firms, but cost uncertainty is important for Cournot firms and not for Bertrand firms.

As a robustness check, we run all regressions in Table 4 with the absolute value of industry-average *CSM* as an additional explanatory variable. Lyandres (2006) suggests that there is a significantly positive relation between leverage and the extent of competitive interactions in the industry, regardless of the type of competitive behavior. The inclusion of the absolute value of industry-average *CSM* does not change our results. The demand and cost uncertainty proxies yield results that are consistent with Table 4: both *DEM* and *COST* measures have a significantly positive impact on the debt ratios of Cournot firms, while only demand uncertainty affects the leverage of Bertrand firms positively. The effect of the absolute value of industry-average *CSM* is statistically negligible in most of our regressions

[9] The results are not reported in the paper, but are available from the authors on request.

after controlling for demand and cost uncertainty. The exceptions are the three regressions with *TDEBT* as the dependent variable in the Cournot sample, in which the absolute value of *CSM* is positively associated with the debt ratio, consistent with Lyandres (2006).

In short, our results indicate that the competitive behavior of firms affects the link between output market uncertainty and a firm's capital structure choice.

5. Conclusions

This study contributes to the limited empirical literature on the relation between a firm's capital structure decisions and its behavior in the product market. We investigate whether the type of competitive behavior (i.e., strategic complements or substitutes) plays a role in determining the impact of demand and cost uncertainty on leverage. While theoretical models of strategic debt explicitly distinguish between Cournot and Bertrand competition, empirical studies neglect this distinction in their analysis of the relation between competition and leverage.

By estimating a measure for competitive strategy developed by previous studies, we categorize firms into two samples: a sample with firms competing in Bertrand (strategic complements) and a sample with firms competing in Cournot (strategic substitutes). We find that the samples of Bertrand and Cournot firms differ systematically in terms of firm characteristics. The industries included in the Bertrand and Cournot samples show a different association between demand and cost uncertainty and average debt ratios.

We estimate a conventional capital structure regression for each of the two samples and include proxies of demand and cost uncertainty to investigate the strategic use of debt in different competitive environments. We show that for firms that engage in Cournot competition, both demand and cost uncertainty are positively associated with leverage,

consistent with Brander and Lewis (1986). This result supports the argument that under limited liability, Cournot firms facing output market uncertainty use debt to commit to a large output in an attempt to gain a strategic advantage in the product market. For firms that are characterized by Bertrand competition, cost uncertainty does not significantly affect leverage, but demand uncertainty induces a higher debt ratio. This latter finding is in line with the prediction of Showalter (1995) that higher demand uncertainty is associated with higher debt in Bertrand firms.

Overall, we show that the strategic aspects of capital structure choice are important and that the type of competition matters for the role of output market uncertainty in the link between financing and output decisions.

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Table 1: Summary statistics

This table presents summary statistics for all variables used in this study and compares the means across the Bertrand and Cournot samples. the variable definitions are as follows. *LDEBTBV*: book value of long-term debt ratio, defined as average total long-term debt divided by average total assets. *TDEBTBV*: book value of total debt ratio, defined as average total debt divided by average total assets. *LDEBTMV*: market value of long-term debt ratio, defined as the average total long-term debt divided by the average market value of total assets (which is calculated as total debt plus market value of equity plus preferred stock minus deferred taxes and investment credits). *TDEBTMV*: market value of total debt ratio, defined as the average total debt divided by the average market value of total assets. *TANG*: tangibility, defined as the ratio of average net fixed assets to average total assets. *SIZE*: firm size, defined as the natural log of average total assets. *RISK*: firm business risk, defined as the standard deviation of the ratio between operating income before depreciation to total assets. *NDTS*: non-debt tax shields, defined as the ratio of average depreciation and investment tax credit to average total assets. *PROFIT*: profitability, defined as the average operating income before depreciation divided by average total assets. *MTB*: market-to-book ratio, defined as the average market value of total assets over average total assets. *LIQUID*: liquidity, defined as the ratio of average cash and short-term investments to average total assets. *DEM1*, *DEM2*, and *DEM3*: demand uncertainty proxies, defined as the natural log of the standard error (scaled by sales) of trend regressions (1), (2), and (3) with sales as the dependent variable. *COST1*, *COST2*, and *COST3*: cost uncertainty proxies, defined as the natural log of the standard error of trend regressions (1), (2), and (3) with costs of goods sold over sales as the dependent variable.

	Bertrand sample # obs. = 954				**Cournot sample # obs. = 633**				**Mean comparison (Cournot – Bertrand)**	
	Mean	**Stdev**	**Min**	**Max**	**Mean**	**Stdev**	**Min**	**Max**	**difference**	**p-value**
LDEBTBV	0.156	0.174	0.000	1.145	0.136	0.157	0.000	1.710	-0.020	0.021
TDEBTBV	0.208	0.221	0.000	1.915	0.183	0.183	0.000	1.778	-0.025	0.018
LDEBTMV	0.121	0.159	0.000	0.885	0.138	0.177	0.000	0.837	0.017	0.046
TDEBTMV	0.159	0.193	0.000	1.097	0.180	0.210	0.000	1.033	0.021	0.037
TANG	0.245	0.193	0.000	0.874	0.208	0.161	0.011	0.750	-0.037	0.000
SIZE	5.257	2.285	0.062	12.001	4.874	2.169	0.078	10.433	-0.383	0.001
RISK	0.102	0.150	0.003	2.445	0.087	0.112	0.004	1.010	-0.015	0.037
NDTS	0.046	0.028	0.000	0.313	0.048	0.030	0.005	0.365	0.002	0.194
PROFIT	0.003	0.250	-2.453	0.497	0.038	0.203	-1.129	0.417	0.035	0.004
MTB	2.486	2.213	0.230	25.333	1.914	1.835	0.156	24.779	-0.572	0.000
LIQUID	0.293	0.276	0.000	0.953	0.196	0.190	0.000	0.858	-0.097	0.000
DEM1	-3.149	1.011	-6.125	1.574	-3.399	0.858	-5.634	0.018	-0.250	0.000
DEM2	-3.367	1.074	-6.096	1.333	-3.655	0.921	-6.274	-0.020	-0.288	0.000
DEM3	-3.464	1.091	-6.073	1.358	-3.753	0.929	-6.258	-0.016	-0.289	0.000
COST1	-1.944	2.389	-5.259	6.786	-2.786	1.333	-5.024	4.903	-0.842	0.000
COST2	-2.031	2.401	-5.409	6.781	-2.888	1.363	-5.189	4.797	-0.857	0.000
COST3	-2.092	2.408	-5.378	6.824	-2.954	1.372	-5.393	4.824	-0.862	0.000

Table 2: Correlations

This table presents the correlations between all variables used in this study. Variable definitions are discussed in Table 1.

Panel A: Bertrand sample (# obs. = 954)

	LDEBTBV	TDEBTBV	LDEBTMV	TDEBTMV	TANG	SIZE	RISK	NDTS	PROFIT	MTB	LIQUID	DEM1	DEM2	DEM3	COST1	COST2	COST3
LDEBTBV	1.000																
TDEBTBV	0.841	1.000															
LDEBTMV	0.758	0.632	1.000														
TDEBTMV	0.674	0.738	0.925	1.000													
TANG	0.297	0.292	0.432	0.419	1.000												
SIZE	0.188	0.071	0.227	0.146	0.349	1.000											
RISK	-0.080	-0.019	-0.225	-0.201	-0.251	-0.381	1.000										
NDTS	0.130	0.187	0.174	0.204	0.380	0.075	0.036	1.000									
PROFIT	0.063	0.027	0.216	0.203	0.320	0.442	-0.629	-0.046	1.000								
MTB	-0.134	-0.148	-0.411	-0.438	-0.292	-0.192	0.332	-0.122	-0.361	1.000							
LIQUID	-0.293	-0.362	-0.480	-0.531	-0.590	-0.296	0.383	-0.327	-0.576	0.437	1.000						
DEM1	-0.109	-0.090	-0.211	-0.204	-0.302	-0.321	0.419	-0.026	-0.607	0.212	0.581	1.000					
DEM2	-0.108	-0.092	-0.205	-0.198	-0.278	-0.324	0.395	-0.038	-0.610	0.191	0.569	0.965	1.000				
DEM3	-0.113	-0.097	-0.207	-0.202	-0.284	-0.325	0.389	-0.035	-0.610	0.198	0.569	0.954	0.986	1.000			
COST1	-0.098	-0.102	-0.263	-0.271	-0.328	-0.345	0.491	-0.119	-0.742	0.328	0.661	0.694	0.692	0.692	1.000		
COST2	-0.097	-0.100	-0.259	-0.265	-0.323	-0.347	0.487	-0.116	-0.740	0.322	0.655	0.695	0.695	0.695	0.998	1.000	
COST3	-0.094	-0.096	-0.256	-0.261	-0.321	-0.347	0.485	-0.116	-0.739	0.320	0.650	0.695	0.696	0.697	0.996	0.999	1.000

Panel B: Cournot sample (# obs. = 633)

	LDEBTBV	TDEBTBV	LDEBTMV	TDEBTMV	TANG	SIZE	RISK	NDTS	PROFIT	MTB	LIQUID	DEM1	DEM2	DEM3	COST1	COST2	COST3
LDEBTBV	1.000																
TDEBTBV	0.911	1.000															
LDEBTMV	0.812	0.736	1.000														
TDEBTMV	0.745	0.788	0.946	1.000													
TANG	0.356	0.295	0.505	0.450	1.000												
SIZE	0.334	0.203	0.409	0.317	0.454	1.000											
RISK	-0.216	-0.111	-0.252	-0.217	-0.275	-0.460	1.000										
NDTS	-0.033	0.010	-0.047	-0.031	0.171	-0.102	0.186	1.000									
PROFIT	0.192	0.088	0.193	0.157	0.310	0.460	-0.713	-0.276	1.000								
MTB	-0.233	-0.230	-0.393	-0.420	-0.255	-0.225	0.319	0.033	-0.252	1.000							
LIQUID	-0.460	-0.498	-0.519	-0.558	-0.492	-0.358	0.345	-0.116	-0.398	0.417	1.000						
DEM1	-0.083	0.012	-0.088	-0.021	-0.271	-0.450	0.497	0.123	-0.552	0.086	0.279	1.000					
DEM2	-0.099	0.010	-0.104	-0.028	-0.300	-0.480	0.481	0.113	-0.555	0.062	0.272	0.942	1.000				
DEM3	-0.103	0.001	-0.113	-0.040	-0.308	-0.490	0.486	0.120	-0.557	0.065	0.272	0.923	0.983	1.000			
COST1	-0.132	-0.064	-0.151	-0.116	-0.243	-0.406	0.562	0.117	-0.607	0.226	0.436	0.592	0.582	0.580	1.000		
COST2	-0.130	-0.059	-0.146	-0.109	-0.252	-0.417	0.557	0.113	-0.600	0.226	0.422	0.587	0.586	0.587	0.992	1.000	
COST3	-0.126	-0.053	-0.143	-0.104	-0.249	-0.418	0.549	0.118	-0.596	0.227	0.409	0.583	0.583	0.586	0.986	0.996	1.000

Table 3: Industry averages and ranks

This table presents the industry averages and ranks of four measures of leverage and three measures of both demand and cost uncertainty in the Bertrand and Cournot samples. Variable definitions are discussed in Table 1. The 4-digit SIC industry descriptions are taken from Compustat documentation.

Panel A: Bertrand sample (# obs. = 954)

SIC	Industry description	Obs.	LDEBTBV/rank		TDEBTBV/rank		LDEBTMV/rank		TDEBTMV/rank		DEM1/rank		DEM2/rank		DEM3/rank		COST1/rank		COST2/rank		COST3/rank	
3081	Unsupp plastics film & sheet	17	0.368	1	0.441	2	0.379	3	0.446	4	-3.715	15	-3.902	12	-3.993	12	-2.711	7	-2.727	7	-2.768	6
3086	Plastics foam products	8	0.365	2	0.498	1	0.387	2	0.544	1	-3.922	22	-4.050	18	-4.073	15	-3.107	11	-3.277	13	-3.316	12
2084	Wine, brandy & brandy spirits	10	0.349	3	0.407	3	0.356	4	0.417	5	-3.910	21	-4.059	19	-4.130	20	-3.431	19	-3.481	17	-3.544	18
2421	Sawmills, planing mills, gen	7	0.345	4	0.390	4	0.307	6	0.352	6	-3.639	12	-3.918	14	-4.017	14	-3.388	17	-3.558	20	-3.584	20
3532	Mng machy, eq, ex oil field	2	0.315	5	0.338	7	0.212	12	0.231	13	-3.699	13	-4.124	22	-4.173	21	-3.335	15	-3.386	15	-3.356	14
2211	Broadwoven fabric mill, cotton	16	0.312	6	0.377	5	0.404	1	0.491	3	-3.803	19	-4.013	15	-4.115	18	-3.384	16	-3.426	16	-3.511	17
3444	Sheet metal work	5	0.277	7	0.376	6	0.344	5	0.511	2	-2.909	3	-3.356	5	-3.469	5	-2.775	8	-2.831	8	-2.847	8
3531	Construction machinery & eq	18	0.222	8	0.279	10	0.218	11	0.272	11	-3.422	8	-3.843	11	-4.015	13	-3.643	23	-3.741	23	-3.780	23
2911	Petroleum refining	74	0.219	9	0.262	13	0.268	7	0.311	8	-3.439	9	-3.574	8	-3.685	6	-3.154	13	-3.218	11	-3.252	11
2821	Plastics, resins, elastomers	19	0.217	10	0.263	12	0.246	10	0.296	9	-3.741	16	-4.020	16	-4.114	17	-3.558	21	-3.690	22	-3.765	22
2052	Cookies & crackers	4	0.213	11	0.226	16	0.255	9	0.271	12	-3.881	20	-4.045	17	-4.128	19	-3.712	24	-3.843	24	-4.059	24
3317	Steel pipe and tubes	13	0.205	12	0.256	14	0.262	8	0.330	7	-3.291	6	-3.556	6	-3.741	8	-3.068	10	-3.232	12	-3.346	13
3585	Air-cond, heating, refrig eq	27	0.204	13	0.286	8	0.197	13	0.280	10	-3.929	23	-4.231	23	-4.377	24	-3.474	20	-3.521	19	-3.557	19
2673	Plastic, foil, coated paper bags	2	0.182	14	0.263	11	0.172	15	0.221	15	-3.700	14	-4.321	24	-4.286	23	-2.500	5	-2.533	5	-2.594	4
2082	Malt beverages	14	0.156	15	0.184	20	0.104	17	0.124	19	-3.968	24	-4.104	21	-4.258	22	-3.574	22	-3.685	21	-3.759	21
2834	Pharmaceutical preparations	275	0.153	16	0.204	18	0.068	22	0.092	21	-3.059	4	-3.268	3	-3.365	3	-1.239	2	-1.343	2	-1.405	2
3812	Srch, det, nav, guid, aero sys	43	0.152	17	0.198	19	0.175	14	0.221	16	-3.548	11	-3.792	10	-3.899	10	-3.119	12	-3.194	10	-3.241	10
3634	Electric housewares & fans	13	0.145	18	0.215	17	0.152	16	0.222	14	-3.766	17	-3.911	13	-3.932	11	-3.324	14	-3.372	14	-3.477	15
2836	Biological pds, ex diagnostics	116	0.133	19	0.153	22	0.046	24	0.053	24	-2.311	1	-2.486	1	-2.543	1	1.070	1	1.002	1	0.949	1
2024	Ice cream & frozen desserts	13	0.124	20	0.169	21	0.088	18	0.113	20	-3.784	18	-4.060	20	-4.103	16	-3.399	18	-3.490	18	-3.487	16
3674	Semiconductor, related service	93	0.108	21	0.131	23	0.069	21	0.087	23	-2.804	2	-3.064	2	-3.157	2	-2.400	3	-2.487	3	-2.584	3
3651	household audio & video eq	31	0.092	22	0.234	15	0.085	19	0.198	17	-3.378	7	-3.583	9	-3.789	9	-2.603	6	-2.721	6	-2.793	7
3821	Lab apparatus & furniture	20	0.081	23	0.280	9	0.073	20	0.175	18	-3.503	10	-3.571	7	-3.690	7	-3.005	9	-3.037	9	-3.072	9
3661	Tele & telegraph apparatus	114	0.077	24	0.127	24	0.056	23	0.090	22	-3.086	5	-3.350	4	-3.431	4	-2.443	4	-2.533	4	-2.597	5

Table 3, continued

Panel B: Cournot sample (# obs. = 633)

SIC	Industry description	Obs.	LDEBTBV	rank	TDEBTBV	rank	LDEBTMV	rank	TDEBTMV	rank	DEM1	rank	DEM2	rank	DEM3	rank	COST1	rank	COST2	rank	COST3	rank
2631	Paperboard mills	13	0.381	1	0.428	1	0.469	2	0.548	1	-3.806	16	-4.020	16	-4.081	14	-2.781	6	-2.865	6	-2.922	7
3743	Railroad equipment	6	0.325	2	0.389	2	0.315	4	0.390	4	-3.315	10	-3.686	11	-3.800	12	-3.541	16	-3.593	16	-3.664	16
3334	Prim production of aluminum	8	0.292	3	0.316	3	0.486	1	0.523	2	-4.116	17	-4.429	17	-4.558	17	-3.727	18	-3.973	18	-4.048	18
3357	Drawing, insulating nonfer wire	6	0.243	4	0.284	5	0.268	5	0.312	6	-2.792	1	-3.000	1	-3.322	4	-2.782	7	-2.881	7	-2.893	6
3312	Steel works & blast furnaces	66	0.235	5	0.272	6	0.353	3	0.411	3	-3.502	13	-3.894	13	-4.023	13	-3.146	13	-3.280	13	-3.347	13
2711	Newspaper: pubg, pubg & print	48	0.228	6	0.253	9	0.184	8	0.204	11	-4.248	19	-4.600	21	-4.656	20	-3.564	17	-3.670	17	-3.743	17
2851	Paints, varnishes, lacquers	19	0.202	7	0.240	11	0.160	11	0.189	13	-4.234	18	-4.560	19	-4.579	19	-3.910	20	-4.028	19	-4.111	19
2085	Distilled & blended liquor	2	0.192	8	0.269	7	0.134	12	0.193	12	-4.400	21	-4.545	18	-4.562	18	-4.498	21	-4.465	21	-4.433	21
3652	Phono recrds, audio tape, disk	6	0.180	9	0.252	10	0.166	10	0.224	9	-3.337	11	-3.694	12	-3.744	11	-3.027	11	-3.059	10	-3.129	9
3724	Aircraft engine, engine parts	19	0.178	10	0.225	12	0.244	6	0.303	7	-3.714	14	-3.964	14	-4.189	16	-3.052	12	-3.096	11	-3.169	11
3949	Sporting & athletic goods, nec	24	0.163	11	0.300	4	0.195	7	0.315	5	-3.050	6	-3.271	6	-3.400	6	-2.659	5	-2.726	5	-2.741	5
3442	Metal doors, frames, mold, trim	6	0.155	12	0.177	14	0.131	13	0.152	14	-4.346	20	-4.599	20	-4.726	21	-3.795	19	-4.098	20	-4.168	20
3942	Dolls & stuffed toys	10	0.152	13	0.255	8	0.120	14	0.215	10	-3.292	9	-3.503	9	-3.645	9	-3.333	15	-3.410	15	-3.478	15
3555	Printing trades machy, equip	15	0.123	14	0.209	13	0.167	9	0.296	8	-2.977	3	-3.169	3	-3.202	1	-3.010	10	-3.098	12	-3.169	10
3577	Computer peripheral eq, nec	62	0.093	15	0.138	15	0.066	18	0.096	19	-3.179	7	-3.455	8	-3.513	7	-2.464	4	-2.560	3	-2.641	3
3826	Lab analytical instruments	37	0.089	16	0.130	18	0.053	20	0.079	20	-3.774	15	-3.995	15	-4.129	15	-2.792	8	-2.885	8	-2.959	8
3663	Radio, TV broadcast, comm eq	117	0.082	17	0.130	17	0.066	19	0.102	18	-3.017	5	-3.209	5	-3.323	5	-2.456	2	-2.553	2	-2.612	2
3845	Electromedical apparatus	110	0.081	18	0.115	20	0.045	21	0.066	21	-3.213	8	-3.443	7	-3.522	8	-2.071	1	-2.157	1	-2.234	1
3823	Industrial measurement instr	51	0.080	19	0.124	19	0.082	17	0.123	17	-3.409	12	-3.618	10	-3.699	10	-3.202	14	-3.343	14	-3.381	14
2741	Miscellaneous publishing	4	0.075	20	0.096	21	0.112	15	0.133	16	-3.010	4	-3.150	2	-3.298	3	-2.461	3	-2.596	4	-2.644	4
3695	Magnetic, optic recordng media	4	0.074	21	0.138	16	0.083	16	0.150	15	-2.959	2	-3.179	4	-3.242	2	-2.925	9	-3.054	9	-3.225	12

Table 4: Capital structure regressions with demand and cost uncertainty

This table presents the results of 12 panel data regressions of leverage on conventional capital structure determinants and measures of demand and cost uncertainty. Data are from three consecutive periods: 1990-1994, 1995-1999, and 2000-2004. All models include firm random effects. Variable definitions are discussed in Table 1. *P*-values are reported in parentheses. ***, **, and * indicate statistical significance at the 1%, 5% and 10% level, respectively. White standard errors are used to correct for heteroskedasticity.

Panel A: Bertrand sample

	LDEBTBV			TDEBTBV			LDEBTMV			TDEBTMV		
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)
TANG	0.091*	0.090*	0.091*	0.124*	0.122*	0.124*	0.042	0.041	0.042	0.046	0.045	0.047
	(0.072)	(0.075)	(0.073)	(0.070)	(0.074)	(0.071)	(0.315)	(0.323)	(0.314)	(0.329)	(0.341)	(0.327)
SIZE	0.016***	0.015***	0.015***	0.008**	0.008**	0.008**	0.008***	0.008***	0.008***	0.002	0.002	0.002
	(0.000)	(0.000)	(0.000)	(0.018)	(0.019)	(0.021)	(0.001)	(0.001)	(0.001)	(0.373)	(0.387)	(0.395)
RISK	-0.003	0.001	0.001	0.053	0.060	0.061	-0.050	-0.047	-0.047	-0.048	-0.044	-0.043
	(0.952)	(0.988)	(0.979)	(0.234)	(0.195)	(0.189)	(0.129)	(0.139)	(0.14)	(0.136)	(0.163)	(0.164)
NDTS	-0.037	-0.020	-0.019	0.004	0.035	0.036	-0.076	-0.058	-0.060	-0.116	-0.092	-0.093
	(0.873)	(0.931)	(0.936)	(0.992)	(0.915)	(0.915)	(0.659)	(0.735)	(0.728)	(0.653)	(0.723)	(0.718)
PROFIT	-0.139***	-0.139***	-0.139***	-0.202***	-0.201***	-0.200***	-0.112***	-0.113***	-0.112***	-0.150***	-0.149***	-0.148***
	(0.004)	(0.004)	(0.004)	(0.006)	(0.007)	(0.007)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)
MTB	-0.002	-0.002	-0.002	-0.003	-0.003	-0.003	-0.015***	-0.015***	-0.015***	-0.020***	-0.020***	-0.020***
	(0.465)	(0.463)	(0.444)	(0.261)	(0.266)	(0.245)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)
LIQUID	-0.189***	-0.185***	-0.183***	-0.384***	-0.378***	-0.376***	-0.168***	-0.164***	-0.163***	-0.289***	-0.284***	-0.284***
	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)
DEM1	0.012			0.023**			0.011**			0.016***		
	(0.115)			(0.015)			(0.034)			(0.007)		
COST1	-0.001			-0.001			-0.002			-0.002		
	(0.875)			(0.852)			(0.323)			(0.492)		
DEM2		0.009			0.018**			0.006			0.011**	
		(0.197)			(0.037)			(0.183)			(0.045)	
COST2		0.000			0.000			-0.002			-0.001	
		(0.922)			(0.981)			(0.501)			(0.738)	
DEM3			0.007			0.015*			0.006			0.010***
			(0.319)			(0.088)			(0.187)			(0.070)
COST3			0.000			0.001			-0.002			-0.001
			(0.927)			(0.848)			(0.532)			(0.828)
No. (2-digit SIC) industry dummies	12	12	12	12	12	12	12	12	12	12	12	12
Obs	954	954	954	954	954	954	954	954	954	954	954	954
Between R^2	0.472	0.473	0.457	0.985	0.987	0.983	0.996	0.997	0.997	0.998	0.998	0.998
Overall R^2	0.208	0.207	0.206	0.234	0.233	0.232	0.425	0.424	0.424	0.458	0.456	0.456

Table 4, continued

Panel B: Cournot sample

	LDEBTBV			TDEBTBV			LDEBTMV			TDEBTMV		
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)
TANG	0.038	0.039	0.040	0.054	0.058	0.057	0.093	0.094*	0.095*	0.083	0.086	0.086
	(0.474)	(0.454)	(0.451)	(0.318)	(0.284)	(0.291)	(0.104)	(0.097)	(0.095)	(0.191)	(0.173)	(0.174)
SIZE	0.011***	0.011***	0.011***	0.004	0.005	0.005	0.012***	0.012***	0.013***	0.007*	0.007*	0.007*
	(0.006)	(0.004)	(0.003)	(0.314)	(0.249)	(0.254)	(0.000)	(0.000)	(0.000)	(0.079)	(0.060)	(0.063)
RISK	-0.134***	-0.122***	-0.121***	-0.098	-0.086	-0.083	-0.163***	-0.157***	-0.154***	-0.205***	-0.196***	-0.192***
	(0.002)	(0.005)	(0.006)	(0.227)	(0.279)	(0.294)	(0.000)	(0.001)	(0.001)	(0.001)	(0.001)	(0.002)
NDTS	-0.384**	-0.373**	-0.380**	-0.550***	-0.535**	-0.546***	-0.540***	-0.529***	-0.536***	-0.705***	-0.689***	-0.699***
	(0.014)	(0.017)	(0.015)	(0.008)	(0.011)	(0.010)	(0.001)	(0.001)	(0.001)	(0.002)	(0.003)	(0.003)
PROFIT	-0.018	-0.020	-0.021	-0.101	-0.100	-0.104	-0.096**	-0.095**	-0.096***	-0.134***	-0.131***	-0.134***
	(0.706)	(0.691)	(0.669)	(0.13)	(0.14)	(0.127)	(0.011)	(0.012)	(0.010)	(0.006)	(0.008)	(0.006)
MTB	0.001	0.002	0.002	0.001	0.002	0.001	-0.012***	-0.011***	-0.012***	-0.017***	-0.016***	-0.017***
	(0.601)	(0.567)	(0.583)	(0.709)	(0.649)	(0.695)	(0.008)	(0.008)	(0.007)	(0.005)	(0.005)	(0.004)
LIQUID	-0.305***	-0.299***	-0.297***	-0.493***	-0.485***	-0.483***	-0.298***	-0.294***	-0.292***	-0.469***	-0.464***	-0.461***
	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)
DEM1	0.029***			0.031**			0.022**			0.030***		
	(0.005)			(0.011)			(0.015)			(0.004)		
COST1	0.012**			0.016**			0.012**			0.018***		
	(0.037)			(0.020)			(0.012)			(0.002)		
DEM2		0.024**			0.029**			0.018**			0.027***	
		(0.020)			(0.016)			(0.035)			(0.010)	
COST2		0.012**			0.015**			0.013***			0.018***	
		(0.030)			(0.022)			(0.007)			(0.001)	
DEM3			0.023**			0.026**			0.018**			0.025**
			(0.028)			(0.035)			(0.036)			(0.015)
COST3			0.012**			0.015**			0.013***			0.018***
			(0.030)			(0.017)			(0.009)			(0.002)
No. (2-digit SIC) industry dummies	11	11	11	11	11	11	11	11	11	11	11	11
Obs	633	633	633	633	633	633	633	633	633	633	633	633
Between R^2	0.997	0.991	0.989	1.000	0.999	0.999	0.992	0.995	0.996	0.989	0.995	0.996
Overall R^2	0.327	0.324	0.324	0.339	0.338	0.336	0.528	0.528	0.527	0.528	0.528	0.526

Table 5: Capital structure regressions with demand and cost uncertainty – robustness check

This table presents the results of 12 panel data regressions of leverage on conventional capital structure determinants, measures of demand and cost uncertainty, and *Abs. value CSM*, the absolute value of the industry-average competitive strategy measure. Data are from three consecutive periods: 1990-1994, 1995-1999, and 2000-2004. Other variable definitions are discussed in Table 1. All models include firm random effects. *P*-values are reported in parentheses. ***, **, and * indicate statistical significance at the 1%, 5%, and 10% level. White standard errors are used to correct for heteroskedasticity.

Panel A: Bertrand sample

	LDEBTBV			TDEBTBV			LDEBTMV			TDEBTMV		
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)
TANG	0.091*	0.091*	0.092*	0.123*	0.122*	0.124*	0.042	0.041	0.042	0.046	0.045	0.046
	(0.072)	(0.074)	(0.072)	(0.071)	(0.075)	(0.072)	(0.314)	(0.322)	(0.313)	(0.331)	(0.344)	(0.33)
SIZE	0.015***	0.015***	0.015***	0.008**	0.008**	0.008**	0.008***	0.008***	0.008***	0.002	0.002	0.002
	(0.000)	(0.000)	(0.000)	(0.016)	(0.017)	(0.018)	(0.001)	(0.001)	(0.001)	(0.352)	(0.365)	(0.373)
RISK	-0.002	0.001	0.001	0.053	0.059	0.061	-0.050	-0.047	-0.047	-0.049	-0.044	-0.043
	(0.957)	(0.987)	(0.979)	(0.237)	(0.196)	(0.189)	(0.131)	(0.141)	(0.142)	(0.127)	(0.158)	(0.159)
NDTS	-0.054	-0.039	-0.038	0.043	0.074	0.074	-0.085	-0.069	-0.070	-0.088	-0.063	-0.065
	(0.818)	(0.868)	(0.872)	(0.899)	(0.827)	(0.827)	(0.619)	(0.689)	(0.682)	(0.733)	(0.807)	(0.802)
PROFIT	-0.141***	-0.142***	-0.141***	-0.198***	-0.197***	-0.196***	-0.114***	-0.114***	-0.114***	-0.147***	-0.145***	-0.145***
	(0.004)	(0.004)	(0.004)	(0.007)	(0.008)	(0.008)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)
MTB	-0.002	-0.002	-0.002	-0.003	-0.003	-0.003	-0.015***	-0.015***	-0.015***	-0.019***	-0.019***	-0.020***
	(0.442)	(0.436)	(0.417)	(0.315)	(0.323)	(0.299)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)
LIQUID	-0.191***	-0.187***	-0.185***	-0.379***	-0.374***	-0.372***	-0.168***	-0.165***	-0.164***	-0.285***	-0.282***	-0.281***
	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)
Abs. value CSM	-0.202	-0.216	-0.217	0.465	0.440	0.439	-0.104	-0.117	-0.117	0.341	0.324	0.324
	(0.316)	(0.282)	(0.279)	(0.246)	(0.273)	(0.275)	(0.640)	(0.600)	(0.602)	(0.227)	(0.253)	(0.253)
DEM1	0.012			0.024**			0.010**			0.017***		
	(0.120)			(0.012)			(0.038)			(0.005)		
COST1	-0.001			-0.001			-0.003			-0.002		
	(0.861)			(0.881)			(0.315)			(0.517)		
DEM2		0.009			0.018**			0.006			0.011**	
		(0.211)			(0.034)			(0.193)			(0.038)	
COST2		0.000			0.000			-0.002			-0.001	
		(0.9)			(0.981)			(0.488)			(0.778)	
DEM3			0.007			0.015*			0.006			0.010*
			(0.338)			(0.081)			(0.197)			(0.059)
COST3			0.000			0.001			-0.002			0.000
			(0.947)			(0.815)			(0.519)			(0.867)
No. (2-digit SIC) industry dummies	12	12	12	12	12	12	12	12	12	12	12	12
Obs	954	954	954	954	954	954	954	954	954	954	954	954
Between R^2	0.485	0.469	0.453	0.986	0.988	0.984	0.996	0.997	0.997	0.998	0.997	0.998
Overall R^2	0.209	0.207	0.207	0.237	0.234	0.233	0.426	0.424	0.424	0.459	0.457	0.457

Table 5, continued

Panel B: Cournot sample

	LDEBTBV			TDEBTBV			LDEBTMV			TDEBTMV		
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)
TANG	0.036	0.037	0.038	0.051	0.055	0.054	0.092	0.093	0.094	0.081	0.084	0.084
	(0.497)	(0.477)	(0.473)	(0.348)	(0.312)	(0.318)	(0.111)	(0.104)	(0.101)	(0.204)	(0.186)	(0.186)
SIZE	0.011***	0.011***	0.011***	0.004	0.005	0.005	0.012***	0.012***	0.012***	0.007*	0.007*	0.007*
	(0.006)	(0.004)	(0.003)	(0.324)	(0.26)	(0.264)	(0.000)	(0.000)	(0.000)	(0.082)	(0.062)	(0.065)
RISK	-0.127***	-0.116***	-0.114**	-0.087	-0.075	-0.072	-0.158***	-0.152***	-0.149***	-0.197***	-0.189***	-0.184***
	(0.005)	(0.010)	(0.011)	(0.290)	(0.348)	(0.369)	(0.001)	(0.001)	(0.002)	(0.001)	(0.002)	(0.002)
NDTS	-0.438***	-0.427***	-0.435***	-0.641***	-0.624***	-0.638***	-0.579***	-0.568***	-0.575***	-0.763***	-0.746***	-0.759***
	(0.005)	(0.006)	(0.005)	(0.002)	(0.004)	(0.003)	(0.000)	(0.000)	(0.000)	(0.001)	(0.001)	(0.001)
PROFIT	-0.022	-0.024	-0.025	-0.107	-0.106	-0.110	-0.099***	-0.098***	-0.099***	-0.138***	-0.135***	-0.139***
	(0.649)	(0.633)	(0.613)	(0.107)	(0.115)	(0.104)	(0.008)	(0.008)	(0.007)	(0.004)	(0.005)	(0.004)
MTB	0.002	0.002	0.002	0.001	0.002	0.002	-0.012***	-0.011***	-0.011***	-0.017***	-0.016***	-0.017***
	(0.568)	(0.542)	(0.556)	(0.664)	(0.616)	(0.66)	(0.008)	(0.008)	(0.007)	(0.005)	(0.005)	(0.004)
LIQUID	-0.311***	-0.305***	-0.303***	-0.503***	-0.495***	-0.493***	-0.302***	-0.299***	-0.296***	-0.476***	-0.470***	-0.467***
	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)
Abs. value CSM	0.581	0.578	0.593	0.972*	0.954*	0.981**	0.412	0.410	0.420	0.623	0.613	0.634
	(0.172)	(0.177)	(0.164)	(0.052)	(0.058)	(0.049)	(0.419)	(0.419)	(0.407)	(0.304)	(0.309)	(0.291)
DEM1	0.028***			0.029**			0.021**			0.029***		
	(0.007)			(0.016)			(0.018)			(0.006)		
COST1	0.013**			0.017**			0.013**			0.018***		
	(0.030)			(0.015)			(0.011)			(0.002)		
DEM2		0.023**			0.027**			0.018**			0.026**	
		(0.026)			(0.023)			(0.041)			(0.012)	
COST2		0.013**			0.016**			0.013***			0.019***	
		(0.024)			(0.016)			(0.007)			(0.001)	
DEM3			0.022**			0.024**			0.018**			0.024**
			(0.035)			(0.047)			(0.042)			(0.019)
COST3			0.012**			0.016**			0.013***			0.018***
			(0.024)			(0.013)			(0.009)			(0.002)
No. (2-digit SIC) industry dummies	11	11	11	11	11	11	11	11	11	11	11	11
Obs	633	633	633	633	633	633	633	633	633	633	633	633
Between R^2	0.999	0.995	0.994	0.997	0.998	0.999	0.989	0.993	0.995	0.986	0.992	0.993
Overall R^2	0.329	0.326	0.326	0.343	0.342	0.340	0.529	0.528	0.528	0.529	0.529	0.528

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