Evidence on the external finance premium in the US corporate bond market

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Abstract

Empirical investigation of the external finance premium has been conducted on the margin between internal finance and bank borrowing or equities but little attention has been given to corporate bonds. In this paper we hypothesize that balance sheet indicators of creditworthiness could affect the external finance premium for bonds as they do for premia in other markets. Using 2729 bonds issued by 652 US firms actively trading between 2000-2004 we find that firms with better financial health face lower external finance premia, credit constrained firms have higher premia than unconstrained firms, and the sensitivity of the premium varies between recessions/credit crunches and other periods.

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1 Introduction

The last decade has seen phenomenal growth in the theoretical and empirical investigation of corporate financial decisions through imperfect credit markets. The pathbreaking theoretical work of Jaffee and Russell (1976), Stiglitz and Weiss (1981) on asymmetric information has been extended by Bernanke et al. (1996), Bernanke et al. (1999), Carlstrom and Fuerst (1997) and Carlstrom and Fuerst (2001) to provide the canonical agency cost model of external borrowing from financial markets. The implication of this literature is that corporate financial structure will be affected by constraints arising from the availability and cost of external finance to firms, and will differ in relation to the observable characteristics used by lenders to determine their creditworthiness (Gertler and Gilchrist (1993) and Gertler and Gilchrist (1994)). Following an adverse shock firms with poorer indicators of creditworthiness on their balance sheets will be more constrained than those that are considered creditworthy; the "flight to quality" by lenders, identified by Bernanke et al. (1996), underlies much of the dynamic adjustment observable in the macroeconomy due to the credit channel following an adverse shock.[1] Furthermore, the experience of the US corporate bond market after the credit meltdown in 2001 and 2002 suggests that the financial system can generate an endogenous cycle (the accelerator) that propagates the initial shock over time c.f. Bernanke et al. (1996) and Kiyotaki and Moore (1997). Firms that are initially regarded as uncreditworthy and are refused external finance on this basis can find that their creditworthiness deteriorates further, putting future external finance further out of reach.

Firms that are relatively constrained on the financial markets, will face higher agency costs of borrowing - a higher "external premium" - for raising capital from financial markets compared with the cost of internal finance funded from retained earnings Bernanke and Gertler (1995) with subsequent effects on real activity c.f Mojon et al. (2002) and Vermeulen (2002). The external finance premium is inversely related to the firms' balance sheet i.e. net worth, and to macroeconomic conditions, creating a countercyclical movement in the premium for external funds, which serves to amplify borrower's spending and economic activity in the financial accelerator Bernanke et al. (1996).

[1] Bernanke et al. (1999) use a dynamic New Keynesian model as the baseline macroeconomic framework, however, Gertler and Lown (1999) obtain quantitatively similar results using the larger scale model developed by Muellbauer (1996), and Carlstrom and Fuerst (1997) use an amended RBC model with similar findings. It seems that the credit channel phenomenon is relatively robust to the macroeconomic framework in which is simulated.

Much of the empirical investigation of the external finance premium has been conducted on the margin between internal finance and bank borrowing (e.g. Kashyap et al. (1993),Kashyap et al. (1996); Bernanke and Gertler (1995); Oliner and Rudebusch (1996); Bernanke et al. (1996) or the margin for raising external finance through equity markets (c.f. Lamont et al. (2001), Gomes et al. (2006), Hahn and Lee (2003), Campello and Chen (2005) and Whited and Wu (2006).[2] Relatively little attention has been devoted to the external finance premium on securities-based external finance such as corporate bonds, which is somewhat surprising since although equity and bonds are both contingent claims on the same future returns, bond prices offer simpler forward-looking functions of cash flows that accrue to the holder than equity prices. It is therefore more straightforward to consider the external finance premium for securities than for equites.

There is some evidence that the external premium on bonds varies with firm characteristics as the accelerator model would imply. de Bondt (2004) considers the emerging euro bond market, examining the impact of macroeconomic and financial health indicators on the corporate bond spread with Granger causality tests, multiple regressions and impulse responses. Despite a short sample of data the results suggest there is evidence of a balance sheet channel in operation that influences bond spreads.

Campello and Chen (2005) report evidence that bonds of financially constrained US firms' in the Lehman Brothers Fixed Income Database command higher *ex ante* excess risk premia and these premia move countercyclically with economic and financial conditions. This result is supported by Mody and Taylor (2004) who consider the movement of high yield bonds over government debt, i.e the external finance premium, as a predictor for real economic activity over a similar sample period. However, their evidence is drawn from a sample spanning January 1973-March 1998, which does not include recent events such as the credit crunch of 2001-2, and their paper is primarily about risk pricing in equity markets with supplementary information drawn from bond markets to give a clearer picture of the required *equity* risk premium.

Levin et al. (2004) analyze the financial frictions using measures of expected default risk, and credit spreads on publicly-traded debt for 918 US non-financial firms over the period 1997Q1 -

[2] The latter literature is concerned with questions central to finance such as the nature of equity returns and risk pricing rather than the implications of the scale of the external finance premium for the financial accelerator as such. Among the papers in the finance literature Campello and Chen (2005) is something of an exception since they address risk pricing in equity and bond markets, but bond data is used in order to confirm findings for equity prices.

2003Q3. Their findings support the notion that credit markets are imperfect and that financial market frictions exhibit strong cyclical patterns, especially during the latest economic downturn. They explain the movement of the actual and model-implied credit spreads, which is related to the external finance premium for bonds, using a vector of characteristics such as leverage (debt to equity ratio), Standard and Poor's bond portfolio average credit ratings and industry effects. Their results are derived for relatively large firms and they do not discriminate between financially constrained and unconstrained firms.

In this paper we follow a similar approach to the literature above, examining whether the spread between corporate and government bond yields varies with firm-specific characteristics, but we take two further important criteria into account for the US: the effect of financial constraints and the recession and credit crunch 2001-02. The degree of financial constraints faced by firms is a critical determinant of real responses to financial market imperfections, but the categorization of firms into constrained and unconstrained categories is controversial (c.f. discussion in Fazzari et al. (1988), Fazzari et al. (2000)(FHP hereafter), Kaplan and Zingales (1997), Kaplan and Zingales (2000)(hereafter KZ), Cleary (1999) among others). Many alternative classification schemes have been proposed and we use four different selection crieria to identify constrained and unconstrained firms following Bernanke and Campbell (1988), FHP (1988, 2000), Whited (1992), Bond and Meghir (1994), Gertler and Gilchrist (1994), Carpenter et al. (1994), KZ (1997, 2000) and Almeida et al. (2004).

A major episode within our sample is the 2001-2002 credit crunch. Kwan (2002) documents that commercial paper and bank loans declined considerably in relation to previous years. Among concerns about creditworthiness of issuers/borrowers and the growing bad debt problem for banks, the recession of 2001 appears to have been a significant reason for access to credit to have declined. There is evidence that real variables such as investment and inventory activity respond to the availability of cash flow with a significantly different coefficient for recessions and non-recessions (Gertler and Hubbard (1988)), low growth and high growth (Gertler and Gilchrist (1994)), and for credit crunch and non-credit crunch years (Kashyap et al. (1994)). As Vermeulen (2002) notes, citing Gertler and Gilchrist (1993) and Gertler and Gilchrist (1994), the effects of financial constraints and downturns are more likely to affect small firms than large firms and indeed firms that are weaker on other criteria c.f Bougheas et al. (2006).

In our paper we consider the following testable hypotheses regarding the external finance premium for corporate bonds:

H1: the scale of the external finance premium is inversely related to the strength of the balance sheet, and therefore firms with better firm-specific characteristics face lower external finance premia and *vice versa*.

H2: the external finance premium for bonds is larger for firms classified as financially constrained versus firms that are unconstrained on a wide range of classifications of "financially constrained".

H3: in recessions/credit crunches, sensitivity to firms' balance sheets will vary compared to other periods.

The rest of the paper is organized as follows. Section two offers a brief summary of the theoretical basis for the external finance premium, section three discusses the data, the methodology for determining financial constrained firms and downturns, and the estimation technology. Sections four and five present the empirical evidence and report some robustness checks. Section six concludes.

2 Theoretical background

The influential paper by Bernanke et al. (1999) (BGG, hereafter) provides the theoretical basis for our paper. The BGG model incorporates the costly-state verification (CSV) debt contracting problem into an otherwise standard dynamic new Keynesian general equilibrium model. In the model there are three agents: households, entrepreneurs, and retailers. Entrepreneurs, who are assumed to be risk-neutral and have finite horizons, acquire physical capital K at a price Q at the end of period t, for use in production in period $t+1$. At the end of period t entrepreneur j has available net worth N^j_{t+1} and finances capital with internal funds supplemented by external borrowing from a financial intermediary.

$$B^j_{t+1} = Q_t K^j_{t+1} - N^j_{t+1} \tag{2.1}$$

Ex ante, the expected revenue from the investment project is given by $R^k_{t+1} Q_t K^j_{t+1}$, where $R^k_{t+1}$is the aggregate gross rate of return on capital investment. The realized revenue in the next period is given by $\omega^j R^k_{t+1} Q_t K^j_{t+1}$, where ω^j is a productivity disturbance which is *i.i.d.* across firms and time.

Adopting the CSV approach, an agency problem arises because intermediaries cannot observe ω^j and need to pay an auditing cost if they wish to observe the outcome. The financial contract is a standard debt contract including the following bankruptcy clause:

If $\omega^j \geq \bar{\omega}^j$ the entrepreneur pays off the loan in full from revenues and keeps the residual. The lender receives $\bar{\omega}^j R^k_{t+1} Q_t K^j_{t+1} = Z^j_{t+1} B^j_{t+1}$, where Z^j_{t+1} is the non-default loan rate.

If $\omega^j < \bar{\omega}^j$ the firm defaults on its loan. The lender pays an auditing cost μ and receives what is found, namely $(1-\mu)\bar{\omega}^j R^k_{t+1} Q_t K^j_{t+1}$. A defaulting entrepreneur receives nothing.

It is reasonable to assume that the lender will issue the loan only if the expected gross return to the entrepreneur equals the lender's opportunity cost of lending. Because the loan risk is perfectly diversifiable, the relevant opportunity cost to the lender is the riskleless rate R_{t+1}. Consequently, the lender' expected return is a function of $\bar{\omega}^j$. Higher levels of $\bar{\omega}^j$ raise the non-default pay off to the lender, but also raise the probability of default $(F(\bar{\omega}))$.

The BGG model is concerned with the entrepreneur's problem of demand for capital. In this model the cost of finance depends on the financial health of firms and is negatively associated with the level of internal funds (net worth, N_{t+1}) relative to total financing requirements. Let $s = E[\frac{R^k_{t+1}}{R}]$ to be expected discounted return on capital.[3]

Then

$$E_t[R^k_{t+1}] = s[\frac{N_t}{Q_t K_{t+1}}]R_{t+1} \tag{2.2}$$

The above equation shows how the firm's return on capital depends inversely on the share of the firm's capital investment financed by its own net worth. If the firm can self finance its investment projects, there is no need for external financing and the equilibrium return to capital is equal to the risk-free rate. In this case the external finance premium is zero. Similarly, when the firms need to borrow, the required return on capital will be higher reflecting expected agency costs faced by the financial intermediary, and the premium is high. Thus, the initial financial position of the entrepreneur becomes a key determinant of her cost of external finance.

The role of the financial accelerator mechanism in the model can be seen from equation below and from the definition of aggregate entrepreneurial net worth at the end of period t:

[3] As BGG suggest, the ratio of the cost of finance to the risk-free rate may be equally well interpreted as the external finance premium.

$$N_{t+1} = \gamma V_{t+1} + W^e_{t+1} \tag{2.3}$$

BGG assume that entrepreneurs supplement their income by working in the general labour market. Equation (2.3) indicates that the aggregate net worth is the sum of the entrepreneurial equity (V_{t+1}) and the entrepreneurial wage W^e_{t+1}. Entrepreneurial equity equals earnings from capital employed from t to $t{+}1$ minus the loan repayment.

$$V_{t+1} = R^k_{t+1} Q_t K_{t+1} - (R_{t+1} + EFP_t)(Q_t K_{t+1} - N_t) \tag{2.4}$$

with

$$EFP_t = \frac{\mu \int_0^{\bar{\omega}} \omega R^k_{t+1} Q_t K_{t+1} dF(\omega)}{Q_t K_{t+1} - N_t} \tag{2.5}$$

where EFP_t is the ratio of default costs to the amount borrowed and reflects the premium for external finance.

Equation (2.4) shows that net worth would be affected by unexpected changes in the return on capital, changes in the price of capital, in leverage and in default costs. These changes in net worth will in turn affect the spread between the contractual rate on a loan or bond and the risk-free rate. For a highly leveraged firm, a shock to project returns will have a higher impact on internal funds (and finance premia) than for a firm that has low leverage. To the extent that borrower's net worth is procyclical, the external finance premium will be countercyclical enhancing swings in borrowing and fluctuations of macroeconomic variables will be magnified and propagated through the economy. The model therefore provides theoretical grounding for the intuition that firms with worse balance sheets tend to face higher external finance premia and tend to be more vulnerable to adverse economic shocks.

3 Data, classification methodologies, and estimation method

3.1 Data

We employ data drawn from Datastream for US listed companies, recording the annual average of daily observations on bond yields for the period 2000 to 2004. The analysis includes the universe of domestic corporate US dollar denominated bonds with Datastream coverage.[4] Additionally, this sub-sample contains data on benchmark Treasury yields from Datastream.[5] For each corporate bond that matures at time t, a government bond that has the same maturity is used to provide the risk-free rate, and in those cases where there is no corresponding government bond, the equivalent government bond is constructed and its yield estimated using a simple linear interpolation.[6,7] We also draw data from balance sheets and profit and loss statements for US firms in all sectors from 2000 until 2004.

The distinguishing characteristic of sampled firms is that they issue bonds that are actively traded in the secondary market. For these firms, we have linked market prices of their outstanding securities to Datastream's balance sheet statements. We excluded companies that did not have publicly traded debt during the sample period, so the sample refers only to firms with more than three years of continuous years of access to the bond market. Finally, to control for the potential influence of outliers, we excluded observations in the 0.5 percent from upper and lower tails of the distribution of the regression variables.

Our combined sample contains data for 2729 bonds issued by 652 firms that actively traded between 2000 and 2004 in a variety of sectors such as manufacturing, utilities, resources, services and financials.[8] The panel has an unbalanced structure with the number of observations on each firm varying between three and five. Our sample presents two characteristics that make it especially appealing for our analysis. First, it includes both investment grade and high yield bonds, where previous studies mainly restricted their attention to investment grade bonds, neglecting the effects of the high yield bonds. This is particularly beneficial since firms with high yield bond issues are more likely to be characterized by adverse financial attributes and weak balance sheets, allowing us to investigate the external finance premium for firms more likely to be financially constrained.[9] Second, the sample spans a wide range of sectors of the US economy. This is extremely useful since,

[4] Datastream as well as other databases such as Bloomberg and the Lehman Brothers use large institutional dealers in the bond market as data sources for bond prices and hence the similarity in quality.

[5] We collected benchmark Treasury yields for maturities of 3, 5, 7, 10, and 30 years.

[6] The constant maturity yields are published daily in the Financial Times. Additionally, we crosschecked the above-mentioned yields with the corresponding figures supplied by the Federal Reserve Board.

[7] This methodology is line with the literature (see Collin-Dufresne et al. (2001)).

[8] Our sample includes both non-financial and financial firms. However, non-financial firms dominate in our dataset; for example, only 23% of the observations in our sample correspond to financials, insurance, investment and real estate firms.

[9] The spread in the high-yield bond market was found to have significant explanatory power for the business cycle providing evidence for the existence of a strong financial accelerator Gertler and Lown (1999).

as suggested by Bernanke et al. (1996), the importance of financially constrained firms is generally greater in sectors other than manufacturing.

Our dependent variable measures the external finance premium on corporate bonds using the spread between US corporate bond yields and Treasury bond yields. To calculate an overall firm-specific corporate bond yield, we averaged the yields on the firm's outstanding bonds, using the product of market values of bonds and their effective durations as weights.[10] Thus,

$$YTM^{corp} = \frac{\sum_{i=1}^{N} y_i P_i D_i}{\sum_{i=1}^{N} P_i D_i} \tag{3.1}$$

where y_i is the yield to maturity on the ith bond, P_i and D_i are the market value and the duration of the ith bond respectively. The credit spread is the difference between yield to maturity for corporate and government bonds following de Bondt (2004); Avramov et al. (2004) and Santos (2006):

$$SPREAD = YTM_{t,T}^{corp} - YTM_{t,T}^{gov} \tag{3.2}$$

where $YTM_{t,T}^{corp}$ represents the yield to maturity at time t of a corporate bond that matures at time T and $YTM_{t,T}^{gov}$ the yield to maturity of a government bond with the same maturity. Finally, we matched the firm-specific annual spreads to annual balance sheet data.

The indicators of firms' balance sheets are a central issue in this study and therefore we consider a set of financial variables previously employed in empirical studies. We introduce leverage (LEV) defined as total debt over total assets, as a measure of firms' indebtness. Mojon et al. (2002), Vermeulen (2002) and Bougheas et al. (2006) argue that the higher the leverage, the weaker the balance sheet. We also include a profitability ratio ($PROF$), defined as earnings before interest and taxes relative to total assets, to measure a firm's ability to generate revenue. More profitable firms have a greater cushion for servicing debt and should pay lower spreads on their loans. Therefore we expect a negative relationship between the above ratio and the external finance premium. In this study, we are interested in examining the potential role of monetary policy on firm-specific outcomes. Mojon et al. (2002) include firm-specific interest rates to examine financial accelerator phenomena.[11] We use the interest burden ($INTBURD$), defined as the ratio of interest payments to

[10] See Choi and Park (2002) for details on the approximation of a bond portfolio yield.

[11] Firm-specific interest rate unlike the Federal Funds rate varies across firms and years and therefore mostly reflects idiosyncratic factors. The obvious advantage of using this measure of interest rates is that it

total debt, to show the extent to which a tightening in monetary policy affects the interest payments on debt. Finally, in our study we seek to control for idiosyncratic probability of bankruptcy by including Z-scores. The Z-score ($ZSCORE$) measures the number of standard deviations below the mean by which profits would have to fall in order to eliminate the firm's equity. Hence it is an indicator of bankruptcy risk. Following Boyd and Runkle (1993), we calculate the Z-score as follows:

$$Z = \frac{1}{S_r}[\frac{1}{n}\sum_{j=1}^{n}\frac{2\tilde{\pi}_j}{A_j + A_{j-1}} + \frac{1}{n}\sum_{j=1}^{n}\frac{E_j + E_{j-1}}{A_j + A_{j-1}}] \tag{3.3}$$

where A is the firm's assets, E is its equity, $\tilde{\pi}$ is its profits and S_r is the estimated standard deviation of r, the firms' return on assets.[12] The higher the Z-score the lower the firm's risk, so we expect this variable to have a negative effect on the bond spread. Table 1 provides summary statistics of the variables used in our study. We now turn to the question of how to classify financially constrained v. unconstrained firms and recessions/credit crunches.

3.2 Classification Schemes

A large literature has considered the impact of financial constraints on investment in fixed capital, inventory investment, and employment and R&D activities (see Hubbard (1998); and Bond and Reenen (2006), for surveys). However, the nature of the results is somewhat dependent on the categorisation process determining whether firms are financially "constrained" or "unconstrained" (see, e.g, FHP (1988, 2000); KZ (1997, 2000) and the discussion in Cleary (1999)). The scholarly literature has not settled on a particular strategy to identify financially "constrained" and "unconstrained" firms empirically, but the classification scheme can be critically important for the conclusions of these studies. Therefore, in this paper we use four different measures of financial constraints to ensure the robustness of our results, these are size, age, dividend payout ratio and indebtedness.

Size was employed as a criterion by Bougheas et al. (2006) and is the key proxy for capital market access by manufacturing firms in Gertler and Gilchrist (1994) because small firms are more

provides large cross-sectional information, which is otherwise hardly available.

[12] We calculate the Z-score along the lines of Hale and Santos (2006) and set n=2 and lag the variables one year. Thus, for the Z-score at time t we use the firm's profit at time t-1, and its assets A and capital E both at times t-1 and t-2. The volatility of earnings growth S_r is computed using data for the five years preceding the sample, scaled by average assets for that period.

vulnerable to capital market imperfections and thus more likely to be financially constrained. The firms' year of incorporation has been employed by several studies Carpenter et al. (1994); Gertler and Gilchrist (1994), Bougheas et al. (2006), and is intended to capture the fact that younger firms are more likely to face problems of asymmetric information, since their short track record makes it more difficult to judge their quality (Devereux and Schiantarelli (1990)). The dividend payout ratio, as measured by the ratio of total dividends to total assets, has been used by FHP (1988, 2000); Whited (1992), Bond and Meghir (1994), KZ (1997, 2000) because it is argued that firms will refrain from distributing earnings if they expect to rely on these for real investment, and they will do so if they are financially constrained. Firms that are more indebted (based on the gearing ratio, defined as total debt over shareholders' equity) are more likely to pay a higher external finance premium on bonds since they have a greater probability of bankruptcy (Levin et al. (2004), Bougheas et al. (2006)), which can raise the cost of borrowing, and negatively affect the availability of credit.[13] We report results using all four classification schemes. We use a 30 percent cut-off point in keeping with the normal practice in the literature.[14] We also allow firms to transit between firm classes.[15]

3.3 Recession and credit crunch

We specify a time-period dummy variable to indicate that the US economy is in recession or credit crunch. The identification of downturns and out-of-downturns follows the Business Cycle Dating Committee of the National Bureau of Economic Research which determined that a trough in business activity occurred in the US economy in November 2001. The trough marked the end of the recession that began in March 2001 and the beginning of an expansion.[16] The credit crunch, when some firms were excluded from gaining access to credit lasted from 2001- 2002, and was closely associated with the recession (Kwan (2002), Cantor (2004)). During the years 2001-2002 bad debts increased on bank loans, commercial paper issuance fell and default rates in the US bond

[13] This definition also addresses the "financial fragility" argument, as suggested by Bernanke and Campbell (1988), according to which shocks to the economy have a different impact on high and low debt firms.

[14] Campello and Chen (2005) rank the sampled firms into constrained and unconstrained using 30 percent and 70 percent cut-off points respectively from the Fama-French portfolios.

[15] For this reason, our empirical analysis will focus on firm-years rather than simply firms. See Bond and Meghir (1994), Kaplan and Zingales (1997), Guariglia and Schiantarelli (1998), and Guariglia (2000) for a similar approach.

[16] For more details see the latest report of the Business Cycle Dating Committee of the National Bureau of Economic Research. July 17, 2003.

market associated with most rating categories were at post-war highs (Amato and Furfine (2004) and Altman and Rijken (2004)).

3.4 Panel estimation technology

We employ panel data methods to test the hypothesis that firms with different characteristics face different external finance premia in the US bond market.[17] Consider a standard static linear model of the following form:

$$y_{it} = X_{it}\beta + \lambda_t + \eta_i + \epsilon_i t \tag{3.4}$$

where $i = 1,2,\ldots, N$ refers to a cross section of units (firms in this study), $t = 1,2,\ldots, T$ refers to time period, and denote respectively the dependent variable and the vector of non-stochastic explanatory variables for the firm i and year t. λ represents firm-invariant time-specific effects, η_i is the time invariant unobservable firm specific effects and ϵ_{it} are the disturbance terms that vary with time and across firms. To control for cyclical factors originating from the business cycle we include time dummies in our regressions, we also incorporate sector dummies to control for any fixed effects common across sectors. These are interacted to capture the business cycle effects across different sectors.

Equation (3.4) confronts us with some econometric issues regarding the most appropriate estimation method.[18] Specifically, if the set of our explanatory variables is assumed to be strictly exogenous then the only problem with ordinary least squares (OLS) estimation is the presence of the firm-specific effects η_i. If these firm-specific effects are uncorrelated with X_i then the random effects estimator is unbiased and efficient. If on the other hand, the firm-specific effects are correlated with X_i but remain strictly exogenous then although the random effects estimator is

[17] In adopting the most appropriate econometric strategy we choose to apply static panel data estimators. The choice of a static instead of a dynamic approach is motivated by two important considerations. First, the recession/credit crunch occurs at the very beginning of our sample, and thus the dynamic GMM-procedure poses a problem for our study since requirement for instruments and the use of first differences and lags of dependent variable would lead to a considerable loss of observations from the recession/credit crunch period. This would substantially undermine the asymmetric effects of the financial accelerator, which are vitally important for this study. Second, our sample is relatively short and when applying dynamic panel data estimators to rather short sample one might be confronted with severe bias in the estimates. Using similar reasoning, Mulkay et al. (2000) and Nerlove (2002) point out that static estimation procedure provides more precise estimates. Therefore, we opt for estimations using static rather than dynamic methods.

[18] We would like to thank Steve Bond for his comments on the econometric modelling strategy adopted in this paper.

biased, the within-groups estimator will be unbiased. Finally, if we allow our explanatory variables to be endogenous, we will require instrumental variables that will enable us to construct a GMM estimator.

Given that our sample is drawn from a large population it is more likely that firm-specific terms are distributed randomly across cross-section units, and thus we take a random effects approach to control for unobserved heterogeneity.[19] This choice is formally justified by using both the Hausman and the Breusch Pagan Langrangian Multiplier test. While our random effects model is robust to firm-specific heterogeneity, since we account for these factors explicitly in our model, we may still encounter endogeneity problems. Therefore, the GMM-procedure, which captures both heterogeneity and endogeneity problems simultaneously, is carried out to address this possibility. We use the system-GMM proposed by Arellano and Bond (1991) and Blundell and Bond (1998). The basic idea of the system-GMM estimator is to rely on a system combing Equation (3.4) in levels and in first-differences. [20]

4 Results

In this section we report econometric estimates of both the random effects and the GMM model.[21] The consistency of the GMM estimator depends on the assumption of absence of serial correlation in the error term and on the validity of the instruments. We report serial correlation tests in addition to the Sargan-Hansen test of over-identifying restrictions in all the GMM results below. We use interaction terms for the estimations to identify the asymmetric work of the financial accelerator.[22] Unless otherwise specified the columns of each Table indicate the estimation results for different firm-years according to size (column 1), age (column 2), dividend payout ratio (column 3), and indebtedness (column 4).

[19] Note that the above assumption closely relates to our decision on whether the sample can be considered as part of a larger population since we consider only firms that issue bonds not the universe of US firms.

[20] All estimations were carried out in STATA 9.2.

[21] In the random effects model all estimated standard errors are robust to cluster (industry) correlation. Given that we have repeated observations on firms, clustering allows the observations to be independent between firms, but not necessarily within firms. Details of cluster-adjusted standard errors can be found in (Wooldridge (2002), section 11.5).

[22] Using interaction terms allows us to avoid problems of endogenous variable selection; to gain degrees of freedom; and to take into account that firms can transit between groups. See Kaplan and Zingales (1997), Guariglia (2000), and Vermeulen (2002) for a similar approach.

4.1 External finance premium and firm-specific characteristics

One important assumption of the financial accelerator theory is that borrowers' net worth is inversely associated with the external finance premium and that firms with weak balance sheets are likely to be more vulnerable during real or economic shocks. However, as it was noted by Vermeulen (2002), the "weak balance sheet" is a rather vague term and has to be operationalized. In this section we attempt to test the first hypothesis: whether an inverse relationship between balance sheet indicators and external finance premium holds for firms in the US bond market. Initially, we estimate the empirical model without distinguishing between constrained and unconstrained firms. We use two balance sheet indicators namely the leverage ratio (LEV) and the profitability ratio ($PROF$). In addition to the balance sheet indicators, we also include the interest burden intending to capture the impact of the monetary policy stance, and the Z-score as an indicator of the firm's perceived risk. Finally, to control for the business cycle and fixed effect across sectors we include time and sector dummies.

Table 2 reports the random effects and GMM estimates for the baseline model.[23] The results, based on both methods, show that firms with high LEV face a higher external finance premium compared to those with low LEV. $PROF$ has negative coefficients showing that the greater the profitability of the firms the lower the external premium. An increase in $INTBURD$ shows that as interest payments increase the external finance premium rises. Finally, the $ZSCORE$ attains a negative coefficient implying that firms with high Z-score and therefore with lower bankruptcy risk , face a smaller premium. The estimated coefficients on the balance sheet variables measure the average effect over all sectors, all size classes and all years with the correct sign as predicted by the financial accelerator theory, and suggesting that balance sheet characteristics and the risk of bankruptcy are highly significant determinants of the bond market external finance premium. This confirms that there is a negative association between the external finance premium and firm financial health. Additionally, we found that monetary policy affects the external finance premium through its impact on firms' debt burden. This result is of particular importance because it reveals that the broad credit channel is operative in the US bond market.

[23] The GMM diagnostic tests behave well- there is no sign of second-order serial correlation and the Sargan test of over-identifying restrictions does not reject.

4.2 The financial accelerator and financial constraints

We now consider the impact of financial constraints on the response to balance sheet characteristics in Table 3. We use four different categorization methods for determining whether a firm is constrained or unconstrained based on size, age, dividend payments and indebtedness. Our results are remarkably consistent across these categories, and the GMM estimates tell a similar story to the random-effects estimates.

We observe that *LEV* has estimated coefficients that are positive and significant at the one percent level for both constrained and unconstrained firms in all four categories, but the coefficients for constrained and unconstrained firms are not significant different from each other. We conclude that the external finance premium in the bond market rises for all types of firms with higher leverage.

PROF measures the extent to which more profitable firms face a smaller finance premium. According to the financial accelerator theory we would expect firms with high profitability to face a lower external finance premium and *vice versa*. Profitability has a negative coefficient as expected for all types of firms. In absolute value the coefficients on profitability are higher and significant for unconstrained firms implying that for unconstrained firms that can generate more revenue or which have higher profits the premium is reduced.

INTBURD enters as a significant variable in the regression for firms categorized as constrained. We use this variable to measure the impact of the interest rate payments at the firm-level because it reflects the level of the interest rate and the exposure to interest bearing debt but it also reflects the general monetary policy stance since tightening or loosening of policy is reflected in the burden. In accordance with our expectations, we find that firms with higher interest burdens face higher external finance premia in the bond market.

The risk of default, as measured by the *ZSCORE*, is found to be significant for both types of firms but is not statistically different between constrained and unconstrained firms. The coefficients are negative and in absolute value higher for constrained firms. This finding lends support to the fact that the risk of bankruptcy is an important determinant of the external finance premium in the bond market and higher probabilities of default are associated with higher premia.

The external premium for bank loans moves countercyclically with balance sheet characteristics and the monetary policy stance, and is more sensitive for firms that are financially constrained as reported by FHP (1988, 2000), Whited (1992), Bond and Meghir (1994), Kashyap et al. (1994), Gertler and Gilchrist (1994), Carpenter et al. (1998), KZ (1997, 2000) and Bougheas et al. (2006). We find similar results for the external premium on corporate bonds: the premium is more sensitive to balance sheet characteristics for constrained firms. Two main implications can be highlighted from our results. First, all firms - whether they are classified as constrained or unconstrained by any of the four categorization schemes - face a higher external finance premium on bonds when monetary policy tightens and when leverage increases. Second, the impact of other firm-specific characteristics on the external premium for corporate bonds differs for constrained and unconstrained firms. For example, a higher profitability ratio ($PROF$) significantly reduces the external premium for unconstrained firms but not for constrained firms. These results confirm that the balance sheet channel is operative through the bond market, supporting earlier evidence from the US and Europe in de Bondt (2004), Levin et al. (2004) and Campello and Chen (2005), but there is less indication that the bond market premium differs according to whether a firm is financially constrained or unconstrained.

4.3 Responses in recession and credit crunch

To explore the response to firm-specific characteristics when the economy is in recession/credit crunch we interact the explanatory variables with a recession/credit crunch dummy, D. Previous evidence suggests that there is significant difference in the response of real variables in periods of recession versus non-recession (c.f. Gertler and Hubbard (1988), Gertler and Gilchrist (1994), Kashyap et al. (1994), Vermeulen (2002) and Mody and Taylor (2004). There is anecdotal evidence in Kwan (2002) that the credit crunch of 2001-2002 also influenced access to commercial paper and bank finance. As far as we are aware the impact of the recession/credit crunch has not been explored for bond finance, and this section addresses this issue by examining the sensitivity of the external premium to balance sheet variables in the 2001-02 recession/credit crunch episode versus other times. Table 4 reports coefficients on variables interacted with the dummy variable D (recession/credit crunch) and interacted with 1-D (out of recession/credit crunch) for constrained and unconstrained firms. At the foot of the Table is a test of equality between coefficients with p-values in brackets.[24]

[24] The test is reported as a χ^2 statistic for the random effects models and as an F statistic for the GMM estimates.

Our results in Table 4 give a clear indication that there is a significantly different response in recessions/credit crunches with respect to *INTBURD* but not to *LEV*, *PROF* or *ZSCORE*. When the recession/credit crunch dummy is interacted with constrained and unconstrained firms we observe that constrained or unconstrained firms experienced different external finance premia in bond markets in recesssion/credit crunch, D, versus other periods, 1-D. In six cases we confirm the greater sensitivity to *INTBURD* for non-recession/crunch versus recession/crunch, five of which occur for constrained firms. *INTBURD* itself would have fallen during the recession/credit crunch reflecting two factors - first, monetary policy loosened significantly during the recession period, and second, some firms would certainly have had reduced exposure to interest bearing debt during the recession either due to a fall in their demand for loans but more importantly due to restricted availability of supply from financial institutions. During the recession/credit crunch firms that were excluded from obtaining external finance from sources lower down the pecking order of finance would inevitably have been excluded from bond market finance also. Therefore the response of the external premium, which reflects firm-specific risk by the spread over government bonds, may have been lower during the recession/credit crunch because bond finance was only offered to the highest quality firms and spreads would have been less sensitive to the balance sheet characteristics of these firms.

We also find some marginal evidence that there is greater sensitivity to *PROF* and *ZSCORE* for non-recession/crunch versus recession/crunch. In addition, our results show that where there is a significant difference in the response for constrained versus unconstrained firms the external finance premium is more sensitive to *LEV*, *PROF*, *INTBURD* and *ZSCORE* for constrained firms both in and out of recession/credit crunch confirming earlier results in Table 3. We conclude that the 2001-02 recession/credit crunch had an impact through the balance sheet on external finance premia in the bond market, and could have operated alongside the bank and commercial paper channels reported by Kwan (2002), with an influence over real variables, as reported by Gertler and Hubbard (1988), Kashyap et al. (1994), Vermeulen (2002), further down the line.

5 Robustness

In this section we provide a robustness analysis of our results, considering the potential selection bias problem.

5.1 Panel Attrition and Selectivity Bias

One feature of our data that could influence biases and inconsistencies in the regression estimates is its unbalanced structure since the number of observations on each firm varies between 3 and 5. Understanding the selection rule and correcting any selectivity bias involves some computational difficulties. Thus, one convenient approach is to adopt some preliminary and computationally simple techniques to establish whether selectivity bias is present or not in the first instance. Verbeek and Nijman (1992) proposed some methods for testing and correcting for sample selection bias in panel data models. In this paper we perform an Added-Variable procedure (or Quasi-Hausman test) as suggested by Verbeek and Nijman (1992) by constructing an artificial variable that tests for attrition bias.[25] The results for the balance sheet indicators and credit spread are shown in Table 5.

We re-estimate our specifications with the random effects method including the artificial variable. Under the null-hypothesis of non-selective response in our panel structure, the estimated coefficient for the added variable is statistically insignificant and thus the estimated model is appropriate. Under the alternative hypothesis of sample selectivity, however, the coefficient is non-zero and static panel data models yield biased and inconsistent estimation results (Wooldridge (2002)). The estimated coefficient of the attrition variable is positive but statistically insignificant in all the specifications suggesting that our findings are not affected by biases resulting from endogenous panel data attrition. Additionally, the coefficients on the other variables are largely similar to those obtained in Table 3. We therefore conclude that this exercise confirms that sample selection is unlikely to introduce strong biases in our estimated coefficients.

6 Conclusion

The external finance premium, as measured by the difference between the cost of internal and external funds, plays a key role in models of the financial accelerator. This has an important bearing on the heterogeneous response to monetary policy by firms with different degrees of financial health. The vast majority of empirical studies on the external finance premium have focused on the margin

[25] We define an indicator variable $response_{it}$ such as $response_{it} = 1$ if (y_{it}, x_{it}) is observed and 0 otherwise. Next, we construct the attrition variable as $attrition_i = \sum_{t=1}^{T} response_{it}$, indicating the total number of periods the ith individual is observed, and include $attrition_i$ as additional regressor in our random effects model..

between internal finance and bank borrowing or equities and relatively little attention has been given to corporate bonds. In this paper we have hypothesized that balance sheet indicators of creditworthiness could affect the external finance premium for bonds as they do for premia in other markets. Our results based on data for 2729 bonds issued by 652 US firms actively trading between 2000-2004 suggest that firms with better financial health as measured by balance sheet indicators face a lower external finance premium supporting our first hypothesis. After separating firms into constrained and unconstrained categories using four different classification schemes we find firms that are credit constrained have higher premia than unconstrained firms offering support for our second hypothesis. This implies that the premium on bond finance reflects the risk characteristics used by other financial markets to constrain the credit available to certain types of firms. Finally, when we consider the recession/credit crunch episode in 2001-02 we find that the sensitivity of the premium varies between recessions/credit crunches and other periods driven mainly by the interest burden, supporting our third hypothesis. We conclude that the impact found in other financial markets during a recession/credit crunch are found in bond markets and may be influential over the path of real variables. These findings provide strong evidence for a US financial accelerator supporting previously documented evidence in the US bond market (Levin et al. (2004) and Mody and Taylor (2004)). The results are consistent with the argument of Campello and Chen (2005) that financial constraints are a dimension of systematic risk that is priced in the financial markets, and especially in the paper market. While others have documented the effects of firm characteristics on the equity premium, we provide new evidence on the external finance premium in the bond market.

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Table 1
Summary Statistics

Variable	Mean	St.Dev.	N
$SPREAD_{it}$	1.272	1.897	2069
LEV_{it}	30.183	17.107	3129
$PROF_{it}$	7.938	6.967	3083
$INTBURD_{it}$	6.547	5.862	2495
$ZSCORE_{it}$	3.614	2.002	3043

Table 2
The baseline model

	R.Effects	GMM
LEV_{it}	0.023***	0.022**
	(4.05)	(2.03)
$PROF_{it}$	-0.026***	-0.027***
	(-3.12)	(-2.56)
$INTBURD_{it}$	0.026**	0.026**
	(2.45)	(2.05)
$ZSCORE_{it}$	-0.116**	-0.217**
	(-2.04)	(-2.10)
$Constant$	2.122***	2.460***
	(3.39)	(3.34)
$JStatistic$		0.126
$m2$		0.573
R^2	0.19	

Notes: In the random-effects estimations the standard errors are corrected for clustering and robust z-statistics are reported in the round brackets. One-step system GMM estimates with robust t-statistics are reported under coefficients. The set of instruments includes the lagged levels of all right-hand side variables dated t-2 and earlier as instruments for the equation in first-differences; and the lagged first-differences of the same variables dated t-1 as instruments for the equation in levels. Time dummies, sector dummies and time dummies interacted with sector dummies were included in all specifications. The J statistic is a test of the over-identifying restrictions, distributed as a chi-squared under the null of instrument validity. $m2$ is a test for second-order serial correlation in the first differenced residuals asymptotically distributed as N(0,1) under the null of no serial correlation. Numbers of firms and of observations are 511 and 1649, respectively.*significant at 10 %; ** significant at 5 %; *** significant at 1 %.

TABLE 3
BALANCE SHEET INDICATORS
AND THE CREDIT SPREAD

	SIZE		AGE		DIVID.		INBEBT.	
	R.Effects	GMM	R.Effects	GMM	R.Effects	GMM	R.Effects	GMM
$LEV_{it} * Constrained$	0.025***	0.039**	0.022***	0.039**	0.030***	0.035**	0.025***	0.027**
	(3.26)	(2.31)	(3.05)	(2.25)	(3.60)	(2.18)	(3.98)	(2.10)
$LEV_{it} * (1 - Constrained)$	0.021***	0.023**	0.022***	0.026**	0.022***	0.014	0.022***	0.024**
	(3.80)	(2.03)	(3.78)	(2.07)	(4.03)	(1.05)	(2.62)	(2.06)
$PROF_{it} * Constrained$	-0.021	-0.017	-0.060**	-0.057	-0.022	-0.083***	-0.030***	-0.034**
	(-1.01)	(-0.92)	(-2.33)	(-1.17)	(-0.89)	(-2.62)	(-2.76)	(-2.53)
$PROF_{it} * (1 - Constrained)$	-0.031***	-0.049***	-0.020**	-0.095***	-0.028***	-0.038***	-0.021*	-0.041**
	(-3.68)	(-3.46)	(-2.35)	(-3.41)	(-3.32)	(-3.80)	(-1.90)	(-2.52)
$INTBURD_{it} * Constrained$	0.035*	0.017	0.036**	0.036*	0.025***	0.055*	0.025	0.029
	(1.81)	(1.21)	(2.29)	(1.68)	(2.89)	(1.90)	(1.17)	(1.23)
$INTBURD_{it} * (1 - Constrained)$	0.021*	0.013	0.020	0.001	0.029	0.018	0.024**	0.016
	(1.75)	(0.88)	(1.45)	(0.056)	(1.41)	(0.85)	(2.55)	(1.52)
$ZSCORE_{it} * Constrained$	-0.140*	-0.320***	-0.062	-0.400***	-0.149*	-0.322**	-0.128**	-0.272**
	(-1.94)	(-2.61)	(-0.84)	(-2.75)	(-1.79)	(-2.32)	(-2.08)	(-2.17)
$ZSCORE_{it} * (1 - Constrained)$	-0.120**	-0.258*	-0.143**	-0.195*	-0.101*	-0.293***	-0.110*	-0.137
	(-2.21)	(-1.78)	(-2.31)	(-1.77)	(-1.86)	(-2.71)	(-1.78)	(-1.12)
$Constant$	2.227***	2.878***	2.191***	3.129***	2.101***	3.153***	2.100***	2.393***
	(3.54)	(3.13)	(3.47)	(3.44)	(3.34)	(4.04)	(3.27)	(2.94)
$JStatistic$		0.215		0.08		0.100		0.226
$m2$		0.659		0.767		0.489		0.565
R^2	0.19		0.19		0.20		0.19	

Notes: The set of instruments includes the lagged levels of all right-hand side variables dated t-2 and earlier as instruments for the equation in first-differences; and the lagged first-differences of the same variables dated t-1 as instruments for the equation in levels. Numbers of firms and of observations are 511 and 1649, respectively. Also see notes to Table 2. * significant at 10%; ** significant at 5%; *** significant at 1%.

TABLE 4
THE FINANCIAL ACCELERATOR,
FINANCIAL CONSTRAINTS
AND RECESSION/CREDIT CRUNCHES

	SIZE		AGE		DIVID.		INBEBT.	
	R.Effects	GMM	R.Effects	GMM	R.Effects	GMM	R.Effects	GMM
$LEV_{it} * Constrained * D$	0.030***	0.030**	0.034***	0.052***	0.029***	0.033**	0.026***	0.023**
	(2.68)	(2.04)	(3.00)	(3.43)	(2.94)	(2.28)	(2.88)	(2.02)
$LEV_{it} * Constrained * (1 - D)$	0.020**	0.028**	0.019**	0.038***	0.032***	0.036***	0.027***	0.038***
	(2.45)	(2.42)	(2.34)	(3.08)	(3.74)	(2.78)	(4.32)	(3.95)
$LEV_{it} * (1 - Constrained) * D$	0.019***	0.013	0.021***	0.046***	0.023***	0.020*	0.028***	0.029**
	(2.95)	(1.31)	(3.07)	(3.65)	(3.18)	(1.91)	(2.75)	(2.27)
$LEV_{it} * (1 - Constrained) * (1 - D)$	0.024***	0.028**	0.026***	0.038***	0.024***	0.029***	0.020**	0.038***
	(3.97)	(2.50)	(4.15)	(3.18)	(4.15)	(2.91)	(2.04)	(2.98)
$PROF_{it} * Constrained * D$	-0.061*	-0.068	-0.087**	-0.089*	-0.024	-0.033	-0.043***	-0.056***
	(-1.69)	(-1.17)	(-2.37)	(-1.77)	(-0.92)	(-1.20)	(-3.21)	(-3.27)
$PROF_{it} * Constrained * (1 - D)$	-0.005	-0.014	-0.037*	-0.018	-0.019	-0.015	-0.021	-0.017
	(-0.25)	(-0.60)	(-1.76)	(-0.40)	(-0.59)	(-0.41)	(-1.57)	(-1.05)
$PROF_{it} * (1 - Constrained) * D$	-0.032***	-0.035	-0.024**	-0.062***	-0.035***	-0.048***	-0.018	-0.027*
	(-3.31)	(-1.58)	(-2.48)	(-2.98)	(-3.23)	(-3.70)	(-1.35)	(-1.69)
$PROF_{it} * (1 - Constrained) * (1 - D)$	-0.034***	-0.027	-0.017	-0.028	-0.021**	-0.017	-0.017	-0.014
	(-3.22)	(-1.63)	(-1.40)	(-1.34)	(-2.26)	(-1.18)	(-1.19)	(-0.61)
$INTBURD_{it} * Constrained * D$	0.024*	0.033	0.045***	0.053*	0.024**	0.032**	0.028	0.068**
	(1.70)	(1.32)	(2.87)	(1.76)	(2.26)	(2.03)	(1.21)	(2.46)
$INTBURD_{it} * Constrained * (1 - D)$	0.091**	0.174**	0.062	0.055	0.051***	0.126***	0.034	0.125***
	(2.11)	(2.44)	(1.44)	(0.75)	(2.85)	(2.91)	(1.32)	(3.09)
$INTBURD_{it} * (1 - Constrained) * D$	0.023*	0.041**	0.022	0.075***	0.032	0.112*	0.024***	0.039**
	(1.79)	(2.41)	(1.42)	(2.81)	(1.16)	(1.93)	(2.67)	(2.09)

continued from previous page

	SIZE		AGE		DIVID.		INBEBT.	
	R.Effects	GMM	R.Effects	GMM	R.Effects	GMM	R.Effects	GMM
$INTBURD_{it} * (1 - Constrained) * (1 - D)$	0.013	0.079**	0.031	0.146***	0.030	0.103**	0.043	0.102*
	(0.61)	(2.17)	(1.58)	(2.73)	(1.22)	(1.99)	(1.56)	(1.80)
$ZSCORE_{it} * Constrained * D$	(-0.54)	(-0.58)	(-0.72)	(1.75)	(-0.94)	(-0.69)	(-0.53)	(-0.38)
	-0.228***	-0.158	-0.090	0.082	-0.115**	-0.053	-0.165***	-0.082
$ZSCORE_{it} * Constrained * (1 - D)$	(-3.12)	(-1.42)	(-1.19)	(0.68)	(-2.14)	(-0.59)	(-2.76)	(-0.87)
	-0.105*	-0.132	-0.076	0.141	-0.066	-0.026	-0.080	-0.055
$ZSCORE_{it} * (1 - Constrained) * D$	(-1.68)	(-1.56)	(-1.06)	(1.47)	(-0.71)	(-0.25)	(-1.13)	(-0.65)
	-0.125**	-0.086	-0.169***	-0.062	-0.202**	-0.127	-0.131*	-0.004
$ZSCORE_{it} * (1 - Constrained) * (1 - D)$	(-2.23)	(-0.88)	(-2.71)	(-0.62)	(-2.20)	(-1.05)	(-1.87)	(-0.040)
	(-2.21)	(-1.78)	(-2.31)	(-1.77)	(-1.86)	(-2.71)	(-1.78)	(-1.12)
$Constant$	2.242***	1.390	2.242***	0.767	1.981***	1.036	2.009***	0.552
	(3.37)	(1.37)	(3.37)	(0.70)	(3.08)	(1.09)	(2.94)	(0.62)
$JStatistic$		0.061		0.187		0.100		0.072
$m2$		0.459		0.466		0.519		0.457
R^2	0.19		0.20		0.20		0.19	
Test of equality of coefficients								
$LEV_{it} * Constrained$ & dummy	0.59[0.44]	0.02[0.89]	1.74[0.18]	1.05[0.30]	0.10[0.75]	0.06[0.80]	0.04[0.84]	1.51[0.22]
$LEV_{it} * (1 - Constrained)$ & dummy	0.60[0.43]	2.38 [0.12]	0.61[0.43]	0.57[0.45]	0.02[0.87]	0.69[0.41]	0.43[0.51]	0.41[0.52]
$PROF_{it} * Constrained$ & dummy	2.28[0.13]	0.81[0.36]	2.17[0.14]	1.68[0.19]	0.02[0.89]	0.23[0.63]	1.97[0.16]	4.58[0.03]**
$PROF_{it} * (1 - Constrained)$ & dummy	0.05[0.81]	0.11[0.74]	1.74[0.57]	2.02[0.15]	1.67[0.19]	4.52[0.03]**	0.00[0.96]	0.38[0.53]
$INTBURD_{it} * Constrained$ & dummy	2.90[0.07]*	5.15[0.02]**	0.22[0.64]	0.00[0.96]	3.66[0.05]**	5.39[0.02]**	0.14[0.71]	4.53[0.03]**
$INTBURD_{it} * (1 - Constrained)$ & dummy	0.34[0.55]	2.23[0.13]	0.42[0.51]	3.66[0.05]**	0.01[0.94]	0.02[0.88]	0.61[0.43]	2.17[0.14]
$ZSCORE_{it} * Constrained$ & dummy	4.20[0.04]**	0.66 [0.41]	0.06[0.80]	0.93[0.33]	0.98[0.32]	0.01[0.90]	3.67[0.05]**	0.25[0.61]
$ZSCORE_{it} * (1 - Constrained)$& dummy	0.14[0.70]	0.26[0.60]	3.16[0.07]*	4.88[0.02]**	2.07[0.15]	0.91[0.34]	0.59[044]	0.30[0.58]

Notes: D is a dummy variable, which takes value 1 for the recession/credit crunch period, and 0 otherwise. The set of instruments includes the lagged levels of all right-hand side variables dated t-4 and earlier as instruments for the equation in first-differences; and the lagged first-differences of the same variables dated t-3 as instruments for the equation in levels. Numbers of firms and of observations are 511 and 1649, respectively. Also see notes to Table 2. * significant at 10%; ** significant at 5%; *** significant at 1%.

Table 5
Selectivity Bias test

	Random Effects			
	SIZE	AGE	DIV.	INDEBT.
$LEV_{it} * Constrained$	0.025***	0.023***	0.026***	0.030***
	(3.43)	(3.14)	(3.95)	(3.48)
$LEV_{it} * (1 - Constrained)$	0.021***	0.022***	0.022***	0.022***
	(3.71)	(3.76)	(2.75)	(3.92)
$PROF_{it} * Constrained$	-0.020	-0.061**	-0.031***	-0.023
	(-1.00)	(-2.35)	(-3.04)	(-0.99)
$PROF_{it} * (1 - Constrained)$	-0.033***	-0.021**	-0.021**	-0.028***
	(-3.82)	(-2.47)	(-2.06)	(-3.51)
$INTBURD_{it} * Constrained$	0.036*	0.036**	0.027	0.026***
	(1.86)	(2.26)	(1.39)	(3.08)
$INTBURD_{it} * (1 - Constrained)$	0.022**	0.022*	0.025**	0.030
	(1.97)	(1.69)	(2.01)	(1.27)
$ZSCORE_{it} * Constrained$	-0.142**	-0.051	-0.124**	-0.100*
	(-1.97)	(-0.70)	(-2.14)	(-1.92)
$ZSCORE_{it} * (1 - Constrained)$	-0.114**	-0.142**	-0.106*	-0.140*
	(-2.14)	(-2.31)	(-1.79)	(-1.76)
Attrition	0.657	0.651	0.629	0.621
	(1.47)	(1.48)	(1.39)	(1.39)
Constant	1.671**	1.630**	1.551**	1.575**
	(2.31)	(2.26)	(2.30)	(2.33)
R^2	0.18	0.19	0.19	0.19

Notes: *Attrition* is a binary artificial variable taking the value one if the individual is observed over the entire period (balanced sample) and zero otherwise. Statistically insignificant coefficients suggest that the model is not affected by attrition bias. Numbers of firms and of observations are 511 and 1649, respectively. *significant at 10%; ** significant at 5%; *** significant at 1%.