

Leverage and Corporate Performance: Does Institutional Environment Matter?

Laurent Weill

ABSTRACT. This paper aims to provide new empirical evidence on a major corporate governance issue: the relationship between leverage and corporate performance. We propose two major findings to this literature by applying frontier efficiency techniques to measure performance of medium-sized firms from seven European countries. A maximum likelihood procedure is used to estimate a stochastic cost frontier and the parameters of an equation relating cost inefficiency to leverage simultaneously. We find that the relationship between leverage and corporate performance varies across countries, which tends to support the influence of institutional factors on this link. We then suggest the influence of the efficiency of the legal system and in a lesser degree of the access to bank credit on the relationship between leverage and corporate performance.

KEY WORDS: corporate governance, financial structure, frontier efficiency, leverage.

JEL CLASSIFICATIONS: G32, L26.

1. Introduction

Corporate governance literature aims to improve the understanding of the mechanisms that favor managerial performance. As the improvement of managerial performance is a key component for productivity gains, the corporate governance channels which influence positively managerial performance are expected to favor growth. A major issue in this section of economic literature is the influence of leverage on corporate performance. Two motivations underline the interest in this issue. On the one hand, public policy considerations are significant because of the implications for policies promoting equity among financing sources for

firms. On the other hand, a positive relationship between leverage and corporate performance would mean that international differences in access to credit result in competitiveness advantages. Indeed, a higher access to credit would favor corporate performance through greater leverage, which would lead to greater competitiveness.

From a theoretical perspective, this impact is noticeably rooted in the binding nature of debt: debt financing raises the pressure on managers to perform, because it reduces the moral hazard behavior by reducing “free cash-flow” at the disposal of managers (Jensen, 1986). Consequently, the firms with the higher leverage should be the most inclined to improve their performance. However, a higher leverage means higher agency costs because of the diverging interests between shareholders and debtholders: this moral hazard problem suggests that leverage may be negatively associated with performance (Jensen and Meckling, 1976; Myers, 1977). Thus, the literature provides opposing arguments regarding the relationship between leverage and performance.

A survey of the empirical literature on this debate shows the lack of consensus on the link between leverage and corporate performance. However, two elements may explain this divergence. On the one hand, this literature uses various measures of performance, either basic accounting ratios or more sophisticated measures such as total factor productivity indicators. Consequently, it can be argued that different conclusions can result from the differences in performance measures. This phenomenon may also be the result of the fact that studies use unsatisfactory performance measures, as the disadvantages of using raw accounting measures to evaluate corporate performance are well-known. It is worth

Final version accepted on December 2006

Laurent Weill
Institut d'Etudes Politiques
Université Robert Schuman
47 avenue de la Forêt Noire, Strasbourg, 67000, France
E-mail: laurent.weill@urs.u-strasbg.fr

noting, however, that all studies were only performed on one country. Therefore, different conclusions may result from the influence of the institutional framework on the relationship.

To investigate the influence of both of these elements on the observed differences in the link between leverage and performance, we aim to provide new evidence with respect to this relationship with two major additions to former empirical literature.

The first addition is the use of frontier efficiency techniques to estimate performance measures. Following seminal works from Aigner et al. (1977) and Charnes et al. (1978), these methods provide sophisticated performance measures, the efficiency scores. Why using stochastic frontier approach to measure performance rather than more usual performance indicators? Several advantages can be argued in favor of this approach. First, it provides synthetic measures of performance. Indeed, unlike basic productivity measures (e.g. output per employee), the efficiency scores computed with stochastic frontier approach allow to include several input and output dimensions in the evaluation of performances. Second, it computes relative measures of performance. Namely, a cost frontier is estimated which allows the comparison of each firm to the best-practice companies. As a result, the cost efficiency score assesses how close a firm's cost is to what a firm's optimal cost would be for producing the same bundle of outputs. It then directly provides a relative measure of performance.

Third, efficiency frontiers take the scale effects into account. Indeed, with standard cost ratios, the existence of scale economies may benefit to large firms in terms of performance. With cost efficiency scores, the scale effects are disentangled from the "pure" performance measures. Fourth, whereas total factor productivity measures assess performance by the whole residual from the production frontier for each country, stochastic frontier approach allows to disentangle the distance to the production frontier between an inefficiency term and a random error, taking into account exogenous events.

The second addition to former empirical literature is the fact that we proceed to an

empirical work in seven European countries to include various institutional frameworks in the analysis. Institutional factors include the architecture of the financial and legal systems, as La Porta et al. (1997) pointed out the role of these latter characteristics as determinants of the structure of financing.

These both improvements allow us then to bring new robust evidence on the relationship between leverage and corporate performance and the possible influence of the institutional framework on this issue. We then use a maximum likelihood procedure to estimate the parameters of a stochastic cost frontier along with an equation relating inefficiency to leverage and some control variables.

The structure of the paper is as follows. Section 2 presents the background of the relationship between leverage and corporate performance. Section 3 describes the data and variables. In Section 4, we present the methodology used for the cost efficiency measures. Section 5 develops the empirical results. Finally, we provide some concluding remarks in Section 6.

2. Background

This section displays the theoretical and empirical background of the relationship between corporate performance and leverage. We then present some insights regarding the impact of institutional environment on this link.

2.1. Theoretical background

Though the Modigliani and Miller (1958) theorem suggested that the financial structure has no influence on firm value, a number of theoretical works have provided arguments in favor of the non-neutrality of financial structure in economic terms. Among the works contesting the relevance of Modigliani–Miller theorem, a major portion suggests a relationship between leverage and corporate performance.

The studies on the link between leverage and corporate performance can be classified in two categories. The first one includes the works based on information asymmetries and signaling. Firm insiders (managers or shareholders)

possess some private information about the characteristics of the firm. It has then been demonstrated that these information asymmetries between borrowers and lenders induce some adverse selection problems: the inability of lenders to price a loan according to the borrower's quality results in an imperfect pricing, leading to credit rationing (Stiglitz and Weiss 1981). Therefore, "high-quality" borrowers have incentives to show their quality. However, they need to provide this private information by using a credible signal, meaning a signal that cannot be provided by "low-quality" borrowers. Debt can then be adopted as this signal as the choice of financing by debt rather than by equity, in order to convey valuable information to the lenders (Leland and Pyle, 1977). In particular, Ross (1977) advanced that a "good-quality" company can issue more debt than a "low-quality" one, because the issue of debt leads to a higher probability of default due to the debt-servicing costs which represent a costly outcome for firm insiders. As a result, debt is a credible signal of the quality of firms and "good-quality" firms are more inclined to issue debt. Thus, this theory suggests that the highest performing firms, those having the more profitable investments, acquire more debt: thus, a positive relationship should exist between corporate performance and leverage.

The second category of studies on the relationship between leverage and corporate performance is linked to the agency costs literature. As mentioned by Jensen and Meckling (1976), significant agency costs can indeed arise from conflicts of interest between categories of agents (managers, shareholders, debtholders). These authors identify in fact two types of conflicts that have different implications leading to opposite theories on the link between leverage and performance.

First, agency costs result from the conflicts of interest between shareholders and managers. The key problem is here the moral hazard behavior of managers that can waste firm resources or minimize their effort rather than increasing firm value, as they have their own objectives. In this way, debt financing raises the pressure of managers to perform (meaning

to reduce their waste of resources and to increase their effort) as it reduces "free cash-flow" at the disposal of managers (Jensen, 1986). Indeed, debt implies interest payment obligations that must be satisfied by managers, under the threat of a bankruptcy if these obligations are not satisfied. Grossman and Hart (1982) also argue that debt financing provides better incentives for managers to perform as they aim to avoid the personal costs of bankruptcy. Consequently leverage should exert a positive influence on corporate performance.

Second, agency costs also arise because of the conflicts of interest between shareholders and debtholders. Indeed shareholders have incentives to take actions that benefit themselves at the expense of debtholders, and consequently that do not necessarily maximize firm value. This divergence of interests has two manifestations, coming from moral hazard issues. On the one hand, it gives incentives to shareholders to invest in riskier projects than those preferred by debtholders (Jensen and Meckling, 1976). This "asset substitution" comes from the asymmetry of gains for shareholders: if an investment provides returns above the debt value, gains accrue to shareholders. Yet if the investment fails, losses are shared between debtholders that do not receive the repayment and shareholders that suffer from the loss of capital, given the limited liability of shareholders. However, conflicts between shareholders and debtholders can also lead to underinvestment, as demonstrated by Myers (1977). As a result, the agency costs resulting from the conflicts of interest shareholders-debtholders suggest that a higher leverage is correlated with a lower corporate performance.

In summary, theoretical literature provides opposing arguments with respect to the relationship between leverage and corporate performance. Whereas theories based on signaling and the agency costs resulting from the conflicts of interest shareholders-managers provide arguments in favor of a positive relationship, the research analyzing the agency costs from the diverging interests between shareholders and debtholders suggests a negative

relationship. Therefore, has empirical literature allowed to discriminate between theories?

2.2. *A short review of the empirical literature*

A few empirical studies have been performed to analyze the relationship between leverage and corporate performance. The major difference between them is found in the definition of corporate performance. One series of papers uses basic accounting measures of performance. Majumdar and Chhibber (1999) test the relationship between leverage and corporate performance on a sample of Indian companies. Adopting an accounting measure of profitability, return on net worth, in order to evaluate performance, they observe a significant negative link between leverage and corporate performance. Kinsman and Newman (1999) use various measures of performance on a sample of US firms, based on accounting or ownership information (firm value, cash-flow, liquidity, earnings, institutional ownership and managerial ownership). They perform regressions of leverage on this set of performance measures. Their conclusion is the existence of robust relationships between leverage and some of the measures of performance such as a negative link with firm value and cash-flow. However, criticism of this work is based on the use of contested performance measures, such as liquidity, but also on their joint inclusion in regressions, that mixes their influence.

We can also mention several empirical works that focus on the determinants of leverage and test the profitability variable. It must be emphasized however, that profitability cannot be strictly considered as a performance variable to explain leverage, since profitability is the source of internal financing. As a result, there exists a negative impact of profitability on leverage, as higher profitability means a reduced need for external financing such as financial debt. Here the conclusion is undoubtedly a negative relationship between profitability and leverage (Van der Wijst and Thurik, 1993; Rajan and Zingales, 1995; Chittenden et al., 1996; Johnson, 1997; Michaelas et al., 1999).

There is however a second series of works focusing on the relationship between leverage

and corporate performance that develop more sophisticated measures of performance. Pushner (1995) aims to investigate the relationship between leverage and corporate performance in conjunction with the influence of equity ownership in Japan. Here, corporate performance is measured by total factor productivity: a production frontier is estimated, in which performance is equal to the residual of OLS estimate. He concludes that a negative relationship exists between leverage and corporate performance. Two studies test the role of financial pressure on corporate performance, which is a closely related issue. Both analyze data on the United Kingdom and again measure corporate performance as total factor productivity. Nickell et al. (1997) observe a positive link between financial pressure and productivity growth, while Nickell and Nicolitsas (1999) conclude to a weak positive effect of financial pressure on productivity growth.

To conclude this brief survey about former empirical literature, it appears that there is no consensus on the relationship between leverage and corporate performance. Furthermore, we observe two key elements for the understanding of the link between leverage and performance. The first element is the fact that all studies test this link only in one country, which can explain the different results, since the institutional framework may play a role in the relationship between leverage and corporate performance. This is the reason why we investigate this relationship in several countries. The second element concerns the measures of performance employed, either accounting measures or total factor productivity indicators. In the following study, we adopt frontier efficiency scores to evaluate performance. Efficiency scores own a couple of advantages in comparison of other measures of performance. Comparing to raw measures of performance, efficiency scores allow the inclusion of several outputs and inputs and consequently provide synthetic measures of performance. In comparison to all other measures of performance (raw measures or productivity measures), efficiency scores have the advantage of relative scores that directly take into account the comparison with the best companies.

2.3. *The role of institutional environment*

The previous subsections have displayed the theoretical and empirical elements on the relationship between leverage and performance. Namely, while theoretical literature provides three main arguments, empirical literature has shown different results depending of the investigated country, suggesting a possible influence of institutional factors on the relationship. Therefore, this subsection aims at briefly investigating which institutional factors may exert an impact on the link between leverage and performance and how.

As European small and medium-sized companies widely rely on banking debt (Corbett and Jenkinson, 1994), a first institutional factor which may influence the relationship between leverage and performance is the access to bank credit for firms. Due to the absence of satisfactory information on credit rationing, we define the access to banking credit as the ratio of claims of deposit banks on private sector to GDP. This factor may exert an impact on the relationship between leverage and performance through the “signaling argument”: the access to bank credit acts upon the possibilities for firms to use indebtedness as a signaling argument.

Next to access to bank credit, the attributes of the legal system may also influence the relationship between leverage and performance. Indeed La Porta et al. (1997) emphasize how legal institutions shape the external finance and therefore the financial structure. These legal factors notably include three dimensions of the legal system, which are measured by indices provided by La Porta et al. (1998). The first index measures the protection of creditor rights. It aggregates four different creditor rights, taking the value of 1 if the creditor right is protected and 0 otherwise. The second index measures the protection of shareholder rights, aggregating in a similar way six different shareholder rights. These both indices may be criticized notably on two points. First, they only consider some dimensions of the protection of creditor rights or shareholder rights. Second, they give the same weight to the different dimensions of the protection in the aggregation, while some dimensions may be more important.

However, in spite of these shortcomings, these indices have become widely used in the literature and can now be considered as the norm to assess investor protection.

A third index, also provided by La Porta et al. (1998), deals with the efficiency of the legal system, to assess the enforcement of the rights. This dimension is notably measured by the “rule of law” index, which is provided by private credit risk agencies. It has to be stressed that this index only proxies the quality of enforcement of the rights. It is however widely used in the absence of better measures.

These three legal factors may act upon the relationship between leverage and performance through the “free cash-flow argument” and the moral hazard issues coming from the conflicts of interest between shareholders and creditors. Namely, the protection of creditor rights increases the power of creditors in face of shareholders and consequently helps to reduce moral hazard problems. Similarly, the protection of shareholder rights enhances the power of shareholders in face of managers and then weakens the role of the “free cash-flow argument”. Finally, by improving the enforcement of the law, the efficiency of the legal system increases the protection of creditor and shareholder rights, and consequently strengthens both arguments mentioned above on the relationship between leverage and performance.

3. *Data and variables*

The sample includes about 11836 manufacturing companies from 7 European countries: 1279 from Belgium, 3029 from France, 314 from Germany, 4403 from Italy, 409 from Norway, 90 from Portugal and 2312 from Spain. The choice of countries results from the availability of data required for the analysis. The data are unconsolidated balance sheet data for 3 years: 1998, 1999, 2000. They are extracted from Amadeus database edited by Bureau Van Dijk, which include mainly medium-sized companies. Our choice to work on unconsolidated balance sheet data stems from the fact that Amadeus database only provides unconsolidated data for the countries of our study. Furthermore, Rajan

TABLE I
Descriptive statistics for variables

	Belgium	France	Germany	Italy	Norway	Portugal	Spain
Number of observations	1279	3029	314	4403	409	90	2312
<i>Output</i>							
Turnover	63,855.0	86,402.9	768,127.2	57,780.9	45,109.5	44,197.0	55,795.7
<i>Inputs</i>							
Personnel expenses	10,655.1	14,801.6	158,813.4	8,531.53	9,425.47	6,373.22	7,698.64
Other operating expenses	39,613.8	40,969.5	499,394.1	32,614.4	25,409.3	17,730.5	35,671.6
<i>Input prices</i>							
Price of labor	39.82	36.48	48.25	31.84	39.91	15.56	27.60
Price of physical capital	3.54	3.42	2.39	2.84	3.32	1.29	2.66
<i>Other characteristics</i>							
Total assets	59,097.03	72,402.0	649,358.0	61,386.7	63,146.2	39,671.2	46,464.3
Total cost	150,806.9	167,313.4	1,974,622.3	123,437.7	104,534.4	72,311.3	130,110.6
Equity	20,412.9	27,024.5	228,365.6	17,335.5	18,577.8	17,417.2	20,011.0
Tangibility of assets (in %)	37.31	30.58	43.92	30.99	42.13	46.55	38.93
Ratio of inventory on assets (in %)	19.83	19.89	18.07	20.32	19.62	19.26	16.90
Ratio of current liabilities on total liabilities (in %)	76.11	81.08	48.20	75.62	65.70	72.01	83.14
Leverage (in %)	66.25	63.74	62.02	73.46	65.17	55.23	56.88

The table presents the mean values for each item by country. All values are in thousand euros, except where indicated.

and Zingales (1995) pointed out that the choice of using consolidated data leads to an increase of the indebtedness ratio in the year when a firm moves to consolidate accounts. We limited the analysis to manufacturing companies in order to have a homogenous sample in terms of financial structure. To this end, we selected companies with CSO code between 2000 and 4999.

Our selection of variables includes chosen input prices, input and output quantities for the cost efficiency estimation of cost efficiency frontiers, and control variables for the equation relating inefficiency to explanatory variables. The definition of inputs and outputs for the cost efficiency frontier includes one output (turnover) and two inputs (labor and physical capital). The price of labor is measured by the ratio of personnel expenses to the number of employees. The price of physical capital is defined as the ratio of other operating expenses (including depreciation) on fixed assets. Total cost is the sum of personnel expenses, measuring labor, and other operating expenses, measuring physical capital.

We adopted the Tukey box-plot, based on the use of interquartile range, in order to clean the sample data from outliers. Firms with observations out of the range defined by the first and third quartiles more or less one and half the interquartile range were excluded for the three ratios used in the analysis: price of labor, price of physical capital and leverage. Table I presents some descriptive statistics for our sample. The differences in size between national samples result from the Amadeus database, which might bias the representativeness of the sample. Indeed the number of companies greatly differs among countries. However, due to the absence of any better database providing accounting information on SMEs in Europe, we use this database, keeping in mind its limitations.

We observe that the mean German company is bigger than the mean companies from other countries, suggesting that our German sample has a greater proportion of large companies. We observe relatively strong differences in leverage across countries: while Italian companies are the most leveraged on average (73.46%), Belgian,

French, German and Norwegian companies have very similar mean values between 62.02% and 66.25%. Furthermore, Portuguese and Spanish companies have a lower leverage on average (respectively 55.23 and 56.88%).

Table A in Appendix describes the national samples by sector, according to the two-digit CSO code. Next to a stochastic cost frontier, our model includes an equation relating inefficiencies to leverage and some control variables. The main explanatory variable is *LEVERAGE*, defined as the ratio of total liabilities to total assets. This definition is frequently adopted in the literature on the determinants of leverage (Rajan and Zingales, 1995; Michaelas et al., 1999).

The other explanatory variables are control variables that take size and industry-related factors into account. How large a firm is can be a determinant of performance: large firms can benefit from economies of scale, or they may suffer from problems in coordination. We consequently use a *SIZE* variable, measured by total assets. Industry-related factors are controlled with three variables. *TANGIBILITY* indicates the tangibility of assets and is measured by the ratio of fixed assets to total assets, while *INVENTORY* indicates the share of inventories, as it is the ratio of total inventories to total assets. Additionally, we include a variable to take the term structure of liabilities: *STDEBT*, defined as the ratio of short-term liabilities to total liabilities.

4. The cost efficiency model

We use the Stochastic Frontier Approach to estimate the cost efficiency scores (Aigner et al., 1977). This approach is frequently applied in banking (Berger and Humphrey, 1997), but also in other industries as surveyed by Lovell (1993). In comparison to the alternative technique using single-year efficiency scores, Data Envelopment Analysis, the chosen approach presents the advantage of disentangle the efficiency and a statistical noise taking exogenous events into account in the residual (the distance from the efficiency frontier). It also allows an easier control of the industry-specific variables in the estimation of the efficiency frontier, which is needed

to provide relatively homogenous efficiency measures. We estimate a common cost frontier for the whole sample of countries, rather than national frontiers for each country, to increase the number of observations in the estimation, as some national samples are relatively small relative to the number of parameters in the estimation.

Cost efficiency measures how close a firm's cost is to what a firm's optimal cost would be for producing the same bundle of outputs. It then provides information on wastes in the production process and on the optimality of the chosen mix of inputs. The stochastic cost frontier methodology¹ based on a multiproduct translog cost function is adopted to calculate cost efficiency scores for the firms of each country of our sample.

The basic model assumes that total cost deviates from the optimal cost by a random disturbance, v , and an inefficiency term, u . Thus the cost function is $TC = f(Y, P) + \epsilon$ where TC represents total cost, Y is the vector of outputs, P the vector of input prices and ϵ the error term which is the sum of u and v . u is a one-sided component representing cost inefficiencies, meaning the degree of weakness of managerial performance. v is a two-sided component representing random disturbances, reflecting luck or measurement errors. u and v are independently distributed. v is assumed to have a normal distribution with zero mean and variance σv^2 . u is assumed to have a truncated normal with m mean and variance σu^2 . According to Jondrow et al. (1982), firm-specific estimates of inefficiency terms can be calculated by using the distribution of the inefficiency term conditional to the estimate of the composite error term.

To analyze the relationship between leverage and performance, several techniques have been proposed in the empirical literature. The more straightforward procedure is the so-called "two-stage procedure": the stochastic frontier model is estimated in the first step, while the obtained efficiency scores are regressed on a set of explanatory variables including leverage in the second step. Although easy and commonly used in the literature, there are two important econometric problems with this two-stage

procedure, as observed by Kumbhakar and Lovell (2000). First, it assumes that the efficiency terms are identically distributed in the estimation of the stochastic frontier model of the first step, while in the second step this assumption is contradicted by the fact that the regression of the efficiency terms on the explanatory variables suggests that the efficiency terms are not identically distributed.

Second, the explanatory variables must be assumed as uncorrelated with the variables of the cost frontier function, or else the maximum likelihood estimates of the parameters of the cost frontier function would be biased because of the omission of the explanatory variables in the first stage. But then, the estimated efficiency terms that are explained in the second stage are biased estimates, as they are estimated relative to a biased representation of the cost frontier.

Therefore, we choose to use the “one-stage procedure” proposed by Battese and Coelli (1995), which solves these econometric problems.² They propose a procedure using panel data, in which the non-negative inefficiency term is assumed to have a truncated distribution with different means for each firm. As a result, the distributions of the inefficiency terms are not the same, but are expressed as functions of explanatory variables. The inefficiency terms are then independently but not identically distributed. They are obtained by truncation at zero of the $N(\mu_{it}, \sigma u^2)$ distribution: $\mu_{it} = z_{it} \delta$, where z_{it} is a vector of explanatory variables, and δ a vector of parameters to be estimated.

The estimated model includes then two equations: a cost frontier function specified in Eq. (1), and an equation to explain the inefficiencies specified in Eq. (2). Our sample is composed of companies from various industries. To take this heterogeneity into account in the estimation of the efficiency frontier, we include dummy variables for the industry according to the two-digit CSO code in the cost frontier function. Furthermore, we aim to investigate the influence of the explanatory variables on the inefficiencies in every country of our sample. We consequently include interactive terms for each explanatory variable, jointing the variable with a dummy variable for each country.

The model is then specified as follows:

$$\begin{aligned} \ln\left(\frac{\text{COST}}{p_L}\right)_{it} = & \alpha_0 + \alpha_1 \ln y_{it} + \alpha_2 \ln\left(\frac{p_K}{p_L}\right)_{it} \\ & + \alpha_3 (\ln y_{it})^2 + \alpha_4 \ln\left(\frac{p_K}{p_L}\right)_{it} \ln\left(\frac{p_K}{p_L}\right)_{it} \\ & + \alpha_5 \ln y_{it} \ln\left(\frac{p_K}{p_L}\right)_{it} + \sum \text{CSO} \quad (1) \end{aligned}$$

where i company ($i = 1, \dots, 11836$), t year ($t = 1998, 1999, 2000$), COST total cost, y turnover, p_L = price of labor, p_K = price of physical capital, CSO21–48 industry codes dummy variables.

$$\begin{aligned} \mu_{it} = & \delta_0 + \sum_{k=1}^7 (\delta_{1k} * \text{Leverage}_{it} \\ & * \text{COUNTRY}_k + \delta_{2k} * \text{Tangibility}_{it} \\ & * \text{COUNTRY}_k + \delta_{3k} * \text{Inventory}_{it} \\ & * \text{COUNTRY}_k + \delta_{4k} * \text{STdebt}_{it} * \text{COUNTRY}_k \\ & + \delta_{5k} * \text{Size}_{it} * \text{COUNTRY}_k) \quad (2) \end{aligned}$$

where μ_{it} mean inefficiency, k country (1: Belgium, 2: France, 3: Germany, 4: Italy, 5: Norway, 6: Portugal, 7: Spain), COUNTRY_k dummy variable for the country k ($\text{COUNTRY}_1 = 1$ if country is Belgium, 0 else,...), Leverage, Tangibility, Inventory, STdebt, Size – the tested explanatory variables described above.

We estimate Eqs. (1) and (2) using maximum likelihood procedures with the FRONTIER 4.1 software by Coelli (1996). We then obtain estimates of the parameters α of the cost frontier function, as well as estimates of the coefficients δ of the relationship between inefficiencies and explanatory variables?³

5. Results

The results of the maximum likelihood procedure are presented in Tables II and III. When analyzing the estimates of the equation relating inefficiencies to explanatory variables, the main conclusion is the evidence of differences across

TABLE II
Maximum likelihood estimates (frontier parameters)

Parameter	Coefficient	t-ratio	Parameter	Coefficient	t-ratio
Constant	0.215***	5.980	CSO34	0.017***	4.285
$\ln y$	0.375***	16.590	CSO35	0.095***	6.620
$\ln (p_K/p_L)$	-0.021*	-1.705	CSO36	-0.015	-1.018
$(\ln y)^2$	0.053***	56.032	CSO37	-0.021	-1.611
$(\ln (p_K/p_L))^2$	-0.031***	-17.492	CSO41	0.067***	4.463
$(\ln y) (\ln (p_K/p_L))$	0.020***	17.073	CSO42	-0.059***	-4.767
CSO21	-0.522***	-9.067	CSO43	0.101***	21.696
CSO22	0.014	1.080	CSO44	0.005***	6.053
CSO23	-0.206***	-11.817	CSO45	0.102***	36.824
CSO24	-0.137***	-2.716	CSO46	0.048***	3.753
CSO25	-0.115***	-20.977	CSO47	-0.088***	-41.293
CSO26	0.060**	2.008	CSO48	0.021*	1.948
CSO31	-0.004	-0.474			
CSO32	-0.037***	-4.877			
CSO33	0.092***	4.913			

(i) The dependent variable is the logarithm of total cost normalized by price of labor.

(ii) *, **, *** denote an estimate significantly different from 0 at the 10, 5 or 1% level.

(iii) y = turnover, p_L = price of labor, p_K = price of physical capital, CSO21–48 industry codes dummy variables.

countries on the sign of the relationship between leverage and efficiency. The coefficient of the crossed variable $\text{LEVERAGE} \times \text{CY}$ is significantly negative for four countries of the study (Belgium, France, Germany, Norway). However this coefficient is negative but not significant for Portugal, and significantly positive for Italy and Spain. Consequently, we observe a positive and significant relationship between leverage and efficiency in four countries, while it is negative and significant in Italy and Spain, and finally not significant in Portugal. These diverging results can be related to the different conclusions observed in former single-country empirical studies. Our conclusion then suggests that institutional factors may influence the relationship between leverage and performance.

Which institutional factors can influence this relationship? They undoubtedly include the architecture of the financial system. But we also have to take into account the attributes of the legal system, as La Porta et al. (1997) pointed out the influence of the architecture of the legal system on the external finance and therefore on the financial structure. All countries of the study have bank-oriented financial systems according to the classification of Demirgüç-Kunt and Levine (2000), so the orientation of the financial system cannot ex-

plain the divergence in results. Therefore we consider four institutional characteristics: the access to bank credit for firms, the protection of shareholder rights, the protection of creditor rights, and the efficiency of the legal system. The indicators for these four institutional characteristics are displayed in Table IV.

The first institutional characteristic is *the access to bank credit for firms*. However, they diverge in access to bank credit. It is measured by the ratio of claims of deposit banks on private sector to GDP, provided by Demirgüç-Kunt and Levine (2000). As Table V reveals, we observe a considerable variation for this ratio across countries: Germany and France clearly dominate the sample with respectively 0.94 and 0.89, followed by Spain (0.69). The other countries, that are, in decreasing order, Norway, Belgium, Portugal, and Italy, have closer values. The link between this institutional aspect and the relationship between leverage and performance is based on the following argument: a diminished access to bank credit reduces the possibilities for firms to use indebtedness as a signaling instrument. Consequently, the “signaling argument”, suggesting a positive relationship between leverage and performance, should play a lesser role in countries with a diminished access to bank credit.

TABLE III
Maximum likelihood estimates (efficiency parameters)

Parameter	Coefficient	t-ratio	Parameter	Coefficient	t-ratio
Constant	-0.326***	-16.198	STdebt*Belgium	-0.205***	-10.813
Leverage*Belgium	-0.096**	-2.106	STdebt*France	-0.041***	-2.750
Leverage*France	-0.243***	-9.824	STdebt*Germany	0.331***	15.072
Leverage*Germany	-0.474***	-4.418	STdebt*Italy	-0.188***	-11.865
Leverage*Italy	0.179***	8.514	STdebt*Norway	-0.347***	-13.875
Leverage*Norway	-0.404***	-15.465	STdebt*Portugal	0.336***	10.397
Leverage*Portugal	-0.099	-1.127	STdebt*Spain	0.085***	7.172
Leverage*Spain	0.269***	14.121	Size*Belgium	0.102E-6***	3.432
Tangibility*Belgium	1.316***	26.053	Size*France	0.413E-7***	3.638
Tangibility*France	1.584***	48.616	Size*Germany	-0.373E-8***	-2.742
Tangibility*Germany	1.287***	8.004	Size*Italy	0.890E-7***	14.085
Tangibility*Italy	1.527***	60.842	Size*Norway	0.130E-6***	9.980
Tangibility*Norway	1.769***	56.510	Size*Portugal	-0.841E-6	-1.842
Tangibility*Portugal	1.691***	39.554	Size*Spain	-0.435E-8	-0.190
Tangibility*Spain	1.154***	50.427	σ^2	0.623***	522.701
Inventory*Belgium	0.262**	2.556	γ	0.183**	2.246
Inventory*France	0.121**	2.591	log <i>L</i>	-2224.320	
Inventory*Germany	0.476***	5.778			
Inventory*Italy	0.445***	129.955			
Inventory*Norway	0.383***	4.808			
Inventory*Portugal	0.479***	12.641			
Inventory*Spain	0.386***	18.753			

(i) The explained variable is the cost inefficiency mean.

(ii) Leverage ratio of total liabilities to total assets, Tangibility ratio of fixed assets to total assets, Inventory share of inventories in total assets, STdebt, ratio of short-term liabilities to total liabilities, Size total assets.

(iii) *, **, *** denote an estimate significantly different from 0 at the 10%, 5% or 1% level.

$$\sigma^2 = \sigma u^2 + \sigma v^2, \sigma = \sigma u^2 / (\sigma u^2 + \sigma v^2)$$

TABLE IV
Institutional indicators

	Shareholder rights index	Creditor rights index	Efficiency of the legal system	Access to bank credit
Belgium	0	2	10	0.56
France	3	0	8.98	0.89
Germany	1	3	9.23	0.94
Italy	1	2	8.33	0.52
Norway	4	2	10	0.57
Portugal	3	1	8.68	0.54
Spain	4	2	7.80	0.69

Shareholder rights and creditor rights indices are obtained from La Porta et al. (1998). Indices on the efficiency of the legal system represent the "rule of law" variable also displayed in La Porta et al. (1998). Indices for access to bank credit represent the ratios of claims of deposit banks on private sector divided by GDP. They are extracted from Demirgüç-Kunt and Levine (2000)

We find limited evidence in favor of this hypothesis. On the one hand, both countries with the lowest access-to-credit ratio do not have a significantly positive relationship between leverage and performance, as this link is significantly negative for Italy and not significant for Portugal.

Furthermore, the country with the highest access-to-credit ratio – Germany – has the highest significantly positive coefficient for the LEVERAGE variable. These elements tend to support the role of the access to bank credit on the relationship between leverage and performance.

TABLE V
Descriptive statistics on efficiency scores

	Belgium	France	Germany	Italy	Norway	Portugal	Spain
N	1279	3029	314	4403	409	90	2312
Minimum	36.57	35.07	46.99	26.82	15.97	30.65	34.39
Mean	90.43	90.62	81.65	79.77	86.83	50.25	67.20
Standard deviation	13.30	13.23	14.28	14.27	15.50	11.15	11.33
Maximum	100.00	100.00	100.00	100.00	100.00	99.72	99.22

We present here the statistics for average efficiency scores over the 3 years.

Nevertheless, there is the special case of Spain with an average access-to-credit ratio relative to the other countries of our sample, but also with a negative relationship between leverage and performance. This institutional factor may then be considered as a possible explanation for the observed differences on the link between leverage and performance across countries.

The second institutional characteristic concerns *the protection of shareholder rights*. We use the index developed by La Porta et al. (1998) to proxy this aspect. This index is scored on a scale from 0 to 6, increasing with the level of protection. It takes six dimensions of the protection of shareholder rights into account. Within the sample, there is a wide variation in the protection of shareholder rights: the shareholders are well-protected in Norway and Spain (with an index equal to 4) and also in France and Portugal (3). The protection is clearly weaker in Germany and Italy (1) and even less in Belgium (0).

The protection of shareholder rights may indeed influence the link between leverage and performance, as well-protected shareholders are less concerned about managers' behavior. Consequently, the "free cash-flow argument" resulting from the conflict of interest between shareholders and managers plays a lesser role. We should then observe a diminished positive influence of leverage on performance in countries where shareholders are well-protected. Our results, however, do not corroborate this assumption. On the one hand, both countries with the best protection of shareholder rights (Norway and Spain) have opposite links between leverage and performance, respectively positive and negative. On the other hand, we also observe a negative relationship in Italy,

where there is one of the weakest protection of shareholder rights in our sample. Therefore, the protection of shareholder rights does not offer an explanation for the diverging results about the link between leverage and performance.

The third institutional characteristic concerns *the protection of creditor rights*. We use again here an index developed by La Porta et al. (1998) to proxy this aspect. This index is scored on a scale from 0 to 4 with a higher score for better protection. It considers four aspects of the protection of creditor rights. The countries in our sample exhibit various degrees of protection of creditor rights: Germany owns the most protective legal system with an index of 3, followed by four countries with an index of 2 (Belgium, Italy, Norway, Spain). Protection is weaker in Portugal and even worse in France with indices respectively equal to 1 and 0. The influence of the protection of creditor rights on the link between leverage and performance relies on the moral hazard issues coming from the conflicts of interest between shareholders and creditors. Well-protected creditors have more power in face of shareholders, which can help to reduce moral hazard problems. Therefore, the negative influence of leverage on performance, resulting from the divergence of interests between shareholders and creditors, should be lower in countries with a better protection of creditor rights.

Nevertheless, we find no evidence to support this hypothesis. Indeed creditors have the same degree of protection of their rights in Belgium, Norway, Italy and Spain. However, the relationship between leverage and performance is significantly positive in both former countries whereas it is significantly negative in both latter countries. Thus, the variations in the protection

of shareholder rights across countries do not seem to provide explanations for the observed differences in the sign of the link between leverage and performance.

Finally, a fourth institutional characteristic is *the efficiency of the legal system*. We proxy this item by using the “rule of law” variable from La Porta et al. (1997). This index assesses the quality of law enforcement, according to the opinion of investors. It is scaled from 0 to 10, with higher scores for more efficient legal systems. Variations within our sample are lower for this characteristic than for the other analyzed institutional characteristics: Belgium and Norway own the most efficient legal systems (index equal to 10), followed in decreasing order by Germany (9.23), France (8.98), Portugal (8.68), Italy (8.33) and Spain (7.80). A more efficient legal system means better protection for both shareholder and creditor rights, which should increase the relevance of the aforementioned assumptions on the role of more protection of shareholder and creditor rights. Consequently, a more efficient legal system should exert two opposite effects on the relationship between leverage and performance. We assume however that the dominant effect is the impact of the efficiency of the legal system on the protection of creditor rights. This hypothesis is motivated by the fact that all countries in our sample have bank-oriented financial systems, according to Demirgüç-Kunt and Levine (2000), which attaches greater importance to the protection of creditor rights – including banks’ rights – than to the protection of shareholder rights.

As a result, the influence of this characteristic on our main question is based on the fact that an efficient legal system may reduce moral hazard problems, as the rules for the protection of creditor rights are more effective. Consequently, the negative influence of leverage on performance should be lessened in countries with a more efficient legal system. The efficiency of the legal system seems to be a key for the interpretation of our diverging results for the relationship between leverage and performance. Indeed, the three countries with the least efficient legal systems are, in descending order, Portugal, Italy and Spain. Namely, these are the three countries of our sample in which we do not observe a

positive and significant relationship between leverage and performance. As a consequence, the efficiency of the legal system may explain our results on the relationship between leverage and performance.

In summary, it appears from our analysis of the institutional characteristics and their influence on the link between leverage and performance that two factors, the access to bank credit for firms and the efficiency of the legal system, may explain the diverging results of the sign of the leverage in our regressions. Indeed, the access to bank credit may weaken the “signaling argument” that supports a positive link between leverage and corporate performance, while the efficiency of the legal system is able to exert a reduction in the moral hazard problems that favor a negative link.

Regarding the other control variables, we observe that there is a negative link between efficiency and TANGIBILITY in all countries. This result can be the consequence of the industry-specific influences: indeed firms from industries with the lower tangibility ratios can be on average more efficient. An alternative explanation based on cash management can however be suggested: a higher tangibility of assets means a lower working capital and consequently a lower net cash position. Consequently, if we consider that cash management reflects the managerial ability to lead a company, it can then be argued that tangibility of assets should be negatively linked to managerial performance. We also observe a negative relationship between efficiency and INVENTORY in all countries. This result can also be explained in terms of industry-specific influences.

Finally, the influence of both other variables varies depending on two groups of countries. STDEBT is significantly linked positively to efficiency in Belgium, France, Italy and Norway, and negatively in Germany, Portugal and Spain. The results are quite the opposite for SIZE, with a negative link with efficiency in the same four former countries, but a positive and significant one in Germany, and a not significant relationship in Portugal and Spain. These differences can also result from discrepancies in the compositions of the samples in terms of industries or size.

In Table V, we present main descriptive statistics for the average efficiency scores during the period. Mean efficiency scores are very different with a range from 50.25% for Portugal to 90.62% for Germany, suggesting the existence of large differences in corporate performance across countries. We also observe very close dispersions of scores with standard deviations between 11.15 and 15.50 points.

6. Concluding remarks

The research presented here has provided new evidence on the relationship between leverage and corporate performance. We use frontier efficiency scores to measure performance to evaluate this issue in seven European countries. We observe that the relationship between leverage and corporate performance varies across countries. Indeed the sign of this link is

significantly positive in five countries, but significantly negative in Italy and not significant in Portugal. These different results tend to support the impact of the institutional framework on this relationship. We then study the possible influence of institutional characteristics. Our analysis suggests that two factors may exert an influence: the access to bank credit for firms, and the efficiency of the legal system.

In normative terms, our results then support different implications according to the institutional framework of the country. In most countries, we provide arguments against policies promoting equity, with the exception of Italy. Our results should, however, be considered with care as this issue needs further analysis to evaluate the importance of each theoretical argument in connection with the institutional characteristics. The empirical analysis should thus be extended to a larger number of countries. It should also

Appendix

TABLE A: Sample breakdown for industries

	Bel	Fr	Ger	It	No	Por	Sp
CSO 21 (extraction and preparation of metalliferous ores)	1	1	0	2	0	0	3
CSO 22 (metal manufacturing)	41	89	18	154	24	3	81
CSO 23 (extraction of other minerals)	18	39	1	11	7	1	30
CSO 24 (manufacture of non-metallic mineral products)	95	142	20	266	19	9	193
CSO 25 (chemical industry)	99	349	45	364	23	8	228
CSO 26 (production of man-made fibres)	10	3	3	11	0	1	8
CSO 31 (manufacture of metal goods)	105	257	20	388	18	5	209
CSO 32 (mechanical engineering)	128	399	63	733	58	5	165
CSO 33 (manufacture of office machinery and data processing))	7	16	6	15	3	0	2
CSO 34 (electrical and electronic processing)	77	258	26	368	21	7	132
CSO 35 (manufacture of motor vehicles and parts)	29	98	18	110	3	3	124
CSO 36 (manufacture of other transport equipment)	12	54	4	54	20	1	30
CSO 37 (instrument engineering)	17	60	6	54	4	0	21
CSO 41 (food, drink and tobacco manufacturing industries: part 1)	120	255	5	293	74	4	257
CSO 42 (food, drink and tobacco manufacturing industries: part 2)	118	180	33	200	14	5	207
CSO 43 (textile industries)	94	115	7	330	11	18	112
CSO 44 (manufacture of leather and leather goods)	3	12	0	71	1	0	13
CSO 45 (footwear and clothing industries)	22	100	3	245	5		54
CSO 46 (timber and wooden furniture industries)	57	112	2	191	42	1	79
CSO 47 (manufacture of paper and paper products)	119	265	17	236	46	5	195
CSO 48 (processing of rubber and plastics)	101	190	10	266	12	5	151
CSO 49 (other manufacturing industries)	6	35	7	41	4	0	18

All scores in percentage.

Bel: Belgium, Fr: France, Ger: Germany, It: Italy, Por: Portugal, Sp: Spain.

proceed to Granger-causality tests to analyze the causality between leverage and corporate performance to evaluate the informative power of each theory on the link between leverage and performance. However, this would require data over a long period, in order to have enough data to perform this analysis.

Notes

¹ See Kumbhakar and Lovell (2000) for further details on Stochastic Frontier Analysis.

² See Wang and Schmidt (2002) for more details on the one-step and two-step procedures to explain efficiency terms.

³ The multicollinearity between the explained variables is tested through the estimation of the condition index of Besley et al. (1980). We measure this index for each year of our estimation. We then obtain values between 19.50 and 20, meaning a moderate multicollinearity for our estimations.

References

- Aigner, D., C. A. K. Lovell and P. Schmidt, 1977, 'Formulation and Estimation of Stochastic Frontier Production Function Models', *Journal of Econometrics* **6**, 21–37.
- Battese, G. and T. Coelli, 1995, 'A Model for Technical Inefficiency Effects in a Stochastic Frontier Production Function for Panel Data', *Empirical Economics* **20**(2), 325–332.
- Berger, A. and D. Humphrey, 1997, 'Efficiency of Financial Institutions: International Survey and Directions for Future Research', *European Journal of Operational Research* **98**, 175–212.
- Besley, D., E. Kuh and R. Welsch, 1980, *Regression Diagnostics: Identifying Influential Data and Sources of Collinearity*, New York: Wiley.
- Charnes, A., W. Cooper and E. Rhodes, 1978, 'Measuring Efficiency of Decision Making Units', *European Journal of Operations Research* **6**, 429–444.
- Chittenden, F., G. Hall and P. Hutchinson, 1996, 'Small Firm Growth, Access to Capital Markets and Financial Structure: Review of Issues and an Empirical Investigation', *Small Business Economics* **8**(1), 59–67.
- Coelli, T., 1996, 'A Guide To FRONTIER Version 4.1: A Computer Program for Stochastic Production and Cost Function Estimation', Centre for Efficiency and Productivity Analysis, University of New England, Working Paper 96/07.
- Corbett, J. and T. Jenkinson, 1994, 'The Financing of Industry, 1970–89: An International Comparison', CEPR Discussion Paper 948.
- Demirgüç-Kunt, A. and R. Levine, 2000, 'Bank-Based and Market-Based Financial Systems: Cross-Country Comparisons', World Bank Working Paper 2143.
- Grossman, S. and O. Hart, 1982, 'Corporate Financial Structure and Managerial Incentives', in J. McCall (eds.), *The Economics of Information and Uncertainty*, Chicago: University of Chicago Press.
- Jensen, M., 1986, 'Agency Costs of Free Cash Flow, Corporate Finance, and Takeovers', *American Economic Association Papers and Proceedings* **76**, 323–329.
- Jensen, M. and W. Meckling, 1976, 'Theory of the Firm: Managerial Behavior, Agency Costs, and Capital Structure', *Journal of Financial Economics* **76**, 323–339.
- Johnson, S., 1997, 'An Empirical Analysis of the Determinants of Corporate Debt Ownership Structure', *Journal of Financial and Quantitative Analysis* **32**(1), 47–69.
- Jondrow, J., C. A. K. Lovell, I. Materov and P. Schmidt, 1982, 'On the Estimation of Technical Inefficiency in the Stochastic Frontier Production Function Model', *Journal of Econometrics* **19**, 233–238.
- Kinsman, M. and J. Newman, 1999, 'Debt Level and Corporate performance: An Empirical Analysis', Proceedings of the 28th Annual Meeting of the Western Decision Sciences Institute, April 6–10, 1999, Mexico: Puerto Vallarta.
- Kumbhakar, S. and C. A. K. Lovell, 2000, *Stochastic Frontier Analysis*, Cambridge University Press.
- La Porta, R., F. Lopez-De-Silanes, A. Shleifer and R. Vishny, 1997, 'Legal Determinants of External Finance', *Journal of Finance* **LII**(3), 1131–1150.
- La Porta, R., F. Lopez-De-Silanes, A. Shleifer and R. Vishny, 1998, 'Law and Finance', *Journal of Political Economy* **106**, 1113–1155.
- Leland, H. and D. Pyle, 1977, 'Information Asymmetries, Financial Structure and Financial Intermediation', *Journal of Finance* **32**, 371–387.
- Lovell, C. A. K., 1993, 'Production Frontiers and Productive Efficiency', in H. Fried, C. A. K. Lovell and P. Schmidt (eds.), *The Measurement of Productive Efficiency: Techniques and Applications*, London: Oxford University Press, 3–67.
- Majumdar, S. and P. Chhibber, 1999, 'Capital Structure and Performance: Evidence from a Transition Economy on an Aspect of Corporate Governance', *Public Choice* **98**, 287–305.
- Michaelas, N., F. Chittenden and P. Poutziouris, 1999, 'Financial Policy and Capital Structure Choice in U.K. SMEs: Empirical Evidence from Company Panel Data', *Small Business Economics* **12**, 113–130.
- Modigliani, F. and M. Miller, 1958, 'The Costs of Capital, Corporate Finance, and the Theory of Investment', *American Economic Review* **48**, 433–443.
- Myers, S., 1977, 'Determinants of Corporate Borrowing', *Journal of Financial Economics* **5**, 147–175.
- Nickell, S., D. Nicolitsas and N. Dryden, 1997, 'What Makes Firms Perform Well?', *European Economic Review* **41**, 783–796.
- Nickell, S. and D. Nicolitsas, 1999, 'How Does Financial Pressure Affect Firms?', *European Economic Review* **43**, 1435–1456.
- Pushner, G., 1995, 'Equity Ownership Structure, Leverage and Productivity: Empirical Evidence from Japan', *Pacific-Basin Finance Journal* **3**, 241–255.

- Rajan, R. and L. Zingales, 1995, 'What Do We Know about Capital Structure? Some Evidence from International Data', *Journal of Finance* **50**, 1421–1460.
- Ross, S., 1977, 'The Determination of Financial Structure: The Incentive Signalling Approach', *Bell Journal of Economics* **8**, 23–40.
- Stiglitz, J. and A. Weiss, 1981, 'Credit Rationing in Markets with Imperfect Information', *American Economic Review* **71**(3), 393–410.
- Van der Wijst, N. and R. Thurik, 1993, 'Determinants of Small Firm Debt Ratios: An Analysis of Retail Panel Data', *Small Business Economics* **5**, 55–65.
- Wang, H. and P. Schmidt, 2002, 'One-Step and Two-Step Estimation of the Effects of Exogenous Variables on Technical Efficiency Levels', *Journal of Productivity Analysis* **18**, 129–144.

Copyright of *Small Business Economics* is the property of Springer Science & Business Media B.V. and its content may not be copied or emailed to multiple sites or posted to a listserv without the copyright holder's express written permission. However, users may print, download, or email articles for individual use.

Copyright of *Small Business Economics* is the property of Springer Science & Business Media B.V. and its content may not be copied or emailed to multiple sites or posted to a listserv without the copyright holder's express written permission. However, users may print, download, or email articles for individual use.