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THE IMPACT OF CAPITAL STRUCTURE ON FIRMS' INNOVATIVE PERFORMANCE

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ABSTRACT

This paper aims at investigating the relationship between firms' capital structure and innovative performance for a group of EU countries. The analysis is carried out on data taken from the EU-Efige Survey, enriched with accounting data retrieved from the Amadeus Database (Bureau Van Dijk). We consider different measures of innovative performance, specifically R&D expenditure on total sales, product or process innovation and patenting activity. The capital structure of the firms is evaluated through different debt ratios, such as short-term debt ratio, long term debt ratio and total debt ratio, as well as the debt to equity ratio, the equity to total assets ratio, the corporate shareholding ratio and the manager shareholding ratio. We also include a set of control variables commonly employed in the empirical literature as determinants of firm innovative performance. The empirical analysis is a work in progress. Policy implications conclude the paper.

Keywords: R&D; innovation; patent; capital structure; probit model.
JEL code: D22, L60, C20, O3.

Introduction

Capital structure and its effects on firm performance is a fundamental issue in finance and several theories have tried to explain this linkage. The capital structure of a company denotes its funding source and the combination of equity and debt that it holds. The funding sources can be internal and external. The supply of external capital, via debt and equity financing, is uncertain and can be limited. Therefore, the access to internal capital can be a source of competitive advantage (Barney, 1991; Wang and Thornhill, 2010).

Debt and equity have different implications for the governance of a company (Williamson, 1988). Debtholders can take control over the firm's assets only if it defaults or violates specific debt contracts. Conversely, large shareholders can directly intervene in the management policy. Debt financing is also less expensive than equity financing mainly due to agency costs and tax effects

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(Myers and Majluf, 1984). Debt financing tends, likewise, to lessen overinvestment, which helps managers to gain compensation and power, but generates no value for shareholders. To hold large debts, however, may create financial distress and increase the risk of default (Wruck, 1990). Therefore, the amount of debt that a firm raises reflects its risk-return preferences and strategic decisions (Wang and Thornhill, 2010).

One of the most important strategic decisions regards the firm's capacity to innovate through new processes or products. In this context, the present study aims at examining how a firm's innovative performance can be affected by the company's funding sources. Indeed, strategic investments often involve large capital expenditures that are beyond a firm's ordinary operating cash flows. Hence, we aim at evaluating if and to what extent a firms' innovative performance is associated with its capital structure.

The rest of the paper is organized as follows. Section 1 presents the literature review. Section 2 describes the empirical design and method. Section 3 presents and discusses the results. The final section offers conclusions and suggestions.

1. Literature Review

The relation between capital structure and firm performance has a long history. Generally, the capital structure refers to a company's funding sources for its assets and particularly the mix of equity and debt. The composition of equity and debt appears on the liability side of company's balance sheet. Indeed, the firms could use internal sources of financing, such as retained earnings and share issuing, or external sources, for instance, loans and bonds. A company is unleveraged if only equity is used, while a mixture of equity and debts involve a leveraged company. In addition, there is another type of capital called hybrid instruments which has some features of both equity and debts (Stulz, 1990). Gitman and Zutter (2012) also stated the definition of capital structure[4] as the mix of long-term debt and equity retained by a firm.

Modigliani–Miller (M&M) theory (Modigliani and Miller, 1958), considered as the fundamental theory of capital structure, theorizes that a firm's value and its investment decisions are not influenced by its capital structure. In particular, a firm's value is determined by its own assets, not by the proportion of debt or equity issued. Thus, any mixture of debt and equity does not affect a firm's value. However, this theory is based on the restrictive assumptions of perfect capital markets,

[4] Capital structure and financial structure are differentiated by the fact that a firm's financial structure is represented through a lot of means of raising funds whereas the level of long-term debts of equity is known as capital structure of a company (Pandey, 1999).

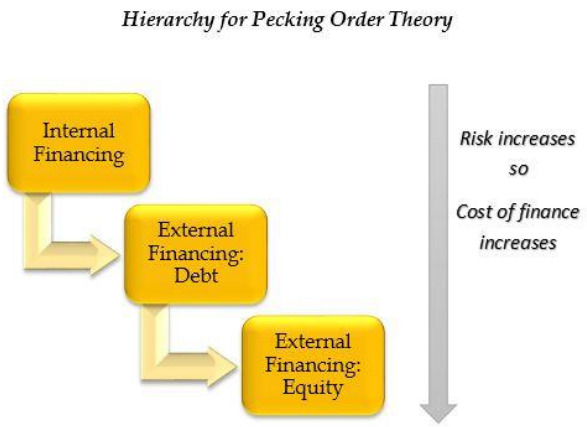
perfect information, no transaction costs and no taxes that are not verified in the real world. Few years later, Modigliani and Miller (1963) 'corrected' their stance by relaxing the assumption of a tax-free world. When the tax deductibility of interest payments enters the model, the value of the firm increases with leverage.

To account for imperfect markets, a set of theories have been proposed as alternatives to M&M theory, namely: the static and dynamic trade-off theory, the pecking order theory, the agency theory, the signalling theory and the market timing theory.

The static trade-off theory (Kraus and Litzenberger, 1973; Myers, 1984) states that a firm will trade-off costs and benefits of debt to maximize firm value. The benefit of debt primarily comes from the tax shield of decreasing income through paying interest (Miller and Modigliani, 1963). Put differently, the tax benefit stems from the fact that interest payment on debts will decrease the taxable income of the company. The cost of debt is derived from direct and indirect bankruptcy costs through the increase in financial risk (Kim, 1978; Kraus and Litzenberger, 1973). Briefly, this theory postulates that the value of a firm with debt is equal to that of a firm without debt plus tax shield after deducting financial distress costs. The dynamic trade-off theory sets-up a multi-period model in which the optimal capital structure of a firm changes over time and expectations and adjustments play an important role (Fischer E.O, Heinkel R & Zechner J, 1989).

The pecking order theory (Myers and Majluf, 1984; Ross, 1977) claims that financing follows a specific hierarchy: internal financing, such as retained earnings, is used first, then debt is issued, and equity is issued when no more debt can be approached. This means that firms will fund new projects initially with internal funds, and will seek external funds only when available internal funds are exhausted. If they cannot access to internal funds, firms will prefer debt over equity. The hierarchy for pecking order is shown in figure 1. It is clear that along with the hierarchy, the risks, as well as, the costs of financing increase.

Figure 1 The Hierarchy for pecking order theory



The agency theory, developed by Jensen and Meckling (1976), Jensen (1986) and Hart and Moore (1994), argues that the optimal capital structure to maximize firm value is the one which minimizes conflicts of interest among stakeholders, managers and debt holders. The conflict between managers and shareholders implies that managers try to achieve their personal goals instead of maximising the firm's value and shareholders' returns. For example, with an excess free cash flow, managers have opportunities to invest in non-profitable projects for personal objectives.

The signaling theory developed by Ross (1977), suggests that the choice of debt/equity level of a firm will result in a signal to the market. Indeed, managers will service debts first in case of firm undervaluation and conversely, equity would be issued if the firm is overvalued. The reason for this action is that a firm only issues additional equity if the stock price is greater than its true value and this issuance also give investors a negative signal which could reduce the share's price (AbuTawahina, 2015). In contrast, debt creation gives a positive signal that a company is confident with its future cash flow and will be able to repay the interests and principal value. In addition to debt and equity issuing, investors can also consider other financial signals such as dividends paying, stock repurchase, announcement of a merger or acquisition, announcement of a tender offer and announcement of a spin off (Markopoulou and Papadopoulos, 2009).

Similar to the signaling theory, the market timing theory suggests to issue equities when the stock price is perceived to be overvalued. However, after that, the company will buy back their own share if it is undervalued. Consequently, the capital structure of the firm is affected by the past market valuation of securities (Baker and Wurgler, 2002).

The capital structure theories are summarized in table 1.

Table 1 Capital structure theories

Capital structure theories	**Main Features**
Modigliani-Miller theorem	Changes in capital structure have no long-term effects on the value of the firm. Financing and investment decisions are separate areas (Irrelevance of capital structure).
Agency theory	There are two types of agency conflicts: shareholders versus managers, shareholders versus debtholders. The optimum debt/equity level is achieved at the point where the total agency cost is minimized.
Static trade-off theory	The optimal capital structure ratio balances the benefit of the interest tax shield and the bankruptcy cost of debt creation.

Dynamic trade-off theory	The optimal debt/equity level will be adjusted in a range in the long term.
Perking order theory	This theory does not suggest an optimal capital structure. The hierarchy is internal financing, external financing-debt and then external financing-equity.
Signaling theory	The choice of capital structure gives a signal to the market. When the firm is undervalued, debt issue is suggested and vice versa, equity is issued in case of firm overvaluation.
Market timing theory	When the stock price is overvalued, the firm should issue equity. However, if there is undervaluation, buying back shares will be suggested.

Source: own elaborations

The literature related to the linkage between capital structure and R&D investment versus fixed investment is less voluminous. R&D investments differ from fixed investments for the characteristic of intangibility and the high degree of uncertainty associated with their output. The typical asymmetric information between firms and investors becomes even more relevant in the R&D setting for two reasons. Since investors have more difficulty to distinguish between good and bad projects, the "lemon premium" for R&D is higher than traditional investments.

In addition, the reduction of asymmetric information through complete disclosure is of limited effectiveness in the case of R&D investments since creative ideas can be easily replicated. For these reasons, firms will face an even higher cost of external than internal capital for R&D, as opposed to ordinary investment (Hall 2002; Cosh, Cumming, and Hughes 2009; Hall and Lerner 2010; Mina, Lahr, and Hughes 2013).

The question whether debt or equity should be preferred by R&D intensive firms is rather more complicated. According to Carpenter and Petersen (2002), Brown, Fazzari, and Petersen (2009) using equity finance instead of debt has several advantages for high-tech firms in the US. Aghion et al. (2004) and Wang and Thornhill (2010) find a nonlinear relationship between the debt/asset ratio and the firm's R&D profile. Firms with both high R&D and those with zero R&D tend to use less debt finance than firms with positive but less intensive R&D. According to Aghion and Bolton (1992) and Aghion et al. (2004) when the size or scope of the investment becomes sufficiently large and when assets become sufficiently intangible there is an incentive for firms to allocate fuller control rights to outside investors by issuing equity.

2. Data and Methodology

2.1 Data

To evaluate the impact of capital structure on firms' innovative performance, we collected data from the latest EU-Efige Survey, enriched with accounting data retrieved from the Amadeus Database (Bureau Van Dijk). The data consist of a representative sample – at the country level and for manufacturing industry – of almost 15,000 firms in seven European countries (Germany, France, Italy, Spain, United Kingdom, Austria and Hungary). Firms' research and innovative activity, as well as their capital structure, are observed over the most recent available years.

2.2 The Variables and the Empirical Model

The response variable of our analysis is dichotomous; hence, we estimate a probit model. More specifically, we assume that each firm is characterized by a latent propensity to innovate, denoted as y_i^* and generated by the following process:

$$y_i^* = \beta' X_i + u_i$$

where the set of regressors *X* includes firm capital structure, as well as the other controls described below. Assuming that a firm innovates when $y_i^* > 0$, and specifying an indicator function y_i, such that:

$$y_i = 1 \; if \; y_i^* > 0$$

$$y_i = 0 \; if \; y_i^* \leq 0$$

the probability to innovate is the probability that the latent propensity is larger than zero:

$$Pr(y_i = 1|X_i) = Pr(y_i^* > 0|X_i) = Pr(\beta' X_i + u_i > 0|x_i) = Pr(u_i > -\beta' X_i|x_i) = F(\beta' X_i)$$

Using the cumulative distribution function of the standard normal distribution, Φ, for $F(\beta' X_i)$ and specifying the *X* vector yields our estimating probit model[5]:

$$Pr\big(INN_{i,t} = 1\big|X\big) = \Phi\big(\beta_0 + \delta CS_{i,t-1} + \phi CTRL_{i,t-1}\big) \qquad (1)$$

where the dichotomous variable *INN* is coded 1 if firm *i* innovates in the considered year, 0 otherwise. We consider different measures of innovative activity for the variable *INN*, namely R&D investment, product or process innovation and patenting activity. More specifically, as an indicator

[5] Choosing the logistic distribution function (i.e., the logit model) would not affect our results.

of research activity we use the ratio of R&D expenditure to total sales. As a measure of innovation output, we consider whether the firm carries out any product or process innovation. By product innovation we mean the introduction of a good which is either new or significantly improved with respect to its fundamental characteristics (innovation is meant to be new to the firm, not necessarily to the market). By process innovation we refer to the adoption of a production technology which is either new or significantly improved (again, innovation is new to the firm, but the firm should be not the first to introduce this process). Finally, we also consider firms' patenting activity as innovation output.

On the right-hand side, the probability to innovate is defined as a function of capital structure (*CS*) and a set of control variables commonly employed in the empirical literature as determinants of a firm's innovative performance.

In our model, the main explanatory variable is given by the capital structure of the firms, measured through different debt ratios, such as short-term debt ratio (STDR) computed as short-term debt over total assets (Mohohlo, 2013; Kausar et al. 2014; Saifadin, 2015), long term debt ratio (LTDR) calculated as long-term debt to total assets, total debt ratio (TDR) which is the ratio between the sum of short-term and long-term debt to total assets. A negative impact of short-term and long-term debt ratios on firm profitability has been found in many previous studies; however, in some papers, no statistical relationship has been found. Apart from the previous three leverage ratios, we also include as explanatory variables, the equity to total assets ratio and cash-flow to total assets ratio.

Other firms' characteristics are included as control variables namely:

- The size of the company (SIZE), measured by the natural logarithm of total assets (Frank & Goyal, 2003; Shen 2012; Javed et al. 2014). According to previous works (Beck et al. 2005, among others), firms' size significantly associates with their performance. In comparison with small firms, larger size firms would tend to have better diversification, economy of scales, capacities and resources (Frank and Goyal, 2003). Hence, we expect a positive impact of firm size on innovative performance of firms.

- The age of the firm (AGE), measured by the number of years since its foundation. Previous studies obtain conflicting results on the impact of age on firm performance. On one side, it is argued that by utilizing their reputation, larger market shares, customers' loyalty and distribution channels, older firms could generate more sales, be more profitable and innovative (Graham and Harvey, 2001; Mahajan and Singh, 2013). On the other side, Stephen (2012) argues that the firm becomes obsolete when it gets older, so facing

difficulties to adopt the requested changes in the business environment. Therefore, the old firm could also be less productive due to its potential inflexibility.

- The propensity to export (EXP), measured by a dummy variable that takes value 1 if the company sells its products abroad 0 otherwise. We expect a positive relationship between export propensity – a signal of firm dynamism – and firm innovative performance.
- The number of high skilled workers (HSW).
- The total factor productivity (TFP).

Finally, the set of control variables also include country and industry dummies[6].

3. Empirical Results

Table 2 shows the estimation results of the probit regression. The positive effects indicate that a rise in each explanatory variable increases the probability of generating innovation activities, distinguished in three components: R&D expenditures, process and/or product innovations and patenting. We report a baseline and an extended estimation for each innovation activity. In particular, an increase in the cash flow ratio by a unit rises the probability of R&D by approximately 0.03, the probability of product or process innovation by about 0.08 and the probability of patenting by 0.06 for the baseline model. The results are similar for the extended model. The long term debt ratio is always significant for all estimations and significantly nurtures the probability of innovation activities. The short term debt ratio does not influence the probability of patenting, but affects the expenditure in R&D and product or process innovation.

The equity ratio is statistically significant only for the variable R&D. This indicates that generally the decision to "go public" on the stock market does not modify the innovation decisions of the companies. With reference to explanatory variables controlling for company characteristics, the size of the company, measured by the total assets, is always significant and increases the probability of innovation. This finding is in line with Schumpeter's idea according to which large companies have a greater propensity to innovate than small companies.

[6] To preserve the anonymity of the surveyed firms, the EFIGE dataset provides information on industrial sectors in the form of a *randomised identifier* ranking from 1 to 11, these values not mapping any particular ordering of the original data.

Table 2 Probit Estimations

Variables	R&D	Product/ Process innovation	Patents	R&D	Product/ Process innovation	Patents
	baseline	baseline	baseline	extended	extended	extended
ln Cash Flow	0.030*	0.078***	0.061***	0.046*	0.076***	0.071**
	0.018	*0.018*	*0.023*	*0.026*	*0.026*	*0.034*
ln STDR	0.085**	0.077**	0.033	0.122**	0.124**	0.086
	0.033	*0.032*	*0.039*	*0.048*	*0.049*	*0.063*
ln LTDR	0.055***	0.064***	0.051***	0.090***	0.087***	0.077***
	0.014	*0.014*	*0.018*	*0.018*	*0.018*	*0.025*
ln equity/total asset	0.045*	0.012	0.045	0.061*	0.007	0.054
	0.025	*0.025*	*0.032*	*0.033*	*0.033*	*0.046*
ln AGE	0.080***	0.059**	0.012	0.047	0.056	-0.054
	0.030	*0.030*	*0.036*	*0.041*	*0.041*	*0.050*
ln total assets	0.307***	0.284***	0.315***	0.365***	0.327***	0.363***
	0.041	*0.041*	*0.049*	*0.059*	*0.060*	*0.077*
Exporter				0.541***	0.390***	0.563***
				0.045	*0.045*	*0.070*
high skilled				-0.027	0.061	0.191**
				0.075	*0.076*	*0.098*
total factor productivity				0.039	0.011	-0.006
				0.050	*0.051*	*0.063*
constant	-1.747***	-1.093**	-2.817***	2.364	2.376	-2.682***
	0.383	*0.441*	*0.375*	*153.993*	*155.200*	*0.681*
country effects	yes	yes	yes	yes	yes	yes
sector effects	yes	yes	yes	yes	yes	yes
Number of obs	7,523	7523.000	7522.000	4,506	4,506	4,505
LR chi2(22)	774.04	421.500	636.570	598.8	308.58	410.96
Prob > chi2	0	0	0	0	0	0
Pseudo R2	0.0766	0.044	0.1025	0.0977	0.0543	0.1148
Log likelihood	-4665.654	-4576.592	-2787.017	-2765.177	-2687.510	-1584.612

Note: standard errors in italics* $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$

The age of the company does not always influence the capacity for creating additional innovation. Likewise, a unit increase in qualified employees does not have any influence on the probability of creating R&D and product and/or process innovations, but it tends to increase the probability of generating more patents. A significant factor that leads to more innovative activities is the propensity of the company to export. Conversely, the productivity growth does not influence the capacity of creating additional innovation.

In brief, the results show that there is a positive relationship between the input and output of innovative performance and the size of the company, its export propensity, the long-term debt ratio and cash flow. It is particularly interesting to notice that the significance of cash flow variable would indicate that a large availability of internal financial sources could foster innovative

activities. Given that R&D and other innovative activities require substantial financial investments, a lack of financial means could hinder innovation (Hyytinen and Toivanen, 2005).

4. Conclusions

It is well known that innovative activities are an engine of economic growth and welfare; moreover, they are very important factors to generate economic progress, strategic changes and competitiveness both for developed and developing economies. Investments in innovations are important for firms and nations to compete for the future and to secure competitive advantage in an increasingly globalized and uncertain economic environment. Starting from this premise, the present study has investigated the extent to which the capital structure of a company and other specific firm factors affect the probability to innovate. Innovative activities have been distinguished in R&D expenditures, process and/or product innovations and patenting. The analysis has been carried out for a set of European countries and considering the manufacturing sector. The results of the probit analysis show that a greater amount of internal financial resources, a substantial export propensity and a greater company's size are paramount keys for the growth of innovation activities. The outputs of innovation (patenting) depend mainly on long term debt, the size of the company and the presence of skilled workers, whereas investments in R&D are pushed by the contribution of several forms of financing, including equities. In addition, product and process innovations are mainly fostered by short and long term debts and the firm's cash flow. All the estimations reveal that larger exporting firms are more likely to have innovative output.

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