RD Intensity and Financing Decisions: Evidence from European Firms

ELKEMALI, Taoufik and BEN REJEB, Aymen and MATOUSSI, Hamadi

King Faisal University – College of Business Administration, P.O 400, 31982, Al-Ahsa, Saudi Arabia, Faculty of Economics and Management of Mahdia, University of Monastir, Tunisia, University of Manouba- LIGUE- ISCAE Tunisia

28 July 2013

R&D Intensity and Financing Decisions: Evidence from European Firms

Taoufik ELKEMALI

University of Montpellier II – MRM, Place Eugène Bataillon, 34095 Montpellier, Cedex 05, France
King Faisal University – College of Business Administration, P.O 400, 31982, Al-Ahsa, Saudi Arabia

Aymen BEN REJEB*

Faculty of Economics and Management of Mahdia, University of Monastir, Tunisia
Laboratory of Management of Innovation and Sustainable Development, University of Sousse, Tunisia

Hamadi MATOUSSI

University of Manouba- LIGUE- ISCAE Tunisia

Abstract

This paper examines whether research and development (R&D) intensity affects the firm's financing decisions. We use a sample of European firms in the period 2002-2011. We argue that R&D asset has three fundamentals characteristics that make it different from ordinary investment and constrain financing choices of the firm. First, The R&D is a specific non-redeployable asset with higher premium risk. Second, it generates stronger growth opportunities and, third, represents a major contributor to asymmetric information. Based on the implications of the transaction cost theory, the agency cost and pecking order theory, we argue that these fundamentals characteristics affect the financial policy. Our results show that R&D-intensive firms exhibit lower leverage, a shorter debt maturity, a lower dividend payment and a higher cash level.

Keywords: R&D intensity; asset specificity; growth opportunities; information asymmetry; financing decisions.

Jel Classification: D23, D82, G32, G35, O32,

---

* Corresponding author (telephone number: +21697310188, fax number: +21673210515).
E-mail addresses: elkemali@yahoo.fr (T. Elkemali), benredjeb_aymen@yahoo.fr (A. Ben Rejeb), hmato_isc@yahoo.ca (H. Matoussi).

1. Introduction

The corporate finance studies have widely shown that the asset structure influences the financial policy of the firm.

Our paper fits in this research area by studying whether R&D intensity influences the firm's financing decisions. We argue that R&D has specific characteristics which differentiate it from ordinary investment. First, R&D is a non- redeployable specific asset, because it presents for any other firm a lower value than the owner assigns to him (Bah and Dumontier, 1998). Williamson (1988) argues that specific assets have lower liquidation and hypothecation value, which increases the premium risk required by the debtholders. Hence, firms with more specific assets prefer equity financing to debt because of the higher costs of external financing.

Second, R&D is also an asset which generates large growth opportunities. According to the agency theory, firms with larger growth options should exhibit lower leverage because of the under-investment (Myers, 1977) and the asset substitution problems (Jensen and Meckling, 1976). If they have to finance by debt, short term debt is privileged because it matures before execution of investment option. These firms distribute also lower dividend since the free cash flow is entirely absorbed by the growth opportunities.

R&D asset is also synonymous of informational asymmetry. The information concerning the R&D activity is little revealed by the managers to investors fearing it might be used by potential competitors. So, these firms privilege internal financing. In the same way, Myers and Majluf (1984) explain in the pecking order theory that firms with high informational asymmetry prefer financing their investments by internal funds. Failing this resource, they finance them by debt and exceptionally by security markets.

Based on these three characteristics, we presume that R&D-intensive firms must exhibit lower debt level, shorter debt maturity and lower dividend payments. To test these hypotheses, we use a sample of European firms in the period (2002-2011) with univariate and multivariate analyses. Our empirical evidence confirms that R&D-intensive firms have specific corporate finance behaviour. Their financial policy is characterised by lower leverage and dividend payment ratio and higher proportion of short term debt and cash reserves than non-R&D firms[1].

This study offers interesting insights in two ways. Firstly, it provides theoretical framework for the corporate finance of R&D-intensive firms. Secondly, to our knowledge, few papers have been devoted to study the effect of R&D on financing decisions while this investment is a crucial factor of innovation and competitiveness.

The reminder of the paper is structured as follows: Section 2 argues theoretically the relation between R&D investment and the firm's financing decisions. Section 3 presents the empirical design. Section 4 is devoted to empirical results. Section 5 concludes.

2. R&D investment and financing decisions

2.1. R&D and asset specificity

The R&D is a specific asset[2] as illustrated by Williamson (1988). According to this author an asset is specific, if it is not reusable without losing totality or a part of its utilisation value. R&D investment requires the acquisition of special machines and very sophisticated technologies which cannot be used in an employment other than that for what they were acquired. These machines constitute a capital not easily redeployable in the case of project failure. R&D is also an asset marked also by exceptional human competences. Using a statistic models, Titman (1984) explains that the costs supported by customers and employees in bankruptcy oblige firms producing specific product to favour internal financing. For the customers, the bankruptcy leads to the loss of futures services like maintenance or the after-sales services. For the employees, this human capital is very specific because the knowledge acquired is not easily transferable without suffering damage. Alderson and Betker (1996), find that liquidation costs are positively correlated with R&D investments. Hall and Lerner (2009) explain that the sunk costs associated with R&D investment are higher than that for ordinary investment. For these authors, "*Banks and other debtholders prefer to use physical assets to secure loans and are reluctant to lend when the project involves substantial R&D investment rather than investment in plant and equipment*".

Campello and Giambona (2012) and Qiu and La (2010) find that the redeployability of tangible assets increases borrowing capacity because it allows creditors to more easily repossess a bankrupt firm's assets. When the firm has lower assets' liquidation values, the debtholders will require high premium risk which increases transaction costs. Consequently, firms more involved in specific assets, as R&D, will face difficulty when they resort to debt and have to rely on equity financing (Harris and Raviv, 1990; Bah and Dumontier, 1998, 2001; Hall and Lerner, 2009; Wang and Tornhill, 2010). Benmelech (2009) concludes that asset redeployability affects debt maturity.

2.2. R&D and growth opportunities

It is generally recognized that R&D activities create strong growth opportunities (Titman and Wessels, 1988; Smith and Watts, 1992; Gaver and Gaver, 1993; Lööf and Heshmati, 2005; Brown, Fazzari, and Petersen, 2009)[3].

The concept of growth opportunities was developed by Myers (1977) to study the effect of the nature of investment on financing decisions of the firm. He defines the value of the firm as the sum of assets in place and growth opportunities perceived as growth options presented to the firm that can be followed or not. The exercise of such options in the future requires additional discretionary expenditure. However, the assets in place do not require such expenditure, because they form a part of the firm's patrimony and do not influence in any way its growth potential.

The agency theory shows that the growth opportunities affect the financial structure of the firm, by i) the under-investment, ii) the assets substitution and iii) the free cash-flow problems.

i) *The under-investment problem*

Myers (1977) explains that the indebtedness of the firm decreases its possibilities of investment. Indeed, any increase in debt value will profit to debtholders but not to shareholders. Beyond a certain level of debt (debt risky), a manager who protects shareholders' interest can refuse to undertake these growth opportunities, because they lead to an increase in the debt value rather than the equity value. In other terms, firms may renounce profitable projects when the advantages will be allocated essentially to the debtholders. Myers (1977) calls this situation an underinvestment problem.

To avoid this situation, Myers (1977) recommends financing these growth opportunities by short-term debts. Shorter debt maturity allows a continual and gradual debt negotiation and matures before the growth option can be exercised.

ii) *The asset substitution problem*

Black and Scoles (1973) and Jensen and Meckling (1976) show that the issuance of debt can lead to a modification of owner-manager's investment policy. In substituting a less risky investment policy by a more risky one, the manager has the possibility to transfer a wealth from creditors to shareholders, even if the riskier investment project has lower economic value.

To face up to the asset substitution problem, related to the undertaking of projects with higher risk than that for which the debt was emitted and evaluated, Jensen and Meckling (1976) recommend less debt for the firms with strong growth opportunities.

iii) *The problem of free cash-flow*

The free cash-flow represents the liquidity remaining once the investments, with net positive present value, were financed. It appears in the majority of cases that the managers do not hold the entirety capital of the firm. On this assumption, they cannot profit completely from their efforts. Thus, managers may devote less time and efforts to control the firm, and focus their attention on projects from which they derive alone satisfactions.

In a moral hazard situation, the free cash-flow is at the disposal of managers for a discretionary uses. The increase in dividend payment represents a first way to reduce this free cash flow. The second way consists in modifying the financial policy in favor of a higher indebtedness. The payment of financial charges decreases the liquidity and the risk of the manager's opportunistic behavior. When growth opportunities increase, the free cash-flow decreases because it is absorbed by these opportunities, therefore, the firm distributes less dividend and the recourse to the debt will not be necessary to discipline the managers.

Many empirical studies have confirmed that growth opportunities affect the firm's financing decisions. Titman and Wessels (1988) propose a debt model which integrates measurements of growth opportunities. Indicators of growth include capital expenditures, total assets growth and R&D over sales ratio. The results provide evidence of negative relation between debt and growth opportunities. Mackie-Mason (1990) has tested the effect of under-investment and asset substitution problems and find, through a probit model, a negative relation between growth opportunities and the probability of emitting debt. Hovakimian, Hovakimian and Tehranian (2004) and Hovakimian (2006) conclude that market to book ratio, as measure of growth opportunities, is negatively related to leverage level. However, Chen and Zhao (2006) find that the relation between market to book ratio and leverage is not robust. They show that firms with higher market-to-book ratios use more debt, and those with lower market-to-book ratios retire more debt.

Barclay and Smith, (1995), Bevan and Danbolt, (2002) and Benmelech (2009) have tested the relation between growth and debt maturity and have concluded that growth opportunities increase the short term debt financing (as recommended by Myers, 1977). The model of Hackbarth and Mauer (2012) predicts that financially unconstrained firms with few growth opportunities prefer senior debt, while financially constrained firms, with or without growth opportunities, prefer junior debt.

Regarding dividend, a number of studies have shown that firms with high growth opportunities pay lower dividend (Rozeff, 1982; Jensen, Solberg and Zorn, 1992; Holder, Langrehr and Hexter, 1998; Utami and Inanga, 2011). The growth opportunities absorb the free cash flow which leads to lower dividend payment ratio.

2.3. R&D and information asymmetry

Prior literature has shown that R&D investment increases informational asymmetry between the firm and its environment. Zeckhauser and Pound (1990) explain that firms with high specific assets are less easily controllable and more confronted to informational problem than those with low specific assets.

Kamien and Schwartz (1978) show that firms involved in R&D activities are reluctant to reveal information about their research project fearing that it might be used by potential competitors.

Myers and Majluf (1984) explain in the pecking order theory that, in the case of high information asymmetry, firms prefer finance their investments first by self-financing, second by less risky debts, and finally by shares issues.

The authors show that when investors are less informed than the managers about the true value of assets and prospects, the firm value can be underestimated by the market. If the firm emits new shares to finance an investment project with high information asymmetry, new shareholders can profit from a net present value higher than that of the project to finance, which results in a clear loss for the old shareholders. As a result, the project is rejected even if its net present value is positive because of the financing mode. To favor the self-financing, the firms with higher information asymmetry should pay lower dividend and exhibit higher cash level.

Bharat, Pasquariello and Wu (2008) and Autore and Kovacs (2009) have studied the implications of the pecking order theory and find that firms prefer to access financial markets and issue equity when the level of information asymmetry is low. An, Hardin III and Wu

(2012) find that firms with more severe information asymmetry are less likely to have access to bank credit lines. Concurrently, more transparent firms are more likely to utilize bank credit lines as opposed to cash for liquidity management.

3. Empirical design

3.1. Hypotheses

Our theoretical framework presumes that R&D investment has specific characteristics which determine financing choices of the firm. First, R&D asset has lower liquidation value which increases the risk premium required by the debtholders. According to the cost transaction theory, R&D-intensive firms will exhibit lower leverage because of the higher cost of debt. Second, The R&D activity generates strong growth opportunities. Based on the agency theory, the firms strongly involved in R&D activity should exhibit lower leverage level and higher proportion of short term debt to reduce the under-investment and asset substitution problems related to these growth opportunities. Moreover, these firms should pay lower dividend because the free cash flows is entirely absorbed by the growth options. Third, R&D asset is also an important contributor to information asymmetry. Managers prefer not revealing information about their R&D investment fearing that the information will be used by potential competitors, so they distribute lower dividend to increase internal finance. In addition, in accordance with the pecking order theory, R&D-intensive firms should exhibit higher cash reserves and, therefore, lower dividend payment ratio. Consequently, the paper tests the following hypotheses:

Hypothesis 1: The R&D-intensive firms exhibit lower debt level and higher proportion of short term debt.

Hypothesis 2: The R&D-intensive firms distribute lower dividend.

Hypothesis 3: The R&D-intensive firms exhibit higher cash.

3.2. Sample selection and data description

Our paper tests the effect of R&D investment on financial policy of European firms over the period 2002-2011. All the data are extracted from WOLDSCOPE database. The firms belonging to the financial and service sectors are removed from the initial sample because of their atypical financial policy behavior. Selected firms must have data concerning their R&D expenditures and financial variables. According to these criteria, the final sample consists of 586 European firms and represents 4757 firm-year observations.

The observations have been decomposed into tertiles based on the R&D expenditures to sales ratio. Our study focuses on the extremes, upper and lower, tertiles which represent respectively the groups of R&D-intensive firms and non-R&D firms[4]. The median tertile represents the normal-R&D group. Table 1 describes the whole sample and the subsamples.

Table 1. Sample Description

	Number	Lower tertile (Non-R&D)	Median tertile	Upper tertile (R&D-intensive)
Initial Sample	1069			
Firms with R&D Reported	586			
Total obs (2002-2011)	4757			
Mean R&D/sales		0.009	0.072	0.225***
Median R&D/sales		0.011	0.051	0.191***

Note: The table indicates the number of firms for the initial sample, for those with R&D reported and the number of observations for the period (2002-2011). For each tertile, the table shows also the mean and median of R&D to sales ratio. The upper and lower tertiles represent respectively the groups of R&D- intensive firms and non-R&D firms.

*** indicates that means (t-test) and medians differences (Wilcoxon test) between R&D- intensive firms and non-R&D firms are significant at 1% level.

3.3. Variable definition

We test whether the R&D-intensive firms exhibit lower debt, and in case of debt financing they prefer short term debt (*H1*). We test also whether R&D-intensive firms exhibit lower dividend payment (*H2*) and higher proportion of cash (*H3*).

Financial structure is studied by leverage, short term debt, dividend payment and cash level. Leverage (*LEV*) is total debt to total asset ratio. Short term debt (*SHTD*), as measure of debt maturity, is measured as short term debt and current portion of long term debt to total debt ratio. Dividend (*DIV*) is measured as the ratio dividend per share to earnings before extraordinary items. Cash level (*CASH*) is defined as the ratio of cash plus short term investment to total assets.

The R&D intensity appears as an independent qualitative variable (*R&D*) which takes the value 1 for R&D-intensive firms (high tertile) and 0 for the non-R&D firms (low tertile).

Several variables are used to control the effect of R&D intensity on financial policy. The papers of Titman and Wessels (1988), Harris and Raviv (1990) and Guedes and Opler (1996), have shown that profitability, asset specificity, growth opportunities, risk, size, and the non-debt tax shields influence total debt and short term debt. Rozeff (1982), Jensen et al. (1992), Baker, Saudi, Dutta and Gandhi (2007) explain that dividend is related to profitability, asset specificity growth opportunities, risk, size, and capital needs. Opler, Pinkowitz, Stulz, and Williamson (1999) and Kim, Mauer and Sherman (1998) have presented also these variables as a determinant of cash.

Profitability is measured both by return on assets and return on equity ratios (Bah and Dumontier, 2001). The return on assets (*ROA*) is operating income to total assets ratio. The return on equity (*ROE*) is determined by earning before extraordinary items ratio to total equity. Asset specificity (*SPECIFCITY*) is approximated by advertising to total assets ratio (Hennart, 1991). Growth opportunities (*GROWTH*) is measured as the market to book ratio (Chen and Zhao, 2006; Hoviakimian, 2006). Huang and Song (2002) approximate the risk by the standard deviation of earnings before interest and taxes (*RISK*). Size is measured as the logarithm of market capitalization (Eddy and Seifert, 1988; Redding, 1997). The capital needs (*CAPEX*) is measured as the capital expenditure to total asset ratio where capital expenditure is the funds used to acquire new fixed assets (Titman and Wessels, 1988; Bah and Dumontier, 2001).

The non-debt tax shields (*NDTS*) is a variable used by Titman and Wessels (1988) to test the determinants of debt. It is calculated by the following relation:

$$NDTS = OI - INT - (TAX/T)$$

Where T is the effective tax rate, (*OI*) represents the operating income, (*INT*) the interest payment and (*TAX*) the income tax payment. Table 2 displays variables measures.

Table 2. Variables and measures

Panel A : Financing decisions variables
Leverage (*LEV*) = Total Debt/Total asset
Short Term Debt (*SHTD*) = short term debt and current portion of long term debt / total debt ratio
Dividend (*DIV*) = dividend per share / earnings before extraordinary items
Cash Level (*CASH*) = cash plus short term investment / total assets.
Panel B: R&D intensity
Dummy variable (*R&D*) = 1 if R&D-intensive firm (upper tertile of R&D/sales)
0 if non-R&D firm (lower tertile of R&D/sales)
Panel C: Control variables
Return on assets (*ROA*) = operating income / total assets
Return on equity (*ROE*) = earning before extraordinary items / total equity.
Asset specificity (*SPECIFCITY*) = advertising expenditures / to total assets
Growth opportunities (*GROWTH*) = market value/ book value
RISK= Standard deviation of earnings before interest and taxes
SIZE = the logarithm of market capitalization
Non-debt tax shields (*NDTS*)= [Operating income- Interest – (Income tax/ Effective tax rate)] / Total assets
Capital needs (*CAPEX*) = capital expenditure / total assets

4. Empirical results

4.1. Descriptive analysis

The results of table 3 confirm that R&D-intensive firms exhibit lower leverage. For these variables, the mean and median difference between R&D-intensive firms and non-R&D firms is significant at 1% level. This result confirms our first hypothesis based on the costs transaction, under-investment, and asset substitution theories. The table shows also that when these firms have to use debt, they prefer significantly the short term debt. The debt maturity theory indicates that the short term debt matures before investment opportunities can be exercised and therefore it avoids the underinvestment problem.

The empirical results validate also the dividend hypothesis based on both pecking order and free cash flow theories. R&D-intensive firms distribute statistically significant lower dividend than non-R&D ones. This confirms that the firms strongly involved in R&D activities prefer internal sources of finance to avoid revealing valuable information about their investment projects that can be used by potential rivals. Another explication is that the R&D intensive firms have lower free cash flow because it is absorbed by the growth opportunities and therefore they pay lower dividend. The table reports also that the cash level is significantly higher for the R&D-intensive firms which confirm that they favor the self-financing.

Table 3. Mean and Median comparison of financing decisions variables between R&D-intensive firms and non-R&D firms

Financing decisions variables	Obs	Mean			Median		
		Non-R&D	Normal R&D	R&D-intensive	Non-R&D	Normal R&D	R&D-intensive
LEV	4786	0,386	0.234	0,117***	0.341	0.187	0.128***
SHTD	4786	0.291	0.471	0.579***	0.252	0.443	0.552***
DIV	4102	0,521	0.374	0,224***	0.542	0.385	0.236***
CASH	4786	0.142	0.211	0.441***	0.121	0.194	0.483***

Note: The table reports the mean and median of financing decisions variables for R&D-intensive firms (high tertile of R&D), normal R&D firms (median tertile of R&D) and non-R&D firms (low tertile for R&D). Leverage, *LEV*, is measured as total debt to total assets ratio. Short term debt, *SHTD*, is the ratio short term debt with current portion of long term debt to total debt. Dividend payment, *DIV*, is measured as dividend per share to earnings per share before extraordinary items. *** indicates statistical significance of 1% respectively, in mean differences (t-test) and median differences (Wilcoxon test) between R&D-intensive firms and non-R&D ones.

4.2. Multivariate analyses for the effect of R&D on financing decisions

To complete the univariate analysis, we test through pooled regressions the effect of R&D intensity on financial policy variables (*LEV*, *SHTD*, *DIV* and *CASH*). Previous studies have shown that others variables, than R&D intensity, can affect firm’s financing decisions. It was largely proved that return on asset, asset specificity, growth, risk, size, and non-debt tax shield influence leverage and short term debt. Empirical studies have shown also that dividend and cash are associated with return on equity, asset specificity, growth, risk, size and capital needs. The models to be tested are as follows:

$$LEV = \alpha_0 + \alpha_1 R\&D + \alpha_2 ROA + \alpha_3 SPECIFICITY + \alpha_4 GROWTH + \alpha_5 RISK + \alpha_6 SIZE + \alpha_7 NDTS + \zeta \quad (1)$$

$$SHTD = \beta_0 + \beta_1 R\&D + \beta_2 ROA + \beta_3 SPECIFICITY + \beta_4 GROWTH + \beta_5 RISK + \beta_6 SIZE + \beta_7 NDTS + U \quad (2)$$

$$DIV = \varphi_0 + \varphi_1 R\&D + \varphi_2 ROE + \varphi_3 SPECIFICITY + \varphi_4 GROWTH + \varphi_5 RISK + \varphi_6 SIZE + \varphi_7 CAPEX + E \quad (3)$$

$$CASH = \mu_0 + \mu_1 R\&D + \mu_2 ROE + \mu_3 SPECIFICITY + \mu_4 GROWTH + \mu_5 RISK + \mu_6 SIZE + \mu_7 CAPEX + I \quad (4)$$

Where *LEV* is the total debt to total asset ratio and *SHTD* is short term debt and current portion of long term debt to total debt ratio. The short term debt is used to test the debt maturity theory. *R&D* is a dummy variable which equals one if the firm is an R&D-intensive firm and zero if is non-R&D one. *DIV* is the ratio dividend per share to earnings before extraordinary items. The level of cash, *CASH*, is measured as the ratio of cash plus short term investment to total assets.

The return on asset, *ROA*, is measured as operating income to total asset. The return on equity, *ROE*, is earning before extraordinary items to total equity. *SPECIFICITY* is advertising expenditures to total asset ratio. *GROWTH* is the market to book ratio. *RISK* is approximated by the standard deviation of earnings before interest and taxes. *SIZE* is determined by the logarithm of market capitalisation. The capital needs, *CAPEX*, is measured as the capital expenditure to total asset ratio. The non-debt tax shield, *NDTS* is the operating income minus interest payment and the ratio of income tax to effective tax rate.

The results reported in table 4 reinforce those of the univariate analysis and confirm a significant negative relation between leverage and *R&D* intensity even after controlling profitability, growth opportunities, asset specificity, risk, size, and non-debt tax shield[5]. The *R&D* variable having three fundamental characteristics (asset specificity, growth opportunities and informational asymmetry), presents a significant coefficient compared to the significance of these criteria taken independently of each other. This result confirms our first hypothesis and joins that found by Bah and Dumontier (2001).

For the control variables, the relation between return on asset and leverage is statistically significant and negative while the size affects positively the total debt. The asset specificity and the growth have, as predicted, a negative and significant effect on leverage.

The relation between risk and total debt is insignificant. The non-debt tax shields is negatively correlated with total debt. A large non-debt tax shields reduces the expected value of interest tax savings and lessens the advantage of debt financing (Downs, 1993). Thus, leverage decreases with the non-debt tax shields.

Table 4. Effect of R&D intensity on financing decisions

$LEV = \alpha_0 + \alpha_1 R\&D + \alpha_2 ROA + \alpha_3 SPECIFICITY + \alpha_4 GROWTH + \alpha_5 RISK + \alpha_6 SIZE + \alpha_7 NDTS + \zeta$ (1)
$SHTD = \beta_0 + \beta_1 R\&D + \beta_2 ROA + \beta_3 SPECIFICITY + \beta_4 GROWTH + \beta_5 RISK + \beta_6 SIZE + \beta_7 NDTS + u$ (2)
$DIV = \varphi_0 + \varphi_1 R\&D + \varphi_2 ROE + \varphi_3 SPECIFICITY + \varphi_4 GROWTH + \varphi_5 RISK + \varphi_6 SIZE + \varphi_7 CAPEX + E$ (3)
$CASH = \mu_0 + \mu_1 R\&D + \mu_2 ROE + \mu_3 SPECIFICITY + \mu_4 GROWTH + \mu_5 RISK + \mu_6 SIZE + \mu_7 CAPEX + I$ (4)

Explanatory variables	Financing Decisions Variables			
	LEV ***(α)***	***SHTD*** ***(β)***	***DIV*** ***(φ)***	***CASH*** ***(μ)***
Intercept	1,747*	1.079	1,959**	1.705*
R&D	-8,256***	3.065***	-5,348***	7.025***
ROA	-2,088*	-1.645	-	-
ROE	-	-	3.325***	1.314
SPECIFICITY	-3,146***	2.059*	-2.824**	2.445**
GROWTH	-3,479*	2.125**	-4.472***	4.102***
RISK	-1,065	0.933	-1.497	1.914*
SIZE	2,122**	-1.567*	1.825**	1.114
NDTS	-3,212***	2.708**	-	-
CAPEX	-	-	-1.475*	2.412**
Adjusted R^2	0,333	0.241	0.187	0.194

Note: The table reports results of pooled regressions of financing decisions variables on R&D intensity variable and the others controls variables for the period (2002-2011). *R&D* is dummy variable which takes the value one if the firms is an R&D-intensive firm and zero if the firm is non-R&D one. Leverage, *LEV*, is measured as total debt to total assets ratio. Short term debt, *SHTD*, is the ratio short term debt with current portion of long term debt to total debt. Dividend payment, *DIV*, is measured as dividend per share to earnings per share before extraordinary items. The return on asset, *ROA*, is measured as operating income to total asset. *SPECIFICITY* is advertising expenditures to total asset ratio. *GROWTH* is the market to book ratio. *RISK* is approximated by the standard deviation of earnings before interest and taxes. SIZE is measured as the logarithm of market capitalisation. The non-debt tax shield, *NDTS*, is operating income minus interest payment and the ratio of income tax to effective tax rate. *CAPEX* is measured as the capital expenditure to total asset ratio. ***, ** and * indicate that the t-statistics is significant respectively at 1%, 5% and 10% level.

Table 4 shows also that firms more involved in R&D activity prefer short term maturity when they have to finance by debt. The relation between these variables is positive and significant. This result corroborates the debt maturity theory presented by Myers (1977) as a solution for the underinvestment problem. The importance of debt maturity is also proved by the positive and significant relation between short term debt and growth. The asset specificity and the non-debt tax shields are positively correlated with short term debt.

The results regarding dividend policy provide evidence that R&D-intensive firms distribute lower dividend even after controlling profitability, growth, specificity, size, risk and capital needs. The relation between dividend payout ratio and *R&D* dummy variable is negative and statistically significant. This relationship is explained by the information asymmetry associated with R&D activity.

Our findings confirm also that the return on equity affects positively and significantly dividend. The firms with high growth opportunities prefer self-financing and, as a result, they pay lower dividend. The risk, as proxy of information asymmetry, is negatively correlated with dividend. The size has not significant implication.

The results of cash model strengthen those of debt and dividend models and ascertain that R&D-intensive firms favor the self-financing. The relationship between *R&D* dummy variable and cash is statistically significant and positive. The variables specificity, growth, risk and capital needs are, as predicted, positively and significantly associated with cash. We notice here the absence of significant effect of return on equity and size.

4.3. Financing decisions and the probability that the firm being a R&D-intensive firms: Logistic regression

To ascertain that R&D intensity affects the financial policy, we ran also logistic regressions. We aim here to test the relation between financial policy variables and the probability that the firm belongs to R&D-intensive firms or non-R&D ones. Because the debt is studied by two measures, leverage (total debt) and debt maturity (short term debt), and in order to avoid a substantially biased regression estimates due to the correlation between theses variables, we ran two logistic regressions.

$$R\&D = \gamma_0 + \gamma_1 LEV + \gamma_2 DIV + \gamma_3 CASH + \zeta \quad (5)$$

$$R\&D = \lambda_0 + \lambda_1 SHTD + \lambda_2 DIV + \lambda_3 CASH + I \quad (6)$$

Where *R&D* is dummy variable equals one for the R&D- intensive firms and zero for the non-R&D ones. *LEV* is measured as total debt to total asset ratio. *SHTD* is short term debt and current portion of long term debt to total debt ratio. *DIV* is the dividend per share to earnings before extraordinary items. *CASH* is measured as the ratio of cash plus short term investment to total assets.

The results of the logit regression, reported in table 5, confirm our research hypotheses. The financial policy variables present the predicted signs since the debt level and dividend are negatively associated with *R&D* dummy variable and the cash and short term debt are positively correlated with R&D intensity. These results indicate that firms with lower leverage and dividend payment and higher cash and short term debt are more probably to be R&D-

intensive firms. All these financial policy variables significantly discriminate the R&D-intensive firms from the non-R&D ones.

Table 5. Financing decisions variables and the probability that the firm belongs to R&D-intensive firms or non-R&D ones: logit regression

Table 5. Financing decisions variables and the probability that the firm belongs to R&D-intensive firms or non-R&D ones: logit regression

$R\&D = \gamma_0 + \gamma_1\, TDTA + \gamma_2\, DIVIDEND + \gamma_3\, CASH + \zeta$ (5)
$R\&D = \lambda_0 + \lambda_1\, SHTD + \lambda_2\, DIV + \lambda_3\, CASH + I$ (6)

Variables	*R&D (5)* (γ)	*R&D(6)* (λ)
Intercept	-0,648**	-0.749**
LEV	-1,056***	-
SHTD	-	0.565**
DIV	-0,788***	-0.645***
CASH	0,912***	0.808***
% corrected predicted	81.09	74.58
R2 McFadden	0.175	0.163

Note: The table presents the results of logit regression for the relation between financial policy variables and the probability that the firm being an R&D-intensive firm or non-R&D one. *R&D* is dummy variable which take the value one if the firms is an R&D intensive firm and zero if the firm is non-R&D one. *LEV*, is measured as total debt to total assets ratio. Short term debt, *SHTD*, is the ratio short term debt with current portion of long term debt to total debt. Dividend payment, *DIV*, is measured as dividend per share to earnings per share before extraordinary items. ***, ** and * indicate that the t-statistics is significant respectively at 1% , 5% and 10% level.

5. Conclusion

The aim of this paper was to study whether R&D intensity affect the firm's financing decisions. We have theoretically argued that R&D asset has three specific characteristics which may affect leverage, debt maturity, dividend payments and cash level.

First, R&D is a non-redeployable asset with lower guarantee value for the creditors. According to the transaction cost theory, the firms more involved in specific assets support higher costs of debt and then prefer the internal finance to external one.

Second, R&D asset generates large growth opportunities and in order to avoid the underinvestment and the asset substitution problem, the firms prefer internal finance to debt. If they have to finance by debt, the R&D-intensive firms prefer short debt term because it is more liquid then long term debt. In addition, the growth opportunities decrease the free cash flow, and results in lower dividend payment.

Third, R&D asset is also a major contributor to information asymmetry. The information about the R&D activity is less revealed by managers for not transferring innovation-related knowledge to rivals. As a result, and in accordance with the Pecking Order

Theory, R&D-intensive firms should favor the self-financing. Therefore, they exhibit lower dividend ratio and higher cash.

Using a sample of European firms, the univariate and multivariate analyses results confirm that R&D-intensive firms exhibit a specific financial policy behavior. Indeed, R&D-intensive firms exhibit lower leverage, lower dividend payment, higher proportion of short term debt and higher cash than non-R&D ones. These results confirm our hypotheses even after controlling for firm size, profitability, asset specificity, growth opportunities, risk, capital needs and non-debt tax shields.

Footnotes

1. Firms with lower R&D activities.
2. See Long and Malitz (1985); Balakrishnan and Fox (1993); Bah and Dumontier (1998 , 2001); Hall and Lerner (2009).
3. See also Coad and Rao (2010) for the test of the relation between firm growth and R&D expenditures. Del Monte and Papagni (2003) and Lee (2009) provide evidence that the effect of R&D intensity on firm growth varies according to the sector. Nunes et al. 2012 conclude that the relation between R&D and growth differs between high-tech and non-high-tech small and medium-sized enterprises.
4. Bah and Dumontier (2001) use an arbitrarily classification. All firms with R&D to sales ratio higher than 5% are assumed to be R&D intensive firms. Firms do not report R&D expenditures are classified as non-R&D firms.
5. Regressions are tested using panel data (pooled regressions). The fisher test of specific effect has rejected the hypothesis of the homogeneity. The calculated F value for the two models exceeds the tabulated F value. The results of the Hausman test indicate that the effects are random for the two equations. The probability (p-value) is higher than 5% for the two equations. We notice also that there is no significant multicollinearity in the independent variables (correlation matrix not reported for the sake of brevity).

References

Alderson, M. J., and Betker, B.L. 1996. Liquidation Costs and Accounting Data. *Financial Management* 25(2): 25-36.

An, H., Hardin III, W., and Wu, Z. 2012. Information Asymmetry and Corporate Liquidity Management: Evidence from Real Estate Investment Trusts. *Journal of Real Estate Finance and Economics* 45, 678-704

Autore, D., and Kovacs, T. 2009. Equity Issues and Temporal Variation in Information Asymmetry. *Journal of Banking and Finance* 34, 12-23

Bah, R., and Dumontier, P. 1998. Spécificité de l'actif et structure financière de l'entreprise. *Banques et Marchés* 232, 28-36.

Bah, R., and Dumontier, P. 2001. Research and development intensity and corporate financial policy: some international comparisons. *Journal of Business Finance and Accounting* 28, 671-692.

Baker, H.K., Saudi, S., Dutta, S., and Gandhi. D. 2007. The perception of dividend by Canadian managers: new evidence. *International Journal of Managerial Finance* 3, 70-91.

Balakrishnan, S., and Fox, I. 1993. Asset specificity, firm heterogeneity and capital structure, *Strategic Management Journal* 14, 3-16.

Barclay, M.J., and Smith, J.C.W. 1995. The maturity structure of corporate debt. Journal *of Finance* 50, 609-631.

Benmelech, E. 2009. Asset Salability and Debt Maturity: Evidence from Nineteenth Century American Railroads. Review of Financial Studies 22, 1545-1583.

Bevan, A. A., and Danbolt, J. 2002. Capital Structure and its Determinants in the UK: A Decompositional Analysis. *Applied Financial Economics* 12(3), 159–70.

Bharat, S., Pasquariello P., and Wu, G. 2008. Does Asymmetric Information Drive Capital Structure Decisions?. *Review of Financial Studies* 22, 3211-3243.

Black, F., and Scholes, M. 1973. The pricing of options an corporate liabilities. *Journal of Political Economy* 81(3), 637-654.

Brown, J. R., Fazzari, S. M., and Petersen, B. C. 2009. Financing innovation and growth: Cash flow, external equity, and the 1990s R&D boom. *Journal of Finance* LXIV(1), 151-185.

Campello, M., and Giambona, E. 2012. Real Assets and Capital Structure. Journal of Financial and Quantitative Analysis, Forthcoming.

Chen, L., and Zhao, X. 2006. On the Relation Between the Market-to-book Ratio, Growth Opportunity, and Leverage Ratio. *Finance Research Letters* 3, 253–66.

Coad, A., and Rao, R. 2010. Firm growth and R&D expenditure. *Economics of Innovation and New Technology* 19 (2), 127-145.

Del Monte, A., and Papagni, E. 2003. R&D and the growth of firms: an empirical analysis of a panel of Italian firms. *Research Policy* 32, 1003–1014.

Downs, T. W. 1993. Corporate Leverage and Nondebt Tax Shields: Evidence on. Crowding-Out. *Financial Review* 28, 549-583

Eddy, A., and Seifert, B. 1988. Firm Size and Dividend Announcements. *Journal of Financial Research* 11, 295-302.

Gaver, J.J., and Gaver, K.M. 1993. Additional Evidence on the association between the investment opportunity set and corporate financing, dividend and compensation policies. *Journal of Accounting and Economics* 16, 125-160.

Guedes, J., and Opler, T. 1996. The determinants of maturity of corporate debt issues. *Journal of Finance* 51, 1809-1833.

Hackbarth, D., and Mauer, D. 2012. Optimal Priority Structure, Capital Structure, and Investment. *Review of Financial Studies* 25 (3), 747 -796.

Hall, B.H., and Lerner, J. 2010. The Financing of R&D and Innovation. *Handbook of the Economics of Innovation*, Elsevier-North Holland.

Harris, M., and Raviv, A. 1990. Capital structure and the informational role of debt. *Journal of Finance* 45(1), 297-355.

Hennart, J. F. 1991. The Transaction Costs Theory of Joint Ventures: An Empirical Study of Japanese Subsidiaries in the United States. *Management Science* 37(4), 483-497.

Holder, M. E., Langrehr, F. W., and Hexter, L. 1998. Dividend policy determinants: an investigation of the influences of stakeholder theory. *Financial Management* 27 (3), 73-85.

Hovakimian, A. 2006. Are observed capital structures determined by equity market timing? *Journal of Financial and Quantitative Analysis* 41, 221–243.

Hovakimian, A., Hovakimian, G., and Tehranian, H. 2004. Determinants of target capital structure: The case of combined debt and equity financing. *Journal of Financial Economics* 71, 517–541.

Huang, S. G. H. and Song, F. M. 2002. The Determinants of Capital Structure: Evidence from China. *China Economic Review* 17(1), 14-36.

Jensen, M., Solberg, D., and Zorn, T. 1992. Simultaneous Determination of Insider Ownership, Debt and Dividend Policies. *Journal of Financial and Quantitative Analysis* 27, 247-261.

Jensen, M.C., and Meckling, W.H. 1976. Theory of the firm: managerial behaviour, agency costs and ownership structure. *Journal of Financial Economics* 3, 305-360.

Kamien, M. I., and Schwartz, N. L. 1987. Self financing of an R&D project. *The American Economic Review* 37, 97-114.

Kim, C-S., Mauer, D.C., and Sherman, A.E. 1998. The determinants of corporate liquidity: Theory and evidence. *Journal of Financial and Quantitative Analysis* 33, 333-35.

Lee, C.Y. 2009. Competition favors the prepared firm: firms R&D responses to competitive market pressure. *Research Policy* 38, 861–870.

Long, M., and Malitz, I. 1985. The investment financing nexus: empirical evidence. *Midland Corporate Journal* 3, 53-59.

Lööf, H., and Heshmati, A. 2005. On the Relationship Between Innovation and Performance: A Sensitivity Analysis. *Economics of Innovation and New Technology* 15(4-5), 317-344.

Mackie-Mason, J. K. 1990. Do taxes affect corporate financing decisions. *The Journal of finance* 45(5), 1471-1493.

Myers, S. C. 1977. Determinants of Corporate Borrowing. *Journal of Financial Economics* 5,147–75.

Myers, S.C., and Majluf, N.S. 1984. Corporate financing and investment decisions when firms have information that investors do not have. *Journal of Financial Economics* 5, 157-175.

Nunes, P.M., Zélia, S., and João, L. 2012. Is there a linear relationship between R&D intensity and growth? Empirical evidence of non-high-tech vs. high-tech SMEs. *Research Policy* 41, 36-53

Opler, T., Pinkowitz, L., Stulz, R., and Williamson, R. 1999. The determinants and implications of corporate cash holdings. *Journal of Financial Economics* 52, 3-46.

Qiu, M., and La, B. 2010. Firm Characteristics as Determinants of Capital Structures in Australia. *International Journal of the Economics of Business* 17 (3), 277-287

Redding, L. 1997. Firm Size and Dividend Payouts. *Journal of Financial Intermediation* 6, 224-248.

Rozeff, M. 1982. Growth, beta and Agency Costs as Determinants of Dividend payout Ratios. *Journal of Financial Research* 3, 249-259.

Smith, C.W., and Watts, R.L. 1992. The investment opportunity set corporate financing, dividend and compensation policies. *Journal of Financial Economics* 31, 263-292.

Titman, S. 1984. The effect of capital structure on a firm's liquidation decision. *Journal of Financial Economics*, 13,137-151.

Titman, S., and Wessels, R. 1988. The determinants of capital structure. *Journal of finance* 43, 1-19.

Utami, S.L., and Inanga, E.L. 2011. Agency Costs of Free Cash Flow, Dividend Policy, and Leverage of Firms in Indonesia. *European Journal of Economics, Finance and Administrative Sciences 33.*

Wang T., and Thornhill S. 2010. R&D Investment and Financing Choices: A Comprehensive Perspective. *Research Policy* 39, 1148–1159.

Williamson, O. 1988. Corporate finance and corporate governance. *Journal of Finance* 43(3), 567-591.

Zeckhauser, R., and Pound, J. 1990. Are large shareholders effective monitors?: an investigation of share ownership and corporate performance. *In: Hubbard, G.* (*Ed.*), *Asymmetric Information, Corporate Finance, and Investment.* University of Chicago Press, Chicago.