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Market valuation of intellectual property assets

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Abstract

This paper investigates the relationship between the innovative activity of the top corporate R&D investors worldwide and their valuation on the financial markets. The empirical analysis is based on a sample of more than 1,500 top publicly listed Multinational Corporations (MNCs) performing a considerable share of the business investment in R&D worldwide. The main dataset covers their intellectual properties, patents and trademarks, filed between 2005 and 2012. The paper extends upon the recent literature on the links between IP assets and the firms' financial valuation. It assesses the potential premium resulting from the interactive use of different IPRs. More importantly, it differentiates the extent to which IPRs confer a market premium to companies with respect to their industrial competitors from the extent to which within-company variations hold the key to a market premium. Finally confirming the relevance of corporate mixes of IP assets, important industrial specificities are found in the premiums granted to both individual and two-ways strategies.

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Keywords: patents, trademarks, innovation, market valuation, within-/between-effects

JEL: O31, O34, L19

1. Introduction

The recognition of knowledge as the fundamental resource for sustainable economic competitiveness and growth has come with an upsurge in the investments into knowledge-based assets. As tangible assets (e.g. machinery, equipment, plants and buildings), knowledge-based assets such as databases, innovative properties (e.g. R&D, patents, trademarks) and economic competencies (e.g. market research, worker training) are now considered as equally or even more strategic elements for the performances of firms. At the policy level, the idea of knowledge-driven economies has triggered a wider commitment into and support for the development of local knowledge bases and pools of knowledge-based assets (e.g. patents pools). These trends have come with a faster increase of intangible capital investments as compared to tangible investments in several countries (Corrado et al., 2009; Dal Borgo et al., 2012).

The market valuation of corporate tangible and intangible assets largely depends on the actual performance of firms and the investors' expectations of future achievements. From a company perspective a higher market valuation can also constitute a relevant enabling factor for accessing less costly and/or greater funds. In tune with this perspective, a flourishing literature, which looks at the effects of firms' intellectual property rights (IPRs) on stock market valuation, has confirmed their contribution to the valuation of companies on financial markets (e.g. Hall et al., 2005). However, most research has investigated this relationship using R&D-and/or patent-based indicators as the main proxies for the intangible assets of firms, leaving underestimated the effects of other corporate knowledge-based assets such as trademarks. While the economic rationale for R&D can easily be related to the upgrading in absorptive capabilities, to exploration purposes and greater opportunities for innovations, patents are commonly justified by the uncertainty to appropriate the expected returns to such intangible innovation investments. Indeed, patents confer the owner the exclusive right to use the related invention for commercial exploitation(s), and to transfer the use right to other parties (e.g. under licence). This exclusive right is limited in time and space, and is granted under strict requirements (novelty, non-obviousness and industrial applicability). However, the recourse to patents features strong sector specificities (Dernis et al., 2015), not all patents lead to commercially viable products, and firms often combine different means to protect the fruits of their innovative activity (Cohen et al., 2000; Gallié and Legros, 2012).

Surprisingly few scholars have attempted to assess the market valuation of trademarks and patents together (e.g. Greenhalgh and Rogers, 2006; Greenhalgh and Rogers, 2012 for a sample of United Kingdom's firms). Trademarks are distinctive signs such as words, pictures, logos, shapes, colours, sounds or any combination of those signs, allowing companies to differentiate their goods and services from those of their competitors. Given their informational role for customers, trademarks may also provide incentives for firms to improve the quality of their offer (Economides, 1988; Cabral, 2000). As such, they can carry valuable information for investors and therewith influence the valuations of companies on financial markets.

Following these arguments, our study exploits a sample of the top R&D investors worldwide to assess the contribution of their patents and trademarks portfolios on their valuation on financial markets. It first adds to the previous economic literature by accounting for the effects of the simultaneous and interactive use of different IPRs (patents and

trademarks). As for the use of patents across industries, there is also a significant heterogeneous recourse to trademarks (Milot, 2012; Dernis et al., 2015).

In line with Ramnath (2002), we argue that investors do not only form their expectations using information exclusively on the target firm. They also benchmark it against firms in the same sector, thus considering conjointly the overall sector performance. Such process calls for the integration of both firm- and industry- specificities in the empirical analysis of the firms' market valuation. As a second contribution, our paper accounts for this neglected feature of investors' evaluation in empirical accounts, and disentangles the effects of the IPRs on market valuation accordingly. Finally a finer investigation at the industry level allows opening a discussion on the industry-specific nature of the links between patents, trademarks, patents and trademarks on the one hand and the market valuation of R&D investors on the other hand.

The rest of the paper is organised as follows. Section 2 outlines the theoretical background. Section 3 presents the data and the methodological framework. Section 4 discusses the results. Section 5 concludes.

2. Theoretical Background

The increasing competition in the markets for technologies reduces the possibility for firms to realise long term returns from their innovative activities. In the Schumpeterian framework, the rents deriving from innovation activities are threatened by the process of creative destruction whereby new entrants challenge the incumbents by introducing innovations that render obsolete the current dominant products and technologies on the market. In order to extend the rent extraction from their innovations, firms have developed complex innovative strategies through the generation of multi-dimensions innovations. These new corporate strategies have shifted the focus from purely technology-based innovations to broader and more systemic conceptions of innovations, often relying on the simultaneous development of technological and non-technological forms of innovations (Frenz and Lambert, 2009; Evangelista and Vezzani, 2010). Indeed, evidence on these mixed modes of innovation show that this shift has occurred in both large and smaller firms as well as in manufacturing and services sectors (OECD 2011). The higher innovation rates and risks of imitation have led firms to combine technological advancements with new business methods, organizational and marketing innovations. This dynamics has been originally pointed out by Hall (1993), who showed the increasing importance of advertising related expenditures for the companies' stock market valuation. In this broader conception of innovation strategies, firms increasingly rely on a wider set of intangible assets and IPRs protection means. These IPR strategies, referred as the IP bundles, allow them to delay the imitation and to extend the temporary monopoly period (Greenhalgh and Longland, 2005). Thus, they may confer them overall higher expected returns from innovation. Our study attempts to account for these firms' behaviours and assesses whether corporate IPR strategies yield higher rewards on the international financial markets.

The returns to innovation at the micro level are generally estimated through output measures related to the profits, sales, productivity (e.g. Geroski et al., 1993; Hall and Bagchi-Sen, 2002), and the stock market performance (Hall, 2000; Hall et al., 2007). However, unlike market valuation, there is a longer and uncertain time lag between innovation spending and the realization of its effects on productivity and on the market via products sales and profit. This

has been referred to as the problem of timing of costs and revenues (Hall 2000). Nevertheless, as underlined earlier by Griliches (1981) and more recently by Hall et al. (2007), the firm's valuation in public financial markets constitutes a relevant indicator of the expected success of its innovation activities.¹

In order to assess the market value of corporate knowledge assets, many scholars have relied on R&D and patents-based indicators² as proxy for firms' innovative activities (Toivanen, et al., 2002; Hall et al., 2005). However patents may have an additional role beyond the conventional protective and incentive functions. Indeed, patents can also constitute a signal to investors that reduces the information asymmetries and mitigates their financial constraints, thus revealing somehow the ability of firms to leverage funds on the markets (Hottenrott et al., 2016). Prior works addressing the effects of corporate patenting activities on the market valuation of firms suggest a positive and significant association, although its importance may differ across jurisdictions (Hall et al., 2007). However partly due to the inherent characteristics of patents,³ some innovations may not be patented. Moreover as pointed out by Greenhalgh and Rogers (2012) some innovations, which reflect new varieties and better qualities of product, may not pass sufficiently the inventive requirements although they may be labelled as innovations. In these cases, firms will recourse to alternative statutory means to protect their innovations (e.g. trademarks or industrial designs). Besides, in order to commercialize their new technologies through a range of products or process innovations firms would often need to implement complementary marketing and organizational methods. In line with these arguments, our paper examines to which extent firms with a wider range of innovative outputs, assessed through their patent and trademarks portfolios, benefit from a higher premium on the financial markets.

Following the conceptual approach of Rujas (1999) on the complementarity between patents and trademarks, we argue that different IPRs may convey different signals to investors. Indeed while patents may carry out information on the technological competencies of the firms and serve more for forward looking purposes, trademarks would rather convey information on the actual commercial and marketing capabilities of the firms. Few studies have attempted to assess the effect of different intellectual protection means on the stock market performances of the firms (e.g. Greenhalgh and Rogers, 2006; Greenhalgh and Rogers, 2012). Their findings on samples of United Kingdom firms' patents and trademarks at the UK International Property Office (UK IPO) and the European Patent Office (EPO) suggest that both patents and trademarks may be significantly associated with the market value of the firm. However, they do not account for the interactive use of these IPs, thus for the additional premium resulting from broader IP strategies. Moreover, our paper examines the strength of the IP-market valuation relationships across different industries.

¹ See Hall (2000) for a detailed earlier review.

² See Kleinknecht et al. (2002) and Hagedoorn and Cloudt (2003) for detailed discussions on the use of these indicators to assess firms' innovative performances.

³ See Acs and Audretsch 1989, Griliches 1990, de Rassenfosse et al. 2013 for discussions on the use of patent as an indicator of innovative activities.

3. Data and Methodology

The sample is built upon the 2013 EU Industrial and R&D Investment Scoreboard,⁴ which provides annual data on the top 2000 R&D investors worldwide. They account for about 80% of the world's business investment in R&D (European Commission 2013). The patents and trademarks filed by these companies at the United States Patent and Trademark Office (USPTO) have been retrieved from the EPO's PATSTAT and OECD internal databases in the framework of a JRC-OECD joint project. The matching has been carried out on a by-country basis using a series of string matching algorithms contained in the Imalinker system (Idener Multi Algorithm Linker) developed for the OECD by IDENER, Seville, 2013. The matching exercise employs information on the Scoreboard companies' subsidiary structure (about 500,000 subsidiaries) as reported in the ORBIS database. Subsidiaries located in a different country with respect to a company's headquarters have been included when performing the matching of patents and trademarks to company-level data. Their patent and trademark applications have been consolidated into the relevant parent company. A more extensive description of the approach used to perform the matching can be found in Dernis et al. (2015).

The final dataset includes information on patents and trademarks filed at the USPTO over the period 2005-2012 for more than 1,500 Multinational Corporations (MNCs). The advantage of using USPTO data resides in the importance of the US markets for both the technologies and end-products. Besides our companies show a relatively higher IP activity in the US market, with the average number of patents and trademarks that is the largest at USPTO for more than half of the industries. Data on market capitalizations were obtained from the Bureau van Dijk's ORBIS database. Additional company level data are taken from the EU Industrial and R&D Investment Scoreboard's dataset.

In the empirical application, we model the market value of a given company upon a series of company indicators influencing the market perception of its actual worth and potential future performances.

In our framework, the market value of a given company could be written as:

$$mcap_{it} = \alpha + \beta_j IPR_{jit} + \gamma X_{it} + \delta controls + \mu_i + \varepsilon_{it} \quad (1)$$

where IPR_j stands for the intellectual property right considered in our study ($j =$ Patents; Trademarks; their interaction), X stands for a series of explanatory variables, and *controls* includes a set of binary variables for the industry (using the ISIC rev.4 classification), the market in which a company i is listed, and the time specific factors. Finally, in equation (1), μ_i represents the unobserved company-specific factors, and ε_{it} the error term; both are assumed to be normally distributed.

To estimate equation (1) we use a correlated panel random effects approach proposed by Mundlak (1978), modified by Neuhaus and Kalbfleisch (1998) and recently discussed by Schunck (2013) and Bell and Jones (2015). The choice of the estimation strategy is driven by

⁴ For more information on the sample of companies included in the EU Industrial and R&D Investment Scoreboard, see <http://iri.jrc.ec.europa.eu/scoreboard.html>.

two orders of consideration. Firstly, most of the variation in the dependent variable is of a cross-sectional rather than temporal nature (see table 1). Thus, a standard fixed effects specification, focusing on the within variation, does not appear as the best approach to estimate the impact of IP assets on a company's market value.

Table 1: Descriptive statistics of the Market capitalization

Market Capitalization (log)	Mean	Std. Dev.	Min	Max	Observations (Companies)	Share of within variation	Share of between variation
All sample	14.49	1.69	7.34	21.04	12074 (1818)	8.2	91.8
Computers & electronics	13.99	1.62	8.82	19.98	2985 (450)	8.7	91.3
Pharmaceuticals	14.25	1.95	9.15	18.82	923 (137)	5.5	94.5
Automobile	14.63	1.58	9.95	19.30	896 (135)	9.2	90.8

Secondly, the correlated panel random effect approach allows us to consider different context specific heterogeneity through the inclusion of time-invariant covariates (for instance the industrial sector in which a company operates or the market in which it is listed) and estimating the within and between effects into a single specification. In our view this approach reflects, in a more realistic manner, the behaviour of investors who do not only consider specific company's performances, but also benchmark them against other companies' performances. Indeed, as pointed out by King (1966), stocks are often seen by investors as falling into groups with 'similar' performance, firms in the same group share similar costs of capital and correlated results. More recently, Piotroski and Roulstone (2004) consider three types of investors and argue that market analysts have a lower access to firm idiosyncratic information than other investors (management or institutional investors with a high ownership stake) and tend to incorporate market- and industry-level information in their stock price formation. This is supported by evidence on a positive relation between analysts' accuracy and industry specialisation and on the fact that they tend to adjust their firm specific earnings forecasts in response to announcements of other firms in the same industry (Ramnath, 2002).

The within (fixed) effect can be incorporated into a random-effects model by decomposing the variables of interest into a between ($\overline{IPR}_i = \frac{1}{n_i} * \sum_{t=1}^{n_i} IPR_{it}$) and a within ($IPR_{it} - \overline{IPR}_i$) component. Thus, following Allison (2009), our hybrid estimation equation can be written as:

$$mcap_{it} = \alpha + \beta_w (IPR_{jit-1} - \overline{IPR}_{ji}) + \beta_b \overline{IPR}_{ji} + \gamma X_{it} + \delta controls + \mu_i + \varepsilon_{it} \quad (2)$$

In equation (2) the coefficients β_w and β_b represent the within and the between effects of a company intellectual property assets, respectively. This formulation, by group mean centering the intellectual property assets ($IPR_{jit-1} - \overline{IPR}_{ji}$), solves the collinearity problems that may arise from the correlation between IPR_{ji} and \overline{IPR}_{ji} as in the Mundlak approach. Therefore, it leads to more stable and precise estimates.

In addition of our main variables of interest, the Log patents and Log trademarks, we consider the impact of the company's sales growth and the influence of sector sales growth on the market capitalization. The former intends to capture the prospects for future growth of a particular company that is not directly linked to its current innovative activities or output; the latter reflects the tendency of investors to prefer companies operating in sectors with higher future growth prospects and the eventual premium for the related companies (see also Hall 1993). Also, firms with a higher labour productivity are expected to obtain higher rewards on the financial markets; it would thus act as a signal of efficiency and potential higher returns. This effect should translate into a positive coefficient on the labour productivity variable, here defined by the ratio of sales over employees. We consider physical investment, as measured by capital expenditures, to control for the differences in the size of companies. Finally, our estimations account for the possibility that markets may penalize firms with very high R&D expenditures as compared to physical investment, by introducing the ratio between R&D and capital investment flows. It should be considered that once controlling for the innovative output (through the inclusion of patents and trademarks), this variable captures the proportion of knowledge inputs not materialized in terms of innovative output with respect to tangible and more tradable investments. The IPRs enter with a lag in the model in order to account for the time delay in the identification and treatment of the information they may convey to the (potential) investors. Similarly all the right-hand side variables, except for the company's and sectoral sales growth, are also one-period lagged.

4. Results

Table 2 reports the results of the estimations over the whole sample of Scoreboard companies and for the three industrial sectors with the highest number of companies within the sample. For the whole sample, Model 1 (first column) shows the results from a specification excluding the interaction term between patents and trademarks, Model 2 (second column) adds the interaction, while for the industry estimations (last three columns) only the second specification is reported.

The first striking result is that the IP strategies have a higher and in general more significant power in explaining cross-sectional rather than within variation of market valuation. Market valuation seems to respond much more to the overall innovative outputs of companies (measured by their average IP outputs); this suggests that investors tend to value more the long-run innovative behaviour of companies. This may also reflect some degree of uncertainty in the evaluation of the potentialities of the latest innovative outputs of a company.

The within elasticity of market value (the increase in a company market value deriving from additional innovative outputs) is significant and around 2% for patents, but not significant for trademarks. Having additional patents exerts a significant and much stronger impact (elasticity of 16.7%) in the Pharmaceuticals industry, while they are not statistically significant in the Computers and Automobiles industries.

Table 2: Market capitalization regressions

	All sample		Sector estimations		
	Model 1	Model 2	Computers	Pharma.	Automobiles
IP - Within effect					
Log Patents	0.022*	0.022*	0.026	0.167***	-0.007
	(0.011)	(0.011)	(0.020)	(0.042)	(0.040)
Log Trademarks	-0.003	-0.003	0.016	-0.028	-0.024
	(0.009)	(0.009)	(0.015)	(0.031)	(0.029)
Patents*Trademarks		-0.009	0.006	0.087	-0.062
		(0.020)	(0.033)	(0.077)	(0.078)
IP - Between effect					
Log Patents	0.326***	0.284***	0.384***	0.214**	0.258***
	(0.017)	(0.024)	(0.038)	(0.090)	(0.083)
Log Trademarks	0.362***	0.275***	0.532***	0.628***	-0.125
	(0.023)	(0.041)	(0.096)	(0.121)	(0.182)
Patents*Trademarks		0.024**	-0.013	0.013	0.078**
		(0.009)	(0.019)	(0.027)	(0.039)
Other variables					
Sales growth (t)	0.245***	0.244***	0.657***	0.063**	0.873***
	(0.019)	(0.019)	(0.045)	(0.030)	(0.122)
Sector sales growth (t)	0.045**	0.045**			
	(0.019)	(0.019)			
R&D-Capital expenditure ratio	-0.079***	-0.080***	-0.080***	-0.030	-0.010
	(0.010)	(0.010)	(0.019)	(0.026)	(0.045)
Log labour productivity	0.265***	0.265***	0.420***	0.193***	0.589***
	(0.016)	(0.016)	(0.034)	(0.033)	(0.084)
Log capital investment	0.211***	0.209***	0.206***	0.124***	0.233***
	(0.010)	(0.010)	(0.018)	(0.025)	(0.037)
Sector fixed effect	Included	Included			
Time fixed effect	Included	Included	Included	Included	Included
Market fixed effect	Included	Included	Included	Included	Included
Constant	11.748***	11.839***	10.580***	11.624***	11.684***
	(0.556)	(0.557)	(0.273)	(0.352)	(0.763)
Observations	8,833	8,833	2,339	675	641
Number of bvd_panel	1,456	1,456	377	115	107
R-squared (overall)	0.692	0.696	0.718	0.821	0.717
Rho	0.723	0.722	0.719	0.683	0.757
RMSE	0.463	0.462	0.428	0.455	0.395

Standard errors in parentheses, clustered at the company level - *** p<0.01, ** p<0.05, * p<0.1

On the one hand, the non-significance of patents in the within estimation for the Computers industry (and to a lesser extent in the Automobiles one) could be due to the "dense web of overlapping IPRs that a company must hack its way through in order to actually commercialize new technology" (Shapiro, 2001, p.120), known as patent thicket, which renders difficult the evaluation of individual IPRs. On the other hand, in the Pharmaceuticals industry, where the market for drugs is much more regulated and new molecules rest on a narrow number of

patents, it is much easier to evaluate the potential impact of a patent on future firm performances. Investors actually grant a higher importance to the technical competencies conveyed by the companies' patent filings from the Pharmaceuticals industry. This is in line with Hall et al. (2014) suggesting an important role of patents in this industry. Finally, corporate trademarking activities do not lead to a significant premium, when considering their within effects.

Looking back at the between effect of IPRs, our results clearly show that financial markets do value the technical and commercial knowledge conveyed by the corporate patents and trademarks. Moreover and differently from the full model estimations of Greenhalgh and Rogers (2006; 2012), which suggest a non-significant impact of trademarks on market valuation, we do find a positive relation between trademarks and market valuation.⁵ More, the between effects of patents and trademarks exhibit a similar magnitude. Twenty years after Hall (1993), who showed the increasing importance of advertising related expenditures during the 1980s, we find that product differentiation through trademarks seem to pay off (in terms of market valuation) as their technological developments.

The inclusion of a proxy for the combined use of patent and trademarks brings further evidence. The coefficients attached to the IPRs considered does not vary that much, where we find a positive and significant impact for their interaction. Having a larger patent portfolio pay off more for those companies which also own trademarks, and vice versa. In other words, investors reward a premium for those companies mastering a wider and possibly interrelated range of technical and commercial competencies. However, among the industries considered, this result holds true only for the Automobiles one. In this industry, the market premium associated to trademarks somehow vanishes away while the interaction term shows up with a positive and significant value. This may reflect the fact that the effects of trademarks operate mainly through patents.

The coefficient on patents is positive and significant across all specifications in the three selected industries. This result highlights the importance of corporate patenting activities when investors benchmark them to take investment decisions. Among the industries considered, (average) patents yield the highest impact in the Computers industry. Consistently with the patent thicket argument this may indicate the need to build up a higher negotiation power through larger patent portfolios in an industry characterized by a very high degree of technological complexity. In the Pharmaceuticals and Computers industries, the higher effects of corporate trademarks stress the importance of developing commercial and marketing competencies in parallel with new technologies.

Consistent results emerge for the remaining variables used in the specification. Firms with a higher sales growth are more likely to yield higher capitalizations on the markets, suggesting a positive valuation of investors on the companies' growth prospects. Again, industrial specificities arise and point at a much lower impact (in the order of one tenth) of sales growth in the Pharmaceuticals sector as compared to the other industries considered. Here, consistently with the within estimates, patents may incorporate a much clearer signal of future performances for investors. Moreover, investors tend to place a positive premium on

⁵ It should be noted that Greenhalgh and Rogers' estimation (2006, 2012) relies on fixed effect specification. Therefore, the non-significant effects of trademarks are in line to those we find for the within variation.

companies operating in sectors with an above-average growth, as suggested by the positive and significant coefficients on the sector sales growth. In other words, companies also benefit from operating in sector with an overall future potential for sales increase. Once the innovative output in terms of patents and trademarks are accounted for, our results indicate that investors would rather penalize companies with higher ratio of R&D over capital expenditures. However, this holds true only for the Computers industry. Consistently with our expectations, firms with a higher productivity also benefit from a market premium, as shown by the persistent positive sign on the coefficient associated to the ratio of sales per employee. Finally, larger firms, or more accurately, firms that *ceteris paribus* have higher investments in tangible investments obtain a higher valuation on the market.

5. Conclusions

Overall, our results confirm the importance of patenting and trademarks activities in influencing the firms' value on financial markets. Indeed they suggest that investors do account for and confer a premium to the technical, functional, commercial and marketing knowledge conveyed by the corporate IPRs. The empirical analysis also highlights the importance of industrial specificities in the IPRs-market valuation relationship and, it does so by considering a finer inspection at the industry level, as compared to the prior literature. We therefore confirm that differences in the relationship between innovation and stock performances originate also in industry-fixed effects, which relate to the characteristics of the technology in use, and more generally to the current technological regime (Mazzucato, 2006). The differences observed between the Computers, Pharmaceuticals and Automobiles sectors point indeed to industry-specific structural features such as the degree of complexity and modularity of the products, as well as differences in the strategic and competitive behaviours of companies. Finally, the empirical approach chosen allowed us to show that the effect of IPRs strategies on market values operates mainly through the cross-sectional dimension. What really seem to matter are the relative abilities of firms to develop new technological and commercial competencies.

Our analysis also supports a broader view of the mix of corporate knowledge-based assets to better assess their effects on the performances of companies and industries and their society-wide impacts. In the context of knowledge-driven economies this is even more important as the rate of intangible investments of firms and countries is expanding rapidly. In the current global economic context such assets constitute an important basis for companies to remain competitive.

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