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Firm market valuation and 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 market valuation. The analysis exploits a sample of more than 1,250 publicly listed Multinational Corporations (MNCs) and their intellectual property rights (IPR) – patents and trademarks – filed between 2005 and 2012. The study contributes to the literature on the IPRmarket value link by examining the premium resulting from the interactive use of different IPR. Moreover, the empirical setting allows differentiating the effects of an increase in market value derived from additional IPR (within-effects) with respect to the premium received for holding more IPR than the competitors (between-effects). The findings suggest that investors value the simultaneous use of the two IPRs and form their expectations by benchmarking firms. Finally, significant industrial specificities are observed in the individual effects of patents, trademarks and their interactions on the market value of firms.

KEYWORDS

Patents; trademarks; market valuation; within-effects; between-effects

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1. Introduction

The transition from industrial to knowledge-based economies came with large investments into the development and protection of intangible assets. Indeed, intangibles computerised information, innovative property and economic competences - are now considered to be equally or even more strategically important for the performances of firms than tangible assets (Corrado, Haltiwanger, and Sichel 2005; OECD 2013; WIPO 2017). This shift has important implications at macro- and micro-economic levels because intangible capital investments are growing faster than tangible investments in several countries (Corrado, Hulten, and Sichel 2009; Dal Borgo et al. 2012) and the management of intellectual property has become central for the economic and financial performance of companies, that is for their survival (Schautschick and Greenhalgh 2016).

On the financial markets, these trends are reflected in the increasing importance that investors place on intellectual property rights (IPR) and, more in general, the importance given to the strategies pursued by companies in appropriating and securing the returns from their innovations. The IPR strategies of companies influence the perceptions and valuations of investors and industry analysts, which in turn are translated into potential premiums on the financial markets (Sandner and Block 2011). Indeed, the market

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valuation of corporate tangible and intangible assets depends on the actual performance of firms and on investor' expectations of their future performance. Moreover, a higher market valuation can also constitute a relevant leverage for obtaining cheaper and/or larger funds (Hottenrott, Hall, and Czarnitzki 2016).

There is a flourishing literature in line with this perspective which has looked at the effects of firms' IPR on stock market valuation, confirming the importance of IPR for the valuation of companies on financial markets (e.g. Hall, Jaffe, and Trajtenberg 2005; Sandner and Block 2011). However until recently, the majority of studies have mainly investigated this relationship by focusing on R&D and/or patents as the main proxies for the technological intangibles of firms (Montresor and Vezzani 2016).

Only a limited number of studies have considered those intangibles which may capture the non-technological capabilities of firms. A few country-specific market value studies have extended their empirical assessment through the integration of alternative IPR such as trademarks (see Schautschick and Greenhalgh 2016 for a summary). Nevertheless, few scholars have assessed the market valuation of trademarks and patents together (e.g. Greenhalgh and Rogers 2006, 2012). Trademarks are 'distinctive symbols, pictures or words that identify specific product and services¹, whose purpose is to legally protect marketing assets, as brands, against imitation or detrimental activities of competitors (Sandner and Block 2011). Differently from patents, they are not subject to novelty requirement but confer a renewable right for exclusive use of the brands. Given their informational role for customers, trademarks may also provide incentives for firms to differentiate and improve the quality of their offer (Economides 1988; Cabral 2000). Hence, they may carry valuable information for investors (de Vries et al. 2017) and so influence the valuations of companies on financial markets, depending on the branding strategies of firms (Block, Fisch, and Sandner 2014). In addition, trademarks may enable the firms to extend the 'monopoly' rents of patented innovations beyond the patent term (Statman and Tyebjee 1981; Reitzig 2004) by steering potential customers through the brand and symbols protected by the trademark(s) (Rujas 1999).

Following these arguments, the study presented in this paper exploits a sample of the top R&D investors worldwide in order to assess the contribution of their patents and trademarks portfolios on their valuation on financial markets. First, it adds to the existing economic literature by considering the simultaneous and interactive use of different IPR (patents and trademarks) on a large sample of R&D-investing firms from different countries and industries. Second, we argue that investors do not form their opinions and projections only using information about the target firm exclusively (Ramnath 2002). Indeed, they also benchmark firms within the same market sector, thus considering the overall sector performance. Translating this practice into an econometric setting requires the correct accounting of between-firms effects in addition to the within-firm effects commonly investigated in the literature. Indeed, the results presented in this paper suggest that differences across firms are more important in explaining the intangibles premiums. Finally, a finer investigation at the industry level brings additional evidence on the industry-specific features of the effects of patents, trademarks and their interactions on the market valuation of companies.

¹Definition from the American Marketing Association accessed online on November 29th, 2018, https://www.ama.org/ resources/Pages/Dictionary.aspx?dLetter=T.

The remainder of the paper is organised as follows. Section 2 outlines the theoretical background. Then, Section 3 presents the data and the methodological framework. Section 4 discusses the results, and lastly, Section 5 presents the conclusions.

2. Theoretical background

As emphasised by Griliches (1981) and more recently by Hall (2000) and Hall, Thoma, and Torrisi (2007), the valuation of firms in public financial markets constitutes a relevant indicator of the expected success of their innovation activities.² In addition, market valuation measures can allow the early effects of firms' innovations to be captured and can be seen as a forward-looking indicator of the performances of firms, relevant to investors who assess future profitability (Griffiths et al. 2011). This is because longer and uncertain time lags can be expected between the innovation investments and the realisation of their effects on productivity and on the market *via* products sales and profit. These delayed effects, known as the problem of timing and costs revenues (Hall 2000), may narrow the scope of impact studies exploiting measures related to the profits, sales and productivity during a given period of time (e.g. Geroski, Machin, and Van Reenan 1993).

The increasing competition in the markets for technologies reduces the possibility for firms to realise long-term returns from their innovative activities. According to Schumpeter (1942), the growth process is largely driven by the so-called creative destruction, a conflict between incumbents and new innovators. In this framework, the rents deriving from innovation activities are constantly threatened by new innovations that make the dominant products and technologies on the market obsolete (Aghion & Howitt 1990). A temporary monopoly power may help firms to recover their R&D investments. Firms in these cases may have greater incentives to invest further, which in turn would reduce the overall under-investments that may derive from the differences between the social and private returns from innovations (Arrow 1962; Bloom, Schankerman, and Van Reenen 2013).

In order to extend the rent extraction from their innovations, firms have developed sophisticated innovative strategies, which often bring together technological and non-technological forms of innovations, such as new business methods, and organisational and marketing innovations (Frenz and Lambert 2009; Evangelista and Vezzani 2010). Indeed, evidence on these mixed modes of innovation show that this shift concerns both large and small firms as well as manufacturing and services sectors (OECD 2011). These dynamics were originally pointed out by Hall (1993), who showed the increasing importance of advertising-related expenditures compared to R&D expenditures in the stock market valuation of companies. This finding supports further the importance of firms on financial markets.

2.1. The importance of patents and trademarks for the valuation of firms on financial markets

The increasing use of intangible assets for the purposes of appropriation and rentextraction by firms has resulted in a rich literature, which examines their effects on the

²See Hall (2000) for a detailed earlier review.

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financial performances of companies (for example, see Hall 2000; Neuhäusler et al. 2011, and the reviews by; Hall and Harhoff 2012; Schautschick and Greenhalgh 2016). However, while research on the link between patents and market value is well established, only a few studies have accounted for the impact of a broader set of IPRs. Earlier studies from the economic literature exploited R&D- and patents-based³ indicators in order to assess the market value of corporate knowledge assets (Griliches 1981; Griliches, Hall, and Pakes 1991; Toivanen, Stoneman, and Bosworth 2002; Hall, Jaffe, and Trajtenberg 2005). A similar emphasis on patents-related measures was also underlined for the IPRs studies in the innovation management tradition (Candelin-Palmqvist, Sandberg, and Mylly 2012). Thanks to the availability of R&D and patent data at the firm level, the market value studies have been able to further confirm the importance of R&D, as well as to identify additional effects of patents indicators on the market valuation of companies: patents embed information about the market value of firms over and above the information R&D is able to convey (Hall and Harhoff 2012). This significant association may present different patterns across jurisdictions (Hall, Thoma, and Torrisi 2007; Belenzon and Patacconi 2013). Moreover, besides their conventional protective and incentive functions, patents can also constitute a signal to investors that reduce the information asymmetries and mitigates their financial constraints, thus revealing somehow the ability of firms to leverage funds on the markets (Hottenrott, Hall, and Czarnitzki 2016).

However, if it is true that patents do carry additional information about the value of firms for financial markets, they may not be as relevant in industries where patents are not so important, and also in the cases where the inventions or innovations are hardly or not patentable. Furthermore, on the one hand, in opting for patent protection of their new processes, firms can disclose 'too much' information, which in turn can be more easily used by competitors (Hall et al. 2014).⁴ On the other hand, partly due to the inherent characteristics of patents,⁵ some innovations may not be patentable. Indeed, some innovations such as new varieties or incremental quality changes may not pass the novelty requirements of patents (Greenhalgh and Rogers 2012). In these cases, firms may make recourse to alternative means of protecting their innovations such as trademarks.⁶

Trademark is the term for the legal protection of brands and other marketing assets (American Marketing Association). Trademarks were originally conceived to attenuate the information asymmetries between buyers and sellers⁷ (informational role of trademarks) by enabling the identification (and differentiation) of the origin of a good and by acting as an incentive for quality improvements of the offers (Ramello and Silva 2006). As such, they can carry valuable information for investors and enable firms to extend the 'monopoly' rents of patented innovations beyond the patent term (Statman and Tyebjee 1981; Reitzig 2004) by steering potential customers through the brand and symbols protected with the trademark(s) (Rujas 1999). Together with brands, trademarks

³See Kleinknecht, Van Montfort, and Brouwer (2002) and Hagedoorn and Cloodt (2003) for detailed discussions on the use of these indicators to assess the innovative performances of firms.

⁴Hall et al. (2014) give a conceptual framework to improve the understanding of the drivers behind the choice firms make regarding informal (e.g. secrecy) versus formal protection (e.g. patents).

⁵See Acs and Audretsch (1989), Griliches (1990), de Rassenfosse et al. (2013) for discussions on the use of patent as an indicator of innovative activities.

⁶See Mendonça, Pereira, and Godinho (2004); Flikkema, de Man, and Castaldi (2014) for evidence on the links between trademarks and innovation.

⁷See Akerlof (1970) for a seminal illustration of these information asymmetries on the 'market for lemons'.

constitute key drivers in the ability to command higher prices. Therefore, they play an important role across different market segments and can account for significant shares of the market value of firms (Corrado and Hulten 2010; Block, Fisch, and Sandner 2014; Schautschick and Greenhalgh 2016; World Intellectual Property Organization, WIPO 2017). The market value effects of individual trademarks will differ depending on the type of trademarks and their relationship to the branding strategy of firms (Krasnikov, Mishra, and Orozco 2009; Block, Fisch, and Sandner 2014).

Moreover, firms often rely on bundles of IPR to protect different facets of the same innovation. Such IPR strategies, referred to as the IPR bundles, may allow innovators to delay the imitation and to benefit from greater innovation returns (Greenhalgh and Longland 2005). The use of IPR combinations is increasingly documented at the country, sectoral and firm-levels (OECD 2011; Millot 2012; and see; Dernis et al. 2015 for detailed statistics about the industry-specific patterns of IPR combinations can significantly increase the probability of receiving larger amounts of venture capital, compared to situations where firms only resort to a single intellectual property (Zhou et al. 2016). These empirical observations are consistent with Rujas's conceptual framework on the complementarity of patents and trademarks. Similarly, it can be argued that different IPR may convey different signals to investors: while patents carry information on the technological capabilities of the firms and serve forward-looking purposes more, trademarks would convey information on the actual commercial and marketing capabilities of the firms (Rujas 1999; de Vries et al. 2017).

Only a few studies have attempted to assess the effects of patents and trademarks together on the stock market performances of the firms, framing the analysis within the Tobin-q approach. The market value of a given company in the Tobin-q framework is derived from the bundle of its tangible (total) and intangible (IPR) assets (see, for example, Griliches 1981 or Greenhalgh and Rogers 2006). Table 1 presents the firm-level studies that are close to the conceptual framework and questions of this paper. Accordingly, only those empirical works that have investigated the role of both patents and trademarks in the valuation of firms on financial markets are considered.

Most of the works considered focused on a sample of firms from a specific country (the UK, France and Australia). To the best of our knowledge, the analysis of Sandner and Block (2011) is the only one to consider a multi-country and multi-sector perspective. This makes any comparisons between countries difficult, but the overall results suggest that trademarks and patents may simultaneously account for a significant share of the valuation of companies on the financial markets. Furthermore, what these studies underline further are the different effects of patents-trademarks combinations across sectoral groups or industries. However, none of the market value studies has investigated the potential impacts of the interactions between patent and trademark portfolios. Yet, such explorations are able to unveil significant patterns on the combined use of patents and trademarks, as emphasised by Llerena and Millot (2013) for a sample of French listed companies.⁸

⁸For close conceptual discussions on other protection means, see also the study on trademarks and copyrights by Somaya and Graham (2006).

How IPs enter in the Sectors analysis estimation	NO Flows (Industries dummies) (averaged)	YES Flows 6 Pavitt macro-sectors (suppliers-dominated; production intensive; science-based; information intensive; software firms)	YES Stocks for Trademark intensity (large coefficients in Machinery & computer eq. Transport equipment and Biotech & Pharma)	YES Flows Manufacturing (Pat & TM) + <i>and</i> Dummies Services (TM only)
IPIP Interaction	ON	ON N	NO (lar	o N
Main results: (sign) and/or sig	PAT/Tangibles assets: (+) significant TM/tangibles assets: non significant	UK PATTORI assets: non-sign (negative only in suppliers- dominated) EPO PAT/Total assets: (+) significant (only in production intensive & science-based) TM/Total assets: non- significant all sectors but (-) significant in information intensive	R&D stock/assets: (+) significant PAT stock/R&D stock: non- significant Citations stock/R&D stock: (+) significant TM stocks/Marketing assets: (+) significant	CTM/TA: (+) significant in manuf. & services UK TM/TA: non-significant EPO PAT/TA: (+) significant in manufacturing UK PAT/TA: non-significant in manufacturing Include diso interaction terms
Variable for Market Value	Tobin's Q (sum of market valuation and book value of debt)	log(market value) = outstanding shares (average in year) × price (end accounting period) + creditors and debt – current assets.	In of Tobin's Q (Market value of comp/Book value of assets)	log(MV/Tangible assets)
Estimation Method (fixed/random)	LSDV and fixed effects	OLS (industry & year dummies)	Non-linear least squares	OLS with industry & year log(MV/Tangible assets) dummies
Sample	1994–1996 averaged 60 Australian listed firms	19892002 4367 UK companies	1996–2002 1216 companies from different countries	1996–2000 1600 UK companies
Author/year	Bosworth and Rogers (2001)	ers (6)	Sandner and Block (2011)	Greenhalgh and Rogers (2012)

How IPs enter in the	estimation	Dummies	Patent Trademark publication	Flows
	Sectors analysis	YES Pharma & Chemicals <i>(complementarity)</i> Computer & Electronics (substituability)	One firm – one product	YES Pharma: within PAT & TM (+) sign. between TM (+) sign. Auto: between PAT (+) sign. Computer & Elect: between PAT, TM, PAT&TM (+) sign
didi	Interaction	YES (dummies)	Q	YES
Main results:	(sign) and/or sig	Only PAT: not significant Only TM: (+) significant PAT & TM: (+) significant	Patent application/grants: stronger effects on Apple's abnormal returns with patent application Trademark filing: non- significant reaction	Within effects: not significant for PAT, TM, PAT & TM Between effects: (+) significant for PAT, TM, PAT & TM
	Variable for Market Value	log(Market value):	Stock returns at day t (In of Trading volume/Market capitalisation)	Market capitalisation = market price × outstanding shares + long term debts and current liabilities
Estimation Method	(fixed/random)	Supermodularity tests	OLS + testing average returns on days close to patent/trademark publication	Panel estimation – Decomposition of within and between effects
	Sample	2007 French listed companies	Korkeamäki 1999–2009 and Case study (Apple, Takalo introduction of (2013) different versions of iPhone)	2005–2012 1,273 listed Multinational Corporations from different countries
	Author/year	Llerena and 2007 Millot Frenc (2013) co	Korkeamäki and Takalo (2013)	This study

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The contribution made in this paper provides complementary evidence on this issue and provides an assessment of the effects of patents, trademarks and their combined use on the market value of companies. Furthermore, the present study exploits a sample of leading R&D-investing companies worldwide and so also contributes to the still underdocumented features of IPR complementarities in large firms (Zhou et al. 2016).

2.2. Why are the links between IPRs and market valuation industry-specific?

The well-known taxonomy of Pavitt (1984) and the subsequent literature (e.g. Malerba and Orsenigo 1997; Marsili 2001; Castellacci 2008) have greatly advanced the knowledge on the industry-specific nature and processes of innovation. They illustrate how different industries are characterised, for instance, by different dominant types of innovation, sources of technology, the requirements of users, and appropriability conditions. The specific pattern of innovative activity that emerges in a given industry therefore depends on the technological regime or the combination of specific technological opportunities, the conditions for the appropriability of innovations, the patterns of cumulativeness of technical advances and the properties of the knowledge base (Breschi, Malerba, and Orsenigo 2000). Industrial specificities in the innovation process are associated with differentiated marketing and IPR strategies implemented by firms across industries (Cohen, Nelson, and Walsh 2000; Krasnikov, Mishra, and Orozco 2009; Gallié and Legros 2012). In other words, appropriability conditions are likely to influence the relationship between the innovation and their market performances of companies; and they are likely to do so differently across industries and depending on the IPR considered (Greenhalgh and Rogers 2006; Castaldi and Dosso 2018).

Focusing on the recourse to patents and/or trademarks, Dernis et al. (2015) confirm that strong industrial specificities can also be observed among large R&D-investing companies. For instance, companies operating in the Computers and electronics, Pharmaceuticals and Transport equipment sectors tend to rely more often on IPR portfolios made of patents and trademarks than on single IPR strategies - only patents or only trademarks - (Dernis et al. 2015). These distinctive patterns partly reflect the relative importance of each IPR, their combination, and their eventual relevance as means of appropriation of innovation returns across different industries. The use of patents (and trademarks) as indicators of innovation activities has been extensively discussed in the literature (Acs and Audretsch 1989; Griliches 1990; de Rassenfosse et al. 2013 on patents and; Mendonça, Pereira, and Godinho 2004; Malmberg 2005; Flikkema, de Man, and Castaldi 2014 for evidence on trademarks). With respect to patents, Hall et al. (2014) drew attention to a dichotomic picture, distinguishing between discrete product industries – such as pharmaceuticals, metals, and metal products – where patents are still the preferred means to secure the returns to innovation, and *complex* product industries – such as computers, software, electrical equipment and transportation equipment – where they serve more strategic purposes (Hall et al. 2014). Using evidence at the trademark level in the automobile industry, Malmberg (2005) suggested that automobiles companies would opt for models number rather than trademarks for their new products. The author concludes: 'The negative conclusion regarding the use of trademark in these companies must therefore be considered valid also today.' (Malmberg 2005, 35). These arguments are accounted for in the present study and the paper provides an updated, yet partial, assessment of the relevance of patents, trademarks and their combination across different industries, namely Computers, Pharmaceuticals and Automobiles.

These three IPR-intensive sectors feature very distinct patterns of innovation behaviours and marketing strategies. These differences should translate into specific combinations of patents and trademarks that help sustain the IPR-based competitive advantages of firms (Reitzig 2004). Patents and trademarks in the pharmaceutical industry are more likely to be used as complements to protect the new molecules and to extend the rent extraction beyond the patent term through strong brand- and reputation-building strategies (Reitzig 2004; Millot 2012); one patent and trademark pair in this industry can indeed have a high valuation (Thoma 2015). In more complex industries such as computers and transport equipment, characterised by fast product depreciation rates, and where single-branded products are commonly based on many patents (Hall et al. 2014, Reitzig 2014), investors are likely to grant relatively much higher value to patents than to trademarks (Llerena and Millot 2013). Nevertheless, companies such as Apple (Computers industry) or Toyota, (Automobiles industry) feature in the most valuable trademarks-protected brands of the world.⁹ This questions Malmberg's earlier finding on the low importance of trademarks in the Automobiles sector where trademarks-protected brands are used to differentiate products and services, as well as for reputational purposes (Hoeffler and Keller 2003). However, traditional carmakers are facing a greater technological competition on the parts and components segment, a growing standardisation shifting the power from automobile brands to suppliers, and the recent opening up of patent portfolios in key technologies such as electric vehicles, batteries and fuels life cells¹⁰ These dynamics have speeded the patent race, shortened the technology cycles, and may have favoured the increased use of alternative or complementary means of protection (Alcácer, Beukel, and Cassiman 2017). At the same time, one or a few valuable patents may actually grant a great market power and provide the basis to build up strong trademark-protected brands on technological reputation. Similarly, technological competition in the computers industry is particularly strong and firms rely heavily on patents (Daiko et al. 2017). However, the decrease of production prices and of the margins derived from technological advances has led some companies to develop strong trademark-based differentiation strategies. This hints at the importance of combining technological and non-technological intangibles in this industry.

As shown in Table 1, the relationship between IPR and market value is indeed industry-specific. However, empirical research is still needed to improve the understanding of the effects of patents and trademarks and their combined use in distinct industrial contexts. Consequently, this study contributes to the literature on the IPR-market value link and examines how patents-trademarks combinations yield different pay-offs for leading R&D-investing firms operating in the computers, pharmaceuticals and automobiles industries.

⁹See the Forbes's 2018 ranking of the World's most valuable brands at https://www.forbes.com/powerful-brands/list/ #tab:rank.

¹⁰See Tesla Motors and Toyota companies' announcements to open their patents portfolios related to hybrid and electric vehicles technologies: https://www.forbes.com/sites/briansolomon/2014/06/12/tesla-goes-open-source-elon-musk-releases-patents-to-good-faith-use/#73b5853c3c63 and https://techcrunch.com/2019/04/03/toyota-is-giving-automakers-free-access-to-nearly-24000-hybrid-car-related-patents/..

3. Data and methodology

3.1. Data

The original sample is based on the 2013 EU Industrial and R&D Investment Scoreboard,¹¹ which provides annual data on the top 2000 corporate R&D investors worldwide. These companies account for about 80% of business investment in R&D in the world (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 the OECD internal databases in the framework of a joint JRC-OECD project. The matching was carried out on a country-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.¹² The matching exercise uses information on the subsidiary structure of the Scoreboard companies (about 500,000 subsidiaries) as reported in the Bureau van Dijk's ORBIS¹³ database. Subsidiaries located in a different country than the headquarters of a company were included for the matching of patents and trademarks to company-level data. Their patent and trademark applications were consolidated into the relevant parent company. A detailed description of the approach used to perform the matching can be found in Dernis et al. (2015).

The initial dataset includes information on patents and trademarks filed at the USPTO by more than 1,500 Multinational Corporations (MNCs) in the period 2005–2012.

The advantage of using USPTO data lies in the importance of US markets for both the technologies and the end-products. Besides, these companies show a relatively greater IPR activity in the US market, with the average number of patents and trademarks being the largest at the USPTO for more than half of the industries. Data on market value were obtained from the ORBIS database and market value is calculated by multiplying the share price by the number of outstanding shares. Additional company-level data are taken from the EU Industrial and R&D Investment Scoreboard's dataset. The availability of the different data used in the analysis reduces the estimation sample to 1273 companies.

Most of the companies in our estimation sample are headquartered in the US (38.6%), in a European country (24.7%) or in Japan (24.4%); the remaining 12.4% of companies are headquartered in the Rest of the World (Table 2). In terms of sectors, the sample is largely composed of companies operating in the Computer & Electronics one (25%).

In accordance with the extant literature, separate sector regressions were run on the companies operating in Computer & Electronics (Computer), Pharmaceuticals (Pharma, 7%) and Transport Equipment (Auto, 8%).On the other hand, other sectors largely represented in the sample such as Chemicals (8%) and Machinery (9%) are not discussed. However, separate regressions were also run for these two sectors, which show similar

¹¹For more information on the sample of companies included in the EU Industrial and R&D Investment Scoreboard, see at http://iri.jrc.ec.europa.eu/scoreboard.html.

¹²IDENER is a private research SME company composed of a team of researchers with a scientific background in different disciplines related to systems engineering (electronics and computer, systems integration and control, and process engineering).

¹³The ORBIS database provides economic and financial information on over 280 million of public and private companies in the world. More details about the contents and the uses of ORBIS can be found at https://www.bvdinfo.com/en-gb /our-products/data/international/orbis.

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Region	# of companies	Frequency (%)
USA	491	38.6
EU	314	24.7
(Germany	70	5.5)
(France	57	4.5)
(UK	51	4.0)
Japan	310	24.4
Rest of the world	158	12.4
(Taiwan	54	4.2)
(China	35	2.8)
Total	1,273	100

Table 2. Distribution of companies across world regions.

regression results to those obtained for the Automobiles industry. It should be noted that, by construction, the sample does not need to be representative of the population of firms across countries and sectors as it is explicitly compiled to represent the top R&D investors in the world. Moreover, the availability of stock market data and the various propensities of firms to file patents and trademarks at the USPTO tend to favour US companies and the Computer & Electronic sector. All in all, compared to similar studies, the sample used in the study presented in this paper covers more countries and seems to be better suited to analysing the links between IPRs and market value for multinational companies.

3.2. Econometric strategy

In the empirical application, we model the (natural logarithm of) market value of a given company upon a series of indicators influencing the market perception of its actual worth and potential future performances. Similarly to prior contributions (e.g. Greenhalgh and Rogers 2012), the market capitalisation is computed as the market price multiplied by the outstanding shares plus the long-term debts and current liabilities.

To estimate the relationship between IPRs and the market value of a given company, the following equation was estimated:

$$mcap_{i,t} = \alpha + \beta_{j}IPR_{ji,t-1} + \gamma X_{i,t} + \vartheta Z_{i,t-1} + \delta_{1}year + \delta_{2}industry + \delta_{3}market + \mu_{i} + \varepsilon_{it}$$
(1)

where IPR_{jit} represents the intellectual property rights (j = Patents; Trademarks; their interaction) filed by company *i* in year *t*; in particular, we consider the number of patents applications and registered trademarks. X_{it} stands for a series of explanatory variables that enter into the estimation equation without a lag. In particular, we control for the total assets of a company, its one-year sales growth and the sales growth of the sector in which a company operates. The inclusion of total assets is crucial to align the estimation framework to the Tobin-q theory and to estimate the coefficients attached to the IPR variables correctly. Z_{it-1} represents the lagged values of the labour productivity of a company (proxied by the ratio of sales over employees). A set of binary variables is also introduced as controls for year, industry (using the ISIC rev.4 classification) and the financial market on which a company *i* is listed. Finally, μ_i in equation (1) represents the unobserved company-specific factors, and ε_{it} the error term; both parameters are assumed to be normally distributed.

To estimate equation (1), this study uses a correlated panel random effects approach initially 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 two considerations. First, the greatest share of the variation in the dependent variable is cross-sectional: more than 95% of the market value variation in our data is due to differences between firms (see Table 3), while changes in market value of individual firms (within) explain less than 5%.¹⁴ Given the nature of the data a standard fixed effects specification, focusing on within company variations, does not appear to be the best approach to estimating the impact of IPR on a company's market value.¹⁵

Second, the correlated panel random effect approach allows different context-specific heterogeneity to be considered 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. This approach reflects, in a more realistic manner, the behaviour of investors as they do not only consider specific company's performances, but also benchmark them against the performance of other companies. 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 more restricted access to idiosyncratic information about firms than other investors (management or institutional investors with a large ownership stake) and tend to incorporate market- and industry-level information in their stock price formation. This is supported by the evidence on a positive relationship between the analysts' accuracy and the industry specialisation and on the fact that they tend to adjust their firm-specific earnings forecasts in response to announcements by 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 $(\overline{IPR}_i = \frac{1}{n_i} * \sum_{i=1}^{n_i} IPR_{it})^{16}$ and a within $(IPR_{it} - \overline{IPR}_i)$ component. Therefore, following Allison (2009), the *hybrid* estimation equation can be written as:

Market Capitalisation (log)	Mean	Std. Dev.	Min	Max	Observations (Companies)	Share of within variation	Share of between variation
All sample	14.69	1.78	9.44	20.25	6856 (1273)	2.4	97.6
Computers & electronics	14.07	1.67	9.44	19.78	1756 (322)	3.5	96.5
Pharma	14.07	2.23	9.52	18.84	468 (91)	2.4	97.6
Auto	15.20	1.74	10.24	19.15	833 (102)	2.0	98.0

Table 3. Descriptive statistics of the market value.

¹⁴Please note that these numbers are computed on the whole market capitalisation figures and are not limited to the estimation sample.

¹⁵Moreover, a fixed effect framework only looking at deviations around firms' averages may be largely influenced by short-run fluctuations, subject to measurement framework and other transitory influences (Griliches 1990).

¹⁶Where n_i stands for the number of years for which we observe a company in the sample.

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

The coefficients β_w and β_b in equation (2) represent the within and the between effects of the intellectual property assets of a company, respectively. This formulation, by company mean centring 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.

3.3. Discussion of the variables used for the empirical analyses

The main variables of interest are the natural logarithm (Ln) of patents and trademarks counts and the interaction between these two and then transformed as explained with the paragraph above. In addition, the (logarithm of) total assets of a company is controlled for, a standard approach in market value studies.

We also control for the impact of the sales growth of the company and the influence of sector sales growth on its market value. The former captures the prospects for future growth of a particular company that is not directly linked to its current innovative activities while the latter reflects the tendency of investors to prefer companies operating in sectors with higher future growth prospects and the eventual premium for related companies (see also Hall 1993).

Furthermore, firms with higher labour productivity, a signal of efficiency and greater potential returns, are expected to obtain higher rewards on the financial markets. This effect should translate into a positive coefficient on the labour productivity variable, here defined by the ratio of sales over employees.

Finally, the possibility that markets may penalise firms with very high R&D expenditures as compared to physical investment is accounted for by introducing the ratio between R&D and capital investment flows. It should be noted that once controlling for the intangible assets considered (patents and trademarks), this variable captures the proportion of knowledge inputs not materialised in terms of IPR compared to tangible and more tradable investments. The IPR 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. Because yearly data are used, the eventual immediate reaction of markets to a patent (trademark) filing cannot be discerned as in Korkeamäki and Takalo (2013) and the IPR variables should be lagged so as to be able to identify their effect. Moreover, given the theoretical arguments, we do not think that longer lags would provide useful information as in productivity or profit studies. Descriptive statistics of the variables and correlations among them are reported in Table A1 and Table A2, respectively (see the Appendix).

As a robustness check, the model is also estimated by integrating the 'quality' of the IPR in accordance with the insight of Scherer (1965) that the quality of patented inventions varies across patents, firms and industries. Among the proxies for IPR 14 🛞 M. DOSSO AND A. VEZZANI

quality (see Squicciarini, Dernis, and Criscuolo 2013) a slightly modified measure of scope, originally proposed by Lerner (1994) was used in this study.¹⁷

The scope (s_{IP}) of a patent (trademark) is the number of distinct technology (product) classes contained in the IPR document (ip). Technologies feature intrinsic characteristics that can confer them a broader or narrower scope; the same holds true for products.¹⁸ Therefore, the scope of a patent (trademark) is weighted according to the *IPC4* (Nice) classes it refers to.¹⁹ In particular, the average scope of all the patents and trademarks containing that specific class in a given year (s_c) was computed for each IPC4 and Nice class. The scope of an IPR is then normalised by the average scope of the classes contained in it:

$$wscope_{IP} = \frac{s_{IP}}{\frac{1}{s_{IP}}\sum_{c} s_{c}}$$

Accordingly, the within- and between-effects of patents and trademarks on the market valuation of firms are addressed by considering together their volume and using quality adjusted measures.

4. Results

4.1. Estimates for the whole sample

Table 4 reports the results of the estimations for the whole sample of companies. The industry-specific results are discussed in the next section.

The first two columns report the estimates using the volumes of patent and trademark activities, while the last two columns present the results for the regressions using quality adjusted volumes. For each of the two models, a specification (spec. 1) is presented first where the interaction between patents and trademarks is not included, and then the results from a specification including the interactions (spec. 2) are reported. Although the correlations of our explanatory variables show acceptable levels (see Table A2 in the appendix), we also run two additional specifications (3 and 4) with only total assets and the IPR explanatory variables. The coefficients of these specifications do not differ significantly from the estimates obtained when the full set of explanatory variables are included (see Table 4).

The estimations confirm that markets grant a premium for holding a larger sets of IPRs than the competitors (between-effects) rather than to the additional innovation assets of a company (within-effects). In contrast to the previous literature, by looking only at within-effects (see Table 1), the approach taken in this study allows us to highlight a key feature of the investors' endeavours on the financial markets: they mainly form

¹⁷The most common way of accounting for patent quality is by weighting patents by forward citations. However this paper uses the scope, because it is the only measure that can be built on both patents and trademarks. Moreover, it should be noted that forward citations are an ex-post measure (normally considering between 3 and 7 years lags) of the goodness of a patented technology. Considering both market and technology uncertainty it seems hard to assume that market operators are able to effectively discount the potential of a patented invention. The authors think that it is a more plausible hypothesis to assume that the market operator considers the product/technology breadth.
¹⁸Think about comparing a car engine with a medical pill.

¹⁹Trademarks are filed in accordance with the International Classification of Goods and Services, also known as the Nice Classification, while the International Patent Classification (IPC) is used to allocate patents to technological fields.

	COL	Counts	Quality	Quality adjusted	Counts without controls	out controls
	Spec. 1	Spec. 2	Spec. 1	Spec. 2	Spec. 3	Spec. 4
IP – Within effect						
Log Patents (t-1)	0.001	0.001	0.001	0.002	-0.001	-0.001
	(0.008)	(0.008)	(0.008)	(0.008)	(0.008)	(0.008)
Log Trademarks (t-1)	0.003	0.003	0.000	0.001	-0.003	-0.003
	(0.006)	(0.006)	(0.006)	(0.006)	(0.006)	(0.006)
Patents*Trademarks (t-1)		-0.002		-0.018		0000
IP - Between effect		(+10.0)		(cinn)		(+10.0)
l og Patents (t-1)	0.128***	0.077***	0.132***	***060'0	0.119***	0.073 ***
	(0.013)	(0.018)	(0.013)	(0.018)	(0.013)	(0.018)
Log Trademarks (t-1)	0.169***	0.062**	0.195***	0.096***	0.167***	0.069**
	(0.018)	(0.031)	(0.020)	(0.034)	(0.018)	(0.031)
Patents*Trademarks (t-1)		0.030*** (0.007)		0.028*** (0.008)		0.027*** (0.007)
Other variables						
Total assets (t)	0.661***	0.657***	0.658***	0.655***	0.691***	0.688***
	(0.011)	(0.011)	(0.011)	(0.011)	(0.011)	(0.011)
Sales growth (t)	0.260***	0.259***	0.259***	0.258***		
	(0.014)	(0.014)	(0.014)	(0.014)		
Sector sales growth (t)	0.026**	0.026**	0.026**	0.026**		
	(0.012)	(0.012)	(0.012)	(0.012)		
R&D-Capital expenditure ratio (t-1)	-0.064***	-0.065***	-0.065***	-0.066***		
	(0.00/)	(0.00/)	(0.00/)	(0.00/)		
Log labour productivity (t-1)	0.162***	0.163***	0.162***	0.162***		
				(0.012)		
	Included	Included	inciuaea	Included	inciuaea	included
	included	included	included	included	Included	included
Market fixed effect	Included	Included	Included	Included	Included	Included
Constant	4.479***	4.622***	4.538***	4.644***	3.801***	3.922***
	(0.406)	(0.406)	(0.406)	(0.406)	(0.412)	(0.413)
Observations	6,856	6,856	6,856	6,856	6,856	6,856
Number of bvd_panel	1,273	1,273	1,273	1,273	1,273	1,273
R-squared (overall)	0.891	0.891	0.891	0.892	0.884	0.884
R-squared (between)	0.901	0.902	0.901	0.902	0.896	0.896
R-squared (within)	0.300	0.300	0.300	0.300	0.249	0.250
Rho	0.800	0.800	0.800	0.800	0.795	0.794
RMSE	0.262	0.262	0.262	0.261	0.273	0.272

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their expectations by benchmarking firms and award a premium for holding more innovation assets than the competitors.

In other words, when jointly considering the within and between effects the within elasticity of market value – the increase in the market value of a company derived from additional IPR – is not significant, either for patents or for trademarks. Market valuation responds significantly to differences in the overall IPR of companies (the between effect); the estimated between elasticities (spec. 1) are of 12.8% for patents and above 16% for trademarks when the interaction term is excluded (spec. 1, Table 4).

These findings suggest that investors tend to value the long term and overall innovative capabilities of companies more by benchmarking them against other companies. This may also reflect some degree of uncertainty in the evaluation of the market potentialities of the latest intangible assets developed by a specific company. Indeed, one specific patent or trademark may have a huge immediate impact on the market valuation, as illustrated in several case studies (e.g. the Apple's iPhone, see Table 1). Nevertheless, the initial uncertainty about the future success of new technological solutions and products – especially when technological alternatives are being developed by different companies - and the highly skewed distribution of IPR value (Gambardella, Harhoff, and Verspagen 2008) suggest that on average (and ex-ante) the probability that a single IPR has a significant impact are small. In other words the innovative track record of firms and the market context matter. An intuition of this finding can be illustrated by the story of the Google glasses. Google glasses were launched at the beginning of 2013 and perceived by many as a potential game changer in the consumer good market. In 2015, Google announced that they were considering closing the project, which was later continued in enterprises versions. During this period, Google launched many other innovative projects and its innovative leadership has hardly been questioned so far.

Overall, the results show that financial markets do value the technical and commercial capabilities conveyed by corporate patents and trademarks. Moreover and in contrast to the full model estimations of Greenhalgh and Rogers (2006, 2012) suggesting a non-significant impact of trademarks flows on market valuation, a positive and strong relation between trademarks and market valuation is found.²⁰ Despite the different specifications, the results for the trademarks variable are in line with the findings of Sandner and Block (2011). Twenty years after Hall (1993), who showed the increasing importance of advertising related expenditures during the 1980s, we find that product differentiation through trademarks pay off (in terms of market valuation), besides the effects of new technological developments.

The inclusion of a proxy for the combined use of patents and trademarks brings further findings. The coefficients associated with each individual IPR do not differ much but a positive and significant impact is found for their interaction. This latter result suggests that having a larger patent portfolio pay off more for those companies which also own trademarks, and *vice versa*. In other words, investors seem to award a premium to those companies mastering a wider and possibly interrelated range of technical and commercial capabilities. Moreover, this result also holds true in the model integrating

²⁰It should be noted that the estimation of Greenhalgh and Rogers (2006, 2012) relies on fixed effect specification. Therefore, the non-significant effects of trademarks are in line with those found for the within variation.

quality-adjusted volumes, while the between coefficients of patents and trademarks slightly increase.

Consistent results emerge for the remaining control variables across the different models and specifications. Larger firms, or more accurately, firms that *ceteris paribus* have greater total assets would obtain a higher valuation on the market. Firms with higher sales growth are also more likely to yield a higher value on the markets, confirming the positive valuation that investors to the growth performances of companies. Moreover, investors tend to place a positive premium on companies operating in sectors with 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 sectors with overall potential for sales increase. Once the intangible assets (in terms of patents and trademarks) have been accounted for, the results indicate that the investors would rather penalise companies with a higher ratio of R&D over capital expenditures. As expected, firms with a higher productivity also benefit from a market premium, as shown by the persistent positive sign on the coefficient associated with the ratio of sales per employee.

4.2. Estimates by industry

Table 5 provides the estimations results for the regressions focusing on Computers and electronics, Pharmaceuticals and Automobiles, three industrial sectors with a large number of companies in the sample.

In line with the aggregate results, the industry-specific regressions confirm that markets are more likely to reward the companies for being more innovative than their competitors (between-effects) rather than for their additional intangible assets as individual companies (non-significant within-effects of single IPR). Nevertheless, the within-elasticity of market valuation of pharma companies to the interaction term is significant which suggests that, in this sector, specific combinations of patents and trademarks can be a relevant signal to investors. By pairing patents and trademarks pharmaceutical companies can yield high rewards, 'independently' of the performances of their competitors. This finding is consistent with the empirical analysis of Thoma (2015) who found that patents-trademarks pairs stand out due to higher valuations in the pharmaceuticals industry. Besides, the non-significance of the within coefficients on single IPR confirms the intuition of Reitzig (2004) according to which (exclusively) patents-based competitive advantage is fading away in many industries. The study even suggests that pharmaceuticals companies are not an exception anymore. However, developing an effective combination of IPR can indeed mitigate this trend in the pharmaceutical sector, especially if new technological developments are combined with 'strong, trademark-protected brands' (Reitzig 2004, 39). The nonsignificance of patents in the within estimation for the Computers and Automobiles industries 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, 120), which is known as the patent thicket. The existence of these thickets makes the evaluation of individual IPR difficult in these complex products industries (Heeley, Matusik, and Jain 2007), where patents are also likely to be used for strategic purposes (Hall et al. 2014).

		Spec. 1 – Counts			Spec. 2 – Counts		0,	Spec. 3 – Counts	
	Computer	Pharma	Auto	Computer	Pharma	Auto	Computer	Pharma	Auto
IP – Within effect									
Log Patents (t-1)	-0.006	0.058	0.000	-0.006	0.062	0.000	-0.011	0.059*	0.007
	(0.017)	(0.040)	(0.025)	(0.017)	-0.04	(0.025)	(0.018)	(0.035)	(0.026)
Log Trademarks (t-1)	0.006	0.013	0.015	0.005	0.008	0.015	0.005	0.006	0.025
	(0.013)	(0:030)	(0.017)	(0.013)	-0.03	(0.017)	(0.013)	(0:030)	(0.018)
Patents*Trademarks (t-1)				0.023 (0.028)	0.215*** (0.083)	0.025			
IP – Between effect				(0-2010)	(000-01)	10000			
Log Patents (t-1)	0.153***	0.005	0.082**	0.120***	0.017	0.082*	0.166***	-0.003	0.084**
- - -	(0.025)	(0.078)	-0.037	(0.031)	(0.090)	(0.048) 0.02	(0.027)	(0.080)	(0.040)
Log Irademarks (t-1)	0.26/***	0.462*** (0.088)	0.024 -0.047	0.150* (0.077)	0.48/**** (0.144)	0.02 (0.102)	0.266*** (0.041)	0.464*** (0.090)	0.033 (0.052)
Patents*Trademarks (t-1)				0.025*	-0.008	0.001			
Other variables				((1))	(000)	10.022)			
Total assets (t)	0.617***	0.590***	0.835***	0.613***	0.599***	0.833***	0.617***	0.622***	0.834***
	(0.024)	(0.048)	(0.031)	(0.024)	(0.049)	(0.032)	(0.025)	(0.048)	(0:030)
Sales growth (t)	0.489***	0.03	0.646***	0.487***	0.024	0.644***			
	(0.039)	(0:030)	(0.070)	(0:039)	(0:030)	(0.070)			
R&D-Capital expenditure ratio (t-1)	-0.099***	-0.056**	-0.025	-0.101***	-0.060**	-0.024			
	(0.015)	(0.026)	(0.027)	(0.015)	(0.026)	(0.027)			
Log labour productivity (t-1)	0.155***	0.094***	0.131**	0.156***	0.085**	0.131**			
:	(0.029)	(0.034)	(0.052)	(0.029)	(0.034)	(0.052)	•		
Time & market fixed effect	Included	Included	Included	Included	Included	Included	Included	Included	Included
Constant	5.241***	5.180***	2.554***	5.442***	5.014***	2.586***	4.938***	4.528***	2.435***
	(0:30)	(0.612)	(0.485)	(0.322)	(0.645)	(0.530)	(0.298)	(0.585)	(0.432)
Observations	1,756	468	550	1,756	468	550	1,756	468	550
Number of bvd_panel	322	91	102	322	91	102	322	91	102
R-squared (overall)	0.867	0.906	0.938	0.868	0.908	0.938	0.841	0.901	0.926
R-squared (between)	0.886	0.908	0.946	0.886	0.91	0.946	0.863	0.903	0.935
R-squared (within)	0.324	0.281	0.429	0.325	0.292	0.429	0.241	0.267	0.342
Rho	0.752	0.772	0.759	0.751	0.768	0.763	0.768	0.781	0.775
RMSE	0.293	0.336	0.214	0.293	0.335	0.214	0.31	0.337	0.229

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Looking at the between-effects row in Table 5, it can be seen that patents and/or trademarks have significant effects on the market valuation in the selected industries. Again, this result highlights the importance to investors of benchmarking corporate IPR portfolios when making the investment decisions. In fact, in the Computer and Automobile industries, only the between differences seems to matter. In other words, in these industries, the markets seem to grant higher premiums to the companies that seem relatively more innovative than their competitors (between-effects), rather than rewarding a premium to any additional innovation assets from a company (withineffects). Nevertheless, significant differences emerge across the industries and depending on the IPR or their combination: i) in the Computer industry, both patents and trademarks are significantly valued by the markets; ii) only patents are effective for Automobile companies²¹ and; *iii*) for Pharmaceutical companies, only trademarks show significant between-effects. For the Automobiles companies, the results of this study would thus not contradict the earlier work of Malmberg who suggests that these companies may still not prefer trademarks (only) to protect their new products (Malmberg 2005). Regarding the pharmaceuticals industry, where the within variations matter, the results suggest a lesser importance of benchmarking the patenting activity of companies. The fast development of generic or alternative drugs have certainly influenced the trend in this industry, making the implementation of strong differentiation strategies even more fundamental, for instance through massive investments in trademarks-protected brands and other marketing assets.

The results for the remaining control variables are similar to the ones observed for the aggregate regression. However, two main differences arise. First, there is no significant effect of sales growth in the Pharmaceuticals sector as compared to the other two industries. Consistently with the within estimates, IPRs, here trademarks, may incorporate a much clearer signal of economic performances for investors. Second, the negative effect of a higher ratio of R&D over capital expenditures is statistically significant for the Computer and Pharmaceutical industries. This ratio in the former industry is much higher (also due to lower capital expenditures), while the pharmaceuticals companies are the subject of research and drugs development costs that are rising quickly (and requiring longer periods).²²

5. Conclusion

The study presented in this paper provides evidence on the strategic role of IPRs in the valuation of firms on the financial markets. Investors do account for and confer a premium on the technical, functional, commercial and marketing information conveyed by corporate patents and trademarks. The empirical application on a large sample of R&D-investing firms from different countries and industries shows that investors value the simultaneous use of patents and trademarks, hinting at a premium for their complementary use. Moreover, the findings presented in this paper indicate that the expectations of investors are made (more) by benchmarking firms, rather than only by using information on the

²¹As mentioned in section 3, separate regressions for the Chemicals and Machinery provide results similar to those obtained for Auto companies.

²²See https://www.mckinsey.com/industries/pharmaceuticals-and-medical-products/our-insights/the-road-to-positive -r-and-38d-returns and https://www.ncbi.nlm.nih.gov/pmc/articles/PMC3146086/.

target firm. From a company perspective, a key implication is that during the development of new technologies and product, IPR should be identified and managed by considering the strategies of relevant competitors. Failure to do so might limit the ability of companies to effectively communicate their capacity to appropriate and secure their innovation returns to the markets.

The analysis also confirms the relevance of industrial specificities in the IPR-market valuation relationship and does so by considering a finer inspection at the industry level, compared to the previous literature. The relationship observed between the innovative outputs of companies and their stock market performances is, for instance, influenced by the patterns of the dominant technologies in use, and more generally by the current technological regime - technological opportunities, conditions for the appropriability of innovations, patterns of cumulativeness in technical advances and properties of the knowledge base - that prevail in a given industry (Breschi, Malerba, and Orsenigo 2000; Mazzucato 2006). Besides, the differences observed between the Computer, Pharmaceutical and Automobile industries point to 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. Unfortunately, our data do not allow us to investigate further into the industry-specific features of technological regimes and their impact on the IPR-market valuation relationships. Significantly, the findings on the Pharmaceuticals industry confirm the intuition of Reitzig (2004) concerning the declining importance of only patents-based commercial successes. In fact, the analysis actually suggests that pharmaceuticals companies do not seem to be an exception anymore. From a corporate point of view, this underlines the need to devote more careful attention to trademark management, not only to protect brands and marketing assets but also to send signals to the financial markets.

Moreover, the estimations suggest that the effect of IPR strategies on the market value of firms mainly operates through the cross-sectional dimension (the between effects prevail). What really seem to matter are the relative superior abilities of firms to develop new technological and commercial capabilities. When interpreting the overwhelming importance of the between effects as compared to the within effects, it should also be noted that the sample covers the top corporate R&D investors worldwide and consequently does not include high innovative start-ups which have recently come onto the market. For these companies, which often rely upon narrow and specialised IPR portfolios, the within effect may be substantially significant.

Furthermore, some additional research avenues can be identified in relation to the caveats of the analysis and dataset. First, the use of alternative IPR quality indexes, for example, based on the number and content of claims, oppositions or renewals, may facilitate a finer assessment of the importance of specific IPR in the competitiveness of firms. Second, characterising the trademarks families and the associated branding strategies – creation, modernisation, and/or extension of brands – of large firms will also contribute to the identification of the trademarks filing strategies that feature higher premiums on the financial markets. Finally, richer qualitative analyses of patents and trademarks combinations at firms and products levels may contribute to solving the puzzle of strategic IPR versus IPR always leading to or supporting news products and services.

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Table A1. Descriptive statistics.

	Who	ole sample	Co	omputer	F	Pharma		Auto
	Mean	Standard Deviation	Mean	Standard Deviation	Mean	Standard Deviation	Mean	Standard Deviation
Market Capitalisation (In)	14.69	1.8	14.07	1.7	14.07	2.2	15.20	1.7
Total Assets (In)	14.84	1.73	14.19	1.55	14.24	2.11	15.50	1.68
Patents (In)	3.06	1.75	3.70	1.75	2.70	1.66	3.41	1.74
Trademarks (In)	1.60	1.34	1.39	1.21	1.79	1.75	1.46	1.29
Sales growth	0.06	0.29	0.05	0.24	0.07	0.69	0.05	0.19
Sector sales growth	0.43	0.50	1.02	0.57	0.32	0.19	0.40	0.36
R&D-Capital expenditure ratio (In)	0.02	1.56	0.83	1.18	1.45	1.44	-0.16	0.81
Log labour productivity (ln)	-1.37	0.79	-1.53	0.61	-1.48	1.10	-1.38	0.63

Table A2. Correlation across variables.

	1.	2.	3.	4.	5.	6.	7.	8.	9.
1. Market value (In)	1.000								
2. Total assets (In)	0.888	1.000							
3. Patents within (In)	-0.002	-0.009	1.000						
4. Trademarks within (In)	0.006	0.005	0.074	1.000					
5. Patents between (In)	0.446	0.487	-0.015	-0.006	1.000				
6. Trademarks between (In)	0.551	0.462	-0.024	-0.001	0.492	1.000			
7. Sales growth	0.011	-0.106	-0.004	0.008	-0.087	-0.014	1.000		
8. Sales growth (sector)	-0.170	-0.205	-0.002	0.011	0.162	-0.064	0.074	1.000	
9. R&D-Capital expenditure ratio	-0.470	-0.563	0.006	-0.007	0.037	-0.038	-0.010	0.262	1.000
10.Llabour productivity (ln)	0.294	0.350	0.000	0.002	0.133	0.096	-0.187	-0.108	-0.224