The effect of trademark breadth on IPO valuation and post-IPO performance

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Abstract: Trademarks differ in their breadth and can span up to 45 different categories of goods and services. We combine trademark research with real options theory and assess the impact of trademark breadth on IPO valuation and post-IPO performance. We hypothesize that an increased trademark breadth provides firms with additional flexibility associated with an increased IPO valuation and post-IPO performance. We also argue that this flexibility constitutes an option value that should be amplified for service-intensive and more diversified IPO firms. Analyzing a sample of 1,517 firms that performed an IPO in European markets between 2012 and 2015, we find support for most of our hypotheses. Specifically, we find that a higher trademark breadth is associated with increased firm valuation and post-IPO performance. Also, we show that the positive relationship is more pronounced for service-intensive and more diversified firms. Finally, our findings suggest that the effect is non-linear and diminishes for high breadth levels.

Keywords: Trademarks, trademark breadth, diversification, IPO, buy-and-hold returns.

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1. Introduction

Initial public offerings (IPOs) are a critical source of financing for innovative and fast-growing firms (e.g., Certo et al., 2009). Because of their importance for the financing of entrepreneurship and innovation, the IPO literature is vast and has comprehensively assessed the determinants of IPO valuation and post-IPO performance (e.g., Colombo et al., 2019). While this research stream has already considered patents as an important determinant of IPO valuation and performance, the literature is so far silent about other forms of intellectual property, particularly trademarks.

This is surprising because trademarks are central to a firm's strategy to protect their brands from imitation by competitors (e.g., Flikkema et al., 2019; Mendonça et al., 2004; Sandner and Block, 2011). While patents protect firms' technological assets, trademarks relate to marketing assets (e.g., Block et al., 2015; Castaldi and Giarratana, 2018). As such, trademarks are crucial in later phases of the innovation process to protect the brand under which new products or services are introduced to the market (e.g., Flikkema et al., 2014; Seip et al., 2018). Trademarks differ in their breadth, which refers to the number of distinct goods and service classes where the brand is protected. Prior research shows that trademark breadth impacts firm valuation (e.g., Block et al., 2014; Sandner and Block, 2011). Building on this work, we analyze whether, when, and to what extent trademark breadth is associated with IPO valuation and post-IPO performance.

Our theoretical arguments are based on real options theory (Myers, 1977). We argue that an increased trademark breadth provides firms with additional flexibility at the time of the IPO. Stock markets value this flexibility and regard trademarks and their breadth as an option for a firm to leverage its brand and introduce its innovations into new markets and industries being associated. Accordingly, trademark breadth should be associated with a higher IPO valuation. We also hypothesize that this flexibility or option value should be amplified for service-intensive and more diversified IPO firms.

In addition to assessing the effect of trademark breadth on IPO valuation, the IPO context also enables us to link trademark breadth to firms' post-IPO performance, which allows us to assess whether trademark breadth not only influences firm valuation but also actual performance. Understanding whether trademarks increase firm valuation and enable companies to outperform their peers is critical for a precise appraisal of the benefits of trademarks and their economic relevance.

To address our research questions, we analyze a sample of 1,517 firms that performed an IPO in European markets between 2012 and 2015. We find that a higher trademark breadth is associated with increased IPO valuation and post-IPO performance, supporting our hypotheses. Also, we show that the positive relationship is more pronounced for service-intensive and more diversified firms. Finally, our findings suggest that the effect is non-linear and diminishes for high levels of trademark breadth.

The contribution of our findings is twofold. First, we contribute to research on trademarks in entrepreneurial finance. While this research comprehensively documents the effect of a higher number of trademarks on firm valuation and performance (e.g., Fosfuri and Giarratana, 2009; Hsu et al., 2021; Greenhalgh and Rogers, 2012; Zhou et al., 2016), few studies include trademark breadth (Block et al., 2015; Sandner and Block, 2011). Using real options theory, we show that trademark breadth constitutes an option that is valued by IPO investors. Going further, we show that this option is also associated with increased performance. This link has not been documented empirically before and underlines the importance of trademarks for firms. Furthermore, the application of real options theory, which is novel in trademark research, enables a better conceptual understanding of the mechanisms through which trademarks lead to superior valuation and performance. Prior research can build on these initial insights to further explore the value-added trademarks.

2. Conceptual framework

2.1 Prior research on trademarks, valuation, and performance

2.1.1 Trademarks and firm valuation

Prior research empirically documents a positive association between trademarks and firm valuation. Based on a sample of 1,216 US and European firms, Sandner and Block (2011) find that larger trademark portfolios lead to higher stock market valuations (Tobin's q). This finding is in line with Fosfuri and Giarratana (2009) and Kransikov et al. (2009), who find that a higher number of trademarks positively contribute to firms' market values for US firms. Similarly, Greenhalgh and Rogers (2012) find a positive association using a comprehensive sample of large UK firms. While these studies focus on established stock-listed companies, other studies in entrepreneurial finance assess the role of trademarks in venture capital (VC) valuations. Specifically, Block et al. (2014) assess 5,467 funding rounds that involve 2,671 start-ups and show that the number of start-ups' trademarks positively influence VC valuations. However, the effect is inversely U-shaped, so that the positive effect diminishes for firms with a large trademark portfolio. Similarly, Zhou et al. (2016) document higher VC valuations for start-ups with trademarks.

While the relationship between the number of trademarks and higher firm valuations has received ample attention in prior research, we could only identify two studies that also consider the effect of trademark breadth. First, Sandner and Block (2011) introduce the concept of trademark breadth and argue that trademark portfolios with a higher breadth should be associated with higher stock market valuations. However, they fail to find a significant association between trademark breadth and valuation. Second, Block et al. (2014) find a significant association between increased trademark breadth and VCs' firm valuations. However, the relationship is non-linear and follows an inverse U-shape, indicating that the additional value of increased breadth decreases for very

high breadth values. The existence of a non-linear relationship could explain the non-finding reported by Sandner and Block (2011).

2.1.2 Trademarks and firm performance

Prior research also shows a positive relationship between a higher number of trademarks and firm performance across a range of performance measures. For example, Greenhalgh and Longland (2005) use data from large UK firms and relate a higher number of trademarks to subsequent increases in firm productivity. Similarly, while Greenhalgh and Rogers (2012) use UK data to document a positive association between trademark activity and firms' value-added premium. Besides, Brem et al. (2017) use data on 2,873 Spanish firms and find that a higher number of trademarks corresponds with increased turnover. This association is evident for both small and large firms.

Other studies empirically document a positive association between trademarks and increased firm survival (e.g., Buddelmeyer et al., 2010; Jensen et al., 2008), a frequently used performance measure in the context of entrepreneurial firms. While Helmers and Rogers (2010) show that trademarks, in addition to patents, improve firm survival considerably, they also find trademarks to be more important for survival than patents in some industries, such as retail, finance, and health. Similarly, Srinivasan et al. (2008) show that diverse product portfolios combined with trademarks increase firm survival (in contrast to patents) and accelerate exit by acquisition (as do patents).

Most recently, Hsu et al. (2021) use a stock market-based performance measure to assess whether the stock market accurately values new trademark registrations. In their investigation of 305,422 USPTO trademark registrations of US public firms between 1976 to 2014, Hsu et al. (2021) find that the stock market tends to undervalue trademarks, as evidenced by higher abnormal stock returns. This undervaluation is especially pronounced for opaque, hard-to-value firms.

All of these studies assess the number of trademark applications as a determinant of firm performance. We were able to identify one study that considers trademark breadth as an additional determinant of performance. In their study of 47 US-based service firms (in management consulting), Castaldi and Giarrantana (2018) do not find a clear association between trademark breadth and performance, which they operationalize as the ratio of total sales and employees.

2.2 Trademarks as productive assets: the importance of trademark breadth

Trademarks are legally recognized protection rights for intellectual property in the form of words, phrases, or symbols. As property rights, trademarks seek to identify the source of goods and services and to prevent imitation. Thus, trademarks provide legal certainty and confer the exclusive right for using the registered trademark, licensing or selling it, and for defending the trademark against competitors (WIPO, 2021).

We argue that high trademark breadth constitutes a productive asset that can increase firm valuation and performance. The literature agrees trademarks can serve as an effective protection mechanism for firms' investments in (current and future) marketing activities, brands, and reputation (e.g., Block et al., 2014; Castaldi and Giarratana, 2018; Flikkema et al., 2019). Thus, trademarks constitute productive assets because they enable firms to more effective appropriate innovation rents (e.g., Barroso et al., 2019; Castaldi, 2018). The ability to legally protect these intangible marketing assets generates value in two ways (e.g., Barroso et al., 2019; Castaldi, 2018; Block et al., 2015). First, trademarks have a *protection function.* This protection function can create value because it strengthens the firm's competitive position by making freeriding and imitation by competitors more difficult (e.g., Barroso et al., 2019; Block et al., 2014; Krasnikov et al., 2009). Second, trademarks have an *exchange function*. Firms can profit from licensing or selling their marketing assets, which is only possible if these assets are legally protected by trademarks (e.g.,

Flikkema et al., 2014; Block et al., 2015). Block et al. (2014) emphasize that this exchange function may be particularly important to investors (and thus, firm valuation) because it enables them to continue to use, license out, or sell trademarks even in case the firm is unsuccessful and closes down.

Both value-generating functions (i.e., *protection* and *exchange*) are amplified if trademark breadth is higher. A higher trademark breadth increases the trademark's legal scope so that it can be enforced more broadly (Sandner and Block, 2011). Promoting the trademark across different markets also enables the trademarking firm to leverage the brand equity across a portfolio of markets (Castaldi and Giarrantana, 2018). This increases the firm's opportunities to appropriate innovation rents, for example, via licensing or increased sales when entering new markets (e.g., Flikkema et al., 2019; Nasirov et al., 2019).

2.3 Trademark breadth as a real option

Real options theory (Myers, 1977) applies the logic of financial options contracts to investments into "real" assets (e.g., physical capital, human capital, intellectual capital). In analogy to a financial option, real options refer to small initial investments that create opportunities for firms to more readily respond to future contingent events (e.g., Kogut and Kulatilaka, 2001). The price of the option is the initial investment, which is typically small, limiting the downside risk of real options. In contrast, the upside potential of a real option is typically high and stems from the expected payoffs that an option can potentially yield. Besides, real options theory argues that options allow firms to reduce uncertainty by keeping several options open and by observing the development of each option (Gunther McGrath and Nerkar, 2004). After the initial investment, an option period

follows during which the firms gain new information about the value of the option. If this information is favorable, a firm can choose to exercise the option, while the firm can choose to defer the option if this information is unfavorable (e.g., Kogut and Kulatilaka, 2001; Ziedonis, 2007).

Due to its parsimonious nature, real options theory is commonly used to explain firms investments decisions to foster growth in the areas of innovation (e.g., Gunther McGrath and Nerkar, 2004; Ziedonis, 2007) and market entry (e.g., Brouthers et al., 2008; Miller and Folta, 2002). Trigeorgis and Reuer (2017) provide a recent review of real options theory's application in management research and illustrate its different applications. One such application concerns firms' intellectual property strategy (e.g., Bloom and Van Reenen, 2002; Gunther McGrath and Nerkar, 2004). Specifically, patents can constitute a real option that creates a proprietary opportunity for later decisions. For example, after securing a patent, firms can later decide to commercialize the patented knowledge themselves, license it out, or decide to do nothing with it

3. Hypotheses

3.1 Trademark breadth and IPO valuation

We argue that trademark breadth constitutes a real option that is associated with an increased IPO valuation. When registering a trademark, the applicant has to indicate the industrial classes (i.e., categories) the firm intends to use the trademarked good or service in. The Nice classification, which is the typical classification used to capture trademark breadth, distinguishes 45 good and service classes (WIPO, 2021). The Nice classifications indicate the market space the company operates in or intends to operate in the future and establish the trademark's legal scope of protection (e.g., Castaldi and Giarratana, 2018; Sandner and Block, 2011).

Following a real options logic, the registration of a trademark across multiple product or service classes enables firms to generate additional value from the trademark in the future. The

downside risk of applying for a trademark across a range of Nice classes is limited, as the application in multiple classes is relatively simple and incurs little additional costs (WIPO, 2021). However, the potential payoff can be substantial if the firm decides to leverage its trademark across different product and service classes, for example, by introducing a product or brand successively across multiple markets. In this case, the firm can easily benefit from the protection and exchange function of an increased trademark breadth. This increases the firm's opportunities to appropriate innovation rents, for example, via licensing or increased sales when entering new markets (e.g., Flikkema et al., 2019; Nasirov et al., 2019). However, if the firm realizes that the trademarked product or brand cannot be leveraged across different markets, it can simply forego the option without incurring any additional costs.

Research in entrepreneurial finance shows that growth options are associated with increased IPO valuation. For example, Aggarwal et al. (2009) as well as Abel and Eberly (2012) consider the value of growth options associated with future technological upgrades measured with R&D spending or industry price-to-sales comparables, positively influence firm valuation. Thus, we suggest that increased trademark breadth constitutes an option for future growth that will be valued positively by IPO investors and hypothesize:

H1: Increased trademark breadth is positively related to IPO valuation.

3.2 Boundary condition: trademark breadth and IPO valuation for service-intensive firms

We argue that the importance of trademark breadth will be particularly pronounced for service-intensive firms. Our rationale is twofold. First, services lack tangible attributes and are high in experience and credence characteristics (e.g., Nayyar 1990). Hence, customers face a higher degree

of information asymmetry because they can only assess the quality of the service after they purchase and experience it. To reduce this information asymmetry, customers will attach higher importance to a firm's brands and reputation (e.g., Castaldi and Giarratana, 2018; Davies et al., 2010). For service firms interested in introducing their services to new markets, it is thus essential to leverage established brands when entering additional markets via an increased trademark breadth. Second, the intangibility of services enables an easier imitation by competitors (Amara et al., 2008). This further emphasizes the need for formal protection across a range of related market segments, which supports firms in appropriating rents from their innovations. Trademarks are especially important in this regard because services cannot be protected with patents. Thus, service firms often have to rely on trademarks to legally safeguard their brands associated with their services (e.g., Block et al., 2015).

Both arguments suggest that trademark breadth represents a more valuable real option for service-intensive firms. This argument is largely in line with Castaldi and Giarratana (2018), who describe that service firms almost always benefit from diversification if they add new services to their portfolio of offerings. This is because diversification enables service firms to realize economies of scope and to position themselves more coherently as full-service providers. However, Castaldi and Giarratana (2018) also point out that diversification into product markets is associated with a decrease in performance because the addition of product offerings can undermine their strategic positioning and require larger adaptions of their business models. Similarly, we argue that an increased trademark breadth offers a higher upside potential (i.e., increased real options value) for firms in service industries because their future market diversification and appropriation activities more heavily rely on trademark protection compared with firms that are also active in product industries. Therefore, we hypothesize:

H2: The positive association between a trademark breadth and IPO valuation is amplified for service-intensive firms.

3.3 Boundary condition: trademark breadth and IPO valuation for firms with a higher level of diversification

Additionally, we argue that the importance of trademark breadth will be particularly pronounced for firms that possess a higher level of diversification when conducting an IPO. Firms that are active in more industries likely possess capabilities that enable them to more effectively harvest the benefits of an increased trademark breadth when entering new markets. In contrast, a firm that is only active in one industry may face higher uncertainty and higher costs when entering new markets, which decreases the likelihood and speed with which new market opportunities are pursued. In this case, an increased trademark breadth may provide little value. This notion is consistent with prior findings in management research that indicate that prior diversification experience can positively influence the subsequent introduction of new products and entry into new markets (e.g., Mayer et al., 2015).

This argumentation is also consistent with real options theory. Specifically, Kogut and Kulatilaka (2001) develop a real options model that explicitly recognizes the importance of the firm's organizational capabilities in the pursuit and valuation of real options. Similarly, Ziedonis (2007) notes that the value of a real option is highly firm-specific and depends on the firm's prior experience. Applied to the relationship between diversification and trademark breadth, this suggests that diversification-related capabilities may aid firms in leveraging the value that trademarks can yield as a real option. For example, firms with a higher level of diversification might possess superior insights about which NICE classes are the most beneficial to register their trademarks in or could more quickly identify the markets that they can leverage their increased trademark breadth in. This

suggests that firms that already possess diversification capabilities and can more easily appropriate innovation rents. We argue that this is reflected in a higher IPO valuation and hypothesize:

H3: The positive association between a trademark breadth and IPO valuation is amplified for firms with a higher level of diversification.

3.4 Trademark breadth and post-IPO performance

We argue that an increased trademark breadth represents a productive asset that leads to an increased IPO valuation. We mainly attribute this value increase to trademark breadth's protection and exchange function. Observing the long-run performance of the firms in our sample allows us to study whether the expectation associated with the presence of the signal is confirmed.

H4a: An inverted U-shaped relationship exists between trademark breadth and post-IPO performance, where trademark breadth is positively related to IPO valuation to a point, after which it becomes negative.

H4b: The positive association between a trademark breadth and post-IPO performance is amplified for service-intensive firms.

H4c: The positive association between a trademark breadth and post-IPO performance is amplified for firms with a higher level of diversification.

3. Research design

3.1 Sample and data

[TBD]

3.2 Variables

3.2.1 Dependent variables: IPO valuation and post-IPO performance

We measure IPO valuation with Tobin's. Tobin's Q is the ratio of market value of assets to book value of assets, where market value is the sum of the book value of assets and the market value of common stock (calculated usng the offer price) minus the book value of common stock.

We measure post IPO performance via buy-and-hold returns. Specifically, we use 3-year Buy-and-Hold Abnormal Returns calculated as in Loughran and Ritter (1995).

3.2.2 Independent variable: trademark breadth and interaction terms

Trademark breadth refers to the number of distinct goods and service classes of a trademark. When registering a trademark, the applicant has to indicate the classes (i.e., categories) the trademark is valid in once it is granted, thus establishing the trademark's legal scope of protection (Sandner and Block, 2011; Block et al., 2014). Usually, trademark breadth is operationalized via the World Intellectual Property Organization's (WIPO) international trademark classification system ("Nice classification") (e.g., Block et al., 2014a; Flikkema et al., 2019; Sandner and Block, 2011). The Nice classification was established in 1957 and distinguishes 34 classes referring to goods and 11 classes referring to services (WIPO, 2019).[†] Overall, trademarks associated with fewer classes tend to protect single products or narrow product lines (i.e., low breadth), while trademarks with many classes often protect wider product or service lines or umbrella brands (e.g., Sandner and Block, 2011; Block et al., 2014b). Trademark breadth can be measured at the trademark level (i.e., breadth of a single trademark) or aggregated at the firm level (i.e., breadth of the firm's trademark portfolio). In this study, we use capture trademark breadth aggregated at the firm level, which is in line

[†] Some studies use a similar US classification system but the conceptual argumentation is the same (e.g., Castaldi and Giarratana, 2018).

with most prior studies (e.g., Block et al., 2014a; Castaldi and Giarratana, 2018; Sandner and Block, 2011).

To operationalize H2, we use ratio of service-related trademarks, over the total number of trademarks registered by each firm at the IPO.

Prior management research typically captures the level of corporate diversification via the number of industries that the firm is active in, as indicated by the Standard Industrial Classification (SIC) codes (e.g., Sambharya, 2000; Varadarajan and Vasudevan, 1987). For H3, we use the number of SIC codes. The variable represents the number of industry codes in which the listing company is active at the time of the IPO, according to the Standard Industrial Classification.

3.2.3 Control variables: Trademark breadth and interaction terms

[TBD]

4. Results

4.1 Descriptive statistics

[TBD]

4.2 Main results

[TBD]

4.3 Additional analysis and robustness checks

4.3.1 Exploring a non-linear association between breadth and IPO outcomes

Prior research indicatesthat the positive effect of trademark breadth on firm valuation may be subject to diminishing returns. Specifically, Block et al. (2014) find that the relationship between

breadth and VCs' firm valuations is non-linear and follows an inverse U-shape, indicating that the additional value of increased breadth decreases for very high breadth values. The existence of a non-linear relationship could partially explain the non-finding reported by Sandner and Block (2011). Because of this preliminary evidence, we explore the existence of an inverted U-shaped relationship between breadth and valuation as well as performance in IPOs.

The rationale as to why an inverted U-shaped between trademark breadth and IPO outcomes could exist is twofold: First, an increasing trademark breadth is more costly because applicants need to pay per class, even if the cost per class is not substantial. This discourages trademark applications in an excessively large amount of classes because the costs will eventually outweigh the marginal benefits of adding further classes (Block et al., 2014). Second, IPO firms suffer from resource constraints that make it difficult for them to simultaneously extend their operations across a large range of market segments. This argumentation is in line with prior research in finance that describes diversification discount (i.e., a negative association between high levels of diversification and a firm's market value) (e.g., Campa and Kedia, 2002; Lang and Stulz, 1994). This argumentation is also coherent with prior research on firm diversification which widely documents an inverse U-shaped relationship between diversification and performance (e.g., for meta-analyses, see Palich et al., 2000 and Schommer et al., 2019). This is because the benefits of increased diversification can be offset by additional costs that arise with increasing levels of diversification after a certain point. For example, complexity increases with diversification so that coordination and integration costs tend to grow disproportionately with increased diversification.

Hence, we reestimate our main models and additionally include trademark breadth squared. Table 6 displays the results.

- Please insert Table 6 about here -

5. Conclusion

5.1 Summary of main findings

[TBD]

5.2 Implications for theory and practice

[TBD]

5.3 Limitations and avenues future research

First, our sample is restricted to European IPOs between 2012 and 2015. While our sample provides a representative snapshot of the European IPO market in that period, the generalization of our findings to other geographic (e.g., US, Asia) and temporal snapshots (post COVID-19) is unclear. For example, it could be that the evaluation of firms with high diversification or in service industries differs across place and time. Therefore, future research should revisit our findings and assess their validity in other geographic context or over time.

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Tables

Table 1. Definition of variables and data sources.

Variable	Definition	Data source(s)
Dependent variables		
Tobin's Q	Ratio of market value of assets to book value of assets, where market value is the sum of the book value of assets and the market value of common stock (at offer price) minus the book value of common stock.	EURIPO, Datastream
BHAR	3-year Buy-and-Hold Abnormal Returns calculated as in Loughran and Ritter (1995).	EURIPO, Datastream
Independent variable		
Trademark breadth	Average number of unique Nice classes covered by the IPO trademarks of a firm.	EURIPO
Control variables		
Trademark applications	Number of US trademark applications filed by the IPO firm before the IPO.	EURIPO
Service trademark ratio	Ratio of service-related trademarks, over the total number of trademarks registered by each firm at the IPO.	EURIPO
Number of SICs	Number of industry codes in which the listing company is active at the time of the IPO, according to the Standard Industrial Classification.	EURIPO
Size	Inflation-adjusted sales in the year prior to the IPO in 2015 millions of Euros, using Purchasing Power Parities (EU27=1). Yearly average exchange rates are used before 2009 between the ECU and national currencies to obtain a euro-equivalent and for companies based in non-euro countries. Natural logarithms are used in the regressions.	EURIPO, Eurostat, Datastream
Performance	Return on assets, in the year prior to the IPO.	EURIPO, Amadeus
Leverage	Ratio of debt to total assets, in the year prior to the IPO.	EURIPO, Amadeus
Patents	Number of patent applications filed by the IPO firm before the IPO.	EURIPO
Dilution ratio	Shares offered at listing over number of shares outstanding before the IPO.	EURIPO, Dealogic
Participation ratio	Percentage of the offer made of shares sold by existing shareholders.	EURIPO, Dealogic
Country dummies	Set of dummy variables controlling for companies in UK, Germany, France and Italy. Reference case is company from other countries.	-
Industry dummies	Set of dummy variables controlling for industries (according to the ICB, Industry Classification Benchmark). Source: EURIPO.	EURIPO
IPO-year dummies	Set of dummy variables controlling for calendar IPO year. Reference case is 2015.	-

Notes: EURIPO is a database of European IPOs owned and managed by the University of Bergamo. The list of IPOs from EURIPO includes all and only those 'real' Initial Public Offerings. As for Initial, we refer only to companies that had never been publicly listed before, on whatever stock exchange. As for Offerings, we refer only to new listings raising money, regardless of whether primary or secondary shares are being issued/sold. We therefore exclude introductions (admissions with no initial offer, common on the AIM and on all the other second markets), re-admissions, market transfers, as well as cross-listings of companies already listed on other stock markets. IPOs of investment entities (such as investment trusts) are also excluded. Private placements, however, are included. Further details are available in Vismara et al. (2012).

Table 2. Descriptive statistics.

	Full sample (1,517 obs.)	**With TMs (934 obs.)**	**Without TMs (583 obs.)**	**Test on the difference**
Dependent variables				
Tobin's Q	4.26	4.73	4.02	0.71**
BHAR (%)	-27.56	-16.55	-44.11	41.64**
Independent variable				
Trademark breadth (No.)	-	1.61	-	-
Control variables				
Trademark applications (No.)	-	15.22	-	-
Service trademark ratio (%)	-	44.23	-	-
Number of SICs	2.67	2.77	2.43	0.28
Firm size	64.46	72.68	48.17	24.51***
Age at IPO (years)	11.03	12.22	8.69	3.53***
Performance (%)	-6.85	-8.25	-14.10	6.84**
Patents (No.)	0.98	1.50	0.72	0.78
Leverage (%)	52.09	47.02	62.15	-15.13
Dilution ratio (%)	35.19	34.40	36.75	-2.35
Participation ratio (%)	16.12	17.82	12.75	5.07***

Notes: TMs = Trademarks. N = 1,517 firms performing their IPO in European markets (Euronext, Deutsche Borse, London Stock Exchange, and others – i.e., Athens, Budapest, Cyprus, Dublin, Ljubljana, Luxembourg, Madrid, Malta, Milan, Nasdaq OMX, Prague, Warsaw, and Wien stock exchanges) during 2002–2015. Mean values calculated on the full sample, as well as for firms with and without trademarks applications at the IPO. The last column reports the statistical difference between means. *, **, and *** indicate significance at the 10%, 5%, and 1% levels, respectively, of the t-test (z-test for dummy variables) for the difference in means between the two groups.

Table 3. Correlation matrix and variance inflation factors (VIFs).

#	Variable	1	2	3	4	5	6	7	8	9	10	11	12	VIF
1	Tobin's Q	1.00												-
2	BHAR	**0.24**	1.00											-
3	Trademark breadth	-0.04	-0.07	1.00										2.44
4	Trademark applications	-0.05	-0.05	**0.27**	**-0.38**									2.38
5	Service trademark ratio	**0.26**	**0.18**	**-0.75**	1.00	1.00								1.25
6	Number of SICs	**-0.19**	**-0.11**	**0.13**	0.03	0.03	1.00							1.22
7	Firm size	**-0.69**	**-0.24**	**0.15**	**-0.51**	**0.15**	0.09	1.00						2.08
8	Age at IPO	**-0.27**	**-0.16**	**0.22**	**-0.32**	**0.22**	0.06	**0.38**	1.00					1.27
9	Performance	**-0.14**	-0.02	0.06	-0.06	0.06	0.02	**0.19**	**0.09**	1.00				2.56
10	Leverage	**0.17**	0.04	-0.03	0.02	-0.03	-0.01	**-0.17**	**-0.09**	**-0.86**	1.00			2.54
11	Patents	-0.03	-0.02	-0.04	-0.01	-0.05	-0.01	0.08	**0.09**	-0.01	0.01	1.00		1.02
12	Dilution ratio	-0.06	-0.05	-0.05	-0.01	-0.04	-0.02	0.08	**-0.13**	-0.02	0.05	-0.01	1.00	1.07
13	Participation ratio	**-0.24**	**-0.17**	**0.10**	**-0.26**	**0.11**	0.07	**0.33**	**0.26**	0.06	-0.06	0.07	**-0.13**	1.20

Notes: Coefficients statistically significant at less than 1% are bold. VIFs are calculated with reference to Tobin's Q as a dependent variable (average=1.87).

Table 4. Results of OLS regressions to assess the effect of trademark breadth on firm valuation (H1, Model 1), including moderating effect for service-intensive firms (H2, Model 2), for highly diversified firms (H3, Model 3), and for both moderating effects (Model 4).

Model	**(1)**	**(2)**	**(3)**	**(4)**
Dependent variable	**Tobin's Q**	**Tobin's Q**	**Tobin's Q**	**Tobin's Q**
TM breadth	0.198**	0.196**	0.196**	0.190**
	(0.085)	(0.085)	(0.085)	(0.085)
TM breadth × Service TM ratio		1.395**		1.631**
		(0.639)		(0.683)
Number of SICs × TM breadth			-0.104*	-0.130**
			(0.057)	(0.061)
Control variables				
TM applications	0.001	0.001	0.001	0.001
	(0.001)	(0.001)	(0.001)	(0.001)
Service TM ratio	0.154	-2.068*	0.401	-2.279*
	(0.426)	(1.216)	(0.521)	(1.215)
Number of SICs	1.335***	1.314***	1.451***	1.589***
	(0.183)	(0.183)	(0.218)	(0.217)
Firm size	-2.765***	-2.756***	-2.773***	-2.772***
	(0.117)	(0.116)	(0.118)	(0.117)
Age at IPO	-0.283*	-0.290**	-0.277*	-0.275*
	(0.145)	(0.145)	(0.146)	(0.145)
Performance	0.221***	0.225***	0.221***	0.226***
	(0.032)	(0.034)	(0.032)	(0.034)
Leverage	0.477***	0.487***	0.475***	0.487***
	(0.071)	(0.074)	(0.070)	(0.074)
Patents	0.021	0.021	0.021	0.021
	(0.015)	(0.015)	(0.015)	(0.016)
Dilution ratio	-0.293	-0.260	-0.309	-0.288
	(0.634)	(0.635)	(0.633)	(0.635)
Participation ratio	-0.327	-0.329	-0.322	-0.317
	(0.685)	(0.685)	(0.686)	(0.686)
Constant	45.822***	45.823***	45.681***	45.479***
	(1.941)	(1.925)	(1.938)	(1.927)
Country dummies	Yes	Yes	Yes	Yes
Industry dummies	Yes	Yes	Yes	Yes
IPO year dummies	Yes	Yes	Yes	Yes
Observations	1,517	1,517	1,517	1,517
R-squared	0.550	0.551	0.550	0.552

Notes: TM = Trademark. Robust standard errors are in parentheses. *, **, and *** indicate significance at the 10%, 5%, and 1% levels.

Table 5. Results of OLS regressions to assess the effect of trademark breadth on post-IPO performance (Model 1), including moderating effect for service-intensive firms (Model 2), or for highly diversified firms (Model 3), or for both moderating effects (Model 4).

Model	**(1)**	**(2)**	**(3)**	**(4)**
Dependent variable	**BHAR**	**BHAR**	**BHAR**	**BHAR**
TM breadth	0.048**	0.048**	0.047**	0.048**
	(0.022)	(0.023)	(0.023)	(0.023)
TM breadth × Service TM ratio		0.036**		0.035**
		(0.016)		(0.013)
TM breadth × Number of SICs			-0.025	-0.023
			(0.041)	(0.044)
Control variables				
TM applications	-0.001	-0.001	-0.001	-0.001
	(0.001)	(0.001)	(0.001)	(0.001)
Service TM ratio	-0.043	-0.110	-0.064	-0.105
	(0.273)	(0.775)	(0.339)	(0.780)
Number of SICs	-0.057	-0.058	-0.067	-0.065
	(0.121)	(0.120)	(0.147)	(0.152)
Firm size	-0.153**	-0.152**	-0.152*	-0.152*
	(0.077)	(0.077)	(0.078)	(0.078)
Age at IPO	-0.155	-0.155	-0.156	-0.156
	(0.095)	(0.095)	(0.095)	(0.095)
Performance	0.057	0.057	0.057	0.057
	(0.044)	(0.044)	(0.044)	(0.044)
Leverage	0.124	0.124	0.124	0.124
	(0.106)	(0.107)	(0.106)	(0.107)
Patents	-0.002	-0.002	-0.002	-0.002
	(0.007)	(0.007)	(0.007)	(0.007)
Dilution ratio	-0.573	-0.572	-0.572	-0.572
	(0.387)	(0.387)	(0.388)	(0.388)
Participation ratio	-1.140***	-1.140***	-1.141***	-1.140***
	(0.395)	(0.395)	(0.395)	(0.395)
Constant	4.738***	4.738***	4.750***	4.747***
	(1.171)	(1.172)	(1.171)	(1.168)
Country dummies	Yes	Yes	Yes	Yes
Industry dummies	Yes	Yes	Yes	Yes
IPO year dummies	Yes	Yes	Yes	Yes
Observations	1,517	1,517	1,517	1,517
R-squared	0.144	0.144	0.144	0.144

Notes: TM = Trademark. Robust standard errors are in parentheses. *, **, and *** indicate significance at the 10%, 5%, and 1% levels.

Table 6. Results of OLS regressions to assess the effect of trademark breadth on firm valuation and on post-IPO performance, assessing a quadratic effect for trademark breadth.

Model	**(1)**	**(2)**	**(3)**	**(4)**	**(5)**	**(6)**
Dependent variable	**Tobin's Q**	**Tobin's Q**	**Tobin's Q**	**BHAR**	**BHAR**	**BHAR**
TM breadth	0.034**	0.033**	0.036**	0.052**	0.053**	0.065*
	(0.015)	(0.016)	(0.017)	(0.024)	(0.023)	(0.028)
TM breadth^2	-0.018**	-0.019**	-0.017**	-0.025**	-0.024**	-0.026**
	(0.007)	(0.009)	(0.008)	(0.012)	(0.011)	(0.012)
TM breadth × Service TM ratio		1.271**			0.068**	
		(0.606)			(0.027)	
TM breadth^2 × Service TM ratio		-0.035			-0.014	
		(0.124)			(0.029)	
TM breadth × Number of SICs			-0.123**			-0.028*
			(0.069)			(0.015)
TM breadth^2 × Number of SICs			0.017**			0.012*
			(0.008)			(0.007)
Control variables						
TM applications	0.001	0.001	0.002	-0.001	-0.001	-0.000
	(0.001)	(0.001)	(0.001)	(0.001)	(0.001)	(0.001)
Service TM ratio	0.155	-2.094*	0.420	-0.043	-0.095	-0.056
	(0.426)	(1.216)	(0.522)	(0.273)	(0.781)	(0.339)
Number of SICs	1.329***	1.309***	1.469***	-0.067	-0.068	-0.070
	(0.185)	(0.185)	(0.220)	(0.121)	(0.120)	(0.148)
Firm size	-2.768***	-2.760***	-2.782***	-0.159**	-0.157**	-0.160**
	(0.116)	(0.116)	(0.117)	(0.077)	(0.077)	(0.078)
Age at IPO	-0.275*	-0.281*	-0.278*	-0.141	-0.142	-0.143
	(0.146)	(0.146)	(0.146)	(0.096)	(0.096)	(0.095)
Performance	0.220***	0.224***	0.221***	0.056	0.056	0.056
	(0.032)	(0.034)	(0.032)	(0.043)	(0.043)	(0.043)
Leverage	0.477***	0.487***	0.476***	0.124	0.124	0.124
	(0.070)	(0.074)	(0.071)	(0.105)	(0.105)	(0.105)
Patents	0.021	0.022	0.020	-0.002	-0.003	-0.003
	(0.015)	(0.015)	(0.015)	(0.007)	(0.007)	(0.007)
Dilution ratio	-0.273	-0.230	-0.248	-0.538	-0.553	-0.529
	(0.633)	(0.634)	(0.632)	(0.386)	(0.387)	(0.388)
Participation ratio	-0.302	-0.312	-0.279	-1.096***	-1.082***	-1.092***
	(0.680)	(0.677)	(0.680)	(0.395)	(0.394)	(0.395)
Constant	0.001	0.001	0.002	-0.001	-0.001	-0.000
	(0.001)	(0.001)	(0.001)	(0.001)	(0.001)	(0.001)
Country/industry/IPO year dummies	Yes	Yes	Yes	Yes	Yes	Yes
Observations	1,517	1,517	1,517	1,517	1,517	1,517
R-squared	0.550	0.552	0.551	0.147	0.148	0.147

Notes: TM = Trademark. Robust standard errors are in parentheses. *, **, and *** indicate significance at the 10%, 5%, and 1% levels.

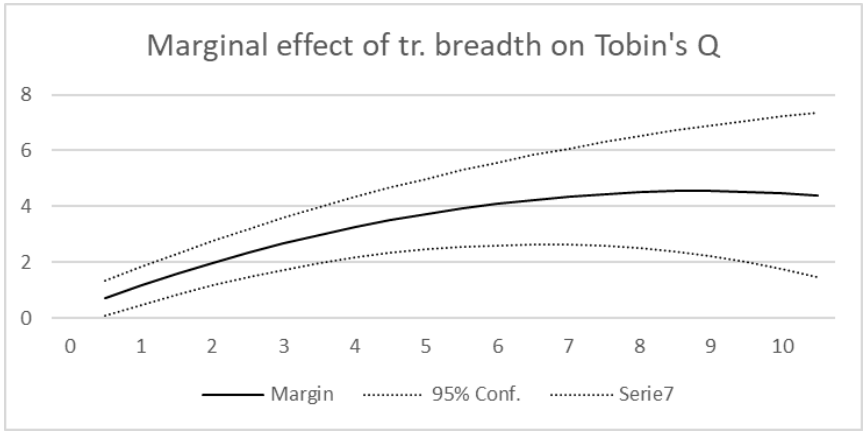
Appendix – Tables and Figures to be considered for inclusion/revision

Table A1. Distribution of firms according to classes and groups

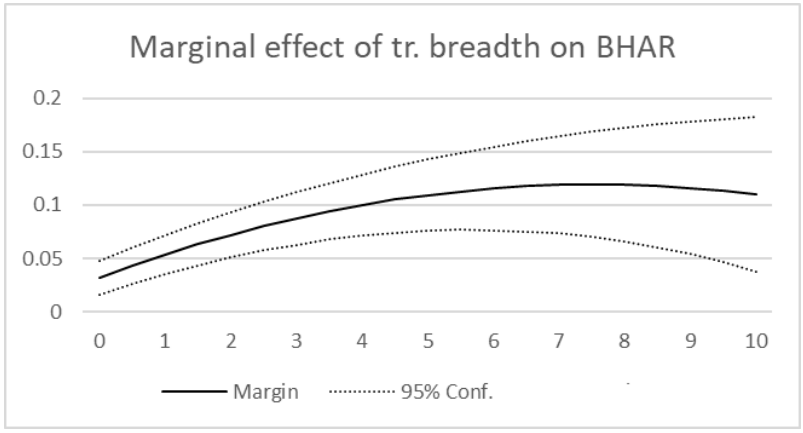
Trademark breadth	# firms
0	583
1	319
2	251
3	107
4	89
5	59
6	45
7	26
8	19
9	11
10	8

Figure A1. Graphical illustration of the main squared terms (estimates in Table 6) and interaction effects (estimates in Table 4).

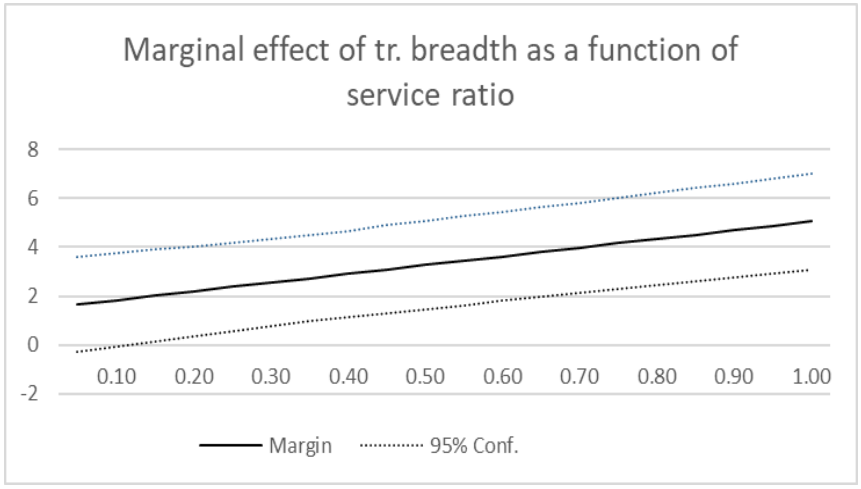
Panel (a): trademark breadth and firm valuation



Panel (b): trademark breadth and firm performance



Panel (c): trademark breadth and firm valuation in service industries



Panel (d): trademark breadth and firm performance in service industries