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The Dynamic Relationship between Investments in Brand Equity and Firm Profitability: Evidence using Trademark Registrations[1]

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Abstract

Most marketing practitioners and scholars agree that marketing assets such as brand equity significantly contribute to a firm's financial performance. In this paper, we model brand equity as an unobservable stock that results from up to thirty years of past brand-related investment flows. Using firm-specific trademarks as investment proxies, our results show a significant long-run impact on financial performance. The dynamic profile of brand-related investments has an inverted-U shape that reaches its peak after eleven years. On average, it takes four years before brand related investments show a positive return, and investments older than nineteen years show no significant impact. For the median trademarking firm, brand equity contributes 265,000 Euro to annual profits.

Keywords: Brand Equity, Firm Profitability, Intellectual Property Rights, Trademarks

JEL Classification: O31, O34

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1 Introduction

Most marketing practitioners and scholars agree that marketing assets such as brand equity significantly contribute to a firm's financial performance. As an asset, brand equity provides value to the firm today and in the long-run. But when do brand-related investments actually impact firm performance? Most studies looking at the relationship between marketing efforts and brand equity focus on consumers and identify short-run effects (Yoo et al., 2000; Buil et al., 2013).

Marketing researchers interested in the long-run financial value of brand equity to the firm generally follow two approaches. The first approach exploits the forward-looking nature of pricing in an efficient capital market. A firm's valuation is seen as reflecting investors' expectations about future cash flows. For instance, Simon and Sullivan (1993) calculated the implied intangible asset value of a firm based on a Tobin's Q model. They further postulated that a firm's intangible asset value is composed of brand equity, non-brand related factors such as research and development expenditures, and industry-wide factors. Using a cross-section of publicly traded firms, brand equity was estimated based on advertising and other brand-related investments. Sandner and Block (2011), who also applied a Tobin's Q approach, used trademark registrations as a proxy for brand equity and found a positive effect of trademark stocks on firm value. The second approach uses acquisition transactions to infer the long-run value of brand equity. For instance, Bahadir et al. (2008) obtained brand equity estimates from filings at the U.S. Securities and Exchange Commission on 133 M&A transactions. The filings contained the aquiring firm's assessed value of the target company's brands, which reflected the aquirer's expectations about future brand-related cash flows. While quite informative, these approaches do not

reveal how past investments to build brand equity contributed to its current financial value.

In this paper, we study the relationship between past brand-related investments and current financial performance. Financial performance is measured using the firm's profit margin. This indicator captures both revenue and cost effects of brand equity. We model brand equity as a stock that results from up to thirty years of past brand-related investment flows. This formulation is possible due to the availability of consistent time series on a firm's trademark registrations, which serve as annual proxy variables for the firm's brand-related investments. Our approach reveals the dynamic profile between past brand-related investments and current profitability.

Based on a representative sample of public and private firms in Germany, our results show that brand equity has a significant long-run impact on firm financial performance. The dynamic profile of brand-related investments has an inverted-U shape. On average, it takes eleven years before investments into brand equity have their peak impact on profits. Brand-related investments do not show any return in the first four years and investments older than twenty years are not significantly related to current profits. Among trademarking firms, the median contribution of brand equity to annual profits is 265,000 Euros.

The rest of the paper is organized as follows. Section 2 discusses existing literature and our conceptual framework. The third section is devoted to the data description and the econometric estimation method. The results are presented in Section 4 and the final section concludes.

2 Prior Literature and Conceptual Framework

2.1 Brand Investments and Brand Equity

In the literature, a number of conceptual models suggest that brand equity moderates the relationship between a firm's marketing actions and its subsequent financial performance. Rust et al. (2004) presented a "chain of marketing productivity" model in which tactical marketing choices such as advertising and branding initiatives affect brand equity before showing up as changes in the firm's financial position. Keller and Lehmann (2006) emphasized that company marketing programs first impact how consumers think and feel, then influence their purchasing decisions, and finally affect firm performance. Raggio and Leone (2007) argued that brand equity and brand value are distinct concepts with brand equity being an individual-level construct that moderates the impact of marketing activities that influence brand value, which is an organizational level concept. The predominant view seems to be that firm-level outcomes ultimately reflect consumer-level effects such as brand knowledge, loyalty, associations, and so forth (Ailawadi et al., 2003).

At the consumer-level, brand equity is inherently multidimensional and unobservable. It might initially be synonymous with a branded product or service, but over time it can develop qualities that exist above and beyond the objective product or service such as customer awareness, perception of desirable overall quality, and favorable associations (Keller and Lehmann, 2006). In this sense, the development of brand equity is likely to take time, but once a brand becomes familiar, people will select those products or services over an unknown brand (Aaker, 1991).

It is well understood that a company's brand equity is built over time through a variety of management choices such as expenditures on advertising, promotions, market

research, loyalty programs, distribution channel development, product-quality and customer service efforts, and new product development (Kirk et al., 2013). Advertising is one of the most visible and most expensive marketing activities, but the direct effects of advertising expenditures are not durable. For instance, Vakratsas and Ambler (1999) and Wang et al. (2009) noted that advertising expenditures exert an impact on sales that dies out over a relatively short period of time. Advertising helps, however, to achieve a high level of brand awareness, which is necessary to build brand equity (Keller, 2013). The indirect effects of advertising can thus be long-lasting and might help to accumulate customer's awareness and knowledge about the brand (Wang et al., 2009). The awareness of a brand might induce potential customers to purchase and thus evaluate the product or service.

A positive evaluation of the branded product is necessary for building a strong brand (Farquhar, 1989, 1990). The evaluation of a product enables customers to assess (i) how functional or effective the product is, (ii) how reliable it is, (iii) how durable it is, (iv) how easy it is to use, (v) how it tastes, sounds or smells and (vi) what side effects it may have (WIPO, 2013, p.81). This creates brand knowledge, which is more than just objective characteristics of the brand. It encompasses the thoughts, feelings, perceptions, images, experiences, and so on that become linked to the brand in the minds of customers (Leone et al., 2006).

However, a positive evaluation of a company's offerings is not sufficient to build brand equity. Customers have to keep the positive experience with the product or service in mind. The message for marketing practitioners is to focus on unique aspects of the brand that are easy for consumers to remember (Farquhar, 1989, 1990). A memorable name, an easy to recognize symbol or even notable packaging might represent the unique

aspect of a brand. Srinivasan et al. (2011) called the unique and memorable aspects of a brand the symbol system that firms use as the public face of the brand. The symbol system enables customers to identify the goods and services they prefer for whatever reasons. The symbols that represent a brand are, however, only valuable as long as it is impossible for other companies to attract customers by using similar symbols (Economides, 1998).

Trademarks allow firms' to protect the symbol system of their brands against competitors (Srinivasan et al., 2011; von Graevenitz, 2007; Aaker, 1991). Similar to the U.S., European law defines a trademark as follows: "A trade mark may consist of any signs capable of being represented graphically, particularly words, including personal names, designs, letters, numerals, the shape of goods or of their packaging, provided that such signs are capable of distinguishing the goods or services of one undertaking from those of other undertakings" (Article 2, Directive 2008/95/EC of the European Parliament and of the Council). A firm might use a bundle of trademarks to protect different aspects of the symbol system for its brand. The Coca-Cola brand, for example, is one of the most valuable brands world-wide and is protected in Germany by a rich bundle of over 100 trademarks. These trademarks protect the word Coca-Cola, its distinctive lettering, the famous "waisted" bottle shape, as well as several marketing slogans.

Brand equity, even if legally protected, is likely to dissipate over time unless maintained (Aaker, 1991). Brand-building activities are frequently accompanied by trademark registrations. For instance, marketing campaigns intended to maintain and grow brand awareness may be more effective with new trademarks on image-related messages (Krasnikov et al., 2009). New product introductions often leverage existing brands for this purpose. Examples for such brand extensions are the introduction of Coca-Cola light, Coca-Cola zero, and Coca-Cola life.

Trademarks are one of the most effective instruments for establishing a long lasting impression on potential buyers. They incorporate durable symbols, words, and signs that consumers are likely to remember. Trademarks establish brand differentiation, help to avoid confusion among customers, build reputational capital and are a key strategic tool for the long-run development of brand equity (Srinivasan et al., 2011). Managers can choose to renew existing trademarks and introduce new trademarks that reinforce and maintain existing brand image in the minds of consumers. For these reasons, a company's history of trademark registration can serve as a proxy for the firm's investments into its brand equity.

2.2 Brand Equity and Firm Profitability

For our analysis, the firm's economic performance metric must reflect the value of brand equity. Prior research shows that brand equity can influence a firm's performance by increasing revenues and/or by decreasing costs (Simon and Sullivan, 1993; Ailawadi et al., 2003; Keller and Lehmann, 2006; Raggio and Leone, 2007; Krasnikov et al., 2009). On the revenue side, Ailawadi et al. (2003) highlight that brand equity can influence both price and quantity. On the cost side, firms with brand equity can leverage components such as brand loyalty to reach marketing objectives at relatively lower overall costs (Simon and Sullivan, 1993; Aaker, 1991).

In our framework, brand equity is the contribution of a firm's branded products and services to its profitability compared to the firm's profitability without having brands (Dubin, 2007). To capture both channels of influence, we use a firm's profit margin, also called excess return on sales. Following Czarnitzki and Kraft (2010), excess return on

sales is expressed as follows:

$$\frac{\pi}{S} = \frac{S - labour\ cost - capital\ cost - marterial\ cost}{S}$$

with π representing profits and S is sales. If firms are in the long-run equilibrium and operate in a production range characterized by constant returns to scale, excess return on sales (averaged across all products produced by the firm) will equal the Lerner index. With constant returns to scale, marginal costs (MC) are equal to average costs (AC) and the Lerner index L can be written as:

$$L = \frac{p - MC}{p} = \frac{pq - ACq}{pq} = \frac{\pi}{S}$$

with p being price and q the quantity produced. Hence, our measure of profitability is the firm's price-cost margin adjusted for capital costs, or simply profit margin.

We model the firm's profit margin at a point in time as a function of its stock of brand equity and other firm-level determinants (Rexhäuser and Rammer, 2014; Stahl et al., 2012)

$$PM_{it} = \beta_0 + \beta_1 * BrandEquity_{\ it} + X_{it}\delta + \eta_i + \xi_t + u_{it} \tag{1}$$

where PM_{it} is firm $i's$ profit margin in year t. $BrandEquity_{it}$ is the (unobserved) stock of brand equity of firm i at time t. X is a vector of control variables capturing other influences on profit margins (described in the next section). η_i is a firm specific effect on profit margin while the ξ_t are annual time dummy variables accounting for secular trends. u_{it} is an idiosyncratic component.

Analogous to Griliches (1979) treatment of a firm's knowledge capital, we model the firm's unobserved stock of brand equity at a point in time as reflecting current and past levels of brand-related investments:

$$BrandEquity_{it} = \theta_0 + \sum_{j=0}^{k} \alpha_j R_{it-j} + \mu_t + \upsilon_{it} \tag{2}$$

where θ_0 is the level of brand equity regardless of whether the firm makes any brand-related investments (Raggio and Leone, 2009). R_{it-j} captures the firm's brand-related investments in year $t-j$. The α_j coefficients measure the fraction of those investments that contribute to brand equity at time t. μ_t is a trend component that captures all other time-varying influences on a company's brand equity that are outside the control of the firm. υ_{it} is a random transitory component that captures unexpected "shocks" to the firm's accumulated level of brand equity. Substituting (2) into (1) gives:

$$PM_{it} = \phi_0 + \sum_{j=0}^{k} \gamma_j R_{it-j} + \mathbf{X}_{it}\delta + \eta_i + \tau_t + \varepsilon_{it} \tag{3}$$

where $\phi_0 = \beta_0 + (\theta_0 * \beta_1)$, $\gamma_j = \alpha_j * \beta_1$, $\tau_t = \xi_t + \beta_1 * \mu_t$ and $\varepsilon_{it} = \beta_1 * \upsilon_{it} + u_{it}$. The coefficients of interest are the γ_j. These coefficients reveal the dynamic contribution of brand-related investments to the firm's current profit margin. They reveal the shape of the lag distribution that characterizes how past brand-related investments contribute to current profits. With a sufficiently long and complete time series of brand-related investments and appropriate assumptions about ε_{it}, equation (3) could be estimated directly. However, long and complete time series data on firm level brand-related investments do not exist. For our empirical implementation, we use a firm's annual number of trademark registrations as

proxy variables for past brand-related investments. Trademarks have been used as proxy variables for marketing investments in at least two prior studies (Fosfuri and Giarratana, 2009; Ceccagnoli et al., 2010).

Prior research in the economics and marketing literatures that used trademarks created stocks of trademarks for each company instead of using trademark flows. For instance, Sandner and Block (2011) sum all past trademarks under the assumption there is no "depreciation" of the effectiveness of individual trademarks over time. This approach assumes the α_t are constant and equal to one across all years $(\alpha_j = 1)$ in equation (2). In a recent contribution to the marketing literature, Krasnikov et al. (2009) followed that methodology. In our empirical analysis, we are able to relax this assumption. We hypothesize that the dynamic relationship between past investments in brand equity and current profitability is not constant or monotone. The contribution of a trademark to brand equity might be small, even negative, in the beginning as firms try to build consumer awareness and experience. As marketing efforts have their impact, the value of brand equity is likely to rise. Furthermore, past investments in brand equity are likely to depreciate in the sense that these investments do not have the same effect on current profitability. To allow for a non-linear relationship between past investments and current profitability, we implement a vintage model that uses flows rather than stocks.

3 Data and Estimation Method

3.1 Data

Most of our firm-level data come from the Mannheim Innovation Panel (MIP), which constitutes the German part of the European Community Innovation Survey (CIS). The survey

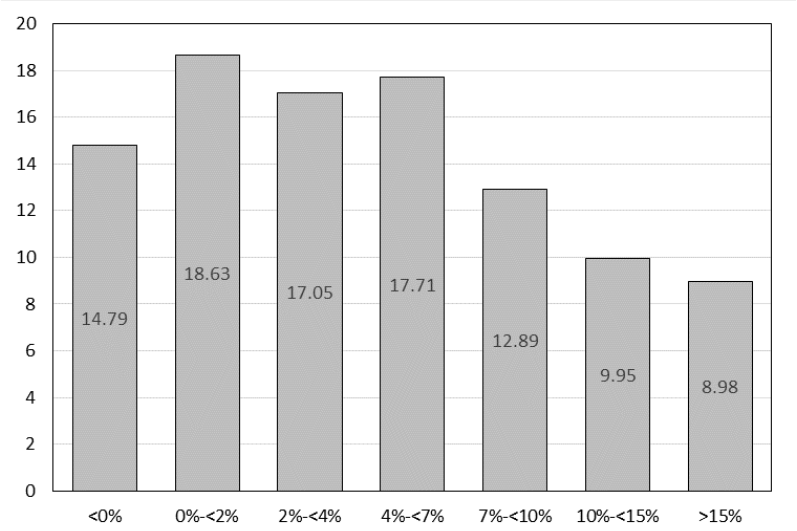
is a stratified random sample (by sector, size, and region) that targets the population of all German firms with at least five employees in manufacturing and service industries. The survey is conducted annually since 1993 by the Centre for European Economic Research (ZEW) and asks firms to report general and innovation related information covering the prior three years. The methodology and questionnaires are internationally harmonized across the countries and based on the Oslo Manual: "Proposed Guidlines for Collecting and Interpreting Technological Innovation Data" (OECD, Eurostat, 2005). German survey data are improved through extensive non–response surveys and are considered to be of high quality (Eurostat, 2013). Further information on the survey methodology, data, and validity is provided by Peters (2008) and Aschhoff et al. (2013).

This study combines the MIP survey information for the period from 2001 through 2010 with administrative data on each firm's trademark and patenting activity. The trademark data come from the Office for Harmonization in the Internal Market (OHIM) and the German Patent and Trade Mark Office (DPMA). The OHIM data reflect trademarks valid in all European Union (EU) member states while the DPMA trademarks are specific to Germany. In the empirical model, we will also control for patent applications by the firms. Patent application data come from the European Patent Office (EPO) and Germany's DPMA. All administrative data were matched to the German CIS using assignee name and address information and specialized software developed at the Centre for European Economic Research. The final database is an unbalanced panel of 10,230 firms with a total of 33,840 firm-year observations. It is unbalanced because firms do not always respond to the MIP survey. About 4% of the firms have 10 years of data, another 10% have at least 8 years of data, 45% have 4 years of data, and the remaining 41% have less than 4 years.

3.1.1 Dependent Variable: Firm Profitability

Because firms typically view their profit margin as proprietary, the MIP survey question was designed to obtain interval responses as opposed to exact figures. Respondents could choose from among seven categories: less than 0 percent, 0 to less than 2 percent, 2 to less than 4 percent, 4 to less than 7 percent, 7 to less than 10 percent, 10 to less than 15 percent, and 15 percent and more.

Figure 1: Distribution of Firm Profitability



For all 10,230 firms in the sample, Figure 1 shows the distribution of return on sales, which we call profit margin for simplicity. About 15% of the sample firms are losing money as shown by the height of the bar above the ”less than 0%” category. Most firms (about 53%) report profit margins less than 7% and about 31% of the firms earning profit margins over 7%.

3.1.2 The Trademark Measure of Brand Equity

We proxy for a firm's brand-related investment using thirty-one years of trademark activity. One of the main advantages of using trademarks to proxy for investments into

brand equity is that comprehensive administrative data are publicly available. For German firms, the administrative data show that more than 1.5 million trademarks were registered at DPMA since 1894 and nearly 0.9 million Community trademarks were registered at OHIM since its foundation in 1996. The combined DPMA and OHIM data allow us to have a long time series on the number of trademarks each firm registered. We use the registration date of the trademarks and use only trademarks that are still valid (active). Trademarks expire after 10 years, unless the firm renews them. Similar to Krasnikov et al. (2009), we assume expired trademarks, which are no longer valid, do not contribute to firm profitability. [2]

Figure 2: Age Distribution of Trademarks in 2010

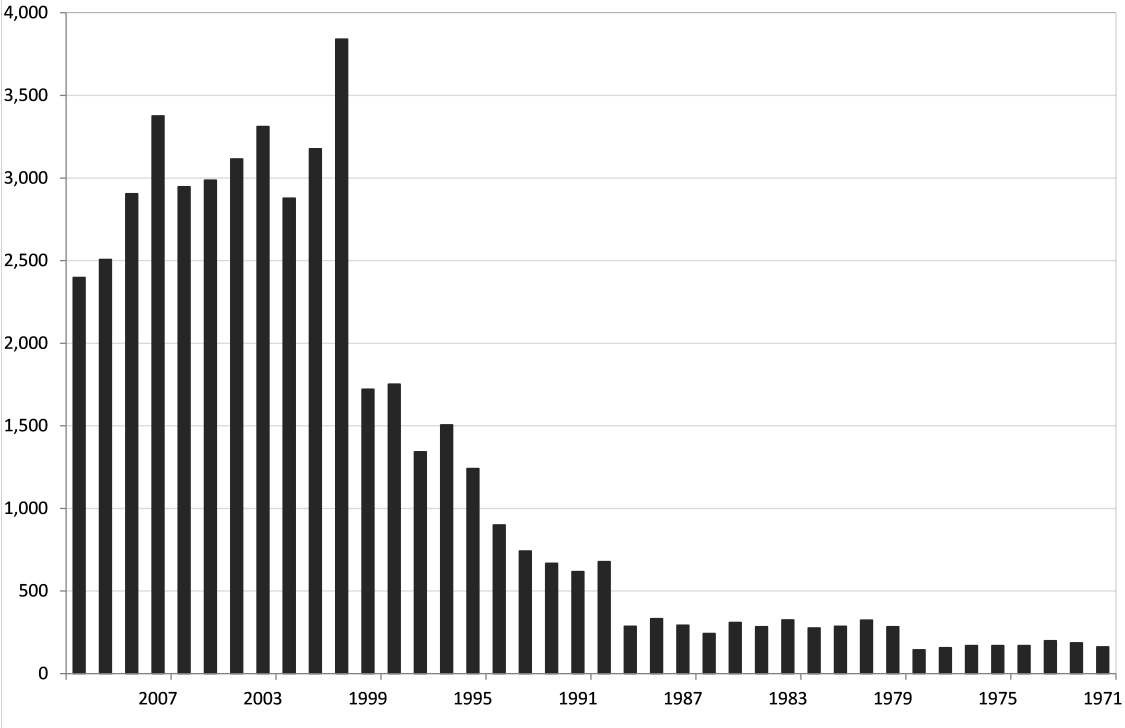


Figure 2 shows the age distribution of registered and valid trademarks in our data for the year 2010. Most trademarks are less than eight years old and the number of valid trademarks falls quickly with age. This is caused by two effects. First, the number of

[2]The empirical results are nearly identical with using all trademarks (expired and active).

trademark registrations has increased tremendously since the early 1990's (Schautschick and Greenhalgh, 2013). Second, a large fraction of registered trademarks are not renewed and expire after the protection period of ten years. Of the trademarks that have been registered in 1999, only 54% have been extended.

3.2 Empirical Implementation

We estimate the contribution of brand equity to firm profits using firm-level panel data. In the survey, firms reported profit margins in intervals. To account for this, we used an ordered probit regression model with known thresholds. Since we know the thresholds of the categories, we are able to interpret the coefficients of the estimation directly as marginal effects (Wooldridge, 2002, p. 508). The panel structure of the data allows us to estimate both pooled regression models and random effects models, which have the added feature of controlling for firm-level unobserved heterogeneity as indicated in equation (3).[3]

Our data allow us to use thirty-one years of annual trademark registration flows to proxy for brand-related investments. We allow the distributed lag to have a polynomial shape by using an Almon formulation. Following the Weierstrass-theorem, the Almon approach to distributed-lag models assumes that γ_j can be approximated by a suitable-degree polynomial in j, the length of the lag. Intuitively, a second order polynomial makes sense because it allows the contribution of brand-related investments to increase and decrease over time. In this case, the lag coefficients are restricted to the following

[3]Note that a fixed effects version of the ordered Probit model does not exist.

form:[4]

$$\gamma_j = a_0 + a_1 j + a_2 j^2 \tag{4}$$

Substituting (4) into (3) and using trademark registrations (TM) to proxy for R, we obtain

$$\begin{aligned} PM_{it} &= \phi_0 + \sum_{j=0}^{k} (a_0 + a_1 j + a_2 j^2) TM_{it-j} + \mathbf{X}_{it}\delta + \tau_t + \varepsilon_{it} \\ &= \phi_0 + a_0 \sum_{j=0}^{k} TM_{it-j} + a_1 \sum_{j=0}^{k} jTM_{it-j} + a_2 \sum_{j=0}^{k} j^2 TM_{it-j} + \mathbf{X}_{it}\delta + \tau_t + \varepsilon_{it} \end{aligned} \tag{5}$$

Defining

$$\begin{aligned} Z_{1t} &= \sum_{j=0}^{k} TM_{t-j} \\ Z_{2t} &= \sum_{j=0}^{k} jTM_{t-j} \\ Z_{3t} &= \sum_{j=0}^{k} j^2 TM_{t-j} \end{aligned} \tag{6}$$

The equation simplifies to

$$PM_{it} = \phi_0 + a_0 Z_{1t} + a_1 Z_{2t} + a_2 Z_{3t} + \mathbf{X}_{it}\delta + \tau_t + \varepsilon_{it} \tag{7}$$

In the Almon scheme *PM* is regressed on the constructed variables *Z* (or Almon-polynomial terms), not on the original trademark flows. Once the coefficients on the Almon-Polynomial

[4] We used also a third-degree polynomial, see section 4 on econometric results. As we will discuss below, the results concerning the shape of the value creation by trademarks in our vintage model did not depend on the degree of the polynomial.

terms are estimated, the original γ_j can be calculated from

$$\hat{\gamma}_j = \hat{a}_0 + \hat{a}_1 j + \hat{a}_2 j^2 \tag{8}$$

The resulting gamma coefficients for current and thirty lags of trademark registrations can be interpreted as marginal effects on a firm's profit margin.

3.3 Control Variables

Beyond brand-related investments, a firm's profit margin may be influenced by a variety of other firm–specific and external factors. As firm-specific drivers we include innovation activities, firm size and firm age, region, export orientation, and the type of ownership. Innovation activities are measured by three variables. We control for product innovation by including a dummy variable indicating whether the firm launched at least one new or significantly improved product in the last three years. Accordingly, we also use a process innovation dummy indicating whether the firm has introduced at least one new process in its production in the recent three years. As patented knowledge may result in a profit premium because of the possible exclusivity of the innovation, we also collected information on whether the firm had any EPO patent. Thus, as third innovation variable we use a EPO Patent dummy indicating whether the firm had at least filed one patent application at the European Patent Office.

Firm size is measured by the number of employees. In order to account for the skewness of firm size, we use the log of the number of employees in the regression, $ln(EMPL)$ and also use its squared value to allow for non-linearities. Additionally we use the log of firms' age measured as elapsed years since the date of foundation, $ln(AGE)$.

The dummy *EastGermany* denotes firms located in Eastern Germany, and the dummy *Exporter* stands for firms that realize at least some of their sales abroad. The dummy variable *Group* distinguishes between stand-alone firms (reference group) and those that belong to a group of firms, i.e. this may control for synergy (dis)advantages. Among external factors, market structure is captured by the Herfindahl index of industry concentration. We also use *capitalintensity* defined as tangible assets per employee. The higher the capital intensity, the higher might be the barriers to enter the same market for other firms which may result in higher mark-ups.

We also include time dummies and 12 industry dummies to control for industry characteristics that are not measured by the other structural variables. Descriptive statistics of the variables are presented in Table 1.

Table 1: Descriptive Statistics of Main Variables

	Median	Mean	Std.Dev.	Min.	Max.
Profit Margin	3.00	3.61	1.85	1.00	7.00
Trademarks (D)	0.00	0.34	0.47	0.00	1.00
Almon-Polynomial Term 0	0.00	4.17	30.11	0.00	1200.00
ln(EMPL)	3.69	3.87	1.70	0.00	13.17
ln(Capital intensity)	–3.96	–4.05	1.58	–11.95	2.50
EPO Patent (D)	0.00	0.16	0.36	0.00	1.00
Product Innovation (D)	0.00	0.48	0.50	0.00	1.00
Process Innovation (D)	0.00	0.47	0.79	0.00	4.00
Herfindahl index	0.00	0.01	0.04	0.00	1.00
Exporter (D)	1.00	0.50	0.50	0.00	1.00
ln(AGE)	2.77	2.82	1.13	–0.69	6.52
Group (D)	0.00	0.31	0.46	0.00	1.00
East Germany (D)	0.00	0.33	0.47	0.00	1.00

Notes: (D) denotes dummy variables. Ten time and 12 industry dummies are not presented.

4 Econometric Results

We estimate both pooled and random effects models to analyze the effects of brand-related investments on a firm's profit margin. Both models yield similar results, but a likelihood ratio test rejects the pooled model in favor of the random effects model. For this reason, we present the regression results from the random effects model (results for the pooled model can be found in the Appendix).

Table 2 shows the regression results for three alternative models. Column (1) provides the results for a specification that only includes the first Almon-polynomial term for trademark registrations. This specification corresponds to a stock formulation without depreciation. Similar to Sandner and Block (2011) and Krasnikov et al. (2009), the results show a positive and significant positive effect of trademarks on firm profitability. Each trademark, irrespective of its age, has a marginal impact of 0.008. So, for instance, one more trademark increases expected profits by 0.008 in every year that it remains valid.

In Column (2) we relax the assumption that all valid trademarks, regardless of vintage, have the same effect on current profits. Instead, we allow a quadratic shape over vintages using a second-order polynomial specification that includes all three Almon-polynomial terms. As reported at the bottom of the table, a Wald test shows the Almon-polynomial terms are jointly significant. The coefficient estimates reveal inverted-U time profile between trademarks and the firm's current profit margin.

Column (3) in Table 3 provides a robustness check for the quadratic model. It uses a cubic polynimial specification to relax the functional form restriction on the underlying gamma coefficients. Although the Wald test shows the Almon-polynomial terms are jointly significant, a likelihood ratio test rejects the cubic model in favor of the quadratic

Table 2: Firm Profitability and the Impact of Brand-related Investments

	(1) Point	(2) Quadratic	(3) Cubic
Brand-related Investments			
Almon-Polynomial Term 0	0.008***	–0.009	–0.001
	(0.002)	(0.007)	(0.012)
Almon-Polynomial Term 1		0.005**	0.000
		(0.002)	(0.005)
Almon-Polynomial Term 2		–0.000**	0.000
		(0.000)	(0.001)
Almon-Polynomial Term 3			–0.000
			(0.000)
ln(EMPL)	–0.991***	–0.996***	–1.000***
	(0.112)	(0.113)	(0.113)
$\ln(EMPL)^2$	0.069***	0.070***	0.070***
	(0.012)	(0.012)	(0.012)
ln(Capital intensity)	0.069***	0.069***	0.069***
	(0.026)	(0.026)	(0.026)
EPO Patent (D)	0.299*	0.294*	0.294*
	(0.157)	(0.157)	(0.157)
Product Innovation (D)	0.266***	0.265***	0.265***
	(0.062)	(0.062)	(0.062)
Process Innovation (D)	0.063*	0.062*	0.063*
	(0.036)	(0.036)	(0.036)
Herfindahl index	0.222	0.276	0.291
	(1.153)	(1.153)	(1.153)
Exporter (D)	0.036	0.034	0.033
	(0.097)	(0.097)	(0.097)
ln(AGE)	0.225***	0.223***	0.223***
	(0.046)	(0.046)	(0.046)
Group (D)	0.086	0.084	0.085
	(0.098)	(0.098)	(0.098)
East Germany (D)	–0.065	–0.067	–0.067
	(0.121)	(0.120)	(0.120)
W_Almon	0.000	0.000	0.000
W_Industry	0.000	0.000	0.000
Log-likelihood	-58,845.25	-58,841.91	-58,841.55
Observations	33,840	33,840	33,840

Significance levels: *** p<0.01, ** p<0.05, * p<0.1. Standard errors in parentheses.

Notes: Regression additionally includes three dummies indicating missing values in the variables Exporter, Group, and Capital intensity. W_Almon denotes the p-value of a Wald test on joint significance of Almon polynomials, and W_industry refers to the p-value of the joint significance of the set of industry dummies.

model.

Among the control variables, the results in Table 2 are consistent across all three columns. The quadratic specification for firm size suggests profit margin falls as size increases up to 1,100 employees (this covers roughly 95% of the sample) and increases thereafter. Age is postive and significantly related to profit margin. For innovation activities, having at least one patented invention along with product and process innovations are associated with higher profit margins. Further, higher capital intensity increases profitabilty.

To examine how past trademarks (i.e. brand-related investments) influence current profit margins, Table 3 reports the underlying gamma coefficients using equation (8). These coefficients reveal the dynamic profile between different vintages of trademarks and current profitability. Contemporaneous trademark registrations and those less than four years old have no significant effect on current profits. The impact of trademarks on profitability become positive and significant after four years. The size of the marginal effect increases until the eleventh year and starts to decrease after fifteen years. After nineteen years, the coefficients are no longer significantly different from zero. These results show that current profitability attributable to brand equity largely reflects long-run impacts of past investments. They support the perspective that the brand equity is an asset and reveal an expected payoff profile that takes over a decade to reach its maximum.

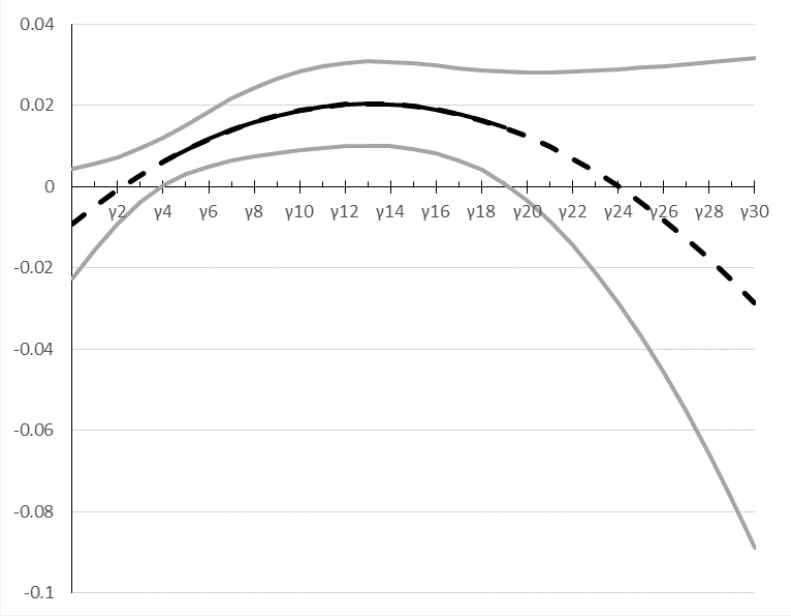
Table 3: Resulting Gammas (Random-Effects Interval Regression)

	(1) Quadratic		(2) Cubic	
	Coef.	Std. Err.	Coef.	Std. Err.
γ_0	–0.009	(0.007)	–0.001	(0.012)
γ_1	–0.005	(0.005)	–0.001	(0.007)
γ_2	–0.001	(0.004)	0.000	(0.004)
γ_3	0.003	(0.003)	0.002	(0.003)
γ_4	0.006**	(0.003)	0.004	(0.004)
γ_5	0.009***	(0.003)	0.006	(0.005)
γ_6	0.012***	(0.003)	0.008	(0.005)
γ_7	0.014***	(0.004)	0.011**	(0.005)
γ_8	0.016***	(0.004)	0.013**	(0.005)
γ_9	0.017***	(0.005)	0.016***	(0.005)
γ_{10}	0.019***	(0.005)	0.018***	(0.005)
γ_{11}	0.020***	(0.005)	0.020***	(0.005)
γ_{12}	0.020***	(0.005)	0.022***	(0.006)
γ_{13}	0.020***	(0.005)	0.024***	(0.007)
γ_{14}	0.020***	(0.005)	0.025***	(0.008)
γ_{15}	0.020***	(0.005)	0.026***	(0.009)
γ_{16}	0.019***	(0.005)	0.027**	(0.011)
γ_{17}	0.018***	(0.006)	0.026**	(0.012)
γ_{18}	0.016***	(0.006)	0.026**	(0.013)
γ_{19}	0.014**	(0.007)	0.024*	(0.013)
γ_{20}	0.012	(0.008)	0.022	(0.014)
γ_{21}	0.010	(0.009)	0.018	(0.014)
γ_{22}	0.007	(0.011)	0.014	(0.014)
γ_{23}	0.004	(0.013)	0.009	(0.014)
γ_{24}	0.000	(0.015)	0.003	(0.015)
γ_{25}	–0.004	(0.017)	–0.005	(0.017)
γ_{26}	–0.008	(0.019)	–0.013	(0.020)
γ_{27}	–0.013	(0.022)	–0.023	(0.025)
γ_{28}	–0.018	(0.025)	–0.035	(0.032)
γ_{29}	–0.023	(0.028)	–0.047	(0.040)
γ_{30}	–0.029	(0.031)	–0.062	(0.050)

Significance levels: *** p<0.01, ** p<0.05, * p<0.1. Standard errors in parentheses.

Figure 3 illustrates the dynamic profile between investments in brand equity and firm profitability by plotting the gamma coefficients along with the 95% confidence bounds. The figure suggests marketing managers who wish to maximize the impact of brand-related investments on firm profitability could follow a "vintage strategy". Such a strategy would involve creating an age–weighted portfolio of investments. As seen in Figure 3, it would involve a continuous and smooth investments in branding rather than an alternative strategy that emphasizes large and intermittent "big event" expenditures.[5]

Figure 3: Lag-distributed Marginal Effects of Brand-related Investments (95% Conf. Interval)



Profitability of trademark portfolios

Among trademarking firms, most have a trademark portfolio which consists of at least two active trademarks. For these firms, the profitability of trademarks will reflect the contribution of all trademarks in their portfolio depending on the trademark vintage. Our results allow us to calculate the annual contribution of trademark portfolios to firms' cur-

[5]The graphical representation is based on Column (2) of Table 3. Note that the dotted part of the curve represents values that are not significantly different from zero (based on the 95% confidence interval).

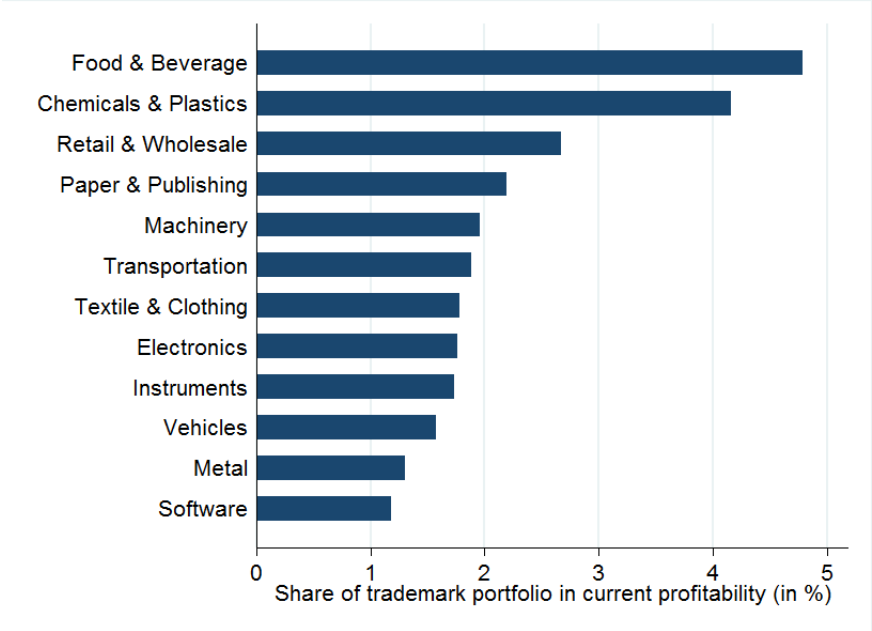
rent profitability. To do this, we create a weighted portfolio by multiplying the number of trademarks by vintage with their respective regression coefficients. As the dependent variable is measured as return on sales, we can subsequently multiply the weighed portfolio contribution to return on sales with the firm's sales in order to obtain a value distribution in EURs. The median value of a firm's trademark portfolio amounts to about EUR 265.000 per year. However, it is also important to notice that the value distribution is skewed. For instance, 20% of trademarking firms do not obtain any profits from their portfolios. This can be explained by the non–linear nature of the development of trademark values. As our econometric results suggest, portfolios only show a positive impact on current profits if the trademarks are older than four years. Furthermore, for the upper quartile of trademarking firms, the contribution to current profits exceed EUR 2 million EUR per year, all else constant.

Profitability of trademark portfolios across industries

To further explore our results, we calculated the share that trademark portfolios contribute to current profitability at the industry level by taking the average across firms within an industry. Figure 4 presents these results by ranking industries from the largest to the smallest contribution to current profitability. Similar to Simon and Sullivan (1993), we also find considerable heterogeneity across sectors in Germany. The food and beverage industry shows the highest share of current profitability attributable to their trademark portfolio at nearly 5%, on average. This industry includes famous German beer brands such as Becks but will also include German subsidiaries of major international companies like Coca Cola and Pepsi. This is followed closely by chemicals including pharmaceuticals, rubber and plastics which are important industries in Germany. This includes for instance

BASF and Bayer. Trademark portfolios in Retail and Wholesale Trade also conotribute nearly 3% to current profitability, on average. For the other industries the contributions are more uniform and range between 1.3% and 2.2%, on average.

Figure 4: Profitability of trademark portfolios across industries



A comparison with Interbrand values

Interbrand, one of the world's leading branding consultancies, offers a ranking of the 'Best German Brands' based on its own valuation methodology for brands (Interbrand, 2014; Chu and Keh, 2006). We make use of Interbrand's ranking as an external and independent source to validate our findings by considering the 50 most valuable German brands. For these 50 German firms, we construct their trademark portfolios by vintage and use our estimated regression coefficients as described above to calculate the portfolio contribution to current profitability using the firms' sales in 2013. We were unable to locate sales figures of eight out of the 50 companies, and therefore use the remaining 42 German companies ranked by Interbrand for our comparison. The correlation between both rankings

was analyzed using the Spearman rank correlation test. Spearman's correlation coefficient ρ is equal to 0.46 and we are able to reject the hypotheses of no correlation between the two rankings at the one percent level. This finding is supportive of our approach, but we cannot calculate the value of individual brands for a company.

5 Conclusion

Our research uses the modeling approach for unobservable knowledge stocks introduced by Griliches (1979) as the conceptual and empirical framework for understanding how brand equity influences firm-level profitability. This approach recognizes that brand equity is an unobservable, consumer-level construct that can be built up over time to provide long-run financial value to the firm. Firms build brand equity through brand-related investments in trademarks, advertising, loyalty programs, and so forth.

Our analysis answers an important question about these investments: how do past investments in brand equity contribute to current profitability? Understanding this dynamic payoff profile can help marketing managers formulate better marketing strategies and set expectations among shareholders and other investors about payoff time horizons.

Implementing the Griliches (1979) framework would be straight forward if sufficient time series information existed on each firm's brand-related investments. Unfortunately, these data are not generally available, especially for privately-held firms. As Krasnikov et al. (2009) and Sandner and Block (2011) pointed out, trademark registrations are brand-related investments that are traceable to individual firms and cover a long period of time. Our empirical implementation uses thirty-one years of trademark information to proxy for firm-level brand-related investments. We used the annual flow of trademark registrations

and estimated the dynamic payoff profile between brand-related investments and current profitability through a vintage model.

Starting with a representative sample of public and private firms in Germany, we constructed a panel database over the period 2001 through 2010 and combined it with administrative data on each firm's patents and trademarks. Our estimation results support the view that brand equity is an asset that has long-run value to the firm. The payoff profile shows an inverted-U shape with peak payoffs occurring from eleven and fifteen years after initial investment. On average, investments into brand equity do not contribute to profits in the first four years and after nineteen years. These findings suggest marketing managers could maximize the profitability of brand-related investments by following a "vintage strategy" that involves creating an age-weighted portfolio through continuous and smooth brand related-investments.

Using our model, we were able to estimate the firm and industry-level contributions of brand equity to profitability as well as examine the rank correlation of our model results with Interbrand's ranking of the "Best German Brands". Based on firm-specific trademark portfolios, the contribution of brand equity to profitability is highly skewed across firms. For twenty percent of trademarking firms, brand equity does not contribute to current profits, probably reflecting a brand equity "build up" period since the trademarks by these firms are less than four years old. The median contribution of brand equity to firm profitability was EUR 265,000 per year, with the upper quartile earning profits greater than EUR 2 million per year. When aggregated to the industry level, food and beverage industry ranked highest with nearly 5% of its annual profitability attributable to brand equity. Finally, comparing rankings from our model with those of Interbrand showed a positive and highly significant correlation.

While our research helps advance the literature on modeling and estimating the contribution of brand equity to firm-level profits, much work remains to be done. As pointed out by Raggio and Leone (2009), firms possess some brand equity even without making specific brand-related investments such as trademarks. The Griliches (1979) framework (equation 2 above) incorporates this possibility, but we could not provide an estimate as this contribution is not separately identifiable from the intercept on the firm's profit margin. The use of trademark flows to proxy for firm-level brand related investments is a step forward, but is also limited. Many firms, particularly small firms, do not formally register trademarks. If other brand related investments such as marketing campaigns differ disproportionately from the rate of trademark registrations between small, medium-sized and large firms, our estimates could be biased. Therefore, studies that use more comprehensive measures of brand-related investment should be conducted in the future.

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6 Appendix

Table 4: Pooled vs. Panel Interval Regression

	(1) Pooled Regression	(2) Panel Regression
Brand-related Investments		
Almon-Polynomial Term 0	–0.016*	–0.009
	(0.009)	(0.007)
Almon-Polynomial Term 1	0.006**	0.005**
	(0.003)	(0.002)
Almon-Polynomial Term 2	–0.000**	–0.000**
	(0.000)	(0.000)
ln(EMP)	–1.025***	–0.996***
	(0.081)	(0.113)
$\ln(EMP)^2$	0.076***	0.070***
	(0.008)	(0.012)
ln(Capital intensity)	0.185***	0.069***
	(0.025)	(0.026)
EPO Patent (D)	0.237**	0.294*
	(0.108)	(0.157)
Product Innovation (D)	0.298***	0.265***
	(0.083)	(0.062)
Process Innovation (D)	0.153***	0.062*
	(0.049)	(0.036)
Herfindahl index	–1.753**	0.276
	(0.748)	(1.153)
Exporter (D)	–0.066	0.034
	(0.083)	(0.097)
ln(AGE)	–0.006	0.223***
	(0.032)	(0.046)
Group (D)	0.291***	0.084
	(0.085)	(0.098)
East Germany (D)	–0.308***	–0.067
	(0.075)	(0.120)
W_Almon	0.000	0.000
W_Industry	0.000	0.000
W_Time	0.000	
σ_u		5.153
σ_e		3.340
ρ		0.704
Log-likelihood	-66,259.97	-58,841.91
Observations	33,840	33,840

Significance levels: *** p<0.01, ** p<0.05, * p<0.1. Standard errors in parentheses.

Notes: Regression additionally includes three dummies indicating exporter, group, and capital intensity are missing. P-values of Wald tests on joint significance are indicated by "W_".

Table 5: Resulting Gammas (Random-Effects Interval Regression)

	(1) Pooled Regression		(2) Panel Regression	
	Coef.	Std. Err.	Coef.	Std. Err.
γ_0	–0.016*	(0.009)	–0.009	(0.007)
γ_1	–0.010	(0.007)	–0.005	(0.005)
γ_2	–0.004	(0.004)	–0.001	(0.004)
γ_3	0.001	(0.003)	0.003	(0.003)
γ_4	0.006**	(0.003)	0.006**	(0.003)
γ_5	0.010***	(0.003)	0.009***	(0.003)
γ_6	0.013***	(0.005)	0.012***	(0.003)
γ_7	0.016***	(0.006)	0.014***	(0.004)
γ_8	0.019***	(0.007)	0.016***	(0.004)
γ_9	0.021***	(0.007)	0.017***	(0.005)
γ_{10}	0.022***	(0.008)	0.019***	(0.005)
γ_{11}	0.023***	(0.008)	0.020***	(0.005)
γ_{12}	0.023***	(0.008)	0.020***	(0.005)
γ_{13}	0.023***	(0.008)	0.020***	(0.005)
γ_{14}	0.023***	(0.007)	0.020***	(0.005)
γ_{15}	0.021***	(0.007)	0.020***	(0.005)
γ_{16}	0.020***	(0.006)	0.019***	(0.005)
γ_{17}	0.018***	(0.005)	0.018***	(0.006)
γ_{18}	0.015***	(0.005)	0.016***	(0.006)
γ_{19}	0.011***	(0.004)	0.014**	(0.007)
γ_{20}	0.008	(0.005)	0.012	(0.008)
γ_{21}	0.003	(0.006)	0.010	(0.009)
γ_{22}	–0.001	(0.008)	0.007	(0.011)
γ_{23}	–0.007	(0.011)	0.004	(0.013)
γ_{24}	–0.013	(0.013)	0.000	(0.015)
γ_{25}	–0.019	(0.016)	–0.004	(0.017)
γ_{26}	–0.026	(0.020)	–0.008	(0.019)
γ_{27}	–0.034	(0.024)	–0.013	(0.022)
γ_{28}	–0.042	(0.027)	–0.018	(0.025)
γ_{29}	–0.050	(0.032)	–0.023	(0.028)
γ_{30}	–0.059	(0.036)	–0.029	(0.031)

Significance levels: *** p<0.01, ** p<0.05, * p<0.1. Standard errors in parentheses.