What doesn't kill you makes you stronger: on the determinants of trademark survivability over the long term

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Abstract

Purpose – Brands and trademarks are rather different in essence but complementary phenomena in practice. Trademarks provide legal protection to brands, representing a concrete and measurable asset. They are strategic for brand managers, but they have been relatively neglected in branding studies. This paper aims to delve into an entire trademark registry of a Western economy and identifies the factors that determine trademark duration over the long term.

Design/methodology/approach – To analyze trademark survival, this study relies on the Cox Proportional Hazard Model that estimates the hazard rates as a function of the survival time and a set of covariates. This allows examining the factors influencing the mortality rate of trademarks at a particular point of time through their life span.

Findings – The results reveal that legal oppositions significantly reduce competitors' trademark duration, serving as a protective measure against entrants threatening the market power of incumbents. Also, that the number of assignments/licenses and trademark breadth, reflecting brand value, enhances survival. Finally, other positive factors include the number of trademarks and patents held by applicants, as well as their status as nonresidents or firms.

Originality/value – The investigation analyzes all existing trademarks recorded in the first official registry of the world—institutionalized in Spain in 1850—and tracks their longevity up to 2010. This is an original approach that contributes to the understanding of the long-term consequences of distinct legal, commercial and administrative trademark strategies. The results provide interesting insights for both branding scholars and practitioners.

Keywords Trademarks, Quantitative methods, Brand lifecycle, Survival analysis

Paper type Research paper

1. Introduction

Brands and branding activities are key topics in marketing and management studies. During the last decades, business academic journals have published hundreds of articles devoted to exploring the complexity of brand equity from distinct research and managerial perspectives (see, for instance, Rojas-Lamorena *et al.*, 2022). Nevertheless, little of this work has dealt with trademarks, the more tangible, well-established and quantifiable aspect of brands. In some cases, trademarks and brands have been considered together as part of connected phenomena—and even as synonyms in an increasingly misleading definition (Gaski, 2020)—but they carry distinct characteristics.

Branding links companies' values and consumers' feelings in complex and comprehensive ways. It is a contemporary practice whose roots can be traced to the end of the 19th century but generalized during the post-World War II period (Low and

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Fullerton, 1994). Trademarks originated well before modern branding and marketing as a means of associating products to their manufacturers by signaling their origin, quality or other properties, and differentiating them from similar goods in the marketplace (Higgins and Tweedale, 1995). Trademarks were typically registered and legally recognized, initially at a local level, later on nationally and, nowadays, at a global scale. They were, and still are, the best means of legally defending the reputation of manufacturers and, thereby, brand equity from imitators and rent-seekers. Trademarks also have a unique characteristic: they are the only intellectual property right that can last indefinitely as long as they are renewed. In other words, trademarks are the most "tangible" of the firm's intangible assets that contribute to building enduring and valuable brands.

Marketing and business scholars have primarily examined trademarks in terms of their legal implications (see, for instance, Evans *et al.*, 2019; Krasnikov and Jayachandran, 2022) as well as their impact on various dimensions of firms' financial and economic performance (Fisch *et al.*, 2022; Xiao *et al.*, 2024) and the influence of related administrative procedures (Melnyk *et al.*, 2014; Nasirov, 2020). In all cases, trademarks emerge as strategic assets for companies, requiring brand managers to understand and handle them effectively. Only recently have scholars developed theoretical frameworks for strategic trademark management (Cao *et al.*, 2022), which this study pursues to empirically test. Although trademark registries have existed for centuries, they have been underused in advanced studies on brand strategies, business performance and their theoretical and managerial implications.

This article undertakes a pioneering study: unraveling the determinants of trademark duration over the long term by applying a survival analysis to the entire collection of trademarks registered in a Western economy (Spain, 1850–1920) and tracking their evolution up to 2010. This is a challenging task that qualifies the previous theoretical approaches and brings new findings and insights into trademark strategic management, providing valuable implications for marketing researchers and practitioners.

Methodologically, this study advances the application of the Cox Proportional Hazard Model (Cox, 1972) to test the survival of trademarks. This is a common technique used in health studies—but scarcely applied in social sciences—to estimate risk rates as a function of trademark survivability and a set of specific factors that affect its passing at a given point in time. The method is strengthened through the inclusion of sectoral and geographical dimensions as well as covariate interactions for robustness checks. Leveraging the quality of the Spanish trademark historical statistics, which were directly constructed from the original archival files, this study models the evolution of trademarking throughout more than a century. As a caveat, the analysis is constrained by the availability of only trademark/patent-related explanatory variables, as there is a lack of ancillary historical data on the production and financial performance of the companies owning the trademarks.

Despite this constraint, the findings are robust and enhance recent theories by clarifying the role of litigation, licensing and property rights in trademark management. This work demonstrates the key role of legal oppositions (defensive and offensive) in trademark survival, revealing the distinct tactics used by owners and their effects in increasing/decreasing trademark duration. It also shows that trademark assignments (including selling, licensing, or any other kind of legal transference), trademark breadth (the number of sectors in which it operates), or trademark/patent intensity (the number of registrations in either case by an applicant) positively influence trademark longevity. These insights provide empirical evidence to guide owners in making more informed decisions on trademark management (e.g. registration, management and renewals).

All the above is contextualized, specified and discussed as follows: the next section contains a literature review on trademarks in marketing and business; Section 3 provides a brief historical account of the Spanish trademark system and its sources; Section 4 presents the theoretical approach, hypotheses and variables; Section 5 develops the methodology, the survival analysis strategy and the models; Section 6 offers the regression specifications and estimation results and the last sections conclude by discussing theoretical, analytical, empirical and managerial implications, study limitations and further research.

2. A Literature review on trademarks in marketing and business

Trademark research has been relatively neglected in marketing and business studies with respect to the effort dedicated to other aspects of brands (Sáiz and Castro, 2018). The first papers appeared during the 1980s and were mainly focused on trademark-related legal issues and their strategic and managerial implications. "Trademark Strategy" was the title of two influential articles that deepened on law changes and court cases, and their consequences for managers who could no longer ignore the design of trademark tactics to defend corporate brands (Cohen, 1986, 1991). Building upon this foundation, other scholars explored a variety of legal issues intending to advise brand managers on: the implications of inter-firm trademark transfers (Coolley, 1986); the issue of protection of product characteristics through trademarks (Burgunder, 1997); the consequences of key law changes such as the 1995 Federal Trademark Dilution Act in the USA (see, among others, Morrin *et al.*, 2006); the difficulties in legal actions for trademark infringement and product counterfeiting (Evans *et al.*, 2019; Mitchell and Kearney, 2002) or the effects of key court cases regarding trademarks and brands (Ertekin *et al.*, 2018; Krasnikov and Jayachandran, 2022).

Only recently business and marketing academics have developed new research and models based on the systematic analysis of current trademark records and entrepreneurial data to—among other aspects—propose ways to assess: commercial and low-tech innovation processes (Flikkema *et al.*, 2014, 2019; Mendonça *et al.*, 2004); the financial impact of trademarks and branding (Block *et al.*, 2014a; Crass *et al.*, 2019); the market value of firms and their economic performance (Fisch *et al.*, 2022; Xiao *et al.*, 2024); the role of trademarks in the valuation of startups by venture capitalists (Block *et al.*, 2014b; Zhou *et al.*, 2016) or the predicting capacity of new trademark registrations on firm profitability (Hsu *et al.*, 2022).

There are also applied studies that delve into trademark administrative procedures and their strategical use. For instance, the analysis of firms' motives (proprietary, marketing, exchange) for filing trademarks (intensity) (Block *et al.*, 2015; Patel, 2024); the study of trademark oppositions (received and made) as a measure of trademark value (Nasirov, 2020; Sandner and Block, 2011; Von Graevenitz, 2007); the call to take advantage of existing data sets on U.S. trademark assignments, yet to be exploited academically (Graham *et al.*, 2018); the research on the

factors influencing trademark renewals (Melnyk *et al.*, 2014; Pfeifer *et al.*, 2025); the investigation on trademark breadth and their impact on trademark value (Block *et al.*, 2014b; Nasirov, 2020; Sandner and Block, 2011); the study of the distinct entrepreneurial strategies of pairing patents and trademarks and their consequences (Castaldi, 2024; Thoma, 2020; Xiao *et al.*, 2024; Zhou *et al.*, 2016) or the effects of "submarine trademarks", whose publication is strategically delayed to avoid information disclosure of new products and legal conflicts with similar trademarks (Fink *et al.*, 2022).

All these previous empirical approaches have finally led to the establishment of a theoretical framework structured around legal domains for understanding both trademark strategies and firms' strategic trademark management (Cao *et al.*, 2022). These authors emphasize that new research (like the present study) is crucial to test the theory, particularly in areas such as trademark litigation and licensing, offensive and defensive trademark strategies, the relationship between trademarks and patents and, more broadly, the role of trademarks in strategic decision-making.

From branding management perspectives, trademark research has primarily concentrated on case studies related to consumers' perception of logos, brand imitation and the impact of advertisements (see, for instance, Qiao and Griffin, 2022), leaving aside other key aspects of registered trademarks, such as the factors influencing their long-term survival and endurance. In fact, to conduct these kinds of studies, it is essential to reintegrate historical perspectives into the research agenda—an issue strongly advocated by several marketing scholars in the late 20th century. Their work, published in leading marketing journals, studied both the challenges and advantages that historical methodologies presented to strengthen academic and practical knowledge (see, as an example, Nevett, 1991). They encouraged further historical research, which spurred several case studies focused on the history of advertising, branding, nostalgia and marketing practices (Low and Fullerton, 1994; Stern, 1992).

During the intervening years of the 21 century, historical approaches progressively disappeared from marketing journals, with few notable exceptions. That is the case of literature reviews trying to draw attention back to the issue (Tadajewski and Jones, 2014) or, more indirectly, the resurgence of studies on the strategical use of history and historical nostalgia in marketing and branding (Grappi *et al.*, 2024). One possible explanation for the declining interest in history within the marketing discipline is the generalization of more formal and scientific methodologies. This has reinforced the perception that historical analysis is less rigorous. In contrast, this research is an example of how the historical approach is indeed compatible with methodological soundness and scientific prowess.

3. Trademarks in Spain: history and sources

Contrary to what occurred with patents, Spain was ahead of the Western economies in establishing a centralized and unified registry of trademarks in 1850, preceding France (1857) and Austria/Hungary (1858) and two decades before the USA (1870) and the UK (1875). This pioneering attitude was driven by the spread of counterfeit goods in an increasingly integrated domestic market. Initially, only manufacturers with a factory in the country could register trademarks, granting them the right to prosecute counterfeiters and claim damages. Throughout the second half of the 19th century, trademark registration was extended to salesmen, farmers, traders, professionals, etc. as well as to foreign residents, provided their home countries had signed bilateral or international agreements with Spain (Sáiz and Zofío, 2022).

Posterior Spanish trademark laws were passed in 1902, 1929, 1988 and 2001 to match the increasing business complexity (regulating new modalities such as collective, derived, or guarantee marks), albeit maintaining the original spirit. As in most countries, trademarks could be renewed indefinitely (in subsequent three to five-year periods, depending on the specific law) as long as they were not abandoned. Since 1850, besides ex officio searches by the Spanish Patent and Trademark Office, third parties could submit oppositions to registration. All the aforementioned Spanish laws allowed for the assignment and licensing of trademarks—similar to other forms of property—and codified infringements and penalties, although claims had to be presented under ordinary courts. These basic characteristics of the Spanish trademark system remain nowadays, reflecting a longstanding legal tradition consistent with other trademark systems that extended across Europe and America.

The international community recognized the pioneering role of Spain in the organization of the first national trademark law and a centralized registration system. Trademarks became the first intellectual property modality to internationalize, laying the ground for the foundation of a common track that eventually facilitated the worldwide expansion of intellectual protection. Trailblazing the way, Spain hosted the conference that resulted in the 1891 *Madrid Arrangements* for the *Repression of False Indications of Source on Goods* and the *International Registration of Trademarks*. These agreements established, for the first time, an International Bureau to register trademarks in the contracting countries through a single application. A century later, in 1989, Spain also hosted the signing of the *Madrid Protocol relating to the Madrid Agreement concerning the International Registration of Marks*, currently ratified by 114 countries and known as the *Madrid System*.

Since 1891, there exists a registry of international trademarks in The Hague managed by the World Intellectual Property Organization, which admits international applications filled in three languages: English, French and, unsurprisingly, Spanish. Likewise, when the European Union established the Community Trademark in 1994, they located the registry and the institution in charge—the Office for Harmonization in the Internal Market (currently the Intellectual Property Office)—in Alicante, a pioneering trademarking Spanish province with the highest ratio of records during the 1850s and 1860s.

This long tradition of trademarking has resulted in the creation of distinct national—and even one international—historical registers, which remain largely unexploited. These records offer the opportunity to analyze the evolution of trademarking among countries and to conduct long-term comparative studies on the strategic effects of trademark practices in the world (given the similarities in legal frameworks: registrations/oppositions/renewals, etc.). For instance, the distribution of national trademarks per inhabitant reveals that France and Germany

made intensive use of trademark protection between the 1880s and the inter-war period, whereas Spain and France were far ahead after World War II (Sáiz and Zofío, 2022; Fig. 1). In contrast, the UK or, especially, the USA exhibited fewer registrations per capita than Europe before the 1990s, despite being the cradle of modern branding practices and investments. This discrepancy likely reflects the effect of distinct idiosyncrasies regarding trademark protection and the influence of cultural, industrial and firm-level features, which further research must address.

4. Theory, hypotheses and empirical variables

4.1 Theoretical model

Neoclassical economic theory considers trademarks as private goods that provide information to consumers and markets and that are different in nature from patents or copyrights (Landes and Posner, 2003; Chap. 7). This view has dominated business and management studies until being challenged by scholars arguing that trademarks can be also analyzed as impure public goods that combine rivalrous and nonrivalrous uses by suppliers and consumers (Barnes, 2006). This "referential use" opens the door to market failures and suboptimal levels of trademark protection that existing laws fail to address, which would require additional public intervention.

Marketing and business fields have mainly explored trademarks from strategic perspectives, with only a recent effort to develop a general theoretical framework (Cao *et al.*, 2022). This framework identifies three domains of trademark activity: litigation, licensing and rights acquisition and maintenance. They subsequently lead to related trademark strategies (offensive, defensive, leveraging and proprietary) and management decisions (information disclosure, brand innovation, trademark families, complimentary use of intellectual property rights and trademark lifecycle). However, if, as argued, trademarks are not just private goods and have characteristics of impure public goods, a conflict arises between increasing protection/incentives and ensuring market access (Barnes, 2011). This tension risks social optima by undermining both revenues from property rights—through imitation—and legitimate competition—through bullying behavior and exclusionary practices—which trademark laws seek to address.

The contrasting conceptualizations of trademarks are illustrated on the left-hand side of Figure 1. Regardless of the theoretical perspective, the conclusion that legal regulation is necessary to mitigate market failures and social sub-optima is common to all approaches. This consensus is the cornerstone of the aforementioned domains outlined by Cao *et al.* (2022) for a successful trademark management strategy. It supports our study by guiding the definition of several strategies aimed at increasing the survivability of trademarks over the long term. As shown on the right-hand side of Figure 1, these strategies constitute pivotal mechanisms for navigating the complexities of trademark management. Litigation, for instance, underpins both defensive and offensive strategies, where businesses may either protect their trademarks from infringement or proactively challenge competitors. Licensing reflects strategies related to assignments and leveraging trademark breadth, enabling firms to monetize the value of their trademarks and expand their brand influence. Finally, the domain of property rights encompasses strategies like trademark intensity and patent integration, underscoring the importance of safeguarding and maximizing the value of intellectual property portfolios throughout the trademark lifecycle.

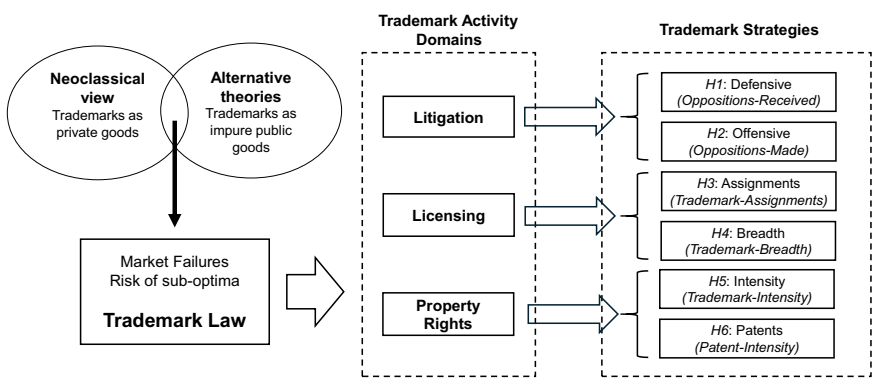
4.2 Research hypotheses

Building on this conceptual foundation, the research hypotheses proposed in this study align with the trademark strategies derived from the three identified domains. This section delves into these hypotheses, and their connections to existing literature, providing a comprehensive analysis of the underlying dynamics.

4.2.1 Litigation as trademark strategy

The literature establishes that legal actions are essential for the survivability of trademarks in highly competitive markets. Several authors have examined the implications of firms' legal strategies, concluding that managers should prioritize the design of trademark tactics to protect corporate brands (among others, Cohen, 1986; Ertekin *et al.*, 2018; Krasnikov and Jayachandran, 2022). Indeed, incumbents in a market tend to increase their reputation by opposing entering trademarks, regardless of whether entrants are actual rent-seekers trying to illegally imitate established brands or legitimate startups that

Figure 1 Conceptual framework for trademark survival strategies and its connection with existing theories



Source(s): Authors' own work

can represent a business threat to brand monopolies (Von Graevenitz, 2007).

An analysis of a successful trademark strategy considers defending from and making oppositions (Nasirov, 2020; Sandner and Block, 2011), whose effects on the duration of trademarks are studied through the following two research hypotheses:

H1. *The more oppositions a trademark receives, the higher the risk of mortality*: The number of oppositions received reflects the potential market threat of the new trademarks, which justifies an aggressive legal action against them and, therefore, the reduction of their survivability.

H2. *The more oppositions a trademark makes, the lower the risk of mortality*: This is the other side of the coin from the perspective of the owner of an established trademark. It is interpreted as the efforts of an incumbent to defend its position in the marketplace based on legal grounds and prevent the consolidation of new entrants.

4.2.2 Licensing/assigning and trademarks' commercial value

In general, the literature acknowledges that assigning trademarks (sold, licensed, or transferred) results in higher commercial value (INTA, 2023; Meyer *et al.*, 1985; Nasirov, 2020). Although selling the trademark can immediately realize its market value, licensing it allows to extend the reach of brands into new markets without significant investment. Licensing a well-known brand allows both the licensor and licensee to benefit from its established reputation and customer base (Jayachandran *et al.*, 2013; Saqib and Manchanda, 2008).

In addition, trademarks present in different markets enjoy network effects that increase the value of a product or service as more people buy it, creating a positive feedback loop (e.g. through a broader customer spectrum and resulting in increased brand recognition). Nevertheless, the literature on this topic yields ambiguous results. Some studies do not find a correlation between trademark breadth and value (Nasirov, 2020; Sandner and Block, 2011) or, if they find a positive effect, it decreases and even becomes negative with the number of Nice classes (Block *et al.*, 2014b). Other studies provide evidence of the positive effects of trademark breadth on firm valuation (Fisch *et al.*, 2022; Xiao *et al.*, 2024) and on trademark survival in the software sector (Melnyk *et al.*, 2014)

The following two research hypotheses test if, as anticipated, assigning/licensing and market breadth positively contribute to trademark success and survivability:

H3. *The more a trademark is assigned, the lower the risk of mortality*: Trademarks are more likely to survive if third parties are willing to sign license agreements (e.g. franchising) or directly acquire them. Assignments provide a way of mitigating some of the costs and risks associated with building a brand, while creating a network of business partners that reinforces trademark durability.

H4. *The more sectors a trademark is registered in, the lower the risk of mortality*: It is reasonable to expect that trademarks registered across sectors possess commercial value in diverse markets, leveraging scope and network economies through a multilateral presence and a diverse client base. This diversification would play in favor of their survivability by reducing dependence on the revenues from a single market.

4.2.3 Property rights

The literature highlights that the protection on firms' intangible assets is crucial for both encouraging investment on technical/commercial innovation and maximizing business revenues (Patel and Pearce, 2018). In general, trademark management benefits from the expertise of prolific applicants in developing successful legal strategies concerning monitoring infringement, use requests and docketing (Patel, 2024). Scholars also show that trademarks and patents interplay in several ways. Trademarks themselves can represent innovation in low-tech industries, marketing activities and the service sector (see, for instance, Mendonça *et al.*, 2004; Flikkema *et al.*, 2019), but can also be used to protect market realizations of patented inventions—i.e. they proxy the commercial success of inventions (Castaldi, 2024). This demonstrate that pairing patent and trademark activity is one of the most efficient ways of increasing inventions' value and the returns of innovation for firms (Thoma, 2020; Xiao *et al.*, 2024; Zhou *et al.*, 2016).

Thus, the next two hypotheses check if the intensity of the use of intellectual protection by trademark owners and the co-existence of patents supporting associated trademarks also influences their longevity:

H5. *The larger the trademark intensity, the lower the risk of mortality*: Trademarks that belong to large portfolios are expected to have a longer duration because of the increased know-how their owners have in successfully exploiting them.

H6. *Trademarks coupled with patents have a lower risk of mortality*: Commercial products sustained by registered patents have a solid innovation base and are backed by complementary intellectual property protection, thereby reducing competitive threats and ensuring market stability, which positively influences trademark duration.

Besides the six previous hypotheses related to the three domains proposed by Cao *et al.* (2022), we include two additional ones capturing the impact of fundamental characteristics of the applicant on trademark success: juridical status (firm or individual) (Block *et al.*, 2015) and place of residence (domestic or foreign) (Hymer, 1976, pp. 34–36).

H7. *Trademarks owned by firms have a lower risk of mortality*: Firms are presumed to have greater capacity than individuals to practice a successful trademark strategy management when registering, developing and defending trademarks thanks to their access to larger human and financial resources.

H8. *Trademarks owned by nonresidents have a lower risk of mortality*: While the entry barriers associated to registering a trademark in a foreign market may be greater for nonresidents than locals, the potential success of a trademark registered by a foreigner is likely higher because establishing a trademark abroad requires larger

investments to overcome those barriers, and only registrations with a higher probability of success will tend to be filed.

4.3 Empirical variables

The variables considered in this study are detailed below, as well as a rationale for their use in testing the hypotheses put forward above. In addition, Table 1 presents their descriptive statistics.

4.3.1 Dependent variable

The dependent variable is "*Trademark-Duration*", measuring the longevity of trademarks in days, i.e. the time elapse between the date of application and the date of expiration. Table 1 shows that, on average, trademarks live 6,527 days (17.9 years) although the median value is lower at 3,905 days (10.7 years). 13.09% of the trademarks live less than a year, whereas almost 60% do not survive beyond 20 years.

Looking at the different duration spans, 25.10% of trademarks survive between 20 and 30 years, suggesting the existence of trademark lifecycles linked to both product cycles and, especially, consumers' purchase habits, who *after a period of habitual purchasing of a single or a few brand/items enter a period of trying other brands/items*, making brand loyalty transitory and time-dependent (Duwors and Haines, 1990). Indeed, only 15.13% of trademarks survive longer than 30 years, and trademarks surviving half a century are uncommon (8.89%). A key issue in survival analysis is the censoring of the data when the occurrence of the event—in this case the ending of the trademark—is not observed. The study tracks trademarks registered between 1850 and 1920 up to December 31, 2010. A total of 1,202 trademarks (2.71%) are right censored because they survive beyond this date and their true lifespan is unknown.

4.3.2 Independent variables

—"*Oppositions-Received*" (used to test *H1*): This variable measures the number of oppositions filed by competitors against the applicant of a trademark. This variable is a good proxy of the perceived disruptive capacity of a new trademark to existing incumbents, who try to prevent its consolidation in the marketplace. Descriptive statistics presented in Table 1 reveal that one out of five trademarks (19.19%) receive opposition upon registration, with the majority being opposed just once.

— "*Oppositions-Made*" (used to test *H2*): This variable measures the number of oppositions filed by the owner of the trademark against competing ones. In the data set, the percentage of trademarks opposing competitors reaches 12.70%, with most of them opposing only once.

—"*Trademark-Assignments*" (used to test *H3*): This variable measures the number of times a trademark has been officially sold, licensed, or transferred. As many as 18.83% of the trademarks are assigned/licensed, 8.22% more than once.

—"*Trademark-Breadth*" (used to test *H4*): This variable measures the number of distinct sectors in which a trademark is registered (up to 13 industries grouping all 45 Nice classes) (see Sáiz and Zofío, 2022, p. 260). In the data set, 9.26% of the trademarks were registered in more than one sector.

—"*Trademark-Intensity*" (used to test *H5*): This variable measures the total number of trademarks registered by the owner of the trademark on record. Most of the trademarks (70.24%) are owned by applicants who register more than one: 15.54% belong to an applicant who has registered two, whereas there are as many as 4,685 trademarks (10.59%) that are part of a portfolio of 21+ registrations.

—"*Patent-Intensity*" (used to test *H6*): This variable measures the total number of patents registered by the applicant of the trademark on record. In the historical data set, 27.61% of the trademarks are paired with patents: 10.22% belong to applicants registering only one patent, whereas 7.65% belong to applicants owning more than five patents.

4.3.3 Juridical status and residency

—"*Firm*" (used to test *H7*): A total of 19,364 (43,77%) trademarks were filed by firms.

—"*Non-resident*" (used to test *H8*): There are 7,257 (16.40%) trademarks registered by nonresidents located in 305 different cities, mainly in Europe and North America.

5. Data and methodology

All trademarks registered in Spain are available in the archive of the Spanish Patent and Trademark Office. Over several years, a multidisciplinary research team developed a historical relational database from the original files filled between 1850 and 1920 (approximately 47,000 trademarks) (Sáiz *et al.*, 2019). This process involved arduous archival research, as well as a laborious effort in the development of a complex entity-relationship model to organize the data (see the details through Figures WA1 to WA11 in the Supplementary Material_Web Appendix A). The resulting database provides information on trademark denomination, logo, description, application/grant/renewal dates, articles protected (classified using the Nice international classification of goods and services), oppositions received and made, assignments/licenses, applicant's name, juridical status, place of residence, etc.

The present study uses a data set extracted from this unique database, comprising approximately 44,500 trademarks with reliable information on their duration and expiration causes up to 2010. Notably, the analysis incorporates daily registration and expiration dates, derived from renewal records and corresponding payments documented in each trademark file. This approach overcomes the faulty practice of patent and trademark offices publishing expired trademarks in batches, especially during critical periods such as wars or political crises. The careful recording of trademark duration in days could not have been possible without the original trademark files. This detailed information enhances the quality of the data for survival analysis, leading to more robust results and implications.

Survival analysis methodology, originally developed in the context of health studies, remains uncommon in the social sciences. Notwithstanding, its application in business and management has grown over the last decades, mainly devoted to investigating the determinants of firms' duration when entering new markets (see, as an example, Srinivasan *et al.*, 2004). Some research has also considered patents and trademarks as explanatory variables to capture the effect of innovative activities on firms' survival. In all cases, these studies consistently find positive effects of trademarking on survival

Table 1 Descriptive statistics of regression variables

Variables	Trademarks (no.)	Trademarks (%)	Min.	Mean	Median	Max.	SD
Trademark-Duration (days)	44,240	100.00	7.00	6,527.00	3,905.00	40,047.00	7,622.00
0 − 365 (1 year)	5,789	13.09	7.00	226.03	220.00	365.00	78.62
365 − 1,825 (1–5 years)	4,118	9.31	366.00	628.46	505.00	1,825.00	323.25
1,825−3,650 (5–10 years)	9,584	21.66	1,826.00	2,109.61	2,064.00	3,647.00	162.26
3,650−5,475 (10–15 years)	4,462	10.09	3,672.00	3,937.88	3,888.00	5,463.00	178.49
5,475−7,300 (15–20 years)	2,490	5.63	5,480.00	5,775.56	5,716.00	7,286.00	221.72
7,300−10,950 (20–30 years)	11,106	25.10	7,304.00	7,832.50	7,552.00	10,946.00	646.95
10,950−14,600 (30–40 years)	1,247	2.82	10,951.00	12,339.34	12,726.00	14,595.00	984.80
14,600−18,250 (40–50 years)	1,512	3.42	14,608.00	15,728.23	15,237.50	18,222.00	925.69
18,250−36,500 (50–100 years)	3,768	8.52	18,259.00	26,726.31	27,544.50	36,463.00	4,821.58
36,500−40,047 (100+ years)	164	0.37	36,523.00	37,760.29	37,505.00	40,047.00	962.57
Oppositions-Received (no.)	44,240	100.00	0.00	0.27	0.00	23.00	0.69
0	35,410	80.04	–	–	–	–	–
1	7,071	15.98	–	–	–	–	–
2	1,153	2.61	–	–	–	–	–
3+	267	0.60	3.00	4.03	3.00	23.00	2.05
Oppositions-Made (no.)	44,240	100.00	0.00	0.22	0.00	64.00	0.99
0	38,620	87.30	–	–	–	–	–
1	3,699	8.36	–	–	–	–	–
2	1,069	2.42	–	–	–	–	–
3+	852	1.93	3.00	4.82	3.00	64.00	4.56
Trademark-Assignments (no.)	44,240	100.00	0.00	0.22	0.00	64.00	0.99
0	35,908	81.17	–	–	–	–	–
1	4,694	10.61	–	–	–	–	–
2+	3,638	8.22	2	2.8	2	11	1.15
Trademark-Breadth (no.)	44,240	100.00	0.00	1.14	1.00	13.00	0.58
1	40,145	90.74	–	–	–	–	–
2+	4,095	9.26	2.00	2.50	2.00	13.00	1.70
Trademark-Intensity (no.)	44,240	100.00	1.00	8.97	3.00	126.00	16.61
1	13,162	29.75	–	–	–	–	–
2	6,876	15.54	–	–	–	–	–
3–5	9,040	20.43	3.00	3.81	4.00	5.00	0.80
6–8	4,415	9.98	6.00	6.96	7.00	8.00	0.82
9–11	2,394	5.41	9.00	9.85	10.00	11.00	0.78
12–14	1,399	3.16	12.00	12.94	14.00	13.00	0.85
15–17	1,264	15.00	15.89	16.00	16.00	17.00	0.83
18–20	1,005	15.00	18.00	18.80	19.00	20.00	0.79
21+	4,685	10.59	21.00	47.83	37.00	126.00	27.36
Patent-Intensity (no.)	44,240	100.00	0.00	1.50	0.00	339.00	6.79
0	32,024	72.39	–	–	–	–	–
1	4,522	10.22	–	–	–	–	–
2	2,222	5.02	–	–	–	–	–
3	1,290	2.92	–	–	–	–	–
4	798	1.80	–	–	–	–	–
5+	3,384	7.65	5.00	14.93	9.00	339.00	19.95
Relative-Trademark-Geographical-Specialization	36,983		0.00	2.28	1.22	337.80	4.25
Relative-Trademark-Geographical-Diversification	36,983		0.76	2.38	2.56	4.38	0.90

Source(s): Authors' own work

likelihood (Buddelmeyer *et al.*, 2010; Patel and Pearce, 2018; Srinivasan *et al.*, 2008).

In marketing, this statistical method has seen limited use. A notable early example, published in the *Journal of Marketing Research*, applied a survival model to analyze brand loyalty through the evolution of purchases (coffee and associated products), concluding that loyalty is generally a time-dependent phenomenon (see the previous quote by Duwors and Haines, 1990). Only a small group of scholars rely on trademarks as a dependent variable to analyze specific dimensions of branding. Using a sample of foreign trademarking in the USA' software industry between 1983 and 2002, Melnyk *et al.* (2014) applied a survival model to evaluate how trademark characteristics (trademark type and breadth), cultural factors (country of origin) and firm data (such as the age and size of the owner company) influence trademark longevity. Pfeifer *et al.* (2025) carried out a similar investigation using registrations from 25 countries in the USA between 2001 and 2019, but to analyze the effects of consumer-based brand equity dimensions on the decision of renewing or terminate trademarks related to fast-moving consumer goods.

The investigation presented in this paper is the first to apply advanced survival analysis to an entire trademark system using historical data and tracking trademark life span over 150 years.

5.1 The hazard function: specification and estimation

To model the factors affecting the survival of trademarks this study relies on the Cox Proportional Hazard Model (Cox, 1972), which estimates the hazard rates $h(t, X)$ as a function of the survival time, t, and a set of $c = 1,\ldots,C$ covariates represented by the vector $X_{(C\times 1)}$. This model allows examining how specific factors influence simultaneously the rate of disappearance of trademarks at a particular point in time throughout their lifespan.

The hazard function underpinning the Cox model can be interpreted as the risk of a trademark ending at time t, and is specified as follows:

$$h(t,X) = h_0(t) \times \exp\left(\sum_c \beta_c x_c\right), \tag{1}$$

where $h_o(t)$ represents the baseline hazard, which in the statistical specification corresponds to the regression intercept, β_0. The Cox model above is semi-parametric because it does not make assumptions about the probability distribution of the baseline hazard $h_o(t)$. However, it does assume a parametric (linear) form for the effect of the predictors on the hazard. Taking natural logarithms on both sides of (1) expresses the equation as a multiple linear regression model of the hazard on the variables x_c. The exponentiated coefficients, $\exp(\beta_c)$, represent the so-called hazard ratios. Once the Cox model has been specified, it is estimated through maximum partial likelihood, thereby handling censored data—in this case, surviving trademarks after the end of the study period.

The Cox model makes several assumptions that need to be tested after estimation to determine the reliability and goodness-of-fit of the results. The most relevant is the proportionality of the hazard ratios among observations or, equivalently, that the estimated coefficients are independent of survival time: $\beta_c(t) = \beta_c$, $\forall\ c = 1,\ldots,C$. Post-estimation diagnostics of the Cox model checks for the proportionality of the hazard (Cox and Oakes, 1984; Therneau and Grambsch, 2000). Unsurprisingly, given the extensive duration of the study period, most of the coefficients in the model do not pass the proportional hazards tests, with their corresponding variables exhibiting nonlinear patterns against the residuals. A violation of the proportional hazards assumption can be resolved by ad-hoc solutions like step functions (stratifying the regressors) or parametric time functions that interact the regressors with time (Zhang *et al.*, 2018; Therneau *et al.*, 2023), or by capturing nonlinearities through quadratic specifications of regressors. After trying these approaches, the empirical section shows that the quadratic approach yields satisfactory results in terms of interpretability and statistical significance. Concretely, let us partition the set of C covariates into those that pass the proportional hazards test in their *linear* (L) formulation, and those that do not and are subject to the *quadratic* (Q) specification, $C = L + Q$. Then, the Cox model (1) can be expressed as:

$$h(t,X) = h_0(t) \times \exp\left(\sum_l \beta_l x_l + \sum_q \beta_q x_q + \sum_q \beta_{qq} x_q^2\right), \tag{2}$$

where β_{qq} are the second-order coefficients associated with the variables requiring a quadratic term.

The study also includes cross-effects among the most relevant covariates to capture the existence of interactions among them and test the robustness of the numerical results to alternative specifications. Let us consider two variables x_j and x_k from the set of C covariates, $j \neq k \in C$, then the interaction variable is defined as $x_{jk} = x_j\, x_k$. The specification of the model including these interactions becomes:

$$\begin{aligned} h(t,X) = h_0(t) & \\ & \times \exp\left(\sum_l \beta_l x_l + \sum_q \beta_q x_q + \sum_q \beta_{qq} x_q^2 + \frac{1}{2}\sum_j \sum_k \beta_{jk} x_j x_k\right) \\ & \times \forall j \neq k,\ j \in \{L,Q\},\ k \in \{L,Q\}. \end{aligned} \tag{3}$$

5.2 Survival models

This section introduces the regressions specified to explain the duration of trademarks. The analysis establishes three models that successively add explanatory factors. This strategy allows us to discuss the regularity of the results as more information is progressively incorporated:

Model 1. *Baseline specification:* The initial model covers a basic scenario that includes as regressors the variables chosen to test each one of the research hypotheses previously presented and related to the three domains considered in the theoretical model for strategic trademark management: litigation, licensing and property rights.

Model 2. *Market (sectoral) and geographical specification*: Model 1 is enhanced to control for the specific sectors (*markets*) where the trademark operates. It also includes two *geographical* indicators intended to capture if the sectoral trademark specialization and diversification of the regions hamper or favor trademark survivability. The first of these measures is *Relative-Trademark-Geographical-Specialization*, capturing if trademarks located in regions specialized in their sector(s) benefit from positive externalities or, contrarily, if detrimental competition effects prevail among specialized trademarks. The second measure is *Relative-Trademark-Geographical-Diversification*, reflecting if regions with a diversified sectoral base offer trademark-friendly environments that result in longer survivability when compared to the national average (see Supplementary Material_Web Appendix B for a detailed explanation of both variables).

Model 3. *Interactions specification*: The last model includes interactions to capture possible crossed effects on survivability (see expression (3)).

The modeling strategy is summarized in Equation 4, while the specifications corresponding to the three incremental models in terms of the variables are presented in Table 2.

6. Results

Following the methodological strategy presented above, after estimating model (1), the analysis tests if the proportional hazard hypothesis holds for each covariate. In long-range cliometric studies, the effect of the regressors on the hazard function is likely to vary over time. Indeed, all basic variables failed to pass the test in the *Baseline* specification, whereas only "*Patent-Intensity*" passed it in the remaining two specifications. As the effect of these variables is not independent of time, the analysis includes their quadratic formulation as previously justified, resulting in the specification of Model 1 presented in Table 2.

Table 3 shows the results of the three estimated models corresponding to the linear coefficient of each covariate c: either β_l or β_q, depending on whether its quadratic specification is required, followed by the quadratic coefficient, β_{qq}. Under the log transformation, the marginal effects of the linear and quadratic covariates are $\partial \log h(t,X)/\partial x_l = \beta_l$, $l = 1, \ldots, L$, and $\partial \log h(t,X)/\partial x_q = \beta_q + 2\beta_{qq}\, x_q$, $q = 1, \ldots, Q$, respectively. The exponentiated value of the coefficients represents the so-called hazard ratios: $HR_l \equiv \exp(\beta_l)$ and $HR_q \equiv \exp(\beta_q + 2\beta_{qq}\, x_q)$, with respect to the

$$h(t,X) = h_0(t) \times \exp(\underbrace{\underbrace{\underbrace{\textit{Trademark / Applicant Factors}}_{\text{Model 1}}, \textit{Markets}}_{\text{Model 2}}, \textit{Geographical Factors}, \textit{Interactions}}_{\text{Model 3}}), \quad (4)$$

Table 2 Hazard models on trademark survivability

Model	Specification
Model 1. Baseline	$\ln h(t,X) = \beta_1$Oppositions-Received $+ \beta_2$Oppositions-Made $+ \beta_3$Trademark-Assignments $+ \beta_4$Trademark-Breadth $+ \beta_5$Trademark-Intensity $+ \beta_6$Patent-Intensity $+ \beta_{11}$Oppositions-Received$^2 + \beta_{22}$Oppositions-Made$^2 + \beta_{33}$Trademark-Assignments$^2 + \beta_{44}$Trademark-Breadth$^2 + \beta_{55}$Trademark-Intensity$^2 + \beta_{66}$Patent-Intensity$^2 + \beta_7$ Firm $+ \beta_8$Non-resident.
Model 2. Market and Geography	$\ln h(t,X) =$ Model $1^* + \delta_s \eta_s + \gamma_1$Relative-Trademark-Geographical-Specialization $+ \gamma_2$Relative-Trademark-Geographical-Diversification, $s = 1, \ldots, 13$.
Model 3. Interactions	$\ln h(t,X) =$ Model $2^* + \varphi_{12}$Oppositions-Received $\times$ Oppositions-Made $+ \varphi_{13}$Oppositions-Received $\times$ Trademark-Assignments $+ \varphi_{15}$Oppositions-Received $\times$ Trademark-Intensity $+ \varphi_{16}$Oppositions-Received $\times$ Firm $+ \varphi_{23}$Oppositions $-$ Made $\times$ Trademark-Assignments $+ \varphi_{25}$Oppositions-Made $\times$ Trademark-Intensity $+ \varphi_{27}$Oppositions-Made $\times$ Firm $+ \varphi_{35}$Trademark-Assignments $\times$ Trademark-Intensity $+ \varphi_{37}$Trademark-Assignments $\times$ Firm $+ \beta_{57}$Trademark-Intensity $\times$ Firm.

Note(s): *As "*Patent-Intensity*" passes the proportional hazards test in Models 2 and 3, its quadratic term is dropped from these specifications
Source(s): Authors' own work

Table 3 Regression results of the Cox models: coefficients, linear HRs and total HRs (including quadratic and interaction terms)

Variable	Model 1. Baseline				Model 2. Model 1 + Market & Geography				Model 3. Model 2 + Interactions			
	Linear coefficient: β_j $(j = l,q)$	Quadratic coefficient: β_{jq}	Hazard Ratio (linear): $\exp(\beta_j)$ $(j = l,q)$	Hazard Ratio (total): $\exp(\beta_j + 2\beta_{jq})$	Linear coefficient: β_j $(j = l,q)$	Quadratic coefficient: β_{jq}	Hazard Ratio (linear): $\exp(\beta_j)$ $(j = l,q)$	Hazard Ratio (total): $\exp(\beta_j + 2\beta_{jq})$	Linear coefficient: β_j and β_{jk} $(j = l,q)$	Quadratic coefficient: β_{jq}	Hazard Ratio (linear): $\exp(\beta_j)$ $(j = l,q)$	Hazard Ratio (total): $\exp(\beta_j + 2\beta_{jq} + \Sigma\beta_{jk})(j = l,q)$
Oppositions-Received	0.5571**	−0.0687**	1.7360	1.5215	0.5429**	−0.0659**	1.7210	1.5085	1.1270**	−0.1430**	3.0864	1.7085
Oppositions-Made	−0.1471**	0.0023**	0.9335	0.8672	−0.1471**	0.0023**	0.8633	0.8672	−0.0956**	0.0011**	0.9088	0.8800
Trademark-Assignments	−1.0570**	0.0988**	0.3474	0.4234	−1.0660**	0.1009**	0.3442	0.4214	−0.5090**	0.0510**	0.6011	0.5586
Trademark-Breadth	−0.0262	0.0000	0.9741	0.9741								
Trademark-Intensity	−0.0043**	−0.0000	0.9945	0.9957	−0.0032**	-0.0000	0.9968	0.9968	−0.0029**	0.0001**	0.9971	0.9928
Patent-Intensity	−0.0055**	0.0000**	0.9945	0.9945	−0.0098**	-	0.9902	0.9902	−0.0092**	-	0.9908	0.9908
Firm	−0.1515**	-	0.8594	0.8594	−0.1326**	-	0.8758	0.8758	−0.0787**	-	0.9243	0.9115
Non-resident	−0.4119**	-	0.6624	0.6624								
Market Agriculture & Cattle					−0.0144	-	0.9857	-	−0.0123	-	0.9878	-
Market Arms					−0.1518**	-	0.8592	-	−0.3564**	-	0.7002	-
Market Metal & Mining					0.0627	-	1.0647	-	0.1905**	-	1.2099	-
Market Beverages					−0.1227**	-	0.8845	-	−0.0274	-	0.9730	-
Market Chemical					−0.0523**	-	0.9490	-	−0.03083	-	0.9696	-
Market Construction					−0.1563*	-	0.8553	-	−0.1949	-	0.8229	-
Market Food					−0.0392**	-	0.9616	-	−0.0168	-	0.9833	-
Market Machinery & Equipment					0.0439	-	1.0449	-	−0.0126	-	0.9875	-
Market Paper & Graphic Arts					0.0817**	-	1.0851	-	0.0270	-	1.0274	-
Market Textiles					−0.0750**	-	0.9277	-	−0.0130	-	0.9871	-
Market Tobacco					−0.1287**	-	0.8792	-	−0.1456**	-	0.8645	-
Market Transports & Communic.					0.1092	-	1.1154	-	0.1679	-	1.1828	-
Relative-TM-Geo-Specialization					0.0134*	−0.0000	1.0140	1.0135	0.0384**	0.0001*	1.0391	1.0394
Relative-TM-Geo-Diversification					−0.0034	0.0014	0.9965	0.9994	0.0503**	-	1.0516	1.0516
Opps-Received x Opps-Made									−0.0708**	-	0.9316	-
Opps-Received x TM-Assignments									−0.2051**	-	0.8146	-
Opps-Received x TM-Intensity									−0.0025*	-	0.9975	-
Opps-Received x Firm									−0.0270	-	0.9734	-
Opps-Made x TM-Assignments									0.0209**	-	1.0211	-
Opps-Made x TM-Intensity									0.0000	-	1.0000	-
Opps-Made x Firm									0.0155**	-	1.0156	-
TM-Assignments x TM-Intensity									0.0005**	-	1.0005	-
TM-Assignments x Firm									0.0499**	-	1.0512	-
TM-Intensity x Firm									−0.0025**	-	0.9975	-
Concordance	0.713				0.704				0.678			
Initial Log Likelihood	−421,265				−346,483				−133,019			
Log Likelihood	−411,535				−338,751				−129,589			
Wald Test	10,180**				8,508**				47,847**			
LR Test	19,459**				15,465**				6,861**			
Score (Logrank) Test	16,396**				12,880**				8,991**			

Note(s): All regressors present a quadratic coefficient except '*Patent-Intensity*', which passes the proportional hazards test
Source(s): Authors' own work

baseline hazard $h_o(t)$. If $HR_c > 1$, $c = l, q$, the event hazard increases, and the probability of survival decreases. On the contrary, if $HR_c < 1$, then the event hazard reduces, and the length of survival increases. The magnitude of all basic variables when increasing or reducing trademarks' duration is highlighted by the color scale included in Table 3; the redder the more detrimental the factor is to trademark survivability, whereas the greener the more it contributes to longevity.

6.1 Baseline specification: testing the research hypotheses

The exposition of the empirical results follows the three domains considered in the theoretical model (Figure 1).

6.1.1 Litigation as trademark strategy

The only variable contributing to higher trademark mortality is the number of incoming oppositions filed by competitors. Thereby, the first research hypothesis "*H1: The more oppositions a trademark receives, the higher the risk of mortality*" is confirmed, with the hazard ratio of the variable "*Oppositions-Received*" being greater than 1. Results show that the first opposition received by a trademark increases the total hazard ratio by 52.15% $(= (\exp(1.5215) - 1) \times 100 = (\exp(0.5571 - 2 \times 0.0687) - 1) \times 100)$. Interestingly, the linear coefficient, $\beta_1 = 0.5571$, responsible for most of the effect of this variable is qualified by the negative value of its quadratic term, $\beta_{11} = -0.0687$, showing the waning effect of successive oppositions.

Also, capturing the opposite side of the legal process, the empirical results confirm the second hypothesis: "*H2: The more oppositions a trademark makes, the lower the risk of mortality*". The hazard ratio of "*Oppositions-Made*" shows that opposing entrants have a positive effect on trademark survivability, this time in favor of the plaintiff. Trademarks opposing competitors reduce their hazard ratio by 13,28%. These numerical results show that receiving opposition is four times more harmful to survival than the benefit of opposing entrants, which is a sensible result. To file oppositions, a trademark needs to survive the early stages of its lifecycle. Therefore, it is relevant that its owner makes sure that there are no legitimate grounds on which an opponent could build a legal case. Conversely, established trademarks will not hesitate to oppose any entrant, sometimes even without reasonable grounds, using the legal system as a deterrent strategy.

6.1.2 Licensing/assigning and trademarks' commercial value

The model also validates the third hypothesis "*H3: The more a trademark is assigned, the lower the risk of mortality.*" In fact, "*Trademark-Assignments*" contributes the most to duration, thereby confirming that the more a trademark is sold, licensed, or transferred, the higher its survivability. Trademarks that have been assigned/licensed are 57.66% less likely to disappear compared to those that have not, exhibiting a concave effect. As for the fourth hypothesis: "*H4: The more sectors a trademark is registered in, the lower the risk of mortality*", the variable "*Trademark-Breadth*" shows that being diversified across

markets reduces the hazard ratio by 2.59%. This implies that registrants realize the benefits of scope and network economies, being reinforced by a multilateral presence and diverse client base.

6.1.3 Property rights

Regarding the variables related to intellectual protection that may contribute to longer survivability, both validate their corresponding hypotheses. Specifically, the hazard ratio of "*Trademark-Intensity*" validates "*H5: The larger the trademark intensity, the lower the risk of mortality*", showing that trademarks belonging to a large portfolio tend to survive longer by benefiting from managerial know-how. Likewise, looking at the hazard ratio of "*Patent-Intensity*", trademarks whose applicants register patents also live longer, thereby confirming "*H6: Trademarks coupled with patents have a lower risk of mortality*". However, from a quantitative perspective, their effect on survivability is mild, as their marginal effects are less than 1%.

Finally, regarding the hypotheses related to the juridical status and residency of the applicants, the results confirm "*H7: Trademarks owned by firms have a lower risk of mortality*" as well as "*H8: Trademarks owned by nonresidents have a lower risk of mortality*". Trademarks registered by "*Firms*" reduce mortality by 14.06% in comparison to individuals, indicating the additional advantage provided by complex organizational structures capable of devoting more resources to business intelligence, legal departments, etc. Moreover, trademarks registered by "*Non-resident*" firms or individuals also see their mortality reduced by 33.76%. This result implies that foreign trademarks can overcome entry barriers and transaction costs, suggesting a self-selection process.

6.2 Specifications controlling for market, geography and interaction effects

A complete discussion of the results for the market (sectoral) and geographical specification (Model 2), as well as those including cross-effects (Model 3), can be found in Supplementary Material_Web Appendix C. In summary, the study finds sectoral heterogeneity, with trademarks in consumer sectors (where they concentrate) presenting longer survival rates. Conversely, the geographical variables of specialization and diversification have either limited effects ("*Relative-Trademark-Geographical-Specialization*") or are not statistically significant ("*Relative-Trademark-Geographical-Diversification*").

The interactions in Model 3, corresponding to expression (3), offer relevant insights. For instance, the litigation variable combining incoming and outgoing oppositions, "*Oppositions-Received* × *Oppositions-Made*", results in a reduction of the hazard rate by 6.84%, confirming that the negative effect of receiving oppositions is mitigated if the trademark itself is capable of engaging opposing infractors. As many as 1,165 trademarks are involved in cross-disputes (2.63%), thereby capitalizing on the increased experience acquired by opposing rivals.

This section concludes by stressing the satisfactory goodness-of-fit characterizing the results. First, the concordance for all three fitted regressions is about 0.7 indicating that the models provide a considerably better explanation about the survivability of firms than a random guess. Second, the values of the Wald test and score log-rank statistics show the overall significance of the model, i.e. the joint null hypothesis that all explanatory variables do not affect the hazard function $h(t, X)$ is rejected.

7. Discussion: theoretical, analytical and empirical contributions

The findings of this work make a novel contribution to the literature on three levels: theoretical, analytical and empirical. In the first level, the results qualify the recent theoretical framework on strategic trademark management (Cao *et al.*, 2022), emphasizing that trademarks exhibit characteristics of impure public goods, which heightens the potential for market failures and conflicts (Barnes, 2006, 2011). This underscores the key institutional role of trademark law and positions litigation and licensing as the central domains of trademark activity, thereby, prioritizing opposing imitators/competitors and assigning rights over leveraging and proprietary strategies.

Analytically, this research enhances the methodological framework by integrating sectoral and geographical perspectives (relative trademark geographical specialization/diversification) into survival analysis. It also addresses statistical challenges related to Cox survival models applied to long-term data, particularly those derived from variables that fail to pass the proportionality of hazard ratios test (ensuring that estimated coefficients remain independent of survival time) (Zhang *et al.*, 2018; Therneau *et al.*, 2023).

Empirically, this study also surpasses the current state of the art. Previous research has used survival analysis to examine how trademark characteristics, firm/cultural variables and consumer-based brand equity dimensions affect trademark renewals. However, these studies relied on limited evidence, focusing only on U.S. trademarks filed by international companies in specific sectors and over short time periods. In this context, the authors found that cultural factors (country of origin) influenced trademark duration. They also describe positive effects from large innovative firms and enduring brands operating across distinct fields (Melnyk *et al.*, 2014). Similarly, previous brand knowledge, relevance and reputation—as well as trademark age—favorably influence the renewal of trademarks (Pfeifer *et al.*, 2025). In contrast, this investigation is the first to apply advanced survival techniques to unveil the drivers of trademark duration across an entire economy (all sectors) over more than 150 years. No other study matches such breadth and depth nor quantifies the combined effect of the most relevant variables on trademark survivability. The findings extend and refine previous empirical analyses as described in the following paragraphs.

By testing trademark-related factors (oppositions/litigation, assignments/licensees, trademark breadth, trademark/patent intensity and sectoral and geographical variables), this research sheds light on the entrepreneurial decisions underlying trademark strategies and their outcomes. The results expand previous studies that use oppositions as proxies for trademark value or reputation (Nasirov, 2020; Sandner and Block, 2011; Von Graevenitz, 2007) by demonstrating the crucial role of these legal procedures—whether defensive or offensive—in trademark survival. Receiving oppositions emerges as the most important factor explaining trademark mortality by substantially increasing the hazard rate. This is counterbalanced by oppositions made, which increases survivability although to a

lesser extent. The effects of these two variables and their related hypotheses *H1* and *H2*, underscore the importance of protecting trademarks and growing a reputation of legal toughness to halt future infringements or, more plainly, deter competition.

Litigation threats safeguard the economic rents that can be generated from trademarks. Evidence indicates that legally active trademarks face a lower risk of being infringed, relative to those that do not engage in litigation (Ertekin *et al.*, 2018; Mahendiran, 2022; Sandner and Block, 2011). This naturally leads to longer survival times as reflected in the results. Altogether, this study concludes that potential infringement of trademark law—or just being perceived as a threat to incumbents in a sector (Von Graevenitz, 2007)—is risky, as receiving oppositions significantly increases the hazard rate (recall that one in five trademarks are opposed at least once).

The results also show that legally backed actions like assigning or licensing trademarks have sizable positive effects on trademark survival, (*H3*), just as they do on trademark/brand value (Jayachandran *et al.*, 2013; Meyer *et al.*, 1985; Nasirov, 2020; Saqib and Manchanda, 2008). This is a particularly valuable result because there is no other research addressing this topic, except the aforementioned description of the USA' trademark assignment unexploited data set (Graham *et al.*, 2018).

Similarly, the findings shed light on the effects of trademark breadth—the number of sectors in which the brand operates—on survivability (*H4*), showing a positive but limited impact on trademark duration. When a company diversifies its revenue, it achieves greater financial stability and fewer risks in case some markets perform poorly. This finding qualifies previous works that found a positive influence of trademark breadth on trademark prolongation in specific contexts (Melnyk *et al.*, 2014). Likewise, the limited effect concurs with studies on trademark value that do not find a correlation with trademark breadth or only identify a mild relationship (Block *et al.*, 2014b; Nasirov, 2020; Sandner and Block, 2011).

The research also provides new evidence to existing knowledge on the relevance of trademark intensity (Patel, 2024) and its combination with patents (Castaldi, 2024; Thoma, 2020; Xiao *et al.*, 2024; Zhou *et al.*, 2016). The findings demonstrate a positive, albeit modest, influence of both the number of trademarks (*H5*) and linked patents (*H6*) on trademark duration. This provides mild support for the revised literature reporting the benefits of pairing trademarks and patents when securing revenues protected by intellectual property. Factors contributing to this low effect are the inherent weaknesses of the Spanish innovation system with relatively frail markets for patented technologies when compared to other European countries (Andersson *et al.*, 2019).

The evidence reveals that juridical status (being a firm, *H7*) and internationalization efforts (being nonresident, *H8*) also increase trademark duration. Moreover, by constructing new geographical and sectoral indicators, the analysis delves into the effect of specific market characteristics (degree of industrial specialization at the regional level, sectoral distribution of trademarks, etc.) on trademark survival, laying the foundations for further geo-located research. Finally, as the investigation provides key insights into long-term trademark practices in a representative country of Western Europe, the results also illustrate the existence of trademark lifecycles (20–30 years, confirming suggestions from Duwors and Haines, 1990). Notably, only a small percentage of pre-1920 trademarks are still alive nowadays, having evolved into enduring brands, a topic warranting further research through specific business case studies.

Certain findings—for instance, the importance of the opposition system or assigning/licensing strategies—may seem self-evident, but the relevance of these results lies in the possibility of quantifying their relative effect and ranking trademark strategies by importance. This study demonstrates that brand managers should pay close attention to these topics, whether overseeing brand departments in large corporations or, especially, managing small and medium-sized businesses. As in the well-known Poe's tale on *The Purloined Letter*—so mysteriously hidden that it was in plain sight for all to see—the complexity of brand equity can obscure simple yet critical aspects of trademark management.

8. Managerial implications

The implications of the study are, therefore, relevant for enhancing decision-making and strategic trademark management. First, to develop and strengthen a brand, investing in legal advice on trademarks—including in-house litigation capabilities—is essential, given the prevalence of opposition proceedings that escalate to lawsuits (see Ertekin *et al.*, 2018; Sandner and Block, 2011). The evidence shows that newcomers to a market often face sustained oppositions from incumbent trademarks, irrespective of actual similarities. Systematically opposing potential competitors proves to be an effective strategy for extending trademark duration. Indeed, corporations are seemingly launching this process even against trademarks completely out of their niche market. A notable example is Apple's practice of opposing all kinds of apple (and even pineapple) logos, whether they come from singer-songwriters, school districts, or food blogs (Mac and Browning, 2022; see also Petty, 2008 on how the historical evolution of trademark legislation increased the power of brands and led to undue consumer restrictions).

Newcomers should seek legal and professional advice when designing logos and be financially prepared to face potential legal battles during trademark registration. Otherwise, their chances of survival dramatically diminish. Once the initial "neonatal mortality" stage is overcome, partnering via trademark assignment, licensing, or franchising is the most effective strategy for a successful business expansion. Assigning trademarks and brands allows firms the ability to scale their market presence while minimizing risk and eliminating the need to raise excessive capital or increase overhead (Jayachandran *et al.*, 2013; Saqib and Manchanda, 2008). Likewise, widening the trademark breadth and intensity by registering it in numerous sectors (which can be also accomplished via assignments/licensees) also has a positive effect on trademark longevity. Carefully blending these two strategies should improve trademark management, as investors react more favorably to the licensing of broader brands (Robinson *et al.*, 2015).

In summary, trademark protection, monitoring and surveillance become critical for both incumbents and

newcomers. Brand managers could benefit from these findings by balancing trademark opposition (received and made), assignment and licensing policies and sectoral expansion strategies to reinforce their trademark survivability and minimize the likelihood of costly court litigation (Mitchell and Kearney, 2002). Even for powerful corporations, tough and prolonged legal disputes can undermine or affect i) brand reputation—drawing public attention to the conflict and potentially impacting consumer perception (La, 2021); ii) market positioning—disrupting marketing messaging or advertising campaigns; iii) market expansion—hindering access to new markets; or even iv) marketing budget allocation—diverting resources due to the expense and duration of lawsuits.

9. Limitations and directions for future research

Regarding the perceived limitations of the study, a remaining challenge is to relate trademark survival to key performance indicators, such as business profitability, degree of market competitiveness, exposure to foreign entrance, etc. Unfortunately, such desirable analyses are constrained by the lack of historical entrepreneurial records (sales, production, employees, financial or managerial data, etc.). This gap in comprehensive, long-term business records on manufacturers' results and firms' performance is a widespread issue across countries that also hampers access to historical patent/trademark data. The Spanish trademark database is a remarkable exception that has enabled the current survivability analysis.

Despite these limitations, the results are robust and offer plenty of room for further research. One promising research avenue is the selection of a representative group of well-established historical firms, with available long-term performance data, to explore their trademarks' timeline, including significant events like oppositions, assignments, managerial decisions, etc. Another interesting line of research is to undertake a thorough survivability analysis of the trademarks that entered the market before 1920 and are still alive; exploring the concept of *enduring branding*. A different approach could focus on trademarks registered by nonresidents in Spain, identifying correlations by country, sector and foreign direct investment- and commerce-related variables. Expanding these methods to other countries with accessible historical data—such as the recently released U.S. trademark relational database, containing approximately 7 m records from 1870 to the present (see Graham *et al.*, 2013)—could provide valuable comparative insights.

By providing new data, methodologies, models and key findings, this investigation leads the way to bring history and trademarks back to the future of branding.

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Supplementary material

The supplementary material for this article can be found online.

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Web Appendix A: Trademark Historical Documentation and Database

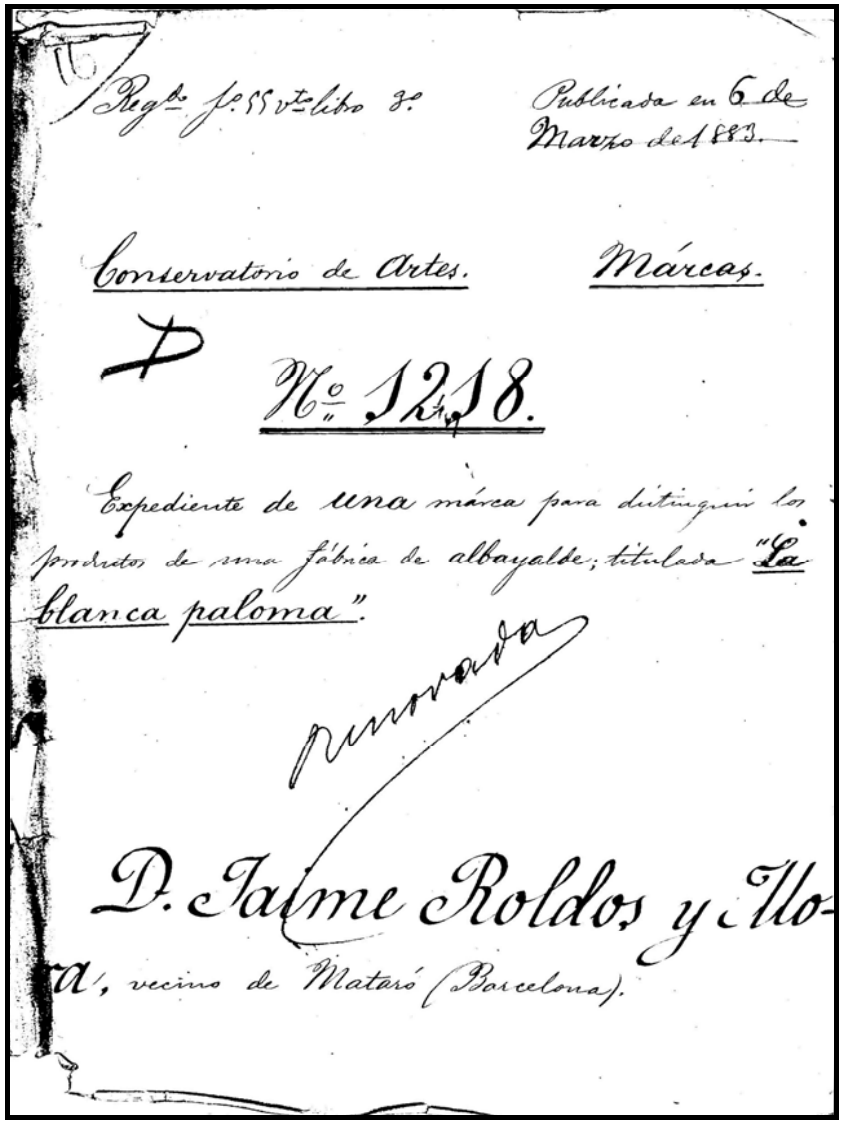
Figure WA1. Trademark historical files and books of registry at the archive of the Spanish Patent and Trademark Office (OEPM)

***Source*: OEPM, Historical Archive.**

Figure WA2. Album with trademarks for smoking paper booklets. Applicants, places, dates, and logos (the 1850s-1860s)

***Source*: OEPM, Historical Archive. Album I *Sencillo, Antiguo*, p. 3.**

Figure WA3. Pages from a trademark file containing data of the applicant, place, dates, description of the logo, product coverage, etc. (1882)



Regte fo 55 vto libro 3o

Publicada en 6 de Marzo de 1883.

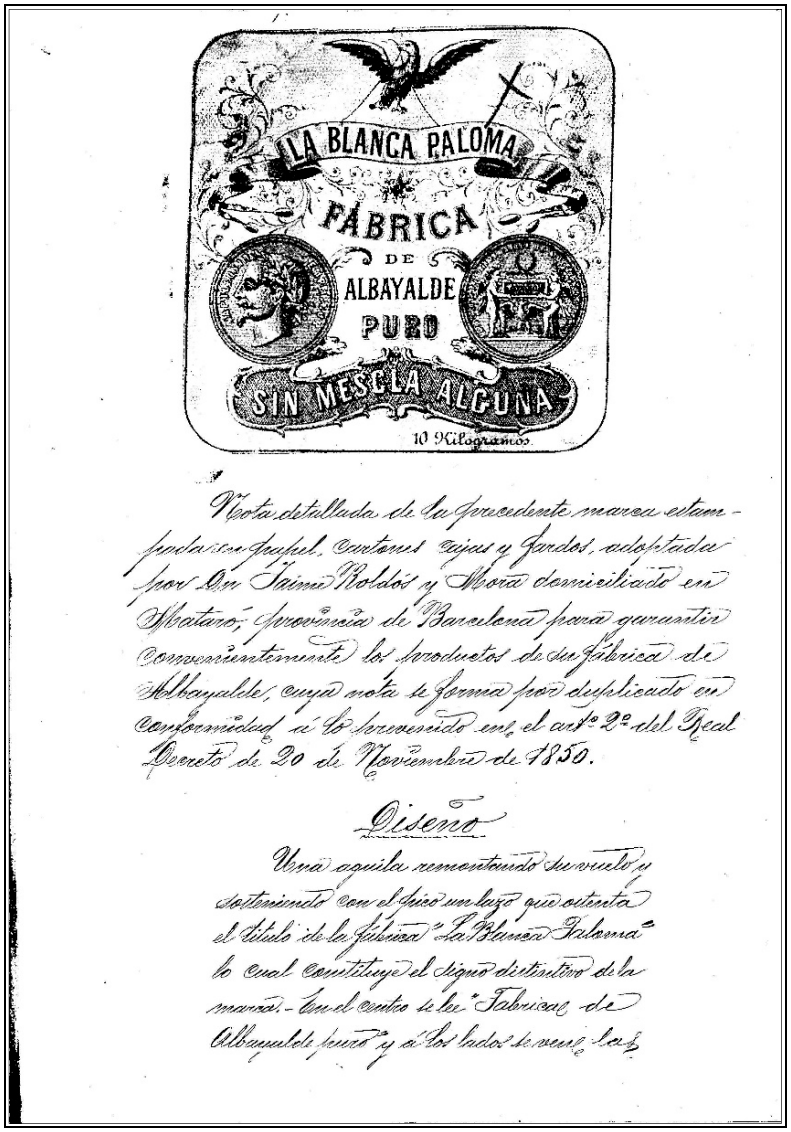
Conservatorio de Artes. Márcas.

No 1218.

Expediente de una márca para distinguir los productos de una fábrica de albayalde; titulada "La blanca paloma".

Presentada

D. Jaime Roldos y Mora, vecino de Mataró (Barcelona).



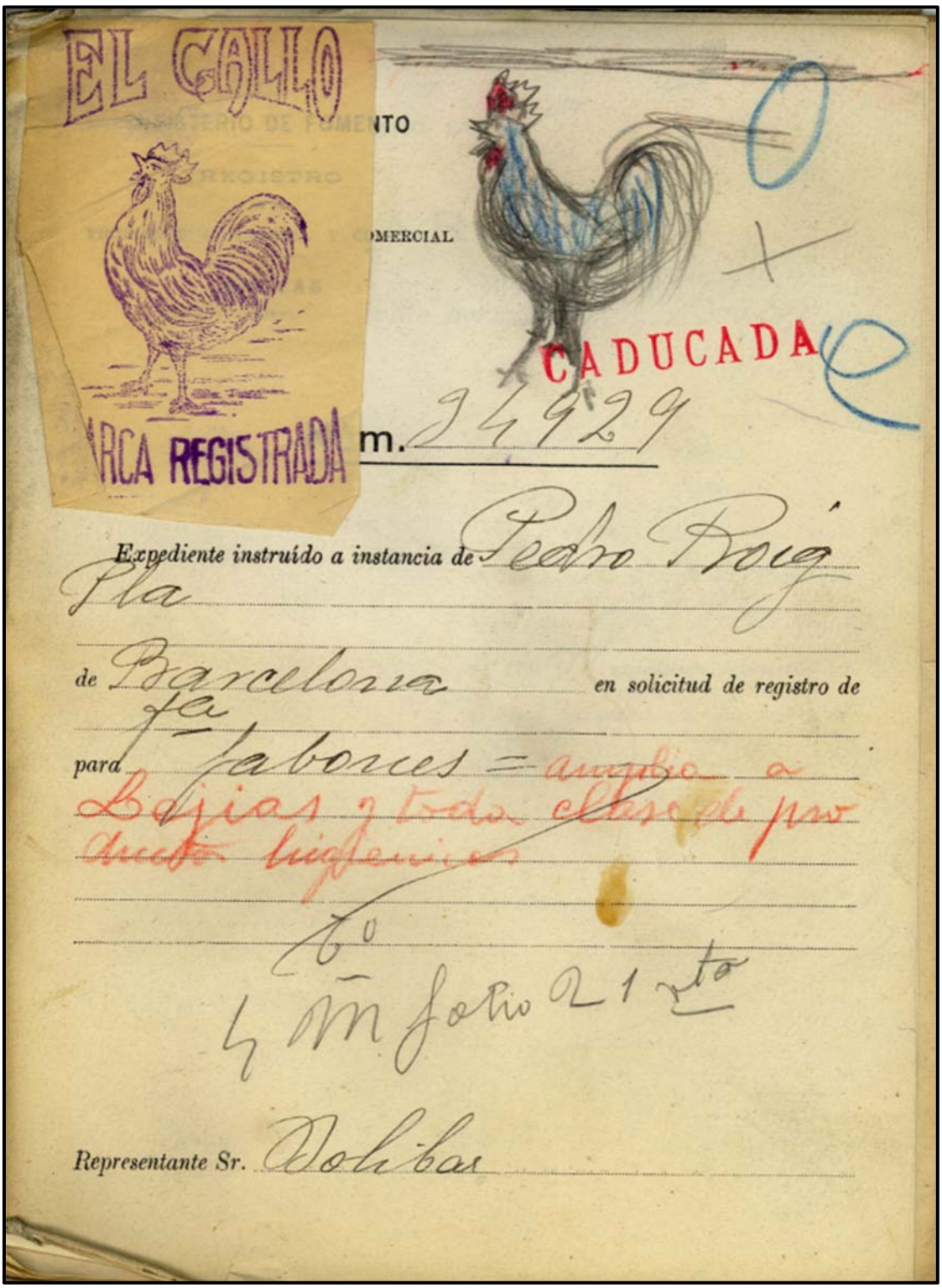
Nota detallada de la precedente marca estampada en papel, cartones rojos y fondos, adoptada por Dn Jaime Roldós y Mora domiciliado en Mataró, provincia de Barcelona para garantir convenientemente los productos de su fábrica de Albayalde, cuya nota se forma por duplicado en conformidad á lo prevenido en el artº 2º del Real Decreto de 20 de Noviembre de 1850.

Diseño

Una aguila remontando su vuelo y sosteniendo con el pico un lazo que ostenta el título de la fábrica "La Blanca Paloma" lo cual constituye el signo distintivo de la marca. En el centro se lee "Fabrica de Albayalde puro" y á los lados se mue[stra]

Source: **OEPM, Historical Archive, Trademark n. 1,218**

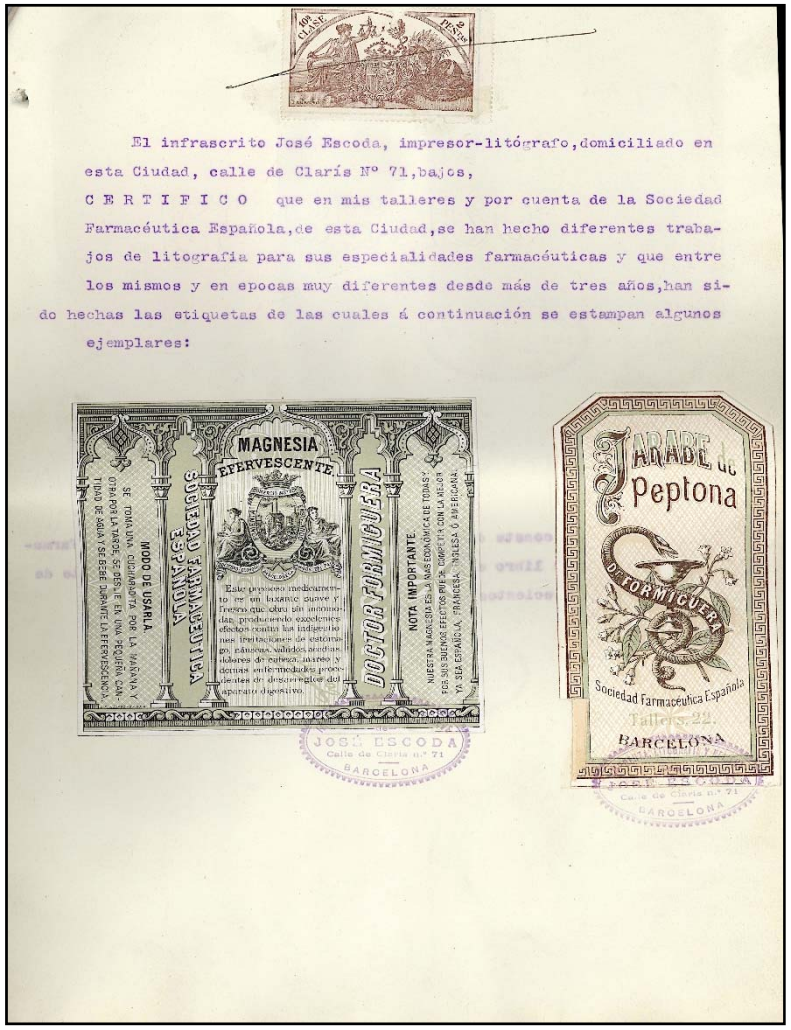
Figure WA4. Front page of a trademark file with data of the applicant, place, dates, product coverage, agent, and logo (1919).



***Source*: OEPM, Historical Archive, Trademark n. 34,929.**

Figure WA5. Examples of oppositions to trademark applications in Spain

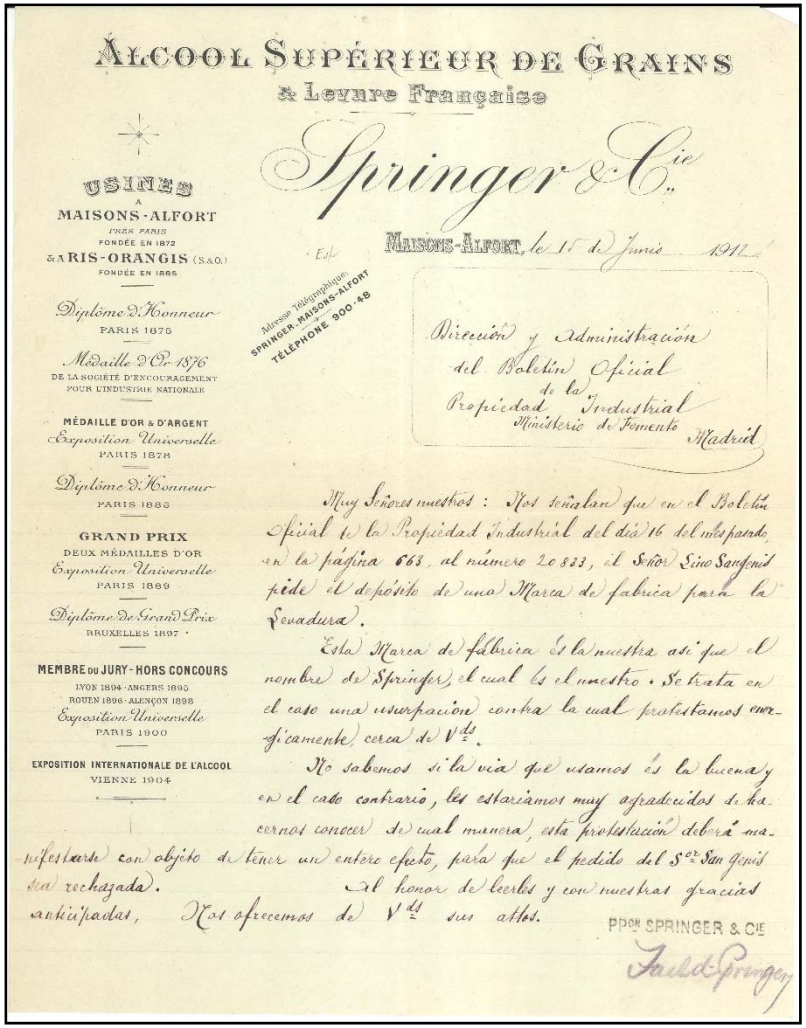
(1907)



El infrascrito José Escoda, impresor-litógrafo, domiciliado en esta Ciudad, calle de Clarís Nº 71, bajos,

C E R T I F I C O que en mis talleres y por cuenta de la Sociedad Farmacéutica Española, de esta Ciudad, se han hecho diferentes trabajos de litografía para sus especialidades farmacéuticas y que entre los mismos y en epocas muy diferentes desde más de tres años, han sido hechas las etiquetas de las cuales á continuación se estampan algunos ejemplares:

(1912)



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PARIS 1878

Diplôme d'Honneur
PARIS 1889

GRAND PRIX
DEUX MÉDAILLES D'OR
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PARIS 1889

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Dirección y Administración del Boletín Oficial de la Propiedad Industrial
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Madrid

Muy Señores nuestros: Nos señalan que en el Boletín Oficial de la Propiedad Industrial del día 16 del mes pasado en la página 668, al número 20833, el Señor Simo Sanfeuis pide el depósito de una Marca de fabrica para la Levadura.

Esta Marca de fabrica es la nuestra asi que el nombre de Springer, el cual es el nuestro. Se trata en el caso una usurpación contra la cual protestamos enérgicamente cerca de Vds.

No sabemos si la via que usamos es la buena y en el caso contrario, les estariamos muy agradecidos de hacernos conocer de cual manera, esta protestación deberá manifestarse con objeto de tener un entero efecto, para que el pedido del Sr. San Genis sea rechazada.

Al honor de leerles y con nuestras gracias anticipadas, Nos ofrecemos de Vds. sus attos.

P.P. de SPRINGER & Cie

Paul Springer

***Source*: OEPM, Historical Archive, Trademarks n. 13,702 and 20,833.**

Figure WA6. Example of a trademark registered in 1900 and assigned in 1916 (sold, together with other two trademarks)

MINISTERIO DE FOMENTO. A. I. C. y O. P.

DIRECCION GENERAL DE AGRICULTURA, INDUSTRIA Y COMERCIO

Don Rafael de la Viesca y Mendez

DIRECTOR GENERAL DE AGRICULTURA, INDUSTRIA Y COMERCIO

Certifico: Que Don Restituto Fernández

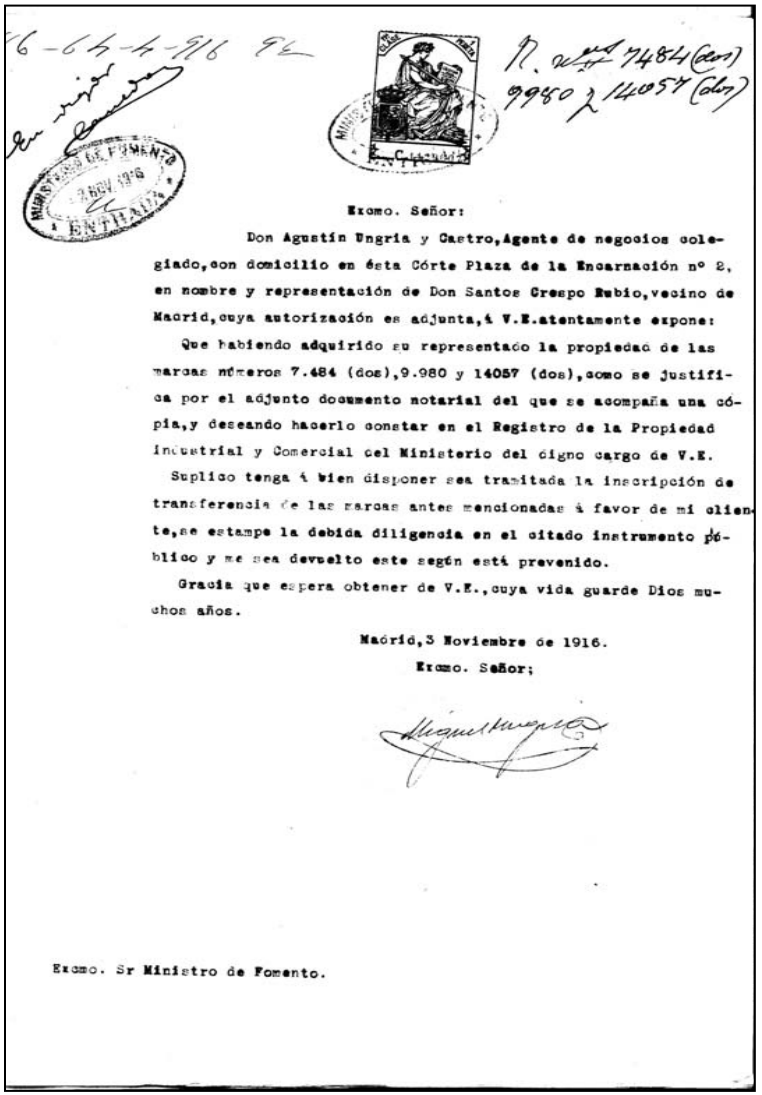
ha solicitado la concesión de propiedad de una Marca de comercio para distinguir Polvos Ramado Denticina.

Y no constando en el Negociado de Industria y Registro de la Propiedad Industrial y Comercial que se haya concedido á otra persona la misma Marca á iguales fines, expido á favor del interesado el presente Certificado, que le asegure la propiedad y uso exclusivo del distintivo que caracteriza la expresada Marca, y autorizado con el sello de esta Dirección general, queda adherido á continuación.

Madrid seis de Febrero de mil novecientos uno.

DENTICINA SACRAMENTO

Tomé razón al libro 2.º folio 73 número 1394 de registro de marcas, y el distintivo anterior consta también al folio 45 del álbum. 4.ª duplicada. El expediente de su razón lleva el número 7484.



6-64-4-916 9L

N. 7484 (cien) 9980 y 14057 (dos)

MINISTERIO DE FOMENTO 3 NOV 1916 ENTRADA

Excmo. Señor:

Don Agustín Ungría y Castro, Agente de negocios colegiado, con domicilio en ésta Córte Plaza de la Encarnación nº 2, en nombre y representación de Don Santos Crespo Rubio, vecino de Madrid, cuya autorización es adjunta, á V.E. atentamente expone:

Que habiendo adquirido su representado la propiedad de las marcas números 7.484 (dos), 9.980 y 14057 (dos), como se justifica por el adjunto documento notarial del que se acompaña una cópia, y deseando hacerlo constar en el Registro de la Propiedad Industrial y Comercial del Ministerio del digno cargo de V.E.

Suplico tenga á bien disponer sea tramitada la inscripción de transferencia de las marcas antes mencionadas á favor de mi cliente, se estampe la debida diligencia en el citado instrumento público y me sea devuelto este según está prevenido.

Gracia que espera obtener de V.E., cuya vida guarde Dios muchos años.

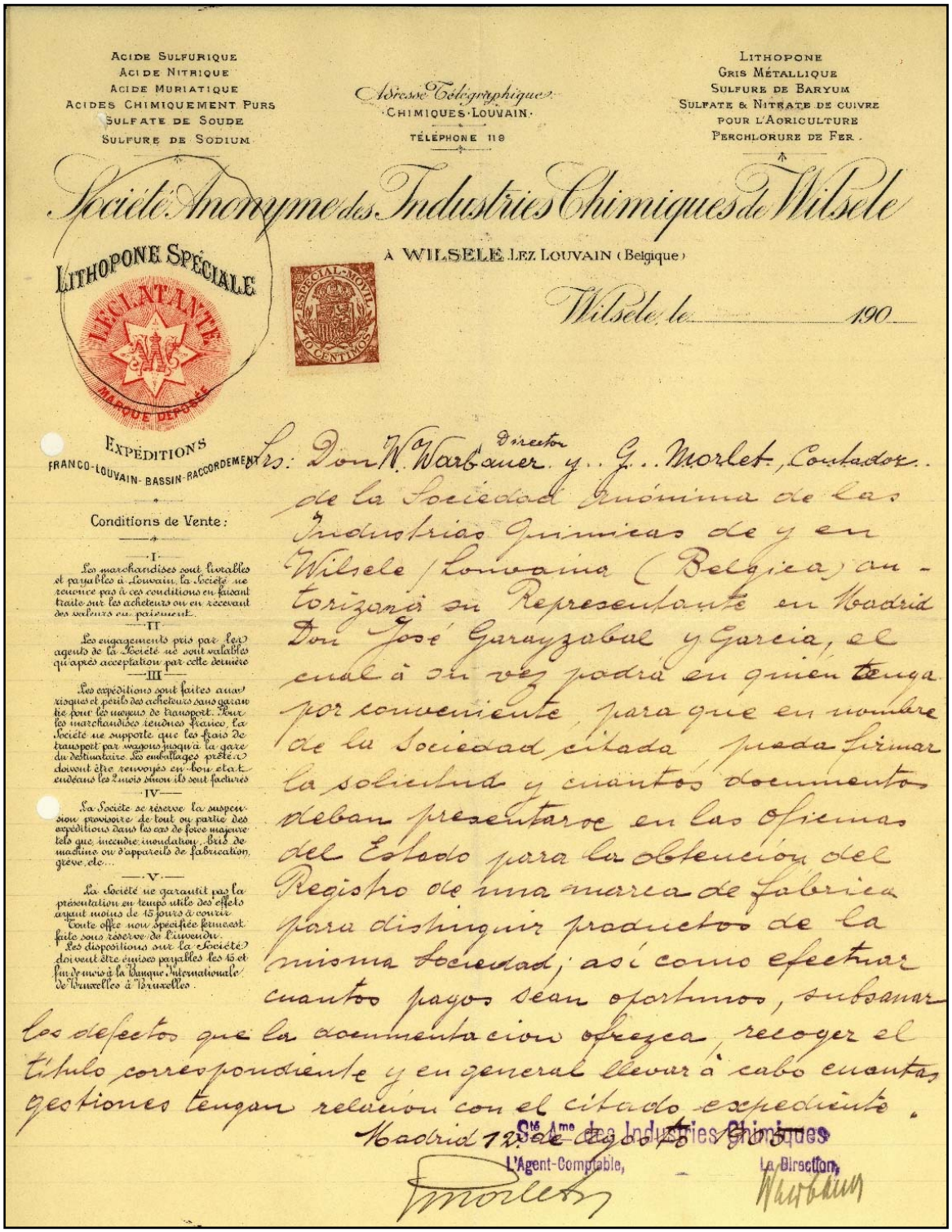
Madrid, 3 Noviembre de 1916.

Excmo. Señor;

Excmo. Sr Ministro de Fomento.

Source: **OEPM, Historical Archive, Trademark n. 7,484**

Figure WA7. Power of attorney from the *Société Anonyme des Industries Chimiques de Wilsele* (Belgium) to register and manage trademarks in Spain (1905)



ACIDE SULFURIQUE
ACIDE NITRIQUE
ACIDE MURIATIQUE
ACIDES CHIMIQUEMENT PURS
SULFATE DE SOUDE
SULFURE DE SODIUM

Adresse Télégraphique:
CHIMIQUES-LOUVAIN
TÉLÉPHONE 118

LITHOPONE
GRIS MÉTALLIQUE
SULFURE DE BARYUM
SULFATE & NITRATE DE CUIVRE
POUR L'AGRICULTURE
PERCHLORURE DE FER.

Société Anonyme des Industries Chimiques de Wilsele

LITHOPONE SPÉCIALE
ÉCLATANTE
MARQUE DÉPOSÉE

À WILSELE LEZ LOUVAIN (Belgique)

Wilsele, le ..... 190..

EXPÉDITIONS
FRANCO-LOUVAIN-BASSIN-RACCORDEMENT

Conditions de Vente:

—I—
Les marchandises sont livrables et payables à Louvain. La Société ne renonce pas à ces conditions en faisant traite sur les acheteurs ou en recevant des valeurs en paiement.

—II—
Les engagements pris par les agents de la Société ne sont valables qu'après acceptation par cette dernière

—III—
Les expéditions sont faites aux risques et périls des acheteurs sans garantie pour les moyens de transport. Pour les marchandises rendues franco, la Société ne supporte que les frais de transport par wagons jusqu'à la gare du destinataire. Les emballages prêtés doivent être renvoyés en bon état endéans les 2 mois sinon ils sont facturés

—IV—
La Société se réserve la suspension provisoire de tout ou partie des expéditions dans les cas de force majeure tels que incendie, inondation, bris de machine ou d'appareils de fabrication, grève, etc...

—V—
La Société ne garantit pas la présentation en temps utile des effets ayant moins de 15 jours à courir.
Toute offre non spécifiée ferme est faite sous réserve de l'invendu.
Les dispositions sur la Société doivent être encaissées payables les 15 et fin de mois à la Banque Internationale de Bruxelles à Bruxelles.

Srs: Don W.a Warbauer, Directeur y G. Morlet, Contador de la Sociedad Anónima de las Industrias Químicas de y en Wilsele (Lovaina) Belgica, autorizan su Representante en Madrid Don José Garayzabal y García, el cual á su vez podrá en quien tenga por conveniente, para que en nombre de la Sociedad citada pueda firmar la solicitud y cuantos documentos deban presentarse en las Oficinas del Estado para la obtención del Registro de una marca de fabrica para distinguir productos de la misma Sociedad; así como efectuar cuantos pagos sean oportunos, subsanar los defectos que la documentación ofrezca, recoger el título correspondiente y en general llevar á cabo cuantas gestiones tengan relación con el citado expediente.

Madrid 12 de Agosto de 1905

Cie Anne des Industries Chimiques

L'Agent-Comptable, Morlet

La Direction, Warbauer

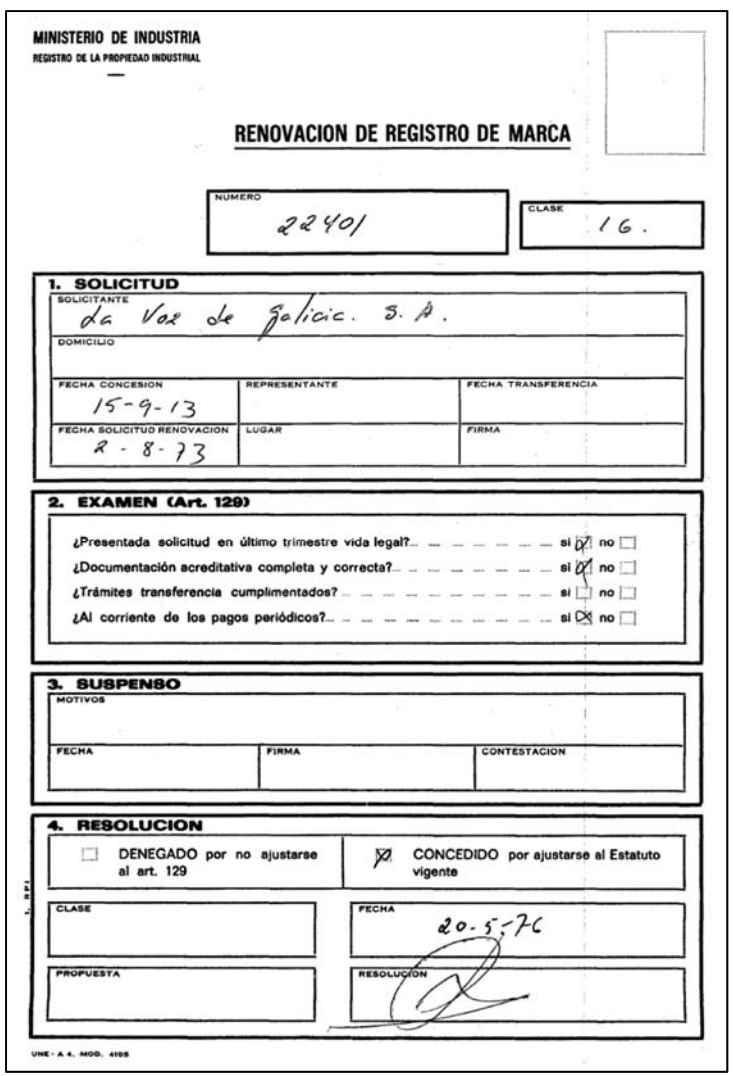
***Source*: OEPM, Historical Archive, Trademark n. 12,298**

Figure WA8. Example of payments (1928) to renew a trademark granted in 1903

***Source*: OEPM, Historical Archive, Trademark n. 9,355.**

Figure WA9. Example of renewal data (1973 and 2003) of a trademark filed in 1913

(1973) **(2003)**



MINISTERIO DE INDUSTRIA
REGISTRO DE LA PROPIEDAD INDUSTRIAL

RENOVACION DE REGISTRO DE MARCA

NUMERO 22401 CLASE 16.

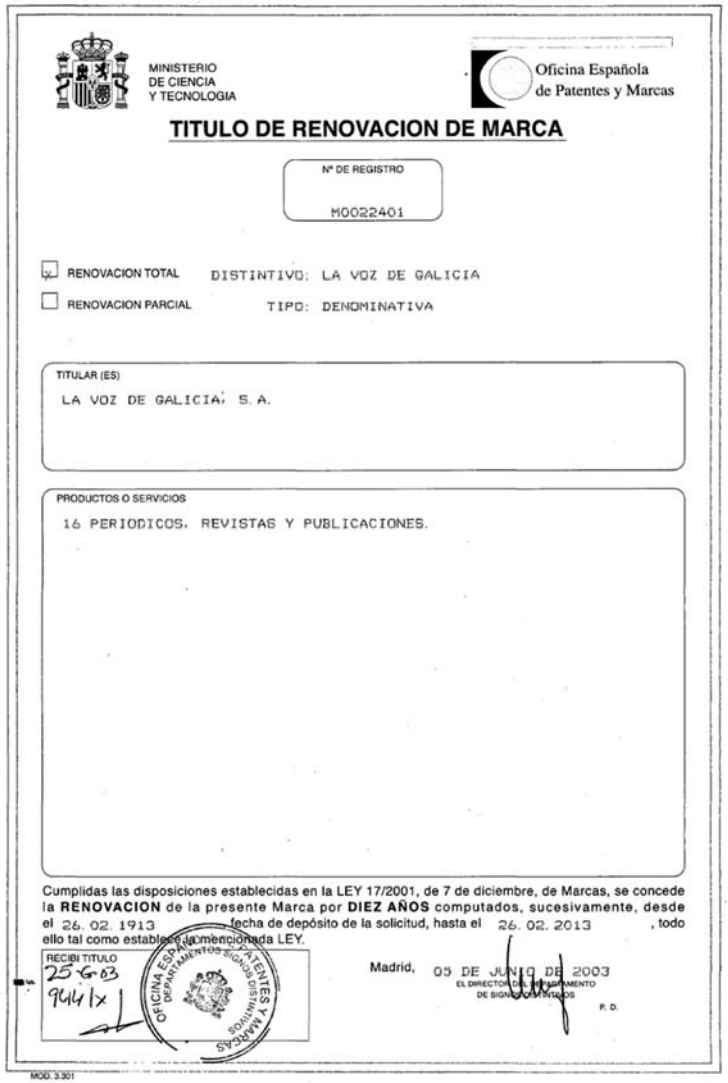
1. SOLICITUD
SOLICITANTE: La Voz de Galicia. S. A.
DOMICILIO
FECHA CONCESION: 15-9-13 | REPRESENTANTE | FECHA TRANSFERENCIA
FECHA SOLICITUD RENOVACION: 2-8-73 | LUGAR | FIRMA

2. EXAMEN (Art. 129)
¿Presentada solicitud en último trimestre vida legal? si [X] no [ ]
¿Documentación acreditativa completa y correcta? si [X] no [ ]
¿Trámites transferencia cumplimentados? si [ ] no [ ]
¿Al corriente de los pagos periódicos? si [X] no [ ]

3. SUSPENSO
MOTIVOS
FECHA | FIRMA | CONTESTACION

4. RESOLUCION
[ ] DENEGADO por no ajustarse al art. 129
[X] CONCEDIDO por ajustarse al Estatuto vigente
CLASE | FECHA 20-5-76
PROPUESTA | RESOLUCION

UNE - A 4. MOD. 4105



MINISTERIO DE CIENCIA Y TECNOLOGIA
Oficina Española de Patentes y Marcas

TITULO DE RENOVACION DE MARCA

Nº DE REGISTRO M0022401

[X] RENOVACION TOTAL DISTINTIVO: LA VOZ DE GALICIA
[ ] RENOVACION PARCIAL TIPO: DENOMINATIVA

TITULAR (ES)
LA VOZ DE GALICIA, S.A.

PRODUCTOS O SERVICIOS
16 PERIODICOS, REVISTAS Y PUBLICACIONES.

Cumplidas las disposiciones establecidas en la LEY 17/2001, de 7 de diciembre, de Marcas, se concede la **RENOVACION** de la presente Marca por **DIEZ AÑOS** computados, sucesivamente, desde el 26. 02. 1913 fecha de depósito de la solicitud, hasta el 26. 02. 2013, todo ello tal como establece la mencionada LEY.

RECIBI TITULO 25-6-03 9441x

Madrid, 05 DE JUNIO DE 2003
EL DIRECTOR DEL DEPARTAMENTO DE SIGNOS DISTINTIVOS
P. D.

OFICINA ESPAÑOLA DE PATENTES Y MARCAS DEPARTAMENTOS SIGNOS DISTINTIVOS

MOD. 3.301

***Source*: OEPM, Historical Archive, Trademark n. 22,401**

Figure WA10. Entity-relationship model built for the Spanish historical trademark database (1850-1920)

***Source*: Sáiz P., Llorens F., Blázquez L., Cayón F. (eds.) (2019) *Base de datos de solicitudes de marcas. España, 1850-1920* (OEPM-UAM [2007-2019], Madrid) see https://www.ibcnetwork.org/e_research_resource.php?id=5**

Figure WA11. Web page at the OEPM to access the historical trademark database (November 2020)

***Source*: http://historico.oepm.es/marcas.php**

Web Appendix B: Geographical specifications

Concerning the sectoral classification, this study also considers a geographical dimension that has proven key in explaining the emergence, consolidation, and diffusion of trademarks through geographical proximity (e.g. Drivas, 2022; Sáiz and Zofío, 2022). The analysis includes two indicators calculated to summarize information on the geographical specialization and diversification of trademarks by sectors:

– *'Relative-Trademark-Geographical-Specialization' (RTMGS).* Sáiz and Zofío (2022) show that locations (provinces) where trademarks are clustered in specific sectors tend to grow in their specialization through time. This investigation clarifies whether a high concentration of trademarks in the same sector may be detrimental or beneficial to their survivability due to competition or synergic effects (i.e., there might be either high natality or high mortality of trademarks with large hazard rates). The method follows the literature measuring the relative geographical specialization of trade, patents, or industries (Bahar *et al.*, 2014; Boschma *et al.*, 2017; Jaffe *et al.*, 1993) and defines an indicator that captures the relative geographical trademark specialization of a location with respect to the national distribution of trademarks. The indicator compares the sectoral specialization of the province in which the trademark is registered—in the surviving years—with the national distribution of trademarks' shares in the same sector(s) and years. Since trademarks can be registered in different sectors the final indicator is calculated as the weighted average of the different sectors where the trademark is registered.

  Let us consider first a specific i-th trademark, i=1,..,I, whose life lasts from the date in which it is registered to the date when it either deceases or our study ends (denoted as $t(i)$ =1,…,T), registered in province $p(i)$—out of p=1,…,q,…,P locations (in our case, 50 Spanish provinces according to the NUTS-3 classification of the European Union)—and operating in one or more of the previously considered thirteen market or sectors, $s(i)$ = 1,…,S.[1]

  Then, the method includes its associated indicator of relative trademark geographical specialization of province $p(i)$ in each sector $s(i)$, which is defined as follows:

$$RTMGS_{p(i),s(i)}^{t(i)=1...,T}=\frac{Prov.Share_{t(i),p(i),s(i)}}{Nat.Share_{t(i),p,s(i)}}=\frac{\left(\sum_{t(i)=1}^{T}TM_{t(i),p(i),s(i)}\right)/\left(\sum_{t(i)=1}^{T}\sum_{s=1}^{S}TM_{t(i),p(i),s}\right)}{\left(\sum_{t(i)=1}^{T}\sum_{p=1}^{P}TM_{t(i),p,s(i)}\right)/\left(\sum_{t(i)=1}^{T}\sum_{p=1}^{P}\sum_{s=1}^{S}TM_{t(i),p,s}\right)},\quad s(i)=1,....,S. \quad \text{(WB.1)}$$

  In the numerator there is the sectoral share in province $p(i)$, $Prov.Share_{t(i),p(i),s(i)}$, defined as the number of trademarks registered in the same life span of the i-th trademark, $t(i)$=1,…,T, province

[1] For computational simplicity, the life span of the trademarks is measured in years.

$p(i)$ and sector $s(i)$, $\sum_{t(i)=1}^{T} TM_{t(i),p(i),s(i)}$, in the total number of trademarks with the same life span existing in that province, $\sum_{t(i)=1}^{T}\sum_{s=1}^{S} TM_{t(i),p(i),s}$. In the denominator, there is the national share, $Nat.Share_{t(i),p,s(i)}$, defined as the total number of trademarks with the same life span of the trademark registered in sector $s(i)$ across all provinces, $\sum_{t(i)=1}^{T}\sum_{p=1}^{P} TM_{t(i),p,s(i)}$, in the total number of trademarks existing in the country in the same period, $\sum_{t(i)=1}^{T}\sum_{p=1}^{P}\sum_{s=1}^{S} TM_{t(i),p,s}$. Consequently, $RTMGS_{p(i),s(i)}^{t(i)=1...,T}$ measures the relative specialization of province $p(i)$ (where trademark i is registered) in the sector (i) (where the trademark i operates), compared to the share of trademarks operating in that sector at the national level. If $RTMGS_{p(i),s(i)}^{t(i)=1...,T} > 1$ then province $p(i)$ is specialized in sector $s(i)$ because its share in the total number of trademarks in the province is greater than the corresponding sectoral share at the national level. Alternatively, if $RTMGS_{p(i),s(i)}^{t(i)=1...,T} < 1$, the province does not exhibit specialization. The province exhibits the same specialization in sector $s(i)$ that the whole country if both shares are equal, i.e., $RTMGS_{p(i),s(i)}^{t(i)=1...,T} = 1$.

Finally, as trademarks can be registered in several sectors, it is crucial to calculate an indicator of trademark geographical specialization that summarizes the provincial specialization considering all those markets where the trademark operates. The method relies on the previously calculated provincial shares, $Prov.Share_{t(i),p(i),s(i)}$, to weigh the individual $RTMGS_{p(i),s(i)}^{t(i)=1...,T}$, i.e.,

$$RTMGS_{p(i),s(i)=1,...,S}^{t(i)=1,...,T} = Prov.Share_{t(i),p(i),s(i)} \times RTMGS_{p(i),s(i)}^{t(i)=1...,T}. \quad \text{(WB.2)}$$

– *'Relative-Trademark-Geographical-Diversification' (RTMGD).* The survivability of trademarks may be affected also by the widespread presence of trademarks in the geographical location where they are registered. The relative trademark geographical diversification indicator complements the previous *RTMGS* indicator by capturing the relative sectoral presence of trademarks with respect to the national average; deviations above the national average would reflect supporting environments in terms of people's awareness and acceptance of trademarks, as well as a more favorable institutional context necessary to implement and enforce trademark law. Considering all s=1,…,13 markets, the indicator measures how similar is the sectoral specialization of the province where the trademark is registered with respect to the national sectoral shares.

Following Duranton and Puga's (2000) specification, the analysis develops the indicator using the previously defined provincial and national shares:

$$RTMGD_{p(i),s}^{t(i)=1,..,T} = 1 / \sum_{s=1}^{13} \left| Prov.Share_{t(i),p(i),s(i)} - Nat.Share_{t(i),p,s(i)} \right|, \quad \text{(WB.3)}$$

where $Prov.Share_{t(i),p(i),s(i)}$ and $Nat.Share_{t(i),p,s(i)}$ are defined as in the numerator and denominator of expression (WB.1), respectively. Consequently, the closer the distribution of the sectoral shares in province $p(i)$ to that of the national sectoral shares, the higher the numerical value of $RTMGD_{p(i),s}^{t(i)=1,..,T}$, indicating that the province exhibits the same diversification as the whole country—note that $RTMGD_{p(i),s}^{t(i)=1,..,T}$ tends to infinity as the denominator tends to zero.

References Web Appendix B

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Duranton, G. and Puga, D. (2000), "Diversity and specialisation in cities: why, where and when does it matter?", *Urban Studies*, Vol. 37 No. 3, doi: 10.1080/0042098002104.

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Sáiz, P. and Zofío, J.L. (2022), "The making and consolidation of the first national trademark system: the diffusion of trademarks across Spanish regions, 1850–1920", *Regional Studies*, Vol. 56 No. 2, pp. 256–275, doi: 10.1080/00343404.2021.1887472.

Web Appendix C: Supplementary Specifications (Models 2 & 3)

WC1. Market (sectoral) and geographical specification

Model 2 controls for the market and the geographical conditions related to the sectoral specialization and diversification of the province where trademarks are registered. The introduction of these variables does not change the estimated hazard rates of the basic variables included in the baseline specification (Model 1), showing the robustness of the previous results. Introducing the market dummies implies that the sectoral diversification variable, '*Trademark-Breadth*', must be dropped from the specification to prevent multicollinearity. Considering the service sector as the reference benchmark, the hazard ratios do not differ in value in four out of the 13 sectors, with their corresponding coefficients not being statistically significant. They are, nonetheless, in the manufacturing of general consumer products (where trademarking concentrates), such as basic chemical goods and food (with a reduction in their hazard rates of around 5.00% each), beverages, tobacco, and textiles (around 10.00%), and arms and construction (around 15.00%). Therefore, all of them exhibit lower hazard rates compared to the service sectors except in the case of paper and graphic arts (8.51% increase), one of the activities with more oppositions during the second half of the nineteenth century due to the competition among paper manufacturers mainly originated in the market for tobacco booklets (Gutiérrez-Poch, 2014), a good whose trademarks are also classified in the tobacco sector (positive coefficients but statistically not significant).

Regarding the geographical variables, and despite the efforts made in the calculation of the relative indices of trademark geographical specialization and diversification, the findings show that operating in locations where there is a high presence of trademarks within the same sectors, '*Relative-Trademark-Geographical-Specialization*', is marginally detrimental to survivability by increasing the hazard rate by 1.35%.[2] This suggests a mild competition effect within the same markets, whereby the higher the geographical specialization the lower the duration. This result qualifies the findings reported by Sáiz and Zofío (2022), who established that the geographic diffusion of trademarks in Spain (measured by a province's probability of transitioning to being specialized in a given market) is favored by the concentration of trademarks in the same market. As for the diversification of trademarks within the same province, '*Relative-Trademark-Geographical-Diversification*', indicating if their use across sectors is widely present and comparable to the national distribution, its favorable hazard ratio is not statistically different from zero.

[2] The specialization and diversification indices can be calculated for trademarks registered in Spain only, implying that trademarks registered by '*Non-residents*' are dropped from the regressions corresponding to Models 2 and 3.

WC2. Interactions specification

The goal with this model is to determine if there exist complementary effects among the main variables to gain further insights about the determinants of survivability and to provide a robustness check of previous results. The method estimates the specification of the Cox model presented in the expression (3) including the cross-effects listed in Model 3 of Table II. The inclusion of the interactions in this enhanced specification significantly alters the linear and quadratic coefficients of the variables with respect to the baseline Model 1 and the market and geographical Model 2. For instance, the coefficient β_1 for '*Oppositions-Received*' increases from 0.5571 in Model 1 to 1.127 in Model 3, while β_{11} decreases from –0.0687 to –0.143. However, the values of the total marginal effects of Model 3, accounting for all coefficients: linear, quadratic, and interactions, do not substantially differ from the results of Models 1 and 2—i.e., the effects are redistributed among the variables. As explained in the main text, it is worth highlighting that the litigation variable interacting oppositions received and made, '*Oppositions-Received* × *Oppositions-Made*', reduces the hazard rate by 6.84%, indicating that if a trademark that receives oppositions also enganges in legal action against competitors, its chances of survival increases. Overall, considering all the coefficients of Model 3, the final effect of '*Oppositions-Received'* including all interactions is 70.85% (=(exp(1.1270–2×0.143 –0.0708 –0.2051–0.0025–0.027) –1)×100), while in Models 1 and 2 it was 52.15% and 50.85%, respectively.

Relevant comments can be made for the remaining cross-effects that are statistically significant, either increasing or decreasing the hazard rates. For example, in the event of receiving oppositions and having assigned the trademark, this remarkably reduces the hazard rate by 18.54%, '*Oppositions-Received* × *Trademark-Assignments*'. On the contrary, trademarks opposing competitors see their survivability reduced by 2.11% if they have been assigned, '*Oppositions-Made* × *Trademark-Assignments*', showing that cross-effects can have ambiguous impacts on survivability. The effects of other interactions can be identified in the same way.

References Web Appendix C

Gutiérrez-Poch, M. (2014), "Producing ashes: brand and cigarette paper in Spain (1850-1936)", *The Brand and Its History: Economic, Business, and Social Value*, presented at the XI Congreso Internacional de la AEHE, Madrid, doi: 10.13140/RG.2.1.4603.5045.

Sáiz, P. and Zofío, J.L. (2022), "The making and consolidation of the first national trademark system: the diffusion of trademarks across Spanish regions, 1850–1920", *Regional Studies*, Vol. 56 No. 2, pp. 256–275, doi: 10.1080/00343404.2021.1887472.