

# **The Making and Consolidation of the First National Trademark System: Diffusion of Trademarks across Spanish Regions (1850–1920)**

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August 2020

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## **Abstract**

This article studies the creation and consolidation of a trademark system tantamount to market integration and commercial specialization of Spanish regions from 1850 to 1920. We analyze the first 47,000 registrations, their geographical distribution, and the drivers behind this trademark expansion. By using a lineal probability model, we find knowledge spillovers across regions are associated with their relative trademark specialization and diversification. We incorporate the role played by transport infrastructure by calculating generalized transport costs. Our results clarify the origins and evolution of geographical differences in commercial innovation and regional specialization in the first country to institute modern trademark legislation.

## **Keywords**

Trademarks/Branding; Specialization/Diversification; Generalized Transport Costs; Regional History; Markets; Spain.

## **JEL**

N93; O34; C25; R12

## 1. Introduction

Trademarking is an exceptionally old practice, with some historians dating it back to the Greek and Roman empires (Johnston, 1974). Signs and marks were used continuously from at least the Middle Ages to the eighteenth century, usually under guilds' rules and with local or regional scope, to signal origins and/or quality and to combat fakes (Belfanti, 2018). Industrialization processes and improvements in transportation were key factors that facilitated a progressive integration of national markets and the emergence of trademark legislation during the nineteenth century. Local manufacturers and traders from distinct regions and areas had increasing opportunities to distribute and sell their products throughout a country, not just a region, and even internationally. However, established practices of counterfeiting and imitation also threatened to shift from a local to a wider scale. Hence, market growth increased fraud, risked reputations, and continued disputes between retailers and producers to control intangible assets such as revenues (Duguid, 2003). Likewise, inter-regional competitiveness among production centers caused conflicts related to distinguishing goods and promoted regional specialization within national markets. Combined, these activities led to the establishment of centralized trademark registries to manage and organize the growing number of distinctive signs and increase economic relevance. Spain instituted national trademark registration in 1850, becoming the first country to do so.

The empirical study of trademarks is emerging as a new research focus of scholars from varied disciplines, including economics, law, sociology, linguistics, anthropology, and business studies (for overviews, see Bently et al., 2008; Castaldi, 2019; Sáiz & Castro, 2018; Schautschick & Greenhalgh, 2016). For example, scholars are now exploring trademarks to measure the financial impact of branding (Krasnikov et al., 2009) and the market value of firms (Sandner & Block, 2011). There is also a growing interest in economic geography and innovation studies in the relationship between trademark records and international trading patterns (Baroncelli et al., 2005; Fink et al., 2005; Mangàni, 2007); and between trademark registrations and innovation processes in certain sectors and firms (Flikkema et al., 2014; Gotsch & Hipp, 2012; Mendonça et al., 2004; Schmoch, 2003).

These new foci on trademark research include regional approaches. Several works study the distinct dynamic of regions in trademark use at the country level (for example by analyzing the regional effect on trademarking by low-tech sectors and firms in Portugal; Mamede et al., 2014) and at the European level (by analyzing trademarks/patents and knowledge-based entrepreneurship or technological capabilities by European Union (EU) regions; Ferreira & Godinho, 2015; and, in this same Special Issue, Drivas, 2020). Moreover, scholars working on regional science are calling attention to the role played by knowledge spillovers emanating from regions with high degrees of specialization and/or diversification, including patent citations, trade, and industrial patterns (Bahar et al., 2014; Boschma et al., 2017; Jaffe et al., 1993). Other scholars are analyzing the necessity of adopting historical perspectives to correctly understand regional dynamics over the long term, including innovation and business developments (Capello & Lenzi, 2018; Fritsch et al., 2019; Henning, 2019). Many of the aforementioned studies generally conclude that diffusion processes are incremental and driven by geographical accessibility and proximity. Although several of these analyses have used patents or trade by products as proxies, trademark diffusion has been barely studied, much less in historical perspective.

This article studies the drivers of regional economic development concerning the commercialization and protection of goods during the process of market integration and first

industrialization of Spain (1850–1920). We constructed a new historical trademark dataset and several gravity-based indicators to measure the exposure of each Spanish province to relative trademark specialization and diversification of the other provinces (Duranton & Puga, 2000; Ellison & Glaeser, 1997). We estimated a linear probability model to explain the likelihood that a province developed mature consumption markets through the widespread presence of trademarks. The diffusion of the national trademark system in Spain took place by geographical proximity, which we incorporated and tested in our model in the form of generalized transport costs (GTCs) rather than using physical distance or contiguity to bordering regions. To do this, we studied historical sources on railway and road networks. Although other models exist (Bahar et al., 2014; Boschma et al., 2017), our model includes the creation and diffusion of trademark systems from a historical perspective, and it accounts for the spatial effects through a matrix of bilateral GTCs based on actual transport infrastructure.

Our results shed light on the importance of the original distribution of trademarks across regions and sectors, the cross-influence of relative regional specialization and/or diversification, and the significance of geography on trademarking diffusion. Understanding these complex processes is relevant to study market integration at a national level from a historical perspective. These lessons can deepen knowledge on current core-periphery structures when economic activity occurs in hierarchical patterns that are concentrated in only a few locations and may result in persistent regional inequalities.

The following section introduces the Spanish trademark system, sources, and data. Section 3 presents the specific research question and the corresponding model of regional diffusion of trademarks; it also provides methodological construction of the necessary variables, the preferred econometric specification, and the estimation strategy. Section 4 describes our findings and the relevance of the results for understanding trademarking evolution and its regional and sectoral dynamics. Section 5 draws the main conclusions and suggests further research.

## **2. The Spanish trademark system: Historical sources and data**

### *2.1. Spain and the origins of modern trademarking*

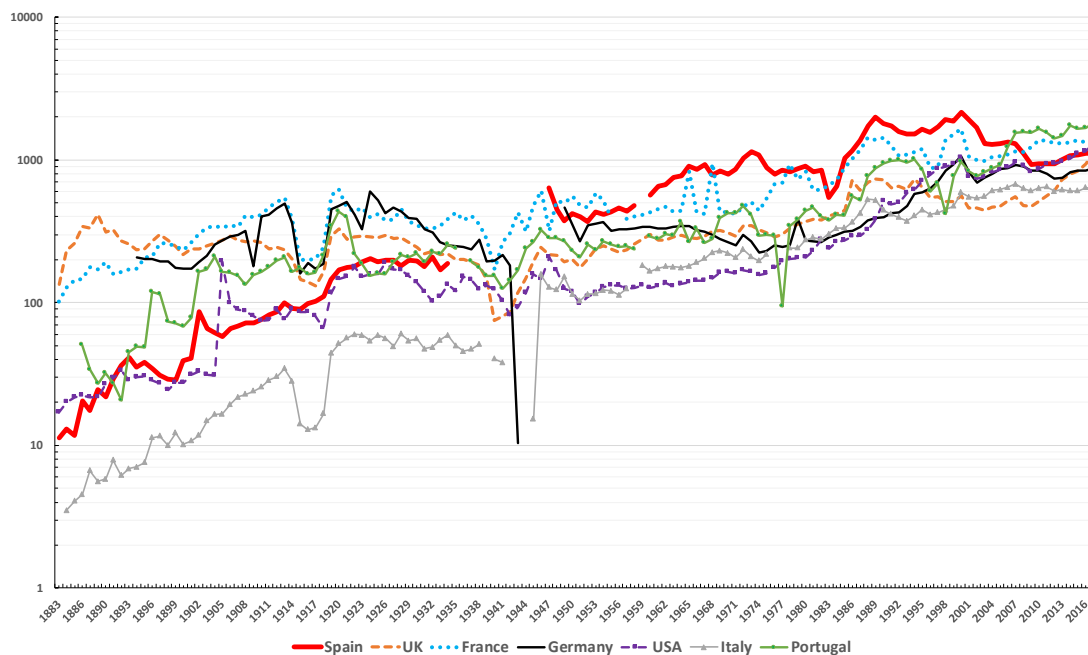
Spain was the first country to pass a modern trademark law, including a national registry, in 1850.<sup>1</sup> Although there was a long tradition of using marks and distinctive signs from medieval through modern times in many countries, such practices were mainly linked to urban areas or county markets, which resulted in limited registrations. Even during processes of first industrialization, there was a delay to establish national trademark laws and registries with respect to patents. During and after revolutions when newly installed liberal governments gained power over guilds, economic privileges, and production/trade regulations, ownership of trademarks was probably seen as contrary to free trade, enterprise, and markets. While Spain was slow in entering the industrialization process in comparison to the frontrunners, it was a pioneer in creating a national trademark system—followed soon after by France and Austria/Hungary in 1857 and 1858, respectively—and years before the United States (1870) and the United Kingdom (1875) (Patel, 1979, Annex 3).

Many countries, including Spain, had developed specific provisions related to counterfeiting in criminal laws before ever passing trademark laws. The reason underlying the early organization of a centralized trademark registry in Spain was the problem of generalized counterfeiting of certain consumer goods with a wide demand in an increasingly integrated market. In Spain, one particular problem was the market for smoking paper, in which many

manufacturers from Alcoy (Alicante) and Capellades (Barcelona) competed nationally. This industry was highly concentrated in small areas and controlled by family firms that sold similar products, essentially differentiated by packaging and branding, which were easy to imitate. The increasing demand from both national and Latin American markets encouraged fraud (Gutiérrez-Poch, 2014). Indeed, approximately 75% of the first 1,000 trademarks registered after 1850 in Spain had to do with rolling paper booklets or, generally, paper manufacturers. Trademarking then progressively extended to virtually all consumer goods and sectors. Likewise, nondurable goods (e.g., food, beverage, tobacco, stationery) triggered trademarking in other countries, such as France, the United Kingdom, and the United States (Duguid et al., 2010).

Figure 1 shows the evolution of national trademark applications per million inhabitants in several key countries over nearly a century and a half. Between the 1880s and World War I, an initial phase of general growth in trademarking—led by France, Germany, and Portugal, with increasing participation by Spain and the United States—clearly slowed during the interwar period. In general, figures rarely exceeded 500 trademarks per million inhabitants per year in the most active countries. During those decades, the process of deepening national markets developed, linked to the so-called second industrial revolution, mass production, and increasing international competition. However, the growth of trademarking was remarkable after World War II, and especially from the 1960s onward, when it was linked to the advent and development of the “information society,” in which knowledge, communication, and branding became crucial (Freeman & Louçã, 2001, Chapter 9; Ramello & Silva, 2006, pp. 937–938). Again, what is striking during this period is the relevant role of Spain, the country with more national trademark applications per million inhabitants during the second half of the twentieth century. Thus, trademarking seems to occur in Mediterranean economies (with the remarkable exception of Italy) more than with technological and industrial leaders. This may be linked to the development of certain consumption sectors and the exploration of other (non-disruptive) forms of innovation and entrepreneurship (Lopes & Casson, 2007).

**Figure 1. Trademark applications per million inhabitants in France, Germany, Italy, Portugal, Spain, the United Kingdom, and the United States (1883–2017)**



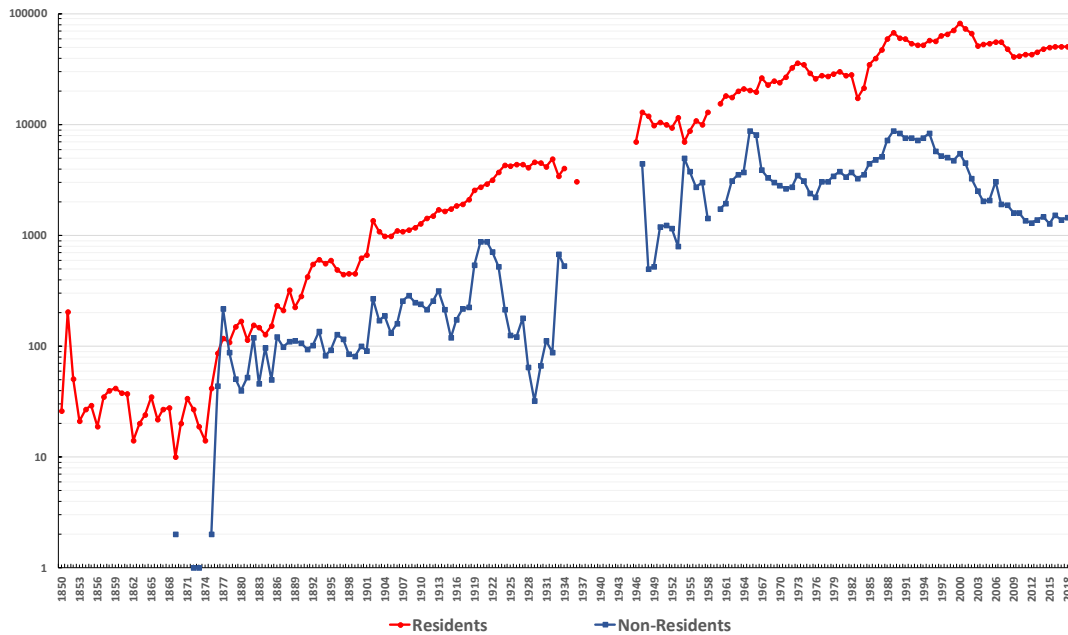
Source: Trademarks: Sáiz et al. (2019) and WIPO (2019); population: Mitchell (2003) and OECD (2019).

Indeed, trademarks seem to capture certain entrepreneurship characteristics more linked to soft innovation and small-firm frameworks, although trademarking motives are complex (see Castaldi et al., 2020). Contrary to disruptive entrepreneurs, soft innovation involves individuals looking for profit opportunities based on price or reputation differentials, not perceived market niches. This approach fits quite well with the historical origins of industrialization and modern economic growth in a lagging and technologically dependent country such as Spain, with long-term weaknesses in its R&D system, prevalence of light industry, and lack of corporations and multinationals, and where the most significant patents (economically) were “patents of *introduction*” of foreign advances until 1986 (Sáiz, 2014). Hence, trademark registrations may constitute a key indicator to track the evolution of such entrepreneurship—more linked to product innovation and commercial capabilities—and may help to explain why Spain had such success in trademarking throughout the nineteenth and, especially, twentieth centuries.

Patent systems usually include a significant number of non-resident applicants, especially in latecomer countries with limited scientific and technological competitive capabilities. That was the case in Spain from the late 1870s onward, when foreign patentees reigned over the patent process (Sáiz & Castro, 2017, Fig. 1). However, national trademark systems were and remain predominantly used by residents, as corresponds to a modality that protects the production and commercialization of goods and services in domestic markets.<sup>2</sup> Figure 2 shows that residents dominated the Spanish trademark system over the long term. Until the mid-1870s in Spain, there were few trademark registrations (an average of 15 trademarks per year), and all were from residents. This accords with a weak industrialization process in a still narrow and fragmented national market. In 1845, political stabilization led to the first modernizing effort (based on the initial organization of the railway and banking systems). This was interrupted by financial and economic crises in 1864 and subsequent socio-political problems. The Bourbon Restoration in 1874 created a second phase of growth, institutional

reorganization, and integration of the national market, which from the mid-1880s was reflected in almost all economic macro-variables and reinforced by Spain's neutrality in the Great War (Maluquer, 2002). As occurred with patents (Sáiz, 2002), total trademark applications increased from the 1880s to the Spanish Civil War (and the following autarchy of Francoist dictatorship, when shortages and rationing meant decreased sales of branded items). However, such trademark increases were from domestic applications, which is not the case with patents.

**Figure 2. Trademarks by applicant's place of residence, Spain (1850–2018)**



Source: Sáiz et al. (2019) and WIPO (2019)

The number of resident trademarks increased again during the 1960s, due to certain economic liberalization policies and significant industrial expansion, which was based on developing modern consumption patterns and strong internal mass markets. These structural changes led to rapid development of the services economy. Total resident trademark applications increased from 15,000 to 40,000 records per year from 1959 to 1973, after which the hard effects of the oil crisis in Spain—together with problems arising during the political transition toward democracy—caused a recession that lasted nearly until Spain's entry into the EU in 1986 (Rojo, 2002). The country's integration into the EU led it to modify its patent and trademark legislation according to European standards and requirements as well as because of its own increasing economic growth. This once again caused a shift in trademark records, which reached approximately 77,000 applications in 1989. Even during the 1990s, Spain maintained high rates of national trademark records, mainly from domestic applicants, because collective registrations through the EU Community Trademark (1994)—or the World Intellectual Property Organization (WIPO) international application since 2004—decreased non-resident applications, as generally occurred in other trademark systems (see Figure 1). Moreover, Spain was among the top five community trademark applicants between 2009 and 2012 (Mendonça, 2014).

### 2.2 Trademarks distribution across provinces

Countries, of course, are not homogeneous entities, and participation in their distinct regions and areas in national and global economies is certainly divergent. Moreover, trademarks and brands, as enduring intangible assets, may be based in path-dependency phenomena.

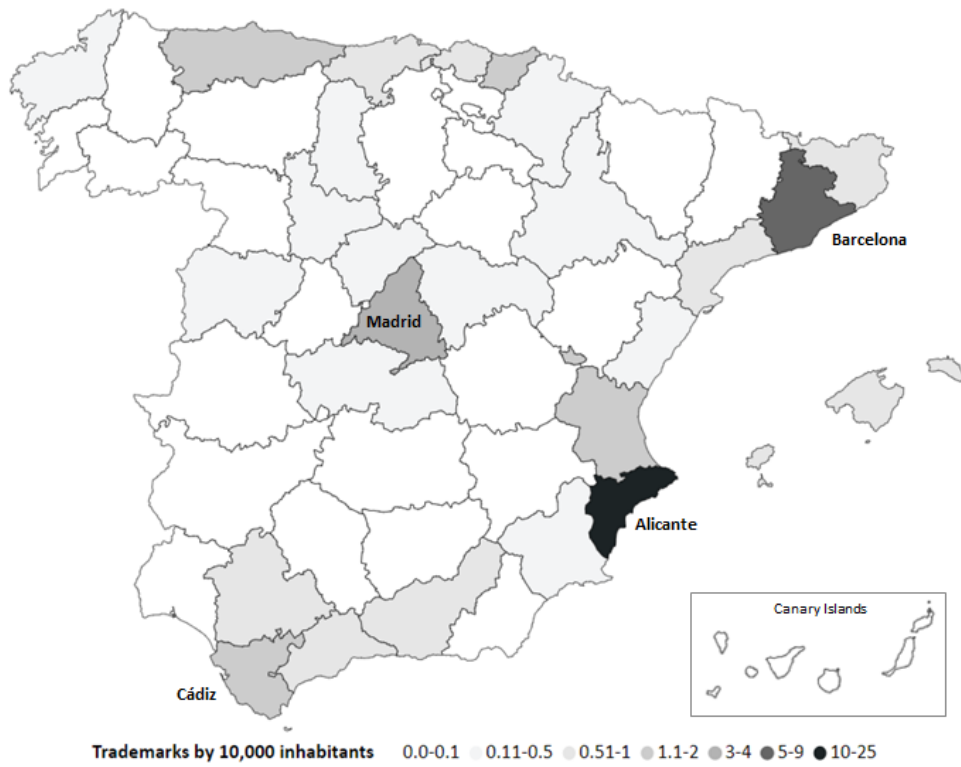
Therefore, regional trademarking must be carefully explored. We have therefore studied every trademark application registered in the Spanish Patent and Trademark Office from 1850 to 1920 (see Figures 1 and 2). That totaled approximately 47,000 historical files, which are mainly manuscripts. From this information, we constructed a robust relational database on each trademark (denomination, description, dates, articles protected, etc.) and on the applicant (name, juridical status, profession, place of residence, etc.). Additionally, we geocoded the locations from which trademarks were applied for by using both Google Maps' application programming interface<sup>3</sup> and the GeoNames geographical database.<sup>4</sup> We then classified the articles protected by each trademark according to the Nice International Classification of Goods and Services (hereafter Nice), as edited by WIPO.<sup>5</sup> The trademark database and geolocation tools are currently available online.<sup>6</sup>

From those sources, we created a dataset for the period under study, with every trademark applied for by residents in each of the 50 Spanish provinces (NUTS-3) and classified by economic sectors. Trademarks may designate several goods or services, which can be in one or more Nice classes. In constructing the dataset, we counted trademarks for protected products. That means that a trademark can be allocated in more than one Nice class. In fact, there are 50,439 designations of goods and services in distinct Nice classes that come from 38,767 resident trademark applications between 1850 and 1920. Our sectoral distribution aggregates Nice classes as follows: Chemical (1–5, 17); Textiles (18, 22–27); Beverage (32, 33); Food (29, 30); Machinery and equipment (7–11); Tobacco (34); Paper and graphic arts (16); Services, including household goods, games, toys, and musical instruments (15, 20, 21, 28, 35, 36, 39–45); Basic metals and mining (6, 14); Agriculture and cattle farming (31); Transports and communications (12, 38); Construction, including lumber, (19, 37); and Arms industry (13).

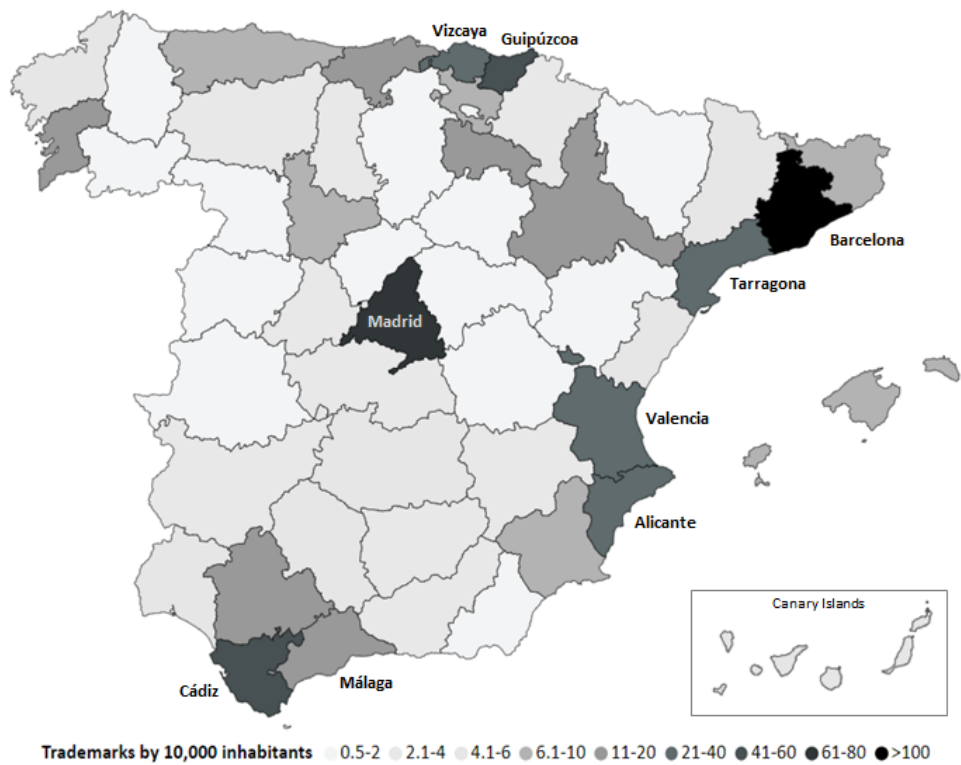
Figure 3 shows basic data of domestic trademarking in Spain from 1850 to 1920 at a provincial level (NUTS-3). We divided the period of analysis into two sub-periods of 34 years each (November 1850 to 1885 and 1886 to 1920). The first sub-period corresponds to the initial but slow industrialization process in Spain and to the pioneering organization of the trademark system, characterized by a low number and low growth rates of applications. The second sub-period coincides with capital consolidation and concentrated trademark registrations with higher growth rates. In general, trademark distribution reflects high regional concentration. Along with Madrid, Spain's political and financial center, the areas with significant trademarks per capita over the national average before 1885 were Alicante, in Valencian Community; Barcelona, in Catalonia; and Cádiz, in Andalusia (followed, under the average, by Valencia, Asturias, and Guipúzcoa). From 1886 to 1920, several bordering provinces in the Mediterranean coast, such as Valencia, Tarragona, and Málaga—together with Guipúzcoa and Vizcaya in the north—joined those initial leaders in doing better than the national average (more than 20 trademarks per 10,000 inhabitants [t/i]). It makes sense to note other provinces such as Sevilla, Cantabria, La Rioja, Pontevedra, and Zaragoza because they substantially increased trademarking from the first to the second sub-period, although they remained under the national average (11 to 19 t/i), as also happened in Baleares, Gerona, Álava, Murcia, Valladolid, and Asturias (6 to 10 t/i). Several locations already had a long tradition of producing food, beverages, canned goods, and other consumer products, and all locations increased their manufacturing output during the period under study.

**Figure 3. Cumulated trademark applications per average population in each province, Spain (1850–1885 and 1886–1920)**

**1850-1885**



**1886-1920**



Source: Trademarks: Sáiz et al. (2019); population: Goerlich et al. (2015).



Figure 4 shows the sectoral distribution of goods and services designated by trademark application in Spain between 1850 and 1920. As expected, trademarks protected widely demanded consumer goods during this period, with more than 75% of total applications related to chemical products (such as pharmaceuticals, cosmetics, soaps, perfumery, paints, varnishes, matches), textiles, food, beverage, tobacco, and paper. There was a lower percentage of applications for untransformed agricultural products and for basic services, including, for example, the commercialization of household goods, furniture, musical instruments, and games. An unexpected finding was the predominance of chemical products and textiles over food and beverage, which had been the classic sectors in early market integration and trademarking expansion in other countries (Duguid et al., 2010). The data interestingly demonstrate that there was also trademark activity in other sectors not usually linked to trademarking emergence, such as machinery and equipment (including intermediate goods), metallurgic products, and, with minor percentages, industrial chemical products (Nice classes 1 and 4), transports, construction materials, and armaments.

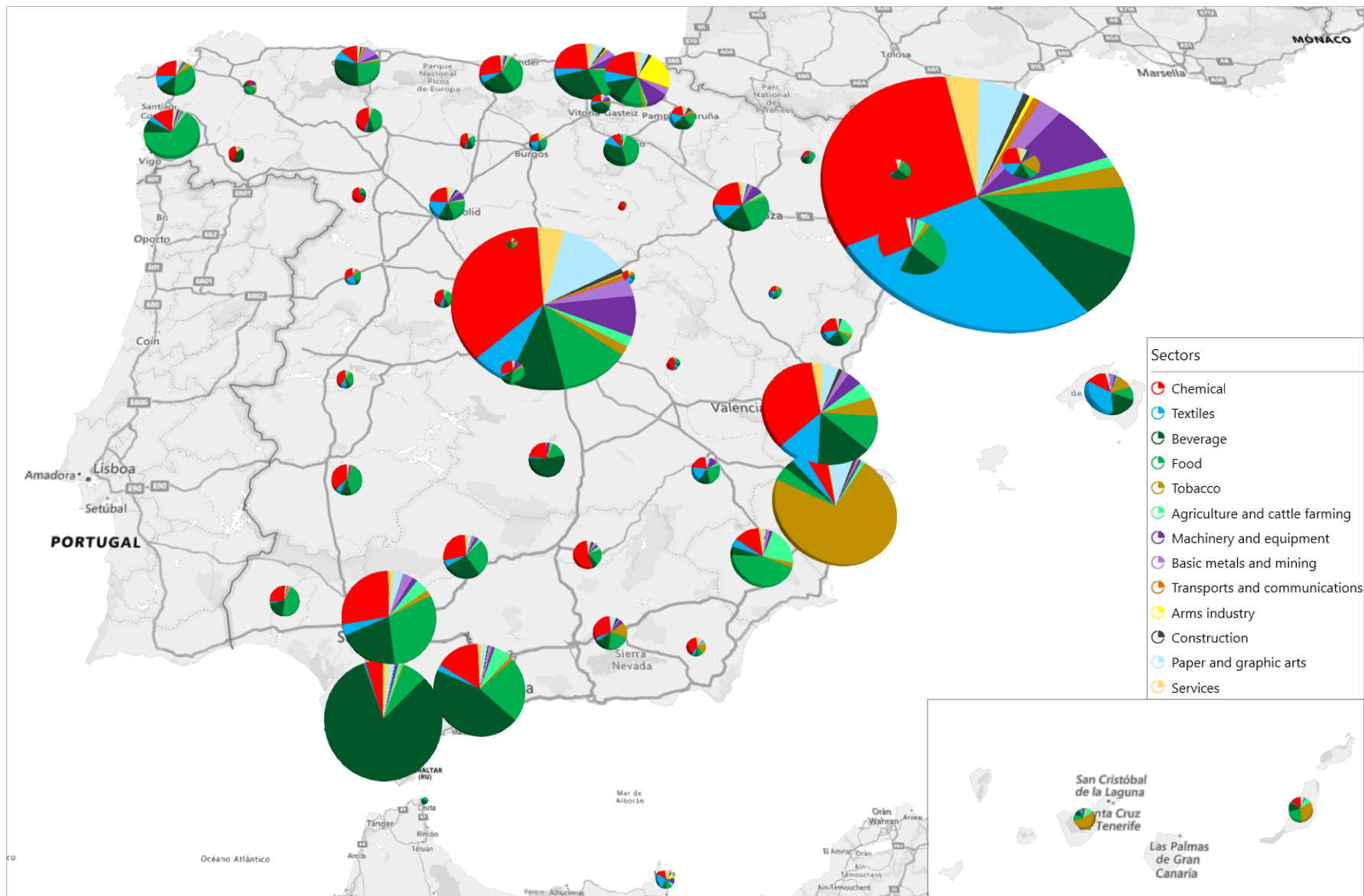
Figure 4 also shows noteworthy regional differences. Consumer chemical trademarks proliferated in almost all regions (more than 25% of registrations across 30 provinces). This was true even in those regions with little other trademark activity, as such as in Castile and León (Soria, Zamora, León, Palencia, Ávila, and Salamanca), Castile–La Mancha (Guadalajara, Cuenca, and Toledo), Extremadura (Cáceres), and eastern Andalusia (Jaén, Almería, and Granada). Consumer chemical trademarks also stood out—with more than 30% of total trademarks—in big cities that had significant numbers of trademarks per capita, such as Madrid, Valencia, Lérida, Tarragona, and Barcelona. This last province, Barcelona, also had a meaningful percentage of trademarks in textiles (27%)—its main industrial production during the period under study. The Balearic Islands had 31% of its trademarks related to textiles and shoe making. In Salamanca, Guadalajara, Teruel, Valladolid, Burgos, and Albacete, between 17% and 20% of trademarks were related to wool textiles. In the Basque Country, trademarks for machinery and equipment, metallurgical products, and armaments stood out—since this is where the main factory centers of these kinds of goods were concentrated. This is also true for Madrid and Barcelona for machinery and equipment, and for several provinces without much trademark activity, such as in Lugo, Toledo, and Albacete, for distinct kinds of intermediate goods. In Asturias, trademarks were prominent in metals and mining. In Eibar in Guipúzcoa, the preponderance of trademarks were linked to armaments, as it was a significant industrial center of firearms production at the European level (Goñi-Mendizabal, 2018). In Guadalajara, where the first Spanish multinational, La Hispano-Suiza, had a vehicle factory, 10% of trademarks (the highest percentage over all provinces) were related to transports (Nadal, 2020).

Alicante (especially in the town of Alcoy) held nearly all trademarks on tobacco-related goods (i.e., paper booklets), with almost 72% of registration in the province. Tobacco trademarks also appeared in the Canary Islands. As occurred with chemical products, food and beverage trademarks were spread across many regions, because, on the one hand, these were widely demanded goods, and, on the other hand, their production was geographically dispersed throughout the Spanish territory. For example, there were regional specializations in wine, flour, canned goods (vegetables, fish, etc.), and olive oil, among other food products (Nadal & Carreras, 1990). Food trademarks accounted for more than 20% of all marks in 28 provinces. In Pontevedra, Murcia, Huelva, Huesca, La Rioja, and Badajoz, over 30% of trademarks were for food products. Beverage marks accounted for more than 20% of all registrations in 15 provinces, and an even higher percentage in the main wine production areas (Ciudad Real, Málaga, La Rioja, and Álava), and especially in Cádiz, famous for the manufacturing and exporting of sherry. In the

provinces of Castellón and Murcia, more than 20% of trademarks were in agriculture. There were lower percentages of trademarks for basic services, household goods, furniture, and construction (3%-8%) throughout provinces with higher numbers of urban and/or middle-class inhabitants—including Barcelona, Madrid, Valencia, Basque Country, and several Castilian towns (such as Burgos, Segovia or Zamora). Madrid, Palencia, and Alicante also had significant numbers of trademarks in paper and graphic arts.

Figure 4 thus reveals two effects. First, between 1850 and 1920, there was a strong correlation between trademark activity and the main industrial areas of Spain. Catalonia, southern Andalusia, the Valencian Community, the Basque Country, Asturias, and Aragón (along with Madrid as the financial and transport center) held the concentration of modern industrial production and therefore the majority of trademarks. Traditionally, cotton, metals (especially iron and steel), and machinery and equipment were the leading sectors of the first industrialization processes in all European countries, including in Spain. Trademark data certainly highlight the main areas of those productions. Barcelona stood out in cotton textile production and related trademarking; in Asturias, Vizcaya, and Guipúzcoa, this was the case with metals, machinery and equipment, and arms. Barcelona, Madrid, and Zaragoza were also centers of machinery production at the beginning of the twentieth century, and consequently had a large share of related trademarking. Second, trademark activity mainly occurred in non-leading sectors that were related to basic consumption and human necessities, in which production was technologically less developed and regionally more dispersed. That is the reason behind the general spread of trademark activity in consumer chemical products, food, beverage, agricultural, and cattle productions (red and greens sectors in Figure 4) throughout nearly all the provinces. This is not surprising, because these widely demanded products were the primary drivers of market integration. Trademarks were, and remain, especially related to consumer products and in urban areas. Furthermore, even in non-leading sectors, trademark data depict the initial process of Spanish regional specialization: smoking paper (Alicante), sherry (Cádiz), sweet wines (Málaga), emergent red wine areas (e.g., La Rioja and Ciudad Real), cider (Asturias), canned seafood (Galician provinces, such as Pontevedra), horticultural products (Murcia), and citrus fruits (Valencia). In the next section, we propose a model to analyze how such regional specialization occurs and to test possible drivers of the trademark diffusion process.

Figure 4. Sectoral distribution of goods and services designated by trademark applications in each province, Spain (1850–1920)



Source: Sáiz et al. (2019).

### 3. Modeling the diffusion of trademarks as indication of national market integration

#### 3.1 Model and variables

This section implements an econometric model to capture whether the consolidation of nationwide consumption-oriented markets came together with a steady diffusion of trademarks across regions. We conjecture that the proliferation of trademarking activity reflects the growing maturity of markets, resulting from their national integration under the rule of law. As shown in the previous section (see Figure 3), the expansion of consumer markets seems geographically driven. Once a given area developed a relative trademark specialization and/or diversification, it appears that surrounding manufacturers adopted trademarking practices and developed their own brands. This process of mirroring trademark registration by local firms depended on the relative proximity to leading markets, implying that the closer the firms were to them, the more likely they developed their own trademark base. Conversely, the more peripheral a location, the less likely firms were exposed to or aware of the benefits that trademarking brought to nationally integrated markets. Moreover, for manufacturers operating in peripheral markets, the anticipated increase in revenues associated with a brand—capitalized as equity—may not overcome the sunk costs associated with creating and nurturing it (e.g., marketing costs, legal issues, advertising and public relations). Consequently, market accessibility through either railway or sea (i.e., cabotage shipping along coastal routes) is critical for trademark expansion and integration of consumption markets based on branding.

Our research question is: How does relative proximity to locations with leading trademark specialization and diversification, along with transport accessibility, affect the diffusion of trademarks? To answer this, we follow the literature modeling the geographical expansion of trade, patents, and industries (Bahar et al., 2014; Boschma et al., 2017; Jaffe et al., 1993). We first consider a set of  $p = 1, \dots, q, \dots, P$ , locations or areas (in our case, Spanish NUTS-3 provinces) whose trademarks are grouped into the  $s = 1, \dots, S$  sectors or industries presented in Figure 4. Then, we analyze whether a province transitions from reduced trademarking activity during the first (base) period (1850–1885) to some degree of specialization in the second (comparison) period (1886–1920) through the following model:

$$N_{p,s}^1 = f\left(RTMSexp_{pq,s}^0, RTMS_{p,s}^0, RTMDexp_{pq}^0, RTMD_p^0, Railway_p^0, Coast_p\right). \quad (1)$$

Here, the dependent variable  $N_{p,s}^1$  is a binary variable that takes the value of one if province  $p$  shows a *relative trademark specialization* ( $RTMS$ ) in sector  $s$  at the comparison period  $t = 1$ , and zero otherwise. As anticipated, whether a location adopts trademark registration depends on: (1) how it is *exposed* to the relative trademark specialization of the remaining  $q$  provinces in the country in the base period,  $t = 0$ , excluding itself, which we denote by  $RTMSexp_{pq,s}^0$ ; (2) its own specialization in the sector of interest,  $RTMS_{p,s}^0$ ; (3) the exposure to the overall *relative trademark diversification* across sectors in the remaining provinces,  $RTMDexp_{pq}^0$  (proxy of the overall presence of trademark registration across markets); (4) its *own* trademark diversification,  $RTMD_p^0$ ; (5) key transport infrastructure in the form of privileged accessibility in the base period by being connected to the national *railway* network; and (6) the existence of a locational advantage by being situated at the coast,  $Coast_p$ . We next explain how each of these variables is defined by presenting a descriptive analysis of the dependent variable capturing the observed specializations by province and sector,  $N_{p,s}^1$ , and we introduce the econometric specification for our regression analysis.

Whether a province transitions from a given level of relative trademark specialization in the base period,  $t = 0$ ,  $RTMS_{p,s}^0$ , to a higher level in the comparison period,  $t = 1$ ,  $RTMS_{p,s}^1$ , depends on the definition of relative trademark specialization as well as the values of the initial and final thresholds that are chosen. Here we define the corresponding indicator as in the previously referenced literature:

$$RTMS_{p,s}^t = \frac{TM_{p,s}^t / \sum_{s=1}^S TM_{p,s}^t}{\sum_{p=1}^P TM_{p,s}^t / \sum_{p=1}^P \sum_{s=1}^S TM_{p,s}^t}, \quad p=1, \dots, P, \quad s=1, \dots, S, \quad t=0, 1. \quad (2)$$

This equation shows the relative trademark specialization indicator of province  $p$  in sector  $s$  at time  $t$ , defined as the share of registered trademarks in that location and industry,  $TM_{p,s}^t$ , in the total number of registered trademarks in that province,  $\sum_{s=1}^S TM_{p,s}^t$ , divided by the share of registered trademarks in that sector at national level,  $\sum_{p=1}^P TM_{p,s}^t$ , in the total number of trademarks in the country,  $\sum_{p=1}^P \sum_{s=1}^S TM_{p,s}^t$ . If  $RTMS_{p,s}^t > 1$ , then province  $p$  is specialized in sector  $s$  because its share in the total number of trademarks in the province is greater than its corresponding share at the national level. Alternatively, if  $RTMS_{p,s}^t < 1$ , the province does not exhibit specialization. If  $RTMS_{p,s}^t = 1$ , then both provincial and national shares are equal. Finally,  $RTMS_{p,s}^t = 0$  means province  $p$  does not have any registered trademarks in sector  $s$ .

The binary dependent variable,  $N_{p,s}^1$ , takes a unitary value if province  $p$  increased its relative trademark specialization from the first to the second sub-period (that is from 1850–1885 to 1886–1920). This requires upper and lower thresholds in each sub-period for  $RTMS_{p,s}^t$ ,  $t = 0, 1$ . Several thresholds have been proposed in the literature studying the diffusion of specialization in trade or industrial production (see, e.g., Bahar et al., 2014; Boschma et al., 2017). If we had followed these authors, the locations starting from a value below 0.5 in the base period would not present a relative trademark specialization if they had a share below the average observed for the entire economy in the comparison period. However, if they presented a higher share than the average,  $RTMS_{p,s}^1 > 1$ , it is assumed that they would reach a specialized position.

Therefore, rather than relying on specific numerical thresholds, we consider the *distributions* of the relative trademark specialization in both sub-periods. The reason is that, as shown in Figures 3 and 4, trademarks were historically concentrated in a few provinces and, therefore, only a few exhibit  $RTMS_{p,s}^1 > 1$ . Thus, adopting this value as the upper threshold severely restricts the number of transitioning observations and does not provide a realistic picture of the diffusion of trademarks in Spain. Likewise, such concentration implies that in the base period (1850–1885), a large proportion of observations (around 90%) show a value of  $RTMS_{p,s}^0$  below 0.5. As a result, given the historical distribution of trademarks in Spain, we consider that a province developed a reasonable degree of trademark presence if it evolved from a relative trademark specialization below the first quartile of the distribution in the base period (corresponding to the 25th percentile of  $RTMS_{p,s}^0$ ) to a value greater in the third quartile in the comparison period (the 75th percentile of  $RTMS_{p,s}^1$ ). These thresholds are strict enough to ensure that a relevant degree of specialization is reached from the base period to the comparison period when calculating the dependent variable.

Table 1 presents the observed specializations by province and sector,  $N_{p,s}^1$ . Under the above criteria, 60 transitions are obtained. These represent 10.7% of all 563 observations that may change

status because their starting value of relative trademark specialization in the base period,  $RTMS_{p,s}^0$ , falls below the lower threshold corresponding to the first quartile of the distribution (in this case, zero for all sectors). The average number of sectoral specializations for all provinces stands at 1.28. For comparison purposes, the four provinces with the highest rate of trademark registration per capita in the base period (see Figure 3, first map) are shadowed in gray in Table 1. They are Alicante, Barcelona, Cádiz, and Madrid (with three, three, one, and two sectoral transitions, respectively). Six other regions specialized in four or more sectors: two provinces in Andalusia (Málaga and Sevilla), two in the Basque Country (Guipúzcoa and Vizcaya), and in the provinces of Pontevedra and Zaragoza. This result is in accordance with both the high numbers of trademarks per capita in those regions and their industrial capacities, as discussed in section 2.2 and mapped in Figures 3 and 4. The results of our econometric model corroborate that provinces that specialized in particular sectors had a situational advantage in terms of their exposure to relative trademark specialization of neighboring regions at the sectoral level (for instance, those identified in gray in Table 1; specific definitions of the variables are below). They also enjoyed good overall transport infrastructure by railway and roads and/or a coastal location.

Concerning the sectors where provincial trademark specialization was spread out, Table 1 offers complementary evidence to Figure 4. For instance, the high concentration of tobacco-related industries and trademarks (e.g., smoking paper in Alicante) hampered new specialization in this sector. Likewise, there were very few transitions to specialization in textiles (the “Barcelona effect”), chemical goods, food, or beverage. Notwithstanding, Table 1 confirms the previously known emergence of new specializations in Asturias (cider production), Ciudad Real (red wine), and Pontevedra (canned seafood). There were also expected specializations in machinery and equipment (six provinces), metals (six provinces), and arms (five provinces). The latter include Guipúzcoa and Vizcaya, which were at the heart of Spanish heavy industry; Zaragoza, which had an increase in machinery factories; and Málaga, where the first iron industries and blast furnaces were established in mid-nineteenth century. Other sectors with provincial specialization show lower trademark activity, but recall that the likelihood of transition is defined in relative terms and is independent of the absolute number of trademarks. These sectors include agriculture and cattle farming; the nine provinces that specialized in related goods reflect how trademarks were linked to basic agrarian advantages (e.g., citrus fruits and rice production in Valencia; horticultural products, including sweet peppers and saffron, in Murcia; almonds and other nuts in Alicante; dry figs and raisins in Málaga; olives in Sevilla). More interesting is trademark specialization in the varied transport industry (in ten provinces), linked to the production of different kinds of vehicles, from trucks to aircraft parts by the aforementioned La Hispano-Suiza in Guadalajara; motorbikes in La Coruña; bicycles in Guipúzcoa (a region with well-known bicycle-related trademarks during the entire twentieth century); ship material in Pontevedra; and miscellaneous vehicle trademarks in Barcelona, Madrid, Valencia, and Vizcaya (Bilbao). These were all industrial provinces with big towns and were key transport hubs in both sub-periods under study. Likewise, and for similar reasons, the emergence of specialized trademarks in the construction sector took place in concentrated population centers (e.g., Barcelona, Madrid, Valencia, Alicante, Vizcaya, and Guipúzcoa), with trademarks proliferating on cement and all kinds of construction materials (tiles, bricks, etc.). Finally, specialization in services (in eight provinces) show how certain urban areas developed trademarks related to household goods, furniture, musical instruments, and games.

**Table 1. Specializations by province and sector from 1850–1885 (base period) to 1886–1920 (comparison period),  $N_{p,s}^1$**

Provinces	Emerging specializations	Sectors												
		Chemical	Textiles	Beverage	Food	Tobacco	Agriculture and cattle farming	Machinery and equipment	Basic metals and mining	Transports and communications	Arms industry	Construction	Paper and graphic arts	Services
Álava	0													
Albacete	1							•						
Alicante	3						•	•				•		
Almería	0													
Asturias	2			•						•				
Ávila	0													
Badajoz	0													
Barcelona	3						•			•		•		
Burgos	0													
Cáceres	0													
Cádiz	1						•							
Cantabria	0													
Castellón	0													
Ciudad Real	1			•										
Córdoba	0													
Cuenca	0													
Gerona	1													•
Granada	0													
Guadalajara	2									•	•			
Guipúzcoa	6							•	•	•	•	•		•
Huelva	0													
Huesca	0													
Jaén	0													
La Coruña	3		•							•			•	

Provinces	Emerging specializations	Chemical	Textiles	Beverage	Food	Tobacco	Agriculture and cattle farming	Machinery and equipment	Basic metals and mining	Transports and communications	Arms industry	Construction	Paper and graphic arts	Services
La Rioja	0													
León	0													
Lérida	0													
Lugo	0													
Madrid	2									•		•		
Málaga	5	•					•		•		•	•		
Navarra	0													
Orense	0													
Palencia	0													
Pontevedra	4				•				•	•		•		
Murcia	3						•			•	•			
Salamanca	0													
Segovia	0													
Sevilla	5			•			•	•					•	•
Soria	0													
Tarragona	2						•		•					
Teruel	0													
Toledo	0													
Valencia	4						•			•		•		•
Valladolid	1							•						
Vizcaya	7		•				•		•	•	•	•		•
Zamora	0													
Zaragoza	4							•	•				•	•
<b>Number of transitions</b>	<b>60</b>	<b>1</b>	<b>2</b>	<b>3</b>	<b>1</b>	<b>0</b>	<b>9</b>	<b>6</b>	<b>6</b>	<b>10</b>	<b>5</b>	<b>8</b>	<b>3</b>	<b>6</b>

Note: Specialization thresholds for relative trademark specialization. Lower threshold: 25th percentile of  $RTMS_{p,s}^0$  (< 1st quartile); upper threshold: 75th percentile of  $RTMS_{p,s}^1$  (> 3rd quartile).

Source: Authors' tabulations based on Sáiz et al. (2019)



As we discuss in the Results section, although the specialization values reported in Table 1 are sensitive to changes in the upper threshold of the relative trademark specialization in the comparison period,  $RTMS_{p,s}^1$ , we take these values as the benchmarks for our baseline model. Nevertheless, in the following section we note the alternative regressions we ran for different upper thresholds. Our econometric results and general conclusions are robust to these variations.

We now describe the calculation of the exposure of province  $p$  to the relative trademark specialization of other provinces,  $RTMS\ exp_{pq,s}^0$ . Since exposure to the relative trademark specialization of other locations depends on the accessibility of province  $p$  to each of the remaining provinces, we account for the generalized transport cost between  $p$  and each of the  $q$  remaining areas,  $GTC_{pq}^0$ . The underlying assumption is that the farther away a location is, the weaker the effect or exposure to its relative trademark specialization. This suggests the possibility of defining an exposure indicator in which the effects of trademark specialization in other locations is weighted by transportation costs. In our approach, the process of diffusion takes place through geographical accessibility. A relevant factor in the openness of consumer markets to varieties of different products (that is, trademarks) is the existence of mature markets in neighboring provinces. Modeling the influence of other locations through a gravity-based trademark exposure indicator differs from the usual approach in the literature, which only considers the effect of nearby locations (e.g., Boschma et al., 2017). However, the use of a simple contiguity matrix based on binary values (valued one if the locations share borders, and zero otherwise) can neither capture the overall regional distribution of trademarks nor the role played by the transportation network. Indeed, markets may have developed in regions whose determinants favor such specialization (e.g., factor endowments, knowledge clusters, etc.), and therefore trademarks may be located in non-adjacent regions. For this reason, it is more appropriate to capture proximity in terms of bilateral transport costs.

To calculate the  $GTC_{pq}^0$ , we computed the least expensive itinerary, normally corresponding to the shortest travel time by ground transportation, among the capital cities of the 47 Spanish provinces located in the Iberian Peninsula.<sup>7</sup> We used detailed maps of the railway and ordinary road networks as they existed in 1867 (Figures 5 and 6).<sup>8</sup> Our methodology calculates the optimal itinerary that minimized the transportation costs between two locations (see Zofío et al., 2014); in general, this implies the use of the railway network. However, several provinces lacked this infrastructure in the base period, so both passenger and freight shipping required road transportation to complete trips. For rail travel, we analyze railway distances and travel times between Madrid and the capitals of each connected province in 1867 (Cabanes & González, 2009). We construct the 47x47 travel-time matrix for all the provinces from contemporaneous sources, including a map that gives distances for railway lines in kilometers (Figure 5). We estimate the best routes for each pair of province capitals: several itineraries were calculated through Madrid (north to south, east to west) as the center of the radial railway system, but most routes were estimated using shorter sections through key network hubs crossed by extant lines or railway companies. By knowing the distances and travel times between Madrid and the capitals of each railway-connected province, we can calculate the hours per kilometer of major rail sections (between Madrid and each province capital) and then determine the travel time corresponding to shorter sections in each route. Linking two or more of these shorter rail sections through cross hubs made it possible to reach neighboring provinces to the north, the south, and so on (without passing through Madrid). When a province capital was not linked to the railway network, we calculate distances by ordinary roads from the most accessible railway stations of neighboring lines (Figure 6). We estimate travel time for such road legs by applying a “penalty”; that is, we multiply the average hours per kilometer of the neighboring railway line by 2.5. This specific multiplier is based on existing estimates of the overall reduction in travel time via railways over ordinary roads, which has been calculated at 60% ( $2.5=1/[1-0.6]$ ); Cabanes & González, (2009, p. 12). In several cases, we

compare our travel time results with contemporaneous sources (*Guía oficial*, 1866) that provided road time tables for certain locations, such as Villalba to Segovia and Vimbodi to Tarragona. Our times are robust. Finally, to obtain the GTC in economic values, we calculate the average railway freight cost in *pesetas* per ton/kilometer at the time (Gómez & San Román, 2005, Fig. 7.3) to determine *pesetas* per ton/hour for each itinerary, thereby completing the bilateral matrix of GTCs.

Based on the foregoing, our indicator of exposure to relative trademark specialization,  $RTMSexp_{pq,s}^0$ , presents the structure of market potential measures commonly used in economic geography studies. These indicators represent a gravity-based measure similar to those used by Condeço-Melhorado et al. (2017), and Maroto and Zofío (2016). In our model, the level of exposure of province  $p$  to the trademark activity of province  $q$  in sector  $s$  is directly related to the relative trademark specialization of  $q$ ,  $RTMS_{q,s}^t$ , and inversely related to the transportation costs between the two locations,  $GTC_{pq}^0$ . Consequently, the overall exposure to the relative trademark specialization of all other provinces, divided by their corresponding transportation costs, results in the following indicator:

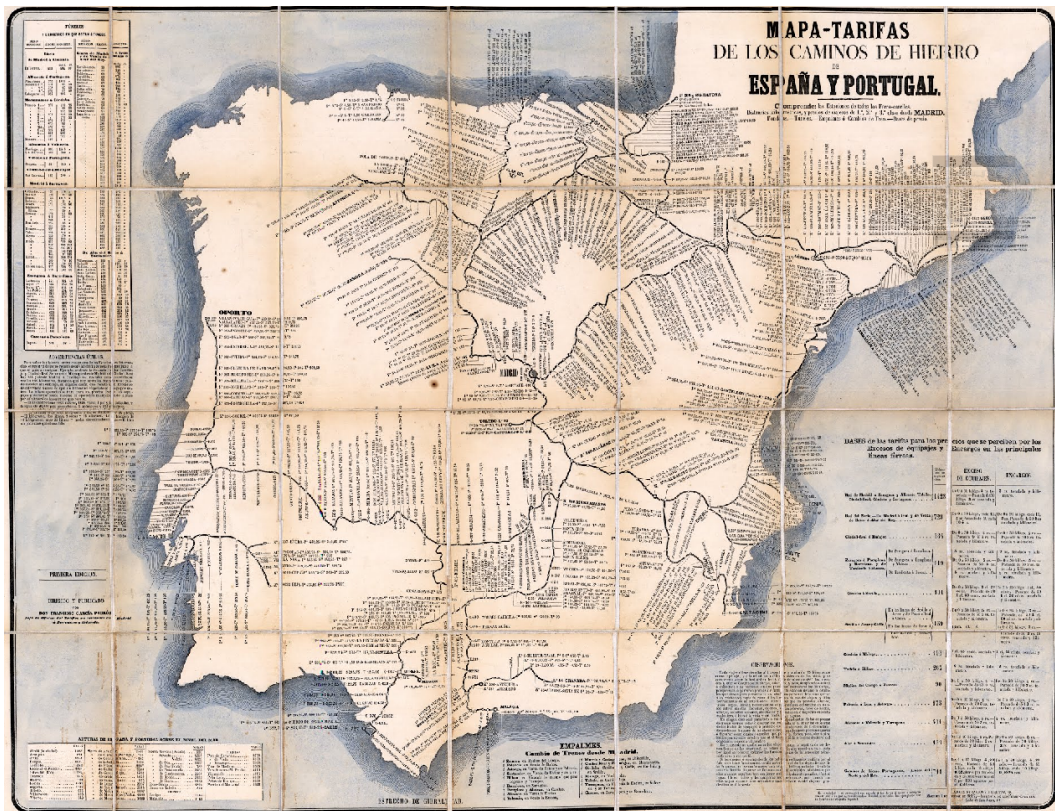
$$RTMSexp_{pq,s}^0 = \sum_{q=1}^{p-1} \frac{RTMS_{q,s}^0}{GTC_{pq}^0}, \quad q=1, \dots, P-1, \quad s=1, \dots, S \quad (3)$$

Given the degree of relative trademark specialization across provinces, the further away (that is, the less accessible or peripheral) province  $p$  is from other provinces in terms of GTCs, the smaller the value of  $RTMSexp_{pq,s}^0$ . Conversely, the closer (more accessible or central) province  $p$  is to the remaining provinces in terms of GTCs, the greater the value of the indicator.

In the model presented in equation (1), we consider that the likelihood of a province transitioning to markets characterized by the presence of trademarks also depends on whether the surrounding provinces, and the province itself, were making general use of trademarks across different sectors. The relative trademark diversification indicator complements the information provided by its specialization counterpart in equation (2) by capturing the trademark “culture” and the institutional settings necessary to implement and enforce it. We define the following (min-max normalized) indicator of relative trademark diversification:

$$RTMD_p^0 = \frac{1}{S} \sum_{s=1}^S \frac{RTMS_{p,s}^0 - \min(RTMS_{p,s}^0)}{\max(RTMS_{p,s}^0) - \min(RTMS_{p,s}^0)}, \quad p=1, \dots, P, \quad s=1, \dots, S. \quad (4)$$

Figure 5. Railway network, Spain, 1867



Source: García Padrós (1867).

Figure 6. Ordinary road network, 1st, 2nd, and 3rd class, Spain, 1876



Source: Ministerio de Fomento (1876).

The relative trademark diversification indicator of province  $p$  is defined as the arithmetic average of the difference between its relative trademark specialization and the observed minimum for each sector, normalized by the range defined by the maximum and minimum observed values:  $\max(RTMS_{p,s}^0) - \min(RTMS_{p,s}^0)$ . The higher the value of  $RTMD_p^0$ , the more trademarks are diversified in that province. If  $RTMD_p^0 = 1$ , then province  $p$  presents the highest relative trademark diversification in the country across all sectors; if  $RTMD_p^0 = 0$ , the province presents the lowest observed values across all sectors. To weigh the intensity of the exposure by how accessible provinces are in terms of their bilateral generalized transport costs, we mirror the structure of equation (3) (which measures the exposure to relative trademark specialization). This results in the following indicator:

$$RTMDexp_{pq,s}^0 = \sum_{q=1}^{P-1} \frac{RTMD_q^0}{GTC_{pq}^0}, \quad q=1, \dots, P-1, \quad s=1, \dots, S. \quad (5)$$

$RTMDexp_{pq,s}^0$  measures the relative exposure of a province to the trademark diversification of all  $P-1$  provinces in a country, weighted by their bilateral transportation costs. The higher the value of the indicator, the greater the exposure to the general presence of trademarks across a wide range of sectors.

We conclude our discussion of the variables in our model by referring to the key variables of transport infrastructure and locational advantages that allowed for a province's increased market accessibility and trademark specialization and diversification. This is captured by the presence of a connection to the railway network of the country,  $Railway_p^0$ , and the possibility of resorting to sea shipping,  $Coast_p$  (by either being located on the coast or enjoying a seaworthy inland waterway; for instance, Sevilla). The least cost optimal itinerary between two coastal locations may correspond to sea shipping, so in our model we control for the effects with dummy variables. Table 2 presents the descriptive statistics of the variables included in the model for the 611 observations of our dataset (i.e., 47 provinces times 13 sectors).<sup>9</sup>

**Table 2. Descriptive statistics of the variables**

Variable*	Mean	St. Dev.	Min.	Max.
$N_{p,s}^1$	0.098	0.298	0.000	1.000
$RTMS_{p,s}^0$	6.482	96.872	0.000	2,339.000
$RTMSexp_{pq,s}^0$	6.344	15.842	0.000	166.456
$RTMD_p^0$	0.045	0.021	0.014	0.0126
$RTMDexp_{pq}^0$	0.044	0.101	0.000	0.489

Notes:

\*Variables:  $N_{p,s}^1$ : binary variable adopting a value of 1 if sector  $s$  in province  $p$  transitions from a value of  $RTMS_{p,s}^0 < 25$ th perc. of  $RTMS_s^0$  in the base period, to a value of  $RTMS_{p,s}^1 > 75$ th perc. of  $RTMS_s^1$  in the comparison period;  $RTMS_{p,s}^0$ : relative trademark specialization in the base period;  $RTMSexp_{pq,s}^0$ : relative trademark specialization exposure in the base period;  $RTMD_p^0$ : relative trademark diversification in the base period;  $RTMDexp_{pq}^0$ : relative trademark diversification exposure in the base period;  $Railway_p^0$ : railway connection in the base period;  $Coast_p$ : coastal location.

Source: Authors' calculations.

### 3.2 Econometric specification and estimation

The econometric specification of model (1) relies on the following regression equation:

$$N_{p,s}^1 = \alpha + \beta_1 \ln(RTMS \exp_{q,s}^0) + \beta_2 \ln(RTMS \exp_{q,s}^0) \times \ln(RTMS_{p,s}^0) + \beta_3 \ln(RTMD \exp_{q,s}^0) + \beta_4 \ln(RTMD \exp_{q,s}^0) \times \ln(RTMD_p^0) + Railway_p^0 + Coast_p^0 + \mu_s + \varepsilon_{p,s}, \quad (6)$$

where, as extensively discussed in the previous section (see Table 1),  $N_{p,s}^1$  takes a unitary value if province  $p$  increased its relative trademark specialization in sector  $s$  from the base to the comparison period (i.e., from 1850–1885 to 1886–1920). The variables of interest capturing the effects of the exposure to relative trademark specialization and diversification are  $\ln(RTMS \exp_{q,s}^0)$  and  $\ln(RTMD \exp_{q,s}^0)$ . We expect a positive sign for the parameter  $\beta_1$  associated with exposure to specialization, implying that the closer a province is to other locations with large specialization values, the more prone it is to develop a relevant trademark presence. Conversely, we do not anticipate the sign of  $\beta_3$ , associated with exposure to diversification. The reason is that being closer to neighboring regions with trademarks across diverse sectors could facilitate the process of trademark diffusion, but it could also hamper it as a result of competition preventing the emergence of local brands. In the econometric specification, each variable measuring exposure to relative specialization and diversification interacts with the indicator corresponding to the province itself:  $\ln(RTMS_{p,s}^0)$  and  $\ln(RTMD_p^0)$ . This allows us to capture whether a province's level of specialization and diversification contributed to the probability of developing trademarks. Therefore, the signs of the parameters  $\beta_2$  and  $\beta_4$ , once related to those of the parameters  $\beta_1$  and  $\beta_3$ , indicate the direction of these effects. Finally, the dummy variables  $Railway_p^0$  and  $Coast_p^0$  capture the particularities of a given province with respect to its geographical accessibility in terms of railway networks and seafaring.

Following previous literature, we estimate regression (6) by relying on the linear probability model (LPM), including sector specific dummies,  $\mu_s$ , and corresponding province specific random error term,  $\varepsilon_{p,s}$ . We count on the simplicity of the LPM model to capture the effects of the variables of interest, thanks to its straightforward interpretability and despite its known—but solvable—shortcomings. This is true particularly because (1) the LPM is inherently heteroscedastic, since the variance of the error terms is correlated with the values of the independent variables, (2) the effect of the independent variables is constant, and (3) the predicted values may fall outside the range of probability values. To control for heteroscedasticity, we estimate the model with robust standard errors (clustered by province). Likewise, we enhance regression (6) to include non-linear effects by squaring the variables and capturing the exposure to relative trademark specialization and diversification, but these terms turn out to be not statistically significant. Finally, although we obtain negative fitted values, there is no single prediction error because all these values correspond to observations that do not specialize; therefore,  $N_{p,s}^1 = 0$ . As for predicted values above one, none were observed. Overall, we consider that the LPM allows us to answer our research question with confidence because it performed well in light of the above qualifications. After carrying out usual post-estimation checks, we consider that our results are reliable, making it unnecessary to use alternatives such as the probit or logit models, whose results are harder to interpret and which have their own drawbacks, for instance, the incidental parameters problem in the presence of fixed effects.

#### 4. Results and discussion

Table 3 reports in the second column the results for our baseline regression corresponding to equation (6). As expected, they show that being surrounded by provinces with high values of relative trademark specialization, weighted by their corresponding generalized transport costs,  $RTMSexp_{pq,s}^0$ , increases the probability of specializing. To determine the magnitude of this effect, we compare the value of the associated marginal effect with the unconditional probability of developing trademarks in a new sector, which is 10.7% in the regression sample. An increment in the (log) of  $RTMSexp_{pq,s}^0$  equal to 10% of its standard deviation increases the probability of specializing by approximately the same magnitude: 10.3% ( $= [0.207 \times 0.053 / 0.107] \times 100$ ). We observe that the value of province's trademark specialization,  $RTMS_{p,s}^0$ , is positively correlated with the probability of transitioning in the comparison period because the sign of the parameter corresponding to its interaction with  $RTMSexp_{pq,s}^0$  remains positive. These results confirm that the historical expansion and consolidation of mature markets characterized by trademark registration was driven by the degree of specialization of neighboring locations, weighted by the geographical proximity. This ultimately demonstrates that proximity to sectoral specializations and costs of transportation played key roles in diffusing knowledge spillovers related to the benefits of trademark registration. This diffusion was necessary to promote and protect brands as markets integrated nationally.

**Table 3. Diffusion of trademarking in Spain (1850–1920)**

Explanatory Variable <sup>4</sup>	Baseline Model: <sup>1</sup> L.T.: 25%, U.T.: 75%		Lax Model: <sup>2</sup> L.T.: 25%, U.T.: 50%		Stringent Model: <sup>3</sup> L.T.: 25%, U.T.: 90%	
	Coefficient	t-value	Coefficient	t-value	Coefficient	t-value
$RTMSexp_{pq,s}^0$	<b>0.165**</b> (0.062)	<b>2.66</b>	0.308*** (0.074)	4.16	0.062* (0.034)	1.81
$RTMSexp_{q,s}^0 \times RTMS_{p,s}^0$	<b>0.010***</b> (0.002)	<b>4.26</b>	0.023*** (0.003)	7.39	0.002*** (0.001)	2.40
$RTMDexp_{pq}^0$	<b>-0.174**</b> (0.084)	<b>-2.08</b>	-0.326*** (0.111)	-3.26	-0.073 (0.053)	-1.38
$RTMDexp_{q,s}^0 \times RTMD_{p,s}^0$	<b>-0.006***</b> (0.001)	<b>-4.97</b>	-0.006*** (0.003)	-2.04	-0.002*** (0.001)	-2.08
$Railway_p^0$	<b>0.122**</b> (0.053)	<b>2.29</b>	0.312*** (0.092)	3.40	0.045* (0.026)	1.74
$Coast_p$	<b>0.094*</b> (0.056)	<b>1.69</b>	0.136*** (0.092)	2.05	0.015 (0.035)	0.43
Observations:	<b>563</b>		563		563	
R-squared:	<b>0.208</b>		0.278		0.168	

Notes:

L.T. is lower threshold; U.T. is upper threshold. <sup>1</sup> Baseline Model: the dependent variable  $N_{p,s}^1$  adopts a value of 1 if sector  $s$  in province  $p$  transitions from a value of  $RTMS_{p,s}^0 < 25$ th perc. of  $RTMS_s^0$  in the base period (L.T.) to a value of  $RTMS_{p,s}^1 > 75$ th perc. of  $RTMS_s^1$  in the comparison period (U.T.). <sup>2</sup> Lax model:  $< 25$ th perc. of  $RTMS_s^0$  and  $RTMS_{p,s}^1 > 50$ th perc. of  $RTMS_s^1$ . <sup>3</sup> Stringent Model:  $RTMS_{p,s}^0 < 25$ th perc. of  $RTMS_s^0$  and  $RTMS_{p,s}^1 > 90$ th perc. of  $RTMS_s^1$ . <sup>4</sup> Variables:  $RTMS^0$ : relative trademark specialization in the base period;  $RTMSexp_{pq,s}^0$ : relative trademark specialization exposure in the base period;  $RTMD_{pq}^0$ : relative trademark diversification in the base period;  $RTMDexp_{pq}^0$ : relative trademark diversification exposure in the base period;  $Railway_p^0$ : railway connection in the base period;  $Coast_p$ : coastal location.

Robust standard errors are in parentheses. \*\*\*  $p$ -value  $< 0.01$ , \*\*  $p$ -value  $< 0.05$ ; \*  $p$ -value  $< 0.1$ .

Source: Authors' calculations.

As to the effect of being exposed to provinces with relatively large trademark diversification,  $RTMDexp_{pq}^0$ , the negative sign of the associated parameter informs us that competition effects dominated and, therefore, the larger the exposure to nearby regions exhibiting mature markets hampered the emergence of local trademarks. Consequently, this “black-hole” effect agglomerating trademarks in a few locations counterbalances the previous effect related to the exposure to relative trademark specialization. It is then relevant to determine which one predominated by looking at their relative magnitudes. In this case, the same increment of the (log) of  $RTMDexp_{pq}^0$  by 10% of its standard deviation *reduces* the probability of specialization by -5.8% ( $= -0.046 \times 0.134 / 0.107$ ). Hence, we conclude that the net effect is positive since the magnitude of the effect associated with the exposure to trademark specialization is double that of diversification. As for the effect of the initial value of  $RTMD_p^0$ , it is positive given the sign of the interaction with  $RTMDexp_{pq}^0$  remains negative. This indicates that the more diversified a province was in the base period, the more likely it transitioned to a specialized position in the comparison period.

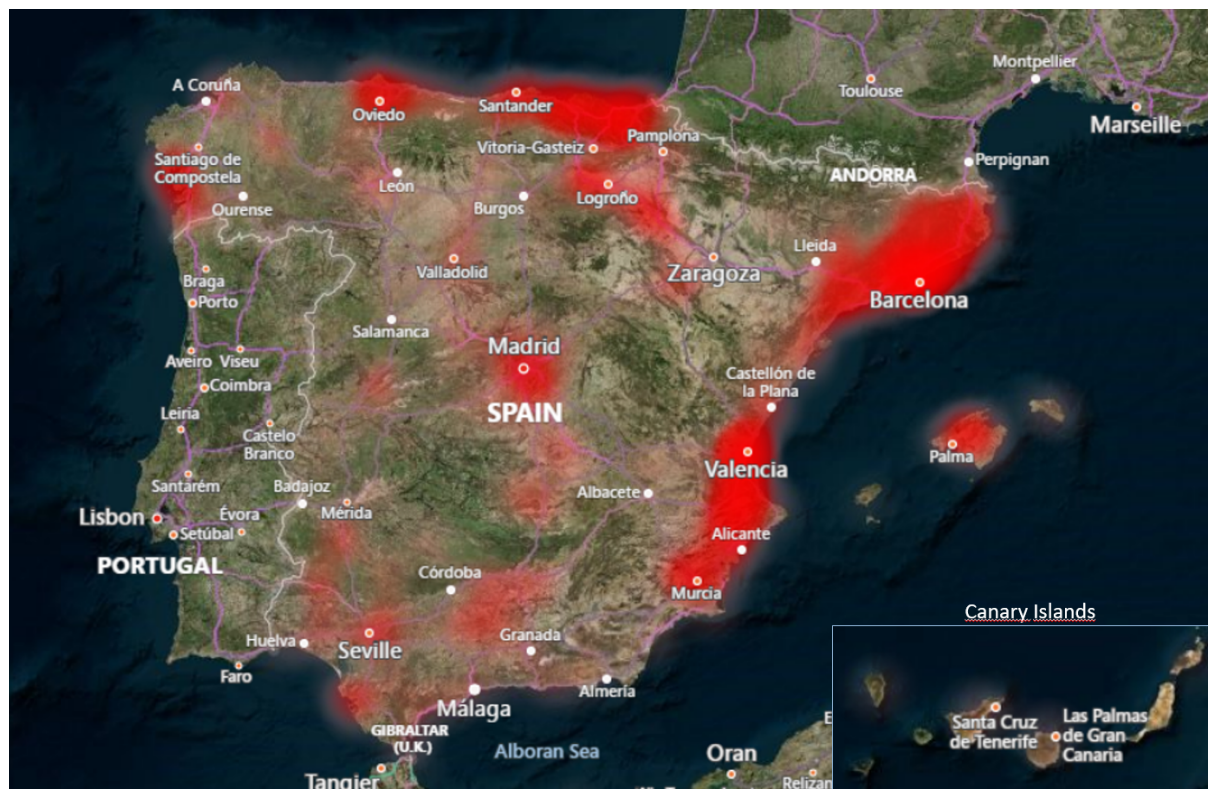
The dummy variables,  $Railway_p^0$  and  $Coast_p^0$  are both positive and significant, reflecting that geographical accessibility increased the probability of specialization. From the value of the associated parameters, we conclude that, taken separately, access to the railway network resulted in a slightly greater advantage than being on the coast. Being connected by railway or located on the coast increased the probability of specializing by 12.2 and 9.4 percentage points, respectively, as compared to locations that lacked a railway or were landlocked.

Finally, we tested the robustness and sensitivity of our results to alternative thresholds. Regarding the lower threshold, reducing or increasing the reference value from the 25th percentile of  $RTMS_{p,s}^0$  to either the 10th or the 50th percentile, thereby decreasing or expanding the number of candidate provinces for specialization, does not change the above conclusions. The reason is that a majority of locations start from a zero-valued  $RTMS_{p,s}^0$  in the base period. Results are also generally robust when lowering the upper threshold but not to its heightening. To show this, we report the results of running the same regression (6) under two alternative definitions of the dependent variable,  $N_{p,s}^1$ . The first relaxes the baseline model by reducing the value that signals a transition from the base period to the comparison period from the 75th percentile to the 50th percentile of  $RTMS_{p,s}^1$ . This change more than doubles the number of provinces that specialized—from 60 to 155—but does not change the results previously observed, as shown in columns 4 and 5 of Table 3 (Lax Model). With the new values, even the  $Coast_p^0$  dummy becomes significant at 5%. Conversely, increasing the threshold to the 90th percentile of  $RTMS_{p,s}^1$ , so we are more stringent in terms of the degree of relative specialization that must be reached, reduces the number of transitioning provinces to just 17, which is too low to properly model the probability of specializing. The new results under this assumption are reported in columns 6 and 7 of Table 3 (Stringent Model). The main variables remain statistically significant, but the exposure to relative trademark diversification  $RTMDexp_{pq}^0$  and the  $Coast_p^0$  dummy lose significance. Therefore, we conclude that the results of the proposed model are quite robust to a more lenient choice for the probability of specializing, but not to a stricter definition, mainly because the number of transitioning provinces rapidly drops to very small numbers. We also tried alternative definitions for some indicators. For example, we can define diversification as the inverse of the well-known Herfindahl—Hirschman Index of industry concentration by replacing the relative trademark specialization indicator with industry shares. Our results remain unaffected by this experiment.

Indeed, our statistical results on trademark diffusion fit well with the historical events. As we have stated, trademarking in Spain emerged, and was concentrated, in a few provinces before 1885: Alicante, Barcelona, Cádiz, and Asturias in the north, and in Madrid (as a political, financial, and

transports center). Trademark registrations progressively, extended throughout the Mediterranean and northern coasts, slowly drawing in other neighboring areas and regions (Figure 7).

**Figure 7. Heat map based on geolocation of trademark applications, Spain (1850–1920)**



Source: Authors' compilation from Sáiz et al. (2019).

Catalonia, along with certain parts of the Valencian Community, were significant industrialized areas in Spain before the 1870s. This was also true for Andalusia (Sevilla, Cádiz, Málaga), but northern regions, such as Asturias, Cantabria, Basque Country (especially Vizcaya and Guipúzcoa), and Zaragoza eventually overtook Andalusia (Nadal & Carreras, 1990). Population (and thus demand) was concentrated in the coastal provinces, where cabotage trade initiated the process of market integration before the 1860s (see Frax, 1981). Railway construction connected Madrid, and intermediate towns, to the coasts, strongly decreasing inland transportation costs (Herranz, 2005). This was key to expanding the national market. The ultimate reason for the emergence of trademark specialization was to fight counterfeiters (Lopes et al., 2020). Starting in the 1880s, other trademark activities—such as those concerning industrial competitiveness, marketing, and business management—complemented this defensive action. Thus, the geography of trademark diffusion reflects clear links both on the supply side (that is, to the main industrial areas of Spain) and on the demand side (to the construction of the domestic market and its progressive integration). The effects of relative trademark specialization and diversification of regions worked in both directions, but the dominant driver in the diffusion of trademark practices was the proximity to relatively specialized trademark provinces before 1885, which directly led to the agglomeration of the majority of registrations during the first sub-period of analysis.

## 5. Conclusion

There are many new empirical studies on trademarks from far ranging fields—from innovation to regional studies—but so far there has been no historical-based approach leveraging systematic long-



term data mining and analyses. Our contribution provides, for the first time, an investigation of the first 47,000 trademarks registered in Spain between 1850 and 1920, a key period of modern economic development. Spain is a significant case study because it initiated the world's first national trademark registry and profusely used trademarks during the nineteenth and twentieth centuries.

Trademarks emerged during incipient industrialization and market integration to counter the sale of fakes that threatened to expand from local to wider scales. However, the evolution and regional extension of trademarking was complex. Since trademarks mainly protect commercial and marketing innovations, it makes sense that their development started in domestic markets. In Spain, trademark registrations were concentrated in a few regions during the period under study, which coincides with the results of current research in other countries, such as the strong regional trademark agglomeration in metropolitan areas in Portugal. Nonetheless, progressive market integration and trademark practices extended throughout Spanish regions and sectors. Our main hypothesis was that such diffusion depended on the geographical proximity to pioneering trademarking regions, characterized to a large degree by trademark specialization and diversification.

Our results confirm that the closer a province was to regions that showed trademark specialization, weighted by their GTCs, the higher the probability of adopting trademark practices and, therefore, of developing integrated markets. This evidence is partially qualified by the effect of being exposed to regions with a relatively large trademark diversification—that is, regions with already mature markets—where competition constrained new trademarks, although the net effect of specialization remained strong on average. Our results also confirm the key issue of accessibility: during the entire period under study, this refers primarily to railway connections, with shipping offering alternative routes for areas that were not landlocked. The key location of the Mediterranean and northern provinces (Barcelona, Alicante, Valencia, Cádiz, Asturias, Vizcaya, and Guipúzcoa) fits the historical evidence on the evolution and extension of the first Spanish industrialization and market integration processes.

To sum up, our findings clarify for the first time how trademark practices originated historically and extended regionally based on geography. This opens new paths for further research on the role of both intangible assets and geographical factors in the process of market integration and regional economic development. To deepen this empirical line of research, constructing additional datasets on the evolution of GTCs among regions during the nineteenth and twentieth centuries would help in developing and testing dynamic models. Results could explain new regional elements related to trademarking extension. Another point for future research would be to test trademark duration, in terms of which regional and entrepreneurial factors matter. Trademarks are the only intellectual property right that may be renewed indefinitely. Indeed, many current global brands were registered during the nineteenth century. It would be intriguing to test through non-linear models and survival functions which variables, including regional effects, influence brand duration and matter for long-term viability of local intangibles. This is also true for analyzing geographical effects on the evolution of patents versus trademarks over the long term to study their interactions and whether or not they follow similar concentration patterns and path dependence dynamics.

This potential research would help scholars in many disciplines understand (1) how regions acquired competencies concerning intangible assets generation and management, (2) what were the key factors that help or hindered such processes, and (3) what policy measures favored a more integrated regional development. As shown in this article, historical approaches complement and expand existing trademark-related research in regional studies.

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## NOTES

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<sup>1</sup> Royal Decree, November 20, 1850.

<sup>2</sup> This is true, in general, for most economies (Duguid et al., 2010, pp. 24–26).

<sup>3</sup> See Google Maps Platform, <https://cloud.google.com/maps-platform/?hl=en>.

<sup>4</sup> See Geonames.org, <https://www.geonames.org/>.

<sup>5</sup> See Nice Classification, <https://www.wipo.int/classifications/nice/en/>.

<sup>6</sup> For further information on the database, see <http://historico.oepm.es/marcas.php>; to access the geolocation tools, see <http://historico.oepm.es/geoposicionamiento/index.php?app=marcas>.

<sup>7</sup> Consequently, the Canary Islands and Balearic Islands, as well as the cities of Ceuta and Melilla, are excluded from our analysis because they were reachable only by sea.

<sup>8</sup> We use a detailed 1876 map of ordinary roads as a valid representation of the network to complete the sections without railway.

<sup>9</sup> The descriptive statistics of the dependent variable  $N_{p,s}^1$  are based on the full sample (611 observations), while the regression sample (563) excludes observations that were specialized in the base period and, therefore, could not transition to specialization. For the variables that are transformed into the log scale prior to the econometric estimation, the minimum value is set to 1e-6.