Market potential and regional economic growth in Spain,

1860 – 1930

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Resumen: In this paper we employ parametric and nonparametric techniques to analyse the effect of the changes registered on regional market potential on the growth of Spanish regions during the period 1860 – 1930. The study of the Spanish experience during these years conforms a case study that allows analyzing whether the construction of new transport infrastructure, as well as the changes in trade policy, that affected the relative market potential of the Spanish regions, ended up shaping regional growth trajectories. In order to carry out the analysis we make use of new evidence on regional inequality patterns in the long term based on recent estimations of per capita GDP for NUTS III Spanish regions (provinces) and an a la Harris measure of regional market potential that takes into account the economic distance between territories according to the changes registered in transport networks, the variations in the actual transport costs and the tariff policy followed over the period. Our results show a clear positive influence of market potential on regional economic growth, particularly along the years 1900 – 1930.

Palabras Clave: Market potential, New Economic Geography, regional growth, economic history

Clasificación JEL: F14, N9, N64, O18, R0

1. Introduction

Regional income inequality is a recurring feature of apparently well-integrated economies such as the European Union. As pointed out by Puga (2002), in 1995 nearly a quarter of European citizens lived in regions with a per capita GDP that was below 75% of the European average. It could be argued that full integration across Europe is still a work in progress and that, in the long term, these differences will tend to diminish. Yet, the magnitude and persistence of regional imbalances are still of great concern for national economies that are often considered the embodiment of long-lasting political and economic integration. The study of the trends and determinants of regional income inequality during past processes of national market integration could be of great use. It could help identify the main forces at work, and may also shed light on the evolution of regional inequality in modern instances of economic and political integration such as the European Union.

From a theoretical point of view, international and regional economics have explained income disparities on the basis of differences between regions' endowments of natural resources, factors of production, infrastructure, and technology (Barro and Sala-i-Martin, 1991). The removal of obstacles that hinder the flow of goods and/or factors would, by itself, cause the convergence of factor returns and living standards. Yet, as stated in the new economic geography (NEG) literature, forces such as agglomeration economies, which are overlooked in conventional analysis, can affect regional disparities—even without large differences in the underlying characteristics of the regions—and prevent convergence.

Empirical economic history studies have suggested that economic growth in the context of the integration of different regions could initially lead to an increase in regional per capita income disparities. The causes cited are regional specialization and structural change, two processes associated with growth and economic integration. Williamson (1965) provided evidence for this assertion by analyzing the evolution of income in a cross-section of countries and by examining the long-term evolution of regional inequality in the US. He first posited that regional inequality within national economies would follow an inverted U-curve throughout the process of economic growth. This would entail growing inequality during the 19th century and convergence from then on. He concluded that structural change and specialization were responsible for the increase

in inequality observed during the initial stages of economic growth. The advance of the structural change and integration processes, and the associated increases in capital movements and internal migrations, would then explain the reduction in income disparities across regions over time.

Kim (1998) performed a rigorous analysis of this hypothesis. By studying the long-term evolution of regional inequality between US States, he confirmed the existence of an inverted U-curve. Moreover, he realized that specialization and divergence in economic structures would be responsible for the increasing segment of this curve during the second half of the 19th century. Conversely, in the 20th century, further progress in the process of growth and national market integration was accompanied by a reduction in regional income inequality. The homogenization of economic structures and productivity convergence across states may have played a central role in this process. In a similar vein, Combes et al. (2011) studied the long term evolution of economic disparities between French *départements*, concluding that the concentration of the spatial distribution of manufacturing and services traced an inverted U-curve starting in the mid-19th century. Interestingly, in line with the arguments proposed in the NEG literature, they found that the existence of agglomeration economies would be a relevant factor for understanding regional income evolution in France between 1860 and 1930.

Shifting our attention to Spain, Rosés et al. (2010) showed that the early stages of the integration process of the Spanish economy was accompanied by a long phase of growing regional disparities. In these early years (1860–1900), the emergence of large differences in production structures across regions favored the upswing in regional economic inequality. Since the beginning of the 20th century, however, a gradual convergence in regional production structures halted the advance of regional inequality. Nonetheless, the persistence of differences in productivity between regions has prevented the emergence of real regional convergence. Rosés et al. (2010) claimed that regional differences in productivity may be due to the presence of agglomeration economies in industrial production processes.

In this paper, our aim is to expand on the research previously discussed by extending the analysis of the proximate causes of regional income inequalities. To do so we follow an empirical framework that captures the main economic factors at work (Ottaviano and Pinelli, 2006). They start from an NEG model and derive an empirical strategy based on

the estimation of growth regressions. Along with the variables typically found in the traditional growth literature, we also include market potential as a key variable to explain disparities in regional economic growth rates.[1] Here, we employ this methodology to study the determinants of regional inequality in Spain during the period 1860–1930. We hereby present this example as an illustrative case study.

Analysis of Spanish market integration and economic growth offers a threefold contribution to the body of existing research. The first contribution of this research is that it entails cross-regional analysis, which yields two basic advantages. One of these advantages is related to the analysis of growth trajectories of territories that share a common institutional framework. This commonality minimizes the varying impact on growth caused by institutional differences. In contrast to cross-country studies, there is no obvious variation in institutions across regions within a national context (Redding, 2010). Furthermore, as claimed by Head and Mayer (2006), regional analysis allows scholars to grasp with greater clarity the effects of the presence of agglomeration economies because interregional transport costs tend to be lower than international ones.

The second contribution of our research is its time span, namely the period from 1860 to 1930. These years span a period of Spanish history characterized by an acceleration in the integration of regional markets owing to enormous advances in national transport networks. Numerous studies have shown that within the increasingly integrated economy of this period market access acted as a determinant of industry location (Martinez-Galarraga, 2012), intensity and direction of migration flows (Pons et al., 2007), and regional wage levels (Tirado et al., 2013). Hence, the period seems to be an especially suitable context in which to analyze the impact of market potential on regional economic disparities.

Because of the new transport networks and changes in Spanish trade policy, the integration of markets asymmetrically altered the market potential of the country's regions. This asymmetrical impact endows the Spanish case with a particularly appealing feature. As pointed out by Redding (2010), the analysis of the effects of market access on the remuneration of factors faces an important empirical hurdle: It is difficult to disentangle the effects of market access from other determinants of

[1] They analyzed Finnish regions for the period 1977–2002, considering the impact on regional economies of the external shock of the collapse of the neighboring Soviet Union.

comparative economic development such as locational fundamentals. This means that the relationships emerging from a significant number of empirical analyses suffer from the problem of causal indeterminacy. Economists have advocated the analysis of this type of relation in the context of exogenous changes in the relative market size of regions or territories. This would involve then analyzing the impact of these changes on factor returns in order to validate the causal nature of the relationships. Examples of such an approach can be found in Hanson (1996), Davis and Weinstein (2002), Wolf (2007), and Redding and Sturm (2008). The study of Spain during this period therefore offers a case study that allows us to analyze whether a new transport infrastructure, as well as changes in trade policy that affected the relative market potential of the Spanish regions, ended up shaping regional growth trajectories.

The third contribution of the study resides in the construction of the measure of market potential. In the absence of data on bilateral trade flows between territories (Redding and Venables, 2004), NEG scholars have commonly used Harris' market potential function to measure regional market potential. This measure is based on taking regional income levels and the geodesic distances between regions as being representative of regional market access. Especially when applied to history, however, the consideration of bilateral transport costs instead of geodesic distances in the calculation of the domestic market potential yields some clear advantages. For instance, it allows us to include different transport modes like railways or coastal shipping, analyze by mode of transport the exact routes used in the transportation of commodities, and consider the freight rates applied by companies. All of these additional factors can be studied, taking into account that their evolution over time may vary for a number of reasons. Numerous factors may have an impact on transport and trade costs. These factors include the country's terrain and geography, the emergence of new transport technologies, the replacement of traditional means of transport, the level of investment in transport infrastructures, the design of the network (often politically decided), the quantity and quality of the lines of communication, or even trade policy. Because Spain's progress in the transport infrastructure and changes in Spain's trade policies asymmetrically altered the economic distance between regions, it seems advisable to use a measure of the regional market potential that accounts for these changes. We therefore employ Harris' market potential function to measure regional market potential, which calculates the

economic distance between territories according to changes in transport networks, variations in the actual transport costs, and the tariff policy in force at the time.

The remainder of the paper is structured as follows. First, we offer a brief summary of the historical process of market integration and economic growth of the Spanish economy. In doing so, we present new evidence on regional inequality patterns in the long term based on recent estimations of per capita GDP for NUTS 3 Spanish regions (provinces) between 1860 and 1930 (Rosés et al., 2010). In Section 3, the proposed measure of regional market potential is explained. In Section 4 we present the results from a nonparametric analysis of the relation between market potential and regional economic growth. Section 5 is devoted to the presentation of the empirical (parametric) analysis and to the discussion of the main results. Finally, Section 6 sets forth the conclusions of our study[2].

2. Market integration, industrial location and regional inequality in Spain (1860–1930)

From a historical point of view, major advances occurred in the integration of national markets and industrialization during the 19th century. The reduction in trade costs within countries was, on the one hand, linked to the elimination of institutional obstacles that hindered the free movement of goods and factors between regions. On the other hand, the fall in transport costs derived from the application to transport of technological improvements during the Industrial Revolution also led to a drop in trade costs. In the case of Spain, the integration of the domestic market ran in parallel with an increase in the spatial concentration of manufacturing and with a rise in regional income inequality. In this section, we review the main evidence regarding these issues for the Spanish case.

First, the economic integration of the regional economies took place during the second half of the 19th century. Before then, during the *Antiguo Regimen* (Ancient Regime), the Spanish market was fragmented, and consisted of a collection of largely unconnected local and regional markets. Historians have stressed two key reasons for this. First, the

[2] The working paper version of this article (Documentos de Trabajo from Asociación Española de Historia Económica (DT-AEHE) No 1409) includes two additional appendices. Appendix 1 contains a description of the theoretical model originally proposed in Ottaviano and Pinelli (2006). According to this model, regional per capita GDP growth is explained by a pool of variables comprising two groups of factors: those customarily cited by international and regional economics as determinants of economic growth differentials across regions (infrastructures, human capital, etc…), and those proposed in the NEG literature, such as differences in the market potential of regions. Appendix 2 presents the data and the sources employed in the analysis.

persistence of institutional obstacles hindered interregional trade. Second, development had been stymied by the deficiencies of the transport infrastructure in Spain, a country that has had to confront serious geographical obstacles throughout its history (Ringrose, 1970). Yet, the second half of the 19th century was witness to a progressive integration of the domestic market, thanks to the institutional reforms undertaken by a sequence of liberal governments and on account of progress in the transport system. These improvements proved to be a determining factor for the integration of the Spanish market, due to both the introduction of the railway and the advances made in other modes of transport (road and coastal shipping), which triggered a fall in transport costs.

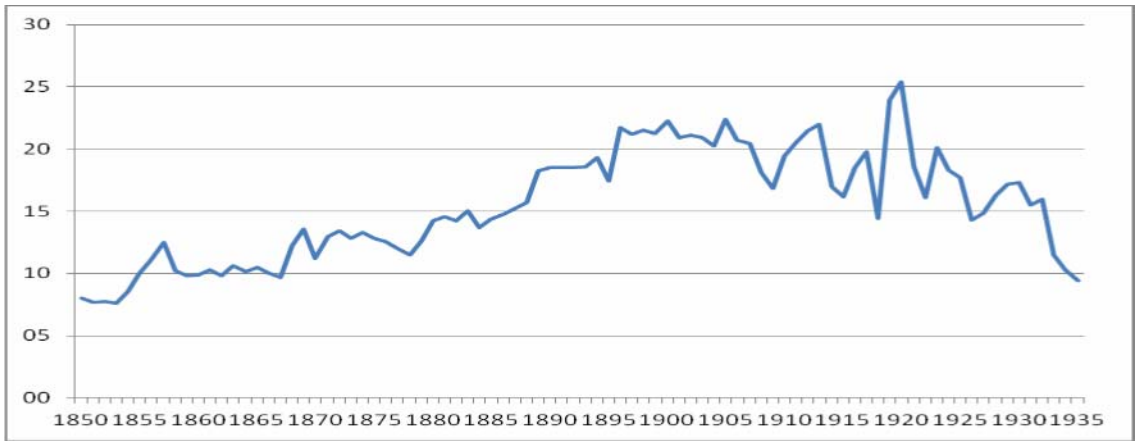
The outcome was the gradual integration of the national market for goods for the main traded products, an integration that was characterized by convergence in regional prices. Various studies have demonstrated the gradual convergence of regional grain prices from the beginning of the 18th century until its culmination in the second half of the 19th century (Peña and Sánchez-Albornoz, 1983; Barquín, 1997; Matilla, Pérez and Sanz, 2008). In addition, the integration of capital and labor markets led to massive advances as well. In the case of the capital markets, the main events that affected the monetary and banking systems (Castañeda and Tafunell, 1993; Sudrià, 1994; Tortella, 1973) favored a reduction in interest rate differentials across regions. Castañeda and Tafunell (1993) showed that interregional short-term interest rate differentials experienced an intense decline after 1850. Lastly, Spain's labor market integration, measured in terms of disparities in regional real wages across regions, has also been extensively analyzed. Rosés and Sánchez-Alonso (2004) showed that PPP-adjusted rural and urban wages converged across different locations prior to World War I, despite low rates of internal migration.[3]

In addition, from 1869 onwards, this context of internal market integration was accompanied by a progressive economic openness towards neighboring countries (Tena, 1999). The reduction in tariff protection levels was most pronounced at the end of the 1880s, when Spain signed several trade treaties with its main trading partners. Nevertheless, the last decade of the century witnessed an important change in terms of the Spanish economy's integration with external markets. In 1883, the gold convertibility of the peseta was abandoned, thus debilitating Spain's position in the

[3] A more detailed description of these processes can be found in Rosés et al. (2010).

international capital markets. Furthermore, from 1892 onwards, the return to protectionism posed a serious threat to external integration. The return to protectionist policies, widespread across countries in the latter decades of the 19th century, was a reaction to the challenges raised by the first globalization. Around that time, many countries also started adopting protectionist measures as part of a strategy to promote their manufacturing sectors and compete in the international markets with British goods. This generated an inverted U-curve plotting the evolution of Spanish international trade during this period. The rate of openness of the Spanish economy followed an increasing trend during the second half of the 19th century. This trend, however, began to reverse in the last decade of that century (see Figure 1).

Figure 1. Openness rates (%). Spain, 1850-1935

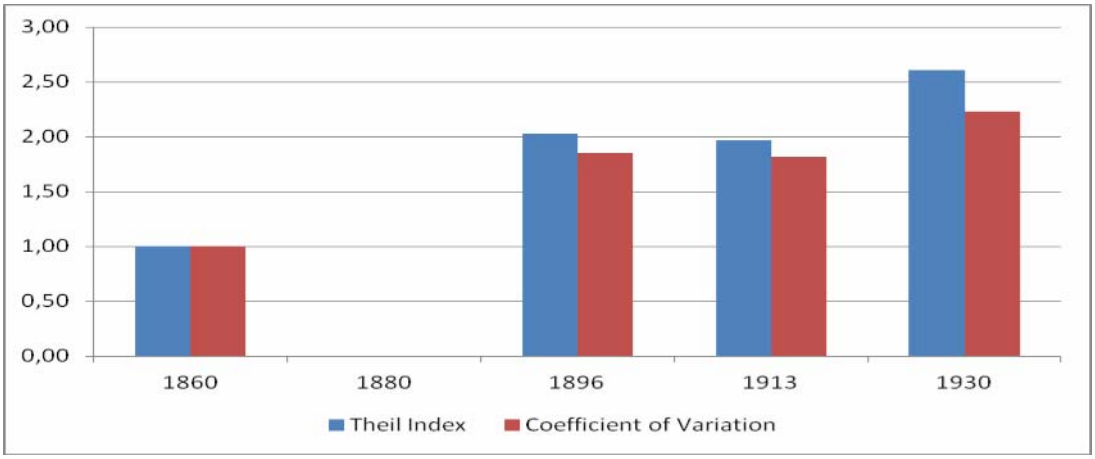


Source: 1850–1913: data for exports and imports from Prados de la Escosura (2010); 1914–1935, Tena (2005); GDP figures from Prados de la Escosura (2003)

Advances in the integration of Spanish national markets for goods and factors drove an intense process of regional specialization. From the middle of the 19th century to the outbreak of the Civil War (1936-1939), industrial production gradually agglomerated in a small number of provinces, a development that has been well documented by historiographers (Nadal, 1987, Paluzie et al., 2004). A recent estimation of regional GVA in Spanish industry, conducted in the context of the reconstruction of regional GDP series (Tirado and Martinez-Galarraga, 2008), has allowed scholars to analyze, through two alternative inequality indexes (Figure 2), the evolution of the geographical concentration of manufacturing activities over the period studied. The general pattern described is one of an increase in the concentration of industry across Spain's provinces up to the 1930s. This is a similar dynamic to that experienced in other countries like the

United States (Kim, 1995) and France (Combes et al., 2011). These nations also experienced an upsurge of agglomeration of industrial production during the early stages of national market integration and industrialization.

Figure 2. Inequality in the distribution of industrial GVA in Spain at province level, 1860-1930 (1860 = 1)



Source: Tirado and Martinez-Galarraga (2008)

Economic historians have extensively investigated the roots and causes of this notable increase in the spatial concentration of manufacturing before the Spanish Civil War. They have done so by studying the role played by the two major explanatory theories from the literature: traditional trade theory (comparative advantage in a Heckscher-Ohlin setting) and new economic geography. How can the location of industry in Spain be explained? Rosés (2003), following Davis and Weinstein (1999, 2003) found evidence that the *home market effect* was driving early Catalan industrialization (around the 1860s). Tirado et al. (2002), in line with Kim (1995), identified scale economies and market size as the determinants of the Spain's industrial geography in the mid-19th century. By the end of the century, the explanatory power of these NEG effects had increased in parallel with advances in the economic integration process. Recently, Martinez-Galarraga (2012) adopting the approach developed by Midelfart-Knarvik et al. (2002), confirmed and extended the previous findings by Tirado et al. (2002).[4] As the domestic market became integrated and industrialization progressed in Spain during the second half of the 19th century, NEG forces grew to be the main determinant of Spain's industrial landscape. In particular, although comparative advantage factors were a

[4] This methodology has been used extensively in economic history: Wolf (2007) analyzed reunified Poland after WWI during the interwar years, Crafts and Mulatu (2005, 2006) studied the Victorian period in Britain, and Klein and Crafts (2012) applied this approach to reexamine the manufacturing belt in the US between 1880 and 1920.

feature of the Spanish case, the scale effects suggested by Krugman (1991), captured by the interaction between economies of scale and market potential, played a decisive role: industries with increasing returns tended to concentrate in provinces with a better access to demand up to the 1930s.

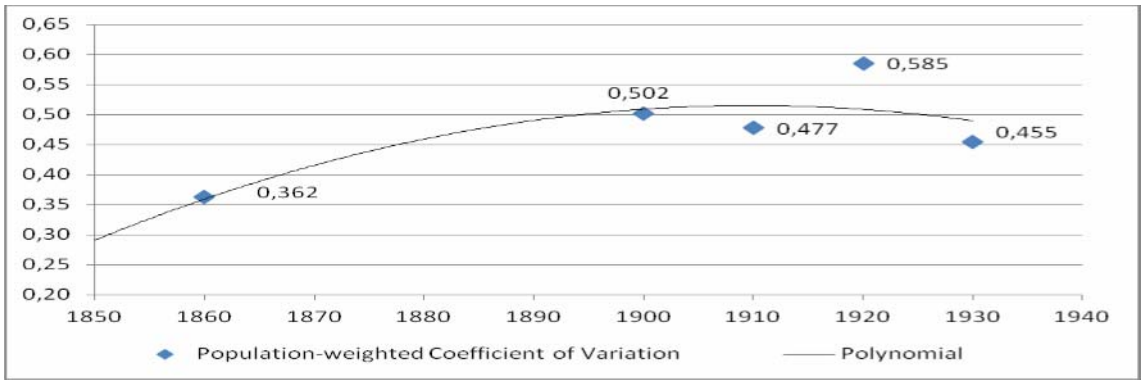
In the context of the Spanish economy, researchers have also tested first the wage equation, in other words the existence of higher wages in regions that have greater market potential resulting from the agglomeration of manufacturers in core regions (*backward linkages*), and, second, the attraction of these wages for generating migratory flows of workers (*forward linkages*). These are some of the centripetal forces stressed by new economic geography (Krugman, 1991) that might be responsible for agglomeration in the early stages of economic development. First, following Hanson's (1998, 2005) influential research based on the Krugman wage equation, the existence of a spatial structure in industrial nominal wages in 1920s Spain has been examined in Tirado et al. (2013). The results verify that wages were higher in regions with greater market potential, and they prove the existence of a wage gradient centered in Barcelona, the main industrial center in interwar Spain. In addition, this work confirmed that domestic market potential became more relevant as the Spanish economy and the main European markets increased protectionism during the 1920s while the wage gradient centered on Barcelona declined.[5]

Second, following Crozet (2004), Pons et al. (2007) established a direct relationship between migration decisions and the market potential of the host regions during the 1920s, thus verifying the presence of forward linkages in the internal migrations between Spain's provinces in the interwar years. Yet, although Spanish workers were drawn to industrial agglomerations, this attraction was limited to relatively close-lying zones. This would explain the apparently low intensity of internal migrations in Spain until the 1920s and the geography of these migrations in the interwar years. The migratory flows to the main industrial centers did not originate from the poorest regions in the south of the peninsula which lay furthest from these industrial centers. This owed to the migration costs that were proportional to the distance that the workers had to travel.

[5] This exercise thus contributed to the existing theoretical and empirical NEG debate about the effects of international integration on the internal geography of countries (Hanson, 1997; Krugman and Livas, 1996; Crozet and Koenig, 2004). A similar long-term analysis for Italy can be found in A'Hearn and Venables (2011).

After describing the evidence gathered at the manufacturing sector level, the next step is to focus on regional inequality in terms of per capita GDP (Rosés et al. 2010). To begin with, taking the population-weighted coefficient of variation as a measure of inequality, Figure 3 plots the long-term evolution of regional income per capita disparities at the province level (NUTS 3). In Spain, the second half of the 19th century witnessed a remarkable increase in regional income inequality. Then, in the early decades of the 20th century, this process came to a halt, and a tendency towards the stabilization of income per capita inequality can be observed in Figure 3.

Figure 3. Regional per capita GDP inequality, Spanish NUTS 3 (1860-1930)



Source: Rosés et al. (2010)

What are the determinants of this evolution? The evidence presented so far shows that NEG forces were driving the agglomeration process observed in the manufacturing sector in Spain from the mid-19th century to the outbreak of the Spanish Civil War. But was the impact of geography limited to the manufacturing sector? Did NEG-type mechanisms have an effect at a more aggregated level when income per capita is considered? In other words, did market potential and its evolution have an impact on regional inequality during the early stages of economic growth in Spain? In order to answer these questions, a sound measure of regional accessibility must be constructed. The next section is thus devoted to presenting our indicator of market potential.

3. Measuring regional market potential in Spain, 1860–1930

In NEG multi-regional models, the capacity of different locations to attract firms and workers varies according to their position relative to one another. Although in NEG studies Harris' market potential function has tended to rely on geodesic distances between locations, there are fundamental reasons to consider bilateral transport costs,

especially in historical studies.[6] During the period analyzed in this paper, remarkable changes occurred in transport technologies. These changes include the expansion of railways and steam navigation. In addition, as a peninsula, Spain's geography made it possible to transport commodities between provinces by both land and sea (coastal shipping). Traditionally, inland transport had been conducted by road and was very expensive because of the country's mountainous topography and the poor state of roads. Furthermore, the absence of navigable rivers deprived Spain of an alternative, cheaper form of transport. The construction of the railway network triggered a reduction in transport costs, but its expansion was gradual and therefore some regions were able to benefit earlier than others from railway transportation. Furthermore, the policymakers responsible for designing the railway network decided upon creating a radial network with a hub in Madrid, the geographical center of the country. At the same time, key advances were made in coastal shipping, such as the transition in navigation from sail to steam and improvements in port facilities. Overall, these changes often follow a regionally asymmetric pattern, thereby unevenly affecting regional transport costs and accessibility.

In order to analyze the potential relationship between market potential and regional income growth, we gathered two different types of empirical evidence. First, we used the new estimations of regional GDP constructed in Rosés et al. (2010). Second, we adopted a new estimation of the market potential of Spanish regions for the five benchmarks considered. The proposed regional market potential measure came from the so-called *nominal market potential* or Harris' market potential function, defined as:[7]

$MP_r = \sum \frac{M_s}{d_{rs}}$, where M_s is a measure of the economic size of province[8] s (i.e., GDP)

[6] The measurement of transport costs has been and remains the subject of much debate. The geodesic straight-line distance, the real distance as a function of the available infrastructure, the distance measured in time (Hummels, 2001), and the transport costs that include the distances and the freight rates, are the alternatives used in empirical studies. Reviews of the literature from an NEG perspective can be found in Combes and Lafourcade (2005), and Lafourcade and Thisse (2008).

[7] This measure of market access suggested by geographers and widely adopted by economists could be considered an *ad hoc* indicator because it has been neither built upon a solid theoretical foundation nor derived from a structural estimate. Advances made by NEG models, however, have helped overcome the lack of theoretical foundation for this empirical measure of market potential. Particularly, Combes et al. (2008) derived an expression for the real market potential (RMP). This equation establishes a relationship with Harris' (1954) equation. Nonetheless, from an empirical perspective, when compared to structural estimates of the market potential, Head and Mayer (2004) expressed a preference for the performance of Harris' equation. See Martinez-Galarraga (2014).

[8] Provinces are Spanish NUTS 3 regions. The insular territories (Balearic and Canary Islands) have not been included, giving a total of 47 provinces.

and d_{rs} is the distance. (In this case, *d* is equal to the bilateral transport costs between provinces r and s.)

Drawing on this expression, Martinez-Galarraga (2014) computed a measure of Spanish NUTS 3 market potential for the years 1867, 1900, 1910, 1920, and 1930, based on the study by Crafts (2005).[9] Market potential figures were obtained as follows. First, the market potential of a Spanish province *r* was disaggregated into two components: the domestic market potential (DMP_r), to which each province's self-potential (SP_r) was incorporated, and the foreign market potential (FMP_r) between the provincial and the international nodes. Hence, the market potential of a province *r* (MP_r) was calculated as the sum of the domestic and foreign market potential:

$$MP_r = DMP_r + FMP_r \ .$$

According to this expression, the domestic market potential for each of the 47 provinces *r* is calculated as follows:

$$DMP_r = \sum_{1}^{s=46} \frac{M_s}{d_{rs}} + SP_r$$

with $SP_r = \frac{M_r}{d_{rr}}$ being the measure of the self-potential of each province r, where d_{rr} is calculated by taking a distance θ_{rr} equivalent to a third of the radius of a circle with an area equal to that of the province:

$$\theta_{rr} = \frac{1}{3}\sqrt{\frac{(area\ of\ the\ province_r)}{\pi}} \ .$$

The next expression yields the foreign market potential of province *r* (FMP_r), where d_{rp} captures the distance from the inland provincial node to the nearest Spanish port:

$$FMP_r = \sum_{1}^{f=4} \frac{M_f}{d_{rp}} \cdot Distance_{pf}^{\delta} \cdot Tariff_f^{\gamma}$$

with $d_{rp} = 1$ if *r* is a coastal province, and $d_{rp} = d_{rs}$ if *r* is an inland province. In this case, M_f is the economic size of the foreign market; d_{rp} captures the transport costs

[9] See Martinez-Galarraga (2014) for a detailed description.

from the inland provincial node to the nearest Spanish sea port p; $Distance_{pf}$ is the distance between the Spanish sea port and the international node f; $Tariff_f$ are the mean tariffs applied in the foreign country *f*; and δ and γ are the elasticities estimated by international trade gravity equations associated to the coefficients for distance and tariffs, respectively.

Hence, the total market potential of province *r* (MP_r) is the sum of the following terms, the first two corresponding to the domestic market potential (including the self-potential of province *r*) and the last one capturing the foreign market potential:

$$MP_r = \sum_{1}^{s=46} \frac{M_r}{d_{rs}} + SP_r + \left[\sum_{1}^{f=4} \frac{M_f}{d_{rp}} \cdot Distance_{pf}^{\delta} \cdot Tariff_f^{\gamma} \right], \qquad (1)$$

with d_{rp} capturing whether province *r* is coastal or inland.

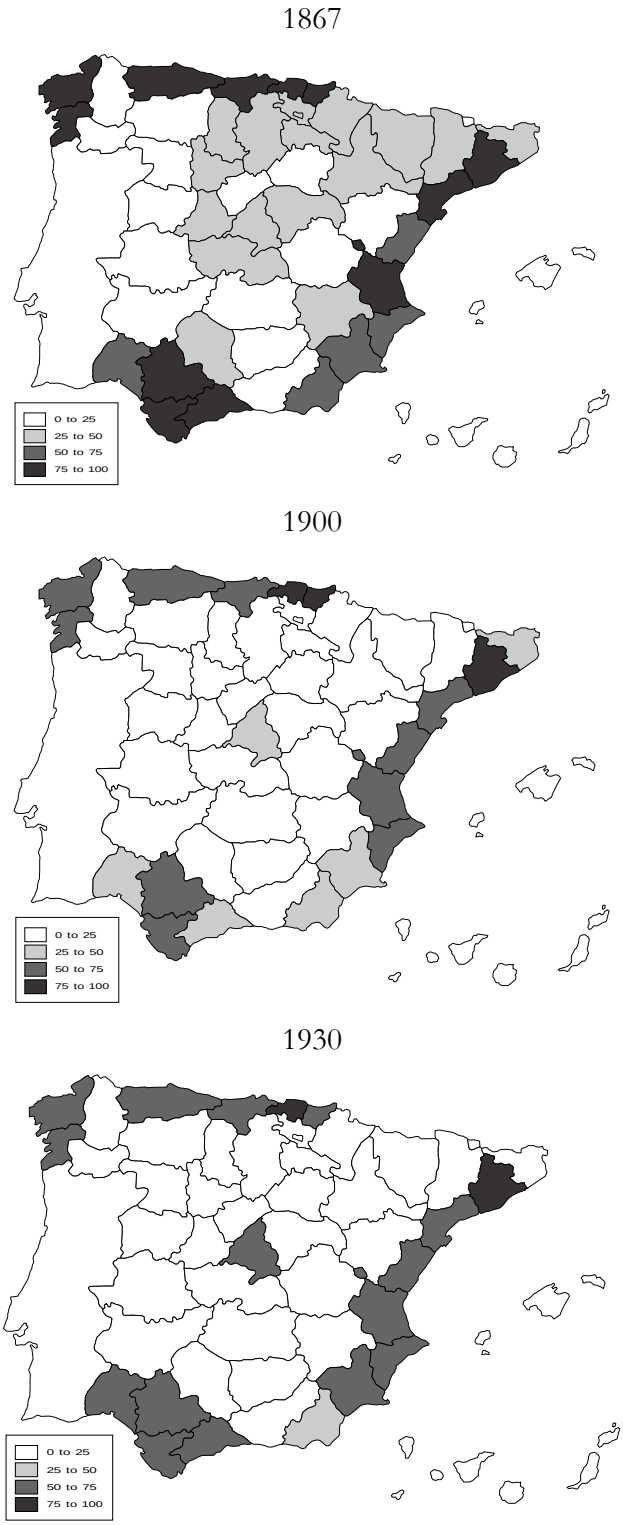
The economic size of the provincial markets (M_r) is measured by the aggregate income. Data on nominal GDP at a NUTS 3 level are obtained from Rosés et al. (2010). To measure d_{rs}, we considered transport costs. In such a case, data on distances and average transport rates for commodities are needed. Internal transport was assumed to be by railway and coastal shipping. For railway distances, the sources were *Ministerio de Obras Públicas* (1902), and Wais (1987). For distances between ports, electronic atlases provided information on the length of sea journeys.[10] As regards transport costs, data on railway rates came from Herranz (2005). Coastal shipping rates in 1865 were obtained from Nadal (1975). In order to consider the reduction in sea transport costs, the data were corrected with the freight rate indices calculated by Mohammed and Williamson (2004). In the first benchmark year in the 1860s, however, only 32 out of the 47 provinces considered were connected to the railway network. For that reason, road transport was also included in the internal market potential estimates at that time.[11] Distances by road were taken from *Dirección General de Obras Públicas* (1861). For road transport prices, we used the information in Barquín (1999). Finally, the relative weight of each transport mode in the coastal provinces came from Frax (1981).

[10] www.dataloy.com and www.distances.com.
[11] On the contrary, by 1930 road transport was still playing an ancillary role. We therefore excluded it from the model (Herranz, 2005).

The construction of the measure for foreign market potential is based on the gravity equation for international trade estimated by Estevadeordal et al. (2003). The elasticities obtained for distance and tariffs (-0.8 and -1.0, respectively) were used to reduce the size of foreign markets. Nominal GDP of the main trading partners for Spain (France, United Kingdom, Germany and United States) came from Crafts (2005), based on the estimates of Prados de la Escosura (2000). Prevailing exchange rates were applied to convert GDP figures from pounds to pesetas. Maritime distances were again obtained from an electronic atlas, and, finally, tariffs came from O'Rourke (2000) and Mitchell (1998a, 1998b).

Figure 4 allows us to examine the geographical pattern of regional accessibility and its evolution from 1860 to 1930. Throughout the period of study, Barcelona emerged as the province with the greatest market potential. Maps are therefore expressed relative to this province. The evidence shows that the most significant changes in the relative accessibility of the Spanish provinces occurred in the second half of the 19th century in parallel with the integration of the domestic market. A centrifugal tendency is observed, and the geographical structure evolved towards a clear division between inland and coastal provinces with the latter showing a higher market potential than their inland counterparts, the sole exception being Madrid. It is possible to hypothesize that the expansion of the railway network—all province capitals were connected to the railway network by 1901—could account for a large share of the changes described in the pattern of market potential. Once this dual structure was established at the end of the 19th century, the division between inland and coastal provinces persisted during the first few decades of the 20th century.

Figure 4. Market potential in Spanish provinces, 1867-1930 (Barcelona=100)



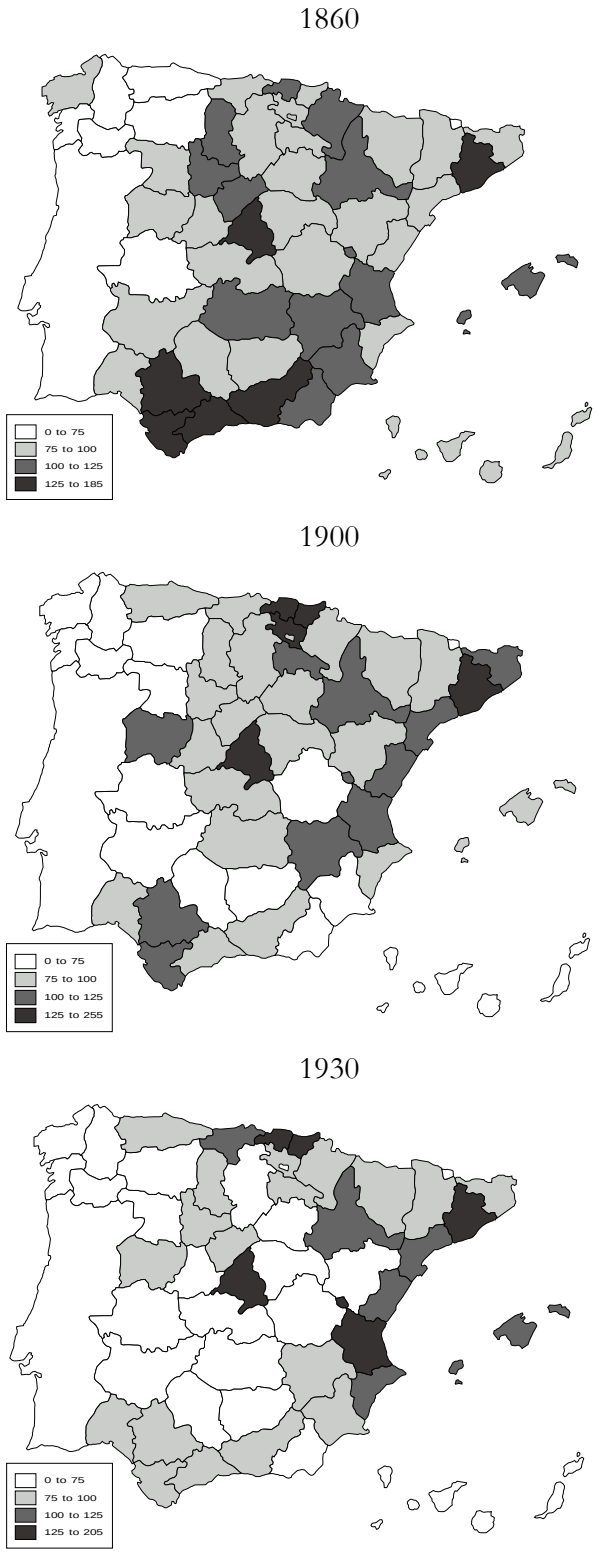
Source: Martinez-Galarraga (2014)

4. Market potential and economic growth in Spain, 1860–1930: nonparametric evidence

From the nonparametric evidence, we seek to analyze whether the changes in relative market potential of the Spanish regions acted as an explanatory element of regional economic inequality. As a first step in the analysis, we present the nonparametric evidence on the relationship between regional per capita GDPs and market potential. To begin with, Figure 5 shows the evidence regarding the geographical distribution of regional inequality at three focal points: 1860, 1900, and 1930.

The evidence shown in Figure 5 apparently illustrates the presence of a relationship between the relative market access of regions and the corresponding regional per capita GDP levels. The centrifugal pattern observed is similar to the evolution of regional market potential (Figure 4), although in the case of per capita GDP the division between inland and coastal provinces is not so marked. To enhance the analysis of these hypotheses, we test the relationship between regional market potential and per capita GDP. To do so, we examine the distribution of regional market potential and the distribution of per capita GDP at the same date. We then study how they are related (Ioannides and Overman, 2004). Figure 6 shows the stochastic kernel estimations of the distribution of regional market potential, conditional on the distribution of per capita GDP at the beginning and at the end of our period of study. In order to make the interpretation easier, the contour plots are also shown. In 1860, both distributions were clearly independent, and regions with similar levels of per capita GDP had very different values of market potential. By 1930, however, this relationship had changed, becoming positive: regions with high per capita GDP also had high market potential. This result illustrates the emergence of a significant positive relationship between market potential and regional per capita GDP at the end of the period analyzed (i.e., 1930).

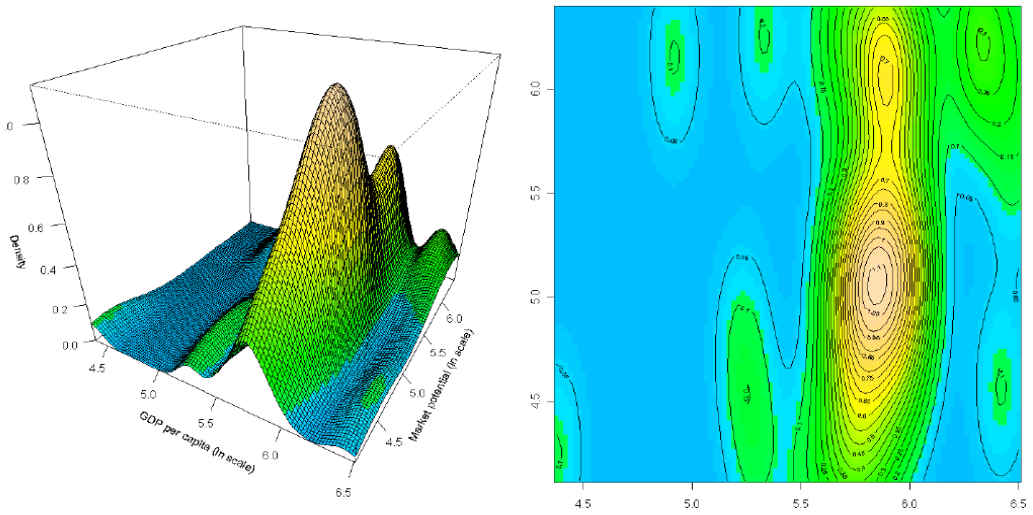
Figure 5. Per capita GDP in Spanish provinces, 1860–1930 (Spain = 100)



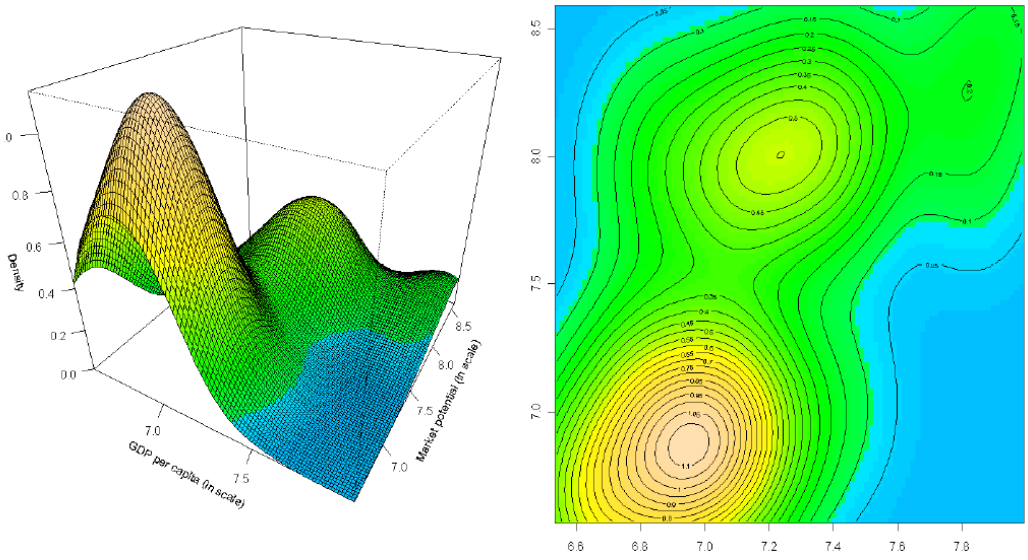
Source: Rosés et al. (2010)

Figure 6. Stochastic kernel estimates of the relationship between regional market potential and per capita GDP

1860, market potential to GDP per capita:



1930, market potential to GDP per capita:

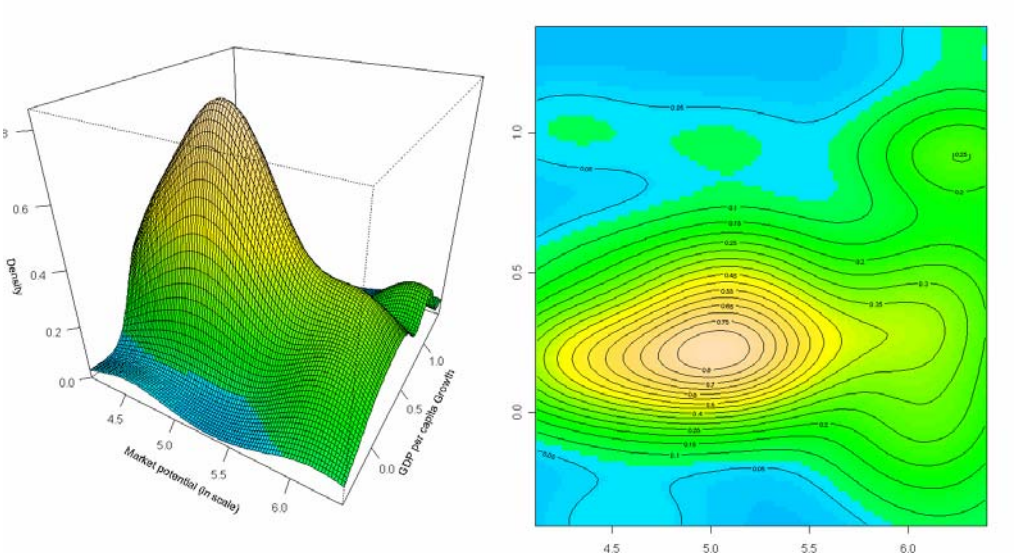


Given this change in the relationship between market potential and per capita GDP, we would expect to find a similar relationship between market potential and per capita GDP growth rates. Figure 7 offers the stochastic kernel estimation of the distribution of regional market potential conditional on the subsequent per capita GDP growth rates. Indeed, the results point in the same direction: in 1860 initial market potential and per capita GDP growth between 1860 and 1900 were independent for most of the distribution, while a clear positive relationship can be deduced for the period going from 1900 to 1930. Thus, a higher market potential implied a higher GDP growth rate in

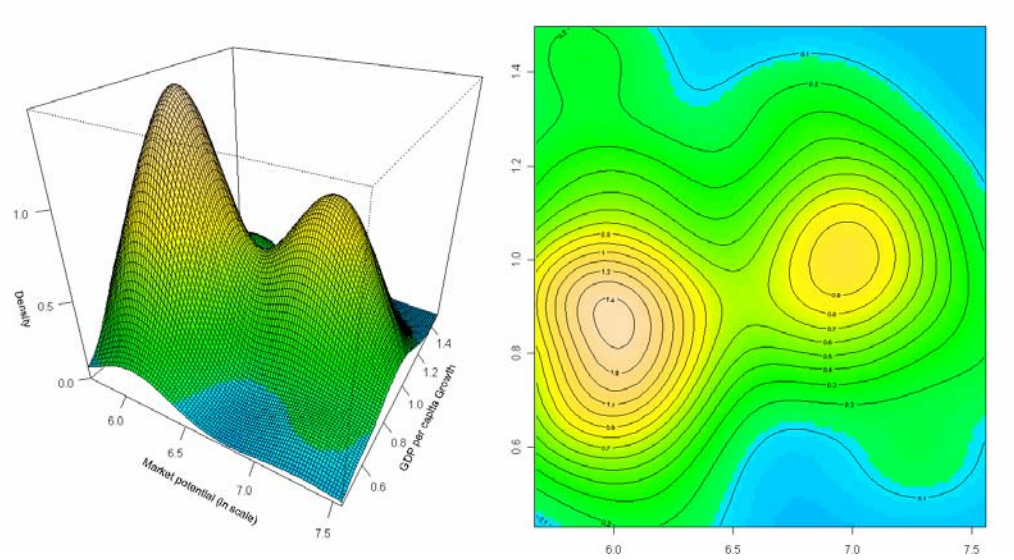
1930, but not in 1860. Overall, these figures indicate a steep change in the relationship between market potential and per capita GDP over time, from independence to a positive influence of market potential on GDP, especially in data corresponding to the period 1900–1930, and particularly in the years 1920–1930. [12]

Figure 7. Stochastic kernel estimates of the relationship between regional market potential and per capita GDP growth

1860-1900, market potential to per capita GDP growth rates:



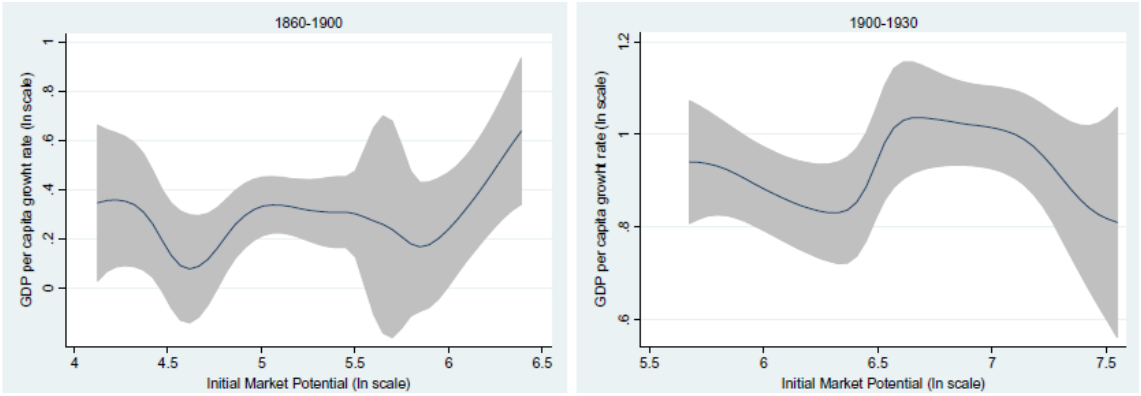
1900-1930, market potential to per capita GDP growth rates:



[12] Figures for all the intermediate periods between 1860 and 1930, omitted from the article due to restrictions on length, are available from the authors upon request.

Next, we conducte a nonparametric estimation of the effects of market potential on regional per capita GDP growth. To do this, we estimate the nonlinear relationship between initial market potential and growth using a local polynomial smoothing for the two main subperiods in our sample (1860–1900 and 1900–1930).[13] Figure 8 shows the results, including the 95% confidence intervals. These graphs complement Figure 7. In the 1860–1900 period, growth can be approximated as a flat line around the value 0.3 for most of the initial market potentials. The relationship is only found to be positive for the highest market potentials, but Figure 7 indicates that the density (the number) of regions with the highest market potential was low. Therefore, although a positive relationship between market potential and regional per capita income growth emerged in the two periods under study, there was a temporal evolution pointing to the increasing influence of market potential over time. Particularly, when focusing on regions with a low initial market potential, the effect on mean per capita GDP growth ranged from 0.2 to 0.4 between 1860 and 1900, and from 0.8 to 0.9 between 1900 and 1930. A similar pattern can be observed for regions with a high initial market potential, although the effect on regional economic growth tended to be higher in these high market potential regions. It ranged from 0.4 to 0.6 in 1860–1900 and from 0.8 to 1 in the period 1900–1930. Moreover, Figure 7 shows that the density (the number) of regions with the highest market potential also increased substantially over time.

Figure 8. Nonparametric estimation of the relationship between regional market potential and per capita GDP growth



[13] The local polynomial smoother fits the growth rate $g_{it} = \left(\ln pcGDP_{it} - \ln pcGDP_{it-1}\right)$ to a polynomial form of $(\ln MP_{it-1})$ via locally weighted least squares. We used the *lpolyci* command in STATA with the following options: local mean smoothing, a Gaussian kernel function to calculate the locally weighted polynomial regression, and a bandwidth determined using Silverman's (1986) rule-of-thumb.

On the basis of this nonparametric evidence, it is possible to identify the existence of a relationship between regional market potential and regional inequalities. This relationship was more important in the period 1900–1930, once the main shifts in the relative market potential of regions were established after the construction of the railway network and changes in external tariff policies took place at the end of the 19th century.

This result is consistent with the evidence provided by Rosés et al. (2010), who found that differences in economic structure and productivity acted together in explaining the upswing in inequality. According to their results, Heckscher-Ohlin forces were the main drivers driving unequal regional development because *between-sector* differences accounted for the majority of regional differences in labor productivity. Nevertheless, *within-industry* differences were also significant in this first phase of Spanish economic growth and market integration, and therefore NEG-type forces could be responsible for the considerable regional inequalities arising during these years. Hence, because the early decades of the 20th century constitute the key period in the relationship studied, the rest of the paper presents the results of analysis that aim to probe into this relationship by making use of the theoretical and empirical method proposed by Ottaviano and Pinelli (2006).

5. Empirical analysis

In the parametric analysis, we exploit the panel structure of our data for the years where we identified the existence of a strong relationship between regional market potential and per capita GDP growth rates. We therefore study the period 1900–1930 using panel data for the subperiods 1900–1910, 1910–1920, and 1920–1930. We depart from the estimation of standard growth regressions derived from the NEG model developed by Ottaviano and Pinelli (2006) for a set of explanatory variables including a measure of market access. The baseline equation, which resembles that proposed by Ottaviano and Pinelli (2006), takes the following form:

$$\ln(w_t) - \ln(w_{t-1}) = \alpha + \beta \ln(w_{t-1}) + \gamma \ln(access_{t-1}) + \delta \ln(controls_{t-1}) + \varepsilon_t, \qquad (2)$$

where the independent variable (i.e., the measure of regional economic performance equal to the logarithmic growth rate of per capita GDP at the province level) is regressed on a set of explanatory variables consistently employed in the growth

literature. Notably, and in contrast to cross-country studies, because regions in the same country tend to share the same institutional framework, this exercise does not include a set of institutional variables. Among the explanatory variables, three sets of variables traditionally considered in the growth literature are included:[14] proximate sources of growth (*physical capital, human capital, knowledge capital, and infrastructures*), structural change variables (*gross value added in mining and the regional share of manufacturing in total employment*)[15], and second nature geography or NEG variables (*market access*). We also include regional fixed-effects to control for other regional characteristics not accounted for in the specification (e.g., first nature causes and geography).

The main explanatory variable in our analysis is regional market potential. In this case, the cross-sectional measure of market potential is normalized by the contemporaneous average market potential to avoid effects from later periods overpowering earlier ones on account of absolute growth in market potential (Black and Henderson, 2003). Regional relative market potential (mp_{it}) can therefore be defined as:

$$mp_{it} = \frac{MP_{it}}{\frac{1}{n_t}\sum_{1}^{n_t} MP_{jt}}.$$

We use alternative measures of market potential, corresponding to the different components of the market potential (see Eq. 1): total, domestic, and foreign market potential. We also use a measure that excludes each province's self-potential to reduce some endogeneity concerns (more on this below).

First, we estimate Eq. 2 by OLS, while correcting for heteroskedasticity by using White's method. Nevertheless, an important component of Harris' market potential function is the contribution of its own GDP to the potential of region *i*, also known as self-potential. By construction, the explanatory variable (i.e., market potential) and the dependent variable (i.e., per capita GDP growth) therefore influence each other and could be simultaneously determined. Furthermore, because we consider the

[14] See, for example, Temple (1999).

[15] It has been pointed out that different paces of structural change could affect regional per capita GDP levels throughout the process of economic industrialization and integration of the Spanish economy, so we attempt to control for this effect in the empirical analysis through the inclusion of variables that capture the productive structure of regions.

infrastructures a key element to explaining the changes in the market potential for regions, our main concern relates to the role of these infrastructures. Policymakers tend to improve infrastructures in the most developed regions, but these infrastructures (roads, railways, etc.) undoubtedly also increase the market access of these locations (Holl, 2012), generating endogeneity and problems with our specification.

To deal with these two issues, we proceed as follows. First, in some estimations we use a measure of market potential that excludes each region's self-potential. By doing so, changes in regional infrastructures may have affected per capita GDP growth in region *i*, but we exclude the possible effect of infrastructures on the market potential of region *i*. In addition, purging the self-potential avoids possible simultaneity problems. Second, to tackle the potential endogeneity problem, we re-estimate Eq. 2 using instrumental variables (IV). We thus need to instrument the market potential variable in the first-stage regressions of the IV estimation. We use two instruments: the (log) distance to the nearest main industrial center (Madrid, Barcelona, or Bilbao) and the lagged regional population density. Population can serve as a good measure of market potential, and in some papers it is used directly instead of GDP (Black and Henderson, 2003; Ioannides and Overman, 2004; Henderson and Wang, 2007). To be cautious, we use the lagged value of the regional population density. Values from 1860 are hence used to estimate market potential in 1900, and so on.

Table 1 shows the results of the OLS estimation of Eq. 2. The first column corresponds to an unconditional convergence regression. The estimated coefficient is clearly significant and negative, indicating convergence across Spanish regions. In the rest of columns, we find that convergence is stronger when all the controls are added. In addition, only one of the four measures of relative market potential is significant: the domestic market potential. As explained previously, however, these OLS estimations are not robust, so we instrument the market potential variables using the lagged regional population density and the (log) distance to the nearest main industrial center, and we estimate the second stage regressions by GMM. These results are reported in Table 2, which also shows some statistics from the first-stage regressions. Our instruments seem to perform well: R^2 in the first-stage regressions exceeds 0.8 in all of the specifications, the weak instruments hypothesis is always rejected using the Stock-Yogo test, and all

the models pass the overidentification test (Hansen J statistic) for any significance level.[16]

Table 1. Regional Growth Regressions (OLS)

Variables	(1)	(2)	(3)	(4)	(5)
Initial per capita GDP	-0.282***	-0.887***	-0.898***	-0.858***	-0.895***
Literacy rate		0.839***	0.826**	0.742**	0.815**
Number of patents per capita		0.736***	0.746***	0.798***	0.746***
GVA in mining		-0.017***	-0.017***	-0.012*	-0.017***
Share of manufacturing in total employment		-3.373***	-3.268***	-4.590***	-3.274***
Total stock of infrastructures		0.322***	0.345***	0.229**	0.341***
Relative market potential		0.003			
Relative market potential without self-potential			-0.058		
Relative domestic market potential				0.204*	
Relative foreign market potential					-0.028
Regional fixed-effects	No	Yes	Yes	Yes	Yes
R^2	0.141	0.629	0.632	0.641	0.631
Observations	141	141	141	141	141

Note: Dependent variable: per capita GDP growth rate (ln scale). All variables in logarithmic scale, except rates and relative market potentials. Significant at the *10%, **5%, ***1% level. All the specifications include a constant.

As regards the control variables, we first focus on the proximate sources of growth. The coefficients associated with the human capital stock, proxied by provincial literacy rates, knowledge capital, proxied by the number of patents per capita, and the provincial stock of infrastructures are all found to be significant (with the exception of the stock of infrastructures in regression 1) and to have the expected signs. That is to say, they confirm the presence of a positive relationship between the relative stocks of these cumulative factors and regional growth.

Nevertheless, results also show the presence of a negative and significant relationship between the structural change variables (share of manufacturing in total employment and GVA in mining) and regional economic growth. Although this result may seem counterintuitive, it is worth noting that between 1860 and 1900 Spain experienced a dramatic increase in regional inequality associated to the divergence of regional

[16] The complete results of the reduced regressions, first-stage regressions and all the tests, excluded from the article due to restrictions on length, are available from the authors on request.

economic structures. So, regions experiencing a fast transformation of their economic structures grew faster than territories where this process was less impressive. In contrast, 1900 marked the onset of a tendency towards the stabilization of regional income per capita inequality levels, propelled by the progressive convergence in economic structures of Spanish regions (Rosés et al., 2010). The estimated negative relationships between structural change values in 1900 and regional economic growth during the period 1900–1930 are consistent with this rationale.

Table 2. Regional Growth Regressions (IV, GMM)

Variables	(1)	(2)	(3)	(4)
Initial per capita GDP	-0.798***	-0.819***	-0.808***	-0.829***
Literacy rate	0.853***	0.940***	0.682**	1.062***
Number of patents per capita	0.733***	0.666***	0.797***	0.654***
GVA in mining	-0.012*	-0.015**	-0.008	-0.017**
Share of manufacturing in total employment	-5.151***	-3.999***	-5.279***	-4.035***
Total stock of infrastructures	0.130	0.184*	0.173*	0.182*
Relative market potential	0.369***			
Relative market potential without self-potential		0.395**		
Relative domestic market potential			0.290*	
Relative foreign market potential				0.229**
Regional fixed-effects	Yes	Yes	Yes	Yes
First stage, uncentered R^2	0.950	0.926	0.983	0.868
First stage, F-test (p-value)	24.15	17.39	19.48	17.50
Hansen J statistic (p-value)	0.598	0.421	0.012	0.524
Uncentered R^2	0.714	0.663	0.774	0.665
Observations	141	141	141	141

Note: Dependent variable: Per capita GDP growth rate (ln scale). All variables in logarithmic scale, except rates and relative market potentials. Significant at the *10%, **5%, ***1% level. All the specifications include a constant.

The IV results confirm the positive effect of initial market potential on per capita GDP growth. The estimated coefficients of the four measures of market potential are significant and positive, and the estimated values are similar, albeit differing by around 0.3. The biggest coefficient belongs to the relative market potential excluding self-potential (0.395), although this value is not far from that of the relative market potential (0.369). This result is noteworthy. The regression using the market potential that excludes each province's self-potential should be especially robust because, by excluding the self-market of the region, we avoided some potential endogeneity and simultaneity concerns.

Interestingly, the coefficient associated with the variable measuring domestic market potential is bigger than that of the foreign market potential. Both are significant. This result must be analyzed in the context of the implementation and reinforcement of a protectionist trade policy by successive Spanish governments from the late 19th century until the 1920s, as explained in Section 2. As protectionism was consolidated, the domestic market potential became more relevant than foreign markets as a driver of regional per capita growth rates. This result confirms the evidence obtained in previous analyses of the industrial sector in Spain during the interwar years (Tirado et al., 2013).

6. Conclusions

Regional income inequality is prevalent in apparently well-integrated economies such as those of the European Union. In fact, as pointed out in the introduction, although income differences across EU Member States have fallen over the past years, inequalities between regions within each Member State have persisted. So, despite considerable resources having been devoted to reducing this divergence, regional inequality remains a matter of concern for European policymakers. We argue that empirical analysis of the historical determinants of regional income inequality, through a period of long-term growth, and integration both internal and external of national economies could be of great help for gaining an understanding of the differences in economic growth across territories.

From a theoretical point of view, international and regional economics have explained income disparities on the basis of differences between regions owing to their endowments of natural resources, factors of production, infrastructure, and technology. In this context, the removal of obstacles to the flow of goods and/or factors would by itself cause convergence of factor returns and living standards. As posited by new economic geography theory, however, relevant forces, which can affect regional disparities—even without large differences in underlying characteristics—and prevent convergence are overlooked in traditional analysis. NEG theoretical models state that the interaction between transport costs, increasing returns and size of market under a monopolistic competition framework can lead to spatial agglomeration of economic activity and to the upsurge of income differences across regions (Krugman, 1991).

In order to contribute to this empirical debate, we have analyzed the determinants of regional inequality in Spain during the period 1860–1930. We believe that the Spanish experience can serve as an illustrative case study for (at least) two reasons. First, in Spain, more than 150 years of economic and political integration have not led to the disappearance of per capita GDP differences between regions. Second, such long-term analysis would permit us to examine whether the effects of the factors highlighted by NEG models (market access) on regional economic growth were relevant during the first stages of economic growth and the process of integration of the Spanish national market.

To complete these aims, we first used an empirical model that, drawing upon the work of Ottaviano and Pinelli (2006), allowed us to analyze in the same framework the role of factors highlighted by Solow-type growth and NEG literature on long-term regional economic growth in Spain. Second, we used the new evidence on regional Spanish per capita income and on market potential for the years 1860–1930. This evidence came from Rosés et al. (2010) and Martinez-Galarraga (2014), respectively. To complete our dataset, we also gathered the data commonly used in growth regressions to identify the main forces that explain regional growth in Spain between 1860 and 1930.

Overall, the results of the empirical analysis indicate that geography matters when explaining regional asymmetric growth, especially during the period 1900–1930. During the second half of the 19th century, agriculture was still the predominant sector in the Spanish economy, industry had begun to take root in only a limited number of regions. Nevertheless, our results show that since the beginning of the 20th century NEG forces, through market potential, had a positive influence on provincial growth differentials, even when we controlled for the proximate causes of growth. The emergence of agglomeration forces would be the outcome of the interaction between increasing returns to scale and a drop in transport costs. These changes were brought about by Spanish industrialization during the second half of the 19th century and the completion of the railway network and the subsequent fall in transport costs, which propelled the integration of the Spanish economy.

Our results can also be analyzed in a context whereby the evolution of regional inequality depends on the magnitude of the impact of structural change and agglomeration forces. Whereas the second half of the 19th century was characterized by

a surge in regional inequality due to increasing provincial differences in structural change, the early decades of the 20th century witnessed a stabilization of per capita income disparities. This period of history was characterized by a convergence in the economic structures of Spain's provinces as industrialization spread to more territories. This evolution counterbalanced the tendency towards agglomeration triggered by the emergence of NEG-type mechanisms. In addition, the protectionist approach of Spain's trade policy from the late 19th century onwards enhanced the role of the domestic market as an explanatory factor of differences in the economic growth of regions.

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