

The upswing of regional income inequality in Spain (1860–1930)

Joan Ramón Rosés ^{a,*}, Julio Martínez-Galarraga ^b, Daniel A. Tirado ^b 

^a *Departamento de Historia Económica e Instituciones and Instituto Figuerola, Universidad Carlos III de Madrid, C/Madrid 126, 28903 Getafe, Spain*

^b *Departament d'Història i Institucions Econòmiques and XREPP, Universitat de Barcelona, Avg. Diagonal 690, 08034 Barcelona, Spain*

A B S T R A C T

This paper studies the evolution of Spanish regional inequality from 1860 to 1930. The results point to the coexistence of two basic forces behind changes in regional economic inequality: industrial specialization and labor productivity differentials. The initial expansion of industrialization, in a context of growing economic integration of regions, promoted the spatial concentration of manufacturing in certain regions, which also benefited from the greatest advances in terms of labor productivity. Since 1900, the diffusion of manufacturing production to a greater number of locations has generated the emulation of production structures and a process of catching up in labor productivity and wages.

Keywords:

Industrialization
Market integration
Heckscher–Ohlin model
New economic geography
Regional convergence

1. Introduction

A source of concern among policy makers is the possibility that the processes of cross national integration, like the European Union and NAFTA, may result in increasing regional inequality.¹ Furthermore, the predictions made by economic theory about the impact of integration on regional economic inequality are at best ambiguous, which calls for empirical analysis.

The Neoclassical trade theory (the Heckscher–Ohlin (HO) model) argues that regional incomes differ because of differences in factor endowments and factor prices (Harry Flam and Flanders, 1991; Slaughter, 1997). The factor price equalization (FPE) theorem, within this framework, is optimistic about the consequences of market integration: the increase in trade and factor movements leads to factor price equalization across regions, and hence, per capita GDP convergence.² It should be noted, however, that market integration may also lead to increasing regional specialization because regions differ in factor endowments. In this situation, the standard HO model allows FPE but not income equality (Rassekh and Thompson, 1998; Slaughter, 1997). Conversely, if regional differences in factor endowments tend to decrease and factor prices converge, one should observe a reduction in regional income disparities.³

On the other hand, the recent new developments in trade theory, the New Economic Geography (NEG), are even less optimistic about the regional inequality impact of integration processes.⁴ NEG models are constructed around the idea that the

* Corresponding author. Fax: +34 91 624 95 74.

E-mail addresses: jroses@clio.uc3m.es (J.R. Rosés), julio.martinez@ub.edu (J. Martínez-Galarraga), datirado@ub.es (D.A. Tirado).

URLs: http://www.uc3m.es/portal/page/portal/dpto_historia_economica_inst/profesorado/joan_roses (J.R. Rosés), <http://www.ub.edu/histeco/cat/jmartinez.htm> (J. Martínez-Galarraga), <http://www.ub.edu/histeco/cat/tirado.htm> (D.A. Tirado).

¹ In the case of the process of European integration, which has lasted more than half a century, regional differences within countries have soared, albeit a substantial decrease in cross-national differences in GDP per capita (Puga, 2002). The fact is that substantial regional inequality appears to be an enduring characteristic of the European economic landscape. Spain is a good example of this situation. According to the most recent data published by the Spanish statistical office (INE, 2008), per-capita GDP in the richest Spanish NUTS II region (the Basque Country) was about two times that in the poorest region (Extremadura).

² However, to hold, the FPE theorem requires a long list of strict assumptions. See, for example, Samuelson (1949), Deardorff (1986) and Leamer (1995).

³ Kim (1998).

⁴ Baldwin et al. (2003) and Fujita et al. (1999) offer an extensive analysis of this framework.

existence of product differentiation, increasing returns to scale and transport costs may generate pecuniary externalities in firms and workers' location choices. In the presence of factor mobility or intermediate inputs, these three factors give rise to agglomeration and, hence, uneven regional specialization. As workers tend to concentrate in a given location, the resulting shift in local demand increases the incentive for firms to concentrate production in that location. Also, workers may obtain a wage premium in these places due to the presence of Marshallian externalities and the subsequent higher labor productivity levels.⁵ In sum, NEG argues that market integration could lead to regional divergence.

To further complicate the situation, economic integration is not the only causal factor for regional convergence and divergence. Williamson (1965) pointed out that regional inequality could have been growing during the initial phases of modern economic growth and declining from certain levels of development. So, in the long run, in parallel with the processes of economic integration and industrialization, changes in economic inequality may have followed an inverted U shape. Similarly, several authors have emphasized the importance of structural change in regional inequalities. For example, Caselli and Coleman (2001) related the convergence among regions within the US to the reduction of agricultural employment in the poorest locations. To summarize, a substantial literature has related the upward trend in regional per capita GDP inequality to the unequal distribution of industrial production.

Finally, the growth theory also offers insights about the causes of regional inequality. In the textbook Solow model, in a closed economy context, differences in capital per worker led to slow income convergence across locations (Barro and Sala-i-Martin, 2003). If we add to the model cross regional movements of capital, convergence rates may increase due to the fact that capital moves from capital abundant to capital scarce regions following differences in its relative remuneration (Barro et al., 1995). The new strand of growth theory, the endogenous growth theory, also makes contradictory predictions about the impact of cross regional integration. In the presence of increasing returns, the basic model (Romer, 1986) predicts that increasing movements of capital will lead to regional divergence. Instead, if we consider that technology is not a public good and, hence, subject to decision making processes of individual agents and their prospect for monopoly rents, an increased scale of the economy will have a lasting positive effect on growth. The monopoly rent increases with the number of consumers, while the costs for innovation are independent of the size of the economy (Crespo Cuaresma et al., 2008).

An obvious historical precedent of these economic unions among nations is the emergence of national markets in many European countries and the United States. During the 19th century, institutional barriers to trade and factor movements within countries were eliminated, transport costs decreased dramatically (particularly with the construction of the railway networks and the improvements in sea transport), and national monetary and financial markets emerged. As a consequence, domestic movements of people, capital and goods grew, and the prices of commodities and production factors tended to converge across locations.⁶ On the other hand, the creation of these national markets was sometimes contemporary to industrialization processes and the subsequent processes of structural change and regional specialization.⁷

In this context, the study of the Spanish experience is particularly appealing. First, the Spanish national market emerged over the second half of the 19th century as a consequence of the expansion of the railway network, the liberalization of markets and the development of a national financial system. However, domestic migrations and structural change were relatively unimportant up to the years following World War I (see Section 2). Second, industrialization developed in certain regions, like Catalonia and the Basque Country, while a large part of the country remained agrarian (Nadal, 1974). Third, different studies have confirmed the fact that manufacturing production became increasingly concentrated during the period, as is suggested by the NEG models (Rosés, 2003; Tirado et al., 2002). Nevertheless, we had sparse and inconclusive evidence about the impact of this industrial concentration on regional income disparities (Rosés and Sánchez Alonso, 2004). Finally, in the European context, Spain was a relatively large country with a low population density that specialized in exportation of agricultural goods and minerals. So, one could expect that its experience to be situated in between two extreme historical experiences: that of the United States, which is characterized by land abundance, the expansion of the land frontier and important transport costs (Kim, 1995, 1998, and Kim and Margo, 2004), and that of Britain, which is marked by high population density, the international specialization in manufacturing exports, and low transport costs (Crafts and Mulatu, 2005, 2006).

The rest of the paper will proceed as follows. Section 2 discusses the process of creation of the Spanish national market. In Section 3, we describe the methods and sources for constructing our new per capita regional GDP database. In Section 4, we present the main stylized facts on the evolution of Spanish per capita regional GDP. The following section considers the subsequent regional specialization and the industrialization patterns. Section 6 decomposes the determinants of regional variation in per capita GDP. Section 7 presents the conclusions.

2. The formation of the Spanish national market

Before the mid 19th century, Spanish regions were relatively independent regional economies. Barriers to interregional trade and the movement of capital and labor were ubiquitous: local tariffs and regulations on domestic commerce were

⁵ An interesting variation of this framework, which combines the HO and the NEG models, is offered by Epifani (2005). This author showed that: (1) if regional differences in endowments are relatively small, agglomeration forces induce an over-specialization, which results in a reversion of the relation between factor prices and factor abundance; and (2) if trading partners are very dissimilar in terms of endowments, the predictions of the Heckscher-Ohlin framework, including the FPE theorem, hold.

⁶ See, for example, Boyer and Hatton (1997) on Britain, and Slaughter (2001) on the United States.

⁷ The classical account of this process is Pollard (1981).

modity markets were scarcely integrated, albeit a certain dependence in commodity prices existed since the eighteenth century,⁸ and prices of production factors differed markedly from one region to another.

Both market liberalization and transport improvements, particularly the completion of Spain's railway network, induced the creation of a national market for most important commodities during the second half of the 19th century.⁹ The successive political reforms of the 19th century gave legal backup to property rights, eliminated tariffs and local restrictions on home commerce and assured the free mobility of people and capital. These actions were implemented in three long waves: the Liberal Revolution (1836–1840), the “Bienio Progresista” (1854–1856) and the “Sexenio Revolucionario” (1868–1874).¹⁰ Simultaneously, major improvements in transport and communication systems took place. The extension of paved roads increased exponentially, from 2000 km to 19,815 km, between 1800 and 1868 (Madrazo, 1984, pp. 163–179). Coastal shipping experienced major advances as a consequence of the improvements in ports and ships, although these technical improvements arrived later and had a smaller impact than in other countries (Frax, 1981). Finally, the Spanish railroad network was completed from 1860 to 1890. With the railways, unit transport costs fell, permitting a widening of the market, growth in urbanization, and an increase in agricultural specialization (Gómez Mendoza, 1982; Herranz, 2006). However, in spite of those gains, the total direct impact of the Spanish railroads was not superior to other European countries given the low importance of railroad transport within Spanish GDP (Herranz, 2006).

The chronology of the creation of capital and labor markets was markedly different from that of commodity markets. In the case of capital markets, integration could be analyzed by observing the premium paid in commercial paper. In Spain, since the eighteenth century, the movements of capital across the main financial centers were based on a system of inland bills of exchange and a network of local based merchant bankers (Castañeda and Tafunell, 1997; Maixé Altés and Iglesias, 2009). These bills were not only subject to transaction costs, but also paid a market premium related to local capital market imbalances. However, commercial paper showed a rapid decline in interregional short term interest rate differentials after 1850 (Castañeda and Tafunell, 1997). This convergence in interest rates across regions could be attributed to profound changes in the banking system. The Spanish banking system began its modernization during the early 1840s, when a new legal framework allowed the establishment of private banks organized as limited liability corporations (Tortella, 1973). Several of these banks were also granted the right of issuing banknotes that had legal tender in the same town where they had been issued but were not accepted elsewhere (Sudrià, 1994). This right of local emission did not ease the integration of capital markets since each issuing bank pursued its own monetary policy. As a result, banknotes were exchanged across cities at a premium. Furthermore, commercial banks had no branches nationwide until the early twentieth century (Anes et al., 1974). However, a new political reform of the financial system dramatically altered this state of affairs. In 1874, the Banco de España became the sole issuing bank, and a national currency—the Peseta—was established (Martorell, 2001). Eleven years later, in 1885, Banco de España developed the first nationwide branch network, allowing movements of capital across towns at constant and cheap rates and, hence, integrating the national capital market (Castañeda and Tafunell, 1997).

The integration of Spanish labor markets has progressed markedly since mid-19th century, albeit the evidence concerning the existence of a fully integrated national labor market is not conclusive. More specifically, the PPPs adjusted wage evidence shows that rural and urban wages converged across different locations prior to World War I, despite low rates of internal migration. This process of wage convergence was interrupted by World War I, which produced a sharp increase in regional wage differentials. These increases proved to be temporary, however; wage convergence re-emerged in the 1920s, this time accompanied by internal migration and substantial re-allocation of labor from agriculture to industry. Despite these patterns, regional disparities remained important within Spain on the eve of the worldwide Great Depression (Rosés and Sánchez Alonso, 2004).

3. A new database on Spanish regional per-capita GDPs: methods and sources

Our estimation of Spanish per capita regional GDP is mainly based on the methodology developed by Geary and Stark (2002).¹¹ This departs from the basic principle that the national per capita GDP is equal to the sum of all regions' per capita GDPs. Algebraically, the total GDP of the Spanish economy is the sum of all regional GDPs:

$$Y_{ESP} = \sum_i Y_i \quad (1)$$

However, given that provincial GDP (Y_i) is not already available, this will be proxied according to the following equation:

$$Y_i = \sum_j y_{ij} L_{ij} \quad (2)$$

⁸ See, for example, Ringrose (1996).

⁹ Barquín (1997), Martínez Vara (1999), Peña and Sánchez-Albornoz (1983) and Simpson (1995).

¹⁰ On these liberal reforms, see Tedde de Lorca (1994) and Simpson (1995).

¹¹ We used regional population data from Nicolau (2005) to convert each region's GDP estimates to GDP per capita.

$$Y_i = \sum_j \left[y_j \beta_j \left(\frac{w_{ij}}{w_j} \right) \right] L_{ij} \quad (3)$$

where, as suggested by Geary and Stark (2002), w_{ij} is the wage paid in region i in sector j , w_j is the Spanish wage in each sector j , and β_j is a scalar that preserves the relative region differences but scales the absolute values so that the regional total for each sector adds up to the Spanish totals.¹² So, in the absence of output figures, Geary and Stark (2002) set a model of indirect estimation based on wage income, which allows for an estimation of GDP by region at factor cost, in current values. The basic data involved in this estimation procedure are national output per worker by sector, and nominal wages and active population, by sector and region. However, in several industries (see below), we had not to resort to indirect estimates given direct estimates of regional output had been computed. It should be noted that this methodology also allows us to compute not only regional GDPs but also figures for the different industries. Geary and Stark (2002) distributed regional GDPs in three different industries (agriculture, manufacturing and services) but, instead, we have considered up to five sectors (agriculture, mining, manufacturing, construction and services) for Spain given the availability of data. However, to simplify our further discussion, we will aggregate mining, manufacturing and construction to generate industrial sector value added.

3.1. Agriculture

In agriculture, we were able to compute direct production estimates (nominal gross value added) for 1900, 1910, 1920 and 1930. More specifically, the quantities of production of different agrarian products collected by GEHR (1991) were multiplied by the relative prices and the transforming coefficients provided by Simpson (1994). Then, these real values were converted into nominal values using the disaggregated agrarian prices provided by Prados de la Escosura (2003). Finally, we have scaled the absolute values so that the provincial total for each sector adds up to the Spanish totals for agricultural value from Prados de la Escosura (2003).

For the year 1860, we have employed a modified version of Geary Stark's method. A major problem with agricultural estimations is that we know the daily wages but not the amount of working days over the year and the amount of female work force in agriculture. Moreover, it is likely that these factors varied widely across regions. For this reason, we have modified the initial estimation based on the original method with a scalar computed by dividing our direct estimation for 1910 by that obtained with Geary Stark's method.¹³ In consequence, we assume that the amount of days worked and the relative amount of women working in each province remained constant between 1860 and 1910.

3.2. Mining

The provincial mining production was calculated from information on the production values disaggregated by province, which were drawn from the Spanish Statistical Yearbook (*Anuario estadístico de España*) for the years 1860, 1910, 1920 and 1930.¹⁴ These figures allowed us to distribute Spain's mining gross value added at factor cost between the different provinces. However, given the absence of direct production data for 1900, we resorted to an alternative methodology: the active provincial population engaged in mining in 1900 was multiplied by a productivity coefficient obtained from 1920 data.¹⁵ In other words, we assume that labor productivity in mining in each province in 1900 was equal to that in 1920.

3.3. Industry: manufacturing and public utilities

To carry out the estimation of regional industrial value added, we begin by assuming the existence of a production function with constant returns to scale where the output is obtained from the contribution of two production factors, labor and capital. In this sector, we have followed the refinement of Crafts (2005) to the original Geary and Stark (2002) methodology, using tax data to allocate non wage manufacturing income across regions. The industrial gross value added (GVAIND) is defined as:

$$GVAIND_{it} = \alpha_{it} (\omega_{it} * L_{it}) + (1 - \alpha_{it}) (r_{it} * K_{it}) \quad (4)$$

with α_{it} being the share of the wage income in industrial gross value added in region i at time t , ω_{it} industrial wage in region i at time t , L_{it} the total active industrial population in region i at time t , r_{it} the returns to capital in industry in region i at time t , and K_{it} the capital stock in industry in i at time t . For the Spanish case, there is information available for each of the components of Eq. (4) except for r_{it} . For this reason, we had to assume perfect capital mobility. Then,

¹² Spanish GDP was taken from Prados de la Escosura (2003).

¹³ The source of wages is Rosés and Sánchez-Alonso (2004), and the source of agricultural population is the Spanish population census.

¹⁴ We have taken the values of 1915 for 1910 and 1931 for 1930.

¹⁵ This is the year in which mining workforce was more exactly registered by Spanish population census (Foro Hispánico de Cultura, 1957). Chastagneret (2000) gives support to this assumption.

that the number of yearly working days is identical in all provinces, we computed the wage income by multiplying wages by the size of the industrial working population.¹⁸

The data for constructing provincial capital income in Eq. (4) were drawn from several fiscal sources. The main source for our calculations is the *Estadística Administrativa de la Contribución Industrial y de Comercio* (EACI) that collects all statistical information on the industrial tax, which was established in 1845. This industrial tax consisted of a fixed rate over the main means of production in use (Nadal and Tafunell, 1992, p. 256). The rate was different for each type of machinery and industrial branch, but did not adjust immediately to changes in machinery productivity. Furthermore, the coverage of this tax was modified substantially by 1907. Joint stock companies, which were the largest Spanish industrial firms, were exempted from industrial tax payment but assigned to a new corporate tax based on net profits (Impuesto de Sociedades). More prominently, over the years, many firms transformed themselves into joint stock companies in order to benefit from the lower tax rates of this new corporate income tax (Nadal and Tafunell, 1992, p. 259). Later, in 1921, all types of partnerships were assigned to this corporate tax, and hence, many firms were exempted from the payment of the old industrial tax. In consequence, from the year 1907 onward, the information given by the EACI is not representative of industrial activities. Fortunately, *Betrán* (1999: 674–675), in this monumental study on the industrial localization in Spain in the first third of the 20th century, reconstructed the industrial taxes paid in each province in 1913 and 1929, employing data on the two types of taxes paid by industrial companies. In sum, fiscal sources and *Betrán* (1999) allow us to compute the regional participation in the capital income in 1856, 1893, 1913 and 1929.¹⁹

Once the provincial distribution of labor and capital income is obtained, we need to calculate the weight of each factor's income in total industrial gross value added. In this respect, substantial international evidence shows that the output proportions in labor and capital remain relatively stable for long periods (Gollin, 2002). For this reason, we have opted to compute different factor shares for each industry, but not for each industrial benchmark. It should be noted, however, that, given that provincial industrial structure varies over time, these shares also varied in the different benchmarks at the provincial level. More specifically, to compute these factor shares, we used the information from the Input Output Table for Spain in 1958 (*Vicesecretaría Nacional de Ordenación Económica*, 1962.).²⁰ From this source, capital and labor shares were calculated for nine industrial branches²¹. We thus can identify, for this level of aggregation, the factor shares according to the productive structure of the industrial sector in each province and year. The data on the provincial productive structure by year were obtained from the same fiscal sources discussed in the previous paragraph. Finally, with this information, specific factor shares for each province and for each benchmark were constructed, except for the Basque Country and Navarre.²²

3.4. Construction

This sector is composed of two subsectors: residential construction and public works. Data on residential construction were distributed across provinces, with data on urbanization rates (the percentage of the population living in cities with more than 5000 inhabitants) from *Reher* (1994). In the case of public works, we distributed gross national value added across provinces, with data on the provincial stock of infrastructures from *Herranz* (2008).²³

3.5. Services

Many historical studies have suffered from the absence of information on wages in the service industries. *Geary and Stark* (2002: 923), who faced the same problem in their study of the British economy, calculated the service sector wages as a

¹⁶ We have also corrected for errors and underreporting of original data according to *Foro Hispánico de Cultura* (1957).

¹⁷ *Madrazo* (1984) provided data for 1860, *Sánchez-Alonso* (1995) for 1900, *Ministerio de Trabajo* (1927) for 1920, and *Silvestre* (2003) for 1910 and 1930. However, this kind of data is not available for the Canary Islands; we had to assume that their wages are equal to the lowest of the Peninsula.

¹⁸ It should be noted that the coverage of the wages database is far from perfect; thus, we had to make some assumptions: first, the series of wages, not homogeneous throughout time, are representative of industry; second, as regards the use of nominal wages, there will be bias to the extent that there are regional variations in price levels (*Geary and Stark*, 2002, pp. 933–934).

¹⁹ For 1920, due to the absence of fiscal data, capital shares were interpolated employment figures for 1910 and 1930. Finally, the addition of the Basque Country and Navarre in the second half of the 19th century relies on the data in *Parejo* (2001), who estimated the contributions of these regions to the Spanish total based on the historical indices of industrial production. This regional information was split by provinces according to the share of industrial active population in each date.

²⁰ Using this source to elaborate the factor-shares and then apply them in retrospect implies the assumption that the intensity in the use of factors in 1958 is a good proxy for previous years. However, we have to point out that this assumption has also been employed in previous estimations of the Spanish Industrial Production Indices (*Carreras*, 1983; *Prados de la Escosura*, 2003).

²¹ The industrial branches are food, textiles, metal, chemicals, paper, wood, ceramic, leather and miscellaneous industries. However, due to data restriction, the industrial branches considered are only seven (food, textiles and footwear, metal, chemicals, paper, wood and cork, and ceramics) in 1913 and 1929.

²² Since this fiscal information is not available for the Basque Country and Navarre, and it is not possible to know their industrial structures, a similar labor share to the Spanish total is assumed for these regions.

²³ Given that *Herranz's* (2008) database is only available from 1870 onwards, the data for 1860 was only based on urban population.

Madrid	177	Basque C.	205	Catalonia	192	Catalonia	204	Madrid	180
Andalusia	136	Catalonia	184	Basque C.	155	Basque C.	178	Catalonia	167
Catalonia	114	Madrid	163	Madrid	152	Madrid	164	Basque C.	164
Valencia	106	Rioja	108	Balearic I.	101	Navarre	113	Balearic I.	123
Navarre	105	Valencia	105	Valencia	100	Valencia	110	Valencia	120
Balearic I.	105	Cantabria	99	Andalusia	98	Aragon	108	Cantabria	113
Murcia	102	Asturias	94	Aragon	95	Cantabria	94	Navarre	98
Aragon	102	Aragon	92	Cantabria	90	Asturias	87	Aragon	97
Castile–L.M.	97	Andalusia	87	Rioja	88	Balearic I	82	Asturias	95
Basque C.	92	Castile–L.M.	86	Navarre	87	Castile–Leon	81	Murcia	86
Rioja	89	Navarre	83	Castile–Leon	80	Andalusia	76	Rioja	83
Castile–Leon	86	Baleares	82	Castile–L.M.	78	Castile–L.M.	72	Andalusia	77
Cantabria	82	Castile–Leon	82	Asturias	68	Canary I.	72	Castile–Leon	73
Canary I.	79	Extremadura	66	Murcia	67	Rioja	70	Canary I.	71
Extremadura	76	Extremadura	62	Extremadura	65	Murcia	69	Castile–L.M.	65
Asturias	56	Canary I.	60	Canary I.	65	Extremadura	53	Galicia	64
Galicia	49	Galicia	54	Galicia	61	Galicia	49	Extremadura	58

Notes: GDP is regional per-capita GDP with Spanish average set equal to 100. Numbers are subject to rounding errors.
Sources: see Section 3.

weighted average of the agriculture and industry series in each province, where the weights were each sector's share of the labor force. Our strategy is slightly different. Prados de la Escosura (2003) provided the gross value added of eleven different branches of the Spanish service industry: transport, communications, trade, banking and insurance, housing, public administration, education, health services, hotels and restaurants, domestic services and professions. Taking into account this level of disaggregation, we compiled the data on the active population from the Population Censuses. We scaled the absolute values so that the provincial total for each sector adds up to the Spanish totals for the working population engaged in services from Prados de la Escosura (2003). Then, according to the skills and productivity levels of the workforce, we employed different wages. More specifically, we resorted to agrarian wages for domestic service; an unweighted average of industry urban unskilled and skilled wages for commerce, hotels and restaurants; an unweighted average of agrarian and industry urban wages (unskilled and skilled) for transport and communications; and, finally, urban skilled wages for the remaining branches.²⁴

3.6. Stylized facts of the Spanish regional inequality

Before introducing more sophisticated methodologies, it is useful to look at the evolution of regional per capita income trends during the period. Our objective in the next paragraphs is to establish several stylized facts about regional development in Spain. Table 1 ranks all regions according to their 1860, 1900, 1910, 1920 and 1930 per capita relative incomes.²⁵

Relevant evidence stands out from this table. First, the marked stability of the top ranking positions is apparent. Madrid and Catalonia were always among the three first positions of the ranking. Only Andalusia lost this prominence position in 1900, when it was replaced by the Basque Country, which stayed there for the next thirty years. Second, the lower ranking positions also showed notable stability. In particular, Galicia and Extremadura were always in the lower segments of the ranking (i.e., the last four positions). Finally, one can also observe the progressive emergence of a core periphery structure of per capita GDP in Spain, which seems completely formed by 1930.²⁶ The core was located in a triangular area with vertices at Madrid, the Basque Country and Catalonia, while the poorest regions were situated at the Portuguese frontier. In other words, per capita income had a decreasing gradient from the northeast to the southwest of Spain.

Table 2 displays information on the evolution of three different measures of per capita GDP inequality (the Gini coefficient, the Theil index, the variance of logarithms, and their bootstrapped standard errors). Inequality increased substantially during this period of economic growth, market integration and industrialization. Thus, over the entire period, σ convergence (Barro and Sala i Martin, 1991) across Spanish regions did not take place. Also, inequality experienced several trends: rising from 1860 to 1900, declining up to 1910, rising again until 1920 (this year marking the maximum of the period), and declining thereafter.

²⁴ Underlining wages were drawn from Rosés and Sánchez-Alonso (2004).

²⁵ Spanish per-capita GDP log-growth rates (Prados de la Escosura, 2003) during the period were: 0.92 percent (1860–1900); 0.59 percent (1900–1910); 1.39 percent (1910–1920); 1.85 percent (1920–1930) and 1.07 percent (1860–1930).

²⁶ It is important to note that this core-periphery structure is still present in the Spanish economic geography. According to the most recent information from the INE (2008), the richest Spanish regions are Madrid and regions located at the French frontier (the Basque Country, Navarre, Catalonia and Aragon), while the poorest regions are those located in the southern and western parts of the country (Canary Islands, Galicia, Murcia, Andalusia, Castile–La Mancha and Extremadura).

	(0.037)	(0.040)	(0.045)	(0.046)	(0.028)
Theil index	0.046	0.077	0.067	0.101	0.074
	(0.019)	(0-022)	(0.025)	(0.029)	(0.015)
Variance of logs	0.107	0.134	0.115	0.178	0.135
	(0.042)	(0.046)	(0.046)	(0.063)	(0.034)

Notes: The number of observations is 17 in all indices. All inequality indices are population weighted. The standard errors have been bootstrapped with 50 replications.

Sources: see Table 1.

How large were the historical Spanish inequality levels when compared with those prevalent today? The Spanish Gini coefficient of per capita regional GDP in 1860 is practically identical to the average values for all OECD countries in 2005 (OECD, 2008). Instead, the level of inequality prevalent in the peak year (1920) is similar to those observed nowadays in middle income countries like Mexico (which has a Gini coefficient of 0.26). More prominently, this historical peak is double the current value for Spain (historical 0.243 versus the current 0.111). Therefore, regional income inequality was higher during the period considered.

To finish this section, it would be interesting to consider whether these trends in inequality were accompanied (or not) by (unconditional) β convergence (Barro and Sala i Martin, 1991). To tackle this issue in the most basic way, we regressed log growth rates of per capita GDP from 1860 to 1930 on the initial level of per capita GDP in logs, without any control variable. The results indicate the existence of β convergence (the β coefficient of the regression is -0.0055 with a standard error of 0.0036, and the adjusted R^2 is only 0.07), but at a speed of 0.7 percent per year.²⁷ In general, our regressions imply that per capita GDP convergence looks weaker among Spanish NUTSII regions than among countries and regions in other studies. For example, the β estimates made by Barro and Sala i Martin (2003) for personal income in the United States ranged from a minimum of 1 percent per year in the period from 1880 to 1900 to a maximum of 4 percent per year from 1940 to 1950. Also, our estimates are commonly slower than those calculated by these two authors for Japanese prefectures from 1930 to 1990 and for European regions from 1950 to 1990, which ranged from a minimum of 1 percent per year in the 1980s to a maximum of 2.3 percent per year in the 1960s. In other words, the evidence supporting regional convergence in per capita GDP among Spanish regions is, at best, weak.

4. Regional specialization and industrialization

How did the economic structure of Spanish regions respond to this process of progressive market integration? To answer that question, we assemble Krugman indices of regional specialization (Krugman, 1991) that were computed using seven teen NUTS II regions and one digit employment levels (agriculture, industry and services). This index (SI) is defined as follows:

$$SI_{ik} = \sum_{j=1}^n \left| \frac{E_{ji}}{E_i} - \frac{E_{jk}}{E_k} \right| \quad (6)$$

where E_{ji} is the level of employment in sector $j = 1, \dots, n$ for region i , and E_i is the total employment for region i , and similarly for region k . This index ranges between zero and two, where an index value of zero indicates that region i has an identical industrial structure to region k , and a value of two indicates that region i 's industrial structure has nothing in common with that of region k . Indices of regional specialization were calculated for each of the 136 bi regional comparisons (of the seventeen NUTS II regions), and these indices were averaged, first to produce a measure of each region's specialization, and then an overall measure of Spanish regional specialization.

Table 3 shows that, with the reduction of transport costs and the progressive integration of the home market, regional specialization rose substantially in Spain. The overall index was 0.221 in 1860 and rose steadily to a peak of 0.432 in 1920. Then, it decreased slightly to 0.363 in 1930. Note that the movements in the aggregate index cannot be attributed to changes in a small number of regions. If one looks carefully at Table 3, it can be observed that the aggregate pattern is replicated in practically all regions. More prominently, since 1900, it can be observed that the three richest regions (Madrid, Catalonia and the Basque Country) were also the three with the higher specialization indices. Therefore, in terms of the HO model, one should expect a further enlargement of regional inequality following this increasing specialization.

²⁷ This yearly convergence rate is estimated as: $-(1/T) \ln(\theta T + 1)$, where θ is the regression coefficient computed on the initial level of per-capita GDP (Barro et al., 1995). It should be noted that the number of observations is too small and, hence, the results should be read with caution.

Aragon	0.167	0.185	0.261	0.330	0.269
Asturias	0.321	0.273	0.354	0.366	0.279
Balearic Islands	0.174	0.188	0.239	0.508	0.299
Basque Country	0.170	0.458	0.469	0.616	0.478
Canary Islands	0.177	0.192	0.246	0.344	0.378
Cantabria	0.152	0.184	0.234	0.346	0.303
Castile-La Mancha	0.165	0.211	0.280	0.424	0.391
Castile-Leon	0.147	0.248	0.290	0.369	0.302
Catalonia	0.270	0.427	0.454	0.588	0.512
Extremadura	0.164	0.243	0.284	0.456	0.332
Galicia	0.307	0.349	0.377	0.551	0.421
Madrid	0.692	0.771	0.661	0.888	0.804
Murcia	0.161	0.207	0.363	0.307	0.258
Navarre	0.197	0.188	0.231	0.338	0.338
Rioja, La	0.156	0.209	0.230	0.311	0.255
Valencian Com.	0.183	0.189	0.224	0.306	0.258
Spain	0.221	0.277	0.319	0.432	0.363

Sources: see Table 1.

Finally, it is also interesting to study how industry responded to the integration and specialization of Spanish regions. This can be addressed by estimating location quotients (LQs) for the industrial sector. More specifically, we estimated the following equations:

$$LQ_{EMP} = \frac{E_{ji} / E_{jSPA}}{E_i / E_{SPA}} \quad (7)$$

$$LQ_{GVA} = \frac{GVA_{ji} / GVA_{jSPA}}{GVA_i / GVA_{SPA}} \quad (8)$$

where E_{ji} is the level of employment in industry (j) for region i , and E_i is the total employment for region i , and similarly for Spain (SPA) and for the gross value added (GVA) in industry. Location quotients above one indicate concentration of industry in that region, whereas location quotients below one indicate the contrary.²⁸

Table 4 shows that the correlation between per capita GDP and industrialization is far from perfect. The fact is that only for the Basque Country and Catalonia could higher income levels be explained in terms of industrialization. In a sharp contrast, in Madrid, higher income is correlated with lower industrialization levels. Even if one observes in detail the data available for the different benchmarks, one could find several low and middle income regions with industry location quotients above one.

5. The determinants of regional inequality

As we noted in the introduction, differences in regional income, from the trade theory perspective, rely on differences in relative factor prices and industrial structure of the regions. We investigated this question by utilizing a straightforward modification of the procedure developed by Hanna (1951) and also employed by Kim (1998) to separate income differences into industry mix and gross value added (GVA)²⁹ components. The procedure involves constructing two hypothetical regional per worker GDPs and comparing them with actual per worker GDPs. The first assumes that all regions have identical industry mixes and identical industry per worker GVAs, with the industry mix and per worker GVA set equal to the overall national average. The second hypothetical per worker GDP assumes that regions have different industry mixes but identical per worker GVAs, which are set equal to the national average. The difference between the two hypothetical incomes, which are based on industry mix income and the overall national GVA, furnishes a measure of the GDP per worker disparities caused by the divergence in regional industrial structures (industry mix effect). The difference between the actual GDP and the hypothetical industry mix income is a measure of the regional GDP per worker variations due to divergence in per worker GVA (productivity effect).³⁰

²⁸ It should be noted that the first quotient relies only on relative industrial employment, whereas the second also considers the effect of higher industrial labor productivity.

²⁹ Per worker GVA in industry and region i is: $GVA_i = (w_i L_i + r_i K_i) / L_i$. However, given the presence of perfect capital markets, $r_i K_i / L_i$ should be equal across all locations. Consequently, w_i drives per worker GVA differences across all regions.

³⁰ The use of one-digit industrial classification in our calculations may conceal the greater importance of productivity in explaining regional differences in income per capita than is deserved. Regional per worker GVA in manufacturing and services activities may be different due to variations in regional industrial structures at a finer industry level.

Andalusia	1.18	1.08	1.10	1.00	1.06	0.96	0.92	0.87	0.77	0.85
Aragon	0.64	0.56	0.86	0.66	0.66	0.94	0.74	0.99	0.85	1.03
Asturias	0.67	0.95	0.61	0.80	0.57	1.62	1.05	1.45	1.18	1.14
Balearic I.	0.78	1.04	1.10	0.91	1.23	0.89	1.67	1.02	1.25	0.68
Basque C.	1.15	0.78	1.95	1.84	1.76	1.32	1.66	1.62	1.39	1.46
Canary I.	0.55	0.52	0.79	0.67	1.15	0.70	0.83	0.41	1.19	0.64
Cantabria	0.72	0.92	1.00	1.18	0.77	1.20	1.05	1.18	0.99	1.23
Castile-L.M.	0.91	0.78	0.82	0.61	0.69	0.64	0.64	0.52	0.69	0.67
Castile-Leon	0.83	0.80	0.53	0.60	0.47	0.59	0.56	0.49	0.72	0.67
Catalonia	1.67	1.60	2.04	1.55	1.90	1.50	1.96	1.47	1.81	1.61
Extremadura	0.86	1.04	0.75	0.77	0.72	0.71	0.54	0.53	0.77	0.68
Galicia	0.49	0.76	0.43	0.58	0.46	0.52	0.34	0.42	0.61	0.56
Madrid	1.69	1.01	1.52	0.70	1.26	0.94	1.58	1.02	1.19	0.85
Murcia	1.15	1.31	0.70	0.94	1.83	1.05	0.86	0.78	0.90	0.73
Navarre	0.75	0.48	0.82	0.94	0.75	0.67	1.08	0.80	0.64	0.72
Rioja, La	0.97	1.05	1.11	0.83	1.08	0.80	0.81	0.95	1.00	1.18
Valencian C.	1.23	0.97	1.11	0.80	1.06	0.88	1.03	0.85	1.05	0.77

Notes: EMP stands for employment and GVA for gross value added.

Sources: see Table 1.

The evidence presented in Table 5 shows that variations in both industry mix and labor productivity at the broad industry level played central roles in explaining GDP per worker differences.³¹ More prominently, in most cases, a direct correlation is observable between industry mix and wage effect.³² This result implies that a favorable industry mix is accompanied by higher wages, while the contrary also holds.

Let us now summarize several relevant regional stories: Catalonia, the Basque Country, Galicia, Andalusia and Madrid. We consider the first two cases because they are paradigmatic of successful industrialization experiences. On the other hand, Galicia did not industrialize and remained agrarian over the entire period. So, its experience could be considered as typical of underdeveloped regions. Finally, we considered Andalusia and Madrid because they are exceptions to the normal behavior of Spanish regions.

Catalonia has enjoyed a top ranking position in per capita GDP since 1860. At first sight, this ranking position is due to both a favorable industry mix and a productivity effect. However, one could also observe that higher per worker GVAs were only observable in industry and services, while in Catalan agriculture, labor productivity was below the Spanish average. For this reason, we conclude that industrialization is behind the Catalan success.

The history of the Basque Country summarizes perfectly the consequences of rapid industrialization and subsequent structural change. In 1860, the Basque Country was not in the top ranking positions of per capita GDP in Spain, and its industry was relatively small. So, the Basque Country had a highly negative productivity effect (more than 20 percent below the Spanish average). However, only forty years later (in 1900), when Basque industrialization was underway, this situation had changed dramatically: it outperformed Spain in both industry mix and productivity effects by more than 20 percent in productivity and 34 percent in industry mix. It is interesting to note that the Basque country specialized in metal industry (Houtpt, 2002), which is the industry with the higher labor productivity. This Basque lead was still present in 1930, although its advantage due to industry mix had decreased to less than 20 percent given the spread of industrialization to more Spanish regions.

In a sharp contrast, Galicia was among the low ranking per capita GDP regions throughout the period. Corresponding with this low income level, its industry mix and productivity effect were unfavorable (in other words, Galicia specialized in the less productive industries, and its labor productivity was below the Spanish average in all of them).

Andalusia, the most populated region in Spain, lost ground in the per capita GDP rankings throughout the period. In 1860, it was the second richest Spanish region, but in 1930 was in position 12 of 17, with a per capita income of only about 75 percent of the Spanish average (see Table 1 above). The initial pre eminence of Andalusia was not due to region's industry mix, but to favorable wages. In all three one digit industries considered, Andalusia's wages were well above the Spanish average. Forty years later, in 1900, this advantage had vanished, and its wages were slightly below the average; in addition, its industry mix was not particularly different from the nation's average. By 1930, the region had neither a favorable industry mix (e.g., its agricultural employment was ten points over the Spanish average), nor a higher wage level compared with the rest of Spain.

³¹ We have also computed the information collected in Table 5 for 1910 and 1920. However, to save space and to simplify the exposition, we do not discuss these two benchmarks here (these calculations are available upon request from the authors).

³² Specifically, this correlation appeared on 76 percent of occasions in 1860, 65 percent in 1900 and 71 percent in 1930.

<i>Agriculture</i>	60.8	67.0	77.1	59.1	67.9	65.2	52.9	64.6	64.6	60.2	66.7	76.5	29.7	62.3	59.3	60.8	64.0	63.0
<i>Industry</i>	14.7	8.0	8.4	14.3	9.7	6.8	20.8	8.9	10.3	11.3	10.8	6.1	21.1	14.4	9.3	12.1	15.4	12.5
<i>Services</i>	24.6	24.9	14.5	26.7	22.4	28.0	26.3	26.4	25.1	28.4	22.5	17.3	49.2	23.4	31.4	27.1	20.7	24.5
<i>Total</i>	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0
Per worker GVA (in pesetas)																		
<i>Agriculture</i>	774	664	257	357	372	389	480	216	544	744	529	242	358	488	764	430	635	528
<i>Industry</i>	1768	1254	1032	793	1443	986	1571	1436	1176	1305	1335	922	1273	1801	978	1471	1163	1383
<i>Services</i>	1813	1334	1126	1451	1191	1113	1579	1575	1093	1152	801	702	1893	1726	1199	1461	1522	1381
<i>Total</i>	1175	878	448	711	659	632	996	684	747	923	677	364	1306	966	921	836	900	843
<i>Industry-mix</i>	863	809	723	877	802	824	930	830	830	867	812	728	1128	850	876	862	836	843
Difference attributable to (percent)																		
<i>Industry-mix</i>	2.3	-4.1	-15.4	4.0	-5.1	-2.3	9.8	-1.6	-1.6	2.8	-3.8	-14.7	29.1	0.8	3.8	2.2	-0.9	0.0
<i>Productivity-effect</i>	30.9	8.2	-47.8	-21.0	-19.5	-26.6	6.8	-19.3	-10.6	6.3	-18.2	-69.4	14.7	12.8	5.0	-3.2	7.4	0.0
1900																		
Labor per industry (percent)																		
<i>Agriculture</i>	69.9	73.2	82.1	50.6	70.5	71.9	52.6	71.0	80.3	77.2	80.0	86.2	34.2	76.8	71.9	67.7	70.3	71.4
<i>Industry</i>	14.9	11.6	8.2	26.4	14.9	10.6	27.6	13.6	7.2	11.1	10.2	5.9	20.7	9.5	11.1	15.1	15.1	13.6
<i>Services</i>	15.1	15.2	9.7	23.0	14.6	17.5	19.8	15.4	12.5	11.7	9.8	7.9	45.1	13.7	17.0	17.2	14.7	15.1
<i>Total</i>	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0
Per worker GVA (in pesetas)																		
<i>Agriculture</i>	512	722	377	481	443	355	537	327	666	754	533	268	576	431	591	855	906	543
<i>Industry</i>	2523	2164	2730	4803	1660	1552	4005	3100	2670	2107	2003	1652	2428	2897	3002	2483	2384	2896
<i>Services</i>	3366	3161	4091	3305	2318	2248	4885	3405	2741	3766	2494	2821	3666	2623	2395	3111	3305	3429
<i>Total</i>	1244	1259	929	2273	899	813	2356	1179	1069	1256	875	551	2352	965	1165	1489	1481	1296
<i>Industry-mix</i>	1331	1254	1015	1828	1315	1297	1764	1308	1072	1141	1065	909	2330	1161	1294	1394	1321	1296
Difference attributable to (percent)																		
<i>Industry-mix</i>	2.7	-3.3	-24.4	34.4	1.5	0.1	30.8	0.9	-18.9	-12.7	-19.6	-35.5	58.7	-11.0	-0.1	7.3	1.9	0.0
<i>Productivity-effect</i>	-6.7	0.5	-8.8	21.8	-38.1	-46.7	28.9	-10.4	-0.3	9.6	-19.7	-50.1	0.9	-18.5	-10.5	6.6	11.5	0.0
1930																		
Labor per industry (percent)																		
<i>Agriculture</i>	57.0	52.6	41.7	26.0	39.7	32.8	26.2	40.6	57.3	63.6	59.8	65.3	9.0	49.1	60.2	47.0	46.4	47.4
<i>Industry</i>	20.0	22.1	30.7	36.0	32.4	30.9	46.9	25.7	18.6	18.0	20.0	15.8	30.9	23.4	16.5	25.9	27.3	25.9
<i>Services</i>	23.0	25.3	27.6	38.0	28.0	36.3	26.9	33.8	24.1	18.4	20.3	18.8	60.0	27.5	23.3	27.1	26.3	26.7
<i>Total</i>	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0
Per worker GVA (in pesetas)																		
<i>Agriculture</i>	1406	1874	1648	1474	4496	2916	1785	1402	2230	1746	1613	1361	1722	3038	2055	1237	3412	1885
<i>Industry</i>	4418	5686	4827	8169	2892	2157	6136	7361	3622	3326	2606	2546	6237	3678	5437	4959	4168	4878
<i>Services</i>	6623	6035	6684	7643	5537	4420	8145	6813	4846	5690	4401	4966	8297	4847	7514	5585	7157	6610
<i>Total</i>	3206	3769	4014	6231	4268	3228	5537	4759	3120	2757	2377	2228	7066	3686	3887	3377	4603	3922
<i>Industry-mix</i>	3569	3741	4108	4759	4175	4526	4560	4249	3581	3293	3440	3249	5647	3886	3481	3939	3944	3922
Difference attributable to (percent)																		
<i>Industry-mix</i>	-9.4	-4.7	4.6	19.4	6.2	14.3	15.1	8.0	-9.1	-17.5	-13.1	-18.8	36.5	-0.9	-11.9	0.4	0.6	0.0
<i>Productivity-effect</i>	-10.7	0.7	-2.3	26.9	2.2	-33.8	19.4	11.3	-13.8	-17.8	-37.0	-37.7	22.4	-5.3	11.0	-15.4	15.4	0.0

Notes: AND, Andalusia; ARA, Aragon; AST, Asturias; BAC, Basque Country; BAL, Balearic Islands; CAN, Canary Islands; CAT, Catalonia; CNT, Cantabria; CLL, Castile and Leon; CLM, Castile-La Mancha; EST, Extremadura; GAL, Galicia; MAD, Madrid; MUR, Murcia; NAV, Navarre; RIO, La Rioja; and VAL, Valencia. Labor per industry and per worker GVA are actual values and industry-mix and productivity effect are estimated.

Sources: see Table 1.

Madrid's successful experience is closely related to the presence of a large services sector in that region, which could easily be related to a certain nation's capital effect. For example, in 1900, the per worker GDP of Madrid exceeded by about 60 percent the Spanish average, and about 98 percent was attributable to its favorable industry mix. About 45 percent of its workforce was employed in services, as compared to the Spanish average of about 15 percent. More prominently, only per worker GVA in services was higher than the Spanish average. By 1930, the favorable industry mix was still important, but the productivity effect grew substantially due to the fact that relative wages were higher in services and industry than in the rest of the country (this could be interpreted as evidence of the emergence of Marshallian externalities in Madrid).

The procedure of Hanna (1951) offers information about the causes of regional per capita GDP differences, but not in an aggregated way. For this reason, we will approach the overall causes of labor productivity differences across Spanish regions

Primary	Inequality	0.031	0.026	0.012	0.017	0.024
	GDP share (%)	39.5	29.9	27.8	31.9	22.8
Secondary	Inequality	0.010	0.021	0.025	0.022	0.022
	GDP share (%)	20.4	30.3	30.7	30.2	32.2
Tertiary	Inequality	0.016	0.009	0.006	0.016	0.009
	GDP share (%)	40.1	39.8	41.4	37.9	45.0
Within-sector inequality		0.021	0.018	0.013	0.018	0.017
Between-sector inequality		0.049	0.161	0.141	0.067	0.060
Overall Inequality		0.070	0.179	0.155	0.085	0.077
Contribution (percent)						
Primary		17.4	4.3	2.2	6.3	7.2
Secondary		2.9	3.5	4.9	7.8	9.3
Tertiary		9.4	2.1	1.6	7.1	5.2
Within-sector component		29.7	9.9	8.6	21.3	21.8
Between-sector component		70.3	90.1	91.4	78.7	78.2

Sources: see Table 1.

with the Theil T index (Theil, 1967).³³ This index allows us to measure regional inequality in labor productivity using GDP at the industry level and employment figures according to the following equation:

$$T = \sum_{j=1}^3 \sum_{i=1}^n \left(\frac{Y_{ji}}{Y} \right) \log \left(\frac{Y_{ji}/Y}{E_{ji}/E} \right) - \sum_{j=1}^3 \sum_{i=1}^n (\log(x_{ji}) - \log(x)) \frac{Y_{ji}}{Y}, \quad x = \frac{Y}{E} \quad (9)$$

where Y is per capita GDP, E is employment, j indexes industries and i regions. The additive decomposability of the Theil index makes possible its decomposition into two components: the *within sector* inequality component (T_W) and the *between sector* inequality component (T_B). Specifically, Eq. (9) is decomposed into:

$$T = T_W + T_B = \sum_{j=1}^3 \left(\frac{Y_j}{Y} \right) T_j + \sum_{j=1}^3 \left(\frac{Y_j}{Y} \right) \log \left(\frac{Y_j/Y}{E_j/E} \right), \quad (10)$$

where

$$T_W = \sum_{j=1}^3 \left(\frac{Y_j}{Y} \right) \sum_{i=1}^n \log(x_{ji}) - \log(x_j) \frac{Y_{ji}}{Y} \quad \text{for } j = 1, 2, \text{ and } 3, \quad (10a)$$

and

$$T_B = \sum_{j=1}^3 \left(\frac{Y_j}{Y} \right) \log \left(\frac{Y_j/Y}{E_j/E} \right) - \sum_{i=1}^n (\log(x_j) - \log(x)) \frac{Y_j}{Y}. \quad (10b)$$

T_W presents the weighted average of regional inequalities in labor productivity within each sector, while T_B presents inequality in labor productivity between sectors (agriculture, industry and services). The results of computing these different Theil T indices are displayed in Table 6.

The overall regional inequality in per worker GDP grew dramatically from 1860 to 1900, leveled between 1900 and 1910, and decreased thereafter.³⁴ Then, in 1930, the levels of regional inequality only exceeded by about ten percent those prevalent in 1860 (0.077 in 1930 versus 0.070 in 1860). The between sector effect accounts for the lion's share of regional inequality: 70 percent of variation in 1860; more than 90 percent in 1900 and 1910; and more than 78 percent in 1920 and 1930. These two results together give strong support to the hypothesis that relates the upswing of regional inequality to the diffusion of industrialization (Williamson, 1965).

Finally, it would also be interesting to revise the contributions of the different sectors to the within sector component. In 1860, surprisingly, the sector with the major regional differences in labor productivity was the primary sector. What could account for these differences? We believe that two factors were involved: the large differences in relative land endowments across Spanish regions and the way in which we measured agricultural employment. Due to the paucity of the data, we excluded female agricultural labor from our calculations (and it is likely that female participation rates varied widely across

³³ More specifically, we follow the approach of Akita and Kataoka (2003).

³⁴ At this point, readers could be intrigued by the apparent difference between these results and the inequality measures of Table 2. However, the previous inequality measures were population-based, whereas this measure is employment-based. Consequently, it could be hypothesized that the evolution of differences across regions in participation rates accounts for the discrepancy.

6. Conclusions

This article provides the first empirical analysis of the upswing of regional income inequality in Spain. We do this by constructing a new database in regional per capita GDP for the seventeen Spanish NUTS II regions (by aggregating NUTS III provinces) for the years 1860, 1900, 1910, 1920 and 1930. Our approach follows Geary and Stark's (2002) basic methodology but introduces several refinements. More specifically, we estimated agricultural regional output not indirectly but directly from production figures, considered capital differences in manufacturing (like in Crafts, 2005), and used several different wages as determinants of productivity in different services industries.

The formation of the Spanish national market progressed significantly from 1860–1900 due to improvements in transport and institutional changes. At the same time, industrialization and urban expansion were underway. As a consequence, the share of industry and services in the Spanish GDP grew, to the detriment of agricultural participation. These processes were not accompanied by dramatic changes in the positions of different regions in terms of per capita GDP. Only the Basque Country improved its ranking position, while Andalusia lost significant ground, falling from the top to middle positions. Regional incomes practically did not converge, and even diverged from 1860 to 1910. As Trade Theory predicts, in response to market integration, regional specialization increased up to 1920.

What determined the fortunes of the different Spanish regions? In line with the predictions of Jeffrey Williamson, regional inequality increased substantially in Spain during the initial phases of economic growth and industrialization. Furthermore, this inequality growth was mainly caused by divergent patterns of regional specialization; that is, by the very unequal distribution of industry and services. The expansion of industry to a limited number of regions during the second half of the 19th century increased regional inequality; while the contrary holds for the first third of the twentieth century. In this sense, the Spanish experience closely resembles that of the United States (Kim, 1998; Caselli and Coleman, 2001).

Our results also have important implications for judging the validity of alternative theoretical explanations for regional inequality. Broadly speaking, it seems that the proposal of Epifani (2005), which combines HO and NEG models, explains the Spanish historical experience quite well. More prominently, as our decomposition of per capita GDP in productivity and industry mix effects shows, regions that specialized in the most productive industries also enjoyed the higher labor productivity levels. In other words, they had favorable endowments and also benefited from NEG forces. However, it seems that HO forces were the main driver behind unequal regional development, given that between sector differences accounted for the lion's share of regional differences in labor productivity. The increasing returns explanation, mainly related to within industry differences in industry and services, was only significant in the years 1920 and 1930. Therefore, it seems that once industrialization arrived in a considerable number of regions, NEG forces gained momentum to the detriment of regional differences in factor endowments.

Acknowledgments

Rosés acknowledges financial support from the Spanish Ministry of Science and Innovation projects "Consolidating Economics" within the Consolider Ingenio 2010 Program and Projects SEJ2006 08188/ECON and ECO2009 13331 C02 01, and from the European Science Foundation for his visit at ICS, Lisbon, where a large part of the paper was written. Tirado and Martínez Galarraga acknowledge the financial support from the Network in Economics and Public Policies (XREPP) launched by the Generalitat de Catalunya.

References

- Akita, T., Kataoka, M., 2003. Regional income inequality in the post-war Japan. In: ERSA Conference Papers ersa03p480. European Regional Science Association.
- Anuario estadístico de España (ad annum), Madrid.
- Anes, R., Tortella, G., Schwartz, P., 1974. La banca española en la Restauración. Servicio de Estudios del Banco de España, Madrid.
- Baldwin, R., Forslid, R., Martin, P., Ottaviano, G., Robert-Nicoud, F., 2003. *Economic Geography and Public Policy*. Princeton University Press, Princeton (NJ).
- Barquín, R., 1997. Transporte y precio del trigo en el siglo XIX. *Revista de Historia Económica* 15 (1), 17–48.
- Barro, R.J., Sala-i-Martin, X., 1991. Convergence across states and regions. *Brookings Papers of Economic Activity* 1991 (1), 107–182.
- Barro, R.J., Mankiw, G.N., Sala-i-Martin, X., 1995. Capital mobility in neoclassical models of growth. *American Economic Review* 85 (1), 103–115.
- Barro, R.J., Sala-i-Martin, X., 2003. *Economic Growth*. McGraw Hill, New York.
- Betrán, C., 1999. Difusión y localización industrial en España durante el primer tercio del siglo XX. *Revista de Historia Económica* 17 (3), 663–696.
- Boyer, G., Hatton, T., 1997. Migration and labour market integration in late nineteenth-century England and Wales. *Economic History Review* 50 (4), 697–734.
- Carreras, A., 1983. La producció industrial espanyola i italiana des de mitjan segle XIX fins a l'actualitat. Ph.D. Dissertation (unpublished), Universitat Autònoma de Barcelona.

³⁵ Following the typical procedure in the Spanish literature. See, for example, Prados de la Escosura and Rosés (2009).

- Crafts, N.F.R., 2005. Regional GDP in Britain, 1871–1911: some estimates. *British Journal of Political Economy* 52 (1), 54–64.
- Crafts, N.F.R., Mulatu, A., 2005. What explains the location of industry in Britain, 1871–1911? *Journal of Economic Geography* 5 (4), 499–518.
- Crafts, N.F.R., Mulatu, A., 2006. How did the location of industry respond to falling transport costs in Britain before World War I? *Journal of Economic History* 66 (3), 575–607.
- Crespo Cuaresma, J., Doris Ritzberger-Grünwald, D., Silgoner, M.A., 2008. Growth, convergence and EU membership. *Applied Economics* 40 (5), 643–656.
- Deardorff, A.V., 1986. Firless firwoes: how preferences can interfere with the theorems of international trade. *Journal of International Economics* 20 (1–2), 131–142.
- Epifani, P., 2005. Heckscher–Ohlin and agglomeration. *Regional Science and Urban Economics* 35 (6), 645–657.
- Estadística Administrativa de la Contribución Industrial y de Comercio (ad annum), Madrid.
- Harry Flam, H., Flanders, J., 1991. *Heckscher–Ohlin Trade Theory*. MIT Press, Cambridge (MA).
- Foro Hispánico de Cultura, 1957. La población activa española de 1900 a 1957. *Foro Hispánico de Cultura*, Madrid.
- Frax, E., 1981. Puertos y comercio de cabotaje en España. Banco de España, Madrid.
- Fujita, M., Krugman, P., Venables, A.J., 1999. *The Spatial Economy. Cities, Regions, and International Trade*. MIT Press, Cambridge (MA).
- Gómez Mendoza, A., 1982. Ferrocarriles y cambio económico en España (1855–1913). Alianza, Madrid.
- Geary, F., Stark, T., 2002. Examining Ireland's Post-famine Economic Growth Performance. *Economic Journal* 112, 919–935.
- GEHR – Grupo de Estudios de Historia Rural, 1991. Estadísticas históricas de la producción agraria española, 1859–1935. Ministerio de Agricultura, Pesca y Alimentación, Madrid.
- Gollin, D., 2002. Getting Income Shares Right. *Journal of Political Economy* 110 (21), 458–474.
- Hanna, F., 1951. Contribution of manufacturing wages to differences in per capita Income. *Review of Economics and Statistics* 33 (1), 18–28.
- Herranz, A., 2006. Railroad impact on backward economies: Spain, 1850–1913. *Journal of Economic History* 66 (4), 853–881.
- Herranz, A., 2008. Infraestructuras y crecimiento económico en España (1850–1935). Fundación de los ferrocarriles españoles, Madrid.
- Houpt, S., 2002. Putting Spanish steel on the map: the location of Spanish integrated steel, 1880–1936. *European Review of Economic History* 6 (02), 193–220.
- Kim, S., 1995. Expansion of markets and the geographic distribution of economic activities: the trends in us regional manufacturing structure, 1860–1987. *Quarterly Journal of Economics* 110 (4), 881–908.
- Kim, S., 1998. Economic Integration and Convergence. U.S. Regions, 1840–1987. *Journal of Economic History* 58 (3), 659–683.
- Kim, S., Margó, R.A., 2004. Historical perspectives on U.S. economic geography. In: Henderson, J.V., Thisse, J.F. (Eds.), *Handbook of Regional and Urban Economics*, vol. 4 (Chapter 66). Elsevier, Amsterdam, pp. 2981–3019.
- Krugman, P., 1991. *Geography and Trade*. The MIT Press, Cambridge (MA).
- Leamer, E.E., 1995. The Heckscher–Ohlin model in theory and practice. *Princeton Studies in International Economics* 77. Department of Economics Princeton University, Princeton (NJ).
- Madrazo, S., 1984. El sistema de transportes en España. Turner, Madrid.
- Maixé-Altés, J.C., Iglesias, E., 2009. Domestic monetary transfers and the inland bill of exchange markets in Spain, 1775–1885. *Journal of International Money and Finance* 28 (3), 496–521.
- Martínez Vara, T., 1999. La integración del mercado del trigo en el Norte y la Castilla del Duero, 1800–1860. Algunas Reflexiones. *Noticario de Historia Agraria* 19, 43–73.
- Martínez-Galarraga, J., Paluzie, E., Pons, J., Tirado, D.A., 2008. Agglomeration and labour productivity in Spain over the long term. *Ciometrica* 2 (3), 195–212.
- Martorell, M., 2001. Historia de la peseta: la España contemporánea a través de su moneda. Editorial Planeta, Barcelona.
- Ministerio de Trabajo, 1927. Estadística de salarios y jornadas de trabajo referida al período 1914–1925, Madrid.
- Nadal, J., 1974. El fracaso de la Revolución Industrial en España, 1814–1913. Ariel, Barcelona.
- Nadal, J., Tafunell, X., 1992. Sant Martí de Provençals, pulmó industrial de Barcelona (1847–1992). Columna, Barcelona.
- Nicolau, R., 2005. Población, salud y actividad. In: Albert Carreras, A., Tafunell, X. (Eds.), *Estadísticas históricas de España: siglos XIX–XX*, vol. I. Fundación BBVA, Madrid, pp. 77–154.
- OECD, 2008. *Regions at a Glance: 2009 Edition*. OECD, Paris.
- Parejo, A., 2001. Industrialización, desindustrialización y nueva industrialización de las regiones españolas (1950–2000). Un enfoque desde la historia económica. *Revista de Historia Industrial* 19–20, 15–75.
- Peña, D., Sánchez-Albornoz, N., 1983. Dependencia dinámica entre precios agrícolas: El trigo en España, 1857–1890. Banco de España, Madrid.
- Pollard, S., 1981. *Peaceful Conquest*. Oxford University Press, Oxford.
- Prados de la Escosura, L., 2003. El progreso económico de España, 1850–2000. Fundación BBVA, Madrid.
- Prados de la Escosura, L., Rosés, J.R., 2009. The Sources of Long-run Growth in Spain, 1850–2000. *Journal of Economic History* 69 (4), 1063–1091.
- Puga, D., 2002. European regional policies in light of recent location theories. *Journal of Economic Geography* 2 (4), 373–406.
- Rassekh, F., Thompson, H., 1998. Micro Convergence and Macro Convergence. Factor Price Equalization and Per Capita Income. *Pacific Economic Review* 3 (1), 3–13.
- Reher, D., 1994. Ciudades, procesos de urbanización y sistemas urbanos en la península ibérica, 1550–1991. In: Guàrdia, M., Monclús, F.J., Oyón, J.L. (Eds.), *Atlas histórico de las ciudades europeas. Península Ibérica*. Salvat – Centre de Cultura Contemporània de Barcelona, Barcelona, pp. 1–30.
- Ringrose, D., 1996. Spain, Europe and the “Spanish Miracle”, 1700–1990. Cambridge University Press, Cambridge (MA).
- Romer, P.M., 1986. Increasing Returns and Long-Run Growth. *Journal of Political Economy* 94 (5), 1002–1037.
- Rosés, J.R., 2003. Why isn't the whole of Spain industrialized? New Economic Geography and early industrialization, 1797–1910. *The Journal of Economic History* 63 (4), 995–1022.
- Rosés, J.R., Sánchez-Alonso, B., 2004. Regional wage convergence in Spain 1850–1930. *Explorations in Economic History* 41 (2), 404–425.
- Samuelson, P.A., 1949. International factor–price equalisation once again. *Economic Journal* 59, 181–197.
- Sánchez-Alonso, B., 1995. Las causas de la emigración española, 1880–1930. Alianza Editorial, Madrid.
- Silvestre, J., 2003. Migraciones interiores y mercado de trabajo en España, 1877–1936. Ph.D. Dissertation (unpublished), Universidad de Zaragoza.
- Silvestre, J., 2007. Temporary Internal Migrations in Spain, 1860–1930. *Social Science History* 31 (4), 539–574.
- Simpson, J., 1994. La producción y la productividad agraria española, 1890–1936. *Revista de Historia Económica* 12 (1), 43–84.
- Simpson, J., 1995. *Spanish Agriculture: The Long Siesta, 1765–1965*. Cambridge University Press, Cambridge (MA).
- Slaughter, M.J., 1997. Economic Development and International Trade. *American Economic Review* 87 (2), 194–199.
- Slaughter, M.J., 2001. Does trade liberalization converge factor prices? Evidence from the antebellum transportation revolution. *Journal of International Trade and Economic Development* 10 (3), 339–362.
- Sudrià, C., 1994. Los bancos de emisión provinciales en la España del siglo XIX. In: Tedde, P., Marichal, C. (Eds.), *La formación de los bancos centrales en España y América Latina (siglos XIX y XX)*. Servicio de Estudios del Banco de España, Madrid, pp. 81–107.
- Tedde de Lorca, P., 1994. Cambio institucional y cambio económico en la España del siglo XIX. *Revista de Historia Económica* 12 (3), 525–538.
- Theil, H., 1967. *Economics and Information Theory*. North Holland, Amsterdam.
- Tirado, D.A., Paluzie, E., Pons, J., 2002. Economic integration and industrial location: the case of Spain before World War I. *Journal of Economic Geography* 2 (3), 343–363.

