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Alfonso Díez Minguela, M.Teresa Sanchis Llopis

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This paper studies regional income inequality in France since mid-nineteenth century. Given the dominant role played by Île-de-France and the city of Paris, which inspired the publication of "Paris et le désert française" (Gravier, 1947) and a debate on regional development in the aftermath of World War II, France seems an ideal scenario to examine the dynamics of regional income. In doing so, we first document the existing evidence before and after the development of national accounting. Using different approaches, several studies have produced regional (département, NUTS3) Gross Domestic Product (GDP) estimates from 1840 to 1930. Thus, our first contribution is to present these findings, assess the appropriateness of each methodology, and address potential concerns. The comparison of existing estimates for 1861-1930 raises some doubts about the pattern of regional inequality followed since 1861 to 1911. Hence we present new estimates for 1860-1930 based in the Geary and Stark (2002) method. In short, our estimates sum up new evidence in favour of an incessant decline in regional inequality since mid 19th up to 1930 and turn down the hypothesis of a potential U-shaped pattern in France since mid 19th century to nowadays. Additionally, we found that the use of nominal relative wages could overestimate the level or regional income inequality.

Keywords: Economic History, Regional inequality, France

JEL Classification: N93; N94; 018; R11

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« Il nous reste beaucoup à faire pour surmonter notre ignorance et ce n'est certainement pas en ignorant ou en combattant systématiquement l'histoire quantitative (macro) économiquqeu e les économistes théoriciens, purs de tout empirisme, et les historiens «qualitatifs » ou « micro-observateurs », purs de tout calcul ou de tout concept, contribueront à dissiper cette obscurité»

Jean-Claude Toutain (1996: 918)

1. Introduction

Since the aftermath of WWII, the debate about regional income inequality in France has been dominated by the ideas exposed by Gravier (1947) in "*Paris et le désert française*".[1] In this book Gravier argued that the excessive concentration of population and economic activities in Paris was detrimental for country's overall economic development since the city acted "as a monopolist group devouring the national substance". According to this author, Paris dominance was a direct consequence of the centralist policies implemented since mid-19th century. Successive governments had overinvested in the capital city where they located not only a large part of the administration and education institutions (*the Grandes Écoles*) but also the centre of the country's transport networks. This argument of the trade-off between the agglomeration of economic activity in Paris and the economic development of the rest of the country inspired French regional policy during the 1950s and 1960s (Marchand, 2001) and still have substantial social and political predicament.

However, the classic hypothesis of an inverted U-shaped curve in the long run evolution or regional income inequality proposed by Williamson (1965) or the most recent

[1] Jean-François Gravier is the most influential geographer of post-World War II France.

theoretical and empirical research in Economic Geography[2] gives little support to the pessimistic Gravier's arguments. Williamson (1965) proposed that income differences across regions grew in the early stages of industrialization. However, once the "*disequilibrating tendencies*" fade, convergence between backward and industrialized regions "*becomes the rule*". Several country studies have empirically have tried to test this hypothesis in the fifty years that have passed since its publication.[3]

In France, scant data have limited the evaluation of the long-term dynamics of regional inequality. The pioneer study was carried on by Delefortrie and Morice (1959) and provided estimates for only two years with a time spam of almost one century (1864 and 1954). Thereafter Toutain (1981, 1987, 1993) laid solid foundations for quantitative analysis. Notwithstanding, to our knowledge, there are still few and incomplete studies to draw a complete picture of the historical evolution of French regional GDPs. In the last decade, there have been published three databases. Combes et al. (2011) provide regional (NUTS3) population, employment and value-added data by economic sector for 1860 and 1930 (and partially for 1896). Otherwise, Caruana-Galitzia (2013) presents a parametric estimation of Gross Value Added by departments for 1872, 1886, 1901 and 1911. Finally, Bazot (2014) studies interregional (NUTS3) inequalities using the *patente* tax to estimate Non Agricultural Value Added for eight years between 1840 and 1911. These sets of data shed puzzling results. All of them display concentration of non-agricultural value added activities around Paris at least until 1930. But while Combes et

[2] Recent empirical studies strongly support the hypothesis of an inverted U-shaped relationship between spatial inequality and economic development (Barrios & Strobl, 2009; Lessmann, 2014).

[3] Crafts (2005) and Geary and Stark (2015) for Great Britain. Martínez-Galarraga et al. (2015) for Spain; Badia-Miró et al. (2012) for Portugal; Felice (2011) for Italy; Buyst (2010 2011) for Belgium and Enflo & Roses (2015) for Sweden.

al (2011) and Bazot (2014) reveal an early decline in per capita regional income inequalities in France, Caruana-Galitzia (2013)'s data exhibit an increasing trend up to 1911. Overall, the inconclusive findings call for new estimates to shed further light in French historical GDP distribution in this determining period of French modernization, 1860-1930.

Thus the contribution of this study to the literature is twofold. First we construct novel regional (NUTS3) GDP estimates, which allow us to roughly describe the evolution of regional inequality by departments from 1860 to 1930. In particular, our estimates fill in some gaps between the existing estimations up to 1930. In particular we provide new estimations for 1911 following the Geary-Stark method (Geary and Stark, 2002) and check the robustness of the Geary-Stark method by providing new estimates for 1860, 1892 and 1929. We compare with Combes et al (2011), Caruana-Galitzia (2013) and Bazot (2014). In short, we end up with a GDP dataset for 84/88 NUTS-3 regions for 1860, 1892, 1911 and 1929.

The paper is organized as follows. Section 2 presents a novel dataset of per-capita GDP by departments (NUTS3). Second we test its robustness by comparing with the existing estimates (Combes et al, 2011; Bazot, 2014; Caruana-Galitzia, 2013). Hence in section 3 we deep into the biases provoked by each estimation method in order to shed more light on the sources of regional income inequality in France. In order to have a more comprehensive knowledge of the evolution of regional income distribution, section 4 presents the kernel density estimates to draw the shape of the regional income distribution at any cross-section and calibrate how correcting by regional relative price could alter regional inequality in per capita incomes.

2. A primer in French macroeconomic history

In France, official National Accounts started to be published in 1949 by INSEE. As in other countries, backward historical series of national GDPs have been estimated following different methods. Macroeconomic history or *l'histoire quantitative macro-économique* has a long tradition in this country[4]. Toutain (1996), for instance, examine the reconstitution of macroeconomic aggregates, such as Gross Domestic Product (GDP) and its components, in the nineteenth and early twentieth century[5]. That said, there have been two main attempts to reconstitute GDP (in current prices) further back in time. On the one hand, Toutain (1987) constructed *séries historiques* of domestic product and several of its components from 1815 to 1938[6]. Lévy-Leboyer and Bourguignon (1990), on the other hand, estimated annual time-series between 1820 and 1913[7]. Figure 1 illustrates the evolution of GDP in France since 1815. Although there are several methodological differences, these series are still the backbone of French macroeconomic history[8].

[4] It could be argued that *Physiocrats* employed a scientific method, based on data and analysis, in their works. Even more, the Marquis de Vauban attempted to estimate national income in the late seventeenth century.

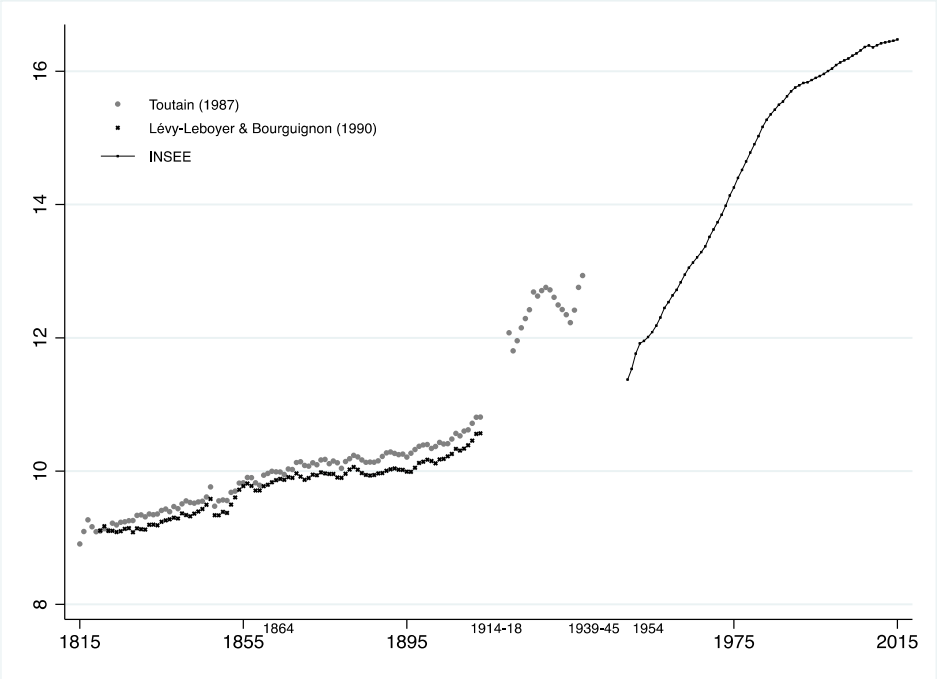
[5] See also Chadeau (1989) for an overview of several long-run time series of economic variables.

[6] Toutain (1987) also estimated an annual time-series of GDP (in constant prices, 1905-13=100).

[7] Originally published in French as *'L'économie française au XIX^e siècle: Analyse macro-économique'* in 1985, Lévy-Leboyer and Bourguignon (1990) published annual time-series of GDP and domestic product of Agriculture, Industry, Transport, Services and Government.

[8] Caron (1981) already pointed to the difficulty of measuring agricultural activity in the nineteenth century. In this regard, Toutain (1987) extracts labour force information from the population censuses. Lévy-Leboyer and Bourguignon (1990), however, assume that activity rates did not vary much during the nineteenth century, and derive long-run series from population data (Marchand and Thélot, 1991).

Figure 1. Gross Domestic Product (GDP) in France 1815-2014



Note: GDP estimates in current prices (millions of French francs) are in logarithmic scale.

Source: Toutain (1987); Lévy-Leboyer (1990), INSEE.

Nonetheless, the above evidence says little about the spatial distribution of economic activity over time. INSEE[9] provides official estimates of regional GDPs at NUTS-2 level only since 1990 and EUROSTAT at department level since 1990[10]. The scant evidence about the spatial distribution of income in the past is based on subnational estimates of income and production. Toutain (1981), for instance, estimates physical product per inhabitant (and per active person) for 21 regions in 1784-85, 1840, 1865,

[9] INSEE. "Produit Intérieurs Bruts Regionaux de 1990 à 2014".

https://www.insee.fr/fr/statistiques/1893220

[10] http://ec.europa.eu/eurostat/web/regions/data/database

These website used to provide estimates for 1982, however in recent updates the data begin in 1990.

1896, 1931 and 1970, which illustrates the "*inertia of the relative regional positions*" since the nineteenth century. Lévy-Leboyer (1982), using agricultural product per inhabitant and per active person from 1851 to 1970, briefly describes the regional dynamics. Anyway, these initial approaches use macro-regions, thereby masking some relevant features. In order to shed further light, Toutain (1961, 1993) reconstituted agriculture production (in current prices) by *département* in 1840, 1892, and 1929[11]. As regards total production or income, there are just two major works: (a) Delefortrie and Morice (1959) and (b) Combes et al. (2011). Both estimations follow a *bottom-up* approach by adding up incomes or final output.

Delefortrie and Morice (1959), henceforth DM1959, essentially contains a direct or bottom-up reconstitution of factor incomes in agriculture, manufacturing, commercial and non-commercial services by *département* in 1864 and 1954[12]. In doing so, a myriad of sources was used. Agricultural income in 1864, for example, was derived from labour incomes and capital revenues published in the *Agricultural Survey* of 1862. In manufacturing, labour income was estimated with average wages from the *Industrial Survey* 1861-65 and labour force from the population census of 1866. Equally, average profits for industrialists and merchants, as well as incomes for liberal professions, were reconstituted with fiscal information and the population census of 1866[13].

[11] See Toutain (1993: Annexe B) for a detailed description of sources and methodology. Furthermore, Delefortrie and Morice (1959) provide agricultural production by *département* in 1860-64, while the Ministère du Commerce published an estimation in 1912 (Toutain 1993: Annexe B).

[12] Delefortrie and Morice (1959) was commissioned by the *Fondation National des Sciences Politiques*.

[13] The *patente* was a tax levied on non-agricultural activities. Lavergne and Henry (1908) criticised the use of the *patente* to estimate industrial or commercial profits because of its poor coverage. The complementary use of other administrative enquiries for 1844 and 1880 let them to conclude that the "main" part of the *patente* hardly represents 3% of overall net profits. Using the number of owners in the

Administrative sources permitted the estimation of the labour incomes of public servants, army, navy, domestic workers and transports workers, while the cadastre was used to reconstruct real state revenues.

To estimate the net incomes by department in 1954 DM1959 depart from the same sources than INSEE for the National Accounts[14]. However some adjustment are made to pass from Gross Product to Net Income. To estimate the net profits in agriculture, they use data published at the *Annuaire Statistique de la France 1954* and at the *Statistique Agricole Annuelle 1954* to detract intermediate inputs and own consumptions. For industrialists, merchants and liberal professions revenues are derived from fiscal sources, specifically from the *tax proportionelle*, a levy charged over individuals and small firms[15]. Capital assets and real state revenues are estimated using the same fiscal source. For labour incomes several sources are used. In agriculture, social security quotes are used because there is not any agricultural survey for this year. In manufacturing and services, every year the firms used to give evidence to the state of the number of employees and the wages paid. This information let to document accurately labour incomes in these sectors[16]. Wages paid to public servants were widely

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population census of 1866, Delefortrie and Morice (1959) estimate total net profits at national level. Then, the contribution of each department to the *patente* was used to allocate this figure.

[14] A correcting coeficient was applied to level the sum of the departments with the incomes estimated at national level by the Service des Études Économiques et Financières (SEEF) to set the National Accounts.

[15] Data were comunicated by the *Direction Générale des Impôts, Contributions directes et Cadastre* and the Public Finance Ministry.

[16] The firms filled in the "1024 bulletin" that was used with fiscal purposes in order to adminístrate the payment of the direct Contribution. The INSEE used to process and publish the information collected throughout these bulletins.

documented. Despite its limitations, the painstaking effort of DM1959 provides a snapshot of the distribution of income within France in 1864 and 1954.

Combes et al. (2011), henceforth CO2011, followed in Delefortrie and Morice's (1959) footsteps to estimate departmental value-added in 1860 and 1930[17]. Contrary to DM1959, this approach focused on the production-side. Agricultural value-added comes from the *Agricultural Survey* of 1862 and 1929 (Toutain, 1961; 1992)[18]. Therefore, the 1860/64 values "*closely matched those in Delefortrie and Morice*" (Combes et al. 2011: 261). As regards manufacturing, CO2011 followed the work of Brigitte Desaigues, who reconstructed industrial product by departments with numerous sources, such as the *Industrial Surveys* of 1860 and 1861/1865, among others[19]. The industry-level value-added from this source are applied to the whole industry labor force. A relevant difference between DM1959 and CO2011 approaches lies with the labour force. While the former relies on the population census, the latter one, following Marchand and

[17] Combes et al. (2011) combine their novel database with EUROSTAT estimates for 1982 and 2000 to examine the spatial distribution of economic activity over time. Also, value-added and employment for agriculture and services is also presented for 1896.

[18] Toutain (1961; 1992) estimation of agricultural value-added is based on the *Agricultural Surveys* of 1852, 1862, 1892 and 1929. All of these sources present pitfalls. For example, female and childhood labour were underestimated or temporary work double-counted. Besides, interregional exchanges of intermediate goods were hard to measures.

[19] Although Brigitte Desaigues' work was cited in Combes et al. (2011) as *forthcoming*, it has not been made available or published. The *Industrial Surveys* of 1860 and 1861/65 tended to exclude small-scale industries and craftsmen. In order to overcome this, Desaigues imputed the value-added of a representative sample of small industries (less than five workers).

Thelot (1991), made certain adjustments[20].

Toutain calculates the value-added in manufacturing in 1930 mainly with the *Manufacturing Survey* provided in the *Census Appendix of 1931*. Notwithstanding this survey low coverage, information could be extrapolated to the whole industrial workers according to the *Population Census of 1931*. Likewise, the *Industrial Surveys* does not provide information on the tertiary sector. Therefore for the service sector, Toutain (1967) uses similar sources than in the 1860 estimates.[21] The value-added of the transportation industries is realocated across departments according to their share of the labour force. Using numerous sources, Toutain (1967, 1987, 1997) also estimates the revenues of housing, public services, retailing and wholesale, professions and household services in 1860 and 1930.

Using the above information, table 1 presents regional inequality, measured either as a single or a population-weighted coefficient of variation of income or value-added per capita, in France from 1860/64 to 2012. In general, it appears that disparities declined until 1990, increasing thereafter. However, the direct estimations of DM1959 and CO2011 leave a lot of decades unfilled and this makes less evident whether convergence across departments occurred mainly during the *Belle Époque*, the interwar years, or after World War II. There are not available estimations between 1860 and 1930, between 1930 and 1954, and between 1954 and 1990.

[20] The corrections made by Marchand and Thélot (1991) are widely accepted by the literature as a standard reference to impute employment across sectors in a consistent way throughout time.

[21] Fiscal sources, State and local communities account records, Cadastre information and data provided by the *Statistique Générale de la France* (1930) are among the sources used by Toutain to reconstruct the revenues of five service sectors (housing, public services, retailing and wholesale, professions and household services). See in Combes et al. (2011) the appendix for a complete description of the sources.

Table1. Regional inequality in France since 1860/64.

Source	Variable	Year	Coefficient of variation single	Coefficient of variation pop-weighted	Obs.
Delefortrie and Morice (1959)	income	1864	0.248	0.314	86
	(per capita)	1954	0.166	0.254	86
Combes et al. (2011)	value-added	1860	0.290	0.353	86
	(per capita)	1930	0.210	0.314	86
EUROSTAT	GDP	1982	0.166	0.251	86
	(per capita)	1990	0.159	0.296	86
		1999	0.168	0.302	86
		2012	0.200	0.345	86

Notes: See Table 1 for the list of departments included in the sample. EUROSTAT comprises ESA1979 for 1982 and 1990 and ESA2012 for 1999 and 2012. Population data come from INSEE.

The first gap in the literature, 1860 to 1930, is our central motivation. The historical evidence reported for other Western European countries confirms that in most of them regional disparities increased in the second half of the 19th century, [22] with the diffusion of the industrialization processes, and that convergence did not start until the 20th century. In the case of France, the available evidence does not let to clear up whether convergence begun in 1860 or with the turn of the century. The remainder of this paper

[22] Kim (1995, 1998) tested the inverted U-shaped relationship between per capita income and regional disparities in the US regions for 1860-1987. In the last decade, there have been published studies about the long run evolution of regional income inequality within several European countries. Crafts (2005) found that the coefficient of variation of GDP per head increased rapidly up to the WWI and declined after the WWII. However, Geary and Stark (2015) contradict this conclusion and find that regional inequality declined since 1861 up to 1911. In Spain regional inequality declined after 1930 (Martínez-Galarraga,Rosés and Tirado 2011, 2015); in Portugal, after 1970 (Badia-Miró *et al*. 2012) and in Italy, after 1950 (Felice 2011). In Belgium (Buyst 2010, 2011) and Sweden (Enflo et al 2011; Enflo and Roses 2015) there is no confirmation of an inverted U-curve pattern.

first introduces other indirect approaches that have tried to fill in the gaps between 1860 and 1930, then discusses their limitations and finally presents original estimates.

3. A new set of historical GDP by departments

The efforts presented above to measure departmental income and value-added follow a direct method of estimation. Evidently, this is the preferred approach since it makes use of a vast amount of information. Nevertheless, historical records are scarce and, above all, inconsistent. In France, although population censuses were carried out on a frequent basis since 1791[23], there are few *Agricultural*[24] or *Industrial Surveys*[25] from which production can be directly observed. This scarcity of original sources, basically on manufacturing, explains why there are only two direct estimates on departments GDPs: the estimation of DM1959 for 1860 and those of CO2011 for 1860 and 1930. Besides,

[23] The first population census dates to 1791. There are eleven population censuses for the 19th century (1801, 1817, 1822, 1836, 1841, 1846, 1851, 1861, 1856, 1872 and 1896) and thirteen for the 20th (1901, 1916, 1926, 1931, 1941, 1946, 1954, 1962, 1954, 1962, 1968, 1975, 1982, 1990 and 1999).

[24] France has Agriculture Surveys for 1840, 1862, 1892, 1911 and 1929. These surveys used to be quite exhaustive and let to distinguish between seeds, animal consumption, human consumption and food-industry consumption. This information let DM1959 and Toutain (1993) to estimate agriculture revenues without falling into double accounting and to substract the intermediate consumptions. Toutain (1993) also uses these surveys to impute the agriculture ouput by departments in 1840, 1862, 1892, 1911 and 1929.

[25] Only the population censuses of 1861 and 1931 include an industrial survey, with detailed information by departments: *Statistique de la France. Industrie: Resultats Generaux de l'enquête effectué dans les annnees 1861-1865* and *Enquêtes annexes du recensement de 1931: Enquête Industrielle*. The Population Census of 1896 contains a census of professions with figures of employment and wages by departments, however it does not give any information on value added, capital stock or intermediate inputs as the industrial surveys of 1861-1865 and 1931 use to do.

reliability is an issue, particularly when recording certain economic activities, where by-employment existed.

Notwithstanding all these limitations, some studies have attempted to indirectly estimate departmental income. Caruana-Galizia (2013), henceforth CA2013, computes per-capita GDP between 1860 and 1911 with a simple parametric approach. For this, it estimates the following specification,

$$\ln(Y)_{i,1860} = \alpha + \beta_1 . \ln(P)_{i,1860} + \beta_2 . \ln\left(\frac{I}{LF}\right)_{i,1860} + \beta_3 . \ln\left(\frac{S}{LF}\right)_{i,1860} + \varepsilon_{i,1860}$$

where Y and P stand for Gross Value Added (GVA) and population in department i in 1860 while the share of employment in industry and services is (I/LF) and (S/LF). With data from Combes et al. (2011) and using Ordinary Least Squares (OLS), the parameters $(\beta_1, \beta_2, \beta_3)$ are estimated. This approach thus relies on the relationship between the level of income in each department and its sectoral employment. Then, CA2013 collected information on population and sectoral employment in 1872, 1886, 1901 and 1911[26]. Using the latter information and the estimated parameters, departmental GVA for those years are computed.

A fundamental assumption of this approach is the stability of parameters over time. But, this is somewhat questionable because relevant socio-economic changes occurred since 1860. It also implies that the distribution of national income is driven by shifts in population and sectoral employment, hence neglecting differences in labour

[26] In order to avoid time-inconsistency, Caruana-Galizia (2013), following Marchand and Thélot (1991), made some adjustments to the employment data (Caruana-Galizia, 2013: 75-76).

productivity across departments[27]. This is a strong assumption, particularly in a context in which France was subject to relevant socioeconomic changes. In the second half of the 19th century, the industrialization process speeded up. Hence, in 1913 industry had doubled its share in total output with regard 1815, while agriculture halved to 24%.[28] At national level, manufacturing labour productivity increased at an average annual rate of 3.45% for 1860-1930[29]. There are reasons to guess that improvements in labour productivity were not evenly distributed across departments. One reason has to deal with economic theory that postulates an increase of regional inequality in the first phases of modern economic growth related with differences in labour productivity and in the GDP composition[30]. The other is a common issue in the French political debate since mid 19th century such as the increasing distance between Paris and the rest of regions.[31]

In this regard, if we regress the above specification with data for 1930 and compare the resulting parameters with the ones estimated by CA2013 for 1860 we find that they are not stable across time. [32] This result rests robustness to the estimation made by CA2013

[27] Although Caruana-Galizia (2013: 72-73) acknowledges the potential role of labour productivity, it is argued that "*a more efficient allocation of labour among economic activities*" is what "*really counts*".

[28] According to Toutain (1987)'s estimates of historical GDP.

[29] Value added from Toutain (1987) and total active population in manufacturing from Marchand and Thélot (1991) for 1860 and Population Census for 1930.

[30] Williamson (1965).

[31] This debate attracted considerable attention after the publication of the second edition of Jean-François Gravier's *Paris et le désert français* in 1953.

[32] While the original or 1860 parameters would be $(\hat{\beta}_1, \hat{\beta}_2, \hat{\beta}_3) = (1.037;\ 0.326; 0.149)$, the parameters in 1930 would be $(\hat{\beta}_1, \hat{\beta}_2, \hat{\beta}_3) = (1.050; 0.247; 0.325)$. Caruana-Galizia (2013: Table 1) reported slightly different values for 1860 $(\hat{\beta}_1, \hat{\beta}_2, \hat{\beta}_3) = (1.047;\ 0.325; 0.151)$.

because he assumes that the changes between 1860 and subsequent years are exclusively motivated by the process of structural change and not by differences in productivity growth across departments. Although CA2013 provides several robustness checks, the lack of comparable estimates at the departmental level between 1860 and 1911 is a major concern. In this regard, the following section will compare and discuss these estimates with our own estimations.

Bazot (2014), henceforth BA2014, followed a complete different approach. In place of estimating a relationship for a base year and projecting forward, it derives departmental income following a two-step strategy. First, BA2014 takes agricultural value-added from Toutain (1961, 1993) for 1840, 1860, 1892, and 1911. Then, it estimates non-agricultural value-added (NAVA) using the *patente* a "*general tax levied upon all individuals, whether French or not, carrying out non-agricultural activities on their own account in France*" (Bazot, 2014: 309)[33]. For this, the *patente* returns are assumed to be proportional to the departmental NAVA. Thus, BA2014 first constructs a coefficient of proportionality ρ_t for each year t as follows,

$$\rho_t = \frac{(Y_t - A_t)}{C_t}$$

where Y_t is Gross Domestic Product (GDP), A_t is the agricultural value-added, and C_t is the amount of the *patente*. Then, Z or the NAVA of each department i in year t would be:

[33] Delafortrie and Morice (1959) also used the *patente* to estimate departmental income from merchants, industrialists and other professional activities in 1864. See Bazot (2014: 311-313) for more information.

$$Z_{i,t} = C_{i,t} . \rho_t$$

Then, the departmental GDP would be equal to:

$$Y_{i,t} = A_{i,t} + \frac{C_{i,t} . (Y_t - A_t)}{C_t}$$

In short, Bazot (2014) approximates departmental GDP with a hybrid methodology where agricultural value-added comes from Toutain (1961, 1993) while NAVA is derived with the *patente*. Following this approach, Bazot (2014) estimates departmental GDP between 1840 and 1911 on a decadal basis[34]. Using the *patente* to distribute non-agricultural value-added (NAVA) across departments also present certain challenges, the most important one related with the representativeness of the sample of the individuals levied with this tax, as should be explained in the next section.

In order to complement the above methodologies, we have estimated departmental GDP in 1892, 1911, and 1930. Our approach follows Geary and Stark (2002) who departed from the fact that national output, or Y, equals the sum of its parts or Y_i:

$$Y = \sum_i Y_i$$

Likewise, Y_i can be expressed as:

$$Y_i = \sum_j y_{ij} L_{ij}$$

[34] Although Toutain (1993) only publishes agricultural value-added by department in 1840, 1860, 1892, and 1911, Bazot (2014) approximates intermediate years (1850, 1869, 1880, 1900) keeping constant the share of agricultural value-added in 1840, 1860, 1892 and 1911 respectively.

where y_{ij} represents the average value added per worker in department i and industry j, while L_{ij} captures the number of workers. In our case, historical estimates of national output are available from Toutain (1987), while population censuses provide the number of individuals by major economic activity. Having said that, the fundamental issue in this approach is the measurement of regional labour productivity in each industry or y_{ij}. Geary and Stark (2002) used regional wages by industry to proxy labour productivity,

$$Y_i = \sum_j \left[y_j \beta_j \left(\frac{\omega_{ij}}{\omega_j} \right) \right] L_{ij}$$

where y_j stands for the value-added per worker in France in industry j while β_j is a scalar that preserves differences across departments, thereby guaranteeing that the national level is equal to the sum of its parts. Similarly, (ω_{ij}/ω_j) reflects the wages paid to workers in department i and industry j with respect to the national average[35]. The Geary and Stark (2002)'s method consists on allocating national GDP across regions using information on sectoral shares of employment (agriculture, industry and services) and relative wages. They assume that regional sectoral productivity relative to the national average is reflected in the relative wages. The estimate uses three sets of data: labour force by region and sector; national GDP by sector and relative wages by sector to compare sector wages in each region with the national sector wage.

[35] See Geary and Stark (2002), Appendix: Method for a detailed explanation.

This method also presents limitations and potential biases.[36] It is debatable whether relative nominal wages are a good proxy of labour productivity differences. For example, Geary and Stark (2002) assume no variation in regional price levels. Therefore, it is difficult to disentangle whether regional differences in wages reflect only labour productivity or also other factors. In any case, Geary and Stark (2015) have recently shown that, given the adequate wage and employment data, their approach yields accurate regional GDP estimates.[37]

To simplify matters, we have also estimated departmental GDP with a two-step strategy. First, agricultural value-added in 1892, 1911, and 1930 comes from Toutain (1961, 1993). The above method is thus used to compute non-agricultural value-added (NAVA) in each department. Labour force in 1892 and 1930 from Combes et al. (2011), while information for 1911 have been drawn from the population census[38]. Regarding nominal wages, we have collected this information from several sources[39]. Although NAVA contains several economic activities (industry, transport, public administration…) our

[36] One of the criticisms to the Geary-Stark method is to rely exclusively in labour incomes and not to include capital revenues (Crafts 2005). However, the Geary-Stark method uses wages only as indicators of regional sector productivity (Geary and Stark 2015; 126) and not to estimate a multiple of the total wage income as Crafts (2005) suggests. Hence the distribution of GDP across regions is based on the sector labour productivity that depends on both the stock of capital and the state of technology in each department. By comparing with official estimates for 1971 and 2001 Geary and Stark (2015) test that their method provides accurate estimates of regional GDP.

[37] This method looses accuracy when moving back in time the wage coverage is reduced. Fortunately, French official statistics provide a wide set of wages by industries or professions in 1860, 1892, 1911 and 1929.

[38] Although Combes et al. (2011) provide labour force for 1896, we assume this information for 1892. Population data come from the harmonized national censuses published by INSEE.

[39] See the appendix for a complete description of the data sources.

approach is built on male industrial wages reported in historical sources. Alternatively, Geary & Stark (2002) proposed to proxy wages in services as the weighted average of agricultural and industrial wages.

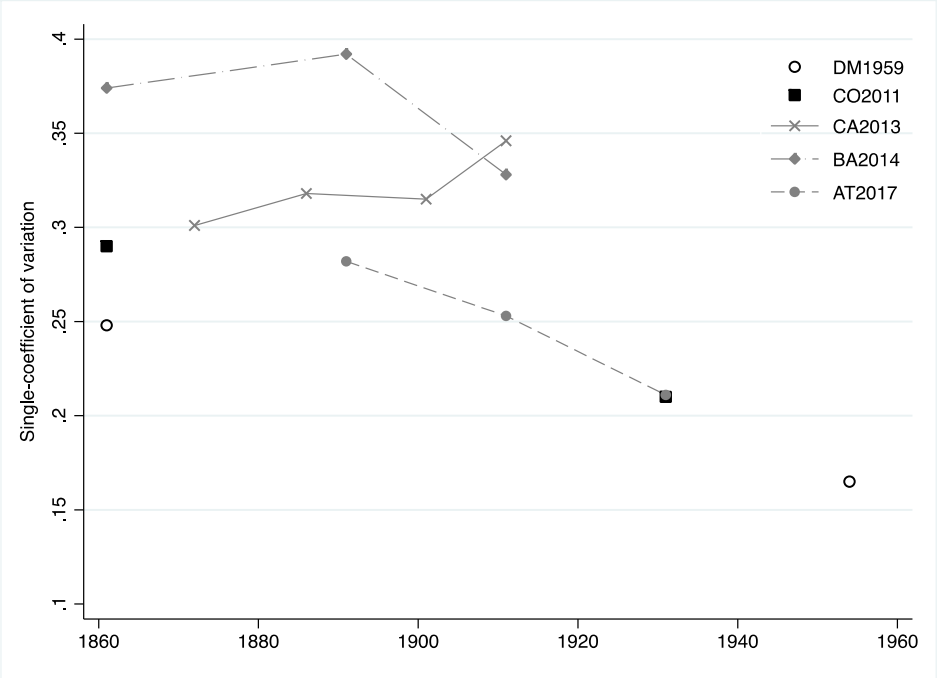
4. Regional income inequality in France, 1860/64 - 1930/1954

In this section, the above information is used to describe regional income inequality in France from 1860/64 to 1930/54. For this, we have compiled a dataset of departmental income (or GVA) and population. The department is thus the spatial unit of analysis. As a result of territorial changes occurred during the period of study we have introduced some adjustments. Following Combes et al. (2011), we merge Meurthe, Moselle, and Meurthe-et-Moselle into a «pseudo-department» for the whole period. Second, we merge Seine and Seine-et-Oise. Third, Corse is excluded from the sample, while the Territoire de Belfort was included in (a) Haut-Rhin in 1860 and 1930 (b) Haute-Saône from 1871 to 1918, and (c) Jura in 1954[40]. All in all, the dataset contains data on income or output and population between 1860/64 and 1954 for 86 departments except

[40] France *métropolitaine* contains 96 *départements* or NUTS3 regions. After the Congress of Vienna, France had 86 departments. By 1861 there were 89 with the inclusion of Alpes-Maritimes, Savoie and Haute-Savoie. As a result of the Franco-Prussian War (1870-71), Bas-Rhin and parts of Meurthe, Moselle, Vosges and Haut-Rhin were ceded to the German Empire. These territories were recovered after the Great War (1914-18) and the Territoire de Belfort became the 90th department in 1922. In 1968 Corse was divided into Haute-Corse and Corse-du-Sud, while Seine and Seine-et-Oise were reorganized into 7 departments. For a complete list of the departments included in our sample see table A.1 at the Appendix.

for the period 1871-1918, in which Haut-Rhin and Bas-Rhin were part of the German Empire[41].

Figure 2. Regional income inequality in France 1861-1954



Source: DM1959: Delefortrie and Morice (1959); CO2011: Combes et al. (2011); CA2013: Caruana-Galizia (2013); BA2014: Bazot (2014); AT2017: own estimates (AT2017), see text.

Figure 2 illustrates regional income inequality, measured as a single and a population weighted coefficient of variation of per-capita income or output, for the period of study. As table 1 illustrates, if we evaluate the long-run evolution of regional inequality using direct estimations, such as DM1959 and CO2011, then disparities, on the whole, declined. Interestingly, the level of the single (SCV) and population-weighted coefficient of variation (WCV) goes in line with other related studies (at NUTS-2 level),

[41] Bazot (2014) only includes 83 departments in 1860. Alpes-Maritimes was reconstituted that year, while Savoie and Haute-Savoie were incorporated.

reaching a maximum of 0.290 and 0.353 respectively [42]. However, the indirect methodologies offer a clearly distinct story. On the one hand, using CA2013 estimates, regional inequality in France rose continuously between 1860 and 1911 to the level of 0.327 (SCV) and 0.346 (WCV). This result, combined with estimations from INSEE and Eurostat in the 1980s, is interesting because it supports the presence of an inverted U-shaped relationship between economic development and regional inequality in the very long run. Still, this upward trend is not present when the BA2014 or AT2017 estimates are plotted, neither with DM59 and CO11.

Theoretically, the CA2013 approach requires stable parameters over time, but in a period of rapid socioeconomic change this is somewhat a strong assumption such as the above estimated parameters for 1930 show. Anyhow, Caruana-Galizia (2013: Table 3) also uses this procedure to construct departmental GDP in 1930 to check the robustness of this method. When comparing these estimates with those from Combes et al. (2011), there appears to be a strong correlation, with a reported Spearman-rank correlation of 0.83 at the 1% significance level. However, if we compare our own estimates with those from Combes et al. (2011) the Spearman-rank correlation coefficient rose to 0.99 at the 1% significance level. In a way, our approach outperforms CA2013, thereby casting doubt on the claim that a "*more efficient allocation of labour*" is what really counts (Caruana-Galizia, 2013: 73).

[42] For the period 1860-1950, Belgium reached a maximum single coefficient of variation of 0.283 in 1860-1950 (Buyst 2011); Finland, a maximum of 0.415 (Enflo 2014); Great Britain, maximum of 0.249 (Crafts 2005) and 0.228 (Geary and Stark 2015 and 2016); Italy, 0.396 (Felice and Vasta 2015; Felice and Vecchi 2015); Portugal, 0.454 (Badia-Miro, Guilera & Lains 2012); Spain, 0.444 (Rosés, Martinez-Galarraga & Tirado 2010; Martinez-Galarraga, Roses & Tirado 2015); and Sweden, 0.331 (Enflo, Henning & Schön 2010). See table A.2 at the appendix.

However, the significance of the Caruana-Galizia (2013) equation components to explain regional GDP could be questioned is one takes into account the empirical evidence shed on this issue for other countries. Several studies find the labour productivity catch-up more relevant in explaining regional convergence than the changes in the size and structure of population across regions.[43] And even though, the breakdown of labour productivity gap into a "structural change component" and a "within industry productivity gap component" gives a non negligible role to the last component in explaining both divergence (in the initial phases of industrialization) and convergence (in the subsequent period).[44] These results rest accuracy to the CA2013 method because it concentrates exclusively in the structural change component and ignores the dynamics of within industry productivity differences across departments.

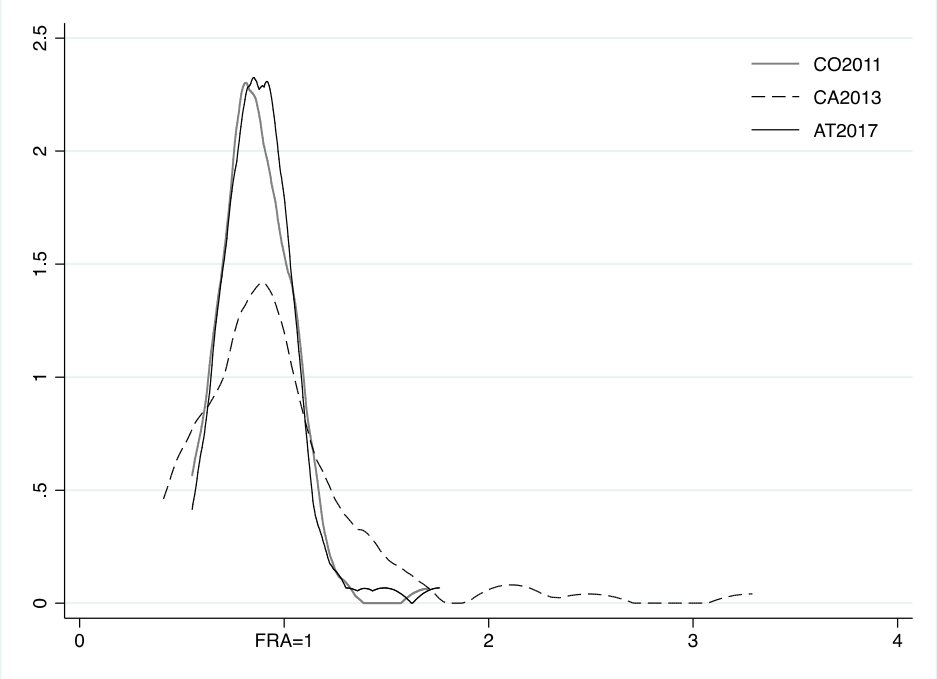
Figure 3 shows the kernel densities of the distributions of each set of estimates, presented as the normalised per-capita income (FRA=1). While our estimation resembles that of Combes et al. (2011), CA2013 does not. More specifically, the coefficients of variation (N=84) with estimates from CO2011 or AT2017 are 0.211 and 0.213 respectively. Using CA2013, however, it rises to 0.472. This would imply that regional inequality followed an upward trend between 1860 and 1930, which appears to be difficult to reconcile with the existing evidence (Delefortrie and Morice, 1959; Combes et al. 2011). Additionally, some departments exhibit surprisingly high levels of

[43] Duro and Esteban (1998) for several European countries and Enflo and Roses (2015) for Swedish regions.

[44] Casselli and Coleman (2011) for the U.S. states; Enflo and Roses (2015) for Swedish regions in 1860-2010.

per-capita income[45]. All in all, this evidence casts doubt on the validity of this methodology to estimate regional income, particularly in periods of substantial socioeconomic change.

Figure 3. Regional inequality (per-capita income; FRA=1) in 1930



Source: CO2011: Combes et al. (2011); CA2013: Caruana-Galizia (2013); AT2017: own estimates, see text.

The second indirect approach, BA2014, hints to a decline of inequality at the turn of the twentieth-century. Using a Gini coefficient, Bazot (2014: 323) argues that "*inequalities in economic development decrease after 1900 but remain quite stable before that date*"[46]. Although this result can be easily reconciled with previous findings, the level of

[45] In terms of per-capita income, Meuse, Meurthe-et-Moselle, Pas-de-Calais, Vosges and Manche will be the richest departments. Seine (including Seine-et-Oise) will not be in the top-25, and below the national average (FRA=1) which seems somewhat puzzling.

[46] Likewise, Bazot (2014: 323) points that the "*distribution of economic development among départements tends to homogenise –especially during the period of high economic growth (1900-1910)-*

regional inequality appears to be extremely high in 1861: 0.374 (SCV) and 0.492 (WCV).[47] As we have previously discussed, using tax returns to estimate departmental income presents several challenges. In particular, it is worth stressing that the *patente* tax economic activities in proportion of their expected profitability. Nevertheless, there are some potential biases. Profitability, for example, was unobserved and thereby guessed. Bazot (2014: 312) stresses that several tax reforms were carried out between 1840 and 1914 to adapt the *patente* "*to the evolution of the economic landscape*". These amendments left exempt a big number of rural and independent workers and small firms.[48] This kind of exempt agents represents a higher share of the total number of owners in the poorest departments than in the richest ones and hence this fact biases the regional distribution of total GDP in favour of the richest departments. Furthermore, Paris accounted for a large and increasing proportion of big companies and even of the taxes assessed on their head offices over profits generated in the factories located in other departments.

In figure 4 we illustrate the ratio of BA2014 estimates (N=83) against those of Delefortrie and Morice (1959) and Combes et al. (2011). For the sake of clarity, figure 4 ranks the departments from 1 (richest) to 83 (poorest) according to BA2014 estimates. All things considered, rankings are rather stable but the upper and lower tails of the distribution appear to be severely biased. That said, it is worth recalling that DM1959

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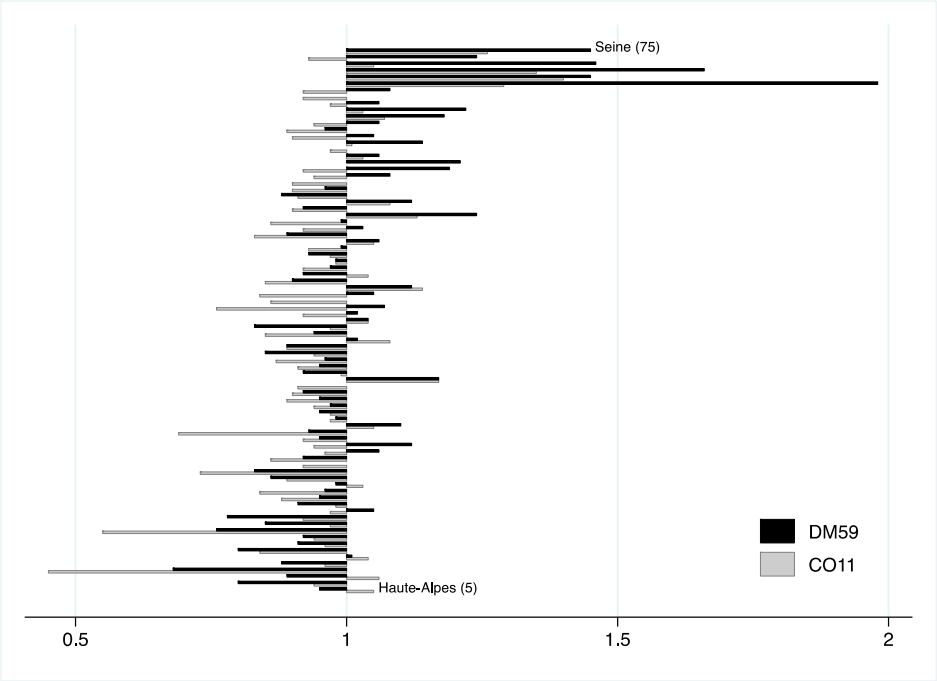
even though the most developed départements deviate from the base –especially during the period of low economic growth (1860-1900)"

[47] For instance the SCV of Great Britain in 1861 was 0.192 and in the UK was 0.277 (Geary and Stark 2015: table 10).

[48] Delefortrie and Morice (1959) outline the importance of this question and corrected for it matching the *patente* information with the list of owners from the Cadastre. However, Combes (2013) does not correct for this question.

and CO2011 offer distinct measures, income and value-added. Still, BA2014 tends to overestimate the richer departments, in terms of per-capita income, and underestimate the poorer ones. Even more, since agricultural value-added comes from Delefortrie and Morice (1959) in all three approaches, the bias results from the estimation of the NAVA[49]. In a way, this would be consistent with the expectation that scale and profitability are usually related.

Figure 4. Relative departments GDP Per-capita in 1860 (BA2014=1)



Note: Departments are ranked following Bazot (2014), being Seine (75) the richest and Haute-Alpes (5) the poorest

Source: DM1959: Delefortrie and Morice (1959); CO2011: Combes et al. (2011); BA2014: Bazot (2014).

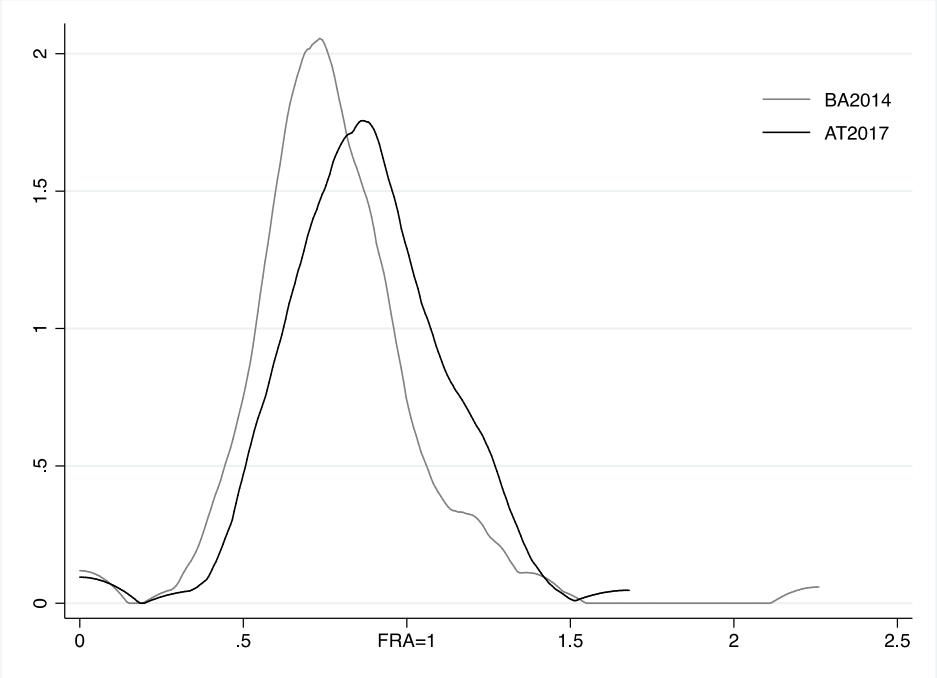
In order to shed further light, figure 5 compares the kernel densities of the distribution of per-capita income in 1911 using our estimates and those presented in Bazot (2014)[50]. As figure 3 and 5 illustrate, and we have discussed above, BA2014 estimates tend to

[49] As Toutain (1992) points in annexe B, agricultural value-added in 1860/64 is taken from Delefortrie and Morice (1959) who reconstituted these estimates using the *Agricultural Survey* of 1862.

[50] Data availability permits the replication of this exercise in 1892/96.

overestimate in the upper-tail of the distribution. This, in turn, skews the distribution, thereby pushing inequality up.

Figure 5. Regional inequality (per-capita income; FRA=1) in 1911



Source: BA2014: Bazot (2014); AT2017: own estimates, see text.

Interestingly, BA2014 and our approach made use of nominal variables, hence omitting potential heterogeneities in prices. Differences in regional prices will impact on nominal wages casting some doubts on the accuracy of relative wages to really reflect differences in real labour productivity between departments. To evaluate the magnitude and sign of this "price-effect" it is tempting to construct a Regional Price Index that convert the nominal estimates into a real regional productivity by using a Purchasing Power Parity basis.

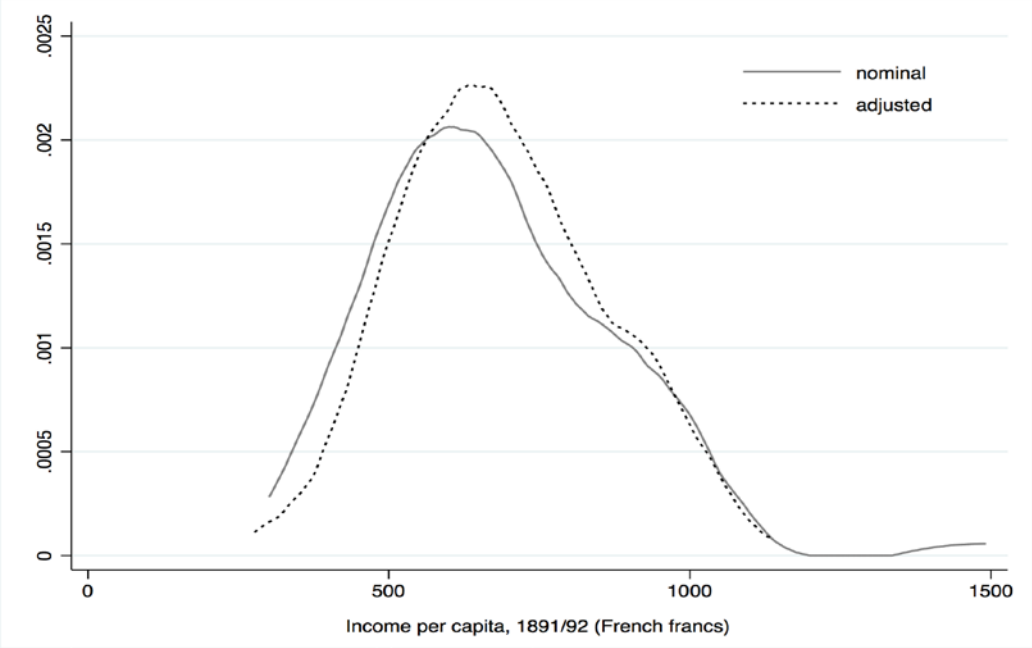
Fortunately, in 1897 the Ministére du Commerce of France published a survey on industrial wages and the length of the working day for 1891/1892. This survey also

contained data on several basic prices (1893/1896) in order to estimate the cost of life in different departments and, hence, to estimate the purchasing power of salaries. The information shed by this source let us to replicate the average expenses of a family of 6 members in food, heating and housing.[51] In general the departments with the highest GDP per capita are also those with the highest price levels, as one should to expect according to the National Price Level Theory (Kravis and Lipsey 1982). At mid 19th century the low level of market integration could influence the local prices and wages and hence important differences could persist not only on non-tradable goods (housing) but also in tradable prices (food and heating). Notwithstanding, most part of the differences in the price level between departments could be explained by the higher cost of accommodation in the most prosperous departments. For instance, in Seine the average accommodation cost more than doubled the national average.

Figure 6 plots the Kernel density functions for 1891 when estimates of per capita GDP are made using nominal wages (solid line) and when deflating by regional prices (dotted line). It can be observed that when correcting by the department price levels in 1891 the dispersion in per capita income is reduced. It would be interesting to explore the evolution of regional prices differentials across time and its impact on the evolution of regional income per capita dispersion. Anyway, we guess that correcting by prices would reduce the level of regional inequality but it would not alter the declining trend of regional inequality observed up to 1930, such as Geary and Stark (2015) have proved for Great Britain.

[51] *Salaires et durée du travail dans l'industrie française*. Republique Française. Ministére du Commerce (1897). Table XXXVII, pp. 254 gives the average home maintenance by departments of a family of 6 members.

Figure 6. Regional inequality (per-capita income; FRA=1) in 1891
Price adjusted



Source: Own estimates, see text.

5. Conclusion

Until nowadays the published estimates of historical GDP by departments in France are not conclusive in two important issues: the level of regional per capita income inequality and its subsequent trend up to 1930. We distinguish between two kinds of studies. On the one hand, there are two direct estimates by departments (DM1959 and CO2011). These studies are considered the best guesses because they gather a wide set of direct and indirect information coming from different sources: official surveys (manufacturing and agriculture), fiscal sources, local and regional administrative accounting... However, the main pitfall of these studies is that the big set of information they managed is available only for 1860/1864, 1930 and 1954. Additionally, there are two datasets based on indirect methods that give estimates for some additional years between 1860 and 1930 (CA2013 and BA2014).

The direct estimates describe a decline in the single and population weighted coefficient of variation between 1860 and 1954, or between 1860 and 1930. However, the indirect estimates well suggest a plateau in the distribution of regional income between 1860 and 1911 (BA2014) or even present an increase between 1860 and 1911 (CA2013). All in all, these upshots prevent from concluding the existence of an U-inverted curve between per capita income and regional inequality in France.

We have shown that the indirect methods provoke some biases in the estimation that could alter the evolution of regional inequality throughout time. Therefore we generate a new set of estimates for the period 1861 to 1930 based in the Geary- Stark method. This method takes relative sector wage with regard national average to scale labour productivity in each region. According to Geary and Stark (2015), with adequate wage coverage this method could give accurate estimates of regional GDP. French official statistics let to muster a wide set of wage data and to build new estimates for 1892, 1911 and 1930. Our data let us to confirm that there was not an increase in regional income inequality in France in 1860-1930 and also reveal that the period under study exhibits an incessant diminished regional dispersion.

Finally, the main criticism to the Geary-Stark method refers to the inability to distinguish which part of changes in nominal wages really respond to changes in real labour productivity and which part to regional inflation. Effectively, when correcting by regional prices differences in 1891, regional per capita income dispersion deflates. A natural extension of this study will be to construct regional price index for every year under study. However, we guess that the evolution of regional income dispersion across time will not be altered when expressing wages in real terms.

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