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Faustine Perrin* and Mickaël Benaim♦

Abstract

The purpose of this chapter is to describe and explain regional patterns of economic development as revealed by data on about 70 variables for France in the middle of the 19th century. The development process occurred at different speed across space. The process turned out to be specific and varied across French counties. The characteristics can be classified in a three part taxonomy based on counties specificities: (1) productive structure; (2) urban-uneducated versus rural-educated structure; and (3) marital structure. Most prosperous counties are characterized by a dynamic industry, gender equality, high education, fertility control within marriage, and low fertility rates. Backward counties are heavily dependent on agriculture and present gender inequalities, a poorly educated population, control of nuptiality, and high fertility rates. The findings resulting from this analysis have implications for our understanding on the origins and consequences of the development process (output growth, human capital accumulation, fertility transition). It contributes to: *(i)* explain the trajectories followed by the French regions; *(ii)* disentangle the reasons behind the emergence of strengths or the persistence of weaknesses; and *(iii)* to explain the variations in the timing and pace to reaching sustained economic growth.

Keywords: Economic Development • Gender • Family • Fertility • Industrialization • 19th Century • France

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1. Introduction

Western countries experienced dramatic demographic, socio-economic, cultural and institutional changes along with their development process. Countries which have reached sustained economic growth experienced similar patterns. Nonetheless, certain areas developed faster than others and different levels of developments can be simultaneously observed within the countries.

In the Unified Growth theoretical framework, the transition to sustained economic growth is explained by interaction between the rate of technological progress and the size and composition of the population that brought about significant reductions in fertility rates (see [Galor and Weil, 2000](#); [Galor, 2011](#)). It enabled economies to the enhancement of human capital formation and income per capita. In more recent formulation, the role of gender equality and family organization has been recognized as a crucial factor of economic development ([Diebolt and Perrin, 2013](#)). However, certain aspects and explanations of the development process remain not fully satisfactory and leave open outstanding questions. Macro models are highly informative but should be completed with in-depth explorations to reflect the considerable variety of the nature, causes, or factors explaining economic development. Although researchers have long been interested in studying the underlying mechanisms of the development process, the interconnections linking demographic, socio-economic, cultural variables remain poorly explained. Identifying a pattern of economic developments may contribute to enlighten the causes and mechanisms behind the transition from stagnation to Modern economic growth. Yet, at present there is no comprehensive assessment or studies capturing the diversity of regional developments in the past.

The purpose of this chapter is to describe and explain regional differences and similarities of French counties during the development process. Gerschenkron perceived the European industrialization as a systematic whole that could only be understood by comparative analysis ([Harley, 2002](#)). In line with Gerschenkron's approach, we aim to build a typology and find patterns in diversity based on the degree of backwardness/precocity of the regions (see [Gershenkron, 1962](#)). In particular, we want to look at the key characteristics of the regions, and therefore, at the possible key factors causing these differences and eventually propelled sustained economic growth. To do so, we explore the French development process, and more specifically, the varieties of French regional experience.

France is a particularly interesting country to investigate notably as it presents a strong heterogeneity across regions. Different states of regional development ran side by side. The national investigation on France can lead to misleading interpretation. France as a whole hides an extraordinary diversity with regards to many aspects – be it economic, social, cultural, or institutional. The process of development was undoubtedly a regional process, spurred on by divergences in the location of infrastructure across regions, as well as by the existence of cultural and social specific characteristics.

We take advantage of the existence and availability of a very good supply of quantitative data at the county-level to investigate the regional specificities that could explain the diversity in the timing and space

with which the economic progress took place in France during industrialization. More specifically, we explore regional patterns of the development process, as revealed by data covering Metropolitan France in the 1850s and gathering economic, demographic, social, cultural, institutional, and geographic characteristics. To do so, we use a principal component analysis coupled with a hierarchical classification. This exploratory approach has the advantage to allow gathering a wide range of quantitative information – which have been highlighted as important by existing literature, or not yet highlighted as important.

We find that French departments can be divided into six clusters according to their socioeconomic characteristics. The indicators are classified into three major dimensions: the productive structure (sectoral specialization), the urban uneducated versus rural educated structure, and the marital structure of the population. The existence of particular conditions in some regions contributes to explain the different trajectories and speed of development followed by these regions and, on a more global basis, the variations in the timing and space of the development process.

We believe in the importance of building a body of knowledge that encompasses the development process and reflects regional diversities. We think that the process of development can be explained and analyzed by considering the co-existence of different stages of development. This chapter is a contribution to this objective. It provides a global synthesis of the spatial demographic, socio-economic, and cultural characteristics of France during its transition to sustained economic growth in the 19th century.

The remaining of the chapter is organized as follows. Section 2 discusses the main features of the French development process. Section 3 introduces the data and methodology used to identify the regional patterns. Section 4 presents the principal component analysis and the hierarchical cluster analysis. Section 5 suggests a typology of regional patterns during the French economic development. Section 6 places a particular emphasis on the relationship between gender equality and the positioning of French counties. Finally, section 7 concludes and opens the discussion on future research.

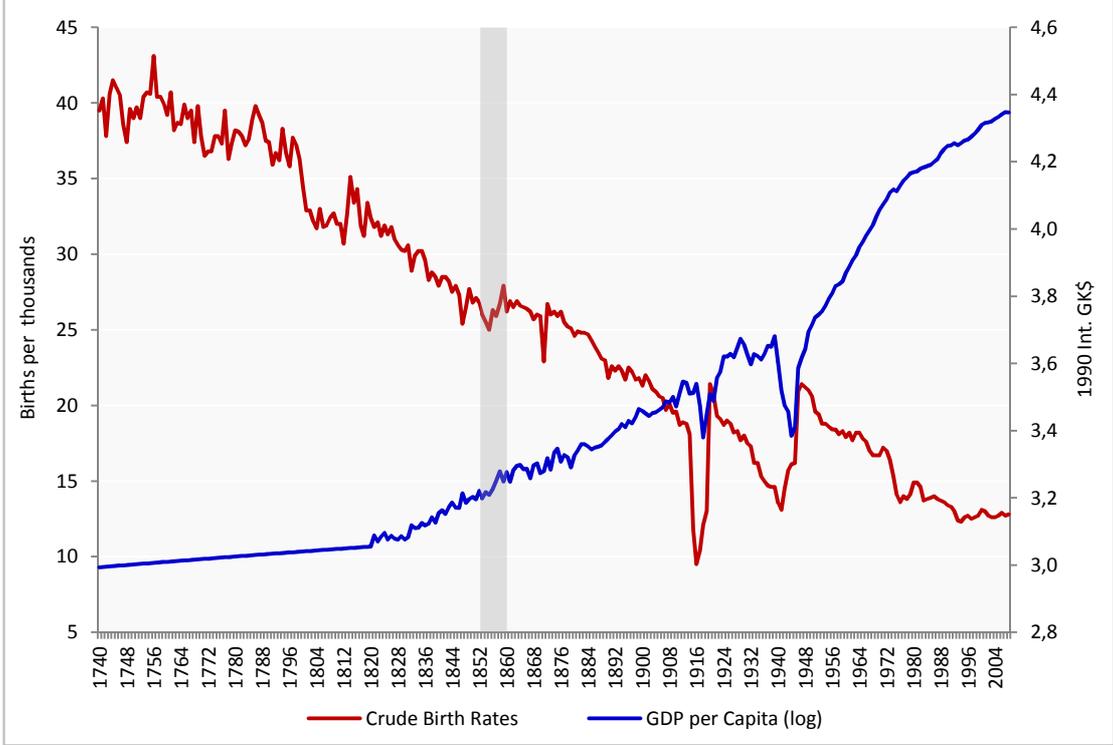
2. A Brief History of the French Development Process

In this section, we document some of the main features of the French development process in order to place our study in the context of longer-term evolutions. We briefly discuss economic, demographic, educational, and cultural evolutions (see [Perrin 2013](#), for a more detailed description of the different aspects covered in Section 2).

Major changes occurred during the development process. France was marked by a rapid transformation of some corners of its economy. The demographic-economic “paradox” suggests that the fertility decline arises naturally as a consequence of economic progress, although more resources could enable the production of more offspring. Despite cross-country variations in terms of timing and speed of economic and demographic changes, developed countries have all experienced similar trends. France is no

exception to the rule (as illustrated by Figure 1). Numerous changes occurred simultaneously to economic and demographic developments.

Figure 1. Crude birth rates and GDP per capita, France 1740-2008



Sources: Crude birth rates from Chesnais (1992) and INSEE (2007) – left axis; GDP per capita from Maddison (2008) – right axis.
 Note: Missing data are calculated by linear interpolation. The grey area highlights the 1850s, period under consideration in our analysis.

Economics

From Agriculture to Industry

The 19th century French economy remained dominantly agrarian and rural. The annual average growth rates of the agricultural products were estimated to 1.2% over the 1820-1870 period. In 1860, the share of the agricultural value-added represented 44% of the national value-added, compared with 31% and 25% for the manufacturing and the service sectors, respectively (Combes et al., 2009). At the turn of the 20th century, 40% of the population was still working in the agricultural sector. Some innovations contribute to the prosperity of the agricultural sector, such as the first threshing machines, or the scythe. Innovations increased households’ purchasing power, which in turn stimulated the consumer goods industries. The agricultural revolution is argued to have enhanced economic prosperity and to be a pre-condition for industrial take-off (Bairoch, 1989).

The French industrial take-off is one of the most precocious, just behind the UK. Dynamic industries already established in the 18th century, e.g. in mines, metallurgy and textiles. Capital being difficult to raise,

industries remained limited to certain cities. Entrepreneurship on a small scale flourished in cities.² The development of industry and trade goes hand in hand with the expansion of cities. French industries continued to develop in the last decades of the 18th century with the introduction of mechanization and the creation of factories, despite the competition from England in the textiles and cotton industries. Contrary to other countries, the French industrialization located (and diffused) significantly in rural areas. Far from disappearing with the development of factories, it grew with the development of the economy (Dewerpe, 1992). By the middle of the 19th century, France had joined the top of the podium of industrialized countries. In 1860, the manufacturing value-added produced in France was only overrun by the UK, and to a lesser extent by Belgian, the US, and Switzerland (Bairoch, 1965). Nonetheless, the French industrial take-off was not as sharp as in other countries, explaining the catch up and overtaking by Prussia at the end of the 19th century, and illustrated by the concurrent persisting importance of the agricultural sector.

Infrastructures

The 19th century experienced the development of road and rail systems, and other permanent infrastructure (tunnels, bridges, etc.). French rail transport began slowly in the 1830s and really started to develop in the 1840s. Railways became a national mean for the modernization of backward and isolated rural regions Weber (1976), although the construction of the railways was originally decided for political and cultural reasons rather than for economic purpose. The railways proved to enhance the industrialization by facilitating the creation of a national market (raw materials, goods, and imported manufactured products). The built system was centralized and mainly radiated from Paris. By contrast, rural France, which needed infrastructures such as better roads and canals, was neglected because of the expense of the railways (Dobbin, 1997).

Education

Profound changes affected the composition of the population during the French development process. While a huge proportion of the population was illiterate before the demographic and economic transition, only a very small fraction of people were still not able to read and write in the late 19th century.

The policies derived from the French Revolution primarily concerned two main aspects: the implementation of measures allowing the spread of revolutionary ideas (and ensuring the rights of citizens) and the diffusion of French language through education (schools). For the Jacobins, the French language had to be the only language spoken across the whole country as the “idiom of freedom” (Abbé Grégoire, 1794). Talleyrand (1791) in his report on the organization of schools deplored the survival of

² Paris was a leading world capital already from the early 19th century (enhanced by the banking system and the availability of capital, and by the large available workforce).

dialects and concludes to the necessity of a common and free primary school, where French would be taught.

Education became a high priority of the successive French governments during the 19th century although the formal training and education of the labor force was not yet perceived as a potential factor of competitiveness and growth. One of the main objectives of education was to transmit culture and train future citizens (Durkheim, 1911). Despite a willingness for homogenization and the creation of a “universal and generic man” (arising from the cultural ideals of the Revolution), large regional disparities persisted. The distribution of enrollment rates and infrastructures were non-uniform across the country. The reforms were also designed to improve the general level of the children of French rural families to a high national level. Several educational reforms (e.g. Guizot, Sée, or the Ferry laws) were implemented from the central government in Paris and then applied to the rest of the country. Literacy rates and enrollment rates in primary and secondary schools increased dramatically for both boys and girls over the 19th century. The development of education occurred gradually: first, in primary education (from the mid-19th century with a catch up of girls towards the end of the century); then, in secondary education (at the end of 19th century and the implementation of the Sée law).

Culture

Language

France was highly fragmented. People in the countryside spoke various dialects. The spread of education among French counties is likely to have been faster in the parts of the country speaking dialects closer to the French language (i.e. *Oïl* and *Franco-provençal* dialects). Through the implementation of the educational policies, most individuals could read and understand the national language at the turn to the 20th century, and the use of regional languages had greatly decreased (Weber, 1979).

Religion

Together with the French Revolution, the role of the juror priests and of the Republican teachers afforded a transformation of both religious and schooling culture with certainly deep repercussions in individuals' life and conscious (Harten and Pitz, 1989). Religious practices might have important effects on individual behaviors regarding family, marriage and sexual practices. For the Church marriage is sacred. Contraception is forbidden and sex is not allowed outside marriage. However, taking into account the difficulty of life for peasant families and their limited resources (Lebras and Todd, 2013), the Church allowed women to delay their marriage in order to avoid having too many children. There exists a demographic ideal type of catholic family characterized by a late age at marriage, high fertility and low illegitimate births. In the mid-19th century, the “Realist” Movement dominated the French literature and extended until the turn of the 20th century. The movement favored science and rationality, and considered

the Church an obstruction to human progress. The anti-clericalism profoundly changed the French religious habits and the role of the Catholic Church had been strongly altered.

Marriage Pattern

Fertility regulation can be the result of traditional means of control such as sexual abstinence, delaying age at first marriage, celibacy, age at first birth. But it can also be the result of more “modern” behaviors consisting in a direct control of the number of births within marriage through spacing out interval between births or stopping child-bearing at a certain age.

Profound transformations affected the marriage pattern in the course of the demographic transition. Prior to the French Revolution, marriage practices were characterized by the classical features of the European Marriage Pattern (Hajnal, 1965): a large share of definitive celibacy,³ marriage at a late age and low frequency of illegitimate fertility. Soon after the French Revolution, the share of definitive celibacy fell sharply, the median age at marriage engaged into an impressive downward path and illegitimate births rose substantially.

Population – Family Organization

On the eve of the 19th century, France was the most populous country of Europe (and the third worldwide, behind China and India). France then remained at the second place behind Russia until the 1860s. Unlike other European countries, France did not experience a strong population growth during the 19th century. The population growth observed during the first half of the 19th century was mainly driven by the countryside. France already engaged in the process of demographic transition since the turn century – namely, about a century prior to other European countries.

Fertility Limitation

The decline in fertility first tended to be an urban phenomenon. The decline started in urban areas a long time before countryside. We also observe a staggering contrast between the contraceptive advances of elites and the generous fertility of urban popular classes (who have a sensitive propensity to control birth) (Flandrin, 1984). A sharp difference emerged during the 19th century. Rural people tended to be more inclined than urban people to choose a restriction of their offspring. In some places like Northern France, the growth of industry seems to have stimulated fertility. Eventually, both urbanized and rural areas reduce their fertility during the 19th century.

³ With the migrations toward cities, the share of single women tended to be lower in rural areas and higher in urban zones. Old single women were two to three times more numerous in urban than in rural areas (Henry and Houdaille, 1979).

The fertility transition appears as a distinctive factor of sustained economic development (as illustrated by Figure 1). According to the adaptation hypothesis (Bonneuil, 1997), individuals might resort to fertility control in reaction to changes in economic and social circumstances, such as decline in infant mortality. In France, mortality rates dropped simultaneously to fertility rates (contrary to most other European countries that first experienced a mortality decline followed afterwards by a decrease in fertility – nearly a century after the emergence of the process in France). The French transition scenario is characterized by an increase in individual longevity. Life expectancy at birth started to increase first slowly and then at an increasing rate from the last decade of the 19th century (always higher for women than for men), while infant mortality dropped substantially at the same period.

Family structure

Over the past two centuries, major changes transformed the French society. The family, as a central institution and backbone of the society, has also evolved along with these transformations. As the economy developed and the industrialization grew, the kinship-based society evolved from dominantly extended family type to nuclear family type, which eventually became the norm. Parsons (1956) argues that the nuclear family evolved to meet the changing economic needs of industrial society.

Family types accord with the environment and the forms of work organization (Dupont, 2004). Most farming families were of extended family types. The extended family consists of parents, children, grandparents (and possibly other family members, such as aunts and uncles) living under one roof, or in several houses very close to each other. The family is entirely responsible for the education of children, the production of food, and the care of the elderly. Two types of extended family can be distinguished: the stem family and the communitarian family. These family types differ from each other with regards to inheritance practices. The communitarian family, usually located in regions with widespread available arable land, is characterized by an equal system of inheritance between (male) children. Family wealth and estates are divided after the death of the parents (Todd, 1990). All sons can get married and bring their wives to the family home. The communitarian family is organized so as to perpetuate the family line generation after generation. They usually have many children who can help with the farming work. The stem-family system is characterized by an unequal system of inheritance. Usually located in regions with scarce arable land, one son inherits the assets and property of the family in order to preserve the lineage. The other children have the choice to remain single within the household or to marry and leave the home (Todd, 2011). The saturation of arable land in certain regions may explain the migration of (non-inheriting) individuals to urban areas, to look for salaried jobs. The rural exodus primarily affected the regions where land is difficult to exploit (especially Southern France and mountain regions (Frémont, 1977)).

The industrialization brought about fundamental changes in the family structure and its functions. According to Parsons, two main reasons explain the development of the nuclear family: (i) the

independence offered to individuals through the development of wage-earning activities; and (ii) the individualism providing individuals the freedom to choose their partner and facilitating the break with extended family members. In contrast to the extended family, the nuclear family type consists of a mother, father and usually two or three children who are biologically related (Murdock, 1949). Two types of nuclear family can be distinguished: the absolute nuclear family and the egalitarian nuclear family. The nuclear family exhibits a total emancipation of children in adulthood. Yet, the division of inheritance among children differs from one type to the other. In the absolute nuclear family, the inheritance is established by testament and usually goes to a single individual, often the son. Brothers and sisters are treated as independent individuals. The egalitarian nuclear family, however, is characterized by an equal division of inheritance among children and encourages the persistence of slightly stronger relations between parents and children until the inheritance is completely divided after the death of the parents.

The development of industries and infrastructures (such as schools) transformed part of families' daily life. The industrialization led to a greater separation of home and professional sphere. Education, which gradually came to be carried out by the State, became a way to empower the children. It contributed to facilitate their integration to the labor market and improve their living standards (as a factor of upward social mobility). Progresses have also been made over time in the relations between men and women and, consequently, family roles and relationships have become more egalitarian.

Gender relations

The commonly pattern of men specialized in paid market work and women in unpaid reproductive and maintenance work in the domestic sphere significantly changes over time. This pattern, based on the existence of a clear demarcation between family and labor market, was the result of a division of labor between gender aiming to combine the possibility of having a maximum of children and income within the household.

The access for single women (usually poorly educated) to salaried jobs increased during the 19th century. The access for married women, particularly those with young children, into the labor force increased significantly during the second half of the 19th century but remained concentrated in sectors requiring few qualifications. The feminization of the workforce led women to acquire more economic power (see also [de Moor and Van Zanden, 2009](#) for a description of the situation in the early modern period). The modern economic role of women marked the rise toward a new family organization, characterized by the plurality between family and professional spheres.

An overall set of mankind's progress (economic, demographic, educational, and cultural changes) occurred during the process of modernization. The French economic development was not a uniform process, neither over time nor across space. It consisted of a mixture between a modernization of the country and individual regional paths linked to socio-economic and cultural specificities.

3. Methodology and Data

a. Methodology

In order to explore the main characteristics of the French counties we propose to perform a Principal Component Analysis (PCA) followed by a hierarchical classification. This choice is justified both by our set of variables (coupling 9 nominal variables and 65 numeric variables), the large number of individuals considered (89 French counties) and, ultimately, by the intrinsic quality of the PCA method.

The PCA reduces the number of dimensions of the dataset (fragmented as a function of common components). As an exploratory method, the purpose is not to explain correlations but to synthesize the information contained in our data set in order to detect interesting patterns amongst a large set of data.⁴ It uses an orthogonal transformation to convert a set of observations of possibly correlated variables into a set of values of linearly uncorrelated variables called principal components⁵ (see [Henning et al. 2011](#) or [Chilosi et al. 2013](#), for a recent application in different contexts).

Following the PCA, we grouped the French counties into different clusters, according to their positioning along the axes, using a Hierarchical Clustering method. These groupings maximize the intra-cluster homogeneity and inter-cluster heterogeneity (see [Everitt et al., 2011](#), for methodological details). In other words, amongst the same cluster, we find counties with similar patterns of characteristics that are sufficiently distinctive to determine other clusters composed by “opposed” counties based on their characteristics. The purpose here is to provide a clearer vision of the specific features of the numerous (i.e. 89) French counties by providing statistical groundings to group them within a limited number of relevant categories.

The PCA and the clustering analysis are powerful tools to represent a large set of information and a large set of observations into a limited number of dimensions and groups. But it is important to bear in mind that some individuals have specific characteristics that might be polished, if not hidden, by the methods. The representation in three dimensions conceals various dimensions, 74-dimensions in our case. All groups (and analyses) are compared to the average. A central position, at the intersection of the two axes, means that the county has an average behavior in relation to other counties on these two axes. A hierarchical cluster analysis proceeds to groupings independently of the use that will be made from the results. Consequently, we must pay a particularly careful attention to the analysis of our result and to the interpretation of the axes ([Jolliffe, 2014](#)).

b. Data

⁴ For more descriptions of principal components, see [Lindeman, Merenda, and Gold \(1980\)](#).

⁵ Intuitively the first principal component of a set of variables is the linear index of all the variables that captures the largest amount of information that is common to all of the variables ([Filmer and Pritchett, 2001](#)).

A great deal of county-level (NUTS 3) data has been collected to conduct the typological analysis of regional development. Most of the variables are built using data from the *Statistique Générale de la France*. These variables are available for 86 counties (French *département*). Three additional counties are part of our sample (Alpes-Maritimes, Savoie and Haute-Savoie), however, all variables are not available for them. These 89 counties constitute our “individuals” in the PCA.⁶ As administrative and statistical borders, the French counties evolved over time. Since the 19th century, some counties have changed their names, others merged or even split. The analysis takes into account those changes.

The 74 variables used in our analysis consist of various socio-economic indicators: demographic variables (e.g. fertility, life expectancy, age at marriage, etc.); economic variables (i.e. urbanization, industrialization, employment, production, wages, means of communications, etc.); education variables (number of schools, literacy rate by genders, etc.); cultural variables (i.e. religious practices, family structure, gender gap index, etc.); and geographic variables (cardinal points, distance to Wittenberg, etc.).

The identifiers, names and descriptions of our variables are given in Appendix (Table A). Most data (otherwise stated) concern the year 1851. We use here a larger number of economic indicators.⁷ They include characteristics on numerous aspects: sectors (agriculture, industry), urbanization, industrialization, wealth but also employment, wages, specialization (by gender) that also reflect the social position of individuals.

4. Analysis

a. Principal Component Analysis

We perform a principal component analysis in order to explore the structure of our data. The method allows us to synthesize the information by reducing our important number of variables to a small number of factorial axes. The three main dimensions are determined using Cattell's (1966) criteria. They are able to explain 50% of the variability observed in the data. Figure 4 presents the three axes and their main characteristics.⁸

Factorial axis 1. – The first axis (horizontal axis) is negatively marked by the agrarian sector (share of farmers or individuals working in the agricultural sector, land inequality), by a lack of educational infrastructure/investments (illiteracy, towns with no schools, distance to Wittenberg), and by marital

⁶ Because of missing data for Alpes-Maritimes (belonging to the Kingdom of Piedmont-Sardinia from 1814 to 1860), Savoie and Haute Savoie, the positioning of these three counties have to be interpreted with caution.

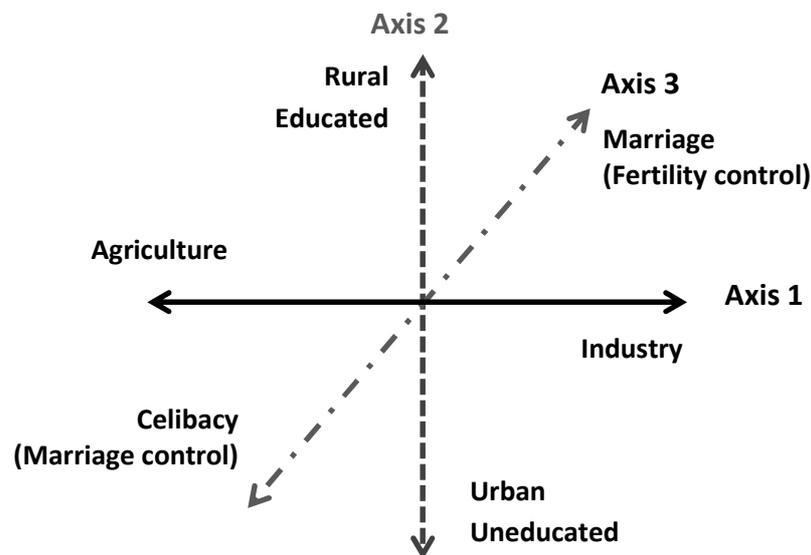
⁷ Among the variables at our disposal, nine have not been used to determine our two main axes, but were simply projected on them. They are used as “illustrative” variables. Thereby, they are projected on the first two axes (see Appendix).

⁸ The result of the principal component analysis is provided on Figure C in Appendix. It shows the position of the variables of the principal components 1 and 2 (left) and of principal component 1 and 3 (right).

fertility; and positively marked by the industrial sector (manufacture output, share of small industries, industrial workers, men's wages, proto-industrialization), and by educational investments (literacy rates, enrollment in public primary schools), as well as by gender equality, transport/communication (railroad), and urban residents.

Axis 1 tends to reflect a fairly well-marked opposition in terms of **productive structure** (sectoral specialization) and to a lesser extent by **infrastructures** (communication and education). Therefore, we find a contrast between very rural counties, led by a strong agricultural production, versus counties more mechanized and oriented toward industrial production. Axis 1 also shows a clear distinction between poorly educated individuals (with little access to education and relatively high fertility rates), rarely owner of their land, versus a more urban and more educated (especially female) population. This first axis explains about 24% of the total variance.

Figure 4. The Three Axes



Factorial axis 2. – The second axis (vertical axis) is negatively marked by the level of urbanization (urban resident, agglomerate population, density) and industrialization (number of industries, industrial workers), by the demographic profile (crude birth rate, children and infant mortality), and by the service sector (domestic workers); and positively marked by rurality (rural resident, rural areas) and by educational investments (schools for boys, enrollment in public primary school, literacy rates, towns with no school for girls),⁹ as well as by health (life expectancy at age 0).

⁹ It is important to specify that counties characterized by a high share of towns without schools for girls where, conversely, usually characterized by a high share of co-educational schools).

Axis 2 tends to reflect the **urban-rural structure** and the **educational structure** of the population. On the one hand, we find counties largely marked by urban population, with high population density, high employment rates and relatively low children and infant mortality rate – lower than the average of other departments. On the other side (positive part of axis 2), we find departments with a more rural population and better educated (both men and women). This second axis explains about 14% of the total variance.

Factorial axis 3. – Finally, the third axis is negatively marked by the classical Western European marriage pattern as described by Hajnal (1965) (late age at marriage, definitive celibacy), marital fertility, and boys enrollment in public primary schools; and positively marked by a reversed marriage pattern (female early marriage, proportion of married women), illiteracy, life expectancy at age 0, and temporary male migration.

Axis 3 tends to reflect the **marital structure** of the population and the method of birth restriction employed by the population. On one side, we find departments largely marked by a population exhibiting early age at marriage larger than the average. On the other side are departments where the share of individuals married young (below 25) is lower than the average (higher rate of definitive celibacy, lower index of marital fertility). This third axis captures around 11% of the total variance.

b. Hierarchical Cluster Analysis

Combining a hierarchical clustering method to the principal component analysis allows us to group counties with similar socio-economic characteristics. The hierarchical clustering is a method of cluster analysis that seeks to build a hierarchy of clusters based on a number of descriptors satisfying intra-classes homogeneity criteria and inter-classes heterogeneity criteria. From a set of n individuals, the clustering method aims to spread these individuals in a number of classes. The hierarchical clustering is called upward as it starts from a situation where all individuals are alone in a class and are then gathered in classes increasingly large. This work is done by successive iteration in which inter-class inertia decreases with each aggregation.

The Ward method (1963) is applied to Euclidian distances of our individuals (counties) represented by their coordinates on the three first factorial axes. The more homogeneous the class is, the lower is the inertia.¹⁰ Ward's method is an algorithm that allows combining two classes of a partition for a more aggregate score. It consists in aggregating the scores (in each iteration) so as to obtain a minimum gain of intra-class inertia and a minimum loss of inter-class inertia.¹¹ The choice of a distribution in 6 classes is

¹⁰ Following Huygens criteria, the total inertia of a partition is constant and equal to the sum of inter and intra-classes inertia.

¹¹ The algorithm used in our analysis is that of Spad 7.0. For more explanations and a comparison of existing softwares, see Chavent, Kuentz et al. (2007).

guided by the intra-class and inter-class homogeneity criteria (see Table B in Appendix). We describe the components of each class in the following section.

5. The Typology of French Counties

The principal component analysis and the hierarchical analysis enable us to suggest a regional typology of economic development, divided into six classes (described in more detail below). Figures 5 and 6 present the distribution of the counties making up each class along with the main dimensions (factorial axis) determined by the principal component analysis.

Figure 5 reveals a relationship between the productive structure (also entitled as the structure of economic activities – axis 1) and the educational endowment/performance (axis 2). Counties specialized in industry tend to concentrate in the right part of the point cloud (developed counties). On the contrary, counties remaining dominantly agrarian tend to concentrate in the left part of the point cloud – related to low levels of development. One can also observe that counties belonging to the educated category are more prone to concentrate in the upper part of the cloud, while counties characterized by low educational endowment/performance locate in the lower part of the figure. Figure 5 makes explicit the link between economic development and human capital endowments but leaves aside the connections with the marital structure of the population. Hence, Figure 6 concentrates on showing the distribution of the counties along the main axis (productive structure – axis 1) and the marital structure of the population (axis 3). Counties located in the upper quadrant of the grid tend to place no control on marriage, but to control fertility within marriage. In contrast, counties located in the lower quadrant of the grid appear as exercising a control over marriage but not controlling fertility within marriage.

The hierarchical cluster analysis allows identifying the groups of cases. The features of the six groups are summarized by a title and then described.

Class 1: Backward, “less developed” counties. – Counties within this class found counties are rather oriented toward agricultural activities – activities in which women are more represented than the average of other counties. Nonetheless, the class is marked by a gender gap index¹² strongly below the general average. These departments also present an age at marriage of both men and women and a share of definitive celibacy higher than the average. Despite these patterns, the marital fertility rate is a lot larger than the average of all counties, so as the crude birth rate which remains above the average. In addition, these departments are also marked by relatively higher mortality rates of both children and infants. We note that children's wages are lower than in other departments. Moreover, these departments have less reliable transportation/means of communication and display low manufacture output. Therefore, Class 1

¹² The index captures the size of the gap between men and women in the following critical areas: economic participation and opportunities, and educational attainment. See Perrin (2014) for more detail on the construction of the index.

groups less developed counties, dominantly agrarian and located in remote areas. They are characterized by low gender equality, high fertility despite a control of nuptiality and low living standard. The 21 counties in this class are located on the left part of the dial and mainly concentrated on the negative side of axis 2 (as can be seen on Figure 5, which displays the position of the French counties regarding the two principal components).

Class 2: Agrarian and uneducated counties. – This is the largest class in terms of number of departments. The 33 departments of this class present high share of illiterates among married individuals, a lack of educational infrastructures and are predominantly agrarian. The industrial production is low in these counties, as are both male and female employment rates in the industry. Contrary to Class 1 counties, a large share of the population married young and the share of definitive celibacy is below the national average, although marital fertility remains a little bit below the national average. Similarly to Class 1, the gender gap index is low. Hence, Class 2 groups counties located in agrarian areas. The population is poorly educated compared to the average of other classes so are living standards. Fertility rates are in the national average. Individuals marry young but tend to exercise some control of fertility within marriage. The counties of class 2 are located in the center of the dial - at the corner of both axes with a gravity center somewhat pulled towards the upper-right part of the dial (see Figure 5).

Class 3: Industrial and rich counties. – The departments that compose this class clearly display a concentration of population in urban areas. These departments are industrial with a rural and agrarian population below the national average. The average wage of men and children within these departments is high – it may be pulled by a larger proportion of professional as well as by a stronger industrial production. In addition, we note that this class is characterized by educational infrastructures for boys below the national average. Finally, these departments present high fertility rates. Class 3 groups rich and industrial counties. They present large gender inequalities in regards with education and wages and high fertility rates. The 8 counties are located in the lower part the dial – more on the positive side of axis 1 (Figure 5).

Class 4: “Protestants” areas, highly educated counties. – This class, which consists of 11 departments, is very interesting with regard to its members’ positioning. Indeed their educational indicators are the most divisive: their enrollment and literacy rates as well as educational structures are larger than in any other counties for both genders. It is also noteworthy that religion appears cleaving for these departments – closely located from Wittenberg and characterized by the largest share of Protestants among the population. Men and women in these departments married on average later than in other departments. Furthermore, the departments of this class show a relatively rich industrial production, but outside urban areas. The class is also marked by a gender gap index fairly larger than in other counties. Class 4 is then composed of counties characterized by highly educated population of both genders. These

counties are mainly rural and present high living standards. Gender equality is high and average fertility rates are close to the national average (26.25 against 26.95, respectively). This class is composed of 11 counties located in the right (and mainly upper) part of the dial (Figure 5).

Class 5: Gendered egalitarian counties using birth control. – Departments of this class are characterized by a high availability of arable land – they are mostly rural. The female population of these departments is highly educated despite a low number of schools dedicated for girls. Female education and literacy is a strongly divisive indicator. Similarly, the gender gap index is clearly larger than the national average. Female average wages are larger than in any other department. Men and children’s wages are also higher but to a lesser extent those of women. These departments have a dynamic industry as revealed by high employment rates in industrial activities but remain also largely rural. Finally, the counties of this class present low fertility rates (24.86) within marriage although women marry younger than the national average. Class 5 differs mainly from Class 4 in regards with fertility. While counties of Class 5 limit fertility within marriage, Counties of Class 4, more religious, tend to “regulate” fertility via nuptiality. The 15 counties that compose this class are located in the upper-right part of the dial (see Figure 5).

Class 6: The peculiar case of Seine. – Seine is different from all other departments. The population density is 29 times larger than the national average. Seine is more industrialized than any other county and the manufacture output is five times that of the national average. The level of gender equality is close to the average. However, this level hides the fact that education and literacy rates are very low for both genders. Total fertility is very high although marital fertility is lower than the national average. Individuals marry late; the share of definitive celibacy is high and the share of illegitimate births is twice that of the national average. Seine is located in the bottom right part of the dial (see Figure 5).

Figure 5. Position of the classes of counties on the first two factorial axes

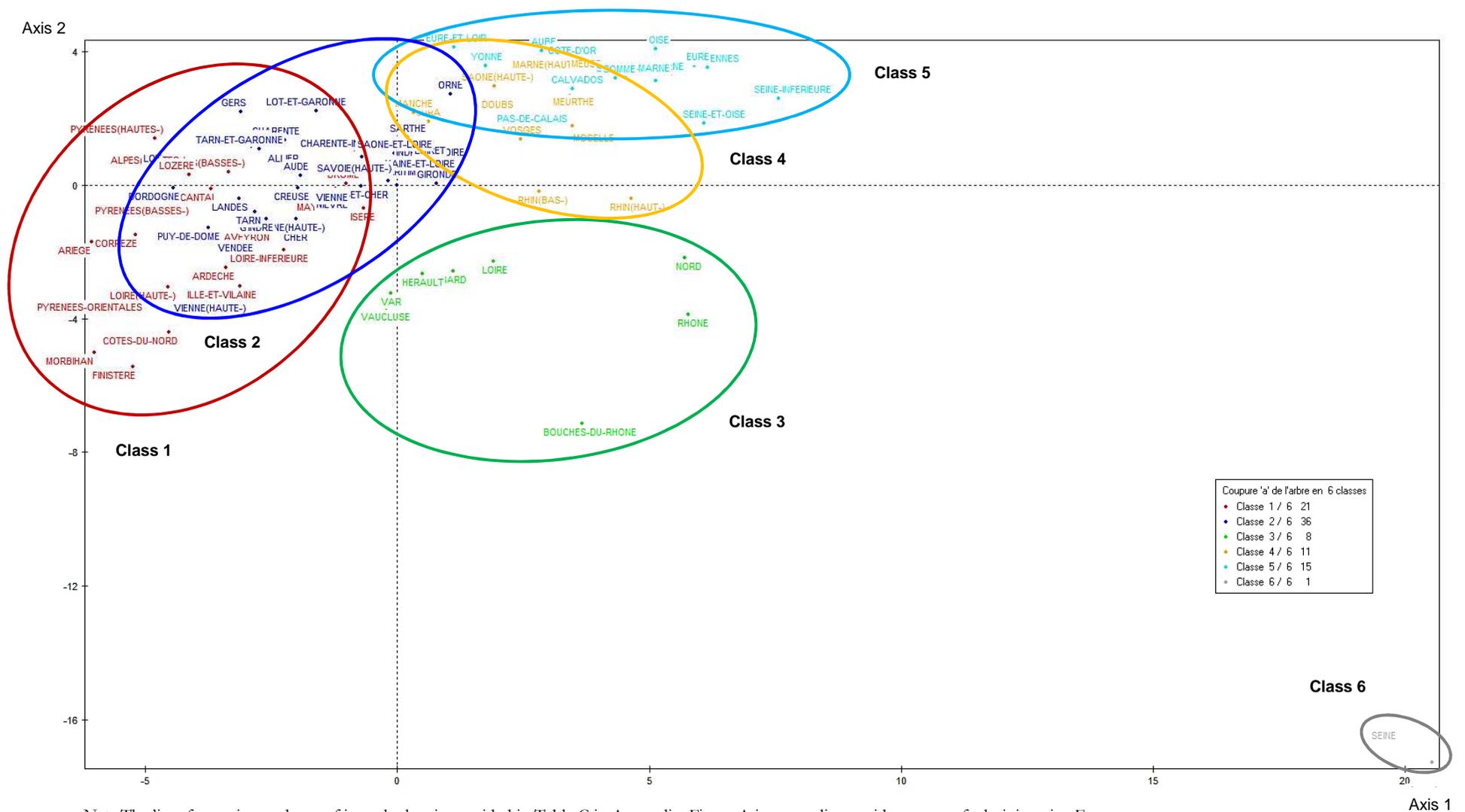


Figure 6. Position of the classes of counties on the factorial axes 1 and 3

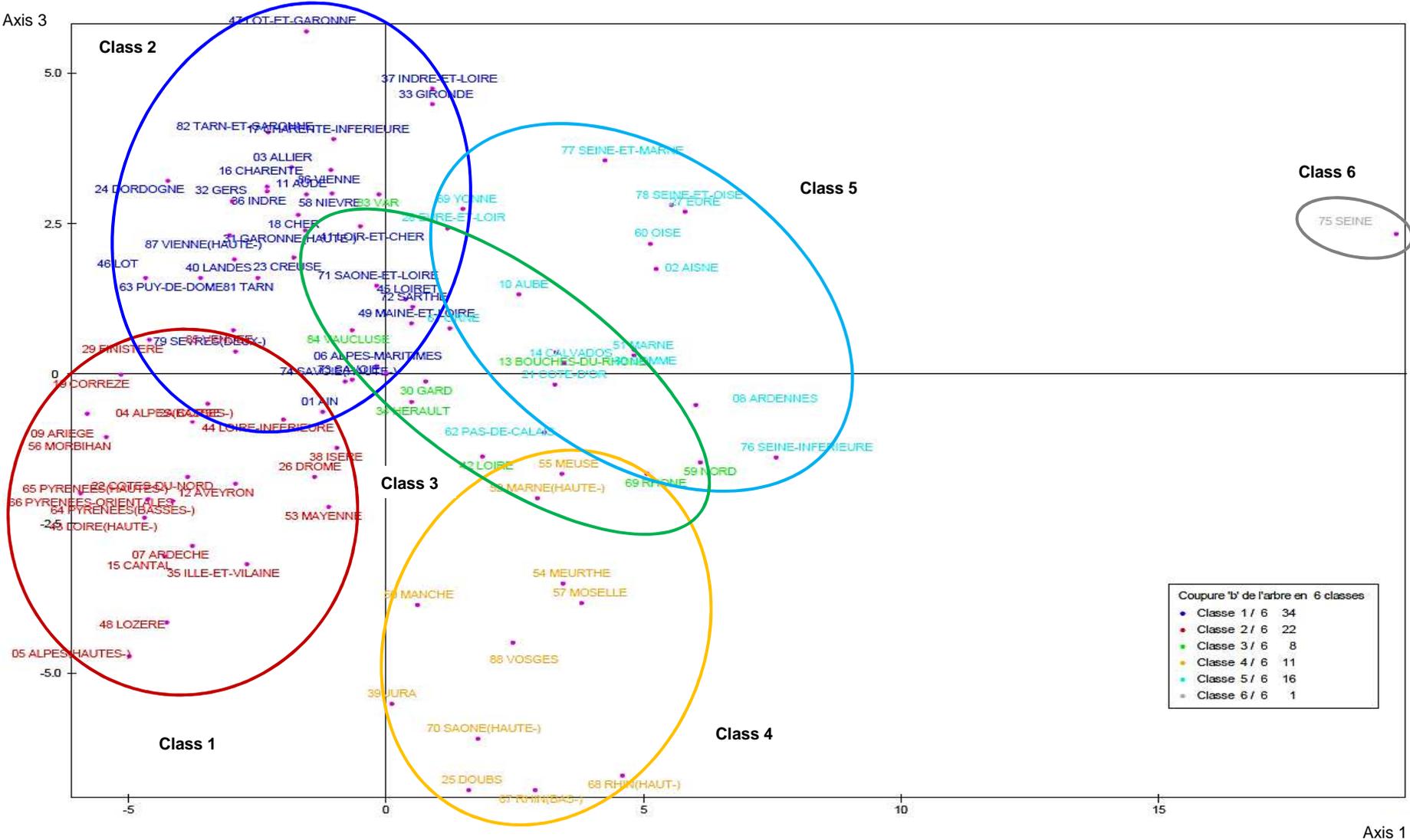
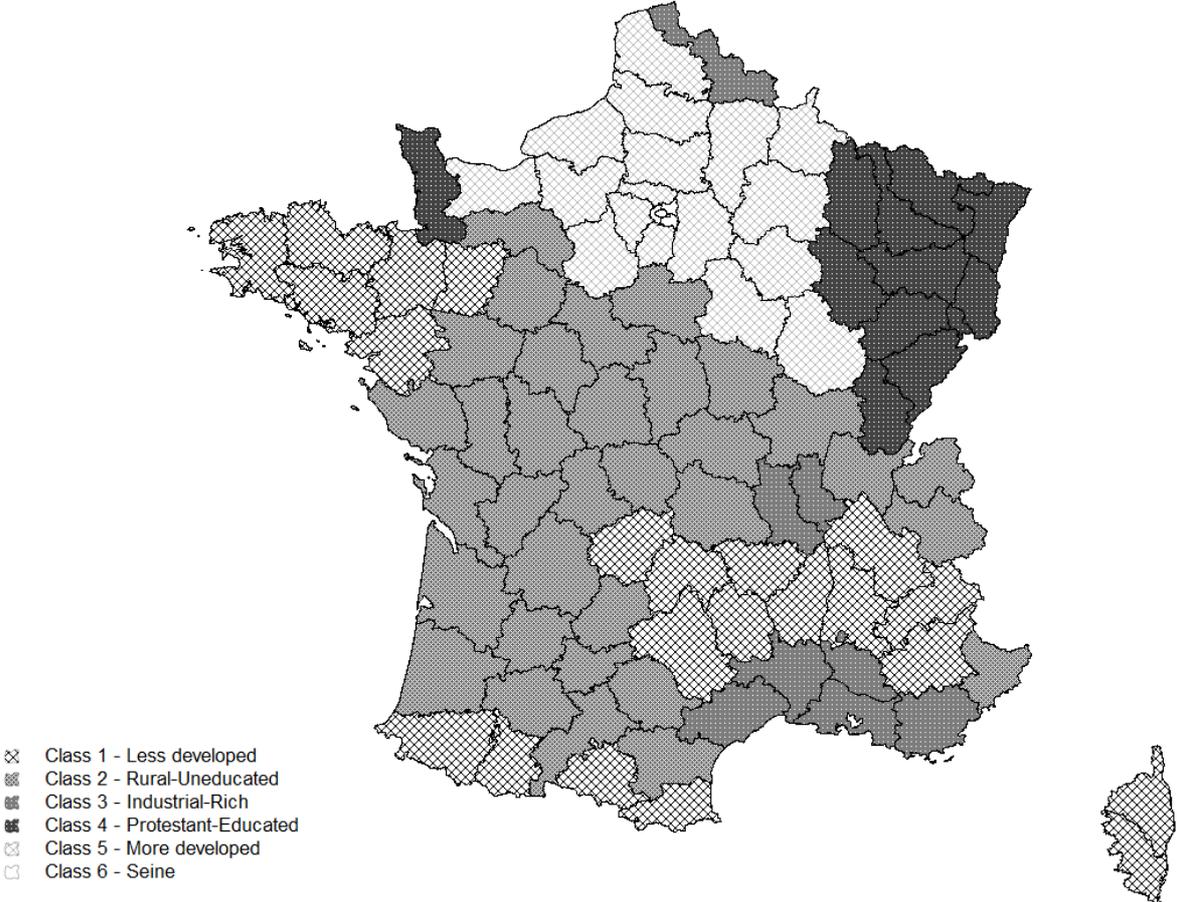


Figure 7 presents the geographical distribution of the six clusters representing the different levels of socio-economic development of French counties in the mid-19th century. Surprisingly, the clusters divide the French territory in such a way that we can distinguish the different zones fairly clearly.

Figure 7. Clusters of French Counties



The methods used to analyze our data allowed us to identify the main socio-economic characteristics and then to identify the positioning of the French counties with different degrees of development. Indeed, France appears to be a mixed (with clear contrasts) country in terms of socio-economic development. Still, we note that counties within a same class present similar characteristics in terms of sectorial specialization, fertility level and educational investments. Counties of Class 5 and Class 4 located in the Northeastern part of France have a dynamic industry. They also both pay great attention to education. However, Protestant religion (practice or influence) seems to matter more for counties of Class 4 which also tend to favor a control of nuptiality as shown by late age of marriage. Counties of Class 4 are concentrated at the Prussian border which may suggest an influence coming from this Protestant country. On the opposite, counties of Class 5 differ in that they seem to strongly control births within marriage: their inhabitants marry young but have a low fertility. Women work sensitively more and earn more.

Counties of Class 3 are also highly urbanized and industrialized. But unlike counties of Class 4 and 5, they do not seem to stress advancements in education. In addition, in Classes 1 and 3, fertility rates are higher than the national average. Contrary to Class 3, Classes 1 and 2 are strongly agrarian. Furthermore, education is low for both genders so as gender equality. One important difference between these two classes lies in their respective demographic indicators. While counties of Class 1 seem to control nuptiality (but not births), counties of Class 2 marry young but have a slightly low fertility within marriage. Nonetheless, counties of Class 2 have an average fertility in the average of all other counties.

6. Family, Gender Equality, and the Positioning of French Counties

The diversity of traditional family structures is likely to have had effects on the trajectory of modernization (Todd, 2011). The regional disparities observed across French counties in the middle of the 19th century appear to be associated with the structure and organizations of traditional family types.

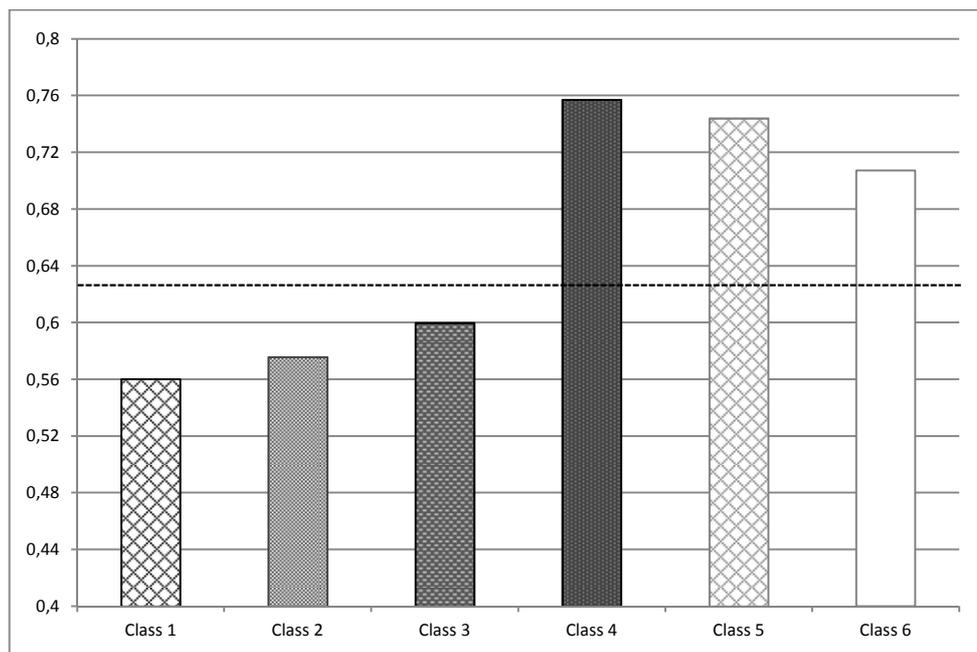
There exist three main fundamental functions that family members have to perform: (i) the economic function – production of goods and services within and outside the home; (ii) the social function – production of education and well-being, transmission of norms and values, inheritance; and (iii) the reproduction function – renewal of generations. These functions are shared between the members of the household. The distribution and division of tasks between family members differed greatly across time and space.

The study of the positioning of nominal variables – our illustrative variables – reveals interesting complementary results (see Figure B and Table E in Appendix). It shows that Class 1 is positively marked by imperfect stem-family (and late rural exodus). The *stem family* is characterized by extended families with several generations living under the same roof. One child – generally, but not always, the eldest – marries and has children that remain in the household in order to preserve the lineage (he inherits the house and the land). The remaining children have the choice to stay unmarried within the household or to marry and leave the home. The inheriting son remains under the formal authority of the father (Todd, 2011). Class 2 is marked by intermediary Atlantic zone and extended family (as well as by late rural exodus). This group gathers extended family types in which all sons can get married and bring their wives to the family home. The inheritance practices and the values remain unclear but unlikely to be egalitarian. Class 3 however is positively characterized by patrilocal nuclear family. This *cooperative family type* is characterized by extended family and equality among male children in inheritance. Sons can get married and bring their wives to the family home (see Todd, 2011). Class 5, however, is strongly marked by egalitarian nuclear family, so as Class 4 but to a lesser extent (both are also marked positively by early rural exodus 1851 and 1891, respectively). The *egalitarian nuclear family* consists of independent families made simply of a couple and their children. It exhibits a total emancipation of children in adulthood. The system is characterized by an equal division of inheritance among children and encourages the persistence of slightly stronger relations

between parents and children until the inheritance is completely divided after the parents' death (Todd, 2011).

Although these variables have not been integrated to the analysis allowing the creation of the axes, their positioning confirms the description provided in Section 2. Hence, on the one hand, more developed counties have undergone an early rural exodus and families were of nuclear type; on the other hand, less developed counties remained dominantly agrarian until fairly recently and were characterized by extended-family type. The evolution in the distribution and division of tasks between family members was spurred by external factors but also by the changing relations between members of the household. Family trends and patterns have indeed evolved in parallel to changes in gender roles and relations (Oláh et al., 2014). The power relations between men and women play a key role in the understanding of family organization. The gender gap index, which captures the level of gender equality in each county, is a cleaving indicator for the construction of our classes (as shown in Section 4). While Classes 1 and 2 present large female-to-male differences in terms of educational and economic opportunities, Classes 4 and 5 rank as the most equalitarian classes by displaying the highest indices.

Figure 8. Gender Gap Index by Class



Note: The gender gap index is bounded between 0 and 1. An index equal to 0 corresponds to perfect gender inequality; while an index equal to 1 reflects perfect gender equality.

Figure 8 presents a histogram of the average gender gap index for each class obtained from the hierarchical cluster procedure. Counties of Classes 1 and 2, characterized by a predominant agricultural sector, large fertility rates, low educational attainment and low literacy rates for both genders display a low gender gap index. Similarly, Class 3 exhibits a gender gap index below the national average (0.63).

Contrary to Classes 1 and 2, Class 3 is characterized by a predominant industrial sector but similar to them, Class 3 is characterized by a relatively high average fertility but low education rates.

On the other hand, Classes 4 and 5 display high values of the gender gap index. They are both characterized by high literacy rates and educational attainment for both genders and a predominance of the industrial sector. Average fertility rates are lower than in the rest of the country for both classes – lower for Class 5 than for Class 4 – but marriage patterns differ strongly between them. Counties of Class 5 seem to control birth within marriage while counties of Class 4 control via nuptiality.

Finally, Class 6 – Seine – is a peculiar case. Seine is far ahead the most industrialized counties in France. From Figure 8, we also note that the level of gender equality is relatively high (although lower than that observed for Classes 4 and 5). However, the high level of gender equality hides in fact levels of educational infrastructure and enrollment rates which are amongst the lowest of France for both genders. In addition to relatively low education rates and a powerful industry, Seine is characterized by high infant mortality and high fertility rates. Looking more deeply into marriage patterns, we note that the share of young single women is very large, so is definitive celibacy; women and men marry late and the index of marital fertility is fairly low. However, the share of illegitimate births is the largest of France.

7. Conclusion

Understanding the underlying mechanisms behind the transition from stagnation to Modern economic growth is of major importance. Western countries have experienced dramatic demographic, socio-economic, cultural, and institutional changes along with their development process. Despite the effort spent on modelling the dynamics that allowed to escape the Malthusian trap and enter a path of rapid economic growth, the interconnections linking economic, demographic, socio-economic, and cultural variables remain puzzling and poorly explained. Identifying a pattern of regional development may contribute to enlighten and deepen our understanding of the mechanisms behind the transition to Modern growth.

This chapter investigates the regional differences and similarities of French counties during the development process. In particular, it provides a typology of regions capturing the diversity of regional development and identifies a (typical) pattern of development. We use a unique dataset of 89 county-level observations in France in the mid-19th century, including more than seventy indicators. The investigation of socio-economic, cultural, and demographic profiles contributes to shed new light on the regional characteristics of French counties. Our data reveal the existence of large regional diversities. Nonetheless, the principal component analysis and the hierarchical cluster analysis uncover similarities between certain counties. The proximity of certain profiles enables us to identify six groups of counties. Three main factors characterize the 89 French counties. It is interesting to note that the most apparent separating

dimensions are: (i) the sectoral specialization (industry versus agriculture); (ii) the rural-educated versus urban-uneducated structure; and (iii) the marital structure (late versus early marriage).

The factor analysis enables us to explore the specificities of French counties using characteristics rarely taken into account to study the diversity of local development. The typology discloses very different profiles of French regions. We find the existence of two extreme profiles: advanced regions versus backward regions. On one side, we find a *modern-progressive form of society* that consists of counties characterized by a dynamic industry, gender equality, high education, low adult and infant mortality, fertility control within marriage, and consequently low fertility rates (Class 5). On the opposite side, we find a *traditional-conservative form of society* made up of agrarian counties characterized by gender inequality, a poorly educated population, high adult and infant mortality rates, control of nuptiality, and high fertility rates (Class 1).

During most of the 19th century, the French society was dominantly agrarian. The family was the unit of production. The second half of the 19th century witnessed the emergence of the industrial sector which continuously rose until the 1920-30's. With the transition from an agricultural to an industrial society, most of the production was produced outside the home. Industrialization together with the increase in education contributed to change women's roles and gender relations. The changes observed during the development process seem to be closely linked to the evolution of gender relations. The agrarian economic system allowed women to better combine their domestic duties and labor in the fields. The number of children was then maximized. With the development of industries it became more difficult for women to combine both types of work. Two profiles emerged from industrialized areas. On the one hand, we find very urbanized and industrialized areas with large gender inequalities. In these areas, we observe a thicker gender division of labor and fertility remains large. Effort is put on education but specifically on boys' education. On the other hand we find industrialized, but still rural, areas putting significant effort on education for both genders. Gender equality is larger, women tend to be more integrated on the labor market and fertility rates are lower. According to [Goode \(1963\)](#), urban growth and industrialization would lead to a simplification of family structures, and ultimately see the diffusion of nuclear families. However, in the case of France, urban growth does not appear as having played such a crucial role.

We observe persistent regional disparities in the background of national evolutions (see [Perrin, 2013](#)). Socio-economic factors explain a great deal of the differences observed between regions. Yet, cultural specificities embedded in the regions' history (language, religion, family types, or inheritance systems) also appear significant in explaining regional disparities, and furthermore in explaining the timing of the transition across regions. Both incentives and cultural norms matter to explain the diversity of regional profiles, in particular with regards to fertility behaviors (see also [de la Croix and Perrin, 2016](#)).

The analysis conducted in this chapter contributes to provide a number of hypotheses about the pattern of development. The typology of French counties suggests the co-existence of different stages of

development at the regional level. The different groups of regions seem to correspond to specific stages of development. The delay of development found in certain regions can be explained by a lack of factors (such as infrastructures, natural resources, etc.) but also by a cultural diversity, reflecting a certain conservatism of the population with regards to gender relations and family organization, and therefore with regards to nuptiality and fertility behaviors. Hence, some indicators seem to be indispensable preconditions for the emergence of subsequent economic development: accumulation of human capital (literacy, schooling), quality of regional economic structure (infrastructures); accumulation of capital (associated with rise in income and wages); locational advantages (minerals, resources, roads, skilled workers); political and intellectual elements (progressivism versus conservatism; secularization); and individual/cultural specificities (family organization, gender equality)

This chapter is a first attempt to classify counties by proposing a typology of regional economic and development performance in the past. It reveals the importance of taking into consideration factors often left aside by more conventional approaches, such as gender relations and family structure. Through this exploratory analysis, we emphasized the importance of considering family as a unit of analysis aiming at providing a better comprehension of social relationships and economic decision-making. This analysis does not provide the key dynamics of the process but offer a new way to look at the process of development in the past. Further analysis is still required to improve and deepen our understanding of the dynamics at play. Extending the scope of analysis to a regional European comparative perspective is a crucial first step that should pave the way for further developments.

Table 1. Summary of the Classes Features

	Gendered – birth control Class 5	Protestant – educated Class 4	Industrial – rich Class 3	Agrarian – uneducated Class 2	Less developed Class 1
Economic	Best economic performance <ul style="list-style-type: none"> Specialized in industry (also women in professions) Rural population Highest economic power for both genders High infrastructures (railroads, steam engines) 	Average <ul style="list-style-type: none"> Professions Not urban population 	High performance <ul style="list-style-type: none"> Specialized in industry (men in professions; women domestics) Urbanized-clustered population High economic power for men and children Infrastructures (powerful steam engine) 	Low performance <ul style="list-style-type: none"> Specialized in agriculture No clustered population Low economic power for both genders (lowest wages in agriculture) Low infrastructures (steam engine) 	Lowest economic performance <ul style="list-style-type: none"> Specialized in agriculture Not rural population Low economic power for both genders (lowest wages in industry) Low infrastructures (railroads, roads, steam engines)
Education	Very high <ul style="list-style-type: none"> High enrollment both genders High literacy both genders High infrastructures (schools for boys, co-educational schools) 	Highest education <ul style="list-style-type: none"> Highest enrollment both genders Highest literacy both genders High infrastructures (schools for boys, schools for girls) 	Average <ul style="list-style-type: none"> Low infrastructures (no schools for girls) 	Lowest education <ul style="list-style-type: none"> Lowest enrollment both genders Lowest literacy both genders Low infrastructures (schools for boys) 	Low <ul style="list-style-type: none"> Low enrollment both genders Low literacy both genders Low infrastructures (co-educational schools)
Marriage	Opposite EMP <ul style="list-style-type: none"> Large share of married women Early marriage High rural illegitimacy 	“EMP” <ul style="list-style-type: none"> Low share of married women Late marriage High rural illegitimacy 	Average <ul style="list-style-type: none"> Low illegitimate birth 	“Opposite EMP” <ul style="list-style-type: none"> Large share of married women Early marriage Low illegitimacy 	EMP <ul style="list-style-type: none"> Low share of married women Late marriage both genders Large definitive celibacy
Fertility	Lowest fertility <ul style="list-style-type: none"> Low crude birth rates Low marital fertility (fertility control within marriage) 	Average	High <ul style="list-style-type: none"> High crude birth rates 	Low <ul style="list-style-type: none"> Low marital fertility (fertility control within marriage) 	Highest fertility <ul style="list-style-type: none"> High marital fertility High crude birth rates
Gender equality	High <ul style="list-style-type: none"> High equality in economic participation and opportunities High equality in education 	Highest gender equality <ul style="list-style-type: none"> High equality in education 	Average	Low <ul style="list-style-type: none"> Low investments in girls education 	Lowest gender equality <ul style="list-style-type: none"> Low economic participation and opportunities for women Low education for girls
Health	Very High <ul style="list-style-type: none"> Low infant & children mortality High life expectancy 	Average	Average	Highest quality of life <ul style="list-style-type: none"> Low infant & children mortality High life expectancy 	Lowest quality of life <ul style="list-style-type: none"> High infant & children mortality Low life expectancy
Cultural	<ul style="list-style-type: none"> Oil language 	<ul style="list-style-type: none"> Oil language Close to Wittenberg – Protestant 	<ul style="list-style-type: none"> Oc language 	<ul style="list-style-type: none"> Distance to Wittenberg 	<ul style="list-style-type: none"> Oc language Distance to Wittenberg
Family organization	Nuclear egalitarian family	“Nuclear egalitarian family”	Cooperative family - patrilocal	Intermediate-extended family	Imperfect stem family

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Appendix

Table A. Description of the Variables

Identifier	Name of the Variable	Description of the Variable
Demographics		
CW_Ratio	Child women ratio	Number of children aged 0-5 per women of childbearing age (15-45), 1851
MF_Rate	Marital fertility rate	Number of new born per married women in age of childbearing (15-45), 1851
CB_Rate	Crude birth rate	Number of birth over total population, 1851
IMF_IG	Index of marital fertility	From Princeton European fertility project, 1851
MW_Share	Share married women	Number of married women per women in age of being married, 1851
AGE_H_55	Male median age at marriage	Men average age at marriage, 1855
AGE_F_55	Female median age at marriage	Women average age at marriage, 1855
Age at marriage <25	Female who married below 25	Number of women who married young (< 30 years old) over total number of married women in age 15-30, 1851
Age at marriage <30	Female who married below 30	Number of women who married young (< 25 years old) over total number of married women in age 15-24, 1851
Ill_urb_birth	Illegitimate urban birth	Number of illegitimate births over total number of births in urban areas, 1851
Ill_rur_birth	Illegitimate rural birth	Number of illegitimate births over total number of births in rural areas, 1851
Def_celib	Rate of definitive celibacy	Share of women who are still single after age 50, 1851
Young_celib	Rate of young celibacy	Share of women aged 35 and less who are single, 1851
LEXP_0	Life expectancy at birth	Life expectancy at age 0, 1851
INF_Mort	Infant mortality	Mortality at age 0, 1851
CHILD_Mort	Child mortality	Mortality at age 5, 1851
Education		
SCHOOL_H	Schools for boys	Number of public primary schools for boys per number of boys aged 6-14, 1850
SCHOOL_F	Schools for girls	Number of public primary schools for girls per number of girls aged 6-14, 1850
No_school_50	Towns with no schools	Towns with no schools of all types, 1850
No_school_F_63	Towns with no schools for girls	Towns with no schools dedicated to girls in 1863
PP_ENROL_H	Boys enrollment rate in primary schools	Number of boys enrolled in public primary schools divided per number of boys aged 6-14, 1851
PP_ENROL_F	Girls enrollment rate in primary schools	Number of girls enrolled in public primary schools divided per number of girls aged 6-14, 1851
LIT_F_6165	Female literacy rate 1861-66	Number of women able to read and to write, 1861-65
LIT_H_6165	Male literacy rate 1861-66	Number of men able to read and to write, 1861-65
1859 ILETRE	Share of illiterate	Number of individuals who were not able to sign their marriage contract, 1859
Economic		
VILLE_2000	Towns	towns populated with more than 2000 inhabitants, 1851
DENS	Density	Number of people per km ² , 1851
URB_Resid	Urban resident	Number of people living in towns of more than 2000 inhabitant per total population, 1851

RUR_Resid	Rural resident	Number of people living in towns of less than 2000 inhabitant per total population, 1851
URB_	Urbanisation	Number of towns of more than 2000 inhabitant per km ² , 1851
RUR_	Ruralisation	Number of towns of less than 2000 inhabitant per km ² , 1851
Urb_pop_H	Share of male urban population	Number of men living in urban areas over total male population, 1851
Urb_pop_F	Share of female urban population	Number of women living in urban areas over total male population, 1851
Rur_pop_H	Share of male rural population	Number of men living in rural areas over total male population, 1851
Rur_pop_F	Share of female rural population	Number of women living in rural areas over total male population, 1851
Pop_agglo	Agglomerated population	From Statistique Générale (towns populated of min 2000 inhabitants), 1851
TEM_H_MIGR	Temporary male migration	Number of migration of people in working age, 1851
Railroad_54	Railroads	Lengths of railroads in km, 1854
Routes_1854	Roads	Length of secondary roads/surface per 1000km, 1854
Voie_com_54		Length communication by land and water (in km), 1854
FARMLAB_F	Female labor force in agriculture	Number of women employed in agriculture over total number of women aged 15-60, 1851
INDUSLAB_F	Female labor force in industry	Number of women employed in industry over total number of women aged 15-60, 1851
FARMLAB_H	Male labor force in agriculture	Number of men employed in agriculture over total number of women aged 15-60, 1851
INDUSLAB_H	Male labor force in industry	Number of men employed in industry over total number of women aged 15-60, 1851
Agriculteurs	Agricultural workers	Number of individuals working in agriculture per 10000, 1851
Indus_gr	Big industry workers	Number of individuals working in big industries per 10000, 1851
Indus_peti	Small industry workers	Number of individuals working in small industries per 10000, 1851
Prof_lib	Professional workers	Number of individuals working in liberal professions per 10000, 1851
Domestique	Domestic workers	Number of individuals working in domestic activities per 10000, 1851
Prof_diver	Various workers	Number of individuals working in diverse labor per 10000, 1851
Workers_H	Share male workers	Number of male workers over total male population, 1861
Workers_F	Share female workers	Number of female workers over total female population, 1861
Workers_C	Ratio female to male workers	Number of female workers over number of male workers, 1861
Wage_H	Average male wage 1861	Average of male worker wages in different industries proportionally to the weight of male in each industry for each department, 1861
Wage_F	Average female wage 1861	Average of female worker wages in different industries proportionally to the weight of female in each industry for each department, 1861
Wage_C	Average children wage 1861	Average of children worker wages in different industries proportionally to the weight of children in each industry for each department, 1861
PROTO_61	Level of proto industrialization	Number of steam engine per capita (in thousands), 1861
MANOUTP_61	Manufacture output	Manufacture output per capita, 1861
Nbr_indus	Industry per 1000 inhabitants	Manufacture of all types per 1000 inhabitants, 1861
Wealth_ind	Wealth per industry	Output per number of industry, 1861
LAND_35	Available arable land	Acreage of arable land per km ² , 1835
INEG_AGR12	Landownership inequality	Share of landowners, 1851
Dernier exode rural	Last rural exodus	Date of the census from which the labor force in agriculture

		goes below 50% of the total labor force (from Lebras et Todd)
WageHagr	Male wage in agriculture	Daily Male wages in agriculture, 1852
WageFagr	Female wage in agriculture	Daily Female wages in agriculture, 1852
Spe_indH	Male specialization in industry	Male industrial specialization (branch of activity in which men are more numerous), 1861
Spe_indusF	Female specialization in industry	Female industrial specialization (branch of activity in which women are more numerous), 1861
TopindwagH	Industry with top male wage	Branch of activity in which men wages are higher, 1861
TopindwagF	Industry with top female wage	Branch of activity in which women wages are higher, 1861

Socio-Cultural

Catholic	Catholics	Number of Catholics per total 100 people, 1861
Protestants	Protestants	Number of Protestants per total 100 people, 1861
WITT_DIST	Distance to Wittenberg	Distance from Wittenberg to the Capital of the department
DIST_GEN_V	Distance to Geneva	Distance from Geneva to the Capital of the department
Dialect	French dialects	County speaking in majority Oil, Oc, Franco-provençal, etc. languages
Structure familiale	Family structure	Diverse types of family structure – depending on the type of family organization; more or less solidary (Le Bras and Todd 2013)
GGI	Gender gap index	Built up using data about gaps on enrollment rates in primary education, secondary education, wage, labor force in agriculture, in industry, 1850s (see Perrin 2014)

Geographic

LAT	Latitude
LONG	Longitude
N/S	Nord or South
E/O/C	East or West

Note: The variables are built using various sources from the Statistique Général de la France: Résultats Statistiques du Dénombrement (1851); Territoire et Population, 1851; Mouvement de la Population 1851, 1854; Statistique agricole de 1852; Industrie, résultats généraux de l'enquête effectuée dans les années 1861-1865; Statistique Comparée de l'Enseignement Primaire, 1829-1877.

Table B. Ascendant Hierarchical Clustering

	Inertia Decomposition		
	Inertia	Counties	Distances
Inter-classes	28,2886		
Intra-class			
Class 1 / 6	7,1671	21	20,9891
Class 2 / 6	5,9717	33	6,4090
Class 3 / 6	2,9187	8	32,3854
Classe 4 / 6	2,7597	11	34,8631
Class 5 / 6	4,0884	15	31,6452
Classe 6 / 6	0,0000	1	813,7990
Total	51,1943		
Quotient (I. inter / I. totale)	0,5526		

Table C. List of Counties – Class Composition

Class 1	Class 2	Class 3	Class 4	Class 5	Class 6
Basses-Alpes Hautes-Alpes Ardèche Ariège Aveyron Cantal Corrèze Corse Côtes-du-Nord Drôme Finistère Ille-et-Vilaine Isère Haute-Loire Loire-Inférieure Lozère Mayenne Morbihan Basses-Pyrénées Hautes-Pyrénées Pyrénées-Orientales	Ain Allier Alpes-Maritimes Aude Charente Charente-Inférieure Cher Creuse Dordogne Haute-Garonne Gers Gironde Indre Indre-et-Loire Landes Loir-et-Cher Loiret Lot Lot-et-Garonne Maine-et-Loire Nièvre Orne Puy-de-Dôme Saône-et-Loire Sarthe Savoie Haute-Savoie Deux-Sèvres Tarn Tarn-et-Garonne Vendée Vienne Haute-Vienne	Bouches-du-Rhône Gard Hérault Loire Nord Rhône Var Vaucluse	Doubs Jura Manche Haute-Marne Meuse Moselle Bas-Rhin Haut-Rhin Haute-Saône Vosges Meurthe	Aisne Ardennes Aube Calvados Côte-du-Nord Eure Eure-et-Loir Marne Oise Pas-de-Calais Seine-Inférieure Seine-et-Marne Seine-et-Oise Somme Yonne	Seine

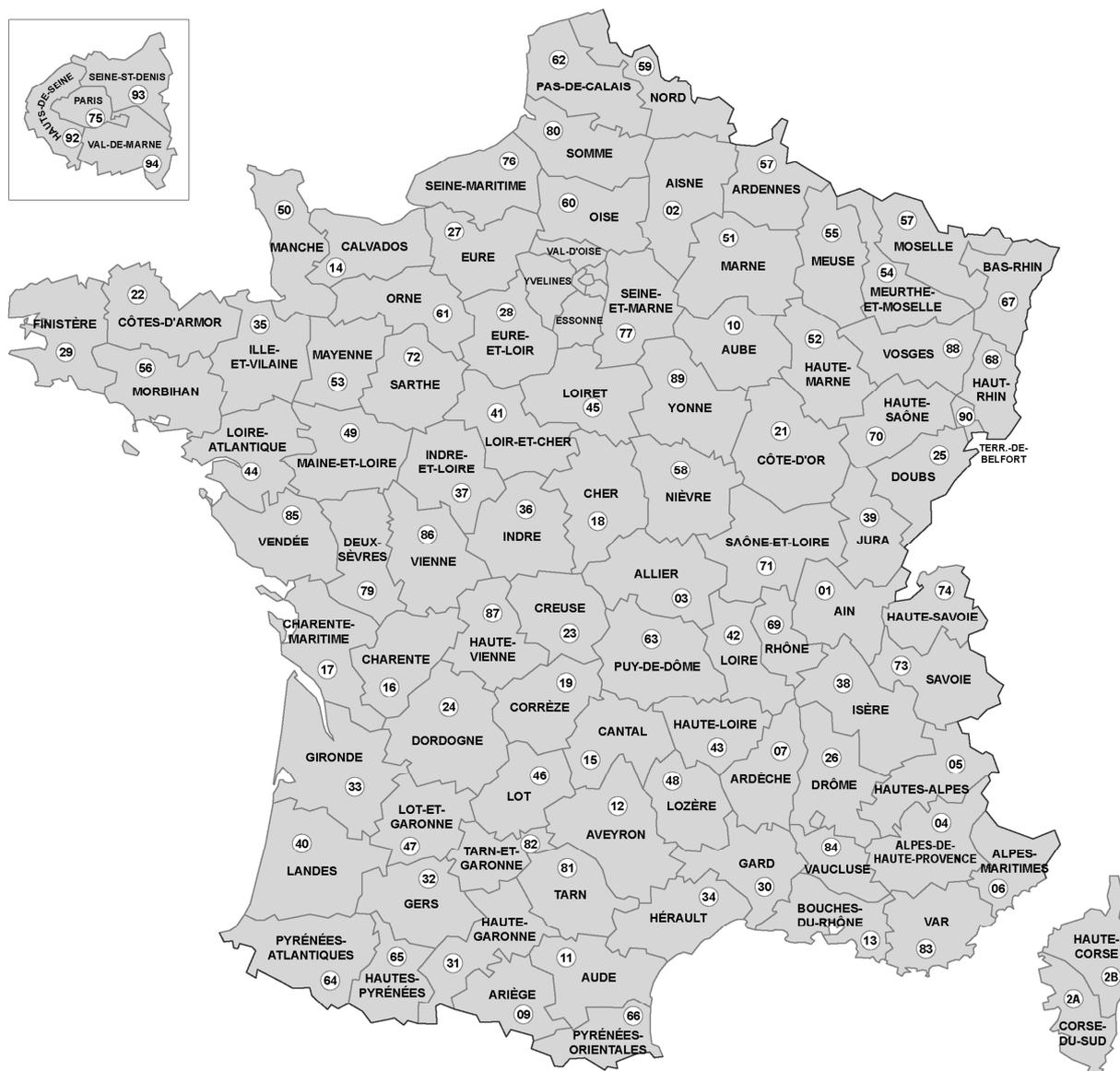
Table D. Important Indicators in Principal Components

Principal Component	Positive (+) /Negative (-)	Important Indicators (List in order of importance)		Factor explained
PC 1 (Axis 1)	Positive	Manufacture output	→	Productivity
		Small industries	→	Structure of economic activities
		Women literacy	→	Educational endowment of women
		Women wage in industry	→	Economic power of women
		Men wage in industry	→	Economic power of men
		Men workers in industry	→	Structure of economic activities
		Women wage in agriculture	→	Economic power of women
		Proto-industrialization	→	Infrastructure – industry
		Women workers in industry	→	Structure of economic activities
		Gender equality	→	Equality
		Men wage in agriculture	→	Economic power of men
		Men literacy	→	Educational endowment of men
		Railroad	→	Infrastructure – communication
	Negative	Workers in agriculture	→	Structure of economic activities
		Men farmers	→	Structure of economic activities
		Illiteracy	→	Educational endowment
		Women working in agriculture	→	Structure of economic activities
		Distance to Wittenberg	→	Culture
		Marital fertility rate	→	Fertility behavior
		Towns with no schools	→	Infrastructure – education
		Inequality in agriculture	→	Equality
		Index of marital fertility	→	Fertility behavior
PC 2 (Axis 2)	Positive	Rural resident	→	Sparse population
		Schools for boys	→	Infrastructure – education
		Boys enrollment in primary schools	→	Educational endowment of men
		Girls enrollment in primary schools	→	Educational endowment of women
		Life expectancy at birth	→	Demographic structure
		Rurality	→	Sparse population
		Towns with no schools for girls	→	Infrastructure – education
		Women literacy	→	Educational endowment of women
		Gender equality	→	Equality
		Men literacy	→	Educational endowment of men
	Negative	Urban resident	→	Population density
		Clustered population	→	Population density
		Density	→	Population density
		Urbanization	→	Population density
		Crude birth rate	→	Fertility behavior
		Number of industries	→	Structure of economic activities
		Child mortality	→	Demographic structure
		Infant mortality	→	Demographic structure
		Men working in industry	→	Structure of economic activities
		Women working in industry	→	Structure of economic activities
		Workforce in domestic sector	→	Structure of economic activities
PC 3 (Axis 3)	Positive	Young age at marriage	→	Marital structure
		Share married women	→	Marital structure
		Life expectancy at birth	→	Demographic structure
		Illiteracy	→	Educational endowment
		Men temporary migration	→	Structure of economic activities
	Negative	Women age at marriage	→	Marital structure
		Men age at marriage	→	Marital structure
		Index of marital fertility	→	Fertility behavior
		Boys enrollment in primary schools	→	Educational endowment
		Definitive celibacy	→	Marital structure
		Men literacy	→	Educational endowment of men
		Girls enrollment in primary schools	→	Educational endowment of women
Schools for girls	→	Educational endowment of women		

Table E. Important Nominal Indicators for Each Class

Classes	Positive (+) /Negative (-)	Important Indicators (List in order of importance)		Factor explained
Class 1	Positive	Last rural exodus – 1968 Imperfect nuclear family type	→ →	Population movement Family structure
	Negative	Nuclear egalitarian family type Oil dialect Last rural exodus – 1851	→ → →	Family structure Language Population movement
Class 2	Positive	Last rural exodus – 1954 Intermediary Atlantic zone Extended family type	→ → →	Population movement Family structure Family structure
	Negative	Women specialized in textile industry Dialects others than Oc and Oil Nuclear egalitarian family type Last rural exodus 1851	→ → → →	Economic specialization Language Family structure Population movement
Class 3	Positive	Nuclear patrilocal family type Top wage in luxe	→ →	Family structure Economic power
	Negative	Oil dialect	→	Language
Class 4	Positive	Last rural exodus 1891 Nuclear egalitarian family type	→ →	Population movement Family structure
	Negative	Oc dialect Last rural exodus 1954	→ →	Language Population movement
Class 5	Positive	Nuclear egalitarian family type Last rural exodus 1851 Men specialized in textile industry Oil dialect	→ → → →	Family structure Population movement Economic specialization Language
	Negative	Oc dialect Last rural exodus 1968	→ →	Language Population movement
Class 6	Positive	Men specialized in machines-metal	→	Economic specialization
	Negative	Nuclear co-residence family type Women top wage in textile Men specialized in building Men specialized in ceramic Women top wage in luxe Men specialized in transport	→ → → → → →	Family type Economic power Economic specialization Economic specialization Economic power Economic specialization

Figure A. Administrative France

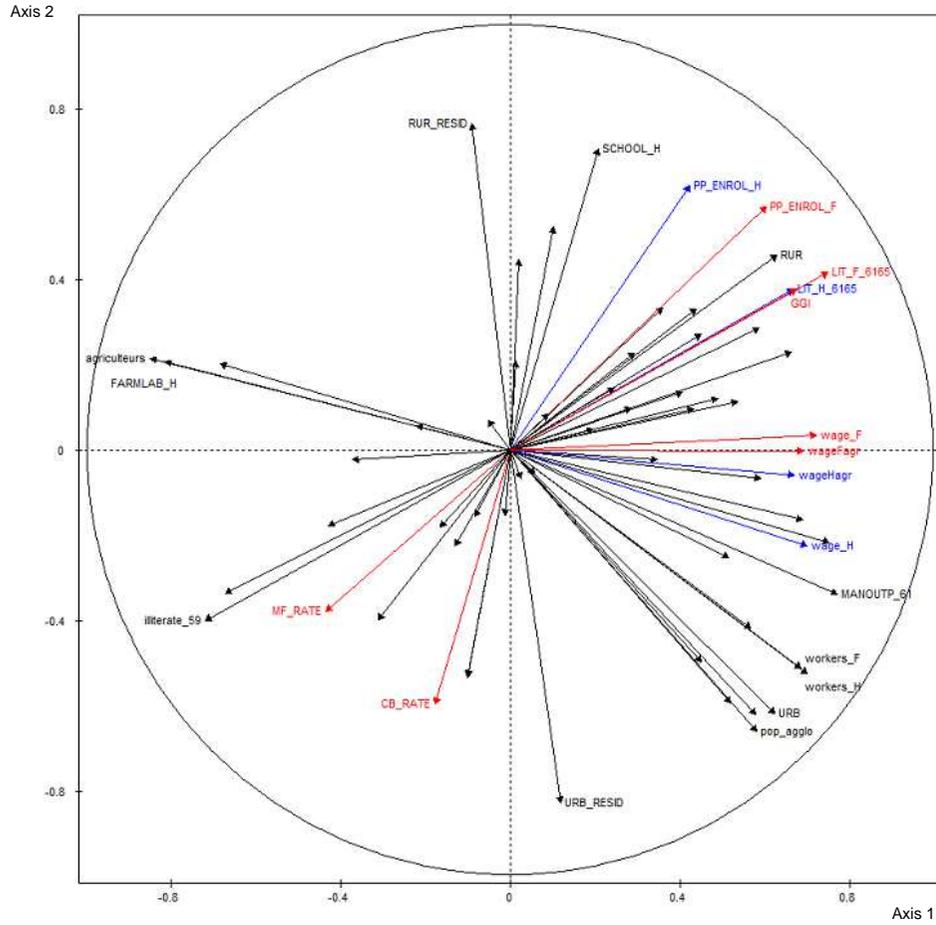


Source: <http://www.cartesfrance.fr/geographie/cartes-administratives/france.html>

Note: The name of several *départements* has changed over time. Prior to 1970, the Alpes-de-Haute-Provence was called Basses-Alpes; prior to 1941, the Charente-Maritime was known as the Charente-Inférieure; prior to 1955, the Seine-Maritime was entitled Seine-Inférieure; and prior to 1968, Paris, Hauts-de-Seine, Seine-Saint-Denis and Val-de-Marne composed the Seine county, while Yvelines, Essonne, Val-d'Oise together were known as the Seine-et-Oise.

Figure C. Projection of the variables on the axes

(a) Axis 1 and 2



(b) Axis 1 and 3

