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Education supply and economic growth in nineteenth-century France

Adrien Montalbo

JEL Codes: I25, N13, N33

Keywords: primary instruction, economic development, nineteenth-century France



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Abstract

The role played by education in the transition from stagnation to growth has been highly debated. Two questions related to this debate remain open: did education impact the economic take-off of countries and their move towards a sustained economic growth ? What level of education was the most relevant during this transition process ? In this article, I investigate these two questions by studying the effect of primary schooling on the economic development of French municipalities during the 19th century and up to World War I. To do so, I rely on a quasi-natural experiment, the Guizot law of 1833. This piece of legislation made mandatory for each municipality over 500 inhabitants to open and fund a primary school for boys. This law constitutes the first coercive measure on schooling supply undertaken by the French state. By implementing a regression discontinuity around the 500-inhabitant threshold defined by the law, I identify a positive impact of primary instruction on the subsequent growth of municipalities. Therefore, primary schooling, and the acquisition of elementary skills, played a major role in the development of French municipalities during the century of industrialisation and modernisation. This more generally reveals a positive impact of basic education during the transition from stagnation to growth.

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1 Introduction

The contribution of education to contemporaneous economic growth has been vastly investigated. Schooling appears to be a strong predictor of economic growth and per capita income, either at the national or regional level¹. However, the role played by education and human capital during the Industrial Revolution and the transition from stagnation to growth is much more debated. In the British case, literacy was for example useless to perform the vast majority of occupational tasks in the mid-nineteenth century [Mitch, 1993]². Its level was low compared to Scandinavian countries as Sweden, which nonetheless lagged behind in terms of economic development [Sandberg, 1979]. Generally speaking, literacy has been deemed irrelevant to explain growth at the country level [Allen, 2003]. More recent studies however found a positive association between upper-tail knowledge, proxied by book production, and pre-industrial economic growth at the country level [Baten and van Zanden, 2008], [de Pleijt and Zanden, 2016]³. [Squicciarini and Voigtländer, 2015] also identified a similar association in the late eighteenth and early nineteenth-century France, using data on subscriptions to the *Encyclopédie* at the level of French cities and departments. If upper-tail knowledge favoured growth and industrialisation up to the mid-nineteenth century, "basic" or "average" education was related to the industrial development of Prussia during the nineteenth century [Becker et al., 2011], [Cinnirella and Streb, 2017]. In the French case, intermediate human capital expansion was favoured by industrialisation at around the same time [Diebolt et al., 2019]. Therefore, if the contribution of human capital to the transition from stagnation to growth still needs more pieces of evidence, the level of education which potentially influenced economic development also remains debated. In this paper, I evaluate the contribution of primary, and therefore basic, education to economic development in nineteenth-century France and until World War I. To evaluate the contribution of this schooling level during the transition from stagnation to growth, I rely on a quasi-natural experiment, the Guizot law of 1833. This law made mandatory for each municipality more than 500 inhabitants to open and fund a primary school for boys. It constitutes one of the first national legislation on education in France⁴ and is the first coercive law aiming at increasing

¹Education has been analysed as a potential driver of long-term sustained growth in the endogenous growth literature [Lucas, 1988], [Romer, 1990], [Galor and Weil, 2000] or as a mere factor of production in neo-classical models [Mankiw et al., 1992]. See [Romer, 1990], [Benhabib and Spiegel, 1994] or [Gemmell, 1996] for early empirical evidence and [Krueger and Lindahl, 2001], [de la Fuente and Doménech, 2006], [Cohen and Soto, 2007], [Ciccone and Papaioannou, 2009] for more recent confirmations relying on the Barro-Lee data [Barro and Lee, 1993]. Recent studies also exhibited a positive link between education years and regional development [Gennaioli et al., 2013]. See [Klenow and Bils, 2000] or [Pritchett, 2001] for a discussion about the potentially over-estimated effect of education. See [Card, 1999] or [Ashenfelter et al., 1999] for a literature review on returns to schooling.

²The 1841 census for England indicates that only 4.9% of men and 2.2% of women had an occupation where literacy was absolutely necessary. The respective percentages for jobs with no need of literacy were of 49.7% and 24.7% [Mitch, 1993]. See also [Galor and Moav, 2006] on this point.

³See also [van Lottum and van Zanden, 2014] on the importance of skills in the maritime sector before the industrialisation.

⁴The 1816 law, which made mandatory to obtain a certificate in order to teach within primary schools, is also an example of early involvement of the French state in education.

schooling supply⁵. In practical terms, this supply meant hiring a teacher. Indeed, the majority of small municipalities had not enough economic resources to build or rent a schoolhouse⁶. In this case, teaching was most often delivered at the teacher's house or within the town hall [Mayeur, 2004]. To investigate the impact of the Guizot law, I rely on a newly constituted database at the level of municipalities collected just before the passing of the law, in 1833. These data cover 22 departments and more than 8 000 municipalities. I select municipalities without primary schools in 1833 close to the population cut-off of the Guizot law to implement a regression discontinuity and investigate the impact of education on economic resources.

The outcome variable used to approximate the level of municipal economic resources is the amount of taxes per capita collected by municipalities in 1881 and 1911. This follows what has been used in [Becker and Woessmann, 2009] or [Cinnirella and Streb, 2017] for example. I provide indications that taxes were closely correlated to production and disposable income at the department level, and that they constitute a good proxy for the level of economic resources. For municipalities above the 500-inhabitant threshold, I find a positive effect of schooling supply on the subsequent level of economic resources in 1881 and 1911, with a magnitude close to 2 francs per capita. This corresponds to around two-thirds of a standard deviation in municipal resources for municipalities close to the threshold. Therefore, the discontinuity design associated to the Guizot law and exploited in this paper suggests a positive impact of primary schooling supply on the economic growth of municipalities during the second part of the nineteenth-century. Since attendance to primary schools was not made mandatory until the Ferry Laws of 1881-1882, this implies that a high percentage of families reacted to the positive supply shock on education by schooling their children. This is confirmed by several monographic evidence [Thabault, 1993], [Blanc and Wacziarg, 2018].

In this paper, I also mention the potential transmission channels between education and economic development during the nineteenth century. More jobs were requiring to master at least literacy during its second part, which can explain part of this association. Also, the diffusion of technological progress may have been faster in municipalities where education was more developed, especially in the agricultural sector. Lastly, primary schooling may have attracted people with a higher preference for education. These migrations might therefore have in turn reinforced the positive effect of instruction on workers' productivity by increasing the share of educated people within a given municipality.

This article contributes to the literature on human capital by investigating its association with economic development in the age of industrialisation and modernisation. Indeed, the nineteenth century, and especially its second part, was characterised by a surge in industrial activities in France. Moreover, the agricultural sector saw its apogee at that time before entering a phase of crisis from the 1880s to the World War I [Duby and Wallon, 1976]. This paper therefore

⁵Some attempts to increase the supply of primary schools did exist before the Guizot law. Indeed a decree, approved on the 17th of November 1794 under the initiative of Lakanal, made the presence of one school per one thousand inhabitants mandatory. This measure was however contradicted by another decree one year later which suppressed the compulsory character of the schooling presence.

⁶In 1833, less than 40% of the municipalities in France had a building dedicated to schooling.

documents the contribution of education in the transition from stagnation to growth. It is directly linked to studies which found a positive association between education and growth in the pre-industrial era [Cipolla, 1969], [de Pleijt, 2018]. High educational achievements have notably been associated to the Little Divergence between England, the Low Countries and the rest of Europe over the 1300-1800 time period [Baten and van Zanden, 2008], [de Pleijt and Zanden, 2016]. The association is however not valid for all European countries [Sandberg, 1979]. Literacy seems also to have been irrelevant for the industrial development of Britain [Mitch, 1993], [Allen, 2003], [Clark, 2005] while basic human capital was closely linked to industrialisation in nineteenth-century Prussia [Becker et al., 2011], [Cinnirella and Streb, 2017]. In the case of France, [Squicciarini and Voigtländer, 2015] show a positive effect of upper-tail knowledge on city growth and industrial performance during the onset of industrialisation, while [Diebolt et al., 2019] exhibit that steam engines were related to the expansion of intermediate education⁷.

Compared to these existing studies, this paper makes several contributions. It provides an evaluation of the causal impact of education on growth during the industrialisation period. Thanks to the quasi-natural experiment of the Guizot law, this impact can be estimated without mixing the influence of education with the one of institutions, geography, culture, the level of past economic resources, ... This reveals the importance of basic education for growth during the nineteenth century. Also, it indicates that changes in schooling levels, induced by the increase in schools' supply, were important drivers of economic growth at that time. Moreover, measuring education and economic resources at the municipality level implies a substantial gain in precision compared to studies at the level of towns or counties. Indeed, most of the studies focusing on towns rely on population growth as a proxy for economic development, while department-level analyses are likely to at least partially confound the effect of education with other factors. Taxes per capita, used in a quasi-experimental design at the municipality level, are therefore a more reliable proxy for economic resources and induce a better estimation of the schooling impact. Finally, since around 90% of the municipalities were less than 2 000 inhabitants in nineteenth-century France and that the urban population overcame the rural one only in 1931⁸, this study helps explaining the economic trajectory of the vast majority of local places in France.

The next section presents some historical facts about the Guizot law, primary schooling and economic development in nineteenth-century France. Section 3 is a description of the data I use while Section 4 presents the results from the regression discontinuity design approach. Section 5 concludes.

⁷This paper is also close to development economics analyses linking schooling supply and economic outcomes as in [Duflo, 2001].

⁸Urban population represented around 25% of total population in the mid-nineteenth century in France, and around 45% in 1911 [Dupâquier, 1995].

2 Primary Education and Economic Development Over the Nineteenth Century

2.1 Primary Schooling and the Guizot Law

The Guizot Law was passed on the 28th of June 1833, making compulsory for any municipality over 500 inhabitants to open and maintain a primary school for boys. Teachers were to be paid on a regular basis, not less than 200 francs a year. This law was the first major step towards universal schooling undertaken in France. To this date, the decision to open a primary school (along with paying the teacher on a fixed basis or not, how much, buying books, blackboards and other pieces of furniture, providing the teacher with an accommodation or a classroom,...) was mainly made at the level of municipalities⁹. Local authorities thus played an important role, along with parents who were in most cases (except when they were listed as indigents by the municipality or when the school was totally free, which was extremely rare at that time) paying fees so that their children could attend school. Before the passing of the law, primary schools were divided into two types. Those only financed by the monthly tuition fees paid by families to the teachers were said to be private. When municipalities were investing in schools, by paying teachers or providing them with a classroom or an accommodation for example, the schools were said to be public. From 1816, a certificate delivered by local authorities and the parish priest was necessary to teach within primary schools. Anyone who obtained one of the three different certificate degrees, the first one being the hardest to get, could freely teach children.

In this context, primary schooling developed differentially across regions [Kennedy and Netter, 1981]. From the early work of the Dupin baron, an opposition has been drawn between a well-educated France above the Saint-Malo/Geneva line and a less-educated one below [Dupin, 1826], [Fleury and Valmary, 1957], [Houdaille, 1977]. For example, in the 1820s, the enrolment per 100 children six to thirteen years of age was higher north of the line, with a mean of 94, compared to south of it, with an average level of 53. This was also true for the schooling of girls [Grew and Harrigan, 1991]. Figure 1 depicts this distinction between French departments. Therefore, before the Guizot Law, primary schools and high enrolment rates were mostly concentrated in the north-east part of France, even if some other regions as the Rhône Valley and the Gironde were also characterised by rather good schooling levels. This pattern remained stable at least until the 1860s in France, even if a convergence in educational attainment was already at work before the Ferry Laws of 1881-1882 [Diebolt et al., 2005], which made primary schooling compulsory. The number of children schooled per 10 000 inhabitants, for example, still followed

⁹A precise description of the daily life of schools and teachers in the eighteenth and early nineteenth centuries can be found in [Duveau, 1957]. Analyses or testimonies on the state of primary schooling by teachers from the early nineteenth century are available in [Lorain, 1837] and [Meunier, 1981]. In order to have an analysis of local schooling development in the eighteenth century, see for example [Vovelle, 1975] or [Laget, 1971]. See [Gildea, 1983] for a local study from 1800 onwards for the departments of Ille-et-Vilaine, Gard and Nord. In order to have a full political analysis and a description of the laws, projects, and debates about primary instruction during this period of time, one can refer to [Gontard, 1959], [Mayeur, 2004] and the second and third chapters in [Furet and Ozouf, 1977].

closely the geographical distribution described in the mid-1850s and mid-1860s. The same is true for percentage of women or men signing their marriage license in 1871-1875.

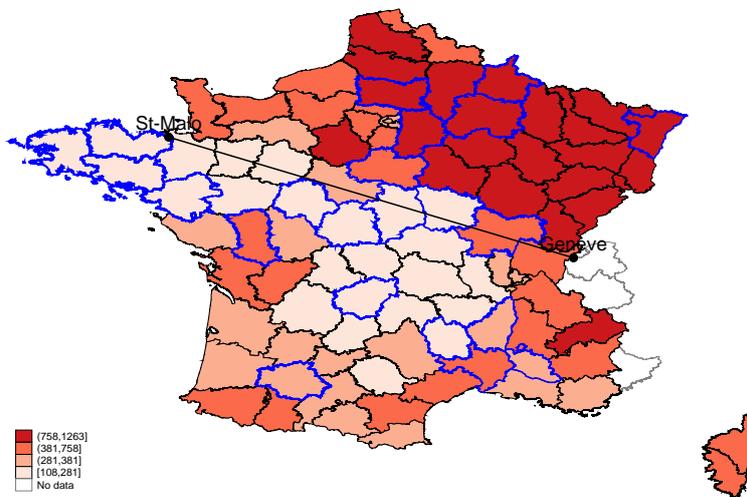


Figure 1: Number of pupils attending primary schools - winter 1833 (over 10 000 inhabitants)

Source: [Motte et al., 2003], Guizot survey - Report to the King.

Note: Departments in blue are the ones for which education data are available at the level of municipalities.

The schooling of girls followed a different path as, until late into the 19th century, numerous religious congregations were in charge the schooling of girls. For example, the *Ursulines* in the south-east, the *Filles de Notre-Dame*, the *Sœurs de la Charité de l'instruction chrétienne* or the *Filles de la Visitation* within the Parisian region [Mayeur, 2004]. But for the majority of them, no education was provided outside of the family sphere. They were not supposed to be taught along with boys within primary schools. However, it was common to gather both sexes when economic resources were too scarce to create two distinct schools¹⁰. It is only with the Falloux Law of 1850 that the opening of a primary school for girls in municipalities more than 800 inhabitants was made compulsory. The Duruy Law of 1867 lowered the threshold to 500 inhabitants. The Ferry Laws then applied to girls too.

2.2 Economics Growth in Nineteenth-Century France

The nineteenth century was, for most Western countries and for France, a period of economic modernisation and growth. Industrial production began to grow substantially from 1815 onwards in France, with an annual rate of 3% for the best years [Lévy-Leboyer, 1968] compared to around 0.5% between 1781-1790 and 1803-1812 [Crouzet, 1996]. The highest rates were attained at the end of the July Monarchy and under the Second Empire. They subsequently dropped below their average value over the century after 1882 [Crouzet, 1970]. This growth

¹⁰At the time of the passing of the Guizot Law, separated primary schools for girls were still rare. Victor Cousin described them as "almost luxury schools" before the Chamber of Deputies in 1833.

remained however quite gradual all over the century, which led some authors to deny the idea of a real industrial take-off in France [Mendels, 1972]¹¹. According to the Industrial survey of 1861-1865, textile and food industries were clearly the leading sectors even in the second part of the century. They represented respectively 31.4% and 20.8% of the industrial value-added, against around 6% for extractive industries and 5% for the metallurgy [Verley, 1997]¹².

The geography of industrial activities also evolved during this century. Data from the 1839-1847 Industrial survey show that manufactures were mostly concentrated in the north-west and western departments close to the Atlantic Ocean in the first part of the century. This concentration was associated to the volume of commercial activities in Atlantic ports like Le Havre, La Rochelle or Nantes [Asselain, 1984]. Big manufactures and steam engines were on the contrary more concentrated in the north and north-eastern parts of France, along with the Rhône Valley. This was associated to the progressive surge of mining and metallurgic sectors in France at that time, in particular to the exploitation of coal and iron. Deposits were indeed highly concentrated in the Nord-Pas-de-Calais, Lorraine, Auvergne, Loire, Dauphiné, Provence and Cévennes areas in France. In some regions as Normandie or the Dauphiné, the concomitant presence of rivers, forests and deposits explains the ancient presence of metallurgic sectors [Léon, 1948], [Richard, 1962], [Kellenbenz, 1963]. Textile activities also followed closely this geographical pattern [Dunham, 1953].

Industrial activities were negatively affected by a general downturn towards the end of the century as the 1880s were particularly bad for French economy. Rural industry was severely altered by this crisis. Indeed, it had first to face the competition of cheaper British products after the free-trade treaty of 1860. Second, the growing unification of the national French market enhanced by the development of rail-roads increased the competition between large and small factories. This contributed to the progressive de-industrialisation of southern France, unable to compete with the triumphant metallurgic manufacturers of the northern and eastern regions. The concomitant agricultural crisis also reduced the purchasing power of rural inhabitants and therefore the outlets for industrial production. All of this favoured the migration and concentration of industrial workers in towns, which participated in the creation of the French industrial working class [Noiriel, 2002].

¹¹This idea, along with the level of industrial performance of the French economy, have been greatly debated. They have been deemed low and stagnating compared to Great-Britain in the 1940s and 1950s, before a revisionist literature insisted on the relatively good economic performance of France during the 19th century and on the distinctive path of growth this country followed [Crouzet, 1966], [O'Brien and Keyder, 1978]. This point of view has subsequently been qualified by authors amending the figures on French productivity growth and insisting anew on the difficulties known by the agricultural and industrial sectors compared to the British ones [Crafts, 1977], [Crafts, 1984]. See [Lévy-Leboyer, 1978] for an analysis of French industrial investment and [Lévy-Leboyer and Bourguignon, 1985] for a macro-economic analysis of French economy along the century. See [Crouzet, 2003] for a historiography of French economic growth during the 19th century, from the "retardation-stagnation" thesis to the "moderate revisionism". To have an economic analysis and description of the industrialisation period in France and other European countries over the century, see [Braudel and Labrousse, 1976], [Verley, 1999] and [Verley, 1997]. For an analysis of the French case under the *Ancien Régime*, see for example [Sée, 1925] or [Woronoff, 1998].

¹²The same was true when taking into account the percentage of the industrial labour-force in each sector. 50% of it was working in the textile sector at that time, 13% in the building one and 14% in the metallurgy [Noiriel, 2002].

Agriculture still remained the sector gathering the highest share of the labour-force in nineteenth-century France. The 1851 census indicates for example that 53.2% of the total population was belonging to a farming family [Démonet, 1990]. In 1881, 47.5% of the labour-force was concentrated in the agriculture, against 26.7% in the industry and 24.9% in services. The farms were most of the times small in France at that time. Their average surface area was of 12 hectares in the mid-19th century, but in half of the departments, half of the farms were less than 5 hectares.

Agricultural production increased by 75% in France between 1815 and 1852. The highest growth rates were concentrated under the July Monarchy and were mainly due to the dynamism of livestock farming. The production increased by 80% between 1852 and 1882 before being struck by a severe downturn as for the industry. This phenomenon characterised most of all root crops as sugar beets and potatoes whose cultivated surface area increased respectively by 116% and 61%. This was partly due to a growing individual consumption. Over the period, for example, the average annual consumption of wheat per capita increased by 34%, that of potato by 40% at least, the consumption of sugar by 118% and of meat by 40%. Livestock farming and wine production also peaked in the mid-1870s. Vineyards represented for example 2.5 millions of hectares in 1874. Cereal production was on the contrary stagnating at that time. [Duby and Wallon, 1976].

The evolution was however far from being homogeneous as some regions were already characterised from the 1830s onwards by the rural exodus of their population. This was especially the case for the Massif Central, Lorraine, Alsace, the alpine department and the wooded countryside of Normandie, Maine and Jura. The growth of agricultural production characterised most of all the regions located south of the line going from St-Malo to Geneva. Moreover, the trade balance remained in deficit for many agricultural products. Productivity growth stagnated and a large part of the increase in production appears to have been due to rising prices.

The end of the century downturn is due to several factors. First, a number of specific crises, as the phylloxera in wine and a series of diseases in silk farming. Second, the globalisation of trade and an increased competition affected negatively agricultural prices. Third, rural exodus accentuated strongly in the second part of the century, especially in peripheral areas. 55 departments knew a negative evolution of their population between 1881 and 1911, 62 of them between 1901 and 1911. Rural population went from 74.5% to 64.1% and 55.8% of the total population in 1851, 1866 and 1911 [Beltran and Griset, 1994]¹³. In this context, agricultural production declined for all products, except for potato and fodder crops. The political reaction to this crisis was a return to more protectionism, notably embodied by the Meline Law in 1892 which increased customs duties on agricultural products.

¹³On this point, see also [Molinier, 1977].

3 Data

3.1 Data on Education

In 1833, when the Guizot Law was passed, a survey at the national level was conducted in order to evaluate the state of primary schooling in France, under the supervision of the French Minister of Education, François Guizot¹⁴. 490 inspectors were sent throughout France in autumn 1833. All primary schools, both public and private, were to be examined. However, primary schools to which only girls were attending were excluded from the scope of the survey as the Guizot law did not apply to them. All departments were inspected, except Corsica.

Data coming from the Guizot Survey of 1833 was published for all French districts in a *Report to the King* [Guizot, 1834]. These districts (*arrondissements départementaux* or *sous-préfectures*) correspond to an administrative subdivision of departments (counties). Two to six of them existed in each department. Only some of the questions asked in the initial survey, those deemed of major interest, were aggregated in this report. From the initial individual (at the level of each primary school) forms, the data were collected for 22 departments and 8 129 municipalities¹⁵. This study will however be made on 21 departments. Indeed, the Bas-Rhin department was not belonging to France any-more after the 1870 Franco-Prussian War. Data on its economic resources are therefore not available at the end of the century. At least one primary school was present in 4 836 of the municipalities (59.5%). This project has been initiated by the *Service d'Histoire de l'Education* of the I.N.R.P, which collected data for the academies of Nantes, Bourges and Nîmes. Other departments were then added to this initial database. In Figure 1, one can see that these departments (in blue) belong to areas with very different levels of enrolment. The Brittany region and the centre part of France with very low levels of enrolment are well represented in the sample. So are the highly educated north-east and the southern part of the country where education was more unevenly distributed, with five departments for each area. To sum up, around 20% of the departments above the St Malo-Geneva line are represented in the sample, against 25% of those below the line¹⁶. This should ensure a high variation in terms of education and a good representativeness of the data used. Their collection was indeed conducted with the aim of catching all the determinants that underpinned primary schools spreading. This, added to the focus at the municipal level, should help avoiding some of the criticisms that were pronounced against the reliance of aggregated historical data on primary schools¹⁷.

The departments selected are quite representative of France for what regards primary education and economic characteristics in the first part of the nineteenth century. Taking average values

¹⁴A lot of information on this survey is available here : <http://www.inrp.fr/she/guizot/>.

¹⁵These departments are: Ardèche, Ardennes, Cher, Corrèze, Côtes-du-Nord (Côtes D'Armor), Finistère, Gard, Gers, Indre, Indre-et-Loire, Loire-Inférieure (Loire Atlantique), Loiret, Lozère, Marne, Morbihan, Nièvre, Oise, Bas-Rhin, Saone-et-Loire, Seine-et-Marne, Deux-Sèvres and Vaucluse. At that time, there were 86 departments. Current denominations of departments are specified in brackets when a change occurred.

¹⁶Excluding the three departments located on this very line.

¹⁷See for example on this point the criticisms made in [Luc, 1986] and [Luc and Gavaille, 1987]. See [Grew and Harrigan, 1986] for a reply and [Furet and Sachs, 1974] for a use of these data.

at the level of districts in order to compare this "municipal level sample" to the entire country thanks to the *Report to the King*¹⁸ shows that the number of (public) primary schools doesn't differ significantly between the sample and the entire country. However, enrolment rates and the percentage of municipalities with schools (60.8% against 71.5% for France) are lower in the sample, which means that the departments at stake were less well-endowed in primary schools than at the national level.

Taking data on the height of 20-years old military conscripts to proxy economic resources¹⁹ shows that the departments in the sample were close to the average national level. When considering industrial factors, the sample differs significantly only in the percentage of municipalities with factories (21.6% against 17.2% for France). The number of workers, their average wages, the amount of industrial production or the presence of large factories (more than 20 workers, the top one-third in terms of size) did not differ significantly between France and the municipality sample. Finally, using the Agricultural survey of 1852 shows no strong difference between France and the municipality sample. Either in terms of agricultural area, production organisation or wages, the sample is quite comparable to national averages.

3.2 Data on Economic Resources

In this article, the economic variable of interest is the amount of taxes per capita collected by municipalities. These data are coming from publications by the Ministry of the Interior entitled *La Situation Financière des Communes de France et de l'Algérie*²⁰, issued each year from 1878 to 1929. I digitalised the 1881 and 1911 years in order to have a measure of the economic resources of municipalities at the end of the growth phase in nineteenth-century France and just before World War I²¹. I selected two years for several reasons. First, it enables me to check if the results obtained are not linked to a particular year. Second, I am able to study the persistence of the effect of education on resources. Lastly, knowing the timing when education potentially influenced development is useful in specifying the transmission channels between the two phenomena. Data from the industrial survey of 1839-1847 are the other economic data used in order to control for industrial production in the estimations²².

The nineteenth century was a time of index-based taxation for the state and the municipalities. This system, implemented during the revolutionary period, remained remarkably stable all

¹⁸See in [Table A1](#) the Appendix.

¹⁹Data on the height, collected at the level of districts for the 1818-1830 time period on 489 160 twenty years old conscripts (that is to say on men born between 1798 and 1810) is presented and analysed in [[Aron et al., 1972](#)]. In 1804, Napoléon instituted a random draw to select the conscripts. Therefore, there is no selection bias with these data as each young men had the same probability to serve. The average height was clearly mirroring the economic development of France. This is in line with other studies exhibiting strong correlations between height, living and health conditions, work at young ages, nutritional intake, ... during the 17th and 18th centuries [[Komlos et al., 2003](#)], the 19th century [[Villermé, 1829](#)], at the end of this former and during the following [[Chamla, 1964](#)], [[Meerten, 1990](#)], [[Brinkman et al., 1988](#)]. See [[Steckel, 1995](#)] for a review of the literature on this point.

²⁰The financial situation of municipalities of France and Algeria.

²¹I selected these years and not 1878 and 1913 for example because they were also census years. I thought that the quality of the data could be improved by this.

²²More information on this survey can be found in [[Chanut et al., 2000](#)].

along the century and no major modifications were implemented to it before the creation of the income tax in 1914. The *Assemblée Constituante* implemented in 1791 a land tax, a personal property tax on incomes coming from other sources than land and commercial activities and a *patente* tax on these commercial resources. An additional tax on the number of doors and windows of habitations was later implemented in 1798. These four taxes, known as the *Quatre vieilles*, constituted the direct "contributions", as they were called, entering the state and municipalities budgets.

The land tax was based on net incomes coming from the use of lands²³, which were evaluated on the 15 preceding years²⁴. The personal property tax was composed of two distinct elements: the taxpayer had first to pay an amount equal to the average value of three workdays. This amount was fixed in each department. The second part of the tax was based on the rental value of personal residential buildings. The basis of the *patente* tax was incomes coming from trade and industry. However, it is only by means of rental value that these resources were taxed. The *patente* amounted to a percentage between 10 and 15% of the rental value of buildings. In industry, additional component depended directly on the number of workers and engines used in the production process [Chanut et al., 2000]. Bakers had the privilege to pay half the tariff while beverage merchants had to pay the double. Since any trading activity was taxed by the *patente*, it reflects perfectly the commercial and industrial activity of the municipalities. The tax on doors and windows was positively related to their number and size. After 1832, the amount was higher in more populous municipalities. Also, the *patente* was the only flat tax of the four, the other three were "impôt de répartition", which means that the amount expected to be drawn from them was decided first by the state, and then divided between municipalities according to their estimated economic resources [Neurrisse, 1996].

Municipalities could also decide to increase what they were perceiving from these taxes by collecting "additional cents" on them. This was done by increasing the rate of the taxes. For example, collecting 3 additional cents was equivalent to ask taxpayers to pay 3 cents more for each franc of tax, which amounted to an increase of 3% in the rate. This was usually implemented to built or maintain byroads or in case of deficit. Additional taxes as the one on dogs implemented in 1855, on private pool tables (1871) or velocipede (1893) were also entering the municipalities' budget but they were marginal compared to the four direct taxes described. Municipalities could also make use of resources coming from the *octrois*, which corresponded to indirect taxes on products imported and sold within the delimitations of the municipality²⁵. However, only the biggest municipalities were concerned by these indirect taxes. 1 538 of them were raising *octrois* in 1881, 1 523 in 1911²⁶.

²³It is only in 1881 that a distinction between built-up and non-built-up property was introduced. Built-up property was from then on taxed according to its rental value.

²⁴The two best and worst years were excluded from the computation. See for example [Kang, 1993] on this tax.

²⁵These *octrois* had been suppressed in 1791 and progressively reintroduced from 1798 onwards. Taxes on beverages were for example re-established in 1804, in 1806 for those on salt.

²⁶They could constitute a crucial source of income for big municipalities. For example, in 1913, half of the resources of Paris were coming from these indirect taxes. The budget of the state was also critically depending on indirect taxes. Registration duties, customs duties and taxes on sales of beverages and transports were

The crucial point here is to know if the amount of taxes per capita adequately reflects the economic resources of local places. One could argue for example that taxes per capita mirror state capacity rather than a higher income. However, it is clear that taxes were closely related to other proxies for economic dynamism at the end of the 19th and beginning of the 20th century in France. Taking average daily wages at the level of departments from [Bassino and Dormois, 2006] returns a correlation of 0.69 with the amount of taxes per capita in 1911. The geographical distribution of both measures was extremely close at the beginning of the 20th century in France²⁷. Taxes were therefore higher within departments with a higher productivity. A direct assessment of the relation between taxes and production can be done at the department level, thanks to the data on disposable income per capita reported in [Delefortrie and Morice, 1959]. Over all French departments, the correlation between disposable income per capita in 1864 and the taxes per capita in 1911 was of 0.64. Even if the two measures may seem distant one from the other, this shows that taxes and production were closely related at this time in France, which reinforces the reliability of taking the amount of taxes as a proxy for economic resources²⁸.

3.3 Demographical Data on Municipalities

Data on the population of municipalities from the censuses is taken from [Motte et al., 2003]. Population dispersion is taken from the Postal Survey of 1847 along with the surface area of municipalities which have disappeared or merged since 1833²⁹. Since this survey is posterior to the Guizot one, I have to assume that population remained stable over the fourteen years separating them, which seems to be a quite reasonable assumption. The *Institut national de l'information géographique et forestière*, a public institute in charge of the diffusion of geographic information in France, provides surface data for the other municipalities. The altitude of municipalities is also taken from this institute.

3.4 Descriptive Statistics

Descriptive statistics are displayed in Table 1. Primary schools were located in 59% of the municipalities in the data. The average taxes per capita nearly doubled between 1881 and 1911, from 7.5 to 13.3 francs³⁰. This increase may partly reflect economic growth. It is also due to the fact that, after 1905 and the passing of the law separating churches and state, resources saved from the suppression of worship budget were split between municipalities according to their contribution to land tax on non-built property.

The average population of the municipalities was around 990 inhabitants in 1836, but 50% of them were less than 631 inhabitants and 90% less than 2 000. Population dispersion could be

constituting half of its budget in the 1830s, 53% in 1913. Direct taxes followed the opposite trend, from 30% to 10% of the budget between the same dates.

²⁷See Figure B1 in the Appendix.

²⁸See Figure B2 in the Appendix.

²⁹More information on this survey is available in [Marin and Marraud, 2011].

³⁰Figure B3 in the Appendix display the distribution of taxes per capita in 1881 and 1911.

high within municipalities as the average scattering was around 47%, with a median value close to 50%.

Table 1: Summary Statistics

Variable	Mean	Std. Dev.	Min.	Max.	N
Primary School - 1833	0.59		0	1	8129
Municipal income, francs per capita - 1881	7.5	10.3	0.4	469.4	7295
Municipal income, francs per capita - 1911	13.3	10.1	0.3	305.9	7302
Population - 1836	989.8	1811.9	30	75895	8064
Population - municipalities with no school > 500 inhab.	1094.1	712.3	500	7803	1769
Population - municipalities with no school < 500 inhab.	308.9	111.8	52	499	1520
Percentage of population scattered	46.8	35.6	0	100	6941
Population growth - 1793-1836	30.1	58.2	-88.4	1500	7931
Surface area - hectares	1725.5	1439.1	8	18359	7844
Average altitude - meters	207.7	194.6	1	1399	7844
Industrial production - 1839, francs per year	71.5	1167.9	0	59138	8129
Postal taxes - 1847, cents of francs	114.5	428.6	0	27894	8129
Distance to post office - kms	7.1	4.6	0	116	7302
Distance to prefecture - kms	36.2	16.9	0	128.3	7844

Source: Guizot, industrial and postal surveys. IGN data, [Motte et al., 2003] and *La Situation Financière des Communes*.

Notes: All variables are defined at the municipal level. The postal taxes correspond to the amount of taxes collected on postal activity within the two-week period when the postal survey was conducted.

4 A Regression Discontinuity Design Based on the Guizot Law

4.1 A Discontinuity in Economic Resources

Since the measure of economic resources I consider is posterior to the one of schooling, there is no reverse causality issue here. However, one might fear that wealthy municipalities would invest more in education at the beginning of the century, these very municipalities being also characterised by high amount of resources later on. In this case, the effect of schooling would be badly estimated with simple OLS. Therefore, I take advantage of the fact that the Guizot law made mandatory for municipalities more than 500 inhabitants to open and finance a primary school after 1833. To this date, municipalities had no legal obligation to do so. Thanks to the Guizot survey, I can know which municipalities had no school at that time. I can therefore select them and apply a regression discontinuity around the threshold of 500 inhabitants to evaluate the impact of the schooling supply shock implied by the law³¹.

Censuses were conducted every five years in nineteenth-century France. Population is taken

³¹See [Lee and Lemieux, 2010] for a literature review of regression discontinuity designs in economics.

from the 1836 Census, three years after the passing of the Guizot law. This census has been deemed of better quality by the historians and its population figures should therefore be more reliable. Also, it makes more sense taking population from this census. Indeed, a municipality with more than 500 inhabitants in 1831 could very well have lost some of them between this date and the Guizot law, falling below the population threshold. 50 municipalities with no schools in the database did follow this evolution. Taking them as being affected by the Guizot law would therefore be a mistake. The discontinuity remains however greatly unchanged taking population from the 1831 Census.

As displayed in [Table 1](#), there are 3 289 municipalities in my database with no primary school in 1833. Among them, 53,8% are above the threshold of 500 inhabitants (1 769 over 3 289). The average population of municipalities with no school and above the threshold of the Guizot law was of 1 094 against 309 for those below the threshold. All municipalities over 7 803 inhabitants had at least a primary school in 1833. 60% of the municipalities above the threshold were less than 1 000 inhabitants and 91% less than 2 000 inhabitants³².

Using the Guizot law in a regression discontinuity design bears some drawbacks as I cannot know if municipalities below the threshold opened or not a school just after 1833. However, as they were very small and had not done so before, there is only a very little probability that a high number of municipalities just below the threshold would do so right after the law while they had no legal obligation to open a school. Therefore, these municipalities were certainly characterised by a long-lasting absence of primary school during the nineteenth-century. If some of them did open a school anyway, the following estimations would return a lower bound for the impact of primary schooling on economic development.

Finally, I can't measure the effect of human capital accumulation using this strategy. I will therefore only be able to evaluate the impact of an increase in schooling supply on growth. However, monographic studies report that the positive supply shock on education caused by the Guizot law contributed to increase significantly enrolment rates. Families often reacted strongly to the presence of a teacher as enrolment rates and literacy increased rapidly after the passing of the law [[Thabault, 1993](#)], [[Blanc and Wacziarg, 2018](#)]. Therefore, the shock in schooling supply was very likely to be associated with a higher human capital accumulation in the municipalities at stake.

In [Figure 2](#), I plot the data-driven regression discontinuity in municipal resources in 1881 and 1911 according to the spread between municipal population in 1836 and the 500-inhabitant threshold. The resources per capita were decreasing in population between 100 and 500 inhabitants. Very small municipalities had therefore on average higher economic resources per capita than municipalities around the 500-inhabitant threshold. There is a jump in resources around this threshold, which indicates a discontinuity related to the presence of a primary school³³. Indeed, total municipal resources were higher just above the population threshold, which explain the jump in resources per capita. These graphs indicate that the positive shock

³²See the histograms of the population above and below the threshold in [Figure B4](#) in the Appendix.

³³[Figure B5](#) the Appendix reports the same figure using the 1831 population. This modification doesn't affect the discontinuity.

on schooling supply and human capital induced by the Guizot law affected positively the level of municipal resources during the nineteenth century and up to World War I.

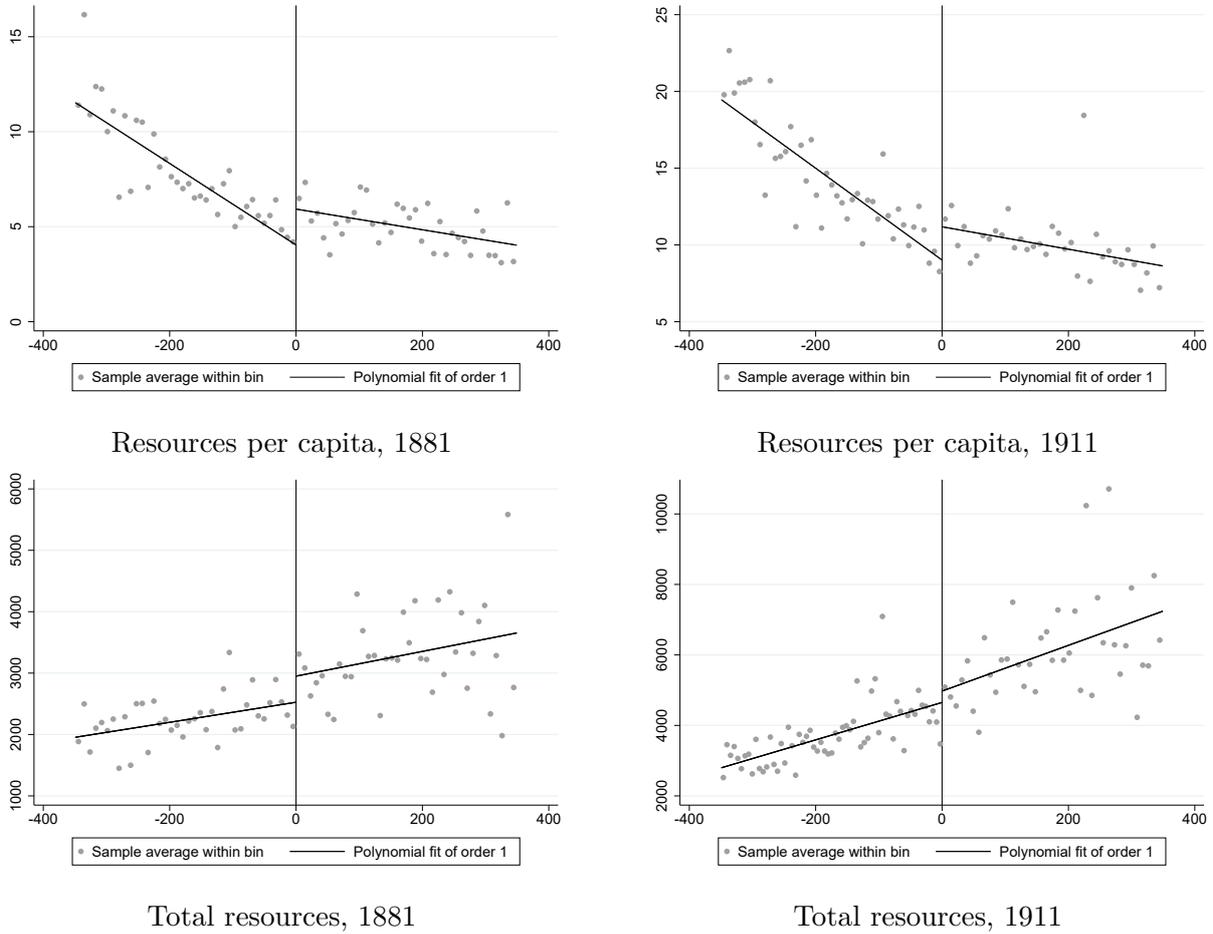


Figure 2: Data-driven regression discontinuity in municipal resources and municipal resources per capita

Source: Guizot survey and *La Situation Financière des Communes*.

Notes: On the x-axis, the distance in terms of population to the 500-inhabitant threshold is displayed. The polynomial fit used is of order one. The number of bins has been selected through the mimicking variance evenly-spaced method using spacings estimators. For the resources per capita and the 1881 year, 38 bins are selected left to the threshold, with an average length of 9 inhabitants (the same for the total resources). 36 bins are selected right to the threshold, with an average length of 9.7 inhabitants. The respective figures for 1911 are of 43 and 35 bins, with average lengths of 8 and 10 inhabitants. For 1911 and the total resources, the figures are of 61 and 39 bins, with average length of 6 and 9 inhabitants.

4.2 Main Estimation Outcomes

As recommended in [Imbens and Lemieux, 2008] or [Lee and Lemieux, 2010], one should check several conditions in order to account for the reliability of the regression discontinuity approach. The first one is the continuity of the running variable density (here population) around the

threshold. If this variable can be completely manipulated by the units in order to obtain or avoid a given treatment, then the regression discontinuity will be biased. If the manipulation is only partial, the estimations will remain valid [McCrary, 2008]. In this case, a complete manipulation would arise if, knowing the 500-inhabitant threshold of the Guizot law and anticipating its passing, municipalities around this threshold tried to artificially lower their population level in order to avoid having to open and fund a primary school. This seems to be unlikely. This idea is reinforced by a graphical analysis exhibiting no discontinuity of population density around the threshold³⁴. A manipulation test, implemented following [Cattaneo et al., 2018], returns a p-value of 0.6591, confirming the fact that municipalities did not manipulate the forcing variable around the threshold.

Finally, two important things remain to check when working with regression discontinuities. First, one needs to investigate the continuity of covariates around the threshold. Second, it is necessary to run falsification tests in order to show that there is no other discontinuities having an impact on the variable of interest. Indeed, a discontinuity in covariates would cast doubt on the comparability between municipalities above and below the threshold. Also, the existence of unexplained discontinuities around different population cut-offs would weaken the reliability of the estimation. Outcomes of Table A2, Table A3 and Table A4 in the Appendix reject these two issues. No covariate used differs significantly around the 500-inhabitant threshold³⁵. There is also no discontinuity in municipal resources per capita around other thresholds until 2 000 inhabitants, either for resources in 1881 or 1911. Above this number, checking for discontinuity would lead to unreliable results as the number of municipalities without school falls dramatically. There is for example only 49 municipalities in the data between 1 900 and 2 100 inhabitants without school. These tests reinforce the strength and the reliability of the regression discontinuity design used in this paper.

Therefore, I turn to the estimations following the non-parametric model :

$$Y = \alpha + \tau D + \beta_1(X - c) + \beta_2 D(X - c) + \varepsilon \quad (1)$$

where Y is my variable of interest, namely taxes per capita in 1881 and 1911³⁶, and X the population level. Let c be the treatment cut-off and D a binary variable equal to one if $X \geq c$. Let h being the bandwidth of data used, then it follows that $c - h \leq X \leq c + h$. In this model, different slopes and intercepts fit data on either side of the cut-off. In Table 2, I report the estimation outcomes using a flexible linear and quadratic specification and using different population bandwidth, from 50 to 150 inhabitants. I report also a bandwidth of 105.9 for the year 1881 and 90.3 for 1911, selected as optimal bandwidths using the *rdwselect* command in *Stata* [Calonico et al., 2017]. The discontinuity, limited to this optimal bandwidth, is displayed in Figure B7 in the Appendix.

³⁴See Figure B6 in the Appendix.

³⁵The covariates are population dispersion, surface area, altitude, population growth between 1793-1836, postal taxes, the distance to the post office and to the prefecture, the latitude.

³⁶I selected taxes per capita and not total taxes so that the outcomes would be more meaningful and easier to interpret.

Results show a positive impact of education on the economic development of municipalities, with a magnitude between 1.5 and 3 francs per capita depending on the bandwidth selected. As expected, the magnitude is higher closer to the threshold where the estimation is the more reliable and where the jump in economic resources per capita is the strongest. But the effect is robust to the choice of different population bandwidth. The magnitude of the impact appears to be high regarding the level of municipal resources around the threshold. Taking for example municipalities with an absolute deviation of at most 100 inhabitants from the cut-off, the average level of resources is of 5.5 francs per capita, with a standard deviation of 4.6. An increase of 3 francs per capita represents 2/3 of a standard deviation in resources around the threshold. Therefore, primary education contributed to increase significantly the economic resources of municipalities during the nineteenth century and until World War I.

Table 2: Non-parametric regression discontinuity estimates - Municipal resources per capita, 1881 and 1911

	Flexible linear					Flexible quadratic				
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)
RD Estimate - 1881	3.002*** (3.034)	2.295*** (2.745)	1.302* (1.751)	1.159* (1.745)	1.320** (2.243)	3.180** (2.126)	3.237*** (2.641)	2.989*** (2.693)	2.470** (2.536)	1.739* (1.932)
Observations	347	500	694	804	957	347	500	694	804	957
Population bandwidth	50	75	105.9	125	150	50	75	105.9	125	150
RD Estimate - 1911	4.039*** (3.190)	2.927*** (2.740)	2.495** (2.473)	1.744** (2.020)	1.549** (2.013)	4.711** (2.448)	4.943*** (3.187)	4.179*** (2.857)	3.804*** (2.959)	3.044** (2.528)
Observations	350	503	599	806	961	350	503	599	806	961
Population bandwidth	50	75	90.3	125	150	50	75	90.3	125	150
Covariates	No	No	No	No	No	No	No	No	No	No

t statistics in parentheses

* $p < 0.05$, ** $p < 0.01$, *** $p < 0.001$

Source: Guizot, industrial and postal surveys. IGN data, [Motte et al., 2003] and *La Situation Financière des Communes*.

Notes: I report the estimation outcomes using a flexible linear and quadratic specification and using different population bandwidth, from 50 to 150 inhabitants. I report also a bandwidth of 105.9 for the year 1881 and 90.3 for 1911, selected as optimal bandwidths using the *rd bwselect* command in *Stata* [Calonico et al., 2017].

In Table 3, I run the same kind of model using a kernel estimation with the *rdrobust* command [Calonico et al., 2017] and the optimal bandwidth selection associated to it³⁷. I stick to a local polynomial of order 1, following [Gelman and Imbens, 2019]³⁸. The difference between columns (1), (5) and (2), (6) is that I include covariates in the last two. These covariates are: population dispersion³⁹, surface area, altitude, population growth between 1793-1836, postal taxes, the

³⁷See for example [Imbens and Kalyanaraman, 2012] on the optimal bandwidth selection.

³⁸The use of other polynomial degrees doesn't modify the outcomes. See Table A5 in the Appendix.

³⁹taken as the share of the total population that did not match the contiguity criterion. See [Roncayolo, 1987] on this point

distance to the post office and to the prefecture, latitude, and a dummy variable indicating if the municipality at stake is in a department with a printing press in 1500. This last variable is included to account for the potential long terms effect of printing presses on the economic development of municipalities via their effect on human capital [Dittmar, 2011]. In columns (3) and (7), I add covariates which are also incorporated in the computation of the optimal bandwidth, which is not the case in columns (2) and (6). Finally, I cluster standard errors at the district level in columns (4) and (8) to account for spatial correlation in the schooling residual. All the specifications return positive and significant outcomes, with a magnitude of around 2 francs per capita. The impact of primary schools' presence is therefore also robust to the inclusion of covariates, the choice of a kernel estimation and the use of clustered standard errors⁴⁰.

The results remain also consistent with the estimation of several robustness checks. The use of a coverage error rate (CER)-optimal bandwidth instead of a mean square error (MSE)-optimal one doesn't modify greatly the outcomes. The is also true for the manual selection of various bandwidths (the same as in Table 2) under the same kernel estimation⁴¹.

Table 3: Non-parametric regression discontinuity estimates - Municipal resources per capita

	1881				1911			
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
RD Estimate	2.009*** (2.63)	1.856*** (3.14)	2.417*** (3.45)	2.254*** (3.00)	3.166*** (3.00)	2.211*** (2.62)	1.815** (2.41)	1.698* (1.86)
Controls	400	333	222	261	339	285	366	388
Treated Units	294	245	182	208	260	212	264	284
Covariates	No	Yes	Yes	Yes	No	Yes	Yes	Yes
Left Clusters				67				72
Right Clusters				62				66
Kernel	Triangular	Triangular	Triangular	Triangular	Triangular	Triangular	Triangular	Triangular
Order Loc. Poly.	1	1	1	1	1	1	1	1
Order Bias	2	2	2	2	2	2	2	2
BW Loc. Poly.	105.9	105.9	73.21	84.40	90.31	90.31	116.7	126.1
BW Bias	188.5	188.5	142.4	148.1	170.3	170.3	218.5	219.4

t statistics in parentheses

* $p < 0.05$, ** $p < 0.01$, *** $p < 0.001$

Source: Guizot, industrial and postal surveys. IGN data, [Motte et al., 2003] and *La Situation Financière des Communes*.

Notes: In columns (3) and (7), I add covariates which are incorporated in the computation of the optimal bandwidth. This is not the case in columns (2) and (6) where the covariates are added without entering in the computation of the optimal bandwidth. I cluster standard errors at the district level in columns (4) and (8).

⁴⁰As specified in [Lee and Lemieux, 2010], the inclusion of covariates should not lead to a different outcomes in a regression discontinuity design. Indeed, if the setting is good and therefore close to a randomised experiment, then the assignment to treatment is, by construction, independent of the baseline covariates. However, the adding of covariates reduces the sampling variability in the estimator. A substantive precision was gained as confidence intervals shrank by around 10% with the inclusion of covariates from column (1) to (3). This is in line with the recent work of [Calonico et al., 2019].

⁴¹See Table A6 and Table A7 in the Appendix.

A potential issue associated to the use of tax data as a proxy for economic resources is linked to the funding of primary schools by municipalities. Indeed, one may imagine that municipalities impacted by the Guizot law would increase the amount of taxes collected to pay their newly hired teacher. Then, this would mechanically raise the taxes per capita without no link with a higher economic growth. Firstly, one should note that there was no specific tax created to finance education. Municipalities could therefore only try to levy more taxes by collecting additional cents on the four existing contributions aforementioned, which was likely to be rejected by the inhabitants. Secondly, municipalities could ask the departments or the state for financial assistance if their resources were too low to pay for the opening of the school. This was very likely to characterise small municipalities, close to the threshold of 500 inhabitants, that is to say those on which the regression discontinuity is applied. Therefore, as the funds needed to finance the primary school were certainly mostly coming from existing taxes or from the financial assistance of departments, it is unlikely that the Guizot law contributed to significantly increase the amount of taxes per capita at the municipality level and then drive the main part of the effect of education on growth.

Moreover, estimations on the level of resources in 1911 are not subject to this issue. Indeed, from 1886 onwards, all municipalities were legally forced to open and fund a primary school. Also, the Ferry Laws of 1881-1882 made attendance to primary schools mandatory. Therefore, all municipalities faced the same funding constraints in 1911 as they faced the same legal obligations on primary schooling. If the impact of the Guizot law on taxes was only due to the need to levy additional resources to finance the primary school, then this effect would only be observable in 1881 and disappear in 1911. This is why the estimations on the 1911 year constitute a robustness check with respect to this issue. As they remain positive and significant, this indicates that the effect of education on growth is not driven by the need to finance primary schools.

One additional problem which might arise using the Guizot law in a regression discontinuity design is linked to the fact that municipalities could exceed the 500-inhabitants threshold later during the century and therefore be forced to hire a teacher. The law indeed applied until 1886, when all municipalities were then legally forced to fund a primary school. Municipalities exceeding the threshold later are counted as non-treated in the previous estimations. The estimated impact of education is therefore a lower bound of the true effect. Higher the number of municipalities concerned by this late treatment, higher the spread between this bound and the true effect. The spread would also be larger if a high number of municipalities did exceed the threshold only a few years after the Guizot law. Indeed, the previous estimations rely on the fact that municipalities abiding by the new law were characterised by a positive shock on schooling supply and human capital. If municipalities belonging to the control group were treated in 1871 for example, this would not alter greatly the estimations as they would benefit from a shock on education only a few years before the first evaluation of economic resources I consider, in 1881. However, they would decrease the effect of education if they were treated in 1841 for example.

A more minor problem concerns municipalities with more than 500 inhabitants when the Guizot law was passed, by which lost population afterwards and went below this threshold. One might fear that these municipalities would consequently abandon their investment in education. This would also bias downward the estimated outcomes as these municipalities would be considered as treated while they were not any-more. As for the previous issue, this problem is more likely to arise if the population of these municipalities decreased shortly after the passing of the law. However, this threat is certainly less problematic compared to the previous one. Indeed, if a teacher was hired and paid by a municipality, and that education services were therefore provided at a lower cost for families in comparison to private teaching⁴², municipal authorities were very unlikely to take a step back and deprive families from these services. When a school was present and funded by a municipality, it extremely rarely disappeared afterwards [Prost, 1968]. Still, these two issues can be tackled thanks to the population data coming from the censuses, even if this re-introduces some selection between the municipalities.

To control for these two issues, I introduced several population restrictions in [Table A8](#) in the Appendix. In column (1), I exclude municipalities with less than 500 inhabitants in 1836, but more than 500 in 1841. These municipalities, potentially opening a school only a few years after the first ones treated by the Guizot law, can bias downward the estimated effects of education on growth⁴³. In column (2), I only compare municipalities with more than 500 inhabitants both in 1831 and 1836 to those with less than 500 inhabitants at the same dates. This controls for the fact that some municipalities may have abode by the new law in 1833, but lost some inhabitants between this date and 1836 and be included in the non-treated group. This concerns 50 municipalities. In column (3), I restrict treated municipalities as the ones with more than 500 inhabitants between 1831 and 1851. A continuous implementation of the law during 20 years should ensure a stable schooling supply within the municipalities at stake. Finally, in column (4), I adopt a more restrictive specification than in column (1) to drop municipalities which might bias downward the effect. I only consider as non-treated the municipalities with less than 500 inhabitants between 1831 and 1881⁴⁴.

The outcomes remain highly unchanged under these various specifications. The magnitude of the education impact is always close to 2 francs per capita in the three first specifications. In the last specification, the most restrictive, the effect is however higher than the ones previously

⁴²Families still had to pay monthly schooling fees so that their children would attend primary schools even when municipal authorities were subsidising the school. However, as shown in [Montalbo, 2019], the fees were lower within public school funded by municipalities compared to private schools. As part of the teachers' salary was provided by the municipality, these teachers could rely less on schooling fees to obtain a decent remuneration.

⁴³On this point, one could try to run a separate regression for each census year. This would amount to selecting municipalities without school in 1836, exceeding the Guizot threshold in 1841 or 1856 for example, and comparing their future level of economic resources to the one of municipalities still under the 500-inhabitant threshold. However, this would critically lower the number of observations. Indeed, only 53 municipalities would be considered as treated in 1841 for example, 30 in 1846, 50 in 1851. Moreover, this would introduce more approximations in the estimation as I cannot observe if a municipality opened a school or not after 1833, which they could have done even if they were not forced to legally. Therefore, running these estimations would be problematic. Within the basic estimation framework, I can at least be sure that a municipality around the population threshold had or not a primary school in 1833.

⁴⁴[Figure B8](#) in the Appendix displays the discontinuity under each specification.

estimated. This is coherent with the fact that some municipalities exceeding the 500-inhabitant threshold between 1833 and 1881 might have biased downward the effect of the schooling supply shock. The estimated growth impact of the education shock is therefore robust to these four population restrictions.

4.3 Timing and Scope of the Effect

The effect of education on economic resources is significant both in 1881 and 1911. Since municipalities around the 500-inhabitant threshold didn't differ significantly in 1833, this reveals a positive effect of primary schooling on the growth of municipalities between the Guizot law on these two dates. In their analysis, [Squicciarini and Voigtländer, 2015](#) point out a positive effect of basic education (school rate in 1837) on the subsequent level of economic resources (disposable income in 1864 and industrial output in 1861), but not the population growth of big cities in France. This work indicates that basic human capital did influence the growth of smaller municipalities during the second part of the nineteenth century. The difference between the two findings can first come from the timing of the effect and from the size of the units of analysis.

Indeed, since primary schooling was well-developed in big cities, it was unlikely to influence their population growth. On the contrary, huge variations in basic educational achievements existed between the vast majority of French municipalities during the nineteenth century, which in turn contributed to influence their economic growth. Moreover, upper-tail knowledge may have been more important for the adoption and implementation of new technologies and techniques in the first part of the nineteenth century, while the acquisition of elementary skills was increasingly required to operate on these evolving technologies as the century went on.

In their work, [Squicciarini and Voigtländer, 2015](#) also insist on the fact that the level of basic skills doesn't affect growth, it only influences the level of economic resources at a given point. They indicate that changes in basic education affect growth, in compliance with other recent findings [[de la Fuente and Doménech, 2006](#)], [[Cohen and Soto, 2007](#)], [[Ciccone and Papaioannou, 2009](#)]. In this study, this is also a change in education which is measured, as the Guizot law prompted an increase in enrolment in the municipalities at stake. Therefore, there seems to be no major contradiction between this work and the conclusions from [Squicciarini and Voigtländer, 2015](#).

Even if education did influence growth in the second part of the nineteenth century, I find no effect on the growth of municipal resources between 1881 and 1911. There is no apparent strong discontinuity in the growth rate around the 500-inhabitant threshold. The estimations even return a negative effect of being just above the threshold. However, the estimates are only slightly significant and not in all specifications⁴⁵. Therefore, the human capital accumulated within primary schools impacted the growth of municipalities mostly between 1833 and 1881.

⁴⁵See [Figure B9](#) and [Table 4](#) in the Appendix. In the estimations, I keep as non-treated municipalities with less than 500 inhabitants until 1881, that is to say the most restrictive specification. Keeping all municipalities wouldn't change the outcomes.

Table 4: Non-parametric regression discontinuity estimates - Growth of municipal resources per capita

Growth of municipal resources, 1881-1911				
	(1)	(2)	(3)	(4)
RD Estimate	-35.22 (-1.30)	-44.10* (-1.67)	-43.82* (-1.66)	-41.51 (-1.57)
Controls	259	220	222	237
Treated units	239	196	196	216
Covariates	No	Yes	Yes	Yes
Left Clusters				68
Right Clusters				67
Kernel	Triangular	Triangular	Triangular	Triangular
Order Loc. Poly.	1	1	1	1
Order Bias	2	2	2	2
BW Loc. Poly.	115.9	115.9	116.8	123.9
BW Bias	213.2	213.2	212.1	215.4

t statistics in parentheses

* $p < 0.05$, ** $p < 0.01$, *** $p < 0.001$

Source: Guizot, industrial and postal surveys. IGN data, [Motte et al., 2003] and *La Situation Financière des Communes*.

Notes: RD estimates on the growth of municipal resources between 1881 and 1911 are displayed. Only municipalities with less than 500 inhabitants between 1831 and 1881 and no school in 1833 are considered as non-treated in the estimations.

This is coherent with the fact municipalities began to converge in terms of education achievements during the second part of the nineteenth century. The educational advantage granted by the Guizot law slowly faded away during these years. The final blow was dealt by the Ferry Laws of 1881-1882 which made attendance to primary schools between 6 and 13 years old mandatory. Therefore, it appears logical to find that the positive effect of education was concentrated before these years. If municipalities affected by the Guizot law kept a higher average level of economic resources per capita in 1911, it is only thanks to the positive impact of education until the 1880s.

The impact of education also varied between the departments in my database, depending on their previous educational achievements. I separated departments above and below the value of 50% of the municipalities with a primary school in 1833. Around one-fourth of the departments at that time were characterised by a lower presence of schools. These departments were therefore performing quite badly on this point. I selected this threshold since around half of the municipalities in my database are located within each side. I can use it to compare the effect of

the Guizot law between the two groups of departments without losing too many observations around the 500-inhabitant threshold. The discontinuity in resources is still valid when focusing on departments previously well-endowed in primary schools. However, this is not the case for the remaining departments where primary schools were scarce in 1833⁴⁶. This is confirmed by the estimation outcomes of [Table 5](#) and [Table 6](#). The impact of education is only significant in departments well-endowed in primary schools in 1833, with a magnitude extremely close to the one estimated in the general case. As a consequence, municipalities affected by the Guizot law did perform better economically than their counterparts, but only in departments where the proportion of municipalities with schools in 1833 was already high.

These results may indicate that the Guizot law was applied differently between the French departments and regions. Indeed, one may hypothesise that local authorities would more carefully control its application and put pressure on, or sanction, municipalities which were reluctant to hire a teacher within areas where education was more common. Also, departments well-endowed in primary schools were also those where economic resources were the highest. Implementing the law is therefore likely to have been easier for municipalities located in richer areas. In the educationally and economically backward departments, investing funds in education was often considered a waste of resources, which were already scarcer than elsewhere. Primary education funding was more likely to be in competition with the provision of other public goods as the development or maintenance of roads for example. In their book, [Furet and Ozouf, 1977](#) present several cases in which authorities were reluctant to invest in primary schooling if economic resources were low. Education was often seen as unnecessary in this case, both by municipal authorities and by the population.

Moreover, even if a first geographical convergence in educational achievements took place before the Ferry Laws in France [[Diebolt et al., 2005](#)], there still existed huge variations in literacy rates between the departments until late into the nineteenth century. For example, men literacy, as measured by the percentage of men signing their marriage contract, still varied between 43% and 99% in 1871-1875. The corresponding percentages for women were 27% and 98%. The Saint-Malo/Geneva division of the territory was therefore still valid when the Ferry Laws were passed, even if mitigated compared to the first part of the century⁴⁷. This points out that families are likely to have reacted less to the schooling supply shock of the Guizot law in educationally backward departments. Finding no significant effect of education on growth within them is therefore partly due to the fact that the law most likely didn't entail a strong increase in the accumulation of human capital.

Lastly, even if a municipality did follow the law and even if families reacted to it, being located in a department where economic resources were low could have contributed to attenuate the effect of education on growth. Indeed, if economic activities were far from being dynamic, an increase in education in a small municipality was unlikely to attract producers. Moreover, if the presence of new technologies was low, more educated people would not necessarily be more productive and would not contribute to increase significantly the volume of resources produced

⁴⁶See [Figure B10](#) in the Appendix.

⁴⁷See [Figure B11](#) in the Appendix.

at the municipal level. This may also account for the absence of effect found in departments with a low endowments of primary schools in 1833.

Table 5: Non-parametric regression discontinuity estimates - Municipal resources per capita. Departments well-endowed in primary schools

	1881				1911			
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
RD Estimate	2.163*	2.069**	2.617***	2.536**	3.175**	2.429**	2.500**	2.349**
	(1.66)	(2.39)	(2.67)	(2.38)	(2.05)	(2.54)	(2.54)	(2.33)
Controls	233	194	145	159	204	172	160	182
Treated units	152	130	102	109	139	117	109	121
Covariates	No	Yes	Yes	Yes	No	Yes	Yes	Yes
Left Clusters				37				41
Right Clusters				33				36
Kernel	Triangular							
Order Loc. Poly.	1	1	1	1	1	1	1	1
Order Bias	2	2	2	2	2	2	2	2
BW Loc. Poly.	118.7	118.7	90.11	96.41	102.8	102.8	96.07	108.6
BW Bias	193.6	193.6	147.3	141.0	193.3	193.3	181.3	192.3

t statistics in parentheses

* $p < 0.05$, ** $p < 0.01$, *** $p < 0.001$

Source: Guizot, industrial and postal surveys. IGN data, [Motte et al., 2003] and *La Situation Financière des Communes*.

Notes: In columns (3) and (7), I add covariates which are incorporated in the computation of the optimal bandwidth. This is not the case in columns (2) and (6) where the covariates are added without entering in the computation of the optimal bandwidth. I cluster standard errors at the district level in columns (4) and (8). Only municipalities belonging to departments with a high ratio of municipalities with primary schools (more than 50%) are taken into account.

Table 6: Non-parametric regression discontinuity estimates - Municipal resources per capita. Departments with a low endowment in primary schools

	1881				1911			
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
RD Estimate	0.462 (0.75)	0.276 (0.49)	0.124 (0.24)	0.113 (0.22)	0.795 (0.78)	0.661 (0.68)	0.675 (0.72)	0.652 (0.63)
Controls	212	175	203	220	228	187	190	213
Treated units	167	137	171	191	191	155	163	189
Covariates	No	Yes	Yes	Yes	No	Yes	Yes	Yes
Left Clusters				30				30
Right Clusters				30				30
Kernel	Triangular							
Order Loc. Poly.	1	1	1	1	1	1	1	1
Order Bias	2	2	2	2	2	2	2	2
BW Loc. Poly.	115.5	115.5	146.0	159.4	131.5	131.5	138.2	155.3
BW Bias	183.2	183.2	209.9	207.0	205.6	205.6	203.6	210.3

t statistics in parentheses

* $p < 0.05$, ** $p < 0.01$, *** $p < 0.001$

Source: Guizot, industrial and postal surveys. IGN data, [Motte et al., 2003] and *La Situation Financière des Communes*.

Notes: In columns (3) and (7), I add covariates which are incorporated in the computation of the optimal bandwidth. This is not the case in columns (2) and (6) where the covariates are added without entering in the computation of the optimal bandwidth. I cluster standard errors at the district level in columns (4) and (8). Only municipalities belonging to departments with a low ratio of municipalities with primary schools (less than 50%) are taken into account.

4.4 Transmission Channels

Why did the Guizot law on primary education contribute to the economic development of municipalities? Firstly, even if attendance was not mandatory until the Ferry Laws of 1881-1882, there are strong evidence showing that enrolment did increase when the law prompted the creation of a school [Thabault, 1993], [Blanc and Wacziarg, 2018]. In many cases, the take-off in enrolment and the decisive step towards the disappearance of illiteracy was done in the years following the Guizot law. The shock in schooling supply induced by the law was therefore sufficiently strong to attract a significant number of children within the classrooms⁴⁸. As discussed previously, the impact on education is however likely to have been higher within departments where schooling children was a more deeply-rooted habit. But another question remains unsolved: why did this increase in basic human capital accumulation favour the growth of municipalities?

Within the literature on education, there are three main transmission channels identified be-

⁴⁸ In another work, I show that the municipalities which invested in education before they were forced to do so by the Guizot law contributed to lower the cost of education born by families and to increase enrolment rates [Montalbo, 2019]. This could explain why, in many municipalities, families were too poor to send their children to school before the law, when the schools were only financed by the schooling fees. However, when the education cost was shared between them and municipal authorities after the law, they could afford paying the now lower schooling fees, which contributed to significantly increase enrolment rates.

tween education and growth. Firstly, education increases the accumulation of human capital in the labour force, then productivity and the level of output. This is the channel describes in the neoclassical models [Mankiw et al., 1992]. Secondly, education may increase the innovation capacity of the economy. The new technologies, products and processes then contribute to promote growth. This is the channel advocated by the endogenous growth theorists [Lucas, 1988], [Romer, 1990]. Last but not least, education can facilitate the diffusion and transmission of knowledge and new information, helping to implement successfully new technologies which could be devised by others. This contributes to enhance economic growth [Nelson and Phelps, 1966], [Schultz, 1975] [Easterlin, 1981].

The first and the third channels certainly bear more explanatory power in this case⁴⁹. Indeed, more educated people may have been less reluctant to implement new technologies, to use new tools or to adopt new production processes, leading to a higher level of economic growth. A good example illustrating this point is the "green revolution" in India and the introduction of high-yielding variety seeds [Foster and Rosenzweig, 1996]⁵⁰. This mechanism is very likely to have been valid for France during 19th century, especially in the agricultural sector. The spread of fertilizers for example, which began to surge in the second part of the century [Clout and Phillips, 1972], or the adoption of more efficient types of plough, especially the adoption of the Dombasle plough in the 1820s and the progressive transition to the Brabant one at the end of the century, may have been facilitated by the proximity of farmers to the new agronomy [Duby and Wallon, 1976], [Beltran and Griset, 1994]. Higher primary schooling achievements may also have increase the productivity of industrial workers, especially since the demand of literate people increased in industry during the second part of the century, notably with the need of reading plans [Mitch, 1993]⁵¹.

Primary education may also have favoured the concentration of more productive people and jobs. Literate and more skilled parents can for example have decided to migrate to a given municipality where primary schooling was well-developed because they had a higher preference for education and because working opportunities were higher there. This Tiebout sorting [Tiebout, 1956] would have reinforced the positive effect of education on economic resources by gathering more productive people. Generally speaking, numerous studies have shown that more educated people were migrating farther away in the 19th century [Heffernan, 1989] [Hoyler, 1998], [Rosental, 2004], [Bonneuil et al., 2008], even in the case of migrations from and to small villages [Rosental et al., 2000], which were numerous up until the the 1880s [Rosental, 1994]. Scholars have insisted on the idea that job opportunities were guiding these migrations.

⁴⁹In the American and British cases, it has been shown that inventors of the nineteenth century did not perform particularly well in terms of educational achievement [Khan and Sokoloff, 1993], [Khan and Sokoloff, 2004], [Khan, 2018]. This tends to discard the second transmission channel.

⁵⁰See also the studies on the American agriculture in the late 1950s [Welch, 1970] and manufacturing industries between 1960 and 1980 [Bartel and Lichtenberg, 1987].

⁵¹Spillover effects of education on nearby workers may also have played a role in the economic development of municipalities [Moretti, 2004a], [Moretti, 2004b]. See [Simon and Nardinelli, 1996] for a historical analysis on British cities.

5 Conclusion

Major economic and social events of the nineteenth century have left a lasting mark in French history. First, the alternation of political regimes resulted in the advent of the republican system. Second, this period was characterised by the industrialisation of the country, along with the progressive modernisation of the agricultural sector. Primary education also developed strongly during this century, in link with growing economic resources and a higher demand for academic skills on the labour market. Important laws sustained this extension by increasing the supply of schools. The Guizot law of 1833 initiated this movement by making mandatory for municipalities more than 500 inhabitants to open and fund a primary school for boys. Then, the Falloux and Duruy laws of 1850 and 1867 extended this legislation to girls. Finally, compulsory schooling was enacted by the Ferry laws of 1881 and 1882.

The positive shock on schooling supply induced by the Guizot law, and the increase in human capital which followed this legislation, impacted the subsequent economic growth of municipalities until the end of the nineteenth century, and up to World War I. Therefore, primary education, and the acquisition of elementary skills, appear to be an important factor in explaining the growth of municipalities during the century of industrialisation and modernisation in France. Several transmission factors may account for this association as the growing need for skills within the industrial or agricultural sector and the more rapid adoption of advanced technologies within municipalities with a more educated labour-force.

More generally, this work points out a positive contribution of basic education in the transition from stagnation to growth. If upper-tail knowledge was related to the pre-industrial development of countries and cities, primary education contributed to the growth of the vast majority of municipalities during the industrialisation and modernisation process. Therefore, changes in human capital accumulation at this level accelerated the transition towards sustained economic growth in France. This relation has also been studied in the case of Prussia but remains to be deeply investigated for other countries. Primary schooling is likely to be an important factor in accounting for the long-term economic growth of municipalities and countries.

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Appendix for on-line publication

Data and descriptive statistics

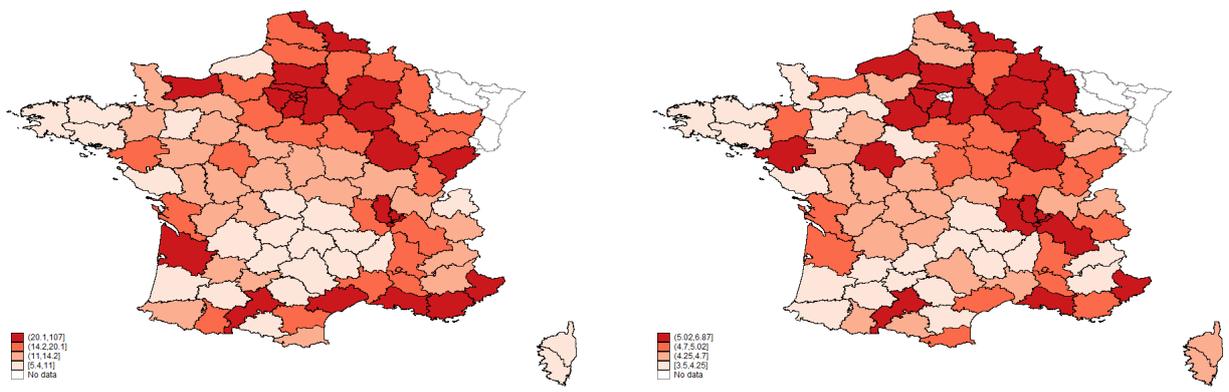
Table A1: Data representativeness, means and t-tests

	France	Municipal level sample	t-test
Population - 1836	91 948	85 794	NS
Number of municipalities	105	90	***
Percentage of population scattered	49.4	55.4	*
Average altitude - meters	300	211	***
Surface area - hectares	1 566	1 869	***
Percentage of municipalities with schools	71.5	60.8	***
Primary schools per 100 municipalities	215	79	NS
Teachers with a fixed salary per 100 municipalities	48.1	51.9	NS
Teachers with an accommodation per 100 municipalities	43.6	46.8	NS
Pupils per 100 children and single people	19.9	16.5	**
High heights among conscripts (%)	32.5	30.2	*
Percentage of municipalities with factories	17.2	21.6	**
Percentage of municipalities with factories > 20 workers	7.6	8.3	NS
Number of industrial workers	3 592	2 531	NS
Industrial male worker daily wage - cents of francs	192	187	NS
Taxes on industrial activities - francs per year	12 733	12 591	NS
Total agricultural area - hectares	143 903	150 892	NS
Land value by hectare - francs	1 825.6	1 644.5	**
Food % in day-workers family spendings	66.4	66.5	NS
Male day-workers daily wage - francs	1.42	1.38	NS
Female day-workers daily wage - francs	0.89	0.87	NS
Day-workers per 100 self-employed	103.6	111.1	NS
Share-croppers per 100 self-employed	10.3	10.9	NS
Tenant farmers per 100 self-employed	16.8	27.8	***

*** p<0.01, ** p<0.05, * p<0.1.

Source: Guizot, industrial, agricultural and postal surveys. IGN data and [Motte et al., 2003]. Military data on conscripts from [Aron et al., 1972].

Notes: All figures are computed at the level of districts. The average population in each district was respectively around 85 794 inhabitants for those belonging to the municipality level sample and around 91 948 inhabitants for the entire France. The difference between the two is non-significant.



Municipal taxes per capita in francs, 1911

Average daily wages in francs, 1911

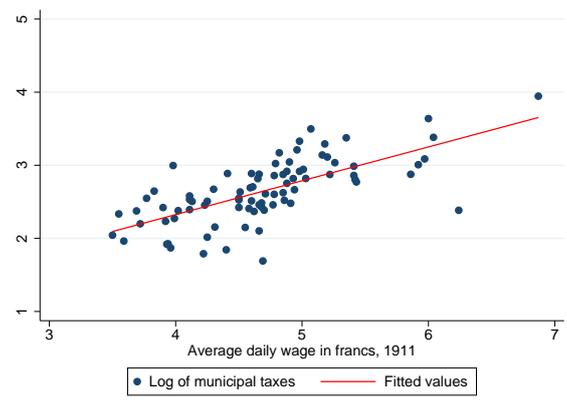
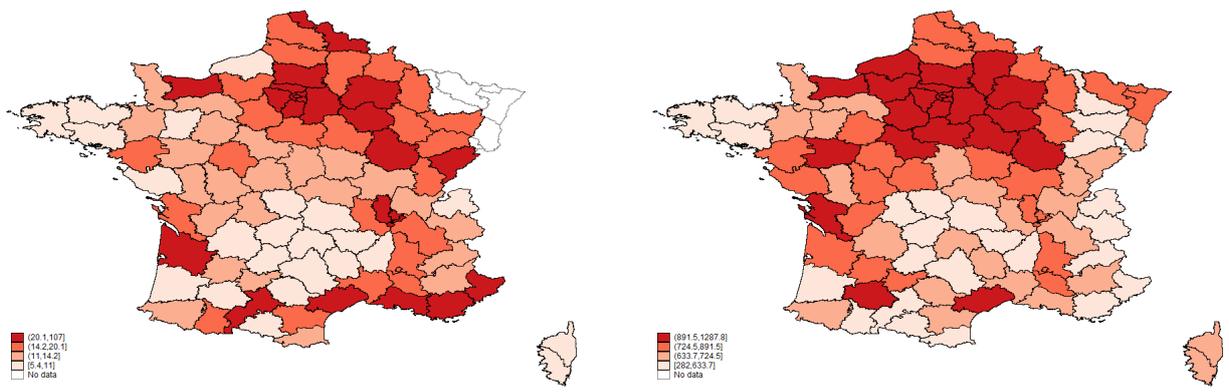


Figure B1: Municipal taxes and average daily wages

Source: [Bassino and Dormois, 2006], [Motte et al., 2003] and *La Situation Financière des Communes*.



Municipal taxes per capita in francs, 1911

Disposable income per capita, 1864

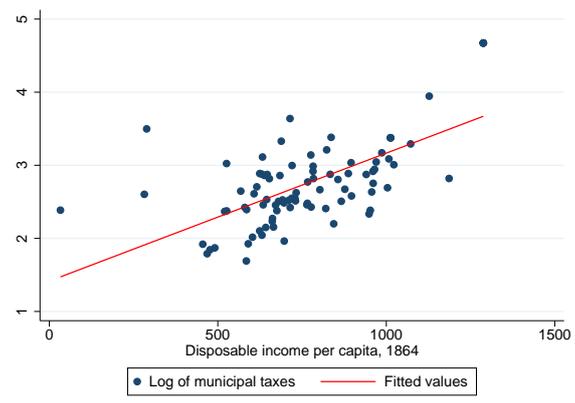


Figure B2: Municipal taxes and disposable income per capita

Source: [Delefortrie and Morice, 1959], [Motte et al., 2003] and *La Situation Financière des Communes*.

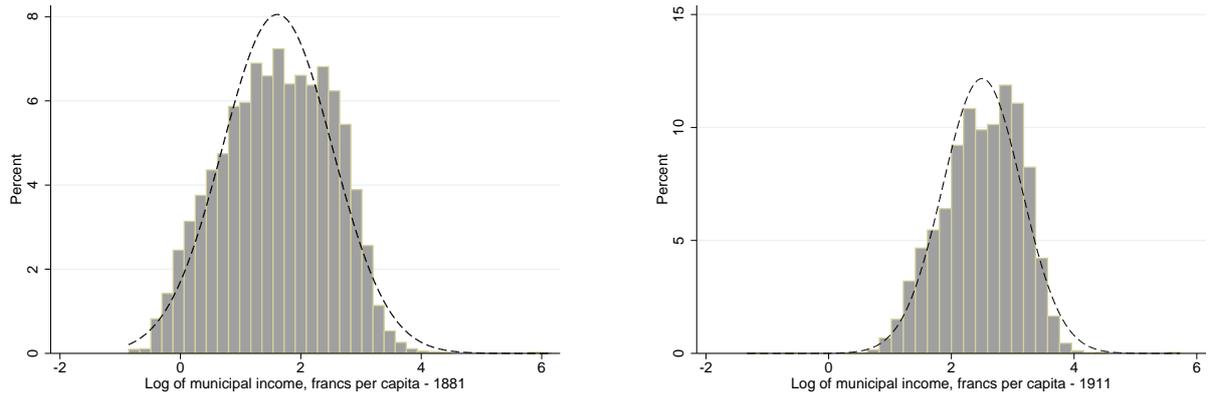
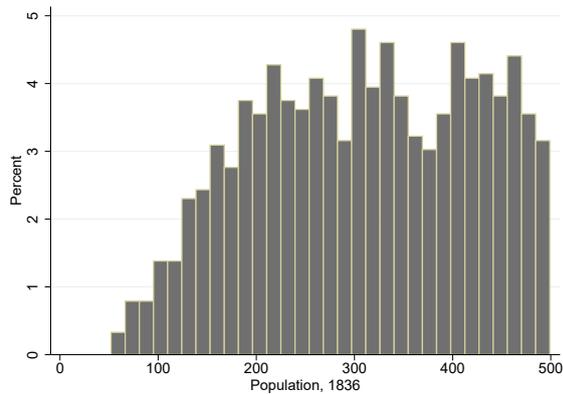


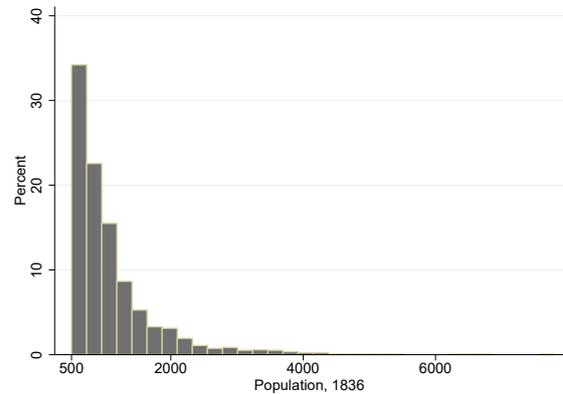
Figure B3: Histograms of the log of municipal resources, 1881 and 1911

Source: *La Situation Financière des Communes*.

Regression discontinuity design



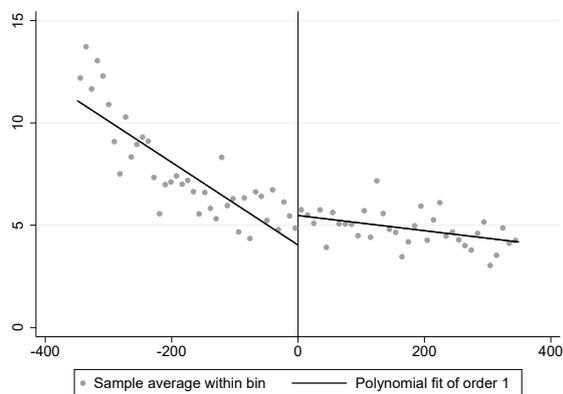
Below 500 inhabitants



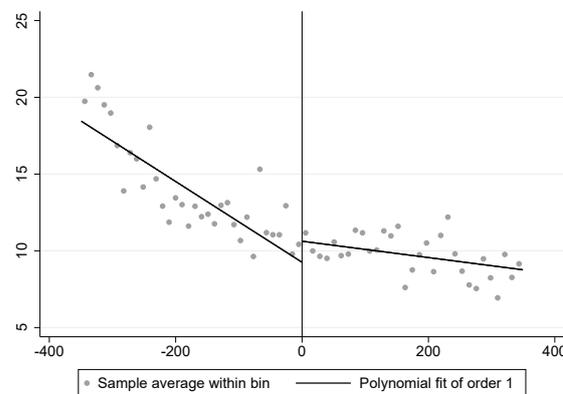
Above 500 inhabitants

Figure B4: Histograms of municipal population in 1836 - Municipalities with no school

Source: [Motte et al., 2003].



Resources per capita, 1881



Resources per capita, 1911

Figure B5: Data-driven regression discontinuity in municipal resources per capita. 1831 population

Source: Guizot survey and *La Situation Financière des Communes*.

Notes: On the x-axis, the distance in terms of population to the 500-inhabitant threshold is displayed.

Population in 1831 instead of 1836 is used. The polynomial fit used is of order one.

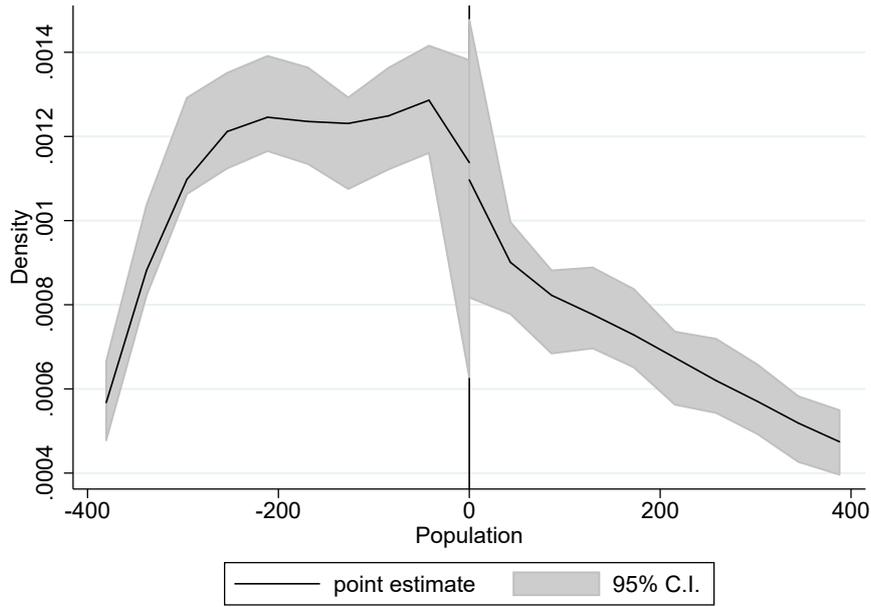


Figure B6: Population density around the 500-inhabitant threshold

Source: [Motte et al., 2003]

Notes: On the x-axis, the distance in terms of population to the 500-inhabitant threshold is displayed. The density of population and its 95% confidence interval are reported in grey.

Table A2: Non-parametric regression discontinuity estimates - Continuity of covariates

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)
	Population dispersion	Surface area	Altitude	Population growth 1793-1836	Distance to post office	Postal taxes	Industrial production	Distance to prefecture	Latitude
RD Estimate	-1.871 (-0.34)	12.73 (0.81)	-58.13 (-1.39)	-12.85 (-1.46)	-0.679 (-0.89)	4.100 (0.46)	11.47 (1.42)	-3.110 (-1.18)	-0.177 (-0.66)
Controls	405	411	411	419	425	433	433	411	382
Treated Units	285	301	301	305	293	310	310	301	279
Kernel	Triangular	Triangular	Triangular	Triangular	Triangular	Triangular	Triangular	Triangular	Triangular
Order Loc. Poly.	1	1	1	1	1	1	1	1	1
Order Bias	2	2	2	2	2	2	2	2	2
BW Loc. Poly.	105.9	105.9	105.9	105.9	105.9	105.9	105.9	105.9	105.9
BW Bias	105.9	105.9	105.9	105.9	105.9	105.9	105.9	105.9	105.9

t statistics in parentheses

* $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$

Source: Guizot, industrial and postal surveys. IGN data, [Motte et al., 2003] and *La Situation Financière des Communes*.

Notes: RD estimates on covariates are displayed in order to check for the continuity around the 500-inhabitant population threshold.

Table A3: Non-parametric regression discontinuity estimates - Falsification tests

		Municipal resources per capita - 1881								
Population cutoffs:	200	300	450	550	700	800	1 000	1 300	1 600	1 900
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)
RD Estimate	-2.214 (-1.57)	-0.646 (-0.64)	0.312 (0.45)	-0.373 (-0.60)	-0.655 (-0.80)	0.196 (0.32)	0.364 (0.59)	0.418 (0.55)	-0.224 (-0.41)	-0.223 (-0.47)
Controls	225	365	415	418	448	426	388	300	131	57
Treated units	349	394	375	289	324	296	253	144	69	57
Covariates	No	No	No	No	No	No	No	No	No	No
Kernel	Triangular	Triangular	Triangular	Triangular	Triangular	Triangular	Triangular	Triangular	Triangular	Triangular
Order Loc. Poly.	1	1	1	1	1	1	1	1	1	1
Order Bias	2	2	2	2	2	2	2	2	2	2
BW Loc. Poly.	96.07	104.1	113.2	120.1	180.7	198.9	247.7	308.1	285.8	252.1
BW Bias	133.1	149.0	172.7	206.4	278.0	318.1	362.0	446.8	462.5	439.8

t statistics in parentheses

* $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$

Source: Guizot, industrial and postal surveys. IGN data, [Motte et al., 2003] and *La Situation Financière des Communes*.

Notes: RD estimates on different population thresholds are displayed.

Table A4: Non-parametric regression discontinuity estimates - Falsification tests

		Municipal resources per capita - 1911								
Population cutoffs:	250	350	450	550	750	850	1 000	1 300	1 600	1 900
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)
RD Estimate	0.432 (0.28)	0.686 (0.62)	-0.683 (-0.78)	0.683 (0.80)	-0.944 (-0.87)	1.257 (1.48)	0.591 (0.72)	0.624 (0.63)	-0.336 (-0.37)	-0.154 (-0.16)
Controls	308	384	514	563	513	372	397	300	153	86
Treated units	357	382	434	362	360	288	256	144	75	68
Covariates	No	No	No	No	No	No	No	No	No	No
Kernel	Triangular	Triangular	Triangular	Triangular	Triangular	Triangular	Triangular	Triangular	Triangular	Triangular
Order Loc. Poly.	1	1	1	1	1	1	1	1	1	1
Order Bias	2	2	2	2	2	2	2	2	2	2
BW Loc. Poly.	92.30	101.4	136.8	153.2	221.5	198.7	250.3	308.2	316.7	343.6
BW Bias	122.9	155.4	201.1	234.0	311.5	348.6	390.9	445.2	481.7	568.1

t statistics in parentheses

* $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$

Source: Guizot, industrial and postal surveys. IGN data, [Motte et al., 2003] and *La Situation Financière des Communes*.

Notes: RD estimates on different population thresholds are displayed.

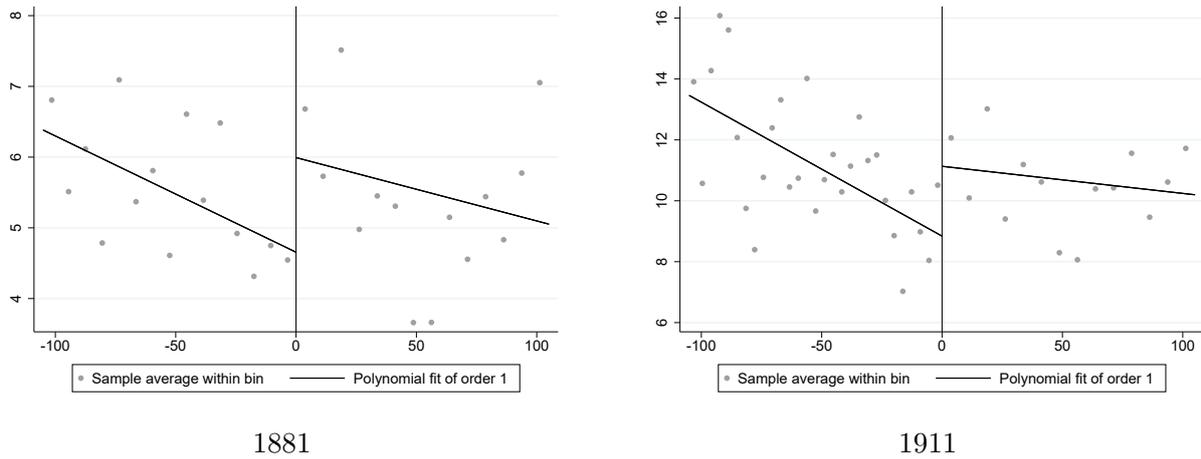


Figure B7: Data-driven regression discontinuity in municipal resources per capita - optimal bandwidth

Source: Guizot survey and *La Situation Financière des Communes*.

Notes: On the x-axis, the distance in terms of population to the 500-inhabitant threshold is displayed.

Table A5: Non-parametric regression discontinuity estimates - Municipal resources per capita, other polynomial degrees

	1881			1911		
	(1)	(2)	(3)	(4)	(5)	(6)
RD Estimate	2.953*** (3.42)	3.304*** (2.67)	4.257** (2.45)	3.370*** (2.66)	3.471* (1.89)	4.365* (1.76)
Controls	333	333	333	285	285	285
Treated units	245	245	245	212	212	212
Covariates	Yes	Yes	Yes	Yes	Yes	Yes
Kernel	Triangular	Triangular	Triangular	Triangular	Triangular	Triangular
Order Loc. Poly.	2	3	4	2	3	4
Order Bias	3	4	5	3	4	5
BW Loc. Poly.	105.9	105.9	105.9	90.31	90.31	90.31
BW Bias	188.5	188.5	188.5	170.3	170.3	170.3

t statistics in parentheses

* $p < 0.05$, ** $p < 0.01$, *** $p < 0.001$

Source: Guizot, industrial and postal surveys. IGN data, [Motte et al., 2003] and *La Situation Financière des Communes*.

Notes: In all estimations, the optimal bandwidth is used. Only the polynomial degree is varying between the columns, from 2 in columns (1) and (4), to 3 in columns (2) and (5) and 4 in columns (3) and (6).

Table A6: Non-parametric regression discontinuity estimates with CER-optimal bandwidth - Municipal resources per capita

	1881				1911			
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
RD Estimate	2.778*** (2.97)	1.856*** (3.14)	2.928*** (3.44)	2.574*** (3.15)	4.115*** (3.23)	2.211*** (2.62)	2.605*** (2.90)	2.107** (2.07)
Controls	253	333	141	197	221	285	237	309
Treated Units	209	245	135	163	187	212	197	228
Covariates	No	Yes	Yes	Yes	No	Yes	Yes	Yes
Left Clusters				67				72
Right Clusters				62				66
Kernel	Triangular	Triangular						
Order Loc. Poly.	1	1	1	1	1	1	1	1
Order Bias	2	2	2	2	2	2	2	2
BW Loc. Poly.	70.91	105.9	49.57	65.67	60.46	90.31	79.02	98.17
BW Bias	188.5	188.5	142.4	148.1	170.3	170.3	218.5	219.4

t statistics in parentheses

* $p < 0.05$, ** $p < 0.01$, *** $p < 0.001$

Source: Guizot, industrial and postal surveys. IGN data, [Motte et al., 2003] and *La Situation Financière des Communes*.

Notes: The specifications in this table are the same as in Table 3. In columns (3) and (7), I add covariates which are incorporated in the computation of the optimal bandwidth. This is not the case in columns (2) and (6) where the covariates are added without entering in the computation of the optimal bandwidth. I cluster standard errors at the district level in columns (4) and (8).

Table A7: Non-parametric regression discontinuity estimates, other bandwidths - Municipal resources per capita

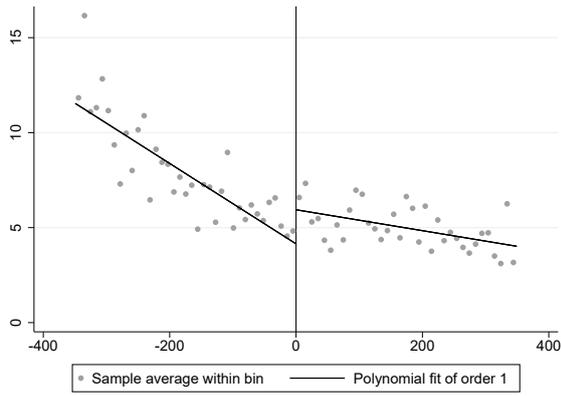
	1881					1911				
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)
RD Estimate	3.059*** (2.77)	2.700*** (2.97)	2.010*** (2.63)	1.702** (2.40)	1.501** (2.32)	4.286*** (3.08)	3.781*** (3.28)	3.167*** (3.00)	2.554*** (2.74)	2.184*** (2.58)
Controls	172	273	400	465	544	172	272	339	464	544
Treated Units	165	223	294	337	402	168	226	260	340	406
Covariates	No	No	No	No	No	No	No	No	No	No
Kernel	Triangular	Triangular	Triangular	Triangular	Triangular	Triangular	Triangular	Triangular	Triangular	Triangular
Order Loc. Poly.	1	1	1	1	1	1	1	1	1	1
Order Bias	2	2	2	2	2	2	2	2	2	2
BW Loc. Poly.	50	75	105.9	125	150	50	75	90.30	125	150
BW Bias	50	75	105.9	125	150	50	75	90.30	125	150

t statistics in parentheses

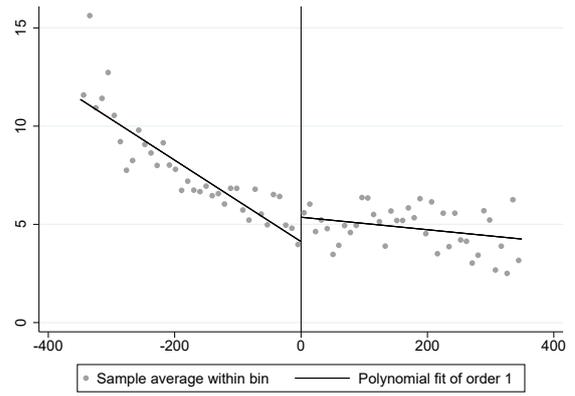
* $p < 0.05$, ** $p < 0.01$, *** $p < 0.001$

Source: Guizot, industrial and postal surveys. IGN data, [Motte et al., 2003] and *La Situation Financière des Communes*.

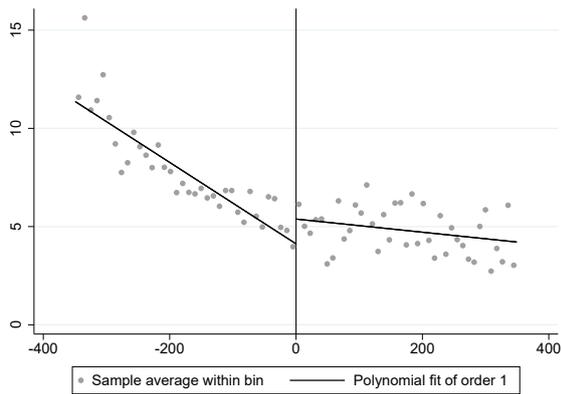
Notes: RD estimates on a choice of different bandwidths are displayed.



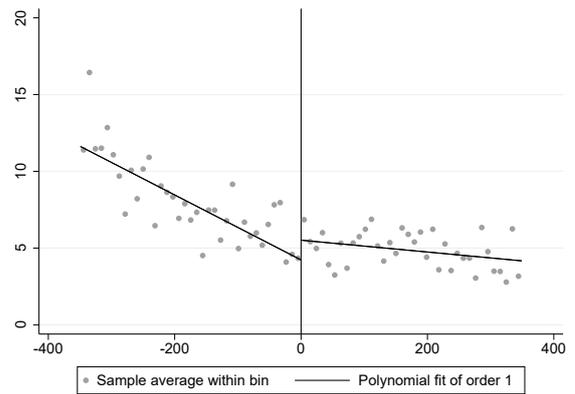
Column 1



Column 2



Column 3



Column 4

Figure B8: Data-driven regression discontinuity in municipal resources per capita - Restrictions on population

Source: Guizot survey and *La Situation Financière des Communes*.

Notes: On the x-axis, the distance in terms of population to the 500-inhabitant threshold is displayed. The polynomial fit used is of order one. The number of bins has been selected through the mimicking variance evenly-spaced method using spacings estimators. Each graph relies on the population restriction defined in [Table A8](#) for the year 1881. "Column 1" designs for example that the first graph represents the discontinuity in resources per capita excluding municipalities with less than 500 inhabitants in 1836 but more than 500 in 1841.

Table A8: Non-parametric regression discontinuity estimates -
Municipal resources per capita, population restrictions

	1881			
	(1)	(2)	(3)	(4)
RD Estimate	2.394*** (3.09)	2.145** (2.57)	2.018** (2.05)	3.842*** (3.72)
Controls	183	180	180	86
Treated units	174	113	91	99
Covariates	Yes	Yes	Yes	Yes
Kernel	Triangular	Triangular	Triangular	Triangular
Order Loc. Poly.	1	1	1	1
Order Bias	2	2	2	2
BW Loc. Poly.	71.94	68.53	68.07	60.41
BW Bias	140.0	133.86	136.18	130.34

t statistics in parentheses

* $p < 0.05$, ** $p < 0.01$, *** $p < 0.001$

Source: Guizot, industrial and postal surveys. IGN data, [Motte et al., 2003] and *La Situation Financière des Communes*.

Notes: See the main text for a description of the population restrictions applied.

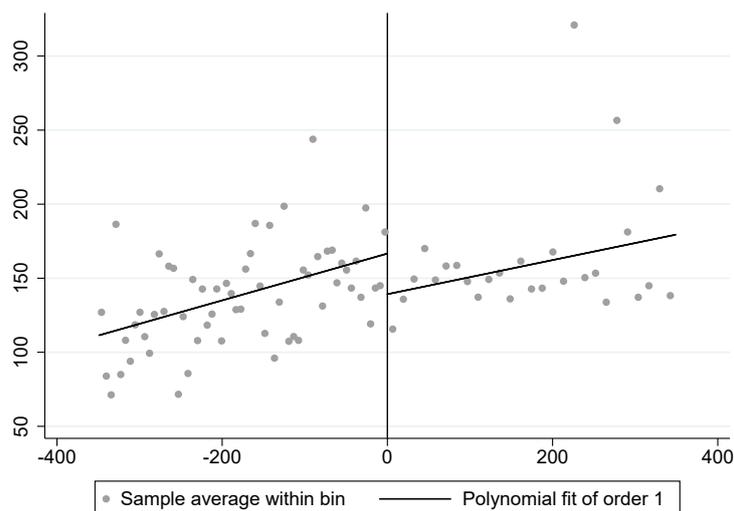
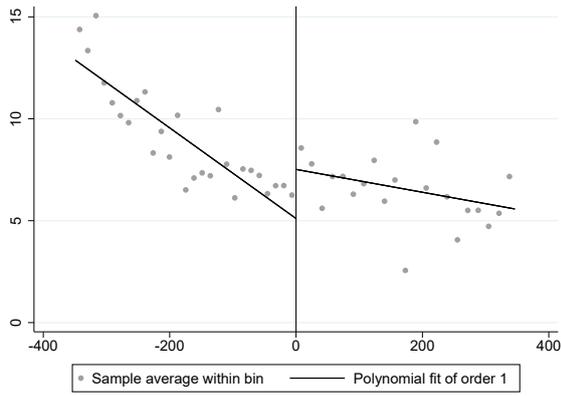


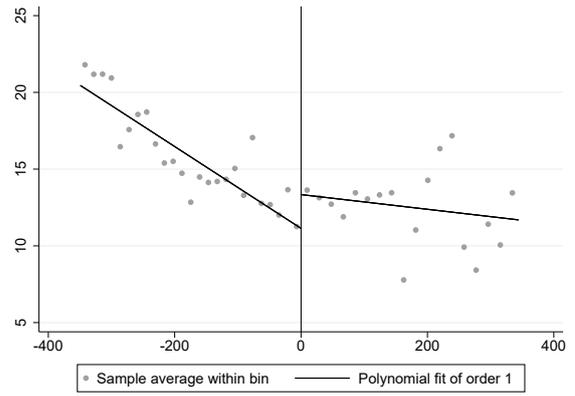
Figure B9: Data-driven regression discontinuity in municipal resources growth between 1881 and 1991 (%)

Source: Guizot survey and *La Situation Financière des Communes*.

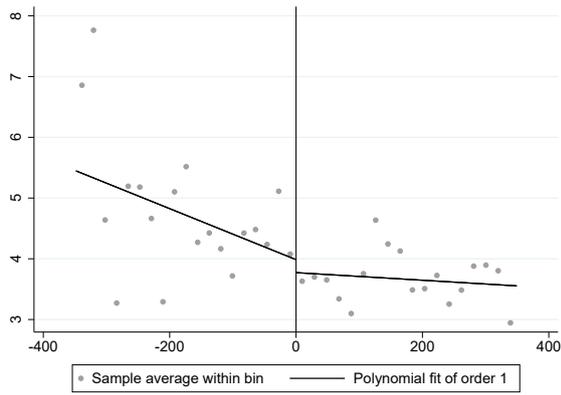
Notes: On the x-axis, the distance in terms of population to the 500-inhabitant threshold is displayed. The polynomial fit used is of order one. The number of bins has been selected through the mimicking variance evenly-spaced method using spacings estimators.



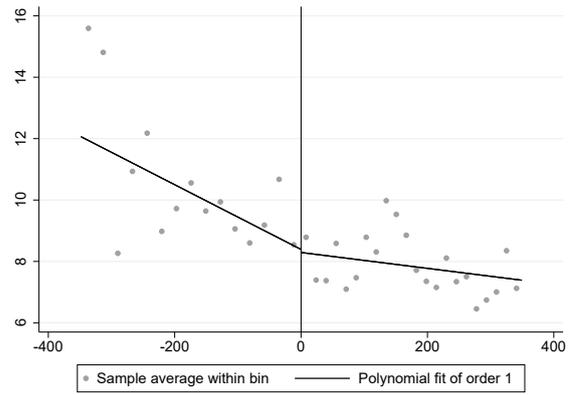
High schooling endowment - 1881



High schooling endowment - 1911



Low schooling endowment - 1881

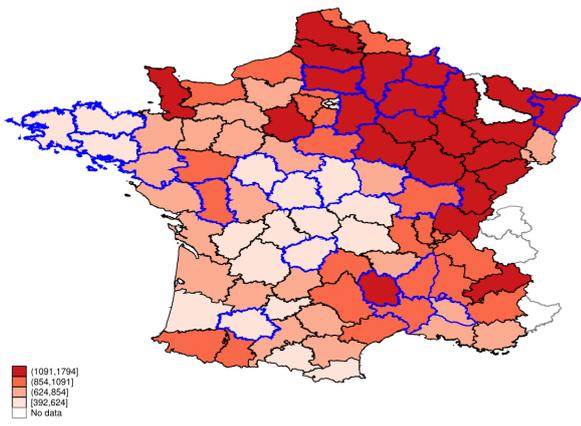


Low schooling endowment - 1911

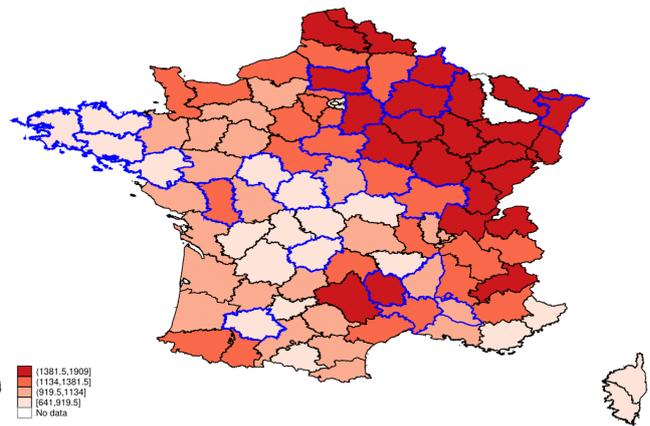
Figure B10: Data-driven regression discontinuity in municipal resources per capita

Source: Guizot survey and *La Situation Financière des Communes*.

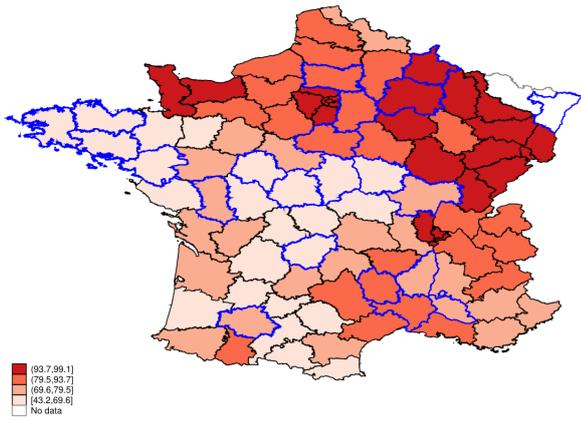
Notes: On the x-axis, the distance in terms of population to the 500-inhabitant threshold is displayed. The polynomial fit used is of order one. The number of bins has been selected through the mimicking variance evenly-spaced method using spacings estimators. Schooling endowments are measured in 1833.



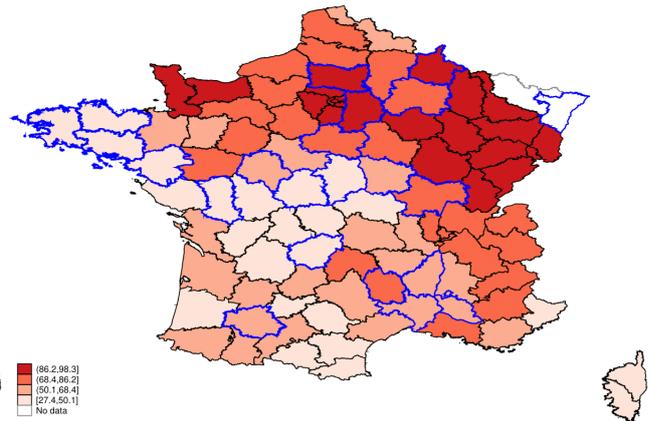
Number of pupils per 10 000 inhabitants 1850



Number of pupils per 10 000 inhabitants 1863



Marriage signatures - men, 1871-1875



Marriage signatures - women, 1871-1875

Figure B11: Enrolment in primary schools

Source: *Statistique générale de la France*.

Note: All types of schools are taken into account, whether public or private.