State intervention, education supply and economic growth in nineteenth-century France

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Abstract

In this article, I explore the association between the rise in education and economic growth during the nineteenth century in France. To do so, I rely on a quasi-natural experiment, the Guizot law of 1833, which made mandatory for each French 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. I also provide evidence that the outcomes are consistent with the hypothesis of a productivity-enhancing effect of education. State intervention and education policy therefore contributed to shape the development path of French municipalities. More generally, these findings point out a positive impact of basic education on growth during the century of industrialisation and modernisation.

JEL codes : I25, N13, N33
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1 Introduction

During the nineteenth century, most western countries were characterised by both a dramatic increase in primary schooling and literacy, most often prompted by state intervention, alongside a sustained economic growth. However, the relationship between the two still lacks empirical investigation. By focusing on the case of France, this article aims at shedding light on the following two empirical questions: can education policy affect economic growth? Did primary schooling and the acquisition of elementary skills contribute to economic development during the century of industrialisation and modernisation?

On the second point, the existing literature has provided mixed evidence. Upper-tail knowledge has been associated to pre-industrial economic growth at the country level [Baten and van Zanden, 2008], [de Pleijt and Zanden, 2016] in Europe, while Squicciarini and Voigtländer, 2015 identified a similar association in the late eighteenth and early nineteenth-century France. Recent studies have also documented that primary education was the main driver of growth in Britain until the mid-eighteenth century [Madsen, 2016], [Madsen and Murtin, 2017]. As regards the nineteenth century, literacy was deemed as useless to perform the vast majority of occupational tasks in the British case [Mitch, 1993][1]. Comparisons across European countries also tend to document a negligible effect of education on growth [Sandberg, 1979], [Allen, 2003], [O'Rourke and Williamson, 1995], [O'Rourke and Williamson, 1997], [Williamson, 1996]. However, basic education was related to the industrial development of Prussia during the nineteenth century [Becker et al., 2011], [Cinnirella and Streb, 2017], and to the convergence in productivity between Italian regions at the same time [Ciccarelli and Fachin, 2017]. A similar effect has been identified in the French case, but associated to intermediate human capital and not primary schooling strictly speaking [Diebolt et al., 2021][2]. Therefore, the contribution of primary education to the nineteenth-century economic development remains highly debated.

In this paper, I evaluate the contribution of increases in primary education, prompted by state intervention, to economic development in nineteenth-century France and until Word War I. I rely on a quasi-natural experiment, the Guizot law of 1833, which made mandatory for each municipality of more than 500 inhabitants to open and fund a primary school for boys. It constitutes one of the first national legislation on education in France[3] and is the first coercive law aiming at increasing schooling supply[4]. In practical terms, this supply meant hiring a

[1] The 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.

[2] Technical education was also closely related to the industrial development. Mokyr et al., 2019 provide evidence of the long-term impact of mechanical competence on the location of textile industries in the eighteenth century in England. In the French case, Squicciarini, 2020 points out that religion impacted negatively industrial concentration through its detrimental effect on technical education during the second part of the nineteenth century.

[3] The 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.

[4] Some 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.

teacher. Indeed, the majority of small municipalities had not enough economic resources to build or rent a schoolhouse[5]. 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 recently 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. As the increase in schooling supply was due to the intervention of the state, this paper also provides evidence about the impact of large-scale public policies on economic development.

Within the analysis, municipal economic resources are approximated by the amount of taxes per capita collected in 1881 and 1911. This type of proxy has already 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 income. 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 sending their children to school. This assertion is supported by several monographic evidence [Thabault, 1993], [Blanc and Wacziarg, 2020].

In this paper, I provide evidence that the effect of primary schooling was due to an increase in productivity and not to a redistribution of resources across municipalities. Using data on the location of mineral deposits and factories, I show that the effect of the Guizot law was concentrated in municipalities with the highest industrial potential. Its impact was indeed only significant in areas where the pool of jobs whose productivity could be increased by education was large. I also discuss the effect of education on population growth and explain why it differed from its impact on economic resources, as municipalities impacted by the Guizot law were characterised by a comparable population than the ones just below the 500-inhabitants threshold.

This article contributes to the literature on human capital and growth which identified education as a strong predictor of economic development and per capita income, either at the national or regional level. It is firstly related to models in which sustained economic growth is due to the accumulation of human capital over time [Lucas, 1988], and to their empirical validations [Gemmell, 1996], [Krueger and Lindahl, 2001], [de la Fuente and Doménech, 2006], [Cohen and Soto, 2007], [Ciccone and Papaioannou, 2009]. As the supply shock on education

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

caused by the Guizot law prompted an increase in enrolment, it is indeed the accumulation of basic skills which was the core determinant of municipal development[6]. Moreover, by showing that primary schooling influenced economic growth in France, this article is also related and in line with previous studies documenting the same effect in developing countries [Page, 1994], [Papageorgiou, 2003], [Keller, 2006]. The accumulation of human capital in nineteenth-century France was due to state intervention on the opening of schools. Therefore, the present findings are also close to evaluations of school-building programs and their impact on individual earnings in developing countries [Duflo, 2001], [Duflo, 2004][7]. Thanks to the quasi-natural experiment of the Guizot law, this paper provides an evaluation of the causal impact of education on growth during the industrialisation period, which can be estimated without mixing it with the influence of institutions, geography, culture, the level of past economic resources, ... It therefore also makes several contributions to the existing literature on the historical relation between education and growth. By documenting that changes in primary schooling achievements, induced by the increase in schools' supply, were important drivers of economic growth during the nineteenth century, it complements and enriches existing studies related to this point [Becker et al., 2011], [Cinnirella and Streb, 2017][8]. It helps specifying the education level which mattered during the industrialisation century, a research question which received less attention than for the pre-industrial era [Baten and van Zanden, 2008], [Squicciarini and Voigtländer, 2015], [de Pleijt and Zanden, 2016], [Madsen and Murtin, 2017].

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 them 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 had fewer than 2 000 inhabitants in nineteenth-century France, and that the urban population overcame the rural one only in 1931[9], this article accounts for the economic development of the majority of local places in this

[6]Education has also been analysed as a potential driver of long-term sustained growth in the endogenous growth literature, [Romer, 1990], [Galor and Weil, 2000] or as a mere factor of production in neo-classical models [Mankiw et al., 1992]. In both, it is the stock of human capital which matters for growth. See Romer, 1990 or Benhabib and Spiegel, 1994 for early empirical evidence. de la Fuente and Doménech, 2006, Cohen and Soto, 2007 and Ciccone and Papaioannou, 2009 also explore this perspective, 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.

[7]Neilson and Zimmerman, 2014 also provide an evaluation of the effect of school construction on education achievements in a poor urban district in New Haven. See Psacharopoulos, 1994 and Psacharopoulos and Patrinos, 2004 for a more general evaluation of the relationship between primary education and individual earnings in developing countries. See for example Card, 1999 or Ashenfelter et al., 1999 for a literature review on returns to schooling.

[8]In Montalbo, 2021a, I also showed that municipalities with better education endowments before any state intervention were characterised by higher levels of resources per capita in the second part of the nineteenth century. This article therefore enriches this previous analysis by showing that state intervention was essential to promote education and development in municipalities without schools in 1833.

[9]Urban population represented around 25% of total population in the mid-nineteenth century in France, and

country.

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.

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. The application of the law was controlled by the education officers of the *Académies*[10], alongside the *préfets*, the administrative heads of departments [Chapoulie, 1989]. Committees at the level of districts[11] were also established to reinforce its application at the local level. On top of this, a body of inspectors responsible for ensuring the application of the law and for controlling the quality of teaching was created in 1835 [Ravier, 2012], [Gevaert, 2017]. Municipalities which refused to abide by the law could be forced to open a school and to finance it by the *préfets*. They could ask for a financial assistance of the departments or of the state if their level of resources was deemed too low to maintain a primary school. After the law, which constitutes the first major step towards universal schooling undertaken in France, teachers were also to be paid on a regular basis, not less than 200 francs a year.
To this date, the decision to open a primary school was made at the level of municipalities[12]. 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]. Above the Saint-Malo/Geneva line, French regions were globally well-educated, while

around 45% in 1911 [Dupâquier, 1995].

[10]These academies were administrative units of the Education Ministry. There were 26 of them in 1833 in France.

[11]These districts (*arrondissements départementaux* or *sous-préfectures*) correspond to an administrative subdivision of departments (counties). Two to six of them existed in each department.

[12]See, [Duveau, 1957], [Lorain, 1837] and [Meunier, 1981] for a precise description of the daily life of schools and teachers in the eighteenth and early nineteenth centuries. Laws, projects, and debates about primary instruction during this period of time are reported in [Gontard, 1959], [Mayeur, 2004] and within the second and third chapters of [Furet and Ozouf, 1977].

education was scarce below this very line [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-eastern 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 between 6 and 13 years old. The number of children schooled per 10 000 inhabitants, for example, still followed 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.

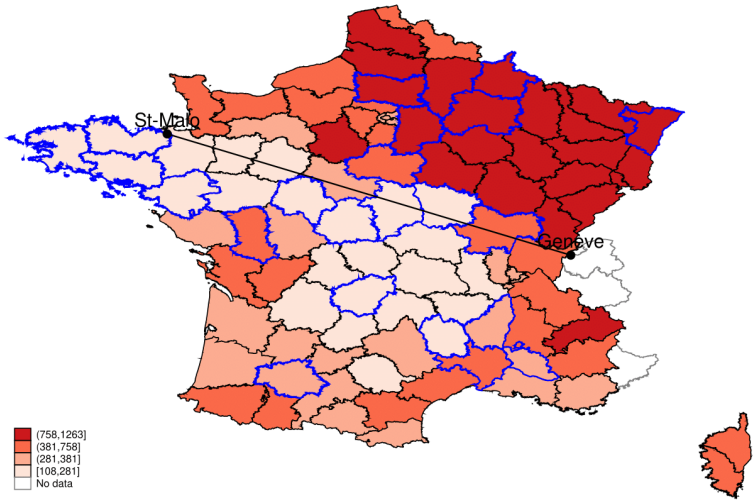


Figure 1: Number of pupils attending primary schools - winter 1833 (over 10 000 inhabitants)

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 nineteenth century, numerous religious congregations were in charge of their instruction. 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 as 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 schools[13]. It is only with the Falloux Law of 1850 that the opening of a primary school for girls in municipalities more

[13]At 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.

than 800 inhabitants was made compulsory. The Duruy Law of 1867 lowered the threshold to 500 inhabitants. The Ferry Laws on mandatory schooling then applied to both boys and girls.

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 remained however quite gradual all over the century [Bairoch, 1999], which led some authors to deny the idea of a real industrial take-off in France [Mendels, 1972][14]. According to the Industrial survey of 1861-1865, textile and food industries were 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][15].

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. 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].

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

[14] This 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 nineteenth 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 nineteenth 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].

[15] The 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].

belonging to a farming family [Demonet, 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-nineteenth 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 the 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 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]. 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.

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 Guizot[16]. 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.

From the initial individual (at the level of each primary school) forms, the data were collected

[16] A lot of information on this survey is available here : http://www.inrp.fr/she/guizot/.

for 22 departments and 8 129 municipalities[17]. This study will however be made on 21 departments as the Bas-Rhin department was not belonging to France any-more after the 1870 Franco-Prussian War. At least one primary school was present in 4 836 of the municipalities (59.5%). This project has been initiated by the *Institut national de recherche pédagogique* (National institute for pedagogical research)[18], 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 Britanny 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 line[19]. 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 schools[20].

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 at the level of districts in order to compare this "municipal level sample" to the entire country thanks to the *Report to the King*[21] shows that the number of (public) primary schools does not 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 resources[22] 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 munici-

[17]These 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.

[18]A French research centre one education associated to the *École Normale Supérieure de Lyon.*

[19]Excluding the three departments located on this very line.

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

[21]See in Table A1 the Appendix.

[22]Data 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 seventeenth and eighteenth 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.

palities 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

To approximate the economic resources of municipalities, I rely on the amount of taxes per capita. These data are coming from publications by the Ministry of the Interior entitled *La Situation Financière des Communes de France et de l'Algérie*[23], 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 I[24]. 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 estimations, along with postal indicators from the Postal survey of 1847[25]. These two survey are posterior to the Guizot law. To use them, I assume that the municipal level of economic resources was not impacted significantly by education between 1833 and the 1840s. This assumption seems to be realistic. Indeed, the influence of human capital on the resources of municipalities was unlikely to be strong in the years following directly the implementation of the law. It would have required a sufficiently high number of pupils going to school to potentially produce an effect on the development of municipalities. This was unlikely to happen in only 10 or 15 years, which the falsification tests of subsection 4.2 confirm.

The nineteenth century was a time of index-based taxation[26] for the state and the municipalities. This system, implemented during the revolutionary period, remained remarkably stable all 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

[23]The financial situation of municipalities of France and Algeria.

[24]I 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.

[25]More information on these surveys can be found in [Chanut et al., 2000] and [Marin and Marraud, 2011].

[26]As evaluating directly the income level of people was impossible at that time, taxes were most of the times based on indexes reflecting the level of economic resources. These indexes could be the number of doors and windows or the renting value of industrial or commercial buildings.

state and municipalities budgets.

The land tax was based on net incomes coming from the use of lands[27], which were evaluated on the 15 preceding years[28]. 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 composed of 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 the industry, an 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. The *patente* was the only flat tax of the four while 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 asking 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. However, 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 municipality[29]. However, only the biggest municipalities were concerned by these indirect taxes. 1 538 of them were raising *octrois* in 1881, 1 523 in 1911[30].

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

[27]It 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.

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

[29]These *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.

[30]They 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 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.

to other proxies for economic dynamism at the end of the nineteenth and beginning of the twentieth 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 twentieth century in France[31]. 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 resources [32].

3.3 Demographic Characteristics of Municipalities

Data on the population of municipalities from the censuses are taken from [Motte et al., 2003]. Censuses were conducted every five years in nineteenth-century France. The population is taken 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, taking population data from this census makes more sense. 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. Considering them as being affected by the law would therefore be a mistake. The discontinuity remains however greatly unchanged when doing so, as robustness checks will show.

Population dispersion[33] is taken from the Postal Survey of 1847 along with the surface area of municipalities which have disappeared or merged since 1833. Since this survey is posterior to the Guizot one, I have to assume that population dispersion 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 body 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 body.

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

[31] See Figure B1 in the Appendix.

[32] See Figure B2 in the Appendix.

[33] This dispersion is taken as the share of the total population that did not belong to the main town within each municipality. See [Roncayolo, 1987] on this point.

1911, from 7.5 to 13.3 francs[34]. This increase mainly reflect economic growth[35]. 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.

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 - 1839-1847, 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

[34] Figure B3 in the Appendix display the distribution of taxes per capita in 1881 and 1911.

[35] It may also be partly due to the fact that, after 1905 and the passing of the law separating churches from the state, resources saved from the suppression of worship budget were split between municipalities according to their contribution to land tax on non-built property in 1904. This measure has been implemented by the Article 41 of the 1905 law. However, as the amount of resources paid to each municipality was extremely low, this article was then repealed in 1935.

Guizot survey, I can identify the municipalities with 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 law[36].
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 had fewer than 1 000 inhabitants and 91% fewer than 2 000 inhabitants[37].

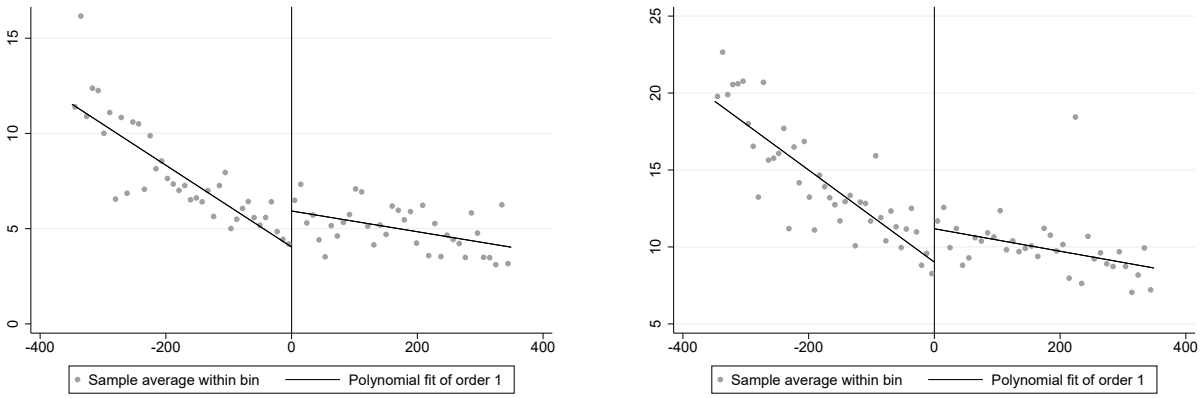
Using the Guizot law in a regression discontinuity design bears some drawbacks as I cannot know if municipalities below the threshold opened or not a school just after 1833. However, as municipalities were very small and had not opened a school before, there is only a very little probability that a high number of them would do so right after the law and with no legal obligation. These municipalities were 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. Therefore, not observing if municipalities below the threshold opened or not a school after the law does not constitute a major threat on the reliance of the estimation outcomes.
Relying on a population threshold to implement an RDD may also be problematic if several policies were defined on the same threshold, leading to a compound treatment on municipalities. As more than five policy changes were, for example, implemented on the 500-inhabitant threshold in modern-day France (from 1962) [Eggers et al., 2018], one might wonder if other historical changes could have influenced economic growth. This is the case for two other reforms on education, the Falloux law of 1850 and the Duruy law of 1867. The first one made mandatory for municipalities over 800 inhabitants to maintain a primary school for girls, while the second lowered this threshold to 500 inhabitants. However, both are unlikely to bias the estimations on the impact of the Guizot law.
Indeed, the Falloux law impacted a very restricted number of municipalities which were lying around the 500-inhabitant threshold in 1833, and which constitute the sample over which the RDD is implemented. For example, over the nearly 2 000 municipalities with no school and between 200 and 800 inhabitants in 1833, only 84 of them were more than 800 inhabitants in 1851 (the closest census to the Falloux law). Taking a bandwidth of 150 inhabitants instead of 300 around the Guizot threshold reduces dramatically the number of municipalities impacted later on by the Falloux law to 4 of them. Therefore, this law affected too small a number of municipalities to bias the estimations of the RDD. It is true that the Duruy law shared the same threshold as the Guizot one. However, it was implemented only 14 years before the first measure of economic resources used. As the schooling of girls was still restricted compared to boys, it is unlikely that the volume of knowledge accumulated by one generation of girls would

[36] See [Lee and Lemieux, 2010] for a literature review of regression discontinuity designs in economics.
[37] See the histograms of the population above and below the threshold in Figure B4 in the Appendix.

have affected the development of municipalities in such a short amount of time. The effect of the Guizot Law could therefore be only slightly over-estimated because of the Duruy law.
Finally, I cannot 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. The estimated effect of education is therefore close to an intention to treat impact. However, monographic studies report that the positive supply shock on education caused by the Guizot law contributed to significantly increase 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], [Diebolt et al., 2005], [Blanc and Wacziarg, 2020]. Gomes and Machado, 2020 document the same effect in Portugal after the implementation of a large primary school building program in 1940, while Duflo, 2001 reports a corresponding phenomenon in the 1970s in Indonesia. Therefore, the shock in schooling supply was very likely to be associated with a higher human capital accumulation in the municipalities at stake. To be more consistent on this point, I relate the growth in literacy rate during the second part of the nineteenth-century to the percentage of municipalities affected by the Guizot law at the level of departments. Figure B5 and Table A2 in the Appendix clearly show that the increase in literacy was higher in departments more strongly impacted by the law, that is where the percentage of municipalities forced to open a primary school was higher. A one percentage point increase in this number was associated to an additional 1.9 percentage point increase in literacy between 1854 and 1895. This adds to the existing evidence that the Guizot law strongly impacted the convergence in education between municipalities and departments in nineteenth-century France.

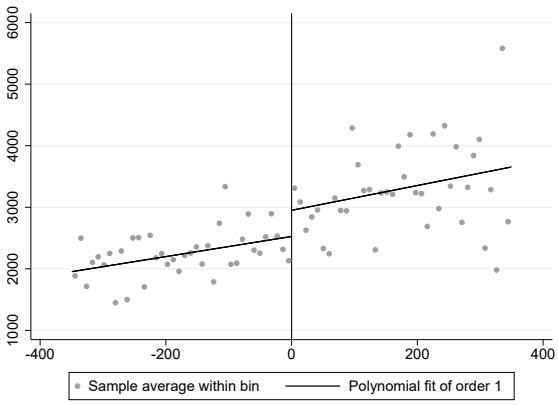
In Figure 2, I plot the data-driven regression discontinuity in municipal resources in 1881 and 1911 according to the spread between municipal population in 1836 and the 500-inhabitant threshold. The resources per capita were decreasing with the population between 100 and 500 inhabitants. Very small municipalities had 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 school[38]. 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 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.

[38] Figure B6 the Appendix reports the same figure using the 1831 population. This modification does not affect the discontinuity.

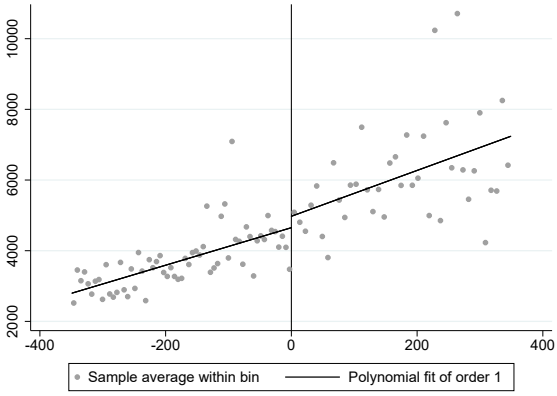


Resources per capita, 1881

Resources per capita, 1911



Total resources, 1881



Total resources, 1911

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 threshold[39]. 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 A3, Table A4 and Table A5 in the Appendix reject these two issues. No covariate used differs significantly around the 500-inhabitant threshold[40]. 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 level, checking for discontinuity would lead to unreliable results as the number of municipalities without school falls dramatically. There is for example only 49 municipalities without school in the data between 1 900 and 2 100 inhabitants. 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 :

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

where Y if my variable of interest, namely taxes per capita in 1881 and 1911[41], 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 *rdbwselect* command in *Stata* [Calonico et al., 2017]. The discontinuity, limited to this optimal bandwidth, is displayed in Figure B8 in the Appendix.

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

[39] See Figure B7 in the Appendix.

[40] The 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.

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

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***	2.295***	1.302*	1.159*	1.320**	3.180**	3.237***	2.989***	2.470**	1.739*
	(3.034)	(2.745)	(1.751)	(1.745)	(2.243)	(2.126)	(2.641)	(2.693)	(2.536)	(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***	2.927***	2.495**	1.744**	1.549**	4.711**	4.943***	4.179***	3.804***	3.044**
	(3.190)	(2.740)	(2.473)	(2.020)	(2.013)	(2.448)	(3.187)	(2.857)	(2.959)	(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 *rdbwselect* 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 it[42]. I stick to a local polynomial or order 1, following [Gelman and Imbens, 2019][43]. The difference between columns (1), (5) and (2), (6) is that I include covariates in the last two. These covariates are: population dispersion, surface area, altitude, population growth between 1793-1836, postal taxes, the 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

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

[43]The use of other polynomial degrees does not modify the outcomes. See Table A6 in the Appendix.

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 errors[44].

The results also remain 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 does not 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 estimation[45].

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***	1.856***	2.417***	2.254***	3.166***	2.211***	1.815**	1.698*
	(2.63)	(3.14)	(3.45)	(3.00)	(3.00)	(2.62)	(2.41)	(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).

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

[44] As 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, adding the 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 work of [Calonico et al., 2019].

[45] See Table A7 and Table A8 in the Appendix.

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 direct contributions, 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 increase directly 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 and 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 or be significantly lower in 1911. This is why the estimations on the 1911 year constitute a robustness check with respect to this issue. As they remain positive, significant and not significantly lower than the 1881 estimates, the effect of education on growth is not driven by the need to finance primary schools. To be even more precise on this point, one should consider the evolution of the price index between 1881 and 1911 to compare the two sets of estimates. The index reported in Sauvy, 1952 decreased from 117 to 100 between the two dates. Once deflated accordingly, the 1881 estimates of Table 3 appear to be always nearly equal to the 1911 ones, with no statistically significant difference between the two[46].

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 on 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 the two numbers. This 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.

[46] See Table A9 in the Appendix.

A more minor problem concerns municipalities with more than 500 inhabitants when the Guizot law was passed, but 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 teaching[47], municipal authorities were very unlikely to take a step back and deprive families from these services. When a school was present ad 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 introduce several population restrictions in Table A10 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 growth[48]. 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 extend the restrictive specification of column (1) by considering as non-treated only the municipalities with less than 500 inhabitants between 1831 and 1881[49].
The outcomes remain unchanged under these various specifications. The magnitude of the education impact is always close to 2 francs per capita in the three first cases. In the last specification, the most restrictive, the effect is higher than the ones previously 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

[47]Families 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, 2021b], 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.

[48]On 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 at the same dates. 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. Therefore, running these estimations would lead to unreliable outcomes.

[49]Figure B9 in the Appendix displays the discontinuity under each specification.

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 did not differ significantly in 1833, this reveals a positive effect of primary schooling on the growth of municipalities between the Guizot law and 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. In this paper, I show 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 comes from both 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, which could explain the absence of relation between primary schooling and population growth in [Squicciarini and Voigtländer, 2015]. 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 did not affect growth, it only influenced the level of economic resources at a given point. They indicate that changes in basic education affected 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. The estimations even return a negative effect of being just above the threshold. However, the estimates are only slightly significant and not in all specifications[50]. Therefore, the human capital accumulated within primary schools impacted the growth of municipalities mostly between 1833 and 1881. 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

[50] See Figure B10 and Table A11 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 would not change the outcomes.

by the Guizot law slowly faded away during these years. The final blow was delivered 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.

4.4 Transmission Channels

4.4.1 Education, Migrations and Demographic Growth

Education might have impacted economic development through various transmission channels. One of the first logical candidates is demographic growth, sustained by migrations. Indeed, more literate and skilled parents with a higher preference for education could have decided to migrate to a municipality where primary schooling was well-developed. This Tiebout sorting [Tiebout, 1956] would have then positively impacted economic growth by gathering more productive people, which would also have contributed to an increase in the number of inhabitants.
However, using the same RDD on population levels every ten years from 1861, or on population growth between 1836-1881 and 1836-1911, does not lead to any significant outcomes, as shown in Table 4. The 500-inhabitant threshold is positively associated to all population indicators, but none of them is statistically significant.

Table 4: Non-parametric regression discontinuity estimates - Population levels and growth

	Population levels						Population growth	
	1861	1872	1881	1891	1901	1911	1836-1881	1836-1911
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
RD Estimate	14.796	49.852	70.092	110.619	150.894	124.844	13.430	29.317
	(0.70)	(0.91)	(0.81)	(0.88)	(0.91)	(0.87)	(0.77)	(0.87)
Controls	1072	1005	1024	1072	1229	1340	1008	1083
Treated units	681	648	664	686	767	814	649	691
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.	267.0	249.8	253.6	265.4	303.7	335.5	249.5	269.8
BW Bias	383.9	362.6	369.2	387.3	436.8	476.1	362.0	391.0

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: Population is taken from censuses, undertaken every 5 years in France. The 1871 census was postponed to 1872 because of the Franco-Prussian war of 1870.

The rationale behind the absence of any significant effect on population is that the Tiebout sorting phenomenon appears to have been only valid for big towns. In the French case, one needs

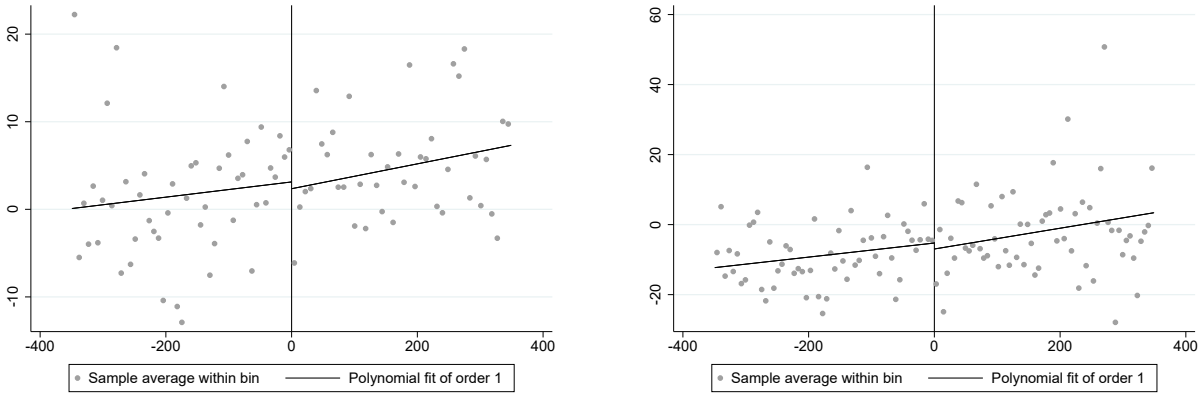
to have in mind that the population of the vast majority of municipalities decreased during the second part of the nineteenth century, in association with a growing rural exodus towards cities. Between 1831 and 1851, at least 790 000 people migrated towards cities, mostly from the Massif Central, Lorraine, Alsace, Normandie, Maine, Jura and from the alpine departments. The Parisian basin was attracted the majority of rural migrants. Between 1851 and 1856, 579 000 new migrants were to be counted. Between 1881 and 1891, around two-thirds of the departments were characterised by negative migration flows [Duby and Wallon, 1976].
Rural migrants were mostly heading towards towns, which contributed to increase dramatically the urbanisation rate in France. The share of people living in municipalities more than 2 000 inhabitants (defined as the urban population in France) went from 25.5% to 44.2% between 1851 and 1911. Therefore, the common rule for small municipalities in nineteenth-century France was to lose population. Figure B11 in the Appendix plots the population level of each population decile as defined in 1836, for the 22 departments belonging to my database. All 1836 deciles kept around the same population between 1836 and 1911, while the 10th one grew from around 2.5 millions to 4 million people. Therefore, the municipalities in the data used also followed the general pattern described for France, as only the biggest municipalities saw their population grew between 1836 and 1911[51].

Small municipalities were losing population and primary schooling was not playing against this phenomenon. It was even in part favouring the exodus. Indeed, when looking at all the municipalities in the database (the 8 000 ones) and comparing their population growth according to the presence of a primary school in 1833, it appears that municipalities with a school before the Guizot law had a lower population growth than their counterparts. The difference between the two is significant for all population deciles, except the first and the last ones[52].
This can be explained by the fact that more educated people were migrating more often and farther away in the nineteenth 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 the appeal of a life in the city was increased by education, in association notably with better job opportunities [Dupâquier, 1995]. Therefore, by providing higher resources for migrations, either in economic terms or thanks to a closer connection with a network of people having already migrated, education may have favoured the departure of people from small municipalities.

These considerations on population growth also bear important implications for the reliability of the RDD. Indeed, as shown in Figure 3, the average growth of municipalities below and above the 500-inhabitant threshold was around zero, both between 1836-1881 and 1836-1911. This implies that, on average, municipalities affected by the Guizot law were not likely to lose population and potentially close the school they had been forced to open (even if undertaking this step was also unlikely, as argued in 4.2). The same is true for untreated municipalities,

[51]The histogram of population growth between 1836-1911 clearly shows that the majority of municipalities lost population during this period of time. See Figure B12 in the Appendix.
[52]See Table A12 in the Appendix.

which on average stayed below the Guizot threshold and did not have to open a school. As argued, these two issues could have contributed to bias downward the estimations. However, the particular features of the demographic evolution of municipalities during the nineteenth century in France increases the robustness of the RDD outcomes and contributes to highly restrict these potential biases. This reinforces the reliability of the Guizot threshold. It also accounts for the fact that no discontinuities in economic resources were found around population thresholds at 350 or 450 inhabitants in Table A4 and Table A5 in the Appendix, which could have happened if a high number of small municipalities had crossed the Guizot threshold at a given point between 1836 and 1881 or 1911.



Population growth (%) - 1836-1881 Population growth (%) - 1836-1911

Figure 3: Data-driven regression discontinuity in population growth

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.

4.4.2 The Impact of Education on Innovation and Productivity

Within the literature on education, there are three main economic transmission channels identified between education and development. Firstly, education can increase 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 bear more explanatory power in this case, as major innovations

were not likely be to achieved in very small municipalities[53]. This idea is supported by the fact that the number of industrial patents filed in municipalities impacted by the Guizot law was extremely low and not significantly higher than in comparable municipalities just under the 500-inhabitant threshold. To investigate this point, I collected data at the municipality level on all industrial patents filed between 1833 and 1871, which are freely available from the *Institut national de la propriété industrielle* (INPI), the public body in charge of collecting and reporting industrial patents in France[54]. Taking the 694 municipalities which constitute the sample of column (1) in Table 3 shows that only 20 municipalities around the Guizot threshold filed at least a patent between 1833 and 1871, 9 below the 500-inhabitant level and 11 above. This low numbers prevent any reliable quantitative analysis and document that the municipalities impacted by the Guizot law were not characterised by a higher innovation rate.
To be more consistent on this point, I also run the RDD estimations by controlling for the number of patents filed per 10 000 inhabitants at the level of departments. Indeed, one could expect that the departments in which more children were brought to school after the Guizot law would also be those in which education was a more deeply-rooted habit, and therefore upper-tail knowledge and innovations more developed. Then, positive spillovers could exist between municipalities with a high innovation rate and the other (often smaller) ones. The estimations still deliver positive and significant outcomes with this additional control[55]. Therefore, the positive impact of primary education on the development of municipalities is valid at the same innovation level.

As regards the first and third transmission channels, 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. Several works in the existing literature indeed link primary education, the diffusion of technology and higher productivity in an historical perspective. A good example illustrating this point is the "green revolution" in India and the introduction of high-yielding variety of seeds [Foster and Rosenzweig, 1996][56]. In the case of Scandinavian countries, literacy also favoured the agrarian transition by facilitating the access of farmers to the credit market and by contributing to the development of the commercial integration of municipalities [Pettersson, 1996], [Nilsson et al., 1999]. Higher primary schooling achievements also contributed to a rise in the productivity of industrial workers, especially since the demand for literate people increased in industry during the second part of the century, notably with the need of reading plans [Mitch, 1993][57].

[53] In the American and British cases, it has also been shown for example 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.

[54] I select 1871 and not 1881 as an upper bound as the data and not directly available after this date. This does not constitute a threat upon the validity of the results as the number of patents filed is extremely low for the municipalities at stake.

[55] See Table A13 in the Appendix. The population level in 1851 is taken to compute the number of patents per 10 000 inhabitants during the 1833-1871 period. This number varied between 0.83 for the Lozere department and 23.2 for the Ardennes, where the textile industry was highly concentrated.

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

[57] Spillover effects of education on nearby workers may also have played a role in the economic development

To identify the potential increase in productivity caused by the shock on education supply, I divide municipalities according to their industrial potential. Indeed, if education did increase the productivity of workers or the diffusion of technology, its effect should have been higher or mostly concentrated in areas where economic activities were more dynamic and could be more strongly impacted by a higher level of human capital. Typically, areas without industry and characterised by the presence of a traditional agriculture are expected to gain less from the development of education. The number of jobs whose productivity could be increased by the skills acquired within primary schools would indeed be lower in these areas compared to the more dynamic ones. Finding such an effect would therefore point towards a complementarity between industrial activities and primary schooling, and a productivity-enhancing impact of education.

To test this rationale, I firstly rely on the location and concentration of mineral deposits around the municipalities at stake as an exogenous source of variation in their industrial potential. The idea is that municipalities with a higher concentration of deposits in their surroundings were more likely to be characterised by the presence of factories. Indeed, mining activities depended directly on the location of ore, but manufacturers from other sectors were also likely to choose to establish their industries close to the mines in order to benefit from stronger market opportunities. Therefore, education is expected to have impacted development more strongly within municipalities with a higher number of deposits nearby.

The data on deposits are coming from the *Bureau de Recherches Géologiques et Minières*, a public body in charge of indexing the geographic coordinates of all the deposits in France, these deposits having been exploited or not. I already relied on these data to instrument the presence of mining activities and industrial factories at the level of municipalities in Montalbo, 2020, following the methodology developed in de Pleijt et al., 2020 and Fernihough and O'Rourke, 2021. I stick to the same variable, the number of iron, coal and copper deposits, which I use as a proxy for the industrial potential of municipalities. These latter constituted the three main types of ore that were exploited at the beginning of the nineteenth century[58]. Contrary to what is done in Montalbo, 2020, I don't rely on the location of deposits in a given municipality, but on their concentration within a given geographical range, as the number of municipalities characterised both by the presence of ore and by a population level around the 500-inhabitant threshold is too low to make any reliable estimation[59]. The advantage of using these data as an industrial proxy is that they are exogenous to the pre and early-nineteenth century development levels [Montalbo, 2020]. Therefore, there is no reason to believe that the municipalities around the Guizot threshold, and characterised by the same concentration of deposits, would be dissimilar. These municipalities share the same industrial potential and differ only in their exposure to the Guizot law on education.

of municipalities [Moretti, 2004a], [Moretti, 2004b]. See [Simon and Nardinelli, 1996] for a historical analysis on British cities.

[58] Figure B13 in the Appendix depicts the number of deposits by department.

[59] For example, only 14 municipalities meet these requirements when considering a 100-inhabitant range around the Guizot threshold.

In Table 5, I therefore run the estimations separating municipalities according to the number of deposits within 25 or 50 kilometres around them. I chose not to taken into account deposits located farther away, as it seems sensible to consider that their influence on industrial activities would be small. The outcomes show a positive effect of education on economic growth when the industrial potential of municipalities is high, but no effect when this potential is low. Municipalities just above the Guizot threshold but with no mineral deposit within a 25 or 50 kms range are characterised by a comparable level of resources per capita in 1881 than those below the threshold. Those with a deposit are on the contrary characterised by a positive impact of primary schooling, with a magnitude of around 2 francs per capita, which is similar to the baseline estimates of Table 3. The positive impact of education is also an increasing function of the industrial potential of municipalities, since the number of deposits within 50 kms is positively related to the magnitude of the estimates[60]. Indeed, this magnitude nearly doubles when the number of deposits goes from more than five to more than twenty.

Table 5: Non-parametric regression discontinuity estimates - Impact of education on resources depending on the industrial potential of municipalities

	Municipal resources per capita - 1881							
	No deposit within:		Deposits present within:		Number of deposits within 50 kms:			
	25 kms	50 kms	25 kms	50 kms	> 5	> 10	> 15	> 20
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
RD Estimate	2.762	0.187	2.009***	1.712**	2.024*	2.040*	2.299**	3.481*
	(1.54)	(0.20)	(2.63)	(2.34)	(1.96)	(1.72)	(2.42)	(1.71)
Controls	124	30	400	453	224	144	59	22
Treated units	71	19	294	354	176	127	54	19
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.	147.0	75.81	105.9	142.8	123.8	162.2	171.2	224.9
BW Bias	240.0	117.0	188.5	238.1	199.6	245.9	246.3	298.2

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], *La Situation Financière des Communes* and *Bureau de Recherches Géologiques et Minières*.

Notes: The mineral deposits are the iron, coal and copper ones. *Deposits present* is a dummy variable, whose value is equal to one when at least a deposit was present within the geographical ranges taken into account, that is to say 25 or 50 kilometres around the municipality considered.

These outcomes point towards a productivity-enhancing effect of education. A higher industrial potential is indeed associated with a positive and growing effect of education, while munici-

[60] I don't run the same estimations for the 25 kms range as the number of deposits is in this case almost always lower than five. I also don't consider restrictions above twenty deposits within a 50 kms range, as this would amount to selecting only a few observations. On this point, see the histograms of the number of deposits in Figure B14 in the Appendix.

palities opening a school with no deposits nearby followed a similar development path. This indicates a complementarity between education and industrial activities, as the Guizot law did not influence the growth of municipalities with no industrial potential. Skills acquired within primary schools were therefore more valuable when the pool of jobs whose productivity could be improved by education was higher. These conclusions are in line with those of Becker et al., 2011 and of Cinnirella and Streb, 2017 who show that primary education was positively associated to a rise in productivity and industrial production during the nineteenth century in Prussia.

I also use data from the Industrial survey of 1839-47 to investigate the relationship between education and productivity more deeply. I consider the number of industrial factories, industrial engines (water, wind, steam and animal traction engines) and of steam engines within a 25 and a 50 kms range around municipalities to approximate the industrial potential. The estimations show that municipalities affected by the Guizot law are characterised by a significantly stronger economic growth when the number of factories or engines was high, but not when it was low[61]. These findings confirm the intuition that education affected growth only when economic activities were dynamic and when it impacted the productivity of workers. Indeed, the presence of engines, and especially steam ones, was associated with mechanized production and more skilled jobs for which education was more likely to be useful. Therefore, the effect of education on development is coming from the concentration of more productive jobs which were positively impacted by the rise in education achievements.

Table 6: Non-parametric regression discontinuity estimates - Impact of education on resources depending on the industrial characteristics of municipalities

	Municipal resources per capita - 1881									
	Industrial factories				Industrial engines				Steam engines	
	Within 25 kms		Within 50 kms		Within 25 kms		Within 50 kms		Within 50 kms	
	Bottom 25%	Top 75%	Bottom 25%	Top 75%	Bottom 25%	Top 75%	Bottom 25%	Top 75%	Bottom 25%	Top 75%
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)
RD Estimate	1.016	1.696*	0.427	1.921**	0.256	2.422***	2.528	1.581*	1.385	1.570**
	(1.32)	(1.93)	(0.41)	(2.19)	(0.25)	(2.76)	(1.33)	(1.96)	(0.93)	(1.97)
Controls	109	366	125	317	123	355	113	311	115	357
Treated units	86	261	75	248	103	247	73	239	77	267
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.	128.0	128.7	135.6	113.1	144.3	124.6	131.0	107.2	119.2	130.4
BW Bias	203.9	215.6	208.7	188.4	211.1	220.8	216.8	176.3	194.2	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], *La Situation Financière des Communes* and *Bureau de Recherches Géologiques et Minières*.

Notes: *Industrial factories*, *Industrial engines*, and *Steam engines* represent the number of factories, engines or steam engines within a 25 or 50 kms range around the municipality at stake. The estimations are carried either over the municipalities for which such numbers are the lowest ones (bottom 25%), or the highest ones (top 75%).

A final point worth mentioning is the fact that the effect of education on growth may have been

[61] See Table 6 in the Appendix.

due to a reallocation of resources between municipalities rather than to a creation of wealth. Manufacturers could for example have chosen to relocate their activities in a municipality where a school was created after the Guizot law. This would have contributed to increase the level of resources per capita of this municipality at the expense of the neighbouring ones. To test for this potential issue, 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, which makes it possible 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 1833, as Figure B15 and Table A14 in the Appendix show. 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.

This result indicates that the municipalities affected by the Guizot law did not simply channelled revenues away from municipalities below the threshold and which did not benefit from the positive shock on schooling supply. In department already well-endowed in primary schools, there would have been no point for economic activities to relocate to the places recently affected, as education was already well-developed and well- geographically distributed. On the contrary, in departments with a low concentration of schools, one municipality "treated" by the law was more likely to become attractive for people and resources. Therefore, the estimated effect of education on growth is not driven by a redistributive mechanism across municipalities[62].

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, alongside 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,

[62]This differentiated impact of the Guizot law according to the previous educational endowment of departments can be explained by the fact that there still existed huge variations in literacy rates between the departments until late into the nineteenth century [Diebolt et al., 2005], as Figure B16 in the Appendix shows. Families are therefore likely to have reacted less to the schooling supply shock of the Guizot law in educationally backward departments, which entailed a lower increase in the accumulation of human capital. This idea is confirmed by the fact that municipalities grew significantly more between 1881 and 1911, that is to say after the Ferry laws on education in 1881-2, when they belonged to departments with a low endowment in education in 1833, as shown in Table A15 in the Appendix.

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. State intervention in education was therefore an important determinant of the French economic development. More generally, this work points out a positive contribution of basic education to growth during the industrialisation period, through an effect on workers' productivity. 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 nineteenth century. Therefore, changes in human capital accumulation accelerated the transition towards sustained economic growth in France. This relationship would deserve more empirical investigations, as primary schooling is likely to be an important determinant of the long-term economic growth of municipalities, regions and countries.

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Appendix for on-line publication

Data and descriptive statistics

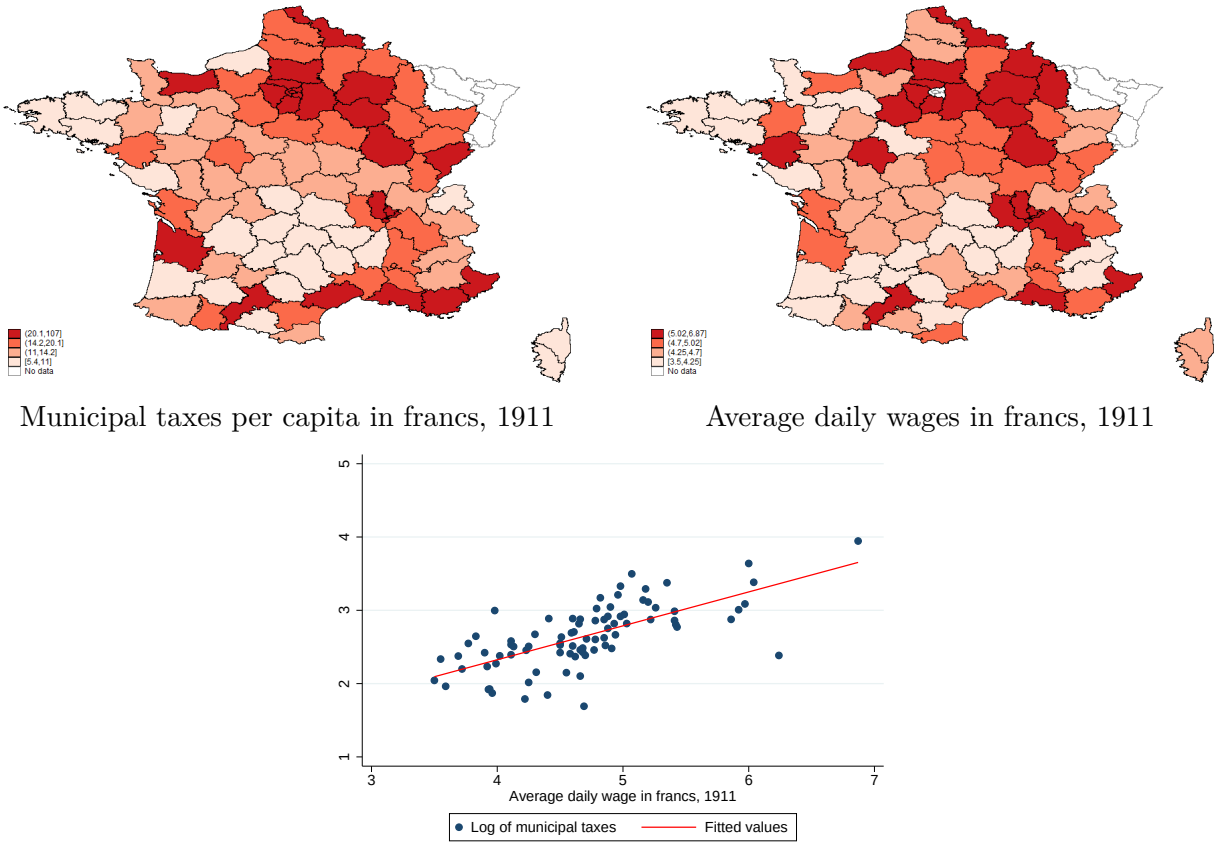
Table A1: Data representativeness, means and t-tests

	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 per 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*.

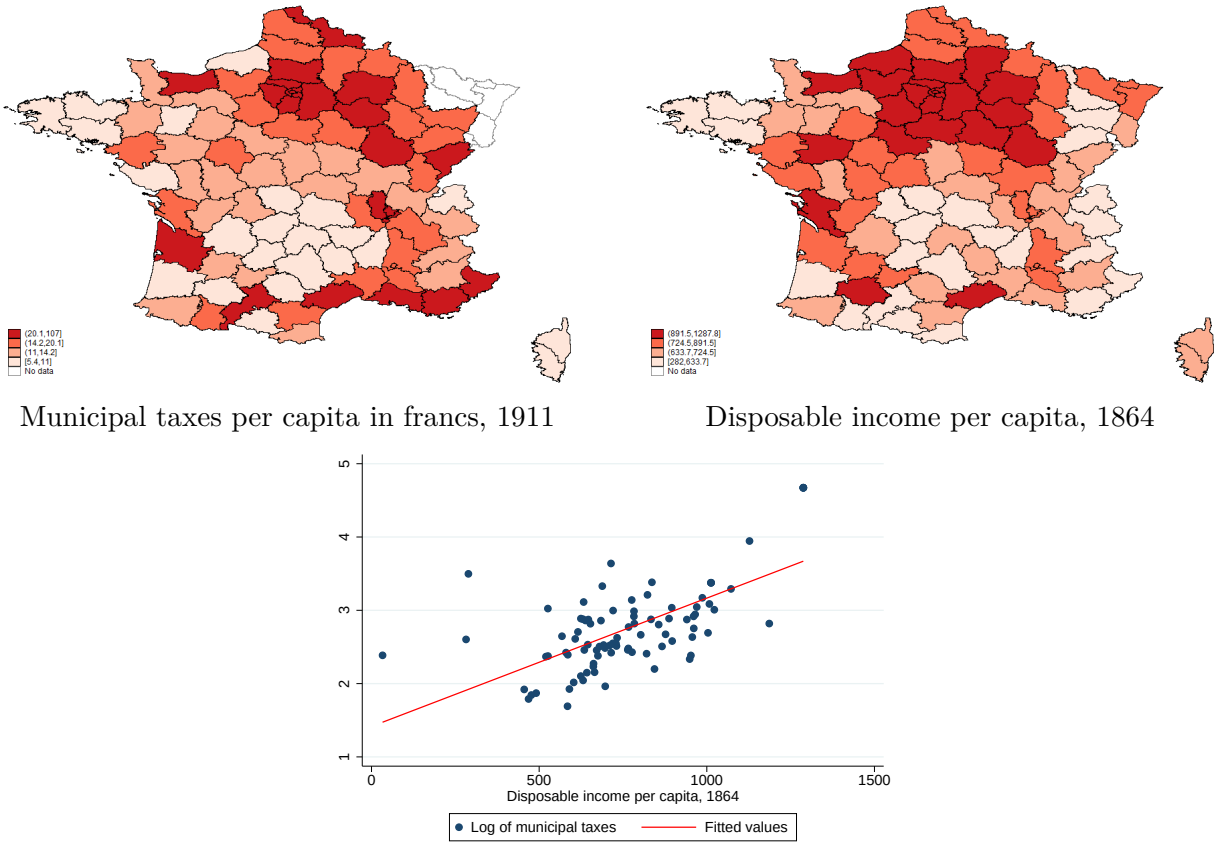


Figure B2: Municipal taxes and disposable income per capita

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

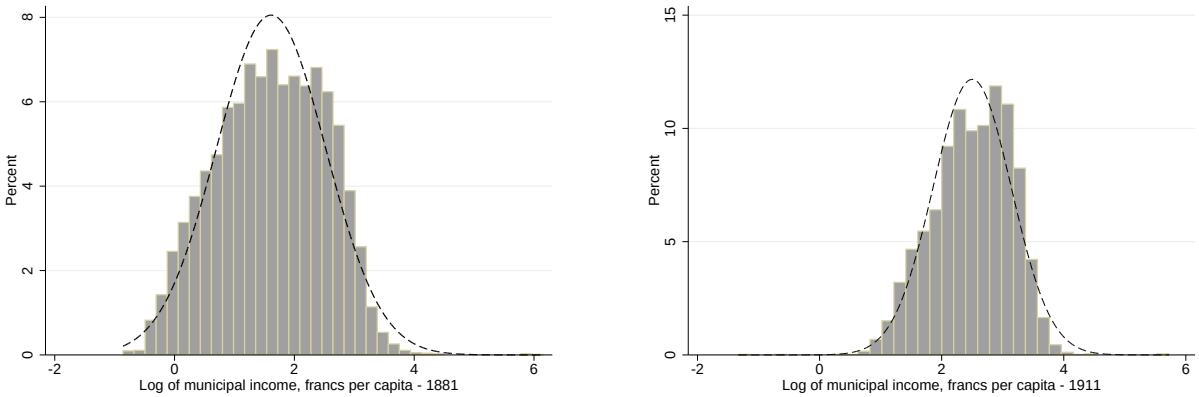
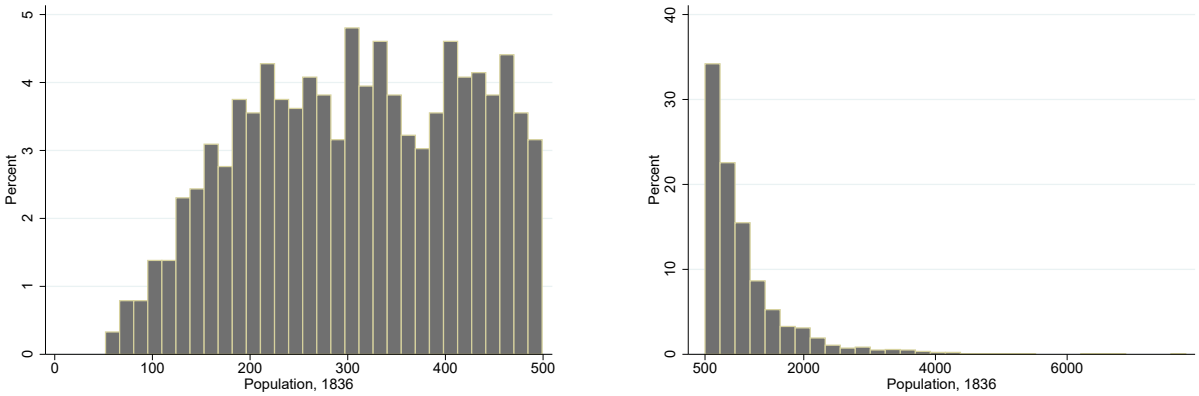


Figure B3: Histograms of the log of municipal resources, 1881 and 1911

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].

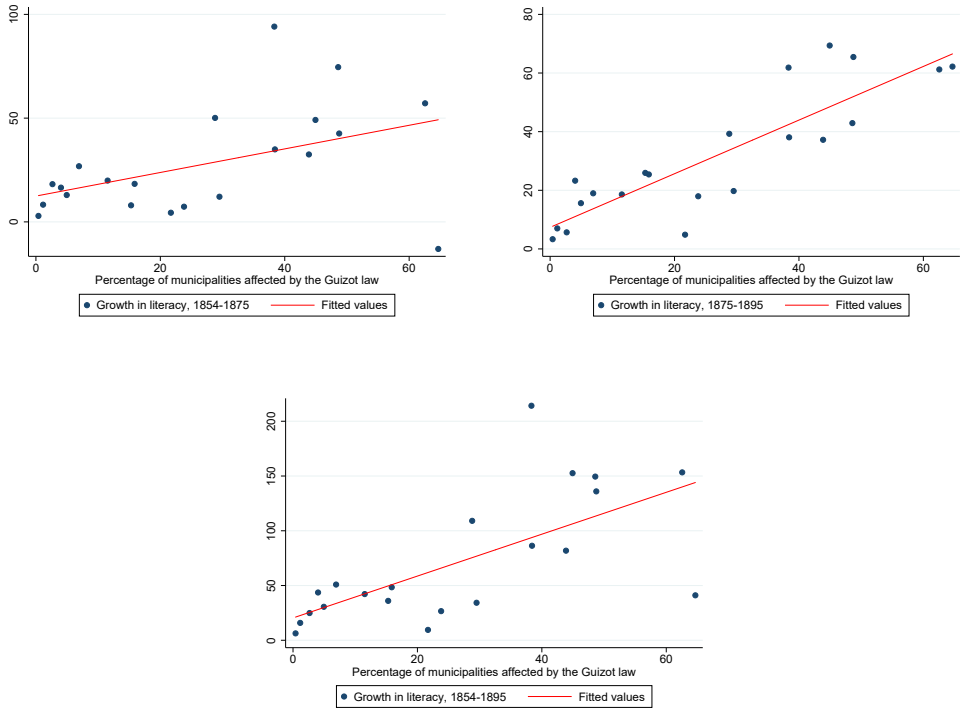


Figure B5: The convergence in literacy after the Guizot law at the level of departments

Source: Guizot survey, *Statistique générale de la France*. [Motte et al., 2003].
Notes: The unit of analysis is the department. The percentage of municipalities impacted by the Guizot law is defined as the number of municipalities forced to open a primary school after the law, relative to the total number of municipalities in a given department. Men literacy is defined as the percentage of men capable of signing their marriage contract.

Table A2: Impact of the Guizot law on convergence in literacy rates at the department level

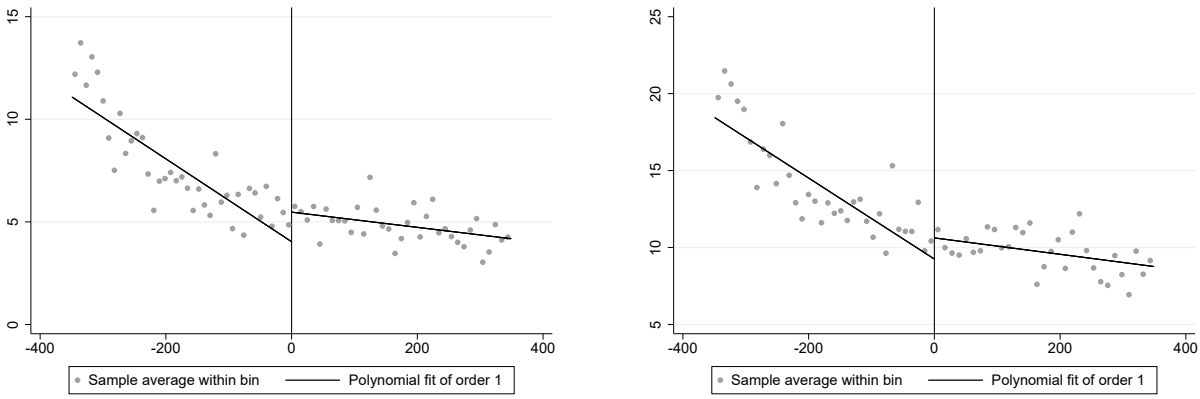
	Growth of men literacy		
	1854-1875	1875-1895	1854-1895
	(1)	(2)	(3)
Percentage of municipalities	0.569**	0.915***	1.912***
impacted by the Guizot law	(2.184)	(7.522)	(3.920)
Observations	21	21	21
R^2	0.201	0.749	0.447

t statistics in parentheses

* $p < 0.1$, ** $p < 0.05$, *** $p < 0.01$

Source: Guizot survey, *Statistique générale de la France*.

Notes: The unit of analysis is the department. The percentage of municipalities impacted by the Guizot law is defined as the number of municipalities forced to open a primary school after the law, relative to the total number of municipalities in a given department. Men literacy is defined as the percentage of men capable of signing their marriage contract.



Resources per capita, 1881 Resources per capita, 1911

Figure B6: 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.

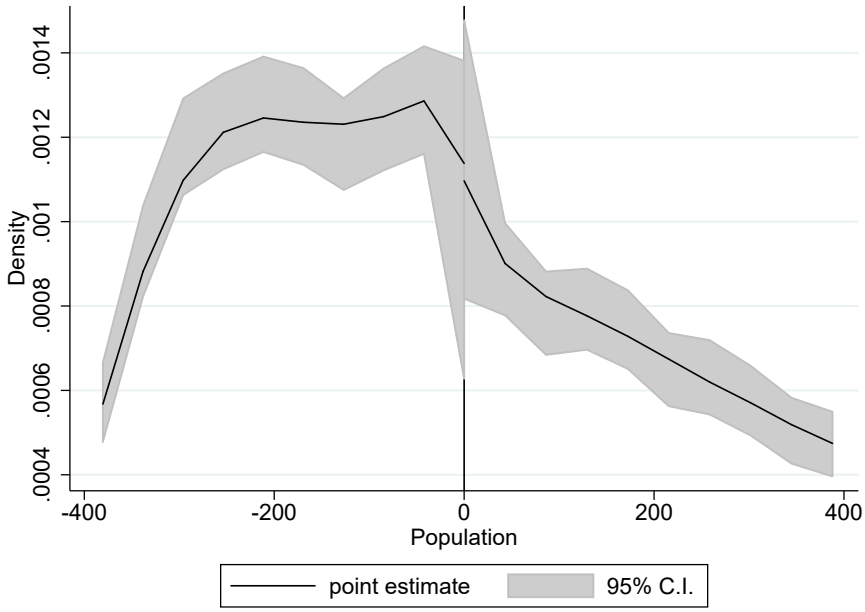


Figure B7: Population density around the 500-inhabitant threshold

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 A3: Non-parametric regression discontinuity estimates - Continuity of covariates

	(1) Population dispersion	(2) Surface area	(3) Altitude	(4) Population growth 1793-1836	(5) Distance to post office	(6) Postal taxes	(7) Industrial production	(8) Distance to prefecture	(9) Latitude
RD Estimate	-1.871	12.73	-58.13	-12.85	-0.679	4.100	11.47	-3.110	-0.177
	(-0.34)	(0.81)	(-1.39)	(-1.46)	(-0.89)	(0.46)	(1.42)	(-1.18)	(-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 A4: 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	-0.646	0.312	-0.373	-0.655	0.196	0.364	0.418	-0.224	-0.223
	(-1.57)	(-0.64)	(0.45)	(-0.60)	(-0.80)	(0.32)	(0.59)	(0.55)	(-0.41)	(-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 A5: Non-parametric regression discontinuity estimates - Falsification tests

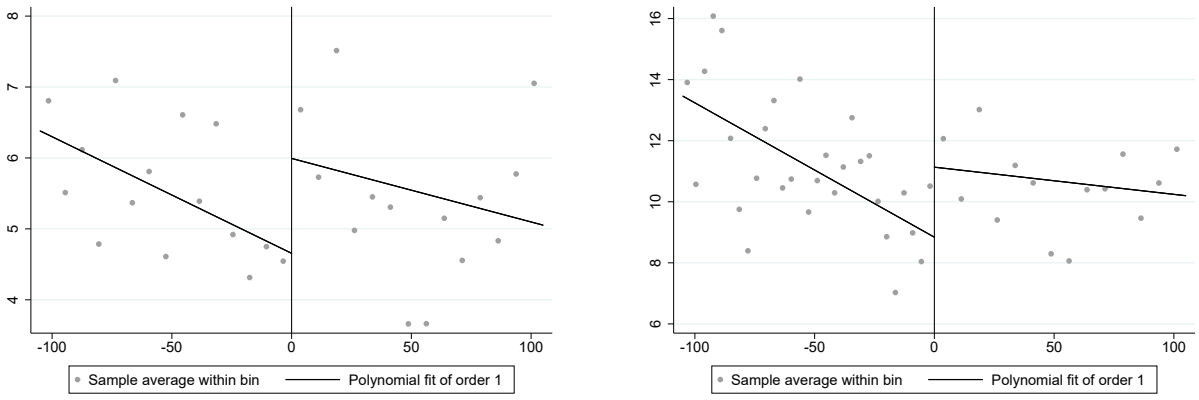
	Municipal resources per capita - 1911									
Population cutoffs:	250	350	450	550	750	850	1 000	1 300	1 600	1 900
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)
RD Estimate	0.432	0.686	-0.683	0.683	-0.944	1.257	0.591	0.624	-0.336	-0.154
	(0.28)	(0.62)	(-0.78)	(0.80)	(-0.87)	(1.48)	(0.72)	(0.63)	(-0.37)	(-0.16)
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.



1881 1911

Figure B8: 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 A6: Non-parametric regression discontinuity estimates - Municipal resources per capita, other polynomial degrees

	1881			1911		
	(1)	(2)	(3)	(4)	(5)	(6)
RD Estimate	2.953***	3.304***	4.257**	3.370***	3.471*	4.365*
	(3.42)	(2.67)	(2.45)	(2.66)	(1.89)	(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 A7: 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***	1.856***	2.928***	2.574***	4.115***	2.211***	2.605***	2.107**
	(2.97)	(3.14)	(3.44)	(3.15)	(3.23)	(2.62)	(2.90)	(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	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.	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 A8: 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***	2.700***	2.010***	1.702**	1.501**	4.286***	3.781***	3.167***	2.554***	2.184***
	(2.77)	(2.97)	(2.63)	(2.40)	(2.32)	(3.08)	(3.28)	(3.00)	(2.74)	(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.

Table A9: Non-parametric regression discontinuity estimates - Municipal resources per capita. Deflated 1881 estimates

	1881				1911			
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
RD Estimate	1.717***	1.586***	2.066***	1.927***	3.166***	2.211***	1.815**	1.698*
	(2.63)	(3.14)	(3.45)	(3.00)	(3.00)	(2.62)	(2.41)	(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). The 1881 estimates are deflated following the price index reported in Sauvy, 1952.

Table A10: Non-parametric regression discontinuity estimates - Municipal resources per capita, population restrictions

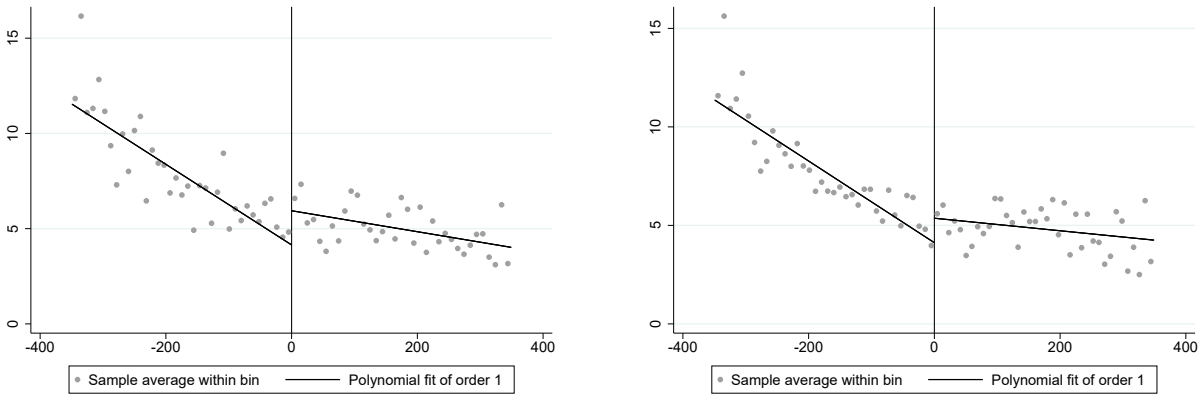
	1881			
	(1)	(2)	(3)	(4)
RD Estimate	2.394***	2.145**	2.018**	3.842***
	(3.09)	(2.57)	(2.05)	(3.72)
Controls	183	180	180	86
Treated units	174	113	91	99
Covariates	Yes	Yes	Yes	Yes
Kernel	Triangular	Triangular	Triangular	Triangular
Order Loc. Poly.	1	1	1	1
Order Bias	2	2	2	2
BW Loc. Poly.	71.94	68.53	68.07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

t statistics in parentheses

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

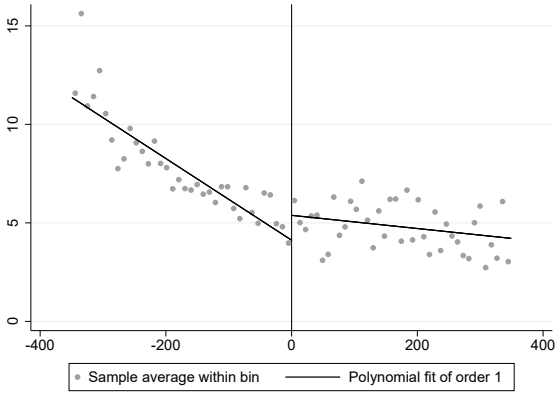
Source: Guizot, industrial and postal surveys. IGN data, [Motte et al., 2003] and *La Situation Financière des Communes*.

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

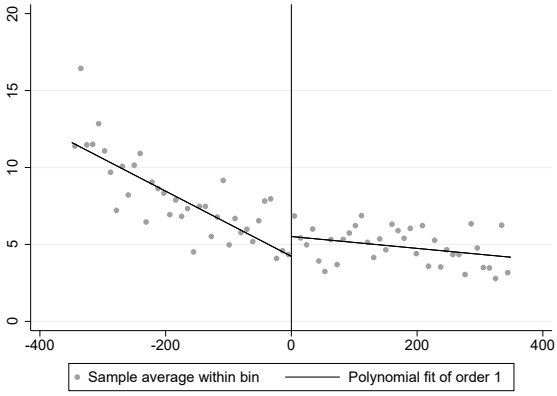


Column 1

Column 2



Column 3



Column 4

Figure B9: 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 A10 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.

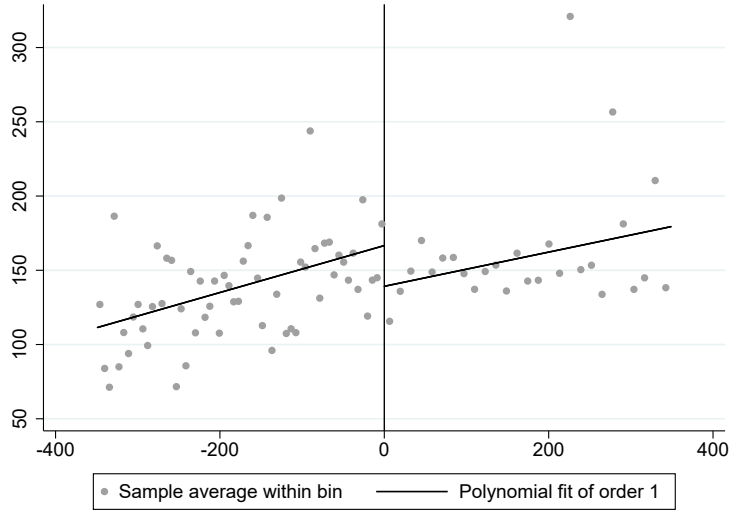


Figure B10: Data-driven regression discontinuity in municipal resources growth between 1881 and 1991 (%)

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.

Table A11: 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	-44.10*	-43.82*	-41.51
	(-1.30)	(-1.67)	(-1.66)	(-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.

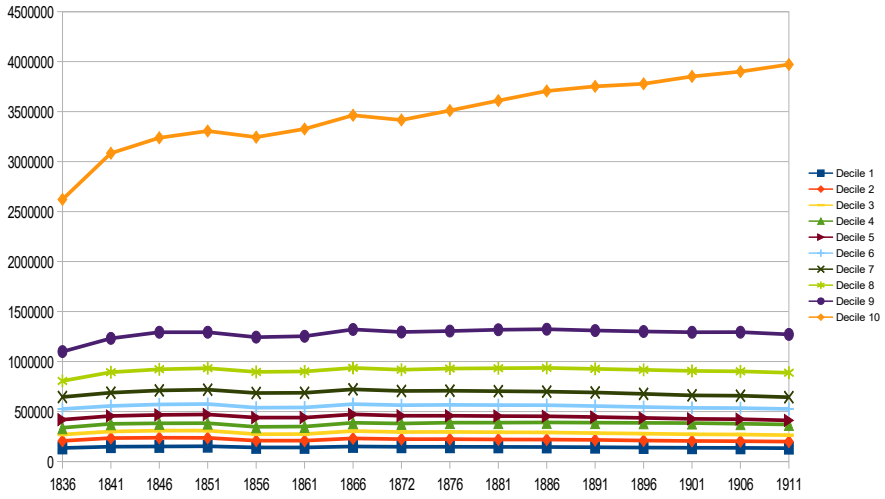


Figure B11: Population growth (in absolute terms) of 1836 population deciles

Source: [Motte et al., 2003].

Notes: The graph represents the population of each decile in 1836 and its evolution until 1911. The sample is restricted to the 22 departments used in the article.

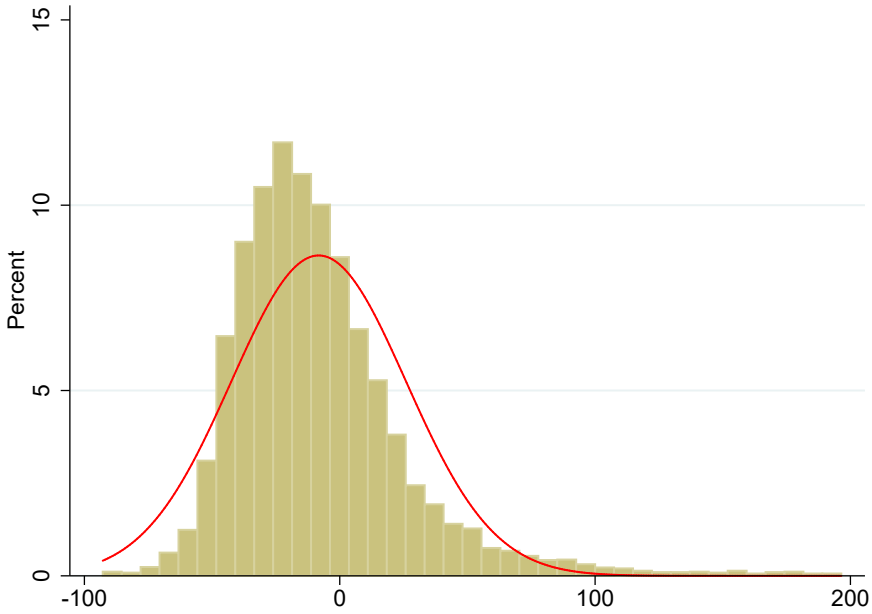


Figure B12: Histogram of municipalities' population growth, 1836-1911

Source: [Motte et al., 2003].

Notes: The vertical axis represents the percentage of observation within each bar of the histogram. The small share of municipalities with a population growth superior to 200%, 0.8% of them, are excluded from the histogram.

Table A12: Mean t-test on 1836-1911 population growth (%) of municipalities, depending on their 1836 population decile

	No primary school		Primary school		
	N	Mean	N	Mean	p-value
Decile 1	454	-10.59	337	-10.95	0.888
Decile 2	382	-14.03	422	-18.35	0.047
Decile 3	358	-8.95	435	-20.73	0.000
Decile 4	359	-6.42	443	-18.56	0.000
Decile 5	329	-4.54	471	-16.99	0.000
Decile 6	329	-2.82	468	-15.07	0.000
Decile 7	316	-5.14	486	-10.11	0.030
Decile 8	316	2.64	487	-6.98	0.000
Decile 9	242	4.15	551	-2.27	0.012
Decile 10	167	5.16	625	7.26	0.568

Source: Guizot, survey, [Motte et al., 2003].

Notes: The 1836-1911 population growth of municipalities with no primary school and belonging to the first population decile in 1836 was of around -10.59%. The corresponding figure for municipalities with a school and belonging to the first decile was or -10.95. The difference between the two is not significant.

Table A13: Non-parametric regression discontinuity estimates - Municipal resources per capita. Additional control: Number of patents per 10 000 inhabitants at the level of departments

	1881				1911			
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
RD Estimate	2.009***	1.498***	1.942***	1.863***	3.166***	1.749**	1.437**	1.336
	(2.63)	(2.72)	(3.04)	(2.65)	(3.00)	(2.21)	(2.01)	(1.53)
Controls	400	333	221	247	339	285	366	391
Treated units	294	245	176	203	260	212	264	287
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	72.55	80.68	90.31	90.31	117.0	127.3
BW Bias	188.5	188.5	135.9	141.8	170.3	170.3	212.7	220.0

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). The number of patents filed per 10 000 inhabitants at the level of departments between 1833 and 1871 is included as an additional control in the estimations.

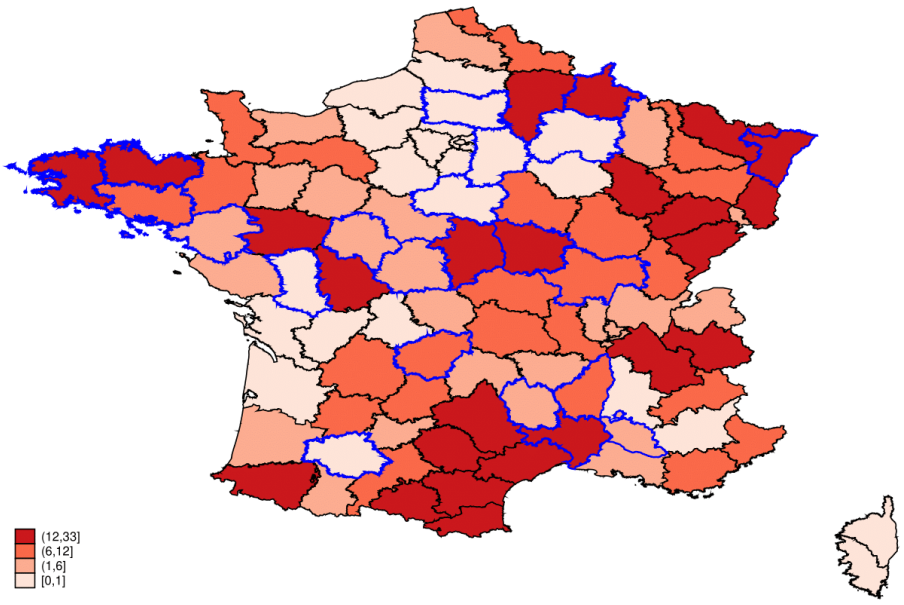


Figure B13: Number of coal, iron or copper deposits

Source: Bureau de Recherches Géologiques et Minières.

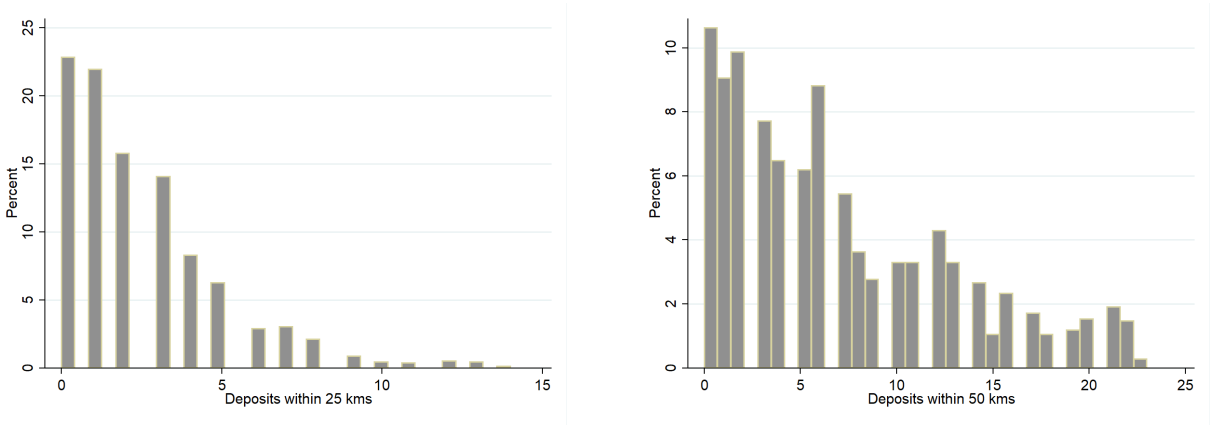
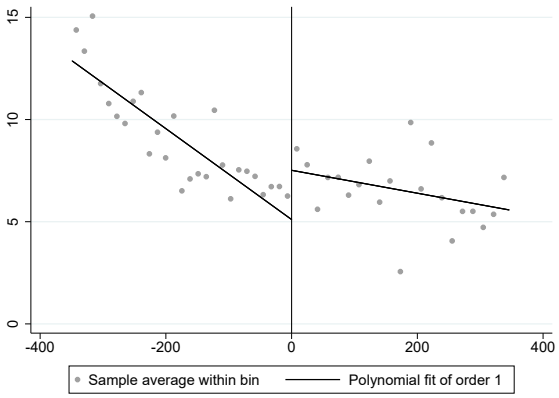


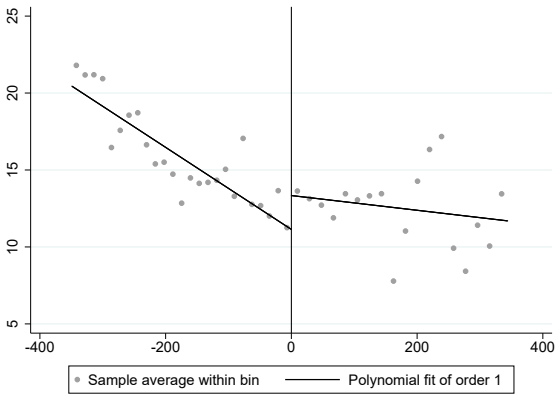
Figure B14: Histograms of the number of deposits within 25 kms and 50 kms around municipalities

Source: *Bureau de Recherches Géologiques et Minières.*

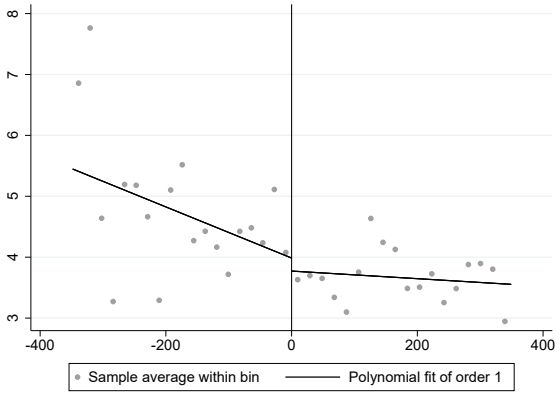
Notes: The deposits taken into account are the iron, coal and copper ones. Municipalities within a range of 350 inhabitants above and below the 500-inhabitant threshold are considered. A value of 5 refers to the percentage of municipalities with 5 deposits within a range of 25 or 50 kilometres.



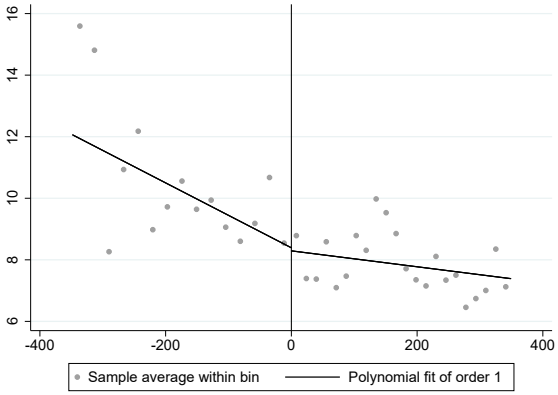
High schooling endowment - 1881



High schooling endowment - 1911



Low schooling endowment - 1881



Low schooling endowment - 1911

Figure B15: 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.

Table A14: Non-parametric regression discontinuity estimates - Municipal resources per capita. Departments with a high or low endowment in primary schools

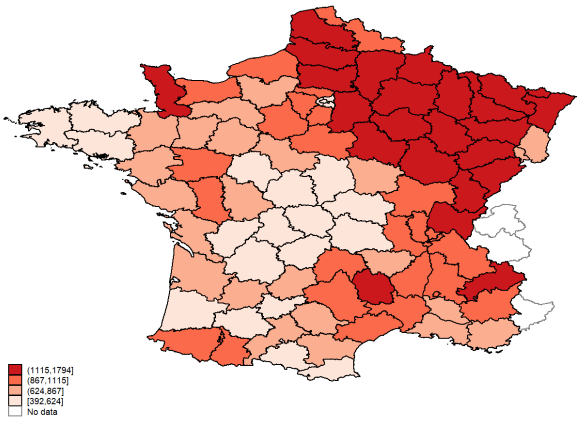
	1881				1911			
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
	Departments well-endowed in primary schools in 1833							
RD Estimate	2.163*	2.069**	2.617***	2.536**	3.175**	2.429**	2.500**	2.349**
	(1.66)	(2.39)	(2.67)	(2.38)	(2.05)	(2.54)	(2.54)	(2.33)
Controls	233	194	145	159	204	172	160	182
Treated units	152	130	102	109	139	117	109	121
Left Clusters				37				41
Right Clusters				33				36
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
	Departments with a low endowment in primary schools in 1833							
RD Estimate	0.462	0.276	0.124	0.113	0.795	0.661	0.675	0.652
	(0.75)	(0.49)	(0.24)	(0.22)	(0.78)	(0.68)	(0.72)	(0.63)
Controls	212	175	203	220	228	187	190	213
Treated units	167	137	171	191	191	155	163	189
Left Clusters				30				30
Right Clusters				30				30
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
Covariates	No	Yes	Yes	Yes	No	Yes	Yes	Yes
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

t statistics in parentheses

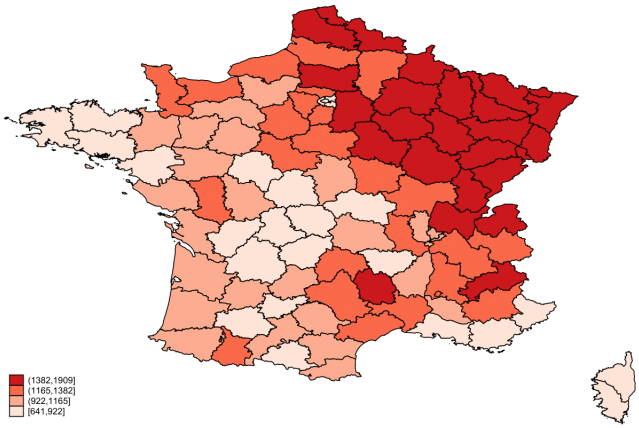
* $p < 0.05$, ** $p < 0.01$, *** $p < 0.001$

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

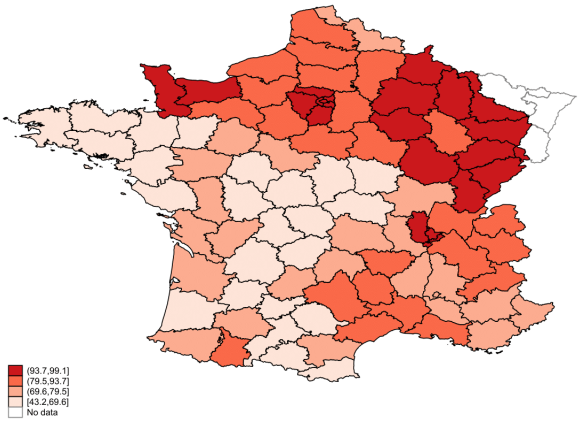
Notes: In columns (3) and (7), I add covariates which are incorporated in the computation of the optimal bandwidth. This is not the case in columns (2) and (6) where the covariates are added without entering in the computation of the optimal bandwidth. I cluster standard errors at the district level in columns (4) and (8). Departments above and below the value of 50% of the municipalities with a primary school in 1833 are considered respectively as well or scarcely endowed in primary schools.



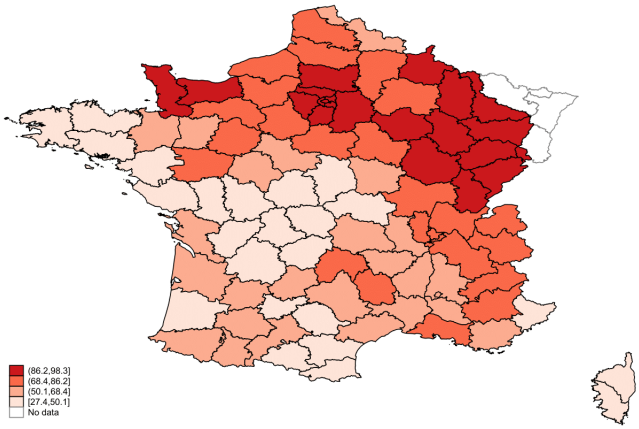
Number of pupils per 10 000 inhabitants 1850



Number of pupils per 10 000 inhabitants 1863



Marriage signatures - men, 1871-1875



Marriage signatures - women, 1871-1875

Figure B16: Enrolment in primary schools

Source: *Statistique générale de la France.*

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

Table A15: OLS estimations - Ferry laws and economic growth, 1881-1911

	Growth of municipal resources, 1881-1911			
Population intervals:	All municipalities		More than 500 inhabitants	
	(1)	(2)	(3)	(4)
Departments with a high schooling endowment - 1833	-33.868**	–	-28.984*	–
	(-2.227)		(-1.811)	
Percentage of municipalities with schools - 1833	–	-1.476***	–	-1.386***
		(-5.905)		(-5.153)
Population, 1836	0.016***	0.007	0.011*	0.005
	(2.640)	(1.153)	(1.867)	(0.815)
Surface area	-0.012	-0.041	-0.011	-0.036
	(-0.344)	(-1.309)	(-0.314)	(-1.080)
Altitude	0.063**	0.039	0.056*	0.043
	(2.081)	(1.412)	(1.929)	(1.584)
Population growth, 1793-1836	0.045	0.050	-0.003	0.016
	(1.113)	(1.392)	(-0.050)	(0.336)
Distance to post office	1.117**	0.914*	1.140	0.921
	(2.068)	(1.838)	(1.459)	(1.235)
Postal taxes	-0.019**	-0.012**	-0.016**	-0.011*
	(-2.606)	(-2.064)	(-2.454)	(-1.981)
Industrial production, 1839-1847	-0.029**	-0.011	-0.037***	-0.020*
	(-2.614)	(-1.038)	(-3.244)	(-1.735)
Steam engines, 1839-1847	0.201	-1.754	1.283	-0.511
	(0.053)	(-0.484)	(0.333)	(-0.138)
Observations	6459	6459	3858	3858
R^2	0.042	0.088	0.034	0.073
Clusters	85	85	85	85

t statistics in parentheses

* $p < 0.1$, ** $p < 0.05$, *** $p < 0.01$

Source: Guizot survey, industrial survey of 1839-1847, postal survey of 1847. IGN data and [Motte et al., 2003].

Notes: The surface area is in hectares and altitude in meters. Postal taxes are in francs, the industrial production in thousands of francs per year. The number of steam engines is accounted for, as well as the distance to the closest post office in kilometres. Departments above and below the value of 50% of the municipalities with a primary school in 1833 are considered respectively as well or scarcely endowed in primary schools. *Departments with a high schooling endowment* is the corresponding dummy variable.