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Industrial activities and primary schooling in early nineteenth-century France

Adrien Montalbo^{*†}

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Abstract

This article investigates the relation between industrial activities and the expansion of primary instruction in early nineteenth-century France. To do so, I use a newly constituted database on the location and characteristics of primary schools at the level of municipalities. This database is extracted from the Guizot Survey conducted in 1833, before the implementation of the first national law making the opening of a school mandatory in any municipality more than 500 inhabitants. By using mineral deposits as an instrument, I first show that the presence of industrial activities and the level of industrial production in a given municipality were positively influencing the presence of primary schools. Second, I show that this was due to an income effect thanks to which municipalities were capable of attracting teachers and of more frequently paying them on a regular basis. Other economic factors, as the agricultural resources of districts, and geographical or demographical factors as population dispersion were also important in explaining the location of primary schools. Finally, I show that this came at a price in terms of children enrolment in schools. The same economic factors were contributing to a diversion of children from schools, either because of a relative impoverishment of workers or because of an increased opportunity cost of schooling.

JEL codes : N33, N63

Keywords : primary instruction, industrial activities, nineteenth-century France

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1 Introduction

There exists a long-lasting debate in economic history about the effects of economic activities, and especially industry, on literacy. It is argued, in the British case, for example, that early industrialisation and the progressive introduction of large-scale factories using steam-power were mainly skill-saving. They favoured the development of low-skilled jobs, or the fall in semi-skilled blue-collar jobs such as weavers, shoemakers or tailors [de Pleijt and Weisdorf, 2014], possibly diminishing the demand for instruction and literacy rate in England too [de Pleijt, 2018]. This comes under the name of the "deskilling hypothesis" [Sanderson, 1972], [Nicholas and Nicholas, 1992]. The same observation is made on the level and growth of secondary instruction in the United States [Goldin and Katz, 1997]. This negative effect of industrial activities on literacy rates is also identified in the French case. In the Nord department, for example, industrial districts are found to be characterized by relatively low literacy rates compared to more agricultural ones between 1831 and 1843 [Leblond, 1970]. By the same token, the presence of a developed textile sector is correlated with less literacy in the diocese of Rouen at the end of the 18th century [Furet and Ozouf, 1977b].

This idea is greatly debated as industrialisation and technical change may also have led to a rise in the demand for some medium and high-skilled workers [Feldman and van der Beek, 2015], [de Pleijt et al., 2016], especially during its second phase [Mokyr, 2008] and therefore have had a positive impact on education¹. Moreover, in the English or French cases, it is not obvious to show that industrialisation was the very cause of a fall in literacy rate [Schofield, 1973], [Corbin, 1975], all the more since a sharp increase in this rate took place at the beginning of the nineteenth century, precisely at the time when industrial activities surged [Laqueur, 1974]. Therefore, some authors argue that large-scale factories contributed to a rise in literacy and that the counter-examples usually put forward in the literature, as Lancashire where the towns of Liverpool and Manchester were located, could be explained taking into account Irish immigration that affected negatively literacy rates [West, 1978]. To them, it seems that, even if industrialisation may have led to a proletarianisation of England's workforce, a lower bound in literacy was already attained at that time. Therefore, the demand for low-skill workers may not have greatly affected literacy as it didn't induce people previously sending their children to school to stop doing so.

In the case of France, there seems to have been a complementarity between technology and human capital. Franck and Galor, 2017, find that the number of steam engines at the department level in 1839-1847 had a strong impact on human capital in the early phase of industrialisation. A larger number of steam engines had a significant impact on the number of teachers later in the century, on the share of apprentices in the population, on the share of literate conscripts, on the number of schoolhouses and on the number of pupils enrolled in primary schools relative to the number of inhabitants. Similarly, Diebolt et al., 2017 found that the number of steam engines within departments was positively associated with literacy rates and primary schools' presence in the first part of the nineteenth century. The association became non-significant

¹See [Katz, 2016] for an illustration in the American context.

in its second part but a positive relation emerged with adult education and superior primary schools, the level of education subsequent to primary schooling strictly speaking².

In this article, I adopt a more micro-historical approach in order to evaluate how industrial activities influenced primary schooling in early nineteenth-century France, that is to say at the beginning of French industrial area. I do so by testing the effect of the presence of industrial factories on the location of primary schools and on enrolment rates at the level of municipalities. I focus on manufactures and not on proto-industrial activities. This level of disaggregation will help to understand in concrete terms both the relationship between the two phenomena and its transmission channels. I also control for the effect of the agricultural characteristics of departmental districts³, trying both to take into account agricultural wealth and its production organization. The main objective is to have a quite exhaustive measure of the potential economic resources of towns and villages in order to see how these resources interacted with the spread and maintaining of primary schools.

I use a newly constituted database on education at the level of municipalities to answer these questions. This database is extracted from a national survey launched by French Minister of Education François Guizot in 1833, the very year he made mandatory for any municipality over 500 inhabitants to open and maintain a primary school for boys. This legislation was the first legally-binding measure on primary schooling that was nationally implemented in France. The survey, conducted in every primary school of every French municipality, provides very precise information on the characteristics of schools, teachers and municipal investment in education. Its aim was to provide reliable information on the state of primary schooling at the beginning of the century in order to evaluate which areas would have to do the major adjustments to abide by the new law. I collected the data at the municipal level for 22 departments, which amounts to 8 129 towns and villages, a primary school being located in 59.5% of them.

I test the influence of industrial activities on primary schooling first using a simple OLS framework. Indeed, the onset of industrialisation in France has been shown to be linked to upper-tailed knowledge influencing positively the adoption of modern technology, this knowledge being uncorrelated with basic indicators of literacy [Squicciarini and Voigtländer, 2015]. However, at the municipal level, things could have been more complex. Manufacturers could have looked for a more docile workforce used to discipline within primary schools [Rosanvallon, 1985], [Johnson, 1970], [Mitch, 1993] or, on the contrary, could have avoided towns with schools where child labour was less abundant. Therefore, I use data on the location of ore to instrument the presence of industrial manufactures. This location was linked to mining activities which depended by definition directly on mineral deposits. Moreover, these activities could have also attracted other industrial sectors, as the production of metal objects and tools or the production of clothes, interested in benefiting from the outlet constituted by the presence of mines.

²This level corresponds to what is called "secondary education" nowadays.

³Administrative territorial subdivision named *arrondissements* in France or *sous-préfectures*.

First, I show that the presence of industrial manufactures was positively and significantly correlated with the location of primary schools, both with the OLS and the IV estimations. The latter appears to be higher in magnitude than the former. This effect is, as expected, greatly due to mining activities when using the instrumental variable technique. It is also greater in magnitude for larger manufactures, namely those more than 20 workers. I secondly show that this is due to the fact that industrial activities were providing municipalities with additional economic resources. Indeed, there is a positive correlation between the presence of larger manufactures, industrial production value, industrial workers wages and the provision of a fixed salary (and the salary amount) to teachers by municipal authorities. This means that, at a time when the decision to invest in primary schooling was not yet mandatory for each municipality, the presence of industrial activities was contributing to improving both the demand for education by increasing the purchasing power of families and the supply by providing municipalities with economic resources. However, I thirdly show that this came at a cost in terms of enrolment rates. Indeed, I find a negative correlation between enrolment rates and the presence of industrial manufactures, industrial sectors whose workforce was constituted by more than 10% of children and industrial production value. This indicates that the opportunity cost of schooling was increased by the presence of factories, especially in sectors where child labour was usual. Wages were also lower in these sectors, meaning that families, who were most of the times budget constrained in early nineteenth-century France, had also to rely more on child labour.

Therefore, industrialisation didn't influence negatively the presence of primary schools and was even contributing to their maintaining within municipalities. However, there is evidence of a diversion of children from schools in towns where industrial activities were present, all the more if they were belonging to sectors employing children massively. This analysis adds to the debate about the influence of early industrialisation in two ways. First, it focuses on France, a country less studied than England for what regards the effect of industrialisation on schools. Second, thanks to data collected at the municipal level, it is possible to study very precisely the relation between primary schooling and economic activities, without having to aggregate information at the districts or departments levels.

This also adds to the understanding of the determinants of primary schools spread before the Guizot Law of 1833 in France. Apart from the presence of industrial manufactures, other economic, geographical and demographical factors also influenced primary schooling. Population dispersion was a pregnant determinant playing against the spread of primary schools, average altitude was so too but to a lesser extent. The relative number of share-croppers to self-employed farmers and the number of animals per inhabitants were also negatively correlated with educational outcomes. This is interpreted as due to an impoverishment of agricultural workers within the share-cropping production organisation and to the intensive use of children as shepherds in areas with a high number of animals. The total population was positively influencing primary schooling, along with agricultural resources measured by the market value of land.

The next section presents some historical facts about primary schooling and industrial activities from the Revolution to the Guizot Law of 1833 and helps to contextualise and to specify the study. Section 3 is a description of the data I use while Section 4 presents the research methodology adopted. Econometric results are presented in Section 5 for what regards the presence of primary schools and transmission channels are studied in Section 6. In Section 7, the influence of economic activities on enrolment rates is presented. Section 8 concludes.

2 A Differentiated Development of Primary Schooling and Industrial Activities

The Guizot Law was passed on the 28th of June 1833, making it compulsory for any municipality over 500 inhabitants to open and maintain a primary school for boys. Teachers were also to be paid on a regular basis and not less than 200 francs a year. This law is the first major step towards universal schooling undertaken in nineteenth-century France. Before 1833 the decision to open a primary school and its functioning (paying the teacher on a fixed basis or not, how much, buying books, blackboards and other pieces of furniture, providing the teacher with an accommodation or a classroom,...) was mainly made at the level of municipalities⁴. Local authorities thus played an important role, along with parents that were in most cases (except when they were on indigent lists or when the school was totally free, which was extremely rare at that time) paying schooling fees in order to make their children attend school. At the end of the day, schools could be totally funded through schooling fees, through fees and municipal grants based on taxation or totally by municipalities and therefore free of charge for parents, this latter case being the less common⁵

At the state level, many reforms took place during the French Revolution, the aim of which was to legislate on primary schooling⁶. The major orientations of the reforms were to separate instruction from religious influences, to organise a distinct teaching for boys and for girls and to grant people with free and universal education. However, the effect of the revolutionary period on education remained small, mainly due to a lack of financial means and to the difficulty to reform instruction in an unstable political context [Mayeur, 2004]. This evolved under the Restoration as attention towards primary instruction increased. From the 29th of February 1816, a written certification of morality was made mandatory in order to be able to teach, this certification being delivered by the mayor and the parish priest. The capacities of teachers were also to be checked and a certificate composed of three different degrees, the third one

⁴A precise description of the daily life of schools and teachers in the eighteenth and early nineteenth centuries can be found in [Duveau, 1957]. Analyses or testimonies on the state of primary schooling by teachers from the early nineteenth century are available in [Lorain, 1837] and [Meunier, 1981]. In order to have an analysis of local schooling development in the eighteenth century, see for example [Vovelle, 1975] or [Laget, 1971]. See [Gildea, 1983] for a local study from 1800 onwards for the departments of Ille-et-Vilaine, Gard and Nord.

⁵A school was said to be public at that time whenever there was a municipal investment. Private schools were, therefore, the ones which were totally funded through fees paid by families.

⁶In order to have a full political analysis and a description of the laws, projects, and debates about primary instruction during this period of time, one can refer to [Gontard, 1959] and the second and third chapters in [Furet and Ozouf, 1977a].

being the lowest on the hierarchy, was needed in order to teach. However, this was also rarely fully applied⁷. Indeed, examinations often took place after the nomination of teachers. If they were unable to pass the tests, authorities should have refused them the certificate and close the school, a measure which was unlikely to be implemented [Prost, 1968].

In this context, primary schooling developed differentially between regions of France. From the early work of the Dupin baron, an opposition between a well-educated France above the Saint-Malo/Geneva line and a less-educated one below this very line has been exhibited [Dupin, 1826]⁸. For example, the enrolment per 100 children six to thirteen years of age was higher above this line (a mean of 94 compared to 53), the coefficient of variation between departments being also lower above than below (30% compared to 48%). This means that enrolment was higher and more concentrated around its mean above than below the line. This was also true for the schooling of girls [Grew and Harrigan, 1991]. In Figure 1, one can see this clear distinction between French departments and its stability over time. Indeed, taking the men marriage signature rate as a proxy for literacy indicates that the geographical spread pattern of primary schooling didn't evolve much from the end of the 17th century to 1833 [Allain, 1881]. Controlling by the age structure doesn't change much the results⁹. Therefore, before the Guizot Law, primary schools and high enrolment rates were mostly concentrated in the north-east part of France, even if some other regions as the Rhône Valley and the area around Bordeaux (the Gironde) were also characterized by rather good schooling levels.

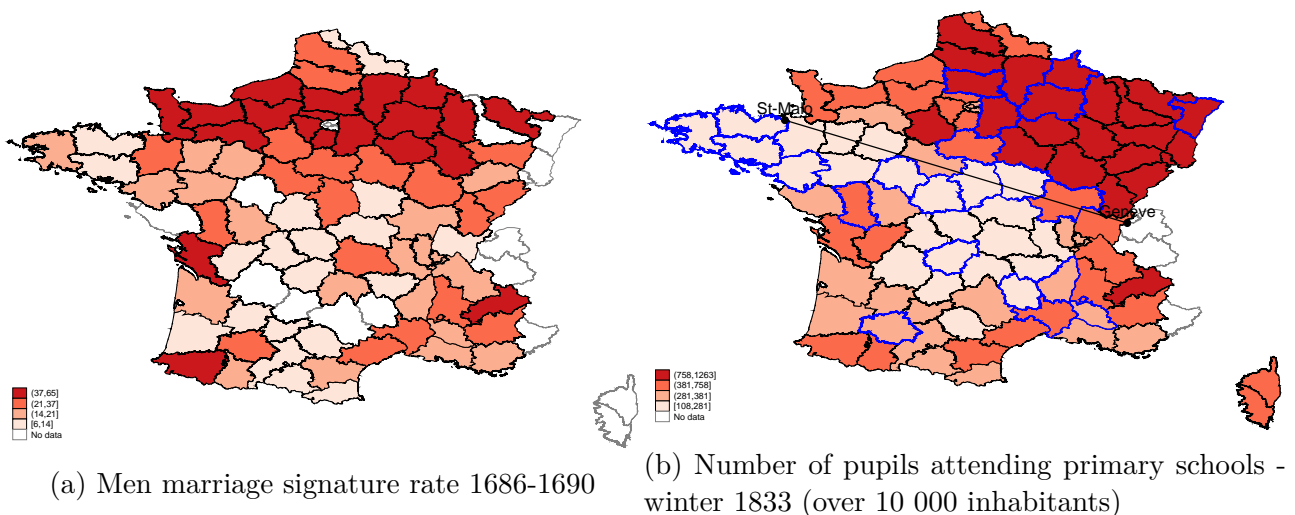


Figure 1: Literacy rate and primary schooling

Source : *Statistique générale de la France*, Guizot survey - Report to the King.

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

⁷See [Nique, 1990] to have a description of educational state measures from 1815 onwards.

⁸This analysis can be in part contested as it didn't take into account the age structure of the population [Fleury and Valmary, 1957].

⁹This is done in Figure 3 in the Appendix.

As reported in [Figure 2](#), the spread and geographical distribution of industrial activities in 1839-1847 differed from the one of primary schooling. Manufactures were mostly concentrated in the north-west and western departments close to the Atlantic Ocean. This is linked to the volume of commercial activities of Atlantic ports like Le Havre, La Rochelle or Nantes which was attracting many industrial sectors to their vicinity [[Asselain, 1984](#)]. Manufactures more than 50 workers, the number of steam engines and the number of industrial workers were more concentrated in the north and north-eastern parts of France, along with the Rhône Valley. This testifies of the progressive surge of mining and metallurgic sectors in France at that time, in particular of the exploitation of coal and iron. Deposits were indeed highly concentrated in the Nord-Pas-de-Calais, Lorraine, Auvergne, Loire, Dauphiné, Provence and Cévennes areas in France. In some regions as Normandie or the Dauphiné, the concomitant presence of rivers, forests and deposits explains the ancient presence of metallurgic sectors [[Léon, 1948](#)], [[Richard, 1962](#)], [[Kellenbenz, 1963](#)]. Textile activities also followed closely this geographical pattern [[Dunham, 1953](#)].

The early nineteenth century is the time period of the first industrialisation in France. Industrial production growth rates began to surge at that time, being superior to 3% for the best years from 1815 onwards [[Lévy-Leboyer, 1968](#)], the highest rates being attained at the end of the July Monarchy and under the Second Empire [[Crouzet, 1970](#)]. This growth remained however quite gradual all over the century which led some authors to deny the idea of a real industrial take-off in France [[Mendels, 1972](#)]¹⁰.

¹⁰To have an economic analysis and description of the industrialisation period in France and other European countries over the nineteenth century, see [[Verley, 1999](#)] and [[Verley, 1997](#)]. For an analysis of the French case under the *Ancien Régime*, see for example [[Sée, 1925](#)].

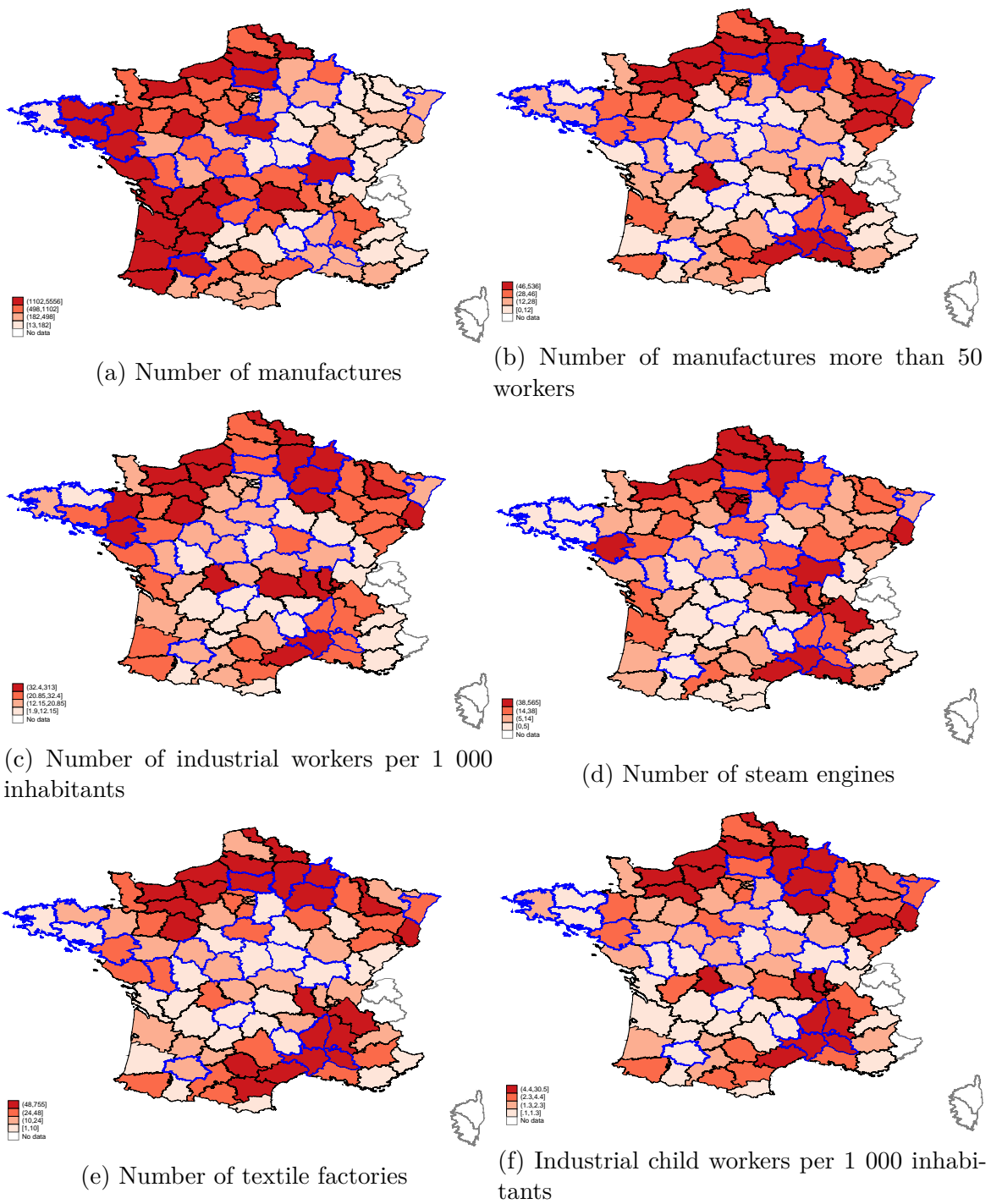


Figure 2: Industrial activities in France, 1839-1847

Source : Industrial survey.

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

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 Guizot¹¹. 490 inspectors were sent throughout France in autumn 1833. The survey was conducted during September, October and November months in order to be sure that students and teachers would be present at school. 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 didn't apply to them. All departments were to be inspected, except Corsica. The data are lost for three departments: Allier, Ille-et-Vilaine and the Nord. The aim of this survey was to know precisely the state of instruction in order to implement the law just passed as efficiently as possible, depending on the previous presence of primary schools¹².

Data coming from the Guizot Survey of 1833 was published for all French districts in a *Report to the King* [Guizot, 1834]. Only some of the questions asked in the initial survey, those deemed of major interest, were aggregated in this report. From the initial individual (at the level of each primary school) forms, the data was collected for 22 departments and 8 129 municipalities¹³. At least one primary school was present in 4 836 of them (59.5%). This project has been initiated by the *Service d'Histoire de l'Education* of the I.N.R.P, which collected data for the academies of Nantes, Bourges and Nîmes. Other departments were then added to this initial database. In [Figure 1](#), one can see that these departments belong to areas with very different levels of enrolment. Collection of data 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 data on primary schools¹⁴. Other data on education is coming from the *Statistique générale de la France*¹⁵.

The departments selected are quite representative of France for what regards primary education and industrial characteristics which will be under scrutiny in this analysis. 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*¹⁶ shows that the sample differs significantly only in the percentage of municipalities with factories (21.6% against 17.2% for France) when consid-

¹¹A lot of information on this survey is available here : <http://www.inrp.fr/she/guizot/>.

¹²There was indeed a lack of information on this point at the national level. Fourcroy tried to organize a similar kind of survey to identify the municipalities with a primary school in 1802 but this failed to give results.

¹³These 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 Vauchuse. At that time, there were 86 departments existing and 26 academies. Current denominations of departments are specified in parenthesis when a change occurred.

¹⁴See for example on this point the criticisms made in [Luc, 1986] and [Luc and Gavaille, 1987]. See [Grew and Harrigan, 1986] for a reply and [Furet and Sachs, 1974] for a use of these data.

¹⁵These data can be found here <https://journals.openedition.org/acrh/2890>

¹⁶See in [Table 10](#) the Appendix.

ering industrial factors. The number of workers, their average wages, the amount of industrial production or the presence of big-size factories (more than 20 workers) didn't differ significantly. The same is true for the investment of municipalities in primary education (provision of a fixed salary or an accommodation to teachers) and for the number of primary schools. 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 the average national level. This is why several agricultural wealth controls and department fixed effects will be introduced in the estimations to reduce potential biases linked to department-specific factors.

3.2 Data on Industrial Activities and Economic Resources

The economic data are coming from two surveys: the industrial survey of 1839-1847 and the agricultural survey of 1852¹⁷. The agricultural survey is used in order to measure the agricultural resources of districts. It can be held as relatively representative of the state of French agriculture in the middle of the nineteenth century. Indeed, compared to other years, harvests have been deemed "normal" by contemporary analysts, a statement that is today considered to be quite accurate [Démonet, 1990]. The major issue with these data is the 20 years time-lapse that separates them from the Guizot survey. However, since agricultural characteristics were quite stable over time, they should still constitute a good approximation of the agricultural resources at the beginning of the nineteenth-century and serve as good controls for agricultural resources of districts.

Data on the location of factories as well as their characteristics are drawn from the industrial survey. These data are available at the level of municipalities, which makes it possible to match them with those on primary schools. Thanks to it, I can know exactly in which municipalities primary schools and/or industrial factories were present. The factories reported in the survey are composed of more than 10 workers in order not to be mingled with craftsmanship. Because of the interruptions and difficulties linked to the gathering of data, the industrial survey suffers some flaws. Moreau de Jonnés himself, the coordinator of the survey with the minister Laurent Cunin-Gridaine, acknowledged the poor quality of information for what regards the South-West part of France. But other areas, like the Seine-et-Marne, are also characterized by these issues. On top of that, Paris is not included in the data. Lyon is imperfectly described as there is no information on silk industry [Chanut et al., 2000]. In spite of this, the data coming from this survey seem to be quite reliable. For example, in the case of average daily wages, they are in compliance with those reported by Villermé, 1971, 1840 and comparable to those coming from other sources like the *Statistique générale de la France*. A comparison with the *Statistique de l'industrie minérale* also reinforces this reliability [Chanut et al., 2000]. In any case, there seems to be no major concern about data quality for the departments under scrutiny in this study.

¹⁷More information on them can be found in [Chanut et al., 2000] for the industrial one, in [Marin and Marraud, 2011b] and [Démonet, 1990] for the agricultural one.

3.3 Demographical Data on Municipalities

Data on the population of municipalities is taken from the *Statistique générale de la France* for the year 1836. Population dispersion is taken from the Postal Survey of 1847 along with the surface area of municipalities which have disappeared or merged since 1833¹⁸. Since this survey is posterior to the Guizot one, I have to assume that population remained stable over the fourteen years separating them, which seems to be a quite reasonable assumption. The *Institut national de l'information géographique et forestière*, a public organism 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 organism.

3.4 Descriptive statistics

Primary schools were located in 59% of the municipalities in the data. This shows that for many of them and many parents, education was either not a major concern or too high a financial burden. This idea is reinforced by the fact that not more than 39% of municipalities were paying teachers a fixed annual salary. Therefore, many of these teachers were actually depending highly on schooling fees to earn their living, all the more since municipal salaries were often low, an average of 97 francs annually, compared to the minimum level of 200 francs fixed by the Guizot Law.

Industrial factories were present in 12% of the municipalities, those more than 20 workers in 6% of them. The majority of manufactures, 72.6%, were less than 20 workers (1 545 factories over the 4 128). The average wage of industrial male workers was of 2 francs per day while those of female and child workers were around 96 and 72 cents of francs respectively.

The average population of the municipalities in the data is around 990 inhabitants, but 50% of them were less than 631 inhabitants and 90% less than 2 000. Their average area was 1 726 hectares, with an altitude of 208 meters. Population dispersion could be high within municipalities as the average scattering is around 47%, with a median value close to 50%. This means that for half of them, more than half of their population was dispersed and not concentrated in the main village (*bourg*)¹⁹.

4 Research Methodology

4.1 Economic Activities Influencing Primary Schooling Through an Income Effect

The core hypothesis in this article is that agricultural, industrial and more generally economic resources have influenced primary schools' spreading. First, because of low economic resources, municipalities may not have been able to favour the creation of these schools. [Grew and Harrigan, 1991](#), tried to evaluate correlations between social, economic factors and the level

¹⁸More information on this survey is available in [[Marin and Marraud, 2011a](#)].

¹⁹See [Table 11](#) in the Appendix to have the summary statistics of all variables used in this study.

of enrolment rate at the department level in nineteenth-century France. They identified a positive correlation between resources and enrolment, meaning that richer departments tended to be characterised by a higher enrolment ratio. This correlation becomes negligible from the 1880 years onwards, which is interpreted by the authors as illustrating the major steps towards education equality undertaken after Ferry laws. [Furet and Ozouf, 1977b](#), focusing at the level of departments or dioceses, identified for the same period a positive link between agricultural resources and the degree of literacy. In rural areas, financial capacities of municipalities were increased by the presence of common goods owned by them, especially common woods that constituted a great source of wealth. In the department of Vienne, for example, the areas exhibiting higher rates of literacy are often those characterised by the presence of chestnut groves. The same idea is also present in [[Guizot, 1834](#)].

Another economic barrier was constituted by the level of schooling fees. As presented in [[Furet and Ozouf, 1977a](#)], these fees were paid by parents to the teacher each month. They constituted one of the major parts of teachers' treatment in areas where they were provided with no fixed salary. Parents paid in proportion to the time spent at school and to the number of subjects their children were learning²⁰. Therefore, parents could pay the minimum fees so that their children were only learning to read while others could pay high fees to study additional subjects as history or linear drawing²¹.

Therefore, ideally, one would like to be able to distinguish between the wealth of municipalities and the purchasing power of families. Indeed, the first one could have contributed to increase the instruction supply of municipalities while the second one could have influenced positively the demand for instruction expressed by families by alleviating the relative cost of schooling. I will try to distinguish between the two by using data on industrial workers wages and taxes on industrial activities collected by municipalities. Both these transmission channels can be gathered into an "income effect" induced by economic activities.

Municipalities and families could also invest more in primary instruction because they anticipated high returns from economic activities²², because of morality concerns, because they intrinsically valued instruction²³, ... The imitation of nearby municipalities investing more in education could have also played a role. Distinguishing between these motivations will not be part of this analysis as it is difficult to know precisely the motivations of local authorities and families. One sure thing is that the opinion towards instruction evolved positively from the Revolution period onwards. This certainly contributed to favour primary schools spreading by

²⁰This was made possible as, at that time, the learning was thought in a more linear way than nowadays. For example, reading and writing were rarely learnt together, a pupil was beginning by learning how to read before learning how to write properly. In this context, many of them actually only learned how to read without undertaking the next step.

²¹A decomposition of these fees for the villages of Bidart in Basse-Pyrénées and of Jouy in Eure-et-Loir can be found in [[Furet and Ozouf, 1977b](#)]. In the first case, parents had to pay 50 cents of francs per month so that their children could learn how to read, 75 cents to read and write, 1 franc to read. In the second, the decomposition was more complex as payments in kind in the form of loaves of bread were also accepted.

²²Even if the evaluation of these returns by families is far from obvious [[Jensen, 2010](#)].

²³One could even imagine that parents were sending their children to school in order to have somebody else looking after them while they were working.

making education more accepted and valued among people²⁴.

4.2 Econometric Model

In this study, I will focus on the beginning of the nineteenth century for three reasons. First, after 1833, the relation between industrial activities and education could be biased by the impact of the Guizot reform. Second, no data at the municipal level are available further back in time. Thirdly, since industrialisation began in the early nineteenth century in France, it would make less sense to study its interaction with primary schooling before this time period. This could be seen as an issue as schools may have been created before economic activities developed. However, even if it were the case, one must remember that teachers were highly dependent on fees paid by families and on the potential financial help delivered by municipalities. Thus, if these municipalities were not able to support them or parents not able to afford to pay fees, teachers could be forced to move in another area²⁵. This was entailing the disappearance of the school. Therefore, at some point, a sufficient amount of wealth was needed either to create a primary school or to maintain it. The estimations will capture both effects: either the direct effect of economic resources on the creation of schools or the indirect one on their maintaining. As seen before, the pattern of education was quite stable over time and differed from the one of industrial activities at the level of French departments. Therefore, there is *a priori* no strong reason to believe that primary schools were influencing manufactures location at the beginning of the nineteenth century. This location was more dependent on the proximity of deposits, commercial networks, and canals, royal roads, ... Moreover, early industrialisation was shown to have been more dependent on upper-tail knowledge in the case of France than on the average literacy, especially for what regards the implementation of modern sectors [Squicciarini and Voigtländer, 2015]. This gives credit to the reliability of the impact evaluation of industrial activities on primary schooling through OLS estimations²⁶. However, since several studies have found a positive correlation between literacy, the height of conscripts (which can be taken as an anthropometric approximation for economic resources) [Aron et al., 1972], [Ladurie et al., 1976], [Ladurie and Demonet, 1980], taxes [D'Angeville, 1836], agricultural and commercial resources [Lepetit, 1986], one cannot totally reject the reverse causality issue.

Therefore, I will instrument industrial activities by the presence of iron, coal and copper deposits. These latter constituted the three main types of ore that were exploited at the beginning

²⁴Still, this effect of this positive "atmosphere" shouldn't be over-evaluated. For example, primary schooling and education have remained for a long time a small part in the budget of municipalities compared to civil servants wages or public works, even if some towns like Mulhouse were exceptions. Around one-fifth of the public budget was dedicated to schooling in 1840 in this city [Suteau, 1995].

²⁵In the autobiography of [Meunier, 1981], a teacher from the Eure-et-Loire department, this precariousness of teaching appears clearly, especially at the beginning of his career during which he remained an itinerant teacher. Even after that, when several schools were created in the municipality in which he was settled, the battle teachers were all engaged in to attract children and benefit from fees made their activity unstable. The memoirs of Louis-Arsène Meunier were not published until 1981. He lived between 1801 and 1887.

²⁶See also [de Pleijt and van Zanden, 2016], [Mokyr, 2005], [Baten and van Zanden, 2008] and [Allen, 2003] for a global analysis at the European level, [Mitch, 1993] for the British case. This latter estimated that, in 1841, only 4.9% of men and 2.2% of women in England were employed in jobs where literacy was absolutely required. Around half of men were employed in jobs where it had nearly no chance of being useful.

of the nineteenth century. Indeed, at the municipal level, the concern for reverse causality is even higher. It is likely that industrial factories were created in towns and villages with schools because manufacturers were looking for an instructed labour-force or because the presence of a school was contributing to fixing workers, which made them more easily handled. On the other hand, one can also imagine that manufacturers were reluctant to implement their factories in municipalities with schools as an educated workforce would have claimed for higher wages or because this would have reduced the availability of child labour.

The agricultural variables at the district level are not instrumented as it is unlikely that the presence of a primary school in a given municipality influenced greatly the agricultural characteristics of a district. On the other hand, it is true that if primary schooling was well-developed in a district, it may have positively influenced the adoption of new techniques making agricultural activities more profitable. However, as mechanization was very low at that time [Démonet, 1990], this issue is of little concern here. Therefore, agricultural characteristics corresponded above all to the intrinsic suitability of land that was unlikely to be greatly influenced by the spreading of instruction.

At the end of the day, the second-stage estimation equation is :

$$School_{m,d} = \alpha_d + \beta_1 Industry_{m,d} + \beta_2 Demo_{m,d} + \beta_3 Agr_{arr,d} + \epsilon_{m,arr,d} \quad (1)$$

where $School_{m,d}$ is a dummy variable which equals one if a primary school is present in a given municipality m within a department d . α_d captures fixed effects at the level of departments. I will introduce them in order to improve estimations by controlling for un-observables at the department level. For example, the fact of being close to the sea or to the frontier could entail a higher wealth for municipalities through trade activities. $Industry$ is a dummy variable which equals one if a factory is present in municipality m , $Demo$ is a set of demographics and geographical variables defined at the municipal level. Agr is a set of agricultural variables defined at the level of districts. Standard errors are indexed by arr because they are clustered at the district level. This is done in order to account for spatial correlation within them. Indeed, as the agricultural variables are defined at a more aggregated level than municipalities, not doing so could cause the standard errors to be seriously biased downward and lead to spurious findings. This may happen for example if the micro units (the municipalities) share some unobservable characteristics in a given group (district) when the estimation is done by OLS [Moulton, 1986], [Moulton, 1990]. This is also true when the estimation is done with instrumental variables techniques [Shore-Sheppard, 1996], [Hoxby and Paserman, 1998]²⁷. For example, the long-term effect of Protestant settlement and the use of a patois are identified in the literature as having influenced schooling spread²⁸. Therefore, standard errors are very

²⁷I tried many of the econometric estimations that are presented without clustering, using only robust standard errors. Outcomes were indeed most of the times significant as standard errors were much lower than the ones found with clusters at the district level.

²⁸Indeed the effects of the Reform and Counter-Reform are found to have had a positive effect on schools. See for example [Laget, 1971] in the case of Bas-Languedoc. Moreover, at the beginning of the nineteenth century,

likely to be correlated within districts as they could share some unobservable characteristics influencing primary schooling. Contrary to department fixed effects, this will not influence the magnitude of coefficients estimated.

The estimation framework of the first stage is the same as in (1) :

$$Industry_{m,d} = \alpha_d + \beta_1 Instr_{m,d} + \beta_2 Demo_{m,d} + \beta_3 Agr_{arr,d} + \epsilon_{m,d} \quad (2)$$

where $Instr_{m,d}$ is a dummy variable taking the value "1" if a deposit is present in the municipality m , this deposit being exploited or not. These data are coming from the *Bureau de Recherche Géologiques et Minières*. This estimation will be done using a standard two-stage least squares technique. As $Industry$ is a dummy variable, one might have wanted to use a non-linear estimation, as Probit or Logit. However, as presented in [Angrist and Pischke, 2008], this kind of regression is technically off-limits.

4.3 Choice of dependent variables and expected effects

For what regards demographic and geographic variables, I control by the average altitude of municipalities, their surface area, their total population and by the share of their population that is considered to be scattered. This last measure is coming from the postal survey and based on a simple contiguity criterion. Houses not contiguous to others were considered as remote and their inhabitants as part of the dispersed settlement²⁹. If a high proportion of them were scattered, this could have made the creation and maintaining of a primary school more difficult as children had to cover long distances to attend school³⁰. If this contributed to reducing the fees teachers were receiving from parents by decreasing the number of pupils, it then should have been financially harsher for teachers to establish in this locality. Moreover, scattered settlement can have led to a lower valuation of schooling by inhabitants, which could be due to financial difficulties or a cultural distance to primary schooling, as Lorain, 1837, an inspector during the Guizot Survey, reported it. Therefore, I expect the scattering of the population to have influenced negatively the presence of primary schools by reducing attendance and teachers' earnings. Descriptive statistics tend to reinforce this logic as the population of municipalities with primary schools was more often characterized by a low dispersion than those with no

the strong presence of a patois was identified by social observers as a barrier to the spread of instruction. Evidence seems to comfort this point of view as, for example, in the case of Morbihan, the fact of speaking Breton compared to French was correlated with a lower literacy rate, for any kinds of profession. However, when looking at Flemish-speaking areas, this was not the case. The effect of patois acted through the written tradition linked to it. As Breton was mainly characterized by an oral tradition, this made it more difficult for children to attend primary schools than Flemish-speaking or German-speaking ones that could first learn to read and write in Flemish or German and then in French[Furet and Ozouf, 1977a].

²⁹This definition may be considered imprecise as it doesn't encompass a clear distance reference and was subject to negotiations between financial administrations and local powers [Roncayolo, 1987].

³⁰This idea is present in [Furet and Ozouf, 1977b] and its effects may have been long-lasting. Indeed, drop-out rates in secondary education in France in the second part of the twentieth century were still closely linked to the dispersion of settlement [Darbel, 1967].

schools ³¹.

The altitude of municipalities may have played the same negative role. Indeed, a mountainous land was associated with less good-quality roads and a less fertile soil, which was certainly diminishing the economic resources of municipalities and their ability to trade with others. Therefore, I expect these municipalities to have invested less in instruction. Moreover, it was certainly harder for children to cover long distances to attend school in this kind of land. However, isolation and long winter months in mountainous areas could give people more time to learn and make teaching activities economically valuable compared to hard agricultural tasks. This seems to be what prompted so many people from the Hautes-Alpes department to become teachers and what explains its very high literacy rate [Sandre and Ozouf, 1979]. The effect of the surface area is *a priori* unclear as it could have favoured population dispersion but also increased the possibility to develop agricultural activities, to exploit forests, to build manufactures, ...

Population effect should be clearer since it entailed a potentially higher number of pupils. On top of that, bigger towns are often economically more active and richer than smaller ones. For example, in the department of Seine-et-Marne, the literacy rate was of 70% and 76% for males under 25 years old and over 30 years old in urban areas while they were of 55.5% and 62% respectively in rural ones. The same pattern was true for women (69.6% and 50% in urban towns against 35% and 9% in rural regions). All these effects are confirmed at the descriptive level since towns with primary schools were more populous and localised at a lower average altitude while their surface area was on average not significantly different from the one of towns without schools ³².

Agricultural variables are used mainly as district-level wealth controls. It is necessary to introduce them in the estimations as many municipalities have developed primary schooling without any link with industrial activities. There are indeed 933 cases of municipalities with at least one industrial factory over 8 129. 79% of the municipalities with a factory were also characterized by the presence of a school while it was the case for 57% of the municipalities with no industry. However, at the same time, there were 4 098 cases of towns with a primary school and no industry over the 4 836 cases with schools³³. Therefore, I use agricultural variables to have a more exhaustive measure of the economic resources of municipalities³⁴. I try to capture both the effect of agricultural resources and of the production organisation.

Agricultural resources will be proxied by the average agricultural land value and by the percentage of day-workers family spendings dedicated to food consumption³⁵. High land prices should

³¹see Table 12 in the Appendix.

³²see Table 13 in the Appendix.

³³See Table 14 in the Appendix.

³⁴In the district of Coulommiers for example, in the Seine-et-Marne department, 12% of the municipalities were characterized by the presence of a factory but 92.5% by the presence of a primary school. At the same time, the average value of agricultural land was higher than the mean one (1 930 francs per hectare against 1 699 francs). This exemplifies the fact that agricultural resources may be useful in explaining schooling spread in districts, along with the presence of factories.

³⁵Demonet, 1990 tries to measure the valued added of agriculture in his work, making a lot of assumption on intermediary consumptions and total final production. Finally, he finds that agricultural wealth is well

have been linked to higher economic resources of municipalities, through property taxes, and then potentially contributing to a higher investment in primary schooling. Food consumption should reveal the capacity of families to invest in primary instruction. Indeed, at that time, the ratio of earnings dedicated to food could be close to 80% for the poorest families³⁶. This was leaving not much room for schooling investment. Therefore, this variable measures the purchasing power of agricultural workers and the economic constraint hanging over them and is expected to have influenced negatively primary schooling.

The production organization is measured by the number of day-workers, of tenant-farmers and of share-croppers respectively to one-hundred self-employed³⁷. I use these data to control for inequalities potentially affecting schooling investment. Indeed, if agricultural workers were abundant compared to landowners, this could have entailed very low means of pressure to demand high wages or a low compensation in order to work the land, implying a lower financial capacity to invest in primary schooling. Following this logic, a high concentration of share-croppers and day-workers has been found to be closely linked to relative impoverishment in the literature [Furet and Ozouf, 1977b](#)³⁸.

5 A Positive Influence of Economic Activities on Primary Schools

5.1 OLS Estimations

In [Table 1](#), I regress the presence of primary schools on economic, demographic and geographic variables without using any instruments. This regression exhibits some effects that will be verified all along this study. First, for what regards demographic and geographic characteristics of municipalities, one can see that the average altitude along with population dispersion were negatively influencing the probability of primary schools presence. One standard deviation in each of these variables was contributing respectively to a 4 and 8 percentage points decrease of this probability. On the contrary, total population had a strong and positive impact on it, of around 12 percentage points.

The effect of agricultural variables is also quite in compliance with what was expected. Indeed, the relative number of share-croppers and tenant-farmers is negatively linked to the presence of primary schools. This is in line with recent studies on the American development [[Galor et al., 2009](#)] or analysis in development economics [[Deininger and Squire, 1998](#)]. Total agricultural area and the number of animals per inhabitant had also a negative impact. This seems coherent with the fact that schools developed more in urban areas. Moreover, as looking after cattle was a task historically dedicated to young children, it seems logical that primary schooling was less

measured by the purchasing power of workers.

³⁶See [[Villermé, 1971, 1840](#)] in the case of industrial workers.

³⁷See the Appendix to have definitions of these categories along with the average area per self-employed. The total agricultural surface area is also controlled for.

³⁸Descriptive statistics on agricultural variables tend to confirm these intuitions. See [Table 15](#) in the Appendix.

likely to develop greatly in districts where more children were working at young ages.

The effect of industrial variables is always positive and significant. The presence of at least one factory was increasing the probability to have at least one primary school in the same municipality by 8.4 percentage points. A one unit increase in the total number of factories was leading to a 2 percentage point increase of the same probability. Finally, the presence of a factory with more than 20 workers (the 37% biggest ones) was increasing this probability by 7.3 percentage points. This shows that industrial activities were linked to a higher spreading of primary schools and that this effect was greatly due to the presence of large factories. Indeed 319 industrial workers were on average employed in municipalities with factories more than 20 workers, with a median value of 104 workers. All these estimations suggest a positive link between agricultural, industrial, economic activities and the presence of primary schools. In the section dedicated to transmission channels, I will show why this can be due to an income effect, valid both for municipalities and families³⁹.

³⁹Ideally, one would like to decompose the effect of manufactures on primary schooling by taking other thresholds on the number of workers. However, this would amount to restricting data too much for any econometric analysis. For example, there are only 194 cases of municipalities with factories more than 20 workers and less than 50. This is why I will take into account factories more than 20 workers, which represent approximately one-third of all manufactures.

Table 1: Industrial factories, big-size factories and primary schools. Standardized variables, OLS estimations.

	(1)	(2)	(3)
	Primary School	Primary School	Primary School
Industry	0.084*** (3.370)	–	–
Number of factories	–	0.020*** (4.420)	–
Factories > 20 workers	–	–	0.073** (2.535)
Percentage of population scattered	-0.080*** (-3.273)	-0.079*** (-3.257)	-0.080*** (-3.272)
Population	0.119** (2.163)	0.120** (2.187)	0.122** (2.219)
Surface area in hectares	0.014 (0.648)	0.015 (0.695)	0.015 (0.690)
Average altitude in meters	-0.037** (-2.011)	-0.038** (-2.029)	-0.038** (-2.072)
Day-workers per 100 self-employed	-0.019 (-0.505)	-0.018 (-0.486)	-0.019 (-0.513)
Share-croppers per 100 self-employed	-0.056* (-1.974)	-0.058** (-2.043)	-0.057** (-2.011)
Tenant farmers per 100 self-employed	-0.041** (-2.320)	-0.042** (-2.393)	-0.042** (-2.385)
Average land area per self-employed	0.005 (0.150)	0.005 (0.171)	0.007 (0.244)
Total agricultural area	-0.058* (-1.873)	-0.058* (-1.840)	-0.058* (-1.850)
Land value by hectare	0.070*** (2.957)	0.070*** (3.001)	0.070*** (2.999)
Food % in day-workers family spendings	-0.041 (-1.415)	-0.041 (-1.405)	-0.041 (-1.394)
Animals per inhabitant	-0.079*** (-4.816)	-0.079*** (-4.841)	-0.079*** (-4.833)
Department fixed effects	No	No	No
District fixed effects	No	No	No
Number of clusters	88	88	88
Observations	6718	6718	6718
R^2	0.216	0.216	0.215

t statistics in parentheses

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

Source : Agricultural, industrial, postal and Guizot surveys. IGN data.

Note : *Primary school* is an indicator variable which takes value 1 if at least a primary school is located in the municipality at stake. *Industry* and *Factories > 20 workers* are also dummy variables taking value 1 if a manufacture (more than 20 workers) is present in the given municipality. All variables are standardized, except the indicators.

5.2 Instruments' Validity

As presented in (2), I use the location of coal, iron and copper deposits to instrument the presence of industrial factories. These deposits are present in 237 municipalities. Over these 237 cases, a factory is located in the same municipality in 81 cases. The idea here is that factories could have been present in the same municipalities as they were exploiting directly these deposits (55 cases over 81). Another reason explaining this correspondence would be that mining activities attracted other industrial factories (as clothing, food industry, ...) because, by fixing the labour-force, they were creating some outlets for these other sectors. Then, these activities may have continued to exist, even if the deposit was depleted and mining factories closed. It is also possible to imagine that some industries were randomly present in municipalities where deposits were localised. This could be true in the case of non-exploited deposits. Following [Murray, 2006], I check the validity and the strength of this instrument.

First, for what regards the validity, I regress the presence of primary schools on that of deposits⁴⁰. The effect is always positive, around 6%, and significant at a ten-percent level. This illustrates the link between deposits and schools that is expected to be due to the presence of industrial factories. The exclusion restriction will be satisfied only if deposits didn't influence directly the creation of schools⁴¹. It seems difficult to argue so, except if one thinks that schools needed ores for their functioning, which is unlikely. However, the presence of deposits could be linked to geographical characteristics that were influencing the presence of schools. For example, if they were located in more mountainous and difficult-to-access lands, this could have deterred municipalities or teachers to open a school. This could have been the case as the population was significantly more scattered (55% against 47%) and average altitude significantly higher (250 against 206 meters) in municipalities with ore⁴². These two characteristics were found in Table 1 to be negatively correlated with the presence of primary schools. However, at the same time, the total population was significantly higher in the municipalities with ore, which was found to be positively linked to the location of schools. Therefore, it is hard to believe that the presence of deposits influenced greatly, significantly, and in a clear direction the presence of schools. Moreover, since schools were localised in the same municipalities as deposits in 164 cases over 237 and as I found a positive and significant link between them in the previous regression, this issue shouldn't be too high.

Still, one could argue that manufacturers were looking for both a primary school and a deposit, since exploiting ores could require a more skilled workforce than, for example, food or clothing sectors. This idea can be directly tested by regressing the presence of industry on an interaction term composed of the location of schools and deposits. This is what is done in Table 2. The effect of the interaction term is never significant. On the contrary, the presence of a deposit is always strongly significant and positive, increasing the probability for a factory to be present in the same municipality by around 15 percentage points. Therefore, the exclusion restriction

⁴⁰In all these regressions, I control for the same variables than in the previous OLS estimations. I don't report them for the sake of simplicity. Results are displayed in Table 16 in the Appendix

⁴¹And if the presence of primary schools didn't influence that of deposits, which is unlikely.

⁴²See the t-tests performed in Table 17 in the Appendix.

seems to be valid here, which makes the use of deposits as an instrument reliable.

Table 2: Presence of schools, deposits and industrial factories

	(1)	(2)	(3)
	Industry	Industry	Industry
Primary School	0.00979 (0.85116)	0.03395*** (3.28381)	-0.00165 (-0.16837)
Presence of a deposit	0.14584*** (2.66080)	0.16877*** (3.08791)	0.15583*** (2.76156)
School*deposit	0.00429 (0.06136)	-0.00883 (-0.13604)	0.01284 (0.18675)
Agricultural controls	No	Yes	Yes
Demographic and geographic controls	Yes	Yes	Yes
Department fixed effects	No	No	Yes
District fixed effects	Yes	No	No
Number of clusters	91	88	88
Observations	6723	6718	6718
R^2	0.156	0.053	0.105

t statistics in parentheses

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

Source : Agricultural, industrial, postal and Guizot surveys. IGN and BRGM data.

Note : *Industry* is an indicator variable which takes value 1 if at least a manufacture is located in the municipality at stake. The presence of a deposit contributes to increase the probability for a factory to be located in the same municipality by around 15%.

5.3 A Stronger Effect with IV Estimations

In [Table 3](#), I regress the presence of primary schools on that of industrial factories and agricultural characteristics using the instrumental variable strategy presented. In all the cases, the presence of ore is significantly linked to that of industries in the first stage. The Sanderson-Windmeijer *F-stat* is superior to ten in the two last cases⁴³ which tends to exclude the issue of weak instrument. This also prevents the estimations to be greatly biased if the presence of deposits is even slightly directly correlated with the localisation of primary schools [[Bound et al., 1995](#)]. The *Regression based p-value*⁴⁴ is inferior or close to 10% which means that I can reject the exogeneity hypothesis of the *Industry* variable.

The influence of the presence of industrial factories is always positive and significant at a ten-percent level, with a magnitude between 35 and 39 percentage points, which is much higher than the effect estimated by OLS. As 56.95% of the municipalities without industry had a primary

⁴³Even if close to ten in the last one. Another rule of the thumb consists in looking at first-stage t-statistics and considering that the issue of weak instruments is avoided when it is superior to 3.5. This is the case in the second specification and close to be in the third.

⁴⁴It relies on a test robust to clustering developed by Wooldridge.

school, this means that if industrial factories were to be present in each of these municipalities, primary schools would be located in almost every one of them too. I interpret this as being due to the fact that factories were localised in municipalities where economic activities were more developed compared to others. Therefore, the economic resources of these towns were sufficient to open and maintain a primary school. This idea is reinforced by the fact that 90% of the municipalities in the data were less than 2 000 inhabitants while it was the case for 70% of them when at least one industrial factory was present⁴⁵. As robustness checks, I tested the same specification but taking into account the absolute number of agricultural workers, the number of agricultural machines and decomposing land value between its different components. This doesn't lead to significantly different outcomes⁴⁶.

When interpreting the effect of factories' presence, it is interesting to look at its magnitude on the stock of primary schools. As the factories were located in 11.48% of the municipalities, and that this increased the primary schools' presence probability by 38.9 percentage points, this means that the effect of manufactures on the stock of schools is of (11.48×38.9) 4.5 percentage points. This implies that over the 59.5% of municipalities in which at least one primary school was present, 4.5 percentage points of them could be explained by the dynamism of economic activities measured by the presence of factories. This amounts to around 370 municipalities over the 4 836 in which a school was present.

⁴⁵The t-test on population size reveals a significant difference at a one-percent level between municipalities with factories, 2 259 inhabitants on average, and municipalities without, 829 inhabitants on average.

⁴⁶See [Table 18](#) in the Appendix.

Table 3: IV estimation - Presence of industrial factories and primary schools. Standardized variables

	(1)	(2)	(3)
	Primary School	Primary School	Primary School
Industry	0.393*	0.389*	0.353*
	(1.789)	(1.840)	(1.785)
Agricultural controls	No	Yes	Yes
Demographic and geographic controls	Yes	Yes	Yes
Department fixed effects	No	No	Yes
District fixed effects	Yes	No	No
Number of clusters	91	88	88
First-stage, dependent variable is the presence of industrial activities			
Presence of ore	0.149***	0.165***	0.164***
	(2.86)	(3.74)	(3.29)
Observations	6723	6718	6718
R^2	0.156	0.051	0.105
$F - stat$	8.112	13.860	10.729
Regression-based p-value	0.073	0.135	0.069

t statistics in parentheses

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

Source : Agricultural, industrial, postal and Guizot surveys. IGN and BRGM data.

Note : The instrument is the presence of iron, copper and coal deposits. The dependent variable is always the location of primary schools in a given municipality.

In order to specify this effect, one can look at the influence of mining activities on schools. Indeed, as the instrument used here is the presence of deposits, it is strongly correlated with the localisation of these activities⁴⁷. From a descriptive point of view, there is a clear link between mining activities and primary schools as nearly 80% of the municipalities in which mines were present were also characterized by the presence of a primary school. Therefore, there were only a few towns with mining activities but no schools. In Table 4, I use the same specification to measure this relation⁴⁸. A significant and positive effect is found, the presence of mining activities increasing by around 30 percentage points the probability for a primary school to be found in the same municipality. This reinforces the idea of a positive effect of industrial activities on the development of primary schooling⁴⁹. This effect is therefore greatly due to the mining sector, which is logical given the nature of the instrument used. Moreover, this helps to understand the high magnitude of the IV coefficients. Indeed, 11.5 factories were on average present in municipalities with mining activities against 3.6 in those with industrial

⁴⁷A correlation of 0.3494 significant at a one-percent level.

⁴⁸The level of the $F - stat$ is higher in each estimation, even if the exogeneity-test p-value is always higher than 10 percent.

⁴⁹The stock interpretation is less interesting here as mining activities were present in only 1.21% of municipalities.

activities but belonging to other sectors⁵⁰. This implies a potentially high amount of resources transferred to these municipalities through taxation.

In the same table, I also report estimation coefficients of the relation between the presence of large factories with more than 20 workers, and the location of primary schools. Descriptively, there is a positive relation between the two since 81.6% of the municipalities with a big-size factory were characterized by the presence of a primary school. Even if the effect is not significant in the second specification, the presence of these factories was entailing an increase of around 42 percentage points of the primary schools' presence probability when department fixed effects are introduced. This higher effect is coherent with what was expected since large factories were more likely to attract, be attracted by and to develop along with other activities. Therefore, the income effect potentially induced by industrial production was likely to be higher when manufacturers were employing more people.

Table 4: IV estimation - Mining activities, large factories and primary schools.

	(1)	(2)	(3)	(4)	(5)	(6)
				Primary School		
Mining activities	0.319* (1.925)	0.342* (1.858)	0.312* (1.860)	–	–	–
Factories > 20 workers	–	–	–	0.467* (1.727)	0.444 (1.599)	0.418* (1.694)
Agricultural controls	No	Yes	Yes	No	Yes	Yes
Demographic and geographic controls	Yes	Yes	Yes	Yes	Yes	Yes
Department fixed effects	No	No	Yes	No	No	Yes
District fixed effects	Yes	No	No	Yes	No	No
Number of clusters	91	88	88	91	88	88
First-stage, dependent variable is :	Mining activities			Large factories		
Presence of ore	0.184*** (3.87)	0.188*** (4.04)	0.186*** (4.02)	0.125*** (3.19)	0.144*** (3.71)	0.139*** (3.49)
Observations	6723	6718	6718	6723	6718	6718
R^2	0.141	0.108	0.117	0.100	0.035	0.060
$F - stat$	14.843	16.107	15.990	10.102	13.579	12.023
Regression-based p-value	0.257	0.147	0.141	0.075	0.115	0.066

t statistics in parentheses

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

Source : Agricultural, industrial, postal and Guizot surveys. IGN and BRGM data.

Note : The instrument is the presence of iron, copper and coal deposits. The dependent variable is always the location of primary schools in a given municipality.

⁵⁰The difference between the two being significant at a one-percent level. This is coherent with what was found in other studies on the effect of mining activities, and especially coal, on the development of cities [Fernihough and O'Rourke, 2014].

So far, I have shown that industrial activities were influencing positively the presence and maintaining of primary schools. The influence of geographic and demographic characteristics of municipalities was also far from being negligible. Several transmission channels can be thought of in order to explain this relation : cultural proximity with education, higher expected returns from families and local authorities, direct investment of businessmen into schooling, a higher demand for an educated workforce where activities were dynamic, an income effect through taxes and a higher purchasing power of workers, ...

Among them, the last one seems to be the most relevant economically. Indeed, if a high demand for skills in economic activities entailing both a greater investment of businessmen into schooling and higher education returns for families existed historically, it seems that it characterized rather the second phase of the industrialisation process⁵¹. The first phase, at the beginning of the nineteenth century, was rather characterized by an accumulation of physical capital, with a low complementarity with human capital [Mitch, 1993]. The increase of this complementarity in the second phase, beginning rather in the 1860s-70s in the case of France, is considered as explaining the rise in industrial wages along with the fall in rental value and inequalities [Allen, 2009], [Galor and Moav, 2006]. Therefore, it seems unlikely that primary schools developed along with economic activities following the logic of complementarity and of demand for skills.

6 Transmission Channels : the Income Effect

In order to study the income effect of industrial activities, I will distinguish between economic resources of municipalities and the purchasing power of families. If this effect is verified, each of them should be linked to a higher investment in primary schooling. One should also note that both were surely working at the same time since the cost of education was lower if both families and municipalities were investing in it. For example, families could certainly invest more in education if local authorities were paying teachers regularly, contributing to the decrease of schooling fees.

6.1 Economic resources of municipalities

To study the income effect, one can look at the level of investment in primary schooling made by municipalities. They should have been able to afford to pay teachers on a regular basis, providing them with an accommodation more often, paying them a higher salary ... when they were richer⁵². From a descriptive point of view, municipalities with factories were more often

⁵¹The greater investment of businessmen into the schooling system was also due to the will to bypass factory laws aiming at regulating child work. This was especially the case in France after the passing of the 1841 law, the first one defining bounds on the length of day-work for children depending on their age for all industrial sectors.

⁵²Technically, municipalities could choose to invest more in instruction even with no income effect and therefore simply organize their budget in favour of primary schooling with the same level of resources. In that case, schooling investment would reflect only a higher preference for primary schooling in these municipalities. However, it is in any case likely that this investment was permitted by higher economic resources, as municipalities

paying teachers on a regular basis (53% of them against 37% when no industry was present), providing them more often with an accommodation (40% against 27%) and a classroom (45.2% against 37%)⁵³. It is also worth noting that, on average, municipalities with a school but no industry were providing teachers with a low annual fixed salary of 147 francs, compared to the minimum level of 200 francs subsequently implemented by the Guizot Law. This level was on the contrary already attained and surpassed in towns with schools and factories, with an average salary amount of 262 francs. The same is true for agricultural resources since municipalities where a fixed salary and an accommodation were granted to teachers belonged to districts in which day-workers' remuneration and land value were higher, the agricultural area smaller but more equally divided between self-employed⁵⁴.

In order to check the causality of this effect, I regress in [Table 5](#) the probability for a teacher to have a fixed salary on the presence of industrial factories. I keep all the observations here and not only the cases of municipalities with a primary school. Therefore, I capture two effects at the same time. First, compared to municipalities with no schools, the influence of industrial activities on the opening of a school with a teacher paid on a regular basis. Second, compared to municipalities with schools but no regular salary, the influence of these activities on the probability to pay teachers regularly. I am forced to do so since the instrument becomes too weak when focusing only on municipalities with schools.

The effects are in compliance with what was found previously. The impact of industrial factories presence is of around 40 percentage points. As teachers paid on a regular basis were present in 37% of the municipalities without industry (2 665 over 7 196), this means that the generalization of industrial production would have theoretically entailed a globally shared financial capacity to pay teachers. In stock terms, as paid teachers were present in 38.92% of the municipalities, this means that (45.3×11.48) 5.2 percentage points of them can be explained by the presence of factories. This figure is higher than the stock contribution of factories to primary schools. This is coherent with the idea that paying teachers regularly was financially more demanding than simply creating a primary school. Consequently, the explanatory power of the income effect is higher here. The influence of economic activities was therefore not limited to the creation of schools, influencing also their organization and their functioning. The effect is also verified taking into account large factories or mining activities, with a slightly higher magnitude in the former case⁵⁵.

were most of the times enable to invest vastly in education.

⁵³See [Table 19](#) in the Appendix.

⁵⁴See [Table 20](#) in the Appendix.

⁵⁵See [Table 21](#) in the Appendix.

Table 5: IV estimation - Presence of industrial factories and fixed salary. Standardized variables

	(1)	(2)	(3)
	Fixed salary	Fixed salary	Fixed salary
Industry	0.395*	0.453*	0.390*
	(1.924)	(1.860)	(1.959)
Agricultural controls	No	Yes	Yes
Demographic and geographic controls	Yes	Yes	Yes
Department fixed effects	No	No	Yes
District fixed effects	Yes	No	No
Number of clusters	91	88	88
First-stage, dependent variable is the presence of industrial activities			
Presence of ore	0.149***	0.165***	0.164***
	(2.86)	(3.74)	(3.29)
Observations	6723	6718	6718
R^2	0.156	0.051	0.105
$F - stat$	8.112	13.860	10.729
Regression-based p-value	0.053	0.067	0.041

t statistics in parentheses

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

Source : Agricultural, industrial, postal and Guizot surveys. IGN and BRGM data.

Note : The instrument is the presence of iron, copper and coal deposits. The dependent variable is always the presence of a teacher paid on a regular annual basis in a given municipality.

If these municipalities were more capable to invest in instruction, it is because economic activities were directly contributing to municipal resources through the taxes collected on these activities, the *patente*⁵⁶. The basis of this tax was incomes coming from trade and industrial activities. However, it is only by means of rental value that these resources were taxed⁵⁷. If the income effect put forward is verified, then municipalities collecting more taxes on economic activities should also be those investing greatly in primary schooling. Descriptively, this is indeed the case as both production value and taxes on this production were higher in towns with schools, where a fixed salary or an accommodation were provided to teachers⁵⁸. For example, these taxes amounted on average to 123 francs per year in municipalities paying teachers regularly against 60 francs in those which didn't. The figures for what regards accommodation

⁵⁶One of the four direct taxes, the *quatre vieilles*, implemented by the Assemblée Constituante in 1791, along with the land tax, the personal property tax and the tax on doors and windows (implemented in 1798).

⁵⁷The *patente* amounted to a percentage between 10 and 15% of this rental value of industrial buildings. An additional component depended directly on the number of workers and engines used in the production process [Chanut et al., 2000]

⁵⁸See Table 22 in the Appendix.

are respectively 167 and 51 francs. Therefore, the municipalities that were investing more in education were also those whose economic resources coming from industrial activities were the highest. These municipalities were also more likely to collect a large amount of taxes on other economic activities.

The use of simple OLS shows that taxes on industrial activities were linked to a higher investment in primary schooling. In [Table 6](#), one can see that municipalities with schools were more likely to pay teachers on a regular basis and were paying them more if industrial taxes collected were high⁵⁹. One standard deviation increase in the amount of taxes collected was increasing the probability to pay teachers regularly by 6 percentage points, while it increased their salary by an amount between 25 and 30 francs. This positive effect of taxes explains also why the presence of large factories was influencing highly primary schooling. Indeed, production value and taxes collected on manufactures were about ten times higher in municipalities with large factories than in municipalities with factories but less than 20 workers⁶⁰. However, I find no significant effect of taxes on primary schooling using the same instrumental variable strategy used previously. The corresponding coefficient is always close to being significant at a ten-percent level but still remains non-significant.

Table 6: Fixed salary, fixed salary amount and industrial taxes. Standardized variables.

	(1)	(2)	(3)	(4)
	Fixed salary	Fixed salary	Salary amount	Salary amount
Taxes on industrial activities	0.060** (2.285)	0.063*** (3.057)	30.906** (2.179)	24.598** (2.350)
Agricultural controls	Yes	Yes	Yes	Yes
Demographic and geographic controls	Yes	Yes	Yes	Yes
Department fixed effects	No	Yes	No	Yes
Number of clusters	80	80	80	80
Observations	3908	3908	3908	3908
R^2	0.145	0.272	0.184	0.351

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

Source : Agricultural, postal and Guizot surveys. IGN and BRGM data.

Note : Only municipalities with schools are taken into account. One standard deviation in the amount of industrial taxes was linked to an increase of around 6% in the probability for teachers to have a fixed salary. The effect on the amount of this salary is between 25 and 30 francs per year.

6.2 Purchasing Power of Workers

As pointed out before, the purchasing power of families is complementary to municipal resources in explaining primary schools presence. Thanks to industrial data, I can check if this purchasing

⁵⁹Taking into account all municipalities as before wouldn't change the results.

⁶⁰See [Table 23](#) in the Appendix.

power was higher in areas with more active economic activities. If this were the case, it would mean that families could invest more easily in instruction, making at the same time the investment of municipalities easier as a larger part of schooling costs would be borne by families. This demand-side argument shouldn't be underestimated since schooling fees could represent a high cost for families. Indeed, on average, paying the monthly fees for one child was equivalent to the daily wage of an industrial female worker, between 50% and 71% of an industrial male daily wage and between 69% and 86% of the wage of an agricultural male day-worker⁶¹.

Therefore, first, in [Table 7](#), I regress industrial workers salaries on the level of industrial taxes in order to see if the purchasing power of families was increased when industrial activities were producing more and when more resources were transferred to municipalities⁶². A standard deviation in the level of industrial taxes entailed an increase of around 27 cents of franc in the daily male industrial salary. This increase is of about 6 cents for what regards child salary, while the effect is positive but not significant for female salaries. When adding department fixed effects, this latter becomes slightly significant. However, the fact that child wages were higher could also have prompted parents into sending their children to work instead of sending them to schools, as the opportunity cost of schooling was increased. Thus, economic activities may have been detrimental to enrolment. The effect could also have been more complex as the employment of one child can have provided families with enough additional resources to pay for the schooling of the remaining ones. I will show in the next section that this issue can be partly explored with these data.

Table 7: Industrial workers wages and industrial taxes. OLS estimations.

	(1)	(2)	(3)
	Average wage industrial male worker	Average wage industrial female worker	Average wage industrial child worker
Taxes on industrial activities	27.233*** (4.990)	4.312 (1.602)	6.011*** (2.675)
Agricultural controls	Yes	Yes	Yes
Demographic and geographic controls	Yes	Yes	Yes
Department fixed effects	No	No	No
Number of clusters	80	65	71
Observations	613	278	311
R^2	0.242	0.178	0.179

t statistics in parentheses

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

Source : Agricultural, industrial, postal and Guizot surveys. IGN data.

Note : A standard deviation of industrial taxes was linked to a 27 cents of franc increase in the industrial male workers daily salary.

⁶¹See [Table 24](#) in the Appendix.

⁶²As I don't have data on prices level, I have to take salaries as a good proxy for purchasing power.

T-tests on wages tend to confirm the idea that municipal investment in primary schooling was linked to a higher purchasing power of people⁶³. Indeed, the daily wages of industrial workers were higher when schooling investment was high. This was particularly the case for men, whose wages were around 2.2 francs when a fixed salary, an accommodation or a classroom were provided to teachers, compared to 2 francs when no such municipal grants were provided. For women, wages were around one franc and 90 cents of francs in the two cases respectively.

Even if these variations in the purchasing power of families are valid descriptively, I don't find any econometrically significant effect of workers' wages on the presence of schools or on schooling investment. This is due to the fact that I can only approximate purchasing power by looking at industrial wages. However, as factories were present in 933 municipalities over 8 129, this measure is restricted to 11.5% of the municipalities. Therefore, I can only evaluate if, in municipalities with manufactures, the level of industrial wages influenced significantly schooling investment, which seems not to be the case. This is coherent with the fact that municipalities with industrial activities were investing more in education than the others. Therefore, regressing schooling investment on wages in a subset of towns where this investment was globally high is unlikely to give significant results. To conclude that the purchasing power of families didn't influence this investment at all, it would be necessary to have data on wages for all the municipalities. Here, I can simply state that municipalities with industry investing more in education were also those in which industrial workers were on average paid more. This indicates a concordance between municipal and families' resources.

7 Economic Activities and Child Work : a Diversion from Schools ?

So far, I have shown that industrial activities and resources contributed to the spread and maintaining of primary schooling, focusing on the presence of schools. However, the development of economic activities could have also led to a diversion of children from these schools, especially if families were financially dependent on child work. Historically, the early nineteenth century was marked by the beginning of the industrialisation in many countries, which has been associated in the existing literature with a potential greater reliance on this very child work. Indeed, the study of British household accounts and of a large body of biographies reveals an upsurge in child labour and a fall in the age at which children were starting to work, especially between 1790 and 1850, for both traditional and modern sectors (agriculture, small-scale manufacturing and services) [Humphries, 2012], [Humphries, 2010]⁶⁴. The same kind of phenomenon was identified in the American cotton and wool industries between 1820 and 1850 [Goldin and Sokoloff,

⁶³See Table 25 in the Appendix.

⁶⁴The employment of children during the Industrial Revolution has been questioned in the English case. The reliability of quantitative data and assumptions made about the work of farmers' children were central in this debate. On this point, see [Cunningham, 1990] and the replies [Kirby, 2005], [Cunningham, 2005]

1982]. In the case of French textile industry⁶⁵, the high reliance on child work was described as linked to the development of mechanisation and a more acute division of labour, contributing to make children more productive and their work complementary to that of adult workers. The impoverishment of families was also associated with this phenomenon, especially in cotton industry as social observers of that time already noted [Villermé, 1971, 1840] [Heywood, 1988]⁶⁶. The study of household accounts shows that subsistence for low-paid workers was only attained if they had no early age children or another person at charge. When children were present, no savings could easily be made, which prompted parents into making them work in factories in order to compensate for the burden they represented on family spendings. Even when both parents and a child were working, Villermé noted that almost 90% of the budget was dedicated to buying food and accommodation, the remaining resources being mostly dedicated to linen and to the maintenance of factory tools⁶⁷.

Therefore, in the historical and economic literature, early industrialisation, roughly between the 1790s and the 1850s, has often been evaluated as detrimental to instruction, even if the relevance of this statement is debated. One central point in this debate is to know whether industrial activities worsened the situation of children with respect to the labour market, especially compared to agricultural activities in which most of them were employed⁶⁸. All in all, economic activities are mainly presented as potentially diverting children from schools by reducing the need for skills or by increasing the dependence of families over child work through a relative impoverishment. Consequently, even if economic activities have entailed a greater investment in primary schooling, it is not obvious that it benefited to the whole population.

7.1 A Stronger Effect in Small Municipalities ...

To evaluate the effect of industrial activities on enrolment rates, I compute t-tests on this enrolment, depending on the presence of factories and high-size factories (more than 20 workers) in municipalities⁶⁹. As no data are available at that time on the age structure of the population, I take the number of pupils per 100 inhabitants as an approximation for enrolment rates⁷⁰. First,

⁶⁵Around 145 000 children under 16 years old were working in the industrial sector according to the Industrial survey, two-third of them in textile manufactures.

⁶⁶Cotton industry was rapidly expanding at the beginning of the nineteenth century in France, especially in the Haut-Rhin department, in towns like Mulhouse or villages like Thann and Dornach and, for the department of Seine-Inférieure (named Seine-Maritime nowadays), in towns like Elbeuf.

⁶⁷This link between economic resources of families and work of children was also identified in the late 19th century United-Sates [Horan and Hargis, 1991]. The negative effect of industrial activities on child work also seems to have been reinforced by the poor enforcement of factory laws in the time period following the one under scrutiny in this study. See for example [Saito, 2006], [Weissbach, 1977], [Pierrard, 1974] and [Pierrard, 1987] in the case of the 1841 law regulating child work in French manufactures.

⁶⁸This is still the case nowadays. A huge part of child work is concentrated in the agricultural sector and consists in domestic labour at the level of households (for girls in particular). For example, in 2006, 69% of active children worked in agriculture, 22% in services and only 9% in the industrial sector [Dumas and Lambert, 2008].

⁶⁹See Table 26 in the Appendix.

⁷⁰This could be an issue since the number of pupils per 100 inhabitants is mechanically lower in bigger towns and, if a sufficient number of factories is present in the same towns, one would find a negative effect of industrial activities on enrolment.

taking all municipalities into account, both in winter and summer (or if one takes the average value between the two), enrolment was significantly lower in municipalities with factories and large manufactures. The average winter enrolment was of nearly 10 pupils per 100 inhabitants when no industrial activities were located in the town and around 7 in the other case⁷¹.

To diminish the issue of age structure, I also compute these t-tests separating municipalities into two categories, less or more than 2 000 inhabitants, 90.6% of them being present in the first one. I make the assumption that the age structure is likely to be close in each category, which seems reasonable as there is no strong reason to think that municipalities less than 2 000 inhabitants differed greatly. Moreover, there are only 5% of the municipalities in the second category that are more than 8 000 inhabitants, which makes this group quite homogeneous too. Enrolment rates were significantly higher in bigger municipalities with industrial activities (an average of around 10.5 against 8.5), while they were significantly lower in smaller ones with industry (an average of 4 against 5)⁷². This asymmetrical effect may reveal a greater diversion from schools caused by industrial activities in these smaller towns. One could imagine that families were more dependent on child work in these places, which entailed this greater attraction of industrial sectors. Therefore, the negative effect of industrial factories on primary schooling may have been rather concentrated in small towns and villages where economic resources were essential to create and maintain schools, but where purchasing power and the financial capacities to send children to school were lower.

In [Table 8](#), I regress the number of pupils per 100 inhabitants attending schools in winter on industrial variables⁷³. To reduce biases linked to age structure and migration flows, I divide estimations by population bounds, estimating the effects on municipalities less than 2 000 inhabitants and on those more than 631, which is the median population level. I don't report the coefficients on municipalities below this level as the effect is close to the one on those less than 2 000 inhabitants, which reinforces the idea that municipalities less than this threshold are quite homogeneous. These estimations and the followings are done with standard OLS. There could exist an issue of endogeneity here as manufacturers may have avoided municipalities with a high enrolment. Indeed, it would have been difficult for them to employ children in areas where sending them to school was a deeply-rooted habit. In this case, low enrolment rates would not have been caused by industrial factories' activity but would have constituted a characteristic prior to their implementation. Therefore, the estimations on enrolment rates can only be interpreted as correlations and not as causal relations. However, they remain instructive. Indeed, if factories were created in towns with low enrolment rates, they can have accentuated this phenomenon by diverting even more children from schools, which is likely to

⁷¹This difference is significant at a one-percent level.

⁷²The difference is significant at a one-percent level for both t-test depending on the presence of factories or large-size factories. The variation in enrolment rate levels between big and small municipalities is explained by the age structure of the population and by the migration of young workers towards bigger towns in order to find work.

⁷³Taking winter enrolment makes more sense than taking summer enrolment. Indeed, many pupils did attend school only between October and April months at the beginning of the nineteenth century since they had to assist adults in agricultural tasks, especially during harvesting time.

be the case as children were employed in manufactures in 503 municipalities over the 933 in which industrial activities were located, with an average number of 47 children employed per municipality.

The effect found is negative, reducing the number of pupils per 100 inhabitants by around 0.8 for the towns below 2 000 inhabitants and by 0.7 for the towns above median population. One additional factory reduces this number by 0.17 for the first category of municipalities, the effect on the second one being negative but non-significant⁷⁴. This tends to confirm the intuition that industrial and economic activities can have diverted some children from schools as enrolment rates were higher in cities without such activities. This could be due to a relative impoverishment and a greater reliance on child work of families working in factories. Without any negative effect on purchasing power, the presence of more dynamic economic activities may also have prompted children to enter the workforce simply because they were (perceived as) linked to better career perspectives than primary schooling⁷⁵.

Not finding any significant effect following the IV strategy may come as a surprise but is, in fact, coherent with the structure of child employment between industrial sectors. Indeed, the instrument restricts greatly the analysis to the mining sector which employed relatively few children at that time. 5.2% of its workforce was composed of children less than 16 years old according to the Industrial survey while they represented 10.5% of total industrial workforce⁷⁶. Moreover, seven sectors over the sixteen reported in this survey did employ more than 10.5% of children and nine more than 6%. Also, the average number of children employed in manufactures is around 26 in municipalities with industrial activities other than the mining sector and 20 in municipalities with mines. Therefore, it is unlikely to find a strong impact of industrial activities on enrolment rates using the location of deposits as an instrument. This is why I stick to OLS estimations in this section.

⁷⁴The effect remains stable after the introduction of department fixed effects.

⁷⁵As a robustness check, I took the number of children 5-15 years old in each department coming from the 1851 French Census. I made the assumption that the share of each municipal population in departments was equal to their share in children population. This still requires the age structure to be the same between municipalities but helps to control for different age structures between departments. The results are not greatly modified as the effect of the presence of industrial activities and large-scale factories on enrolment is still negative, with a higher magnitude for municipalities less than 2 000 inhabitants. See [Table 27](#) in the Appendix.

⁷⁶See [Table 28](#) in the Appendix.

Table 8: Industrial factories and enrolment. Standardized variables, OLS estimations.

	(1)	(2)	(3)	(4)
	Pupils per 100 inhabitants	Pupils per 100 inhabitants	Pupils per 100 inhabitants	Pupils per 100 inhabitants
	Winter	Winter	Winter	Winter
Industry	-0.783** (-2.550)	-0.687** (-2.277)	–	–
Number of factories	–	–	-0.167* (-1.787)	-0.122 (-1.628)
Population	< 2 000	≥ 631 (Median)	< 2 000	≥ 631 (Median)
Agricultural controls	Yes	Yes	Yes	Yes
Demographic and geographic controls	Yes	Yes	Yes	Yes
Department fixed effects	No	No	No	No
District fixed effects	No	No	No	No
Number of clusters	79	80	79	80
Observations	3550	1930	3550	1930
R^2	0.526	0.488	0.525	0.487

t statistics in parentheses

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

Source : Agricultural, industrial, postal and Guizot surveys. IGN data.

Note : Only municipalities with primary schools are taken into account. The effect of the presence of a manufacture in a given municipality is a reduction in the number of pupils per 100 inhabitants of around 0.7.

7.2 ... And in Industrial Sectors Employing More Children

To specify this effect, one can look at the influence of industrial sectors on enrolment rates. Some of them were clearly employing more children than others, as the furniture, textile, luxury, ceramics, building, science and metal objects sectors whose workforce was composed of more than 10% of children⁷⁷. These percentages are computed for France and are not restricted to the 22 departments in my database. The geographical distribution of textile factories, for example, was really close to the one of child workers at that time (see Figure 2). This is coherent with what was said in the existing literature about this sector. Food, chemistry, lightning and leather sectors were, on the contrary, employing a very little share of children (less than 4% of the workforce). Using this data, I split sectors into two groups: a first one in which more than 10% of the workforce was composed of children and a second one in which children were less than 10% of total industrial workers. This amounts to selecting the seven sectors employing more children over the sixteen reported in the industrial data. The idea here is to see if sectors employing children more intensively were linked to a lower level of enrolment rate.

This is what is estimated in Table 9. These sectors were linked to a fall in enrolment rates of around 1.7% for the whole sample and 1% in municipalities less than 2 000 inhabitants or less than median population. This effect is of 0.76% in towns more than this median level, which

⁷⁷See Table 28 in the Appendix to have a decomposition by the 16 sectors reported in the Industrial survey.

reinforces the idea of an asymmetrical effect depending on municipal population. Another way of measuring the influence of sectors is to regress directly enrolment rates on their presence⁷⁸. I find a negative effect of textile, building and ceramics sectors, which were among the ones employing children intensively⁷⁹. The magnitude of the effect is close for textile and building sectors, diminishing enrolment rates by more than 1.7 children per 100 inhabitants. This is quite consistent with previous literature in historical economics that emphasized the importance of child work in factories [Pierrard, 1987], [Julia, 1970], [Cunningham and Viazzo, 1996], either due to the impoverishment of workers or to the complementarity between child and adult work in these sectors.

Table 9: Child-work intensive industrial sectors and enrolment. OLS estimations

	(1)	(2)	(3)	(4)	(5)	(6)	(7)
	Pupils per 100 inhabitants - Winter						
Sectors > 10% child workers	-1.681*** (-4.636)	-0.922*** (-2.834)	-1.240*** (-2.787)	-0.854*** (-2.833)	-	-	-
Textile	-	-	-	-	-1.747*** (-3.375)	-	-
Building	-	-	-	-	-	-1.991*** (-4.715)	-
Ceramics	-	-	-	-	-	-	-1.354* (-1.973)
Population	All	≤ 631 (Median)	< 2 000	≥ 631 (Median)	All	All	All
Agricultural controls	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Demographic and geographic controls	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Department fixed effects	Yes	No	No	No	Yes	Yes	Yes
District fixed effects	No	No	No	No	No	No	No
Number of clusters	80	66	79	80	80	80	80
Observations	3814	3550	1886	1930	3814	3814	3814
R^2	0.479	0.490	0.395	0.481	0.579	0.578	0.577

t statistics in parentheses

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

Source : Agricultural, industrial, postal and Guizot surveys. IGN data.

Note : In these estimations, all dependent variables are dummies which equal 1 if industrial activities are located in a given municipality. The effect of the sectors in which the average percentage of child workers among industrial workers was superior to ten at the national level is measured, both gathering them into a dummy variable or taking them separately. This corresponds to furniture, textile, luxury, ceramics, building, science-letters and arts and metal objects sectors. The presence of these sectors is related to a fall in enrolment of around 1.7 children per 100 inhabitants when all observations are taken into account.

The negative effect of these sectors on enrolment rates can also be explained by the fact that they are characterised by lower industrial wages. Descriptively, at the national level, this is especially true for textile and building sectors. In these two, daily industrial male wages were far below the average level of 1.98 francs, namely 1.78 and 1.82 francs respectively.⁸⁰ This is confirmed by regressing the presence of sectors using child work intensively and the location of textile factories on daily industrial male wages. The effect is negative and significant, with a magnitude of around 15 cents of francs for both. This means that sectors employing more children relative

⁷⁸As the effects are about the same magnitude when taking into account towns with more than 2 000 inhabitants or population above or below the median, I only report the general case.

⁷⁹Textile factories are located in 308 municipalities in the data, building manufactures in 157 and ceramics one in 48.

⁸⁰See Table 29 in the Appendix to have the average industrial wages by sector.

to the total number of workers were also those paying less their male workers⁸¹. This illustrates the fact that when many children were employed in industrial factories, the purchasing power of workers was also reduced. Indeed the same negative effect can be found for female wages. This reinforces the relative impoverishment assumption, meaning that manufactures diverting children from schools were mainly doing so because of the greater reliance of families on child work in the municipalities at stake.

8 Conclusion

By adopting a micro-historical approach and by using a new historical database on primary schooling, this article has investigated the causal link between industrial activities, economic resources and primary schooling in early nineteenth-century France. Before the implementation of the Guizot Law passed in 1833, municipalities could freely choose to open a primary school or not. Schools could also be totally private and only funded by the fees paid by parents. Primary schools were more likely to emerge and to be maintained in municipalities in which industrial activities were located too. The effect is found to have been particularly large for what regards the mining sector and stronger in municipalities with big-size factories.

The positive impact of industrial activities was due to an income effect for both parents and local authorities who benefited from the presence of large manufactures associated with a higher amount of taxes collected and higher industrial wages. Municipalities were, therefore, more often investing in primary schooling when industrial activities were dynamic, by paying teachers on a regular annual basis and providing them with a higher salary.

However, industrial production was also contributing to divert children from schools. This was due to an increasing opportunity cost of primary schooling when these activities were more dynamic. Another reason is that some industrial sectors, as textile or building ones, were contributing to a relative impoverishment of workers which was making families more reliant on child work. This effect was stronger in small municipalities, diverting more children from the primary schooling system.

⁸¹See [Table 30](#) in the Appendix.

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Appendix for on-line publication

Data and descriptive statistics

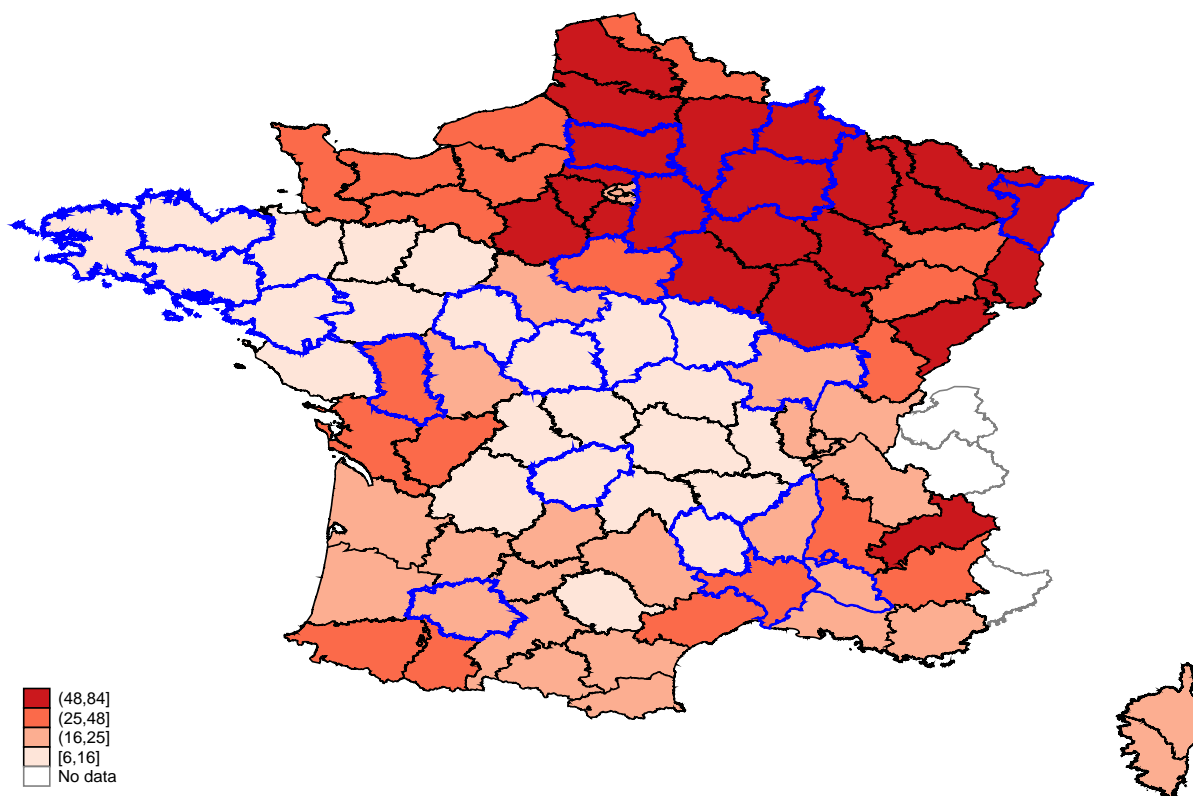


Figure 3: Percentage of children from 5 to 13 years old going to school - winter 1833

Source : Guizot survey - Report to the King, 1851 Census.

Note : I use here the 1851 Census to take into account the age structure of the population. I take into account the proportion of 5 to 13 years old children in the 1851 population and apply it to the 1833 one in order to have the total number of children that could potentially go to school at that time. Therefore, I consider that the major part of the population of children attending primary schools should be contained within these bounds. Then, I compute the percentage of children 5 to 13 years old going to school in 1833 using this measure. Departments in blue are the ones for which education data are available at the level of municipalities.

Table 10: Data representativeness, means and t-tests

	France	Municipal level sample	t-test
Population	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	**
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

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

Source : Guizot, industrial and postal surveys. IGN data and *Statistique générale de la France*.

Note : All figures are computed at the level of districts. The average population in each district is 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.

Table 11: Summary Statistics

Variable	Mean	Std. Dev.	Min.	Max.	N
Primary School	0.59		0	1	8129
Fixed salary	0.39		0	1	8129
Salary amount - francs per year	97.1	184.4	0	5449.5	8129
Pupils per 100 inhabitants	9.5	6.8	0.3	61.6	4658
Percentage of population scattered	46.8	35.6	0	100	6941
Population	989.8	1811.9	30	75895	8064
Surface area - hectares	1725.5	1439.1	8	18359	7844
Average altitude - meters	207.7	194.6	1	1399	7844
Factory	0.12		0	1	8129
Factory more than 20 workers	0.06		0	1	8129
Number of factories	0.5	8.5	0	699	8129
Taxes on industrial activities - francs per year	84.6	1164.1	0	77445	8129
Industrial male worker daily wage - cents of francs	210.7	74.3	40	500	930
Industrial female worker daily wage	96.1	34.2	20	300	466
Industrial child worker daily wage	71.8	30.5	10	200	503
Percentage of industrial child workers	11	13.9	0	66.7	933
Day-workers per 100 self-employed	111.6	73.7	19.1	481.2	90
Share-croppers per 100 self-employed	10.7	17.7	0	103	90
Tenant farmers per 100 self-employed	27.7	43.9	0.3	294.8	90
Average land area per self-employed - hectares	17.1	11.6	3.8	74.3	90
Total agricultural area - hectares	150635	46431.5	49732	265577	90
Land value by hectare - francs	1645.9	607.8	625.7	3925.7	90
Food % in day-workers family spendings	66.5	3.9	59.1	79.2	90
Animals per inhabitant	2	1.1	0.4	5	90

Source : Guizot, agricultural, industrial and postal surveys. IGN data and *Statistique générale de la France*.

Note : All variables are defined at the municipal level, except the agricultural ones defined at the districts level. For example, the number of factories is equal to the average number of manufactures present in a municipality while the land value by hectare is the average market price of agricultural land between districts. Variables with no standard deviation reported are dummy variables. Their mean represent the proportion of municipalities in which they take of value of 1. Primary schools are therefore located in 59% of the municipalities in the data while 39% of municipalities ensure primary school teachers with a fixed annual salary. The equivalent proportions are of 12% and 6% for the presence of industrial factories and factories more than 20 workers.

Description of data

Guizot Survey

School is an indicator variable taking value one if at least one primary school is present in the municipality of reference.

Fixed salary is an indicator variable taking value one if at least one teacher is paid on an annual fixed basis the municipality at stake. The salary amount is therefore given in francs per year.

Accommodation is an indicator variable taking value one if at least one teacher is provided with an accommodation or an accommodation allowance by the municipality.

Industrial Survey

Industry is an indicator variable referring to the presence of at least one industrial factory in a given municipality. An industrial factory is reported only if it exceeded ten workers in order not to be mingled with craftsmanship.

Factory > 20 workers is an indicator variable taking value one if at least one industrial factory with more than 20 workers is present in the municipality under scrutiny.

Industrial production value and taxes : they are both defined annually and in francs. Taxes on production are called the *patente* and are based on the rental value of manufactures.

Industrial wages : daily wages of male, female and child industrial workers in cents of francs.

Bureau de Recherches Géologiques et Minières

Location of deposits : copper, iron and coal. Deposits exploited and not-exploited.

Agricultural Survey

In this survey, all the data are available at the district level.

Number of tenant farmers and share-croppers : both are employed by a landowner to work on his fields and pay him in return. The difference is that share-croppers' payment is in kind (a part of harvests) while tenant farmers pay landowners directly in cash.

Number of day-workers : following [Démonet, 1990], taken as the sum of "aides agricoles" (agricultural assistant) in the survey. They amount to 3.7 millions over all French territory.

Number of self-employed : are gathered in this category all the agricultural workers that could live from their work in the fields, that is to say all the people that own land and work on it directly plus those that own land and make other people work on it. Landowners who

worked on their land but also on someone else's property are not counted. This measure is more restricted as the one made in [Demonet, 1990] who also includes farmers and share-croppers in this category.

Land Value : measured as the mean, in franc by hectare, of four land values considered relevant to describe agricultural land. Namely, ploughable land, vineyards, pastures and forests. In the original data, these lands are decomposed in three quality classes whose repartition in the total land is unknown. Each value is taken as an average value over these three classes.

Agricultural area : in hectares, taking the same four types of land that are used to measure land value.

Food percentage in day-workers spendings : for a day-worker family of five members, food spendings (bread, vegetables, meat, milk, wine, cider, beer and salt) as a percentage of all spendings (food plus accommodation, clothing, heating, taxes and diverse spendings).

Number of animals : taken as the sum of wool animals (rams, sheep, ewes, lambs), pigs, billy goats, goats, young goats and horn animals (bulls, ox, cows, bull-calves, steers, heifers). Horses are excluded from this category as they were mainly bred in the wealthy north-est part of France.

Geographical data from the Institut Géographique National

Average altitude : in meters.

Surface area of municipalities : in hectares.

Postal Survey

Population dispersion : taken as the share of the total population that doesn't match the contiguity criterion. See [Roncayolo, 1987] on this point.

Total population : taken from this survey if missing in the Guizot Survey.

Statistique générale de la France

Number of children : 5-15 years old children, taken from the 1851 French Census.

Literacy 1686-1690 : evaluated as the marriage signature rate for men.

Table 12: Presence of primary schools and scattered population

	High scattering	Middle scattering	Low scattering	Total
No primary school	1733	890	573	3196
	60.5	37.1	27.3	43.4
	54.2	27.8	17.9	100.0
Primary school	1132	1510	1525	4167
	39.5	62.9	72.7	56.6
	27.2	36.2	36.6	100.0
Total	2865	2400	2098	7363
	100.0	100.0	100.0	100.0
	38.9	32.6	28.5	100.0
Observations	7363			

Pearson $\chi^2(12) = 600.6193$ Pr = 0.000.

Source : Guizot and postal surveys.

Note : A high scattering corresponds to the cases in which at least 71.15% of the total population of the municipality is scattered, a middle one when between 13.54% and 71.14 % of the population is scattered and a low one if less than 13.54% of the population is scattered. There are 1733 cases of municipalities with no primary schools and a high scattering. 60.5% of municipalities with a high-scattered population had also no primary school while 54.2% of the municipalities with no primary schools were characterized by a high scattering of their population.

Table 13: Primary schools, demographic and geographic characteristics, means and t-tests

	No primary school	Primary school	t-test
Population	731	1167	***
Average altitude	226.7	195.1	***
Surface area	1725.6	1725.5	NS
Population scattered (%)	58.9	37.8	***

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

Source : Guizot and postal surveys, IGN

Note : The average population of municipalities with no primary school is 731 inhabitants. There are on average 1 167 inhabitants in towns where at least one primary school is present. The difference is significant at a one-percent level.

Table 14: Presence of factories and primary schools

	No industry	Industry	Total
No primary school	3098	195	3293
	43.1	20.9	40.5
	94.1	5.9	100.0
Primary school	4098	738	4836
	56.9	79.1	59.5
	84.7	15.3	100.0
Total	7196	933	8129
	100.0	100.0	100.0
	88.5	11.5	100.0
Observations	8129		

Pearson $\chi^2(12) = 168.1641$ Pr = 0.000.

Source : Guizot and industrial surveys.

Note : There were 3098 cases of municipalities with no primary school and no factory. 43.1% of the municipalities with no factory had also no primary schools. 94.1% of the municipalities in which there was no school were also characterized by the absence of factories.

Table 15: Agricultural characteristics, means and t-tests

	Category 1	Category 2	t-test
Male day-workers daily wage (in francs)	1.17	1.54	***
Female day-workers daily wage (in francs)	0.74	0.96	***
Child day-workers daily wage (in francs)	0.53	0.69	***
Single savings (in francs, by year)	46.44	56.28	*
Family savings (in francs, by year)	58.33	70.6	NS
Food percentage in day-workers family spendings	67.8	65.6	**
Agricultural area (in hectares)	168 804	133 756	***
Mean market value of land (one hectare, in francs)	1 304	1 986	***
Mean market value of ploughable land (one hectare, in francs)	1 003	1 949	***
Mean market value of pastures (one hectare, in francs)	1 690	2 634	***
Mean market value of vineyards (one hectare, in francs)	1 467	1 964	***
Mean market value of forests (one hectare, in francs)	1 134	1 357	*
Animals per inhabitant	2.2	1.7	**
Average area per self-employed (in hectares)	22.9	12.6	***
Day-workers per 100 self-employed	153	83	***
Share-croppers per 100 self-employed	14	8	NS
Tenant-farmers per 100 self-employed	41	18	**
Percentage of municipalities with school	35.2	82.7	***

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

Source : Guizot and agricultural surveys

Note : In order to have descriptive statistics on agricultural variables, I split districts into two categories : one in which more than 58% of the municipalities are characterized by the presence of at least one primary school (*Category 2*) and one in which less than 58% of the them are so (*Category 1*). This 58% threshold corresponds to the median, meaning that 50% of the districts exhibit a higher ratio of municipalities with schools, and 50% a lower one. The daily wage of male day-workers is of 1.17 francs in the first category (where a primary school is present in less than 58% of municipalities) while it is of 1.54 francs in the second one (where a primary school is present in more than 58% of them). The difference is significant at a one-percent level.

Presence of primary schools

Table 16: Presence of schools and deposits - OLS estimations

	(1)	(2)	(3)
	Primary School	Primary School	Primary School
Presence of a deposit	0.05862*	0.06421*	0.05803*
	(1.91749)	(1.85117)	(1.84647)
Agricultural controls	No	Yes	Yes
Demographic and geographic controls	Yes	Yes	Yes
Department fixed effects	No	No	Yes
District fixed effects	Yes	No	No
Number of clusters	91	88	88
Observations	6723	6718	6718
R^2	0.449	0.215	0.359

t statistics in parentheses

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

Source : Agricultural, industrial, postal and Guizot surveys. IGN and BRGM data.

Note : The presence of a deposit (copper, iron and coal) in a given municipality increases the probability to have at least one primary school in the same location by around 6 percentage points.

Table 17: Iron, coal and copper deposit, means t-tests

	No ore present	Presence of ore	t-test
Population	952	2219	***
Average altitude	206	250	***
Surface area	1702	2494	***
Population scattered (%)	47	55	***

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

Source : Industrial survey. BRGM and IGN data.

Note : The average population of municipalities with no ore is 952 inhabitants. There are on average 2 219 inhabitants in towns where a deposit was localised. The difference is significant at a one-percent level.

Table 18: IV estimation - Presence of industrial factories and primary schools. Standardized variables

	(1)	(2)	(3)
	Primary School	Primary School	Primary School
Industry	0.393* (1.789)	0.312* (1.659)	0.306* (1.754)
Percentage of population scattered	-0.044*** (-4.940)	-0.065*** (-3.021)	-0.061*** (-4.721)
Population	0.125* (1.789)	0.093 (1.524)	0.093 (1.471)
Surface area in hectares	0.052** (2.436)	0.022 (1.060)	0.042** (2.085)
Average altitude in meters	-0.045 (-1.540)	-0.028 (-1.321)	-0.053* (-1.820)
Day-workers per 100 self-employed	-	0.012 (0.269)	-0.040 (-0.738)
Share-croppers per 100 self-employed	-	-0.112*** (-3.357)	0.034 (1.003)
Tenant farmers per 100 self-employed	-	0.032 (0.337)	0.177** (2.066)
Average land area per self-employed	-	-0.020 (-0.495)	-0.126*** (-2.717)
Total agricultural area	-	-0.053* (-1.768)	0.030 (0.892)
Ploughable land value	-	0.128** (2.044)	-0.170*** (-3.236)
Pastures value	-	-0.004 (-0.090)	0.115** (2.347)
Vineyards value	-	-0.085 (-1.482)	0.010 (0.216)
Forests value	-	0.026 (0.630)	0.170*** (2.995)
Number of agricultural machines	-	0.020 (0.812)	-0.033 (-1.023)
Food % in day-workers family spendings	-	-0.039 (-0.973)	0.014 (0.428)
Animals per inhabitant	-	-0.066*** (-3.797)	-0.069*** (-3.831)
Department fixed effects	No	No	Yes
District fixed effects	Yes	No	No
Number of clusters	91	70	70
First-stage, dependent variable is the presence of industrial activities			
Presence of ore	0.149*** (2.86)	0.203*** (3.60)	0.198*** (3.31)
Observations	6723	5837	5837
R^2	0.156	0.090	0.130
$F - stat$	8.112	12.777	10.813
Regression-based p-value	0.073	0.181	0.110

t statistics in parentheses

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

Source : Agricultural, industrial, postal and Guizot surveys. IGN and BRGM data.

Note : The instrument is the presence of iron, copper and coal deposits. The dependent variable is always the location of primary schools in a given municipality.

Income effect

Table 19: Industrial factories and investment in primary education, means and t-tests

	No industry	Industry	t-test
Fixed salary (percentage of municipalities)	37	53	***
Fixed salary amount (in francs per year)	83.5	201.9	***
Accommodation (percentage of municipalities)	27	40	***
Accommodation allowance (in francs per year)	5.2	11.5	***
Classroom (percentage of municipalities)	31	45.2	***

Taking into account only the municipalities with schools

Fixed salary amount (in francs per year)	146.6	262.3	***
Accommodation allowance (in francs per year)	9.1	14.9	***

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

Source : Guizot and industrial surveys

Note : In 37% of the municipalities with no industry, a teacher is granted with a fixed salary. The average fixed salary is of 83.5 francs per year in municipalities with no industry. This average salary is of 146.6 francs if when the sample is restricted to municipalities with a school.

Table 20: Industrial factories and investment in primary education, means and t-tests

	No fixed salary	Fixed salary	t-test
Agricultural area (in hectares)	162 015	140 968	***
Mean market value of land (one hectare, in francs)	1 575	1 892	***
Male day-workers wage (in francs per day)	1.37	1.51	***
Female day-workers wage (in francs per day)	0.86	0.95	***
Child day-workers wage (in francs per day)	0.62	0.66	***
Average agricultural area per self-employed (in hectares)	18.78	12.56	***
Day-workers per 100 self-employed	116	86	***
Share-croppers per 100 self-employed	12	5	***
Tenant-farmers per 100 self-employed	27	18	***
	No accommodation	Accommodation	t-test
Agricultural area (in hectares)	158 294	141 089	***
Mean market value of land (one hectare, in francs)	1 591	1 969	***
Male day-workers wage (in francs per day)	1.4	1.5	***
Female day-workers wage (in francs per day)	0.88	0.95	***
Child day-workers wage (in francs per day)	0.63	0.66	***
Average agricultural area per self-employed (in hectares)	17.94	12.38	***
Day-workers per 100 self-employed	112	86	***
Share-croppers per 100 self-employed	11	6	***
Tenant-farmers per 100 self-employed	27	16	***

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

Source : Guizot and agricultural surveys.

Notes : municipalities where a fixed salary was not provided were belonging in districts where, on average, the mean market value of agricultural land was of 1 575 francs against 1 892 francs for municipalities where teachers were paid on a regular basis. This difference is significant at a one-percent level.

Table 21: IV estimation - Mining activities, large factories and fixed salary.

	(1)	(2)	(3)	(4)	(5)	(6)
				Fixed salary		
Mining activities	0.321* (1.938)	0.410* (1.884)	0.330* (1.893)	–	–	–
Factories > 20 workers	–	–	–	0.470** (2.070)	0.517* (1.932)	0.462** (2.097)
Agricultural controls	No	Yes	Yes	No	Yes	Yes
Demographic and geographic controls	Yes	Yes	Yes	Yes	Yes	Yes
Department fixed effects	No	No	Yes	No	No	Yes
District fixed effects	Yes	No	No	Yes	No	No
Number of clusters	91	88	88	91	88	88
First-stage, dependent variable is :	Mining activities			Large factories		
Presence of ore	0.184*** (6.17)	0.188*** (6.19)	0.186*** (6.20)	0.125*** (3.19)	0.144*** (3.71)	0.139*** (3.49)
Observations	6723	6718	6718	6723	6718	6718
R^2	0.141	0.108	0.117	0.100	0.035	0.060
$F - stat$	14.843	16.097	15.970	10.102	13.579	12.023
Regression-based p-value	0.195	0.072	0.122	0.066	0.100	0.055

t statistics in parentheses

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

Source : Agricultural, industrial, postal and Guizot surveys. IGN and BRGM data.

Note : The instrument is the presence of iron, copper and coal deposits. The dependent variable is always the presence of a teacher paid on a regular annual basis in a given municipality.

Table 22: Production value and taxes on industrial activities, means and t-tests

	No primary school	Primary school	t-test
Taxes on industrial activities (in francs per year)	21.2	114.1	***
Industrial production value (in francs per year)	11 069.3	97 535	***
	No fixed salary	Fixed salary	t-test
Taxes on industrial activities	60	123.2	**
Industrial production value	44 675.3	113 658.3	***
	No accommodation	Accommodation	t-test
Taxes on industrial activities	51.4	167.4	***
Industrial production value	38 486.7	154 199.5	***

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

Source : Guizot and industrial surveys.

Note : In the municipalities in which no primary school was present, taxes on industrial activities amounted on average to 21.2 francs per year. This low figure is explained by the fact that in many municipalities, no manufacture was present. The cases are counted as zero value in the computation of the average taxes. Focusing on municipalities with industrial activities would lead to higher figures. The average level in municipalities with a primary school amounted to 114 francs. A t-test confirms that they are different at a one-percent level.

Table 23: Production value and taxes on industrial activities, means t-tests

	Industry < 20 workers	Industry > 20 workers	t-test
Taxes on industrial activities (in francs per year)	125.8	1 179.4	***
Industrial production value (in francs per year)	94 186	1 006 482	***

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

Source : Industrial survey.

Note : In municipalities with factories less than 20 workers, taxes on industrial activities amounted to 125.8 francs per year on average. In towns with manufactures more than 20 workers, this amounted to 1 179.4 francs on average. The difference between the two is significant at a one-percent level.

Table 24: Descriptive statistics, schooling fees and wages

	Average value	
Schooling fees (districts)	1.21	Monthly
Schooling fees (municipalities)	0.96	Monthly
Minimum schooling fees (municipalities)	0.9	Monthly
Industrial male workers	1.97	Daily
Industrial female workers	0.93	Daily
Industrial child workers	0.65	Daily
Agricultural male day-worker	1.4	Daily
Agricultural female day-worker	0.9	Daily
Agricultural child day-worker	0.6	Daily

Source : Guizot, industrial and agricultural surveys.

Notes : Schooling fees and wages are reported in francs. There are two different levels of average schooling fees, one at the districts level and one at the municipal level. The former is coming from the Guizot Survey aggregated and published in the *Report to the King* for the entire France. This value corresponds therefore to a mean level between districts. The latter value is measured only between municipalities belong to the 22 departments for which data are available at the municipal level.

Table 25: Industrial daily wages in cents of francs and schooling investment, means and t-tests

	No fixed salary	Fixed salary	t-test
Daily industrial male wages (cents of franc)	199	221	***
Daily industrial female wages	97	99	**
Daily industrial child wages	68	74	***

	No accommodation	Accommodation	t-test
Daily industrial male wages (cents of franc)	204	220	***
Daily industrial female wages	91	102	***
Daily industrial child wages	71	73	NS

	No classroom	Classroom	t-test
Daily industrial male wages (cents of franc)	205	219	***
Daily industrial female wages	91	101	***
Daily industrial child wages	70	74	NS

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

Source : Guizot and industrial surveys.

Notes : In the municipalities with at least one industrial factory but where no teacher was paid on a fixed basis, the average daily wage of industrial male workers was 199 cents of francs. This wage was of 221 cents of francs in the municipalities with factories and where a teacher was paid regularly. The difference between the two is significant at a one-percent level.

Economic activities and enrolment

Table 26: Industrial factories, means and t-tests

	No industry	Industry	t-test
Pupils per 100 inhabitants - Winter	9.9	6.9	***
Pupils per 100 inhabitants - Summer	4	3.6	***
Pupils per 100 inhabitants (mean)	6.6	5	***
Pupils per 100 inhabitants - Winter, < 2000 inhabitants	10.5	8.2	***
Pupils per 100 inhabitants - Summer, < 2000 inhabitants	4.4	3.8	***
Pupils per 100 inhabitants - Winter, > 2000 inhabitants	3.6	4.7	***
Pupils per 100 inhabitants - Summer, > 2000 inhabitants	2.1	3.2	***
	No industry > 20 workers	Industry >20 workers	t-test
Pupils per 100 inhabitants - Winter	9.7	7	***
Pupils per 100 inhabitants - Summer	4.1	3.6	**
Pupils per 100 inhabitants (mean)	6.5	5.1	***
Pupils per 100 inhabitants - Winter, < 2000 inhabitants	10.4	8.4	***
Pupils per 100 inhabitants - Summer, < 2000 inhabitants	4.4	3.8	**
Pupils per 100 inhabitants - Winter, > 2000 inhabitants	3.8	4.9	***
Pupils per 100 inhabitants - Summer, > 2000 inhabitants	2.4	3.3	***

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

Source : Guizot and industrial surveys.

Note : In municipalities with no industrial factories, 9.9 children per 100 inhabitants were enrolled in primary schools in wintertime. 6.9 children were so in municipalities with industry at the same period. The difference is statistically significant at a one-percent level. Only municipalities with at least one primary schools are taken into account.

Table 27: Industrial activities and enrolment.

	(1)	(2)	(3)	(4)	(5)
	Pupils per 100 children				
Industry	-4.303*** (-3.610)	-2.092 (-1.250)	-2.867** (-2.576)	-1.943 (-1.651)	1.061 (0.774)
Observations	3737	1815	1924	3474	263
R^2	0.571	0.510	0.505	0.592	0.528
Factories > 20 workers	-5.611*** (-3.732)	-2.966 (-1.609)	-3.145** (-2.275)	-2.534** (-2.189)	1.666 (0.933)
Observations	3737	1815	1924	3474	263
R^2	0.528	0.571	0.510	0.504	0.592
Population	All	≤ 631 (Median)	≥ 631 (Median)	$< 2\ 000$	$> 2\ 000$
Department fixed effects	No	No	No	No	No
District fixed effects	No	No	No	No	No
Number of clusters	80	66	80	79	37

t statistics in parentheses

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

Source : Agricultural, industrial, postal and Guizot surveys. *Statistique générale de la France*, IGN data.

Note : Two sets of estimations are displayed in this table. The first one measures the impact of industrial location on the number of pupils per 100 children. The second one measures the influence of large factories on the same outcome. For each of them, the controls used are the same than in the previous estimations. The presence of a factory in a given municipality is related to a decrease of around 4.3 pupils per 100 children when all observations are taken into account.

Table 28: Industrial sectors and percentage of children among workers

	Mean	Standard Deviation	Minimum	Maximum
Furniture	25.7	17.7	0	50
Textile	17.9	16.1	0	100
Luxury	13.8	20.1	0	66.7
Ceramics	11.3	12.6	0	66.7
Building	11.2	15.3	0	75
Science, letters and arts	11.2	14.9	0	75
Metal Objects	10.5	13.5	0	100
Metallurgy	6.4	9.7	0	58.6
Transports	6.3	10.7	0	50
Clothing	5.3	12.5	0	90
Mining activities	5.2	10.4	0	66.7
Wood	5	11.3	0	48.5
Leather	3.8	10.4	0	100
Lightning	3.5	10.6	0	66.7
Chemistry	3.4	9.9	0	76.9
Food	3	8	0	100
All sectors	10.5	14.6	0	100

Source : Industrial survey.

Note : The average percentage of child workers among industrial workers at the national level in textile factories was 17.9, with a standard deviation of 16.1. The minimum percentage in this sector was zero, the maximum one hundred. Sectors are reported in decreasing order with respect to the mean.

Table 29: Industrial sectors and industrial male workers wages

	Mean	Standard Deviation	Minimum	Maximum
Luxury	260	84	110	475
Transports	254	75	130	425
Metallurgy	244	82	100	625
Metal Objects	233	93	75	660
Science, letters and arts	222	79	90	550
Furniture	220	63	125	335
Chemistry	215	62	75	450
Ceramics	213	76	85	500
Lightning	210	74	100	400
Wood	203	72	75	500
Mining activities	202	72	75	500
Food	198	66	50	550
Leather	195	51	75	650
Clothing	190	68	25	450
Building	182	54	75	450
Textile	178	64	25	600
All sectors	198	71	25	660

Source : Industrial survey.

Note : The average wage of industrial male workers was 260 cents of francs in the luxury sector at the national level, with a standard deviation of 84 cents. The minimum wage reported was 110 cents in this sector and the maximum 475 cents. Sectors are reported in decreasing order with respect to the average wage.

Table 30: Child-work intensive industrial sectors and industrial wages. OLS estimations

	(1)	(2)	(3)	(4)	(5)
	Daily industrial male wage				
Sectors > 10% child workers	-17.647* (-1.936)	-15.224* (-1.898)	-12.917* (-1.853)	–	–
Textile	–	–	–	-16.241* (-1.742)	–
Building	–	–	–	–	-16.311 (-1.567)
Agricultural controls	No	Yes	Yes	Yes	Yes
Demographic and geographic controls	Yes	Yes	Yes	Yes	Yes
Department fixed effects	No	No	Yes	Yes	Yes
District fixed effects	Yes	No	No	No	No
Number of clusters	81	80	80	80	80
Observations	614	613	613	613	613
R^2	0.446	0.192	0.335	0.338	0.335

t statistics in parentheses

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

Source : Agricultural, industrial, postal and Guizot surveys. IGN data.

Note : In these estimations, all dependent variables are dummies which equal 1 if industrial activities are located in a given municipality. The effect of the sectors in which the average percentage of child workers among industrial workers was superior to ten at the national level is measured, both gathering them into a dummy variable or taking them separately. This corresponds to furniture, textile, luxury, ceramics, building, science-letters and arts and metal objects sectors. The presence of these sectors is related to a fall in industrial male worker daily wage of around 15 cents of francs.