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Cliometrics of Primary Education in the Long Nineteenth Century France

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Abstract • The objective of this article is to study the links between the financing of primary education, schooling and economic growth in France in the nineteenth century. To do so, we use information on the financing allocated by the State, the departments, the municipalities, and households over the period 1820–1913. Our analysis is in two stages. First, we analyse the evolution of these different types of financing over time, relying on the outliers' methodology to detect the existence of possible breaks in the series. Next, we study the causal relationships between the different types of financing, the number of children enrolled in primary education and the gross domestic product. Over the period studied, our results confirm that mass schooling is primarily driven by political will, before being explained by the increase in wealth available in the economy.

Keywords • primary education; financing; nineteenth century; France

Introduction

This article is part of an evolving historiography that has often been the site of controversies: the methodological debate on the use of statistics and the conclusions that can be drawn from them, on the one hand,[1] and the debate on the impact of legislative changes, on the other.[2] Its primary ambition is, on the basis of a renewed and predominantly quantitative analysis, to provide new evidence[3] of the causal links between the financing of primary education, schooling and economic growth in France in the nineteenth century.

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1 Raymond Grew, Patrick Harrigan, James B. Whitney, "Scolarisation en France, 1829–1906," *Annales: Économies, Sociétés, Civilisations* 39, no. 1 (1984), 116–57; Jean-Noël Luc, "L'illusion statistique," *Annales: Économies, Sociétés, Civilisations* 41, no. 4 (1986), 887–911.

2 Claude Diebolt, Magali Jaoul, and Gilles San Martino, "Le mythe de Ferry: une analyse cliométrique," *Revue d'Economie Politique* 115, no. 4 (2005), 471–97; Bruno Théret, "Les dépenses d'enseignement et d'assistance en France au XIXe siècle: une réévaluation de la rupture républicaine," *Annales: Économies, Sociétés, Civilisations* 46, no. 6 (1991), 1335–74.

3 For the French reader interested in a brief introduction to the topic of evidence in economics, see Claude Diebolt: https://www.blog-afse.fr/billet/les-entretiens-de-lafse-2017-la-preuve-dans-les-sciences-economiques; http://www.touteconomie.org/node/15501 (accessed 15 August 2021).

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Berg, Edquist, Mays, Westberg and Åkerlund offer a stimulating reflection on the history of educational finance, especially the financing of primary and higher education and of popular education.[4] However, there is still a significant gap between the conceptual advance and the quantitative measurement of the effects that gave rise to these concepts. It is true that measurement is difficult and that the instruments available to us are far from adequate. However, this cannot be used as an argument to reject a quantitative approach to the evidence. A concept is, by nature, an abstract image of one or more phenomena, a construction of the mind; only measurement links it to its source. Without measurement, whether potential or actual, a concept must remain sterile, with no possibility of being transformed into action or fuel for the journey to new fields of knowledge.

After the Second World War, developments in school statistics advanced the field of measurement and undoubtedly led to further progress in theory.[5] Nevertheless, progress in observation has all too often been concerned with the present alone. The analysis of very long-term developments, which has rarely led to a corresponding amount of statistical production, has had to make do with existing indicators, which are often very far removed from the theoretical concepts that were sought by this approach. The statistical production of the post-World War II period obviously offers significant hindsight, but this is not enough to confidently cover a period over fifty years long. As regards the historical analysis of the causal relations between education and the economy, for example, statistical production provides very powerful tools for studying the period from 1970 to the present day,[6] but it does not allow for a precise analysis of previous periods and especially of the breakdowns caused by wars, institutional changes or crises, whether economic, demographic, health-related, or anything else. But, since we are examining the past, new statistical constructions can only use the materials bequeathed to us by the past, even though these materials were constructed to meet the needs and issues of enquiries which, by definition, have nothing to do with the questions we are asking ourselves today.

4 Anne Berg, Samuel Edquist, Christin Mays, Johannes Westberg, and Andreas Åkerlund, "The History of Educational Finance," *Nordic Journal of Educational History* 2, no. 1 (2015), 3–22.

5 See especially Theodore W. Schultz, "Investment in Human Capital," *American Economic Review* 51, no. 1 (1961), 1–17; Theodore W. Schultz, *The Economic Value of Education* (New York: Columbia University Press, 1963); Edward F. Denison, *The Sources of Economic Growth in the United States and the Alternatives Before Us* (New York: Supplementary Paper, No. 13, Committee for Economic Development, 1962); Gary S. Becker, *Human Capital: A Theoretical and Empirical Analysis with Special Reference to Education* (New York: Columbia University Press, 1964); Jacob Mincer, "Investment in Human Capital and Personal Income Distribution," *Journal of Political Economy* 66, no. 4 (1958), 281–302; John W. Meyer and Michael T. Hannan eds., *National Development and the World System. Educational, Economic, and Political Change*, 1950–1970 (Chicago: The Chicago University Press, 1979).

6 We are thinking in particular of the work of the *Direction de l'évaluation et de la prospective* of the Ministry of National Education in the form of satellite accounts: Dep/Insee, *Le compte de l'éducation. Principes et méthodes*, 7 (Paris: Les dossiers Éducation & Formations, 1990).

Hence, cliometrics is brought in to construct the new observations that we need.[7] The method itself implies limits, which are the traces left by past generations, which remain discernible. However, much material is available and the question is how it can be exploited. Cliometrics is based on the methods of retrospective national accounting (in particular the drawing-up of satellite accounts).[8] It aims at representing the economy of a country in a simplified form. This approach aims first to observe and measure socio-economic facts. This allows us to break down the complex set of phenomena that compose economic and social activity. Finally, it allows us to make socio-economic facts comparable, in order to classify them in a limited number of categories, so that they can be studied as elements of a homogeneous whole (i.e. in aggregate).

By producing organised knowledge, cliometrics generates its own theoretical field, the adequacy of the two-fold link between the measurement and the theoretical concept on which it is based and the link between the concept and the evidence that gives rise to it. When we wish to observe a historical phenomenon over the long term, we must recognise that our know-how, the instruments we have at our disposal, lag considerably behind the questions we are asking. What does it mean, for example, to juxtapose the instantaneous measurements of a time series, when the object observed is itself continuously evolving? The comparison of levels measured at two somewhat distant dates is certainly not very meaningful. Still, movement that is described in this way has some value. It lets us measure trends, cycles, shocks or crises, setting up a kind of communion between facts and stylised facts.

This research approach, applied to the comparative analysis of educational expenditure in France, Germany, Spain and the United Kingdom,[9] enabled Claude Diebolt and Louis Fontvieille[10] to formulate, on the basis of reconstructed statistical sets,

7 Claude Diebolt, "L'évolution de longue période du système éducatif allemand: 19ème et 20ème siècles," Special Issue of the journal *Economies et Sociétés*, Series AF, no. 23 (1997); Claude Diebolt, "Cliometrica after 10 Years: Definition and Principles of Cliometric Research," *Cliometrica* 10, no. 1 (2016), 1–4; Claude Diebolt, Gabriele Franzmann, Ralph Hippe, and Jürgen Sensch, "The Power of Big Data: Historical Time Series on German Education," *Journal of Demographic Economics* 83, no. 3 (2017), 329–76; Claude Diebolt and Michael Haupert, eds., *Handbook of Cliometrics*, 2nd Edition (Berlin, Springer, "Springer Reference" Collection, 2019). For the French reader interested in a brief introduction to cliometrics, see Claude Diebolt: https://www.blog-afse.fr/billet/la-cliometrie-un-defi-la-mesure-du-temps (accessed 15 August 2021).

8 Jean Marczewski, "Histoire quantitative, buts et méthodes," *Cahiers de l'ISEA*, Série AF, no. 1 (1961), III–LIV.

9 Louis Fontvieille, "Education Growth and Long Cycle:. The Case of France in the 19th and 20th Centuries," in *Education and Economic Development since the Industrial Revolution*, ed. G. Tortella (Valencia: Generalitat Valenciana, 1990), 317–35; Claude Diebolt, *'Education et croissance économique: Le cas de l'Allemagne aux 19ème et 20ème siècles*, (Paris: Bibliothèque de l'Éducation, L'Harmattan, 1995); Diebolt (1997); Claude Diebolt, "Die Erfassung der Bildungsinvestitionen im 19. und 20. Jahrhundert. Deutschland, Frankreich, Großbritannien und Spanien im Vergleich," *Zeitschrift für Erziehungswissenschaft* 3, no. 4 (2000a), 517–38; Claude Diebolt, *Dépenses d'éducation et cycles économiques en Espagne aux XIXe et XXe siècles*, Logiques Economiques, L'Harmattan, Paris, (2000b); Alain Carry, "Le compte satellite rétrospectif de l'éducation en France (1820–1996)," Special issue of the journal *Économies et Sociétés*, Série HEQ, 25, (1999); Vincent Carpentier, *Système éducatif et performances économiques au Royaume-Uni*, 19ème et 20ème siècles (Paris: Logiques Économiques, L'Harmattan, 2001).

10 Claude Diebolt and Louis Fontvieille, "Dynamic Forces in Educational Development: A Long-Run Comparative View of France and Germany in the 19th and 20th Centuries," *Compare* 31, no. 3 (2001), 295–309.

a theoretical explanation of the dynamic relations between education and economic growth in the nineteenth and twentieth centuries, synthesising a decade of collective work in this field. This work led to the hypothesis of a periodic structural transformation of the social system linked to that of the economic system. Education, having been seen as an accompanying investment, formalised by a Keynesian-inspired[11] mathematical model from the end of the Second World War, was presented as one of the causes, if not the determining factor, of economic growth, at least for the most developed countries. This was synonymous with a new mode of regulating the economic and social system in which the accumulation of physical capital remained important, but, in line with the teachings of endogenous growth[12] theorists, became subsidiary to the accumulation of human[13] capital. For Diebolt and Fontvieille, education in the most advanced countries no longer intervened as an exogenous element, helping to correct the imbalances of the economic system, but became an integral part of the economy, perhaps constituting one of the main factors of growth.

In fact, education develops its action at two levels: on the one hand, by raising the productive capacities of the economic system; on the other, as a final consumption good corresponding to a strongly increasing demand linked to the transformations of lifestyles (increase of free time, access to culture and leisure). The phase of economic prosperity from 1945 to 1973 should therefore be studied as a period of extensive development for the education and training system, particularly at secondary and higher levels. As a corollary, the depression phase of the 1970s should be considered a period of intensive development and a search for efficiency characterised by a qualitative improvement in training and in the search for new forms likely to increase the economic yield of the education/economy relationship. Extending this idea, the development of continuous training (by instituting lifelong learning), plays a role in this transformation, developing at the same time the aspect of education and training that is not directly productive.[14] These results have a powerful impact on the most recent work in terms of human capital accumulation. In practice, the

11 Claude Diebolt, "Government Expenditure on Education and Economic Cycles in the Nineteenth and Twentieth Centuries. The Case of Spain with Special Reference to France and Germany," *Historical Social Research. An International Journal for the Application of Formal Methods to History* 24, no. 1 (1999), 3–31.

12 Paul M. Romer, "Increasing Returns and Long-Run Growth," *Journal of Political Economy* 94, no. 5 (1986), 1002–37; Paul M. Romer, "Endogenous Technological Change," J*ournal of Political Economy* 98, no. 5, Part 2 (1990), 71–102; Robert E. Lucas, "On the Mechanics of Economic Development," *Journal of Monetary Economics* 22, no. 1 (1988), 3–42. For a synthetic presentation of endogenous growth theories, see Claude Diebolt and Charlotte Le Chapelain, "Human Capital and Economic Growth," in *Encyclopedia of International Higher Education Systems and Institutions*, ed. P. Teixeira and J. Shin (Springer, Dordrecht, 2019) (Living Online Edition).

13 As an original illustration, we think of the considerable impact of the Sputnik project on the development of education and research and development spending, especially in the United States: "The Sputnik effect of 1957 led to a major expansion of education in the United States, as the forced expansion of the Soviet Union's education system was blamed for the fact that the USSR had operational intercontinental missiles and had surpassed the United States in some important areas despite its much lower capitalisation. Economic models of education, and in particular the theory of human capital, suddenly attracted the keen interest of policymakers and became the basis for economic planning, even supranational planning." Claude Diebolt, Ralph Hippe, and Magali Jaoul-Grammare, *Bildungsökonomie: Eine Einführung aus historischer Perspektive* (Wiesbaden: Springer-Gabler, 2017), V–VI (our translation).

14 Diebolt and Fontvieille (2001), 295–309.

contribution of education to the growth process remains, paradoxically, subject to many uncertainties. A precise understanding of it is almost systematically hampered by the difficulty of assessing human capital endowments in a relevant manner.[15] This difficulty has been the stumbling block of the human capital project since its inception in Chicago by Schultz and his colleagues. Today, this difficulty has led to a severe criticism of its research programme, if not to its being existentially called into question.[16]

The present article is part of this momentum, while returning to its starting point in the nineteenth century in order to fully grasp the complexity of the process. It aims to study how far the evolution of the French education system, in particular the centralisation of the financing of primary education, contributed to the process of massification and democratisation of access to school and primary education in the nineteenth century. A second objective of this article is to analyse how far the beginning of an economic take-off, which occurred in parallel with an increase in educational investment, may have contributed to fostering and feeding this process. To do this, the article uses retrospective national accounts of the primary education funding allocated by the State, departments, municipalities and households over the period 1820–1913, in order to capture what is commonly referred to as the long nineteenth century. To conduct our analysis, we proceeded in three stages. First, we described how the financing of primary education in France worked and the main changes that occurred during the period under study. Second, we analysed the evolution of the different sources of financing by using the outlier detection techniques developed by Darné and Diebolt to detect the existence of possible breaks in the series.[17] Finally, we studied the causal relationships between the different sources of financing and schooling. In doing so, we also tested for causal links with the country's economic growth.

With this in mind, our ambition is to better understand when and how schooling developed in France, what the main stages were and how they should be explained (i.e. what forces drove these developments). Through the results of our analysis, we show the usefulness of statistical tools in understanding the evolution of primary education in the nineteenth century.[18] Our analysis thus contributes to providing new answers to some of the debates and controversies of past decades.

The article is organised as follows. The first part presents the context of our analysis. It recalls the major changes in primary education in France during the nineteenth century, based on the use of graphs to show school enrolments and the various financial sources for primary education controlled by the actors concerned. The second part studies the existence of breakpoints in the series of expenditures (public

15 Nadir Altinok, Claude Diebolt and Jean-Luc Demeulemeester, "A New International Database on Education Quality: 1965–2010," *Applied Economics* 46, no. 11 (2014), 1212–47.

16 Claude Diebolt and Charlotte Le Chapelain, *Le Capital humain: perspectives historiques et cliométriques*, eds., Special issue of the *Revue d'Économie Politique* 130, no. 1, (2020); Eric Hanushek and Ludger Woessmann, *The Knowledge Capital of Nations: Education and the Economics of Growth* (Cambridge, MA: MIT Press, 2015).

17 Olivier Darné and Claude Diebolt, "Unit Roots and Infrequent Large Shocks: New International Evidence on Output," *Journal of Monetary Economics* 51, no. 7 (2004), 1449–65.

18 We are, of course, aware that "quantification, statistics and econometrics may not bring everything to a certainty, but it can give to many historical debates a perspective that would otherwise be completely lacking." Diebolt (2016), 3.

and private) dedicated to the financing of primary education and discusses the results in the light of the major political events of the nineteenth century. The third part analyses the causal relationships between primary education and its financing and questions the role played by economic growth. The final part recalls and discusses the main results highlighted by the analyses undertaken in them.

Financing of primary education and schooling in the nineteenth century

The statistical information analysed in this article comes, first, from the report of the Minister of Public Instruction and Fine Arts, Jules Ferry, to the President of the Republic on 25 January 1880.[19] A permanent statistical commission had been set up by the previous minister in order to clarify everything to do with popular education by providing the most reliable data possible. It should be remembered that in France the first official records on education date back only to 1829, that the statistics were disparate and that the accounts of situations at the communal or departmental level could be very different both from the actual situations (whether or not there were boys' and girls' schools, for example) and from the statistical census. Thus, while we know that the figures published are as accurate as possible, we can tell from comparing the statistics that changes were made from time to time to correct errors or supply missing information.[20] For our cliometric treatment, the data on primary school enrolment in France come exclusively from Briand, Chapoulie, Huguet and Prost.[21] The data on its financing come from Carry, as an extension of the founding work of Fontvieille.[22] The purpose of these statistics is to bring together in a series of coherent tables all the financial flows involved in education, in order to evaluate the cost of education to the national community as a whole, to study its financing and to de-

19 Cf. Diebolt, Jaoul, and San Martino (2005), 471–97.

20 Thus, we may quote a sentence by the chairman of the Commission which produced the 1879 report on education, Emile Levasseur, "Incorrect on many points when examined in detail, these statistics give a fair idea of the great changes which have taken place in our schools over the last half century; they show the progress made over the years and reveal the main influences which have determined it." As a significant example, we mention here the educational statistics of Germany, and more particularly those of the period of the Third Reich. Indeed, from 1936 onwards, the reconstruction of the education account confronts the researcher with a Gordian knot that is difficult to cut. Was the expenditure allocated to the Hitler Youth part of educational expenditure or was this so-called educational investment of a completely different nature and should it be accounted for elsewhere than in the financial resources of education? This is an important question, since, over the period under consideration, the addition or absence of this expenditure determines the direction of the upward or downward trend in educational expenditure. For the interested reader, see in particular Diebolt (1997); Diebolt, Franzmann, Hippe, and Sensch (2017), 329–76.

21 Jean-Pierre Briand, Jean-Michel Chapoulie, Françoise Huguet, Jean-Noël Luc, and Antoine Prost, *L'enseignement primaire et ses extensions. Annuaire statistique, 19ème–20ème siècles. Écoles maternelles, primaires, primaires supérieures et professionnelles* (Paris: Economica/Inrp, 1987).

22 Alain Carry, "Les indicateurs monétaires du volume de l'éducation en France," in *Éducation et croissance économique : évolution de longue période et prospective. Une analyse comparée des systèmes éducatifs allemand, espagnol et français*, ed. Alain Carry, Claude Diebolt, Louis Fontvielle, Clara Núñez, and Gabriel Tortella, Stimulation Plan for Economic Science, European Union, 1, Brussels (1995), 207–310; Carry (1999). We also refer to the State accounts for education as established by Louis Fontvieille, *Évolution et croissance de l'État français: 1815–1969*, Special issue of the journal *Économies et Sociétés*, Série AF, no. 13 (1976), and Louis Fontvieille, *Évolution et croissance de l'Administration Départementale Française 1815–1974*, Special issue of the journal *Économies et Sociétés*, Série AF, no. 14, (1982); based on the financial records of the Compte Général de l'Administration des Finances.

termine the costs of the various levels and activities of education and activities.[23] The field of education is defined by a list of educational activities, ancillary activities and goods and services related to education. The education account considers two categories of economic agent involved in the field: financing units, which bear the educational expenditure, and production units, which carry out the teaching or related activities from the resources made available to them by the financing units.[24] The data used thus have the advantage of correcting the data of the *Statistical Yearbooks* and the *Primary Education Statistics* for double counting.[25] These data have been analysed in numerous previous[26] publications. None of these publications, however, has attempted to study the question of educational expenditure from the angle defined in the present article.

Enrolment

In a context of relative stability in the potential population for primary education, there was throughout the nineteenth century a marked increase in the number of students enrolled in schools. This phenomenon has been observed in all European countries.[27] During the period 1850–1876, there was a dramatic increase in the number of pupils enrolled in primary schools. In 1850 3,321,423 pupils were enrolled in France, that is 51.5 per cent of the population aged 5–15; in 1867, 4,515,967 pupils were enrolled (i.e. 68.6 per cent) and their number rose to 4,716,935 in 1876 (i.e. 73.6 per cent of the age group).

The change in enrolment is even more impressive if one refers to the 1837 pupil census, the first complete census available, when only 2,690,035 schoolchildren attended; the increase over forty years was 75 per cent (Figure 1). By the 1880s, more than 5.5 million children were enrolled in nursery, primary, and upper primary

23 Education expenditure represents the total final expenditure by funders on teaching activities, the organisation of the school system, and activities ancillary to school attendance. Expenditure may be public (financed by municipalities, departments, the State and other public administrations) or private (financed by households).

24 It is plausible to infer that the costs before 1880 were underestimated, perhaps even more so before 1850. Indeed, the salaries of teachers in religious and private schools are probably only partially included in the accounts. In making this inference, we are also aware that "the most beautiful of statistics" can only give what it has. The general account of the finance administration and the ministers' accounts on which we have worked are obviously not immune to occasional omissions. Nevertheless, this does not change the long-term dynamics, nor the breaks that we obtain and compare to legislative changes and innovations.

25 These are possible errors related to the work of recording and processing the accounts: arithmetical errors, imputation errors, non-exhaustiveness and double recording. The analysis of historical archives, in this case the in-depth study of the General Account of the Administration of Finance in the nineteenth century, occasionally reveals poor accounting organisation and, more often, human error through input errors.

26 For example, Diebolt (2000a), 517–38; Diebolt, Jaoul, and San Martino (2005), 471–497; Théret (1991), 1335–74; Sandrine Michel and Delphine Vallade, "Une Analyse de long terme des dépenses sociales," *Revue de la régulation. Capitalisme, institutions, pouvoirs* 1, (2007); Stéphane Zuber, Antoine Bommier, Jérôme Bourdieu, and Akiko Suwa-Eisenmann, "Le développement des transferts publics d'éducation et d'assurance vieillesse par génération en France: 1850–2000," *Économie & prévision* 4, no. 180–181 (2007), 1–17.

27 Peter Flora, *State, Economy and Society in Western Europe 1815–1975: A Data Handbook in Two Volumes* (London: MacMillan Press, 1983).

schools.[28] At the same time, the number of children who could not read or write declined from 6.95 per cent of the population enrolled in primary education in 1834 to less than 1 per cent in the mid-1870s, and to 0.13 per cent in 1912. The period under study is characterised by an almost constant increase in the number of children enrolled in school. It is highly probable that this increase in school enrolment is linked both to a change in the attitude of families, who increasingly entrusted their children to the school institution, and to the sharp increase in the material and human resources made available to primary education.

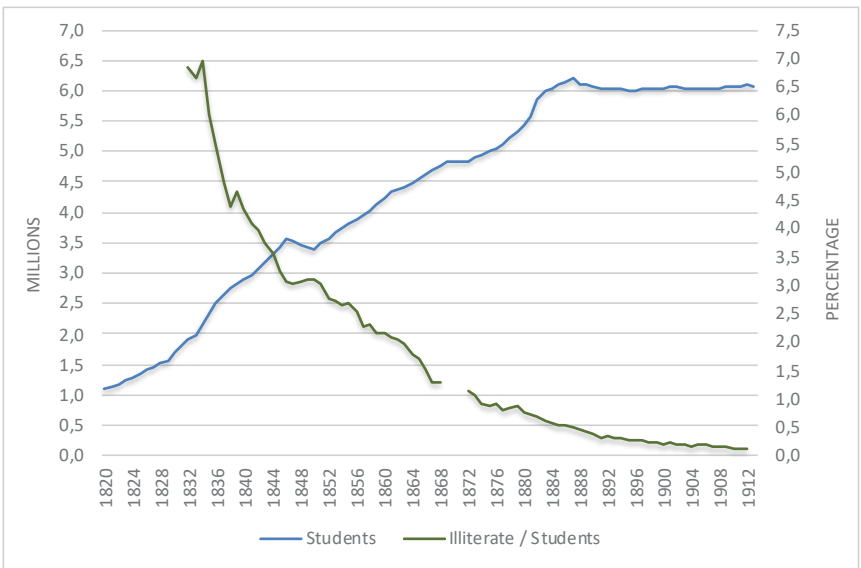

Figure 1. Number of children in school (millions) and share of illiterates (%), 1820–1913
Source: Authors' calculations based on sources cited in the article

If we refer to the graph, the Ferry laws seem to have had very little effect on enrolment rates. The graph does not seem to show any quantitative break in the rate of enrolment but, on the contrary, seems to mark the completion of a process of mass enrolment. Numerous authors have noted the early development of French schooling and the scale of the achievements made even before the Ferry laws were introduced.[29] The question of the effect of the Ferry laws is not a recent one and continues to stimulate debate. Long over-valued for political reasons, the quantitative effects of these laws have been questioned successively, notably by Furet and Ozouf; Théret;

28 In 1880, there were 621,177 pupils (girls and boys) enrolled in nursery schools (public and private) and 5,049,363 pupils (girls and boys) enrolled in primary and upper primary schools (public and private). This makes a total of 5,670,540 pupils enrolled. Authors' calculations based on Briand, Chapoulie, Huguet, Luc, and Prost (1987).

29 For example, Maurice Gontard, *L'Enseignement Primaire en France de la Révolution à la loi Guizot* (1789–1833) (Paris, Les Belles Lettres, 1959); Antoine Prost, *Histoire de l'enseignement en France 1800–1967* (Paris, Armand Colin, 1968); Pierre Chevalier, Bernard Grosperrin, and Jean Maillet, *L'Enseignement Français de la Révolution à nos Jours*, (Grenoble: Université des Sciences Sociales de Grenoble, Série Histoire Institutionnelle, 1968); Françoise Mayeur, *Histoire Générale de l'Enseignement et de l'éducation en France*, Tome 3: De la Révolution à l'École (1789–1930) (Paris: G.-V. Labat, 1981).

Diebolt, Jaoul, Martino, and more recently Chapoulie.[30]

Funding for primary education

The resources made available for primary education progressed rapidly over the period studied. In order to analyse the financing of primary education, it is first necessary to recall its operation and the main changes that occurred during the period under review. The operating costs are essentially represented by the commune's provision of suitable accommodation and a salary for the teacher (as established by the laws of 28 June 1833 and 15 March 1850). In fact, the teachers had to confine with the housing provided by the commune and a fee paid by the parents.

The Guizot law of 28 June 1833 made it compulsory for all municipalities with more than 500 inhabitants to maintain a school and it provided some regulation by determining a financing procedure and a minimum fixed salary for teachers of 200 francs.[31] Thus, the municipalities without sufficient ordinary resources had to vote three additional centimes to the taxes on land, individuals and property. The departments also had to mitigate the possible insufficiency of ordinary communal resources by voting to add two extra centimes on the same taxes. If the communal and departmental resources were insufficient, the State had to contribute to the fixed salaries of primary school teachers.

In fact, when the Falloux law was introduced in 1850, most of the burden fell directly on the municipalities. Thus, out of a total cost of 3.32 million francs (expressed in constant francs), the municipalities contributed 1.1 million francs, the families 796,000 francs, the *départements* 557,000 francs, the State 476,000 francs, and other public administrations 397,000 francs (see Figures 2 and 3).[32] Because of this direct or indirect financing by parents, the highest rates of school attendance were found in areas of rapid economic development and a certain wealth, both because of the need to have a workforce with some education and the obligation to finance the costs of this education. The Falloux law, which established freedom in secondary education, encouraged the growth of congregational or religion-based schools. It also contributed to the growth of girls' schooling by requiring municipalities with more than 800 inhabitants to maintain a girls' school.

30 François Furet and Jacques Ozouf, *Lire et écrire alphabétisation des Français de Calvin à Jules Ferry*, 2 volumes, (Paris: Éditions de Minuit, 1977); Théret (1991); Diebolt, Jaoul, and San Martino (2005), 471–97; Jean-Michel Chapoulie, *L'École d'État conquiert la France. Deux siècles de politique scolaire* (Rennes: Presses universitaires de Rennes, 2010).

31 Jérôme Louis, "L'école primaire pour tous? La loi Guizot du 28 juin 1833," in Enseignants et enseignements au cœur de la transmission des savoirs [online] (Paris: Éditions du Comité des travaux historiques et scientifiques, 2021), http://books.openedition.org/cths/14522.

32 The calculations in constant francs at 1913 prices were based on the methodology presented by Diebolt (1995), which is repeated in Carry (1999): "The choice of the price index poses [...] a major problem: should we choose an index closely linked to educational activity or, on the contrary, favour an index that is as broad as possible [...]. A weighting by wholesale prices would give a volume that is more representative of investment and equipment purchases, while a weighting by consumer prices would be more representative of changes in the volume of wages. [...] We finally chose a compromise by using, until 1913, a two-thirds weighting by consumer prices and the remaining third by wholesale prices. [...] The choice of this weighting is justified only by the fact that wages account for the largest part of educational expenditures." Diebolt (1995). For data, see Carry (1999).

Laws passed from 1867 onwards, and in particular the Duruy law (10 April 1867), greatly modified funding by enrolment. The Duruy law encouraged free education by giving the municipalities the option of levying an additional tax to finance it (article 8) and by supporting poor municipalities in the form of subsidies from the department or the State. Between 1863 and 1869, the overall budget for public education rose from 26 to 37 million francs, reflecting the importance of the policies pursued during this period in a period of overall price stability.[33]

The Republic's laws, (i.e. national legislation) of Ferry (16 June 1881 and 28 March 1882) and Goblet (30 October 1886) contributed to increase in the demand and supply of education and the growth of schooling. In addition to instituting free, secular public primary education and compulsory schooling from the ages of 6 to 13, the Ferry laws also regulated the methods of financing primary education by the municipalities, *départements* and the State, and provided a framework for teachers' salaries. Ferry insisted in particular on the role to be played by the school funds. In addition to the granting of scholarships, which had already been discussed in 1867, each commune was required to set up a school fund to provide financial assistance to pupils from needy families. The Duruy law had already opened up this possibility, which was transformed into an obligation by the Ferry law. The Goblet law specified the structure of primary education and its organisation into three distinct levels: nursery schools and kindergartens; elementary primary schools; and higher primary schools and complementary courses. It also followed on from the Ferry laws by excluding religious personnel from public education. The law of 19 July 1889 on primary education dealt with the distribution of ordinary educational expenses between the State, the *départements* and the municipalities, and in particular made the salaries of teachers the responsibility of the State.

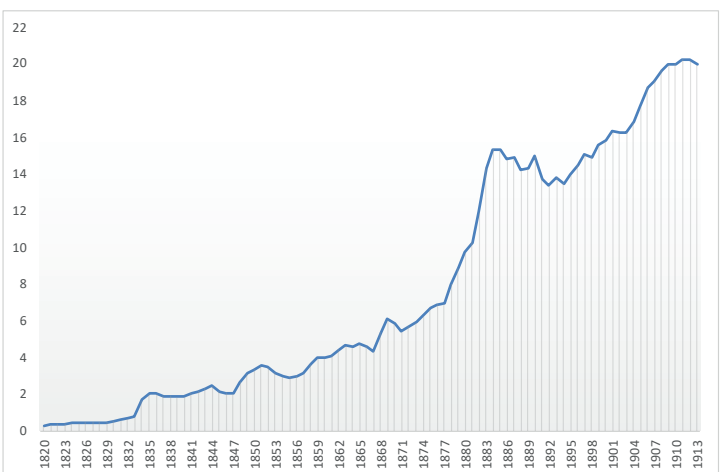

Figure 2. Financing of primary education, 1820–1913 (millions of constant francs)
Source: Authors' calculations based on sources cited in the article
Note: Expenditure on education corresponds to the total final expenditure by public financers (municipalities, départements, State, other public administrations) and private households.

33 Jean-Charles Geslot and Victor Duruy, *Historien et ministre (1811–1894)* (Villeneuve d'Ascq: Presses universitaires du Septentrion, 2009).

One of the objectives of the Third Republic was to make school accessible to all. In addition to the objectives of training and educating the population, the Republican laws aimed to transmit Republican ideals and values and to reduce the influence of the Church (an objective later reinforced by the anti-clerical laws of 1904 and 1905). The massification of access to education was accompanied by a reorganisation of the methods and means of financing and a reallocation of expenditure in parallel with the introduction of the laws. The priority given to primary education in the nineteenth century thus transformed its financing both in volume (Figure 2) and in structure (Figure 3).

The very significant growth in the resources made available to primary education was naturally accompanied by a very sharp increase in operating costs, which increased by a factor of 2.7 in the space of 20 years (i.e. an average annual rate of just under 5 per cent). The operating costs of primary education were financed mainly by the municipalities and households, but also by the State and the *départements*, and to a much lesser degree by donations and legacies. This funding changed significantly over the period 1820–1913 as shown in Figure 3.

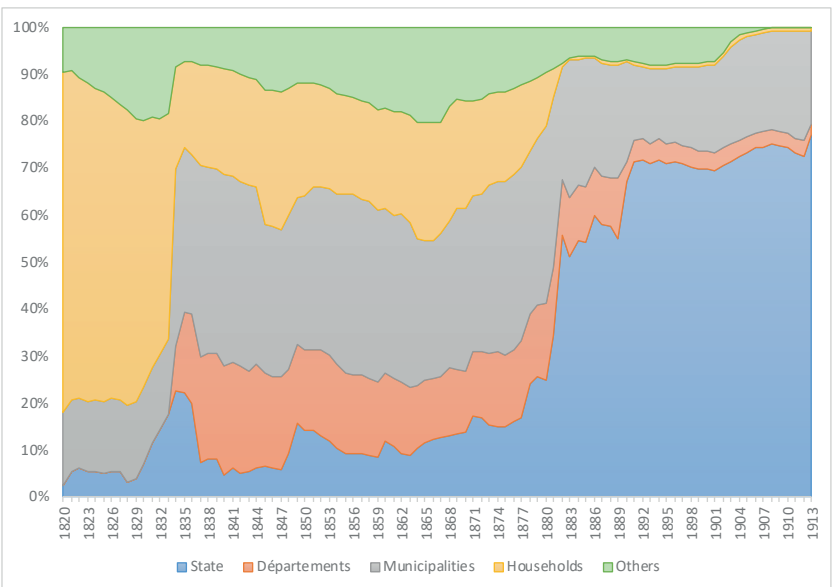

Figure 3. Structure of primary education funding, 1820–1913 (in percent)
Source: Authors' calculations based on sources cited in the article

Several shocks can be observed in this graphic presentation. From 1877 onwards, there was a very steep and rapid increase in state funding and participation. The increase in public investment occurred in the period preceding the implementation of the Ferry laws. 1880 saw a sharp and drastic drop in household funding; 1889 saw a similar drop in funding for the *départements* and municipalities, most likely due to teachers gaining the status of civil servants. The 1890s were at the same time characterised by a steady increase in funding from the municipalities and the State.

While recent historiography has tended, on the margins, to acknowledge the quantitative effect of the Ferry laws (in the wake of Prost's work[34]), it tends to highlight the extent of the qualitative effects of these laws, in particular through the transfer to the State of the effort previously imposed on the local authorities and the growth in educational expenditure financed by the latter.[35]

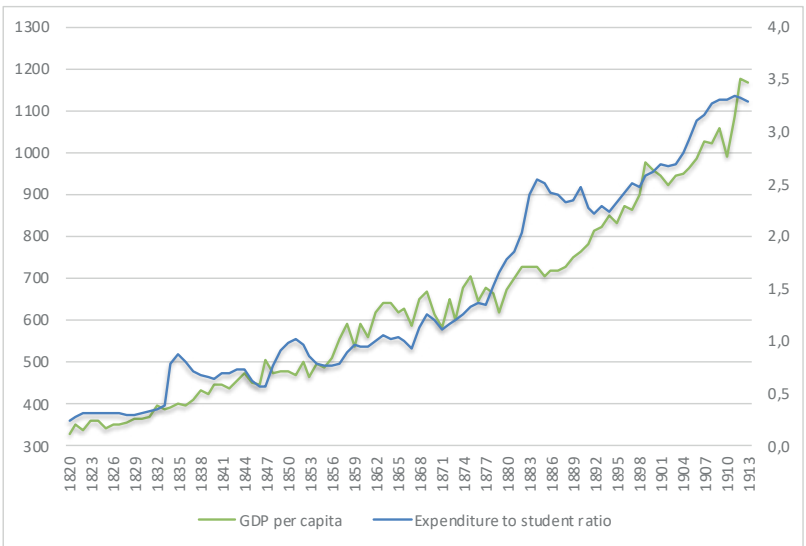

Figure 4. GDP per capita and expenditure per pupil, 1820–1913
Source: Authors' calculations based on sources cited in the article
Note: GDP per capita in millions of new constant francs (left axis)

In parallel with the increase in educational expenditure, France's wealth also increased steadily from 329 million francs per capita in 1820 to 1,167 million francs per capita at the beginning of the First World War (Figure 4). Public expenditure was increasing much faster than the number of pupils enrolled. This growth in French wealth, combined with a growth in educational expenditure and enrolment, raises the question of the impact of economic growth on schooling.

From a purely statistical point of view, the number of pupils enrolled in school is significantly and positively correlated with public expenditure, more specifically with municipal expenditure (Table 1). In concrete terms, this means that when the expenditure on primary education financed by the municipalities' increases, the number of pupils enrolled also increases. Similarly, GDP per capita is significantly correlated with public spending, this time mainly with government spending.

34 Prost (1968).

35 Théret (1991).

Table 1. Correlations between enrolment, GDP per capita and expenditure on primary education

	Expenses					
	Total	(b) State	(c) Départements	(d) Municipalities	(e) Admin Pub	(f) Households
Pupils in school	0.89	0.77	0.71	0.91	0.66	-0.09
GDP per capita	0.96	0.92	0.42	0.89	0.37	-0.28

Note: The correlation coefficient measures the direction and strength of a linear relationship between two variables. It ranges from -1 (strong negative linear relationship) to 1 (strong positive linear relationship). Between -0.5 and 0.5, the relationship is weak.

Breakpoints in primary education and schooling expenditure

With reference to statistical, institutional and legal benchmarks, our approach to the detection of possible breaks in the series aims to show that rare events and crises have varying effects on the time series of the expenditure on primary education in France. The analysis of atypical points (or *outliers*) makes it possible to confirm the existence of changes and of breakpoints that do not appear either graphically or in the descriptive statistics.

Outlier Detection Method

The *outlier* methodology consists in detecting atypical points affecting the evolution of a series.[36] Some breakpoints, on the one hand, may appear graphically; in this case, the application of the method will confirm or deny a graphical intuition. But on the other hand, other breakpoints, not visible graphically, may prove significant. The challenge of this new method is to identify these points, their possible causes and their effect on the series. We consider that an observation is exceptional when its value (positive or negative) is very high and when its frequency is low. Although subjective from a literal point of view, this definition allows us to classify these values into two categories: as rare, isolated events, characterised by a value deviating from the mean by more than three standard deviations; or as extreme, clustered events, characterised by a value deviating from the series mean by two to three standard deviations. In this work, we are interested exclusively in rare events—or atypical values.

The literature identifies four categories of atypical points: IO (Innovative outliers), AO (*Additive outliers*), TC (*Temporary changes*) and LS (*Level shifts*). The first two can be considered temporary changes, the remaining two structural changes. If the IO is seen as a temporary change that can be assimilated to "noise", the AO represents a temporary exogenous change. Although both reflect structural changes, the TS is considered temporary whereas the LS is considered permanent. In this work, we are more specifically interested in *outliers* of types AO, TC and LS, which are more suitable for historical analysis. They can be schematised as shown in Figure 5. An AO is generally considered to affect only one observation in the series but not its future values. A TC causes a rapid change in the level of the series, which quickly

36 Olivier Darné, Claude Diebolt, "Unit Roots and Infrequent Large Shocks: New International Evidence on Output," *Journal of Monetary Economics* 51, no. 7 (2004), 1449–65.

returns to its evolutionary path. Finally, an LS affects the level of the whole series from a certain point and in a definitive way.

These observations that something is unusual may be related to errors in recording or data entry. They can also be associated with specific climatic, natural, political, economic or financial events. The analysis of atypical points thus makes it possible to associate atypical observations with educational, economic, political or financial events, and so on. The economic, financial and/or political events that affect the observations do not all behave in the same way. These events can have various effects on the time series: one-off, permanent or enduring. For example, when we look at the evolution of the proportion of girls in higher education, we expect a significant influence of the Veil law on abortion or of the decrees implementing the Haby law, which made co-education in public schools compulsory. Surprisingly, these laws had only a temporary effect, whereas the Berthoin reform of 1959[37] and the Fouchet-Capelle reform of August 1963[38] have had a permanent effect on the enrolment of girls in higher education.[39]

First, we tested the existence of breakpoints in the time series of primary education expenditures, as financed by the State, départements, municipalities, households, and other public administration expenditures.[40] In a second step, we determined the breakpoints for the series related to schooling and GDP per capita.

37 Ordinance of 6 January 1959 on compulsory education up to the age of 16; decree of 6 January 1959 on the reform of public education.

38 Decree of 3 August 1963 on the pedagogical organisation of secondary schools.

39 Magali Jaoul-Grammare, "L'évolution des inégalités dans l'enseignement supérieur universitaire français. L'influence des réformes institutionnelles et des ruptures économiques," *Économies et Sociétés* 7, no. 46 (2013), 1105–30.

40 General government is divided into three categories: central government (the State, various central government bodies controlled by the State), local government (local authorities, groups of municipalities with their own tax system and "various local government bodies") and other general government entities. This last group includes social security bodies, unemployment insurance and other similar bodies.

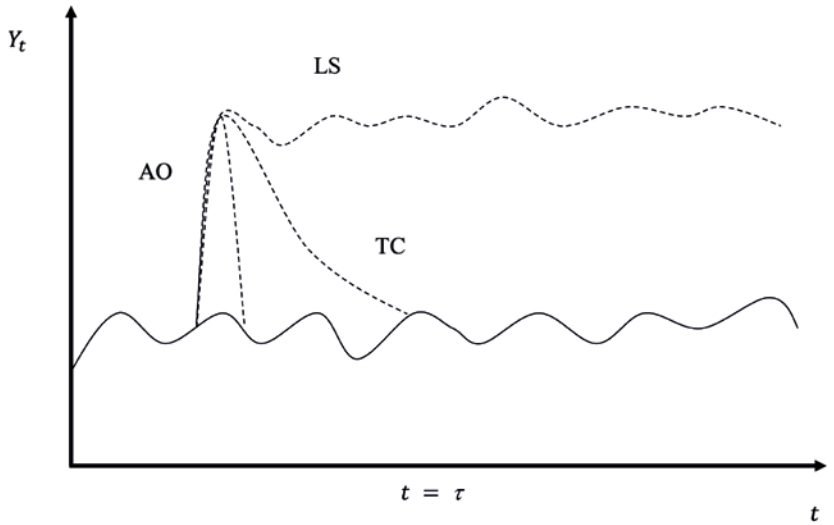

Figure 5. The various types of atypical points

The breakpoints

Until now, historiography has focused mainly on the institutional breaks (regulatory and legal) specific to the dynamics of the French education system. Our ambition is to extend the work of the founding authors and, in so doing, to highlight the quantitative ruptures generated by these institutional changes (*ex post*) or fundamentally causing them (*ex ante*) in the long term. We therefore focus mainly on the TC and LS breakpoints, both of which can be considered structural changes.

Breakpoints in spending

The detection of *outliers* in the various education expenditures for the primary level thus highlights permanent breakpoints in the expenditure structure. The analysis confirms several graphical findings discussed in part 1. It brings out new ones and questions certain others.

Analysis of the breakpoints reveals the importance of the Ferry Laws (1881 and 1882) and the permanent effect that they had on the financing of primary education in France. The Ferry laws mark breakpoints in each of the series studied.[41] Our results confirm Théret's observation that the State was replacing households and municipalities in the financing of primary education (Table 2).[42] It should be noted, however, that it was mainly the laws of 1886 and 1889 that marked permanent breaks in the transfer of primary education funding from the municipalities to the State, while the Ferry laws had only a one-off negative effect on this type of funding.

The Goblet law of 1886 complemented the Ferry laws by entrusting teaching in public schools to exclusively secular staff, thus replacing the religious teachers and reinforcing State intervention. In terms of figures, the implementation of this law led

41 The purpose of the Acts of 2 August 1881 and 20 March 1883 was to increase the endowment funds of the Primary Schools Fund in the form of expenditure from State funds, subsidies and advances from the State to the *départements* and municipalities.

42 Théret (1991).

to a permanent reduction in the weight of primary education expenditure borne by the *départements* and municipalities, which had hitherto contributed to the financing of this type of education, and increased expenditure on the part of the State.

Table 2. Breakpoints in primary education funding

Year	Type	Value (units of standard deviation)	Duration of Effect		Event
Total Expenditures					
1882	LS	3,89	Permanent	(+)	Ferry Law 1881
1883	LS	5,65	Permanent	(+)	Ferry Law 1882
1891	LS	-3,83	Permanent	(–)	Act of 1889
Status					
1878	LS	5,26	Permanent	(+)	Act of 1878
1881	LS	7,02	Permanent	(+)	Ferry Law 1881
1882	LS	17,31	Permanent	(+)	Ferry Law 1882
1884	TC	5,57	Temporary	(+)	Act of 1883
1886	TC	5,16	Temporary	(+)	Goblet Law 1886
1890	LS	21,6	Permanent	(+)	Act of 1889
1906	LS	6,75	Permanent	(+)	Laws of 1904 and 1905
Départements					
1845	LS	-4,35	Permanent	(–)	//
1868	LS	4,7	Permanent	(+)	Duruy Law 1867
1880	AO	5,43	Ponctual	(+)	Bert Law of 1879
1883	TC	11,05	Temporary	(+)	Act of 1883
1886	LS	-8,53	Permanent	(–)	Goblet Law 1886
1890	LS	-27,37	Permanent	(–)	Act of 1889
Municipalities					
1882	AO	-11,87	Ponctual	(–)	Ferry Laws 1881-1882
1886	LS	-5,73	Permanent	(–)	Goblet Law 1886
1891	LS	-6,64	Permanent	(–)	Act of 1889
Households					
1845	TC	5,05	Temporary	(+)	//
1848	LS	8,03	Permanent	(+)	Second Republic
1863	LS	5,62	Permanent	(+)	Order of June 1862
1867	AO	-13,26	Ponctual	(–)	Duruy Law
1871	TC	-11,9	Temporary	(–)	War of 1870
1881	LS	-18,3	Permanent	(–)	Ferry Law 1881
1882	LS	-21,92	Permanent	(–)	Ferry Law 1882

Like the Ferry laws, the Act of 19 July 1889 marked a breakthrough in the financing of public education. This law dealt directly with the ordinary expenses of public primary education and the salaries of its staff. Under this law, the ordinary expenses of public primary education were to be borne by the State, the *départements* and the municipalities. It stipulated that most of the expense, including staff salaries, was to be now borne by the State, thus relieving municipalities of this burden. Analysis of the breakpoints by type of funder confirms, as a permanent positive effect, the transfer to the State of spending not only from the municipalities, as previously mentioned, but also from the *départements* (both permanent negative effects).[43] This transfer reflects the political will to reduce inequalities at the national level through the centralisation of education expenditure at the national level.

Beyond the school laws of the 1880s, other laws and events marked permanent breakpoints in the series of expenditures on public education. Among these breaks, the Duruy law of 1867 (which allowed for the generalisation of schooling in France, lowered the threshold for opening girls' schools to municipalities of 500 inhabitants and accelerated the expansion of girls' education) accompanied the transfer of primary education funding from households to the *départements*.

The law of 1 June 1878, which concerned the resources allocated to the construction of school buildings and the school construction fund, also marked a permanent break in State expenditure. This law, reserved 60 million francs to the Minister of Public Instruction. The law of 20 March 1883 subsidising municipalities from State funds supplemented the laws of 1 June 1878 and 2 August 1881, which allocated subsidies to primary schools. In addition, the law granted an extraordinary credit of more than 13 million francs to the funding for primary schools, junior high schools and high schools (article 3) and authorised the departments to contribute to the advances in order to provide the municipalities with the subsidies allocated to them from the departmental budget for the construction of their school buildings (article 5). The 1883 law thus helps to account for the temporary shocks observed in *département* and State spending in 1883 and 1884.

The anti-clerical laws of 7 July 1904 (the Combes law) and 9 December 1905 (on the separation of Church and State) also marked a permanent break in the series of State expenditures. The Combes law, which prohibited teaching by religious denominations, required the reorganisation of denominational education by the secular clergy and profoundly modified the school map while reinforcing the secularisation of education in France.[44]

While some breaks can be easily interpreted in the light of different laws that came into force during the nineteenth century, other permanent breaks detected in the

43 The permanent negative effect of the 1889 law on total expenditure shows the usefulness of analysing the series in a disaggregated manner, i.e. by type of funder. The effect observed on total expenditure reflects the negative effect of the law on the expenditure of the *départements* and municipalities and conceals the positive effects of the law on State expenditure.

44 Several temporary and one-time breaks also affect the primary education expenditure series. Among these breaks, the Bert law of August 9, 1879, had a one-time effect on departmental expenditures. The law stipulated that all *départements* should have a teacher training college for men and a teacher training college for women. The law stipulates that the school expenses of the primary teacher training colleges should be met by special sums allocated to the primary education service. The Franco-Prussian war of 1870–1871 marked a temporary negative break in household expenditure on primary education.

series are more difficult to explain. For example, the permanent negative break observed in 1845 in *département* spending cannot be linked to the implementation of a particular law at the time in question. However, it does confirm the existence of a budgetary change linked to a transfer of primary education expenditure from the *départements* to households, for which we have no relevant explanatory scheme at present. This break may also be inherent in the construction of the Carry[45] series.

Interpreting the permanent positive break observed in household spending in 1863 is also more complex. A possible explanation, and a line of thought, can be established with the application of the June 1862 decree on school libraries, under which families provided for the loan or rental of a school's books.[46]

Breakpoints in schooling

A more surprising result in the light of current historiography, however, is the positive and permanent effect of the Ferry laws in themselves on primary schooling (Table 3). In fact, this result refines our knowledge of the schooling process in France. We support the hypothesis that, before the Ferry laws, the enactment of various laws led to a steady increase, with an evolutionary dimension, in primary school enrolment. Yet it was the Ferry laws alone that represented a major breakthrough, in particular by promoting public education, and more particularly the public education of girls.[47] It is the purpose of our most recent research on the feminisation of primary education to provide evidence for this intuition, the in-depth quantitative analysis of which remains, to our knowledge, still unfortunately neglected.[48]

Table 3. Breakpoints in primary schooling

Year	Type	Value (units of standard deviation)	Duration of Effect		Event
Number of students					
1882	LS	5,23	Permanent	(+)	Ferry Laws 1881–1882

Note: The *outlier* analysis on the pupil to population ratio reveals the same permanent outlier: 1882 (LS).

Breakpoints in economic growth

The analysis of breakpoints in GDP per capita does not reveal any break over the period studied. The break observed in the financing of schooling is therefore not linked to

45 Carry (1999).

46 Indeed, the establishment of these school libraries relied largely on additional funding from families: "I have attached to the formation of the school library the provision of textbooks for all pupils. A voluntary contribution, or rather a subscription taken out by well-to-do families, will not only provide the children of these families with the books they need to be able to usefully follow the exercises in class, but will also make it possible to put, on loan, works of the same kind into the hands of the children received free of charge in the schools … The Departmental Council […] will fix this contribution each year […] His Excellency the Minister of Finance has been kind enough to authorize the municipal collectors to collect it at the same time and in the same form as the school fees […]." (Circular from the Minister of Public Education, M. Rouland, 24 June 1862).

47 Françoise Mayeur noted in particular in her book (1981): "[…] the work of Jules Ferry was being illuminated in a complementary light: in short, to 'plug the holes in schooling' that had already been established. Girls' schools were opened where they were lacking, precisely in the West and South-West, and the system of hamlet schools was extended." Mayeur (1981).

48 Claude Diebolt, Magali Jaoul-Grammare, Faustine Perrin, "Retour sur les fondamentaux de la féminisation de l'éducation primaire en France," *Miméo*, February (2020), 30 pages.

any break in economic growth. This point will be analysed in greater detail in our third part, which looks at the causal relations between the financing of primary education and schooling, on the one hand, and schooling and economic growth, on the other.

The various analyses of turning points carried out in this section reveal the importance, both quantitative and qualitative, of the role played by the Ferry laws in the financing of primary education. The Ferry laws mark the transition from financing primary education by the municipalities to the public financing of education at all levels by the laws. Our cliometric results indicate the importance of the role played by the Republic's legislation and suggest that the Ferry laws did play a central role, both in the structure and centralisation of primary education funding and in the enrolment of pupils in primary education.[49]

Primary education expenditure, enrolment and economic growth

The evolution of the various indicators shows an upward trend in GDP per capita, in the number of pupils enrolled and in education expenditure. This parallel evolution of the series suggests common correlations, mere graphical intuition of which is not sufficient to confirm the existence of a causal influence from either on the other. The analysis of breakpoints is completed by an analysis in terms of causality with a view to studying the relationships between variables.

Causality analysis

In general, a statistical causal relationship is deemed to exist between two variables if the predictability of one improves when information about the other is included in the analysis. In statistical terms, it is essential to distinguish correlation from causation. The main difference between correlation and causation here is temporality. Causality is based on the fundamental axiom that *"the past and present can cause the future, but the future cannot cause the past."*[50] It is the temporal order that makes it possible to interpret dependence as a causal relationship.[51] Thus, correlation is a symmetrical concept which is silent about the direction of influence, whereas causal direction is established along the *"arrow of time."*[52]

Granger causality analysis is part of the framework of non-structural VAR (*Vector AutoRegressive*) models, to our knowledge introduced into historical research by Eckstein, Schultz and Wolpin.[53] Unlike a non-vector model, which describes the evolution of a single variable in the form of an equation, vector models are composed of several equations. Each equation describes the evolution of a variable according to

49 The analysis of the breakpoints does not, however, reveal any effect of the Guizot law of 1833, in contradiction of the graphic observations and the existing literature on the subject.

50 Clive W.J. Granger, "Tests for Causation: A Personal Viewpoint," *Journal of Economic Dynamics and Control* 2 (1980), 330.

51 Guido M. Kuersteiner, "Granger-Sims Causality," in *Macroeconometrics and Time Series Analysis*, ed. Steven N. Durlauf, Lawrence E. Blume, The New Palgrave Economics Collection, (London: Palgrave Macmillan, 2010).

52 Granger (1980), 334.

53 Zvi Eckstein, Theodore P. Schultz, Kenneth I. Wolpin, "Short-Run Fluctuations in Fertility and Mortality in Pre-Industrial Sweden," *European Economic Review* 26, no. 3 (1984), 295, "The methodology of vector auto-regression appears useful for studying historical series on climatic, economic and demographic variables where we do not yet have a sufficient theoretical foundation for specifying and estimating structural models."

its past values and the past values of the other variables in the system.[54] Thus, all the variables are both exogenous and endogenous, which makes it possible to consider all the possible relationships between the variables without any preconceived notion of their possible endogeneity. The use of these models thus enables us to detach ourselves from those theoretical models, which postulate the endogeneity of one or other of the variables. Furthermore, taking into account a number of time lags allows us to analyse the temporality with which the relationships between the variables take place; in other words, when one variable affects another, how long does it take? The analysis itself can take two non-exclusive directions: the study of causal relationships (short-term relationships) and the study of the dynamics of the model.

Dynamic analysis, for its part, consists of studying the effects of variations in one variable on the variations in the other variable. To do this, crises are simulated via the residual elements of each variable in order to observe how (impulse response function) and in what proportion (variance decomposition) the other variables in the system are affected.

First, we tested the Granger causal relationships between the different primary education expenditure series and schooling. Next, we went on to study the causal relationships between: (*i*) GDP per capita and expenditure; and (*ii*) GDP per capita and enrolment, so as to be able to assess whether the effects we observed stemmed from political will, economic necessity or some need felt by the populations, independently of the wealth created.

Causal relationships

The objective of causality analysis is to determine the direction and sign of a causal relationship. The first step is to assess whether it is the increase in expenditure that led to an increase in enrolment or whether the action took the opposite direction. Second, we assessed how far the level of national wealth, as measured by GDP per capita, caused a change in primary education expenditures and in the number of children enrolled in school. The literature suggests that the relationship between human capital and economic growth is complex and reciprocal.[55] As a premise for

54 See Magali Jaoul-Grammare, Faustine Perrin, "A Gendered Approach of Economic and Demographic Interactions: Evidence from France," *Revue d'Économie Politique* 127, no. 6 (2017), 1083–108, for a detailed presentation of the methodology.

55 The process of human capital accumulation is a key ingredient in the growth process that has enabled economies to move from a long period of stagnation to a state of sustained economic growth; see Oded Galor, David Weil, "Population, Technology, and Growth: From Malthusian Stagnation to the Demographic Transition and Beyond," American Economic Review 90, no. 4 (2000), 806–28; Oded Galor, Omer Moav, David Vollrath, "Inequality in Landownership, the Emergence of Human-Capital Promoting Institutions, and the Great Divergence," *Review of Economic Studies*, 76, no. 1 (2009), 143–79; Claude Diebolt, Audrey-Rose Menard, Faustine Perrin, "Behind the fertility-education nexus: What triggered the French development process?" *European Review of Economic History* 21, no. 4 (2017), 357–92; Claude Diebolt, Faustine Perrin, "From Stagnation to Sustained Growth: The Role of Female Empowerment," *American Economic Review* 103, no. 3 (2013), 545–49; Claude Diebolt, Faustine Perrin, "A Cliometric Model of Unified Growth. Family Organization and Economic Growth in the Long Run of History," in *Cliometrics of the Family: Global Patterns and Their Impact on Diverging Development*, ed. C. Diebolt, S. Carmichael, S. Dilli, A. Rijpma, C. Störmer Studies in Economic History (Cham: Springer, 2019a), 7–31, Claude Diebolt, Faustine Perrin, "Cliometrics of Growth," in *Handbook of Cliometrics*, ed. C. Diebolt and M. Haupert (Berlin: Springer Publishing, 2019b), 403–21; Claude Diebolt, Tapas Mishra, Faustine Perrin, "Gender Empowerment as an Enforcer of Individuals' Choice between Education and Fertility: Evidence from 19th Century France," *Journal of Economic Behavior and Organization*, 188 (August 2021), 408–38; Faustine Perrin, "On the Origins of the Demographic Transition. Rethinking the European Marriage Pattern," *Cliometrica*, in press (2021).

our analysis, we assume that schooling causes growth and, in turn, growth causes schooling.[56]

Expenditures and enrolment

Beyond a change in the funding structure, the various expenditures affected the number of children enrolled in primary school (referred to here as 'enrolment'), as shown by the results of the causal analysis presented in Table 4. Our results demonstrate that any increase in municipal, departmental, or state spending favoured the development of enrolment. When a change occurred, the response time in the number of pupils enrolled depended on the type of expenditure. While a change in state expenditure led to an immediate response in enrolment, the time lag for decentralised expenditure at the commune level was greater. Thus, it took three years for municipalities to notice an increase in enrolment.

We also note the existence of a retroactive loop between *département* expenditure and schooling: an increase in *département* expenditure led to an immediate increase in the number of pupils, which in turn led to an increase in departmental expenditure. In this case, the reaction took place within three years.[57]

Unlike public expenditure (State, *départements*, municipalities) which as ever caused an increase in schooling, the expenditure borne by households created a burden for them, which tended to slow down schooling. The reaction of households to an increase in the burden of primary education expenditure led to an immediate reduction in schooling.

Table 4. Causal relationships between type of expenditure and schooling

	Number of pupils	**Response time** *	**Percentage of dependence** **
States	Expenditure $\xrightarrow{+}$ Number of pupils	Immediate	20%
Département	Expenditure $\xrightarrow{+}$ Number of pupils	Immediate	Δ pupils = 5% Δ expenses
	Number of pupils $\xrightarrow{+}$ Expenditure	3 years	Δ expenses = 10% Δ pupils
Municipalities	Expenditure $\xrightarrow{+}$ Number of pupils	3 years	12%
Households	Expenditure $\xrightarrow{-}$ Number of pupils	Immediate	16%

Note: * Reaction time of one variable to a change in the other variable; ** Percentage change in one variable due to changes in the other variable. The results of the econometric analyses are available in a separate appendix upon request.

Economic growth and the spread of primary education

Analysis of the causal relationships between GDP per capita and the various types of primary education financing rather surprisingly reveals no causal relationship.

56 Claude Diebolt, "Croissance économique et éducation," in *Dictionnaire de l'éducation* , ed. A.Van Zanten (Paris: Presses Universitaires de France, Collection "Quadrige," 2008), 89–93.

57 Further analysis of the number of illiterates, on the other hand, shows no change attributable to increased funding for primary education.

Furthermore, no causal relationship is discernible between GDP per capita and the number of pupils enrolled in primary education.

As mentioned at the beginning of this article, the theoretical literature has long been interested in the role of human capital as an engine of economic growth, in particular by insisting on the role played by public spending.[58] As regards the empirical analyses, they highlight mixed results: some of them find the impact of education spending on economic growth to be weak.[59] Others highlight the central role played by human capital and the centralisation of primary education in the process of economic growth. We are thinking here of the case of Italy, as well as France.[60] At this stage of our knowledge, we believe that the differences observed and the resulting divergence of conclusions could be explained by different contexts and/or scales of analysis.

We know that the causal relationship between economic growth and public spending on education can be affected by many factors and by the context in which these events take place.[61] It may also be the case that primary education alone is insufficient to generate growth and that we may find clearer results using secondary and tertiary education series. It would also be interesting to study the question of educational finance over other periods, with an analysis of government spending on education in the twentieth century.[62]

In fact, our results show two things. On the one hand, they show that it is public expenditure on education that causes the increase in enrolment, and that enrolment may also cause the need for increased public expenditure on education in the *départements*. On the other, they show that the methods of financing, as measured by GDP per capita, do not cause an increase in primary school expenditure, nor do they cause an increase in enrolment. The combination of these results leads us to defend the hypothesis that the increase in investment in primary education is above all the result of a political will, to allow all French children, both girls and boys, to have access to public primary education. This clearly stated objective of the Third Republic of making school accessible to all, in particular with the intention of transmitting Republican ideals and values and reducing the influence of the Church, is confirmed by our cliometric analysis.

58 Lucas (1988), 3–42; Robert J. Barro, "Government Spending in a Simple Model of Endogenous Growth," *Journal of Political Economy*, 98, no. 5 (1990), 103–25; David de la Croix and Matthias Doepke, "Inequality and Growth: Why Differential Fertility Matters," *American Economic Review*, 93, no. 4 (2003), 1091–113.

59 Examples include David A. Aschauer, "Public Investment and Productivity Growth in the Group of Seven," *Economic Perspectives* 13 (1989), 17–25; Robert J. Barro, "Economic Growth in a Cross-Section of Countries," *Quarterly Journal of Economics* 106, no. 2 (1991), 407–43; William Easterly and Sergio Rebelo, "Fiscal Policy and Economic Growth," *Journal of Monetary Economics* 32, no. 3 (1993), 417–58; S. Deverajan, V. Swaroop, and H.F. Zou, "The Composition of Public Expenditure and Economic Growth," *Journal of Monetary Economics* 37, no. 2 (1996), 313–44; Kevin Sylwester, "Income Inequality, Education Expenditures and Growth," *Journal of Development Economics* 63, no. 2 (2000), 379–98; David de la Croix and Catherine Delavallade, "Growth, Public Investment and Corruption with Failing Institutions," *Economics of Governance* 10, no. 3 (2009), 187–219.

60 Adrien Montalbo, "Primary Education and Economic growth in Nineteenth-Century France," *Cliometrica*, in press (2021).

61 See Lant Pritchett, "Mind your P's and Q's: The Cost of Public Investment is not the Value of Public Capital," *Policy Research Working Paper*, no. 1660 (1997).

62 Clémence Cardon-Quint, "State Education Budgets in the 20th Century: Literature Review and Research Perspectives on the French Case," *Rivista di Storia Economica* 2 (2020), 175–221.

The absence of a stable long-term relationship, highlighted by the cointegration tests between enrolment, education financing and economic growth, reflects the importance of the historical and economic context in the evolution of the series, the context generating the events conditioning the evolution of economic growth.[63]

Conclusion

In France, mass schooling is a race in stages. The detection of breakpoints in the financing of primary education clearly points to the importance of the various laws enacted in the course of the nineteenth century. In summary, we can say that the democratisation of primary education was accompanied by a reorganisation of the system, of the modes and means of financing from private to public, together with a strengthening of the role of the State following the adoption of the 'great laws' of the 1880s.

With the introduction of these major laws, our causal analysis suggests that the State replaced households and municipalities in financing primary education. Moreover, in addition to a change in the funding structure, the various expenditures also affected enrolment rates. But the analysis also fails to reveal a causal relationship between GDP per capita and the number of pupils enrolled in primary education, and between GDP per capita and education expenditure. Our results thus suggest that mass schooling in France in the nineteenth century was more the result of a genuine political will than of the increased wealth available in the economy. Our future research will aim to validate or invalidate this result. Indeed, like Alfred Marshall, we believe that ... *it is not the effects of the most obvious causes, nor the causes of the most obvious effects, that usually matter most.* 'What is not seen' is often far more worthy of study than 'what is seen'.[64]

We have deliberately chosen to study the situation at the national level, in order to better understand the way in which formal institutions have allowed the process of massification to take hold. Although the Ferry laws had only a relatively limited effect on the process of mass schooling, they did have a profound effect on the structure of funding and on the reduction of inequalities, by reducing the burden of funding previously borne mainly by the municipalities and by centralising the expenditure at State level. Our results thus reveal a qualitative as well as quantitative effect of the Ferry laws. In so doing, they contribute to the state of knowledge by showing, from new evidence and a cliometric treatment of the field, the full complexity of the schooling process. Our work also points to the need for a renewed and deeper analysis of the role of feminisation. At the same time, our results stress the value of linking historical, theoretical and statistical analysis more firmly together, with the aim of producing advances in knowledge at the frontiers of a discipline and, in so doing, making progress in the common, interdisciplinary if not multidisciplinary knowledge of the structural and spatial dynamics of schooling in France.

The available statistics show the constant progress that was made during the nine-

63 Olivier Darné and Claude Diebolt, "Chocs temporaires et permanents dans le PIB de la France, du Royaume-Uni et des Etats-Unis," *Revue d'Economie Politique* 116, no. 1 (2006), 65–78.

64 "[…] ce ne sont pas les effets des causes les plus connues, ni les causes des effets les plus manifestes, qui ont d'ordinaire le plus d'importance." Ce que l'on ne voit pas "mérite souvent beaucoup plus d'être *étudié* que" ce que l'on voit." Alfred Marshall, *Principes d'économie politique*, Tome Premier (Paris: V. Giard & E. Brière, 1906), 136.

teenth century. Analysing the numerical information allows a better understanding of the general trends and the major efforts and improvements made by the French State during the century. However, there was great diversity at the regional level. As highlighted by Westberg in the case of Sweden, and more particularly Sundsvall, in the second half of the nineteenth century, there were local diversities and varying attitudes to the financing of primary education.[65] Understanding the determinants at the disaggregated level therefore becomes an urgent task for future research. Indeed, geographically speaking there were very different funding structures from one region to another. If we consider the geographical level of the *département*, we find extreme situations where the State's share could be less than 1 per cent or, in contrast, more than 50 per cent. In fact, there was often a kind of compensation between the percentages of the State and the *départements*, so that the *départements* receiving most of their funding from the State were among the least endowed by their departmental assembly. This raises such questions as "What were the 'leading' or dominant geographical areas in the nineteenth century in terms of funding for primary education?"; "Were disparities observed and maintained throughout the period studied?"; "On the contrary, was there a process of convergence and catching up during the nineteenth century?"

All these questions deserve to be studied in detail. Spatial analysis is, in fact, a valuable analytical tool for gaining a better understanding of the structural and spatial dynamics of the French *départements*. This is also what our future research will focus on.

Appendix 1—Atypical points

The methodological approach used in our article was developed by Olivier Darné and Claude Diebolt.[66]. It shows that rare events and shocks can have various effects on the time series studied.

Generally speaking, when economic history is concerned with the analysis of crises, two econometric methodologies are possible. Either, following the traditional approach, such shocks can be studied in terms of impulse response functions. In this case, the analysis is based on the estimation of a VAR model, and is essentially part of an analytical and forecasting approach, since the shocks considered are simulated and therefore fictitious. Or, following the example of the most current cliometric work, the shocks can be analysed in the form of atypical points or *outliers*. In this case, the analysis of shocks is part of an analytical and historical approach, since the shocks were historical events. Our research approach was in line with this second research approach. In other words, we used the outlier detection method.

How can we identify whether exceptional events are rare or extreme? In statistical theory, when an observation deviates significantly from its mean value or trend, it is considered exceptional. It is therefore defined by a particular, non-representative value, and the number of exceptional observations generally does not exceed 1 per cent of the total observations. However, the definition of these values based solely on

65 Johannes Westberg, *Funding the Rise of Mass Schooling: The Social, Economic and Cultural History of School Finance in Sweden, 1840–1900* (London: Palgrave Macmillan, 2017), 242 pages.

66 For the reader interested in other cliometric applications or a complete mathematical and statistical presentation of the *outlier* methodology, see Darné and Diebolt (2004), 1449–65.

their size and rarity is not operational. It is too vague and requires the prior establishment of size and frequency thresholds at which a value can qualify as exceptional.

In this article, after specifying the measurement scale and the reference period, we consider an observation to be exceptional when its value (positive or negative) is very high and its frequency is low. Although subjective from a literal point of view, this definition allows us to classify these values into two categories: rare events and extreme events. A rare event, also called an atypical value, an aberration or *outlier*, is distinguished from an extreme event by its frequency of occurrence. While extreme values appear in groups, atypical values are isolated from each other. Moreover, an atypical value is defined by a value clearly higher than three times the standard deviation of the series, whereas an extreme event represents only a value of two to three times the standard deviation of the series. In this article, we focus exclusively on atypical values.

How to detect atypical values? Rare or atypical observations, other than extreme ones, are defined as such in relation to a standard distribution or model. Let's assume a Gaussian (or even "normal") distribution: the bell curve. In this case, observations that are not compatible with an assumption of the normality of this distribution can be considered atypical values. But not all distributions are normal. When researchers work on a series of data, they will first try to describe the distribution of these data by means of a model, using two parameters, the skewness coefficient and the kurtosis coefficient. These coefficients tell us about the "shape" of the distribution curve, which may be skewed or flatter or sharper than a normal distribution. Atypical events are those that are not consistent with the distribution corresponding to these coefficients.

These atypical events fall into two groups. They may be related to errors in recording or data entry. They can also be associated with climatic, natural, political, economic or financial events. Should these observations be retained or eliminated? Neither of these solutions appears to be universally satisfactory. Keeping the atypical values means taking the risk of selecting a model that does not describe either the whole data set or the exceptional values. Conversely, if the choice is made to eliminate these observations, then it is possible that part of the information contained in the data series will be eliminated. It is therefore important to identify the source of the outlier. Thus, if the event responsible for the outlier occurs only rarely and is therefore unlikely to recur, the removal of this observation will not have any untoward consequences for estimating the underlying model. Conversely, if this event is likely to recur, it should under no circumstances be deleted. The choice to keep certain atypical and isolated observations is particularly justified when it is possible to link this value to an event which is economic, political financial, and so on. However, not all economic, financial and/or political events that affect the observations behave in the same way. These events can have various effects on the time series: one-off, permanent or lasting over time.

Appendix 2—VAR Models

Proposed by Christopher Sims,[67] VAR modelling was initially opposed by "classical" economists. The latter, who tended to be followers of theory (in the sense of the Cow-

67 Christopher Sims, "Macroeconomics and Reality," *Econometrica* 48, no. 1 (1980), 1–48.

les Commission[68]), based their models on theoretical foundations and considered that it was essential to make assumptions about the relationships between the variables. For the more empirical approach, the model had to be based on solid statistical results, which in economics made it possible to reveal the structure of the markets.

VAR models extend the work of Clive Granger[69] on the causal relationship between two variables. Taking this perspective, Sims proposed a model extending the analysis of causality to a system of several variables. He proposed to treat all variables identically, without making any exclusion or exogeneity conditions, by selecting an identical lag for each of them in all equations. The advantages of non-structural VAR modelling over classical modelling are twofold. On the one hand, it allows a better dynamic analysis of the systems by taking into account the intrinsic structure of the series and the dynamic effects between the variables. On the other, it allows all the causal relations between two variables to be considered without any a priori on the exogeneity of one of them.[70]

However, VAR models have limitations. First, there is the problem of the number of variables to be included in the model and the resulting estimation problem. Indeed, VAR models differ from structural models (based on theory) in that they leave more room for empiricism. But, in such cases, how many variables should be chosen? The number of variables to be included in the model thus raises the problem of vanishing degrees of freedom. If, for example, we consider 20 variables and 4 lags, this leads to the estimation of 80 coefficients per equation, and very often the number of unknown coefficients is close to the size of the sample analysed. Another criticism often levelled at VAR models is linked, as already mentioned, to the few theory to which they refer, which regularly qualifies them as a-theoretical models. This theory versus measurement debate had already divided economists in the 1920s, at the time of the creation of the National Bureau for Economic Research (NBER), for example, and resurfaced in the 1980s with the work of Sims and still the debate is far from over. If VAR models are criticised for their lack of theory, the theoretical models of the Cowles Commission supporters have long been criticised for their lack of flexibility.[71] Faced with this Gordian knot, our cliometric approach proposes to reconcile theory and measurement in proportions that offer both the theoretical and the empirical debate necessary for the development of science. Thus, in this article, we draw on the lessons of theoretical models of economic growth and aim to test the possible links with the development of primary education in France via VAR modelling and the analysis of causal relations in the statistical sense of the term.

68 https://cowles.yale.edu/sites/default/files/files/pub/rep/r1932-52.pdf (accessed 15 August 2021)

69 Clive Granger, "Investigation Causal Relations by Econometric Models and Cross-Spectral Methods," *Econometrica* 37, no. 3 (1969), 424–38.

70 For the French reader interested in a presentation of VAR models, we suggest reading Catherine Doz and Pierre Malgrange, "Modèles VAR et prévisions à court terme," *Économie & Prévision* 106 (1992), 109–22.

71 As early as 1976, Lucas, as a precursor, argued that these models are fundamentally flawed in assessing the consequences of alternative economic policy outcomes. Cf. Robert Lucas, "Econometric Policy Evaluation: A Critique" in *The Philips Curve and the Labor Market*, ed. Karl Brunner and Allan H. Meltzer (Amsterdam: North-Holland, 1976), 19–46.

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