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Growth in the Long Run

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HUMAN CAPITAL AND FRENCH MACROECONOMIC GROWTH IN THE LONG RUN

Claude DIEBOLT¹ & Jamel TRABELSI²

Abstract: Much of the economic growth literature has focused on the contribution of human capital to national development. Two assumptions have remained largely unexamined: (I) economic stability results from economic growth, and (II) investments in human capital result in economic growth (*ceteris paribus*). This article questions this education-stability link by analyzing regime shifts in the stochastic process of real Gross Domestic Product (GDP) and education expenditures in France over the period 1820-1990. Results indicate that human capital investment prior to 1945 was a response to economic growth. It is only since 1945 that human capital investments appear to drive economic growth. The results raise the question of whether human capital investment might not be as much a consequence as it is a cause of economic stability in the course of time.

Keywords: Business cycles, cliometrics, economic growth, France, human capital, regime shifts.

Introduction

The aim of this paper is to use the educational statistics available for France to make a fresh examination of the movement of the aggregate series on *per pupil* expenditure on education and *per capita* economic growth in the nineteenth and twentieth centuries. A new interpretation is proposed concerning the relations between education and economic growth. Indeed, in addition to technical progress or quantitative growth of the population, education is a factor which has hitherto been the best explanation of the inequalities in economic development which tend to give developed countries an advantage over the others. This does not mean that raising the average level of education is automatically followed by economic growth. However, it can be considered that the mastery of new technologies requires appropriate levels of knowledge, of which a probably increasing proportion results from education.

In fact, human development was considered by few early writers (Smith, Malthus, Ricardo, Mill, Marx, Marshall, etc.) to be of paramount importance. But, none have considered human beings to be the center of economic theory and the main source for economic growth. This topic did not receive much serious attention in the literature until fairly recently. The publication of *The Economic Value of Education* by Theodore Schultz³ focused considerable attention in the field of inquiry which has become known as the

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³T.W. Schultz, *The Economic Value of Education* (New York: Columbia University Press, 1963).

economics of education. Schultz was the first to theorize the importance of the relationships among investment in education, human capital formation, and the economic development and well-being of nations.

Since this pioneer work, for the most part the research on human capital has been concerned with the difficult task of conceptualizing and measuring the benefits of education, both to the individual and to society.⁴ In view of this, we make a distinction between two procedures for measuring the contribution of education to economic growth.⁵ The first is closely related to the marginalist theory of income distribution. It considers the quantities of education measured in time spent at school and incorporated in the working population. By combining these quantities of education and the differences in income considered to be ascribable to them, one obtains an index of improvement of the efficiency of the labor force that can be included in a production function with the other factors of production.⁶ The second leads to direct estimation of the contribution of education to economic growth. It applies to the expenditure on education that has benefited the working population a rate of profitability of education. This is calculated using comparisons of cost and income differentials.⁷ In spite of their apparent differences, the pattern of reasoning is implicitly the same in both procedures since the contribution of individuals to production can be evaluated on the basis of the income that they have received. Vice versa, the productivity of individuals is itself determined by the education that they have received. However, one should be sure that the individuals earn incomes that match the productivity that is the fruit of their education. If these reserves are justified, this does not mean that education does not play an important role in economic growth. The results obtained to date are remarkable but leave essential questions for economists unanswered. Why does a nation experience a period of economic expansion followed by a recession? Why do some countries develop more rapidly than others? These are simple questions that go unanswered because of the absence of a dynamic perspective. One is obliged to admit that in spite of recent developments in terms of convergence⁸ and endogenous growth,⁹ we do not know how education is related to economic growth. There are numerous hypotheses and a multitude of numerical estimates. On the one hand, there are fairly formalized analytical procedures that are generally somewhat unsatisfactory and on the other, a body of more

⁴E. Cohn & T.G. Geske, *The Economics of Education*, 3rd ed. (Oxford: Pergamon Press, 1990): 20.

⁵M. Blaug, "Where Are We Now in the Economics of Education", *Economics of Education Review* 4/1 (1985): 17-28.

⁶E.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).

⁷G.S. Becker, *Human Capital. A Theoretical and Empirical Analysis with Special Reference to Education* (New York: Columbia University Press, 1964). See also an earlier work by J. Mincer, "Investment in Human Capital and Personal Income Distribution", *Journal of Political Economy* 66/4 (1958): 281-302.

⁸R.J. Barro, X. Sala-i-Martin, "Convergence", *Journal of Political Economy* 100/2 (1992): 223-251.

⁹R.E. Lucas, "On the Mechanics of Economic Development", *Journal of Monetary Economics* 22/1 (1988): 3-42. See also P.M. Romer, "Endogenous Technological Change", *Journal of Political Economy* 98/5 (1990): 71-102.

correct remarks or intuitions that are not precise enough to serve as the foundation for decisions for guiding a growth strategy.¹⁰

This being so, it has become necessary to call upon historical approaches to arbitrate between theoretical reflection and the contingencies of action.¹¹ Indeed, it is stating the obvious to observe that there is a close link between the level of development of a country and the level of education of the population. However, the role played by education in economic growth is not as clear as it would seem.¹² The question whether the key to this is the level of education or, on the other hand, the result of economic development, is far from having been settled by the specialists, and the two hypotheses are still opposed.¹³ In fact, this alternative expresses the two poles of a dialectical relation linking human development and the material means involved. Human development assumes material means, but there can be no material development without human development. It is true that a balance is never achieved, and the results gathered in earlier studies¹⁴ show that both aspects go

¹⁰R.K. Weizsäcker von ed., *Bildung und Wirtschaftswachstum*, (Berlin: Duncker & Humblot, 1998).

¹¹R.J. Barro & X. Sala-i-Martin, *Economic Growth* (New York: McGraw-Hill, Inc., 1995). See also P. Aghion & P. Howitt, *Endogenous Economic Growth* (Cambridge, Mass.: MIT Press, 1998).

¹²J.W. Meyer & M.T. Hannan eds., *National Development and the World System. Educational, Economic, and Political Change, 1950-1970* (Chicago: The Chicago University Press, 1979).

¹³P. Lundgreen with a contribution by A.P. Thirlwall, "Educational Expansion and Economic Growth in Nineteenth-Century Germany: A Quantitative Study", in *Schooling and Society. Studies in the History of Education*, ed. R. Stone (Baltimore: The Johns Hopkins University Press, 1976): 20-66.

¹⁴See especially C. Diebolt, *L'évolution de longue période du système éducatif allemand*, 2 vols. (PhD diss. in Economics, University of Montpellier I, 1994), 1042 pages, C. Diebolt, *Education et croissance économique. Le cas de l'Allemagne aux 19ème et 20ème siècles* (Paris: Editions L'Harmattan, 1995), C. Diebolt, "L'évolution de longue période du système éducatif allemand: 19ème et 20ème siècles", *Economies et Sociétés*, 23/Série AF (1997): 1-370, C. Diebolt, *Développement des Hommes et croissance économique* (Habilitation diss. in Economics, University of Montpellier I, 1998), 302 pages, C. 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*, 24/1 (1999): pp. 3-31, C. Diebolt, *Dépenses d'éducation et cycles économiques en Espagne aux 19ème et 20ème siècles* (Paris: Editions L'Harmattan, 2000), C. Diebolt, "Die Erfassung der Bildungsinvestitionen im 19. und 20. Jahrhundert. Deutschland, Frankreich, Großbritannien und Spanien im Vergleich", *Zeitschrift für Erziehungswissenschaft*, 3/4 (2000): 517-538, C. Diebolt, "Towards a Theory of Systemic Regulation? The Case of France and Germany in the Nineteenth and Twentieth Centuries", in *Discourse Formation in Comparative Education*, ed. J. Schriewer (Frankfurt am Main: Editions Peter Lang, 2000): pp. 55-85, C. Diebolt, "Long Cycles Revisited. An Essay in Econometric History", *Economies et Sociétés* 32/Série AF (2005): pp. 23-47. J.-L. Demeulemeester, C. Diebolt (Guest Editors), "The Economics of Education: Unkept Promises?", *Brussels Economic Review*, 47/3-4 (2004): 303-319. C. Diebolt (Guest Editor), "Towards a Comparative Economics of Education", *Compare*, 34/1 (2004): 3-13, C. Diebolt, L. Fontvieille, "Dynamic Forces in Education Development: A Long-Run Comparative View of France and Germany in the 19th and 20th Centuries", *Compare* 31/3 (2001): 295-309, C. Diebolt, V. Guiraud, "Long Memory Time Series and Fractional Integration. A Cliometric Contribution to French and German Economic and Social History", *Historical Social Research*, 25/3-4 (2000): pp. 4-22, C. Diebolt, V. Guiraud, M. Monteils,

through alternating phases of accelerated growth and slow growth. Material development sometimes goes faster than human development and sometimes the latter emerges as a priority.

In this paper, by generalizing Hamilton's model to a three regime Markov switching model, we analyze regime shifts in the real GDP and in the education expenditures in France. Empirical evidence is established for the presence of a co-movement between these two variables. In addition, our results suggest that since 1947 the real GDP business cycle is driven by the education expenditures.

The outline of the paper is as follows. In section 2 we present our database. In section 3 we provide the methodological markers. Section 4 analyses our results. Section 5 concludes.

2. Data sources

Analysing the educational development and its relation to economic growth requires first of all the production of a set of co-ordinated, homogenous and comparable data. This study required the preparation of estimates for many types of data in accordance with classifications for which often no estimates were previously available. The data drawn up in this paper show the outlay devoted to primary, secondary and higher education. Printed works are mentioned whose range is, *a priori*, national. However, it should be remembered that French statistics concerning primary education were published regularly at the level of individual *departments* (until 1939 and sometimes later)¹⁵. In addition, part of the statistics collected but not published is housed in national or departmental archives. Consultation of these makes up for the lack of educational statistics from 1914 to 1958 (substantial collection of information was performed during this period but a comparatively small proportion was published, probably for reasons of budget)¹⁶.

In a general manner, statistics concerning the education system in France in the nineteenth and twentieth centuries can be classified under two main headings. On the one hand, they consist of statistical data produced by one-off investigations performed at the initiative of a minister, a special commission or a group of members of parliament to examine certain aspects of the functioning of educational facilities. For example, they

Education, Knowledge and Economic Growth. France and Germany in the Nineteenth and Twentieth Centuries (Frankfurt am Main: Editions Peter Lang, 2003), C. Diebolt, M. Monteils, "The New Growth Theories. A Survey of Theoretical and Empirical Contributions", *Historical Social Research*, 25/2 (2000): 3-22, L. Fontvieille, "Education, Growth and Long Cycles. 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): 317-335.

¹⁵N. Daures, C. Diebolt, M. Jaoul-Grammare, G. San Martino, "L'instruction primaire en France au 19ème siècle. Une étude cliométrique du mythe de Ferry", *Economies et Sociétés* 37/Série AF (2007): 1089-1363, C. Diebolt, "Les effectifs scolarisés en France: XIXème et XXème siècles", *International Review of Education*, 45/2 (1999): pp. 197-213.

¹⁶T. Charmasson (Ed), *L'histoire de l'enseignement, 19ème - 20ème siècles. Guide du chercheur* (Paris: Inrp/Publications de la Sorbonne, 1986).

include statistics on primary¹⁷, upper primary¹⁸, secondary¹⁹ and higher education²⁰. They also comprise information collected during the everyday management of educational institutions or of education as a whole and whose main (and sometimes sole) purpose was administrative. This concerns mainly data published in the statistical yearbooks of the SGF (*Statistique Générale de la France*²¹, the main basis for most of the overall studies of the trends in school attendance in France²². State accounts concerning education, as drawn up by Fontvieille²³ and refined by Carry²⁴ using the financial records of the *Compte Général*

¹⁷*Statistique de l'enseignement primaire* (Paris: Imprimerie Nationale). This consists of eight volumes published every five years for the school years 1876-1877 to 1906-1907. The second volume is a retrospective work covering the period 1829 to 1877. It contains an excellent critical study of the statistics published before 1880.

¹⁸*Statistique de l'enseignement primaire supérieur* (Paris: Imprimerie Nationale). This consists of three volumes for the school years 1884, 1887 and 1890.

¹⁹ *Statistique de l'enseignement secondaire en 1865* (Paris: Imprimerie Nationale, 1868), *Statistique de l'enseignement secondaire en 1876* (Paris: Imprimerie Nationale, 1878), *Statistique de l'enseignement secondaire en 1887*, Tome 1 (Garçons), Tome 2 (Jeunes Filles), (Paris: Imprimerie Nationale, 1889). Statistics providing a retrospective view of the numbers of children in French secondary schools (*collèges* and *lycées*) since 1809. The figures published should be used together with the data in the *Annuaire Statistique de la France* to give figures running until 1945. See also *Enquête sur l'enseignement secondaire* (Paris: Imprimerie Nationale). This is a six-volume work, containing irregular statistical information, providing a view of the changes in secondary education until 1899.

²⁰ *Statistique de l'Enseignement Supérieur: 1865-1868* (Paris: Imprimerie Nationale, 1868), *Statistique de l'Enseignement Supérieur: 1878-1888* (Paris: Imprimerie Nationale, 1889), *Statistique de l'Enseignement Supérieur. Enseignement, examens, grades, recettes et dépenses, en 1886. Actes administratifs jusqu'en août 1888* (Paris: Imprimerie Nationale, 1889), *Statistique de l'Enseignement Supérieur: 1889-1898* (Paris: Imprimerie Nationale, 1900). These statistical yearbooks show the trends in school attendance and French state receipts and expenditure in higher education from 1835 to 1898.

²¹A. Desrosières, *La politique des grands nombres. Histoire de la raison statistique* (Paris: La Découverte, 1993): 182 and 185.

²²*Annuaire Statistique de la France* (Paris: Imprimerie Nationale). An annual volume of educational statistics published from 1878 to the present day with interruptions. It consists mainly of statistics published by the *Ministère de l'Instruction Publique*. See especially Vol. 58 (1951), Vol. 72 (1966) and *Séries longues: 1948-1988* (1990). See also *Tableaux de l'éducation nationale. Statistiques rétrospectives*, Service Central des Statistiques et de la Conjoncture, *Tableaux des enseignements et de la formation. Statistiques rétrospectives*, Service Central des Statistiques et Sondages, and *Repères et références statistiques sur les enseignements et la formation*.

²³L. Fontvieille, "Evolution et croissance de l'Etat français: 1815-1969", *Economies et Sociétés* 13/Série AF (1976): 1655-2149. See also L. Fontvieille, op. cit., (1990): 317-335.

²⁴A. Carry, "Les indicateurs monétaires du volume de l'éducation en France", in A. Carry, C. Diebolt, L. Fontvieille, C.E. Núñez & G. Tortella (Eds), *Education et croissance économique: évolution de longue période et prospective. Une analyse comparée des systèmes éducatifs allemand, espagnol et français* (Stimulation Plan for Economic Science, European Union, Vol. 1, 1995): 207-310.

de l'Administration des Finances can also be mentioned. Finally, mention should be made of the sets of statistics published by the *Institut National de Recherche Pédagogique*²⁵, those produced by the Ministry of Education's *Direction de l'Evaluation et de la Prospective* in the form of satellite accounts²⁶ and those drawn up by Diebolt on the quantitative history of education in France²⁷. The real GDP series are drawn up from Toutain and Maddison²⁸.

3. Business cycle asymmetry tests

The degree of asymmetry is measured by the coefficient of skewness, defined, for a stationary univariate stochastic process $\{x_t\}$ as:

$$D(x) = \frac{E[(X_t - \mu_x)^3]}{\sigma_x^3}$$

Where μ_x is the mean of x_t , σ_x is the standard deviation of x_t . Following Sichel²⁹, the type of asymmetry that prevails if $D(X) < 0$ is called deepness, while the type of asymmetry that prevails if $D(X) > 0$ is called tallness.

For the first-differences of $\{x_t\}$, denoted $\{z_t\}$, the coefficient of skewness is given by:

$$D(\Delta x) = \frac{E[(\Delta X_t)^3]}{\sigma_{\Delta x}^3}$$

²⁵J.-P. Briand, J.-M. Chapoulie, F. Huhuet, J.-N. Luc & A. Prost, *L'enseignement primaire et ses extensions. Annuaire statistique, 19ème - 20ème siècles. Ecoles maternelles, primaires, primaires supérieures et professionnelles* (Paris: Economica/Inrp, 1987). This work contains a retrospective set of figures on the number of pupils in pre-elementary, elementary, upper primary, special and technical education. It is an essential tool as it provides the scientific community with original series of statistics in which the errors, inadequacies and disagreement are corrected or indicated. See also J.-N. Luc, *La statistique de l'enseignement primaire 19ème - 20ème siècles. Politique et mode d'emploi* (Paris: Inrp/Cnrs, 1985).

²⁶Dep/Insee, *Le compte de l'éducation. Principes et méthodes* (Paris: Les dossiers Education & Formations, 7, 1990).

²⁷C. Diebolt, "Les indicateurs physiques du volume de l'éducation en France", in A. Carry, C. Diebolt, L. Fontvieille, C.E. Núñez & G. Tortella (Eds), *Education et croissance économique: évolution de longue période et prospective. Une analyse comparée des systèmes éducatifs allemand, espagnol et français* (Stimulation Plan for Economic Science, European Union, Vol. 1, 1995): 45-206.

²⁸A. Maddison, *L'économie mondiale 1820-1992. Analyse et statistiques* (Paris: OCDE, 1995). J.-C. Toutain, "Le produit intérieur brut de la France, 1789-1990", *Economies et Sociétés*, Série HEQ, 1 (1997): 5-136.

²⁹D. Sichel, "Business Cycle Asymmetry: A Deeper Look", *Economic Inquiry*, 31 (1993): 224-236.

If $D(\Delta x) < 0$ then the type of asymmetry is called steepness which means that z_t falls rapidly, but rises very slowly.

As pointed out by Bai and Ng³⁰, the non parametric tests (Triples test), tend to suffer from low power in the presence of serial correlation. Indeed, following Bai and Ng³¹ and Psaradakis and Sola³², the non parametric tests fail to reject the null of zero skewness for a large set of macroeconomic variables. The values of the triple test statistics, given by Table 1 confirm these findings.

Table 1: Triple test statistics for symmetry

Variable	<i>Deepness</i>			<i>Steepness</i>		
	η^a	U^b	Pvalue ^c	η	U	Pvalue
Education expenditures	0.003	0.211	0.583	0.011	0.666	0.747
Real GNP	0.008	0.463	0.678	-0.007	-0.490	0.311

^a: The null hypothesis H_0 , symmetry

^b: U is the Triples test statistics, with is asymptotically $N(0,1)$

^c: P values are those of $N(0,1)$ distribution.

To avoid the problem of lower power of the non parametric tests, we use a parametric test proposed by Clement and Krolzig³³ and based on Markov Switching process. The basic idea behind regime-switching models of business cycles is that the parameters of time series model depend upon a stochastic, unobservable regime variable $s_t \in \{1, \dots, M\}$ which represents the state of business cycle. Particularly, we use Markov-Switching Autoregressive (MS-AR) model class in order to generate steepness, deepness and sharpness (SDS) tests. The basic MSI(M)-AR(p) model is as following:

$$x_t - \mu(s_t) = \sum_{i=1}^p \phi_i(s_t) x_{t-i} + \sum_{i=1}^p \varphi_i(s_t) \mu(s_{t-i}) + \varepsilon_t$$

³⁰J. Bai, S. Ng, "A Consistent test for Conditional Symmetry in Times Series Models", *Journal of Econometrics*, 103 (2001): 225-258.

³¹J. Bai, S. Ng, *op.cit.*, (2001): 225-258.

³²Z. Psaradakis, M. Sola, "On Detrending and Cyclical Asymmetry", *Journal of Applied Econometrics*, 18 (2003): 271-289.

³³M. Clements, H. Krolzig, "Business Cycle Asymmetries: Characterization and Testing Based on Markov Switching Autoregressions", *Journal of Business and Economic Statistics*, 21 (2003): 196-211.

Where (ε_t) is a Gaussian white noise process, ϕ_j and φ_j for $j=1, \dots, p$ are the AR and MA coefficients. We will refer to the cases for which $\phi_j = \varphi_j$ and $\phi_j = \varphi_j = 0$ for $j=1, \dots, p$ respectively as MSM and MSI process. (S_t) is unobservable discrete variable, supposed to represent the current state of the economy. In the case of only one state the model reduces to a standard reduced-form equation.

Generally, in business cycle analysis, a two-state Markov chain is used for empirical applications: expansion and contraction phases. However, the expansion phase can be separated into a high growth phase and more stable growth phase. To capture this in parametric model, we consider three-regime model for which, the state $S_t = 0, 1$ and 2 will correspond, respectively to the recession phase, stable and high phases of growth. Through this study, three states ($S_t = 0, 1$ and 2) are allowed with the probabilities of changing from one regime to other expressed by the following transition matrix:

$$\begin{bmatrix} p_{00} & p_{01} & p_{02} \\ p_{10} & p_{11} & p_{12} \\ p_{20} & p_{21} & p_{22} \end{bmatrix}$$

Where $p_{ij} = \Pr[S_t = j / S_{t-1} = i]$, with $\sum_{j=0}^2 p_{ij} = 1, \forall i$.

4. Empirical Results

We apply the results derived for the deepness and steepness of MSM-AR(1) processes with three regimes to French real GDP and education expenditures. We employ the Hodrick- Prescott Filter in order to render series stationary. The estimated parameters of this model, presented in table 2 indicate that, for education expenditures the expansion and contraction episodes are no persistent. The estimated probability p_{33} is only 0.178.

Table 2: Parameter estimations for the MSM-AR(1) model

	Education expenditures	Real GDP
P_{11}	0.443	0.6529
P_{22}	0.937	0.9871
P_{33}	0.178	0.5119
Φ	0.3561	-0.2599*
μ_1	-0.1559*	-0.14727*
μ_2	0.0171*	0.00181*
μ_3	0.2233*	0.1765*
Σ	0.0551	0.046
Duration 1	1.12	2.88
Duration 2	15.57	17.26
Duration 3	1.14	2.05

Our three-state MSM-AR(1) model fails, for both real GDP and education expenditures to generate contractions and expansions episodes of sufficient duration (respectively one and two years). The middle regime, produced by the three-regime model is more persistent ($p_{22}=0.93$ for education expenditures and $p_{22}=0.98$ for real GDP) with a duration of stable expansion of fifteen and seventeen years.

Table 3: LR tests for asymmetries using the MSM-AR(1) model: real GDP

Tests	LR-Statistics	P-value
MS: Sharpness	57.163	0**
p₁₂ = p₃₂	0.0007	0.976
p₁₃ = p₃₁	0.6440	0.423
p₂₁ = p₂₃	57.037	0**
No-deepness (+)	0.3876	0.533
No-steepness (+)	15.66	0**

The tests for asymmetries in MSM-AR(1) models are displayed in Tables 3 and 4. For the real GDP and education expenditures, Wald tests reject at high confidence level the no-steepness hypothesis. This implies that, in levels, both series tend to undergo rapid increases over a short period of time, and slow, gradual decreases over long periods of time.

Table 4: LR tests for Asymmetries using the MSM-AR(1) model: Education expenditures

Tests	LR-Statistics	P-value
MS: Sharpness	5.09	0.165
p₁₂ = p₃₂	4.09	0.026*
p₁₃ = p₃₁	0.31	0.572
p₂₁ = p₂₃	0.05	0.808
Non-deepness (+)	1.34	0.246
Non-steepness (+)	13.57	0.002**

Moreover, the rejection of $p_{21} = p_{23}$ implies a clear evidence of sharpness for both series. These results mean that moving from the state 1 to the state 2 is more likely than moving from state 2 to state 3.

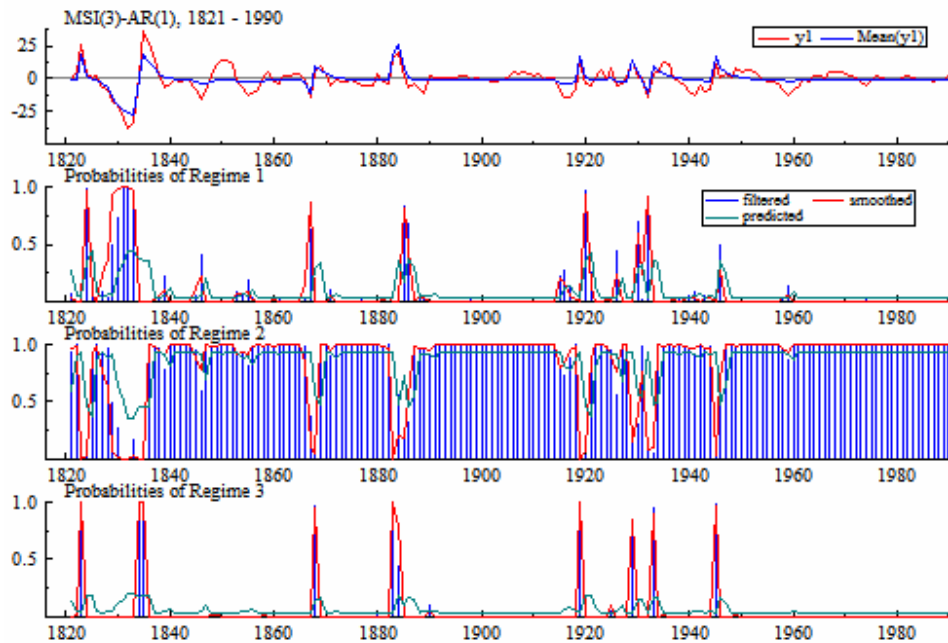


Figure 1: MSI(3)-AR(1) model of French real GNP

The figures 1 and 2 summarize the business cycle characteristics of this models for real GDP and education expenditures. The filtered regime probabilities are shown with a dashed line and the smooth probabilities are shown with a bold line.

In figure 1, we can see that both regimes 1 and 3 are observed respectively until 1932 and 1945 which indicate that the post war period is characterized by an important reduction in the volatility of education expenditures.

It can be seen that, for real GDP (figure 2) the regime 1 depicts very precisely the recessions of 1917/1918 and 1941/1945 which correspond to the First and Second World War. Regime 2 which represents normal growth episodes mainly occurs after expansion. Indeed the economic recoveries from expansion is dominated by the one which characterised by normal economic growth after a recession (transition regime 3 to regime 2). This type of recovery was observed after the 1922 and 1945/1947 expansion. The type of economic recoveries from recessions in to high growth (transition from regime 1 to 3) was observed, especially after the end of the two World Wars (1919, 1922, 1945). Note that regimes 1 and 3 are respectively observed until 1944 and 1947, which might indicate that expansions after 1947 are characterized by a reduced volatility of macroeconomic fluctuations. This structural break appears to be correlated with the normal growth episode observed in the education expenditures since that period.

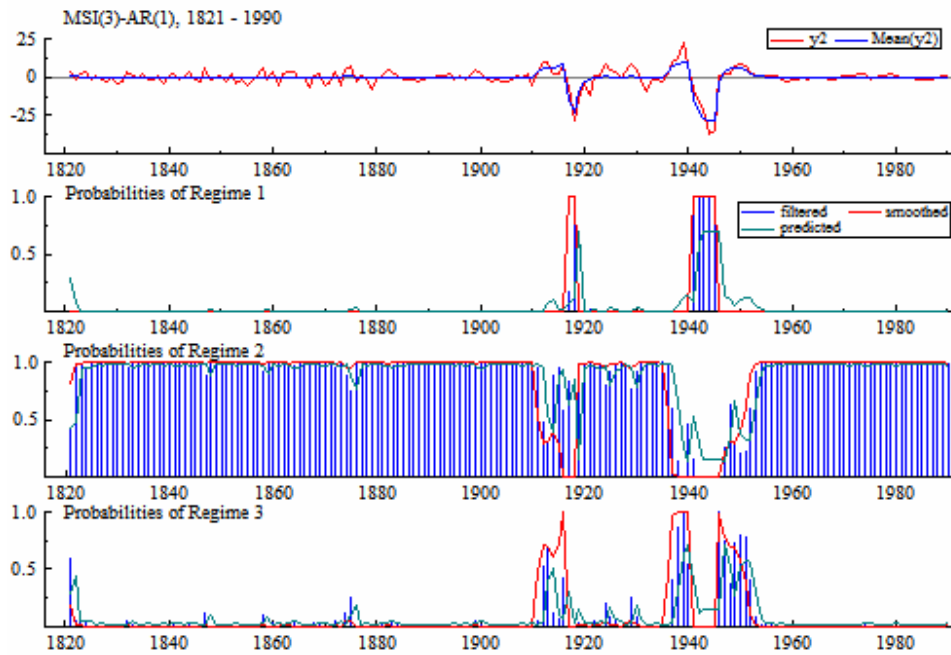


Figure 2: MSI(3)-AR(1) model of French education expenditures

To investigate the business cycle synchronisation between real GDP and education expenditures, we plotted the turning points for both series (figure 3). It indicates the lack of business cycles synchronization between the two variables until 1947. However, we can argue that for the post war period the real GDP cycle is essentially synchronized with the business cycle of the education expenditures.

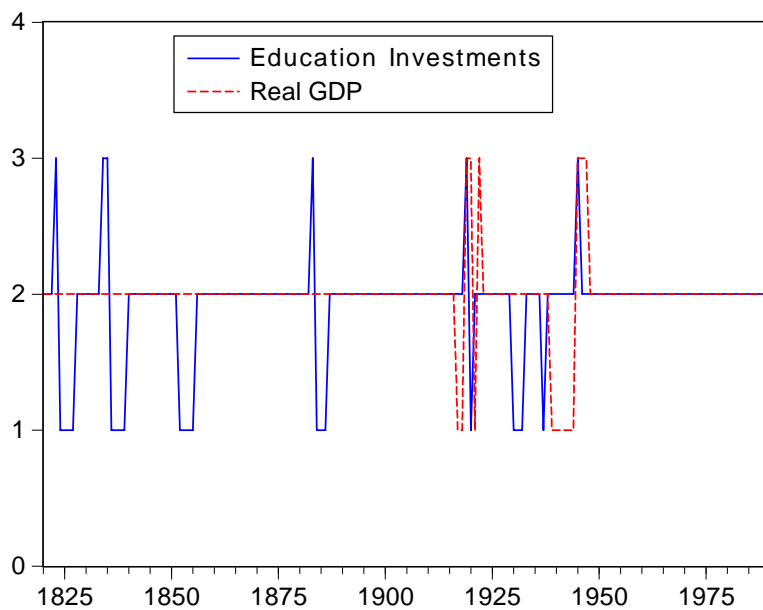


Figure 3: Turing points

Figure 3 shows that this synchronization was driven by the education expenditures which might explain the real GDP turning point in 1947. It seems to reveal the establishment of a dualism within the economic system. Have the frustrations of the industrial era been replaced by a tertiary era paradise in which men and women at last accede to the delights of intelligent activities: services? Anyway, the new role awarded to education and training after World War 2 shows clearly the shifting of the centre of gravity of the economic activity of capital accumulation towards the accumulation of 'information' knowledge and human capital especially.

5. Concluding remarks

The role played by human capital in the French macroeconomic growth process is not as clear as it would seem. Our research showed clearly an important turning point in 1947. The change in trend observed after World War 2, the strong increase in expenditure on education for a period of thirty years and the slowed growth since 1973 obviously raise the question of a possible reversal of movements in both dynamics and level between the real GDP and the investments in education, whether human capital investment might be much a cause than a consequence of economic growth.

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