When education increases job inequalities *

Paul CAHU
Université Paris 1 Panthéon-Sorbonne, EUREQua
& Ecole Centrale Paris, ERASME†

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Abstract

Is it possible to choose between low unemployment rate and low inequalities ? What are the consequences of overeducation on job access exclusion ? We try to bring an answer to these two questions in the French case, studying relations between unemployment, overeducation, wage inequalities and labor market exclusion. Our findings seem to be consistent with the theoretical predictions of a job competition model. Unemployment and a more educated labor force, inducing more overeducation, might increase job inequalities. Overeducation, whichever the way we measured it, could push up the job access inequalities especially for the youngest and less educated workers. Moreover, a long run relation between unemployment inequalities and wage inequalities appears, which may suggest that the French society could choose between two forms of inequalities. Eventually, studying the impact of demographic trends highlights the important role played by overeducation on job exclusion, both directly and indirectly through wage inequalities.

JEL Classification : I28, J24, J31, J64, O47

Key words : inequalities, overeducation, unemployment, job competition

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†Université Paris I, Maison des sciences économiques, EUREQua, 106-112 boulevard de l'hôpital, 75647 Paris Cedex 13, France. Tel : 33 1 44 07 82 13. Fax : 331 44 07 82 31. E-mail : paul.cahu@centrale-paris.net & ERASME - Ecole Centrale Paris

1 Labor market exclusion and schooling

France has experienced a huge increase of schooling since the end of the 60's. These mutations were necessary to adapt the economy to technological change but was a response to a strong social demand too. Indeed educational policy has three particular motivations. First, it rises the productivity of the workers, second it enables to reduce the inequalities in the society by improving social mobility and third it protects the workers from unemployment. Like many countries of the OECD, France had been severely affected by the productivity slowdown in the middle of the seventies. The rise of unemployment, especially among the young workers has surely played an important role in the increase of school attainment. Several contributions support this view.

1.1 Education as a shield when unemployment is high

First of all, many authors show that among the workers the unemployment rate decreases when the level of education rises. Education appears to be a good asset to avoid unemployment. Ahenfelter and Ham (1979) showed that schooling diminished unemployment rate of adult male workers in the United States since 1970. Nickell (1979) provides empirical estimation of the education - unemployment link for Britain in 1971. Other evidence can be found in the survey of Kiefer and Devine (1991). Evidence for younger men is available in Mincer and Leighton (1982). Kiefer (1985) showed a negative effect of education on unemployment in Colorado. evidence for France can be found in Nauze-Fichet and Tomasini.

Second, the household behave to get the observed benefit of education on unemployment. In this frame, the demand for education should increase when the macroeconomic situation decays. Pissarides (1981) provides empirical evidence supporting this assumption, studying school demand of 16 year old pupils in the U.K. Kodde (1988) shows that demand for education is negatively correlated to probabilities of getting a job directly after the secondary school.

Third, these job inequalities seem to rise when overall unemployment level increases. Several authors used theoretical models for explaining this fact. Muysken and Ter Weel (1998) introduced a matching model to underline the exclusion of low-skilled labor. Nickell and Bell (1995) explain that even a symmetric shock of productivity[1] should carry out a higher rise of unemployment among the unskilled workers than among the skilled ones. Their model enables us to conclude that only 20% of the negative impact of productivity slowdown on unemployment inequalities might be due to a biased shock, for western countries such as Germany, U.K., Spain, Netherland and Canada. These results seem to justify that low-skilled workers are always more sharply affected by economic slowdown than others. Auerbach and Skott (2000) propose an other model in which Hicks neutral productivity shock brings out a rise both in wage inequalities and unemployment inequalities, because of overeducation.

Although unemployment and job inequalities seem to be strongly correlated, some authors argue that job-competition model are not accurate to explain it. Pfann and Palm (1990) introduce the idea that this fact could be explained by asymmetric adjustment costs. They affirm that firing a skilled worker is more costly for firms[2] because skilled employees hold jobs that require on-the-job training. Thus, as training is costly, the firms prefer reducing their expenditures by firing the unskilled workers. In this context, job inequalities are more due to frequent firing of unskilled workers than to selected hiring. Van Ours and

[1] A symmetric shock could be opposed to an asymmetric shock, which is biased toward skill employment

[2] If we compare to firing unskilled workers.

Ridder (1995) provide empirical evidence for this thesis in the Netherland during the 80's. Nevertheless, when unemployment rate stays high even after the productivity shock, asymmetric adjustments costs or selection when hiring, have the same consequences in the long-run.

1.2 Educational development as a cause of low-skilled workers exclusion

If empirical studies show that more educated workers are less vulnerable to unemployment than less educated ones, it is less obvious in the OECD countries, that an overall rise of the average level of education might bring down the unemployment level. If education is a relative advantage in the job competition, a general rise of schooling level will above all increase the exclusion of the less educated workers.

This idea was discussed by Lloyd-Ellis (1999). This author argued that when the skilled workers are scarce, the impact of rising schooling on productivity is good and there are no effects on job inequalities. On the contrary, Mortensen and Pissarides (1999) use a theoretical model to explain that the productivity slowdown has a stronger effect on unemployment in Europe, because of social protection. They postulate that increasing education could considerably lower unemployment. This assumption is not entirely convincing if we remember the results of Nickell and Bell. As the productivity shock is not really asymmetric, a rise in education might not lower overall unemployment rate.

Therefore, Kiley (1999) explains that a rise in education could temporarily carry out a fall of productivity due to an induced skill-biased technological change which increases the skilled workers wages. This point of view could be interesting to explain the U.S. case. Acemoglu (1999) supports a similar point of view. Its model shows up how an initial increase in high skilled supply could incite the recruiters starting selection. As an evidence he takes the results of Sicherman (1991), who highlights the fall of overeducation between 1970 and 1990. This transition to a paradigm of selection of skills pushes up inequalities between skilled and unskilled workers. Moreover Mc Kenna (1996) presents a matching model with two sectors and two skill levels. Its model predicts a rise of overall unemployment after a rise in local high skill labor supply, and a higher mismatch in the low-skilled intensive sector after a rise in education. No consensus seems to appear in this area.

In France since the early 70's, we have noticed a rising schooling, contemporary of rising unemployment inequalities between unskilled and skilled workers. This fact is traditionally interpreted with job competition models, derived from the Thurow's theory, see Salais 1980. Sneesens (1995) considers the negative impact of education on job inequalities via a rising overeducation which pushes aside the less qualified workers. This hypothesis has been highlighted by the empirical findings of Forgeot and Gautié (1997) . To explain these results in a more rigorous frame, we will present a theoretical model of job competition in the next section.

2 The model

In this section, we propose a job competition model, where recruiters consider two kind of criteria for hiring workers on unskilled jobs. First they take the diploma into consideration before considering other characteristics, which are assumed independent of the diploma[3]. Every worker in this sector earns the same wage, whatever its level of

[3] The parameter δ measures both the direct and indirect effects of diploma on productivity. We do not suppose here that there are no endogenous bias between diploma and other social economical characteristics. Diploma could indeed signal productive aptitudes such as courage or ability to learn. We made the assumption that everything which is connected to diploma could be separate in the anticipated productivity

education. The recruiters order the different candidates with respect to a measure of anticipated productivity. We assume that this measure could be written as :

$$g_i^a = e^{\delta D_i}\Theta_i \tag{1}$$

where D_i is one where the worker owns the diploma and zero otherwise, and Θ, a synthetic measure of other characteristics. We assume moreover that the distribution of Θ is log-normal with average equaling unity. We will name σ, the standard deviation of the associated normal distribution. Eventually, the utility of the recruiters for a worker i is :

$$ln(g_i^a) = \delta D_i + \theta \tag{2}$$

We note that the order of the candidate only depends on the ratio $\frac{\delta}{\sigma}$. We will next take $\sigma = 1$. We name v the ratio between vacant jobs and the number of workers in this unskilled sector , x the share of graduate workers in this sector, p the probability for a graduate worker to be hired and q the one of a non graduate worker. As graduate should normally find a skilled job, the variable x is directly connected to overeducation. Indeed, x is the product of the share of graduate workers in the economy and the share of this workers who are overeducated.

So there is a direct relation linking p and q :

$$v = px + q(1-x) \Rightarrow q = \frac{v - px}{1-x} \tag{3}$$

We supposed that the recruiters sort out the candidates according to their apparent productivity. He will hire the fraction v of workers, whose value of $ln(g_i^a)$ is the highest. If we note t the ability of the last hired graduate worker, we have with F the standard cumulative normal distribution :

$$p = 1 - F(t) \tag{4}$$

If we note t', the ability of the last hired non graduate worker, we have :

$$q = 1 - F(t') \tag{5}$$

Then, we have an equilibrium relation, which assumes that the utility of the last graduate hired worker (d) equals the utility of the last non graduate one (n) :

$$ln(g_d^a) = \delta + t = ln(g_n^a) = t' \Rightarrow q = 1 - F(t+\delta) \tag{6}$$

Eventually, the model can be solved by finding the probability q, that verifies the relations (3) and (6), which leads to determine t such as :

$$H(t,x,v,\delta) = \frac{v - (1-F(t))x}{1-x} - 1 + F(t+\delta) = 0 \tag{7}$$

If we note $f(t)$ the standard non cumulative normal distribution, we obtain with derivation :

$$\frac{\partial H(v,x,t)}{\partial t} = \frac{x}{1-x}f(t) + f(t+\delta) > 0 \tag{8}$$

Moreover,

$$lim_{t\to-\infty}H(v,x,t) = \frac{v-1}{1-x} < 0$$

function from other strictly independent characteristics.

As we know that $p \geq v$[4], it leads to :

$$1 - F(t) > v \Leftrightarrow t \leq F^{-1}[1-v] = t_v \tag{9}$$

At the superior bound, we have :

$$lim_{t \to t_v} H(v,x,t) = v - 1 + F(F^{-1}[1-v] + \delta) > v - 1 + F(F^{-1}[1-v]) = 0 \tag{10}$$

The function $H(v,x,t)$ is consequently strictly increasing on $]-\infty, t_v[$, with $lim_{t\to-\infty} H < 0$ and $H(v,x,t_v) > 0$. Because of the intermediary values theorem, there is one single t^*, such as : $H(v,x,t^*) = 0$. This value of t defines a single equilibrium for our problem. In addition to that, $\frac{\partial H(v,x,t^*)}{\partial t} > 0$, which guarantees the stability of this equilibrium.

In this model, we define exclusion of low-skilled workers as the ratio between the probabilities to get a job for graduates and non graduates.

$$\Xi = \frac{p^*}{q^*} \tag{11}$$

We will now study the properties of this equilibrium, with the implicit function theorem. The impact of diploma on the equilibrium is obvious.

$$\frac{dt^*}{d\delta} = -\frac{\frac{\partial H}{\partial \delta}}{\frac{\partial H}{\partial t}} = -\frac{f(t+\delta)}{\frac{x}{1-x}f(t) + f(t+\delta)} < 0 \tag{12}$$

We have directly :

$$\frac{dp^*}{d\delta} = \frac{\partial p^*}{\partial t^*}\frac{dt^*}{d\delta} = -f(t)\frac{dt^*}{d\delta} > 0 \tag{13}$$

An increase in the productive value of the diploma pushes up the graduates employment and brings down the hopes of non graduates.

$$\frac{dq^*}{d\delta} = \frac{\partial q^*}{\partial t^*}\frac{dt^*}{d\delta} = \frac{x}{1-x}f(t)\frac{dt^*}{d\delta} < 0$$

As a consequence, we have directly :

$$\frac{d\Xi}{d\delta} > 0 \tag{14}$$

Property : With any, δ, v, $x < v$, we have :

$$\begin{cases} \frac{dp^*}{dx} < 0 \ , \ \frac{dq^*}{dx} < 0 \ and \ \frac{d\Xi}{dx} > 0 \\ \frac{dp^*}{dv} > 0 \ , \ \frac{dq^*}{dv} > 0 \ and \ \frac{d\Xi}{dv} < 0 \end{cases} \tag{15}$$

Proof :

In what follows, we introduce the variable z, which can be equal to x or v. $z = x, v$

$$\frac{dp^*}{dz} = \frac{\partial p^*}{\partial t}\frac{dt^*}{dz} = -f(t)\frac{dt^*}{dz} \tag{16}$$

[4] Because of the good signal provided by the diploma, the graduate candidates always have a better position that the non graduate ones in the labor queue.

With the implicit function theorem, we have :

$$\frac{dt^*}{dz} = -\frac{\frac{\partial H}{\partial z}}{\frac{\partial H}{\partial t}} = -\frac{\frac{\partial q}{\partial z}}{\frac{\partial q}{\partial t} + f(t^* + \delta)} \tag{17}$$

Thus, we have :

$$\frac{dp^*}{dz} = \frac{dq^*}{dz} \frac{f(t^*)}{\frac{\partial q}{\partial t} + f(t^* + \delta)} \tag{18}$$

And

$$\frac{\partial q}{\partial t} = \frac{x}{1-x} f(t) > 0 \tag{19}$$

The sign of $\frac{\partial p^*}{\partial t}$ is the sign of $\frac{\partial q}{\partial z}$.
We have for $q(z, t)$:

$$\frac{dq^*}{dz} = \frac{\partial q^*}{\partial z} + \frac{\partial q^*}{\partial t}\frac{dt^*}{dz} = \frac{\partial q^*}{\partial z}[1 - \frac{\frac{\partial q^*}{\partial t}}{\frac{\partial q^*}{\partial t} + f(t^* + \delta)}] = \frac{\partial q^*}{\partial z} \frac{f(t^* + \delta)}{\frac{\partial q^*}{\partial t} + f(t^* + \delta)} \tag{20}$$

The sign of $\frac{\partial q^*}{\partial t}$ is the sign of $\frac{\partial q}{\partial z}$ too.
Eventually, we have :

$$\frac{d\Xi}{dz} = \frac{1}{q^*}[\frac{dp^*}{dz} - \frac{p^*}{q^*}\frac{dq^*}{dz}] = \frac{1}{q^*}(\frac{\partial q}{\partial z})[\frac{f(t^*)}{\frac{\partial q^*}{\partial t} + f(t^* + \delta)} - \frac{p^*}{q^*}\frac{f(t^* + \delta)}{\frac{\partial q^*}{\partial t} + f(t^* + \delta)}] \tag{21}$$

$$\frac{d\Xi}{dz} = \frac{p^*}{q^*}\frac{1}{\frac{\partial q^*}{\partial t} + f(t^* + \delta)}(\frac{\partial q}{\partial z})[\frac{f(t^*)}{p^*} - \frac{f(t^* + \delta)}{q^*}] \tag{22}$$

To conclude, we have to use the following lemma.

Lemma : With any v, $x < v$, δ, we always have :

$$f(t^*) - \frac{p^*}{q^*} f(t^* + \delta) < 0 \tag{23}$$

See the proof in appendices.

Thus, we obtain that the sign of $\frac{d\Xi}{dz}$ is the opposite of the sign of $\frac{\partial q}{\partial z}$. To conclude the demonstration of the property, we just have to calculate :

$$\frac{\partial q}{\partial x} = -\frac{1 - F(t)}{(1-x)^2} < 0 \tag{24}$$

And :

$$\frac{\partial q}{\partial v} = \frac{1}{1-x} > 0 \tag{25}$$

When the unemployment level rises, the relative probability of getting a job decreases for both graduates and non graduates workers. This model seems to say that when the business activity is bad, the recruiters are more selective and facilitate the hiring of graduates. The rise of unemployment increases the advantage of the graduate. The share of graduate workers should consequently rise with unemployment.

An increase in diplomas brings down the chances of job for graduates. If unemployment makes the diploma more attractive, it brings down its absolute value. The gain for other graduates is negative. The rise of diplomas represents a negative externality for the graduates. The increased share of graduates in the economy also pushes up the unemployment of unskilled workers. As a conclusion, in this model, a rise of diplomas in the economy gradually increases the exclusion of low-skilled workers. In an economy with a high level of unemployment, a generalized increase of diplomas induces negative effects on exclusion of the low-skilled workers. This effect could diminish or even cancel the human capital effect on productivity and then growth.

3 The data

Most of the data we will use for empirical analysis are calculated from the "“enquêtes emplois"[5] of INSEE, from 1965 to 2002. This series is annual, which could carry out some miscalculations. Indeed young graduates arrived in the labor market in September, although these surveys, which indicate wages, levels of schooling and employment are often released in March or April. GDP and total employment are provided by national accounts published by INSEE. The stock of research and development has been built from *R&D* investment flows published by the national department of research since 1959. Series of structure of employment (share of skilled and unskilled employment) are from INSEE *Emplois Revenus, séries longues sur les salaires - 2000*.[6]

Measuring overeducation is not obvious because of the several social and economic dimensions of this phenomenon. Moreover, to have a sufficient long sample, we needed to define an index of overeducation which can be available since 1970. Subjective definitions of overeducation are often used in foreign studies. However, this type of data is not available in France. So we used a normative measure. $OVER$ is defined as the ratio of the share of employed labor force which holds a higher education diploma, and the “skilled" employment. We consider here that skilled employment refers to executive and intermediary occupations. The underlying hypothesis for overeducation is that a graduate from higher education should hold a skilled job. To ensure that our results are robust, we provide two more indicators, available since 1982. The first one, OAF is derived from a correspondence table between level of diploma and occupations. This table, presented by Affichard, defines a worker as overeducated if its level of diploma is above the ones which are required according to the table. The second indicator, OAS, is a linear function of the asymmetry of the distribution of level of schooling within occupations. Asymmetry measures the relative weight of overeducated workers to undereducated workers. Using this indicator based on asymmetry enables us to take into account the evolution of the link education-occupation. All these series are I(1)[7]. If we compare these different indicators, we see that they are all increasing. In addition to that, they all show up two shocks in 1984 and around 1993-1994. Eventually, we could observe for all indexes a change in tendency after the second shock. Overeducation grows faster at the end of the sample.

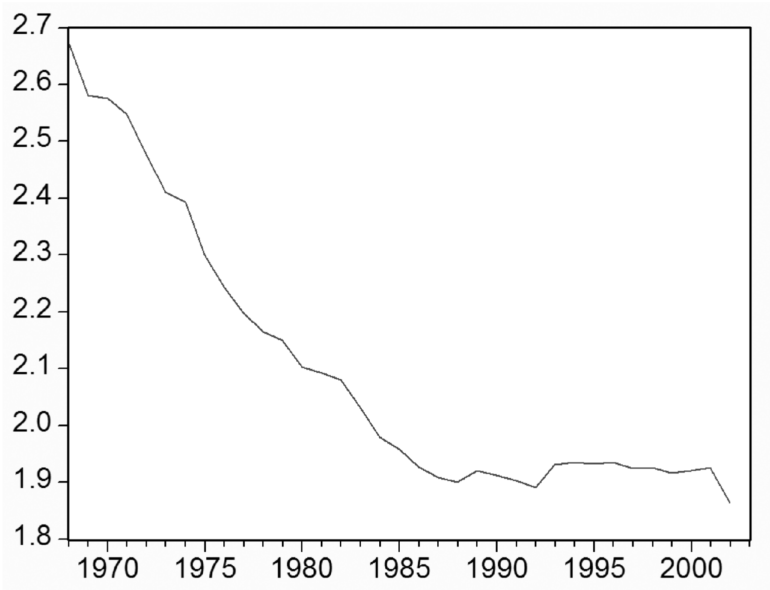
To measure wage inequalities between skilled and unskilled employment, we use data from INSEE, *Séries longues sur les salaires* until 1998. Then we prolong the series with data of “enquêtes emploi" until 2002. The main problem is that the first data are annual average data, whereas the second are spot data. The comparison between these two sources is then complicated. To construct the final series, we simply calculate an average between the two series. The data we obtain is sharply decreasing on the period, which could be

[5] Labor survey

[6] More details about this data set can be found in a previous paper CAHU (2005)

[7] You can see partial autocorrelations in the next section.

interpreted as the consequence of an unbalance between demand and supply of skilled labor. This indicator is built as the ratio between annual wage of executive and intermediary occupation between annual wage of employees and workers. This fact supports the view of an increasing overeducation. It can be bound to Lloyd-Ellis theory that explains on the contrary increasing inequalities in the United States by an insufficient supply of skilled labor regarding to demand. This variable is surely I(1)[8] because the hypothesis of a double unit test root could be rejected at the 1% level.



Wage ratio of skilled and unskilled workers, France.

The main data of our test, measuring exclusion, have been calculated using rate of unemployment according to level of education, published by INSEE "Enquêtes emplois" since 1970. These data are spot data, they give a view on the labor market at one time in the year. To assure more coherence, we should correct these series to calculate an annual average. However this process leads to too smooth series, which is not convenient for cointegration analysis. With the unemployment rate according to five levels of education, we make an index for measuring difference in probability to get a job for employment of skilled and unskilled workers. The first level corresponds to workers having pimary education qualification or no qualification at all. The second level corresponds to workers that havr a diploma of BEPC, which is a diploma of short secondary school and corresponds to 9 years of schooling. We will here consider the workers with these first two levels of education as unskilled workers. Level three corresponds to vocational diplomas as CAP or BEP, which correspond to 11 years of schooling. The fourth level is baccalauréat which is the terminal diploma of secondary school (12 years of schooling) and the fifth corresponds to all workers who own a diploma of higher education. For each level of diploma, we calculate the relative probability to hold a job, where e_i is this index for level i, u_i is the unemployment rate at the level i of education, and $\bar{u}$ the average unemployment rate in all the whole economy.

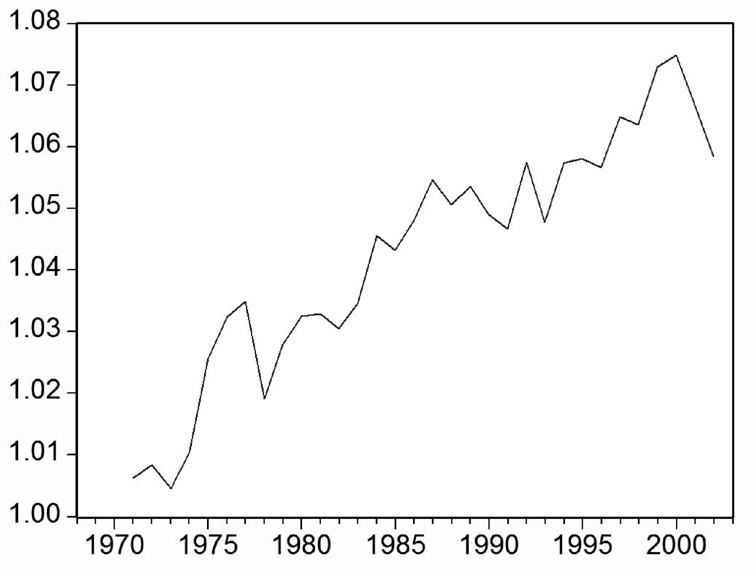
$$e_i = \frac{1 - u_i}{1 - \bar{u}} \tag{26}$$

[8] See partial autocorrelations in appendices

Then, we define the exclusion variable XCL as :

$$XCL = \frac{((e_3 e_4 e_5)^{1/3}}{(e_1 e_2)^{1/2}} \equiv \Xi \tag{27}$$

We can also define the same variable ($XCLY$) among the youngest workers (whose age is below 26). These variables are homogenous with the specifications we used in our theoretical model. They are I(1)[9].



A measure of labor market exclusion of low-skilled workers, France

The exclusion is increasing during the period. Unit root tests on the derivative of the variables seems to indicate that they are I(1) and not I(2).

Null Hypothesis : D(dep. var.) has an unit root	
Dep. var.	ERS stat.[10]
XCL	-6.224496
XCLY	-3.743288
DWS	-2.704979
Test critical values : 1% level	-2.636901
Test critical values : 5% level	-1.951332
Test critical values : 10% level	-1.610747

Table 1 : Testing I(1) vs I(2) cointegration order for variables

4 Empirical evidence

4.1 Correlations

First of all, a preliminary study of the partial correlations shows that the different measures of education are very correlated. In addition to that, exclusion variables, differential wage and overeducation variables are highly correlated. Although these variables

[9] See partial autocorrelations in appendices

[10] Elliott-Rothenberg-Stock DF-GLS test statistic. Critical value are from Mac Kinnon (1996)

are really different in a theoretical context because they are connected to supply, prices and education their dynamics seems to reveal a strong convergence.

	XCL	XCLY	OVER	OAS	OAF	DWS	UR
XCL	1.000	0.931	0.944	0.910	0.824	-0.902	0.908
XCLY	0.931	1.000	0.965	0.801	0.848	-0.858	0.869
OVER	0.944	0.965	1.000	0.915	0.953	-0.832	0.880
OAS	0.910	0.801	0.915	1.000	0.925	-0.691	0.536
OAF	0.824	0.848	0.953	0.925	1.000	-0.444	0.376
DWS	-0.902	-0.858	-0.832	-0.691	-0.444	1.000	-0.916
UR	0.908	0.869	0.880	0.536	0.376	-0.916	1.000

Table 2 : Correlations between model variables

At first sight, overeducation seems to fall down with wage inequalities and to rise with unemployment and exclusion. Overeducation is mostly linked to exclusion, which directly brings support to the basis of our theoretical model. Then overeducation is connected with unemployment. As unemployment and exclusion are closed linked, we could imagine than overeducation affects unemployment through exclusion. The link between overeducation and wage inequalities can simply be related with a competitive market mechanism. As overeducation is a proxy for relative excess of supply to demand for skill workers, it is logical that the relative earnings evolve in order to attenuate this unbalance. We should add that the connections between overeducation and exclusion are higher among the young people. This is logical because as the young workers have few experiment on the labor market, their integration in the labor force mostly depends on their initial education. Few other elements are available for the recruiters to anticipate the young worker productivity. We should then estimate single autoregressive equations to split the different influences of the variables on exclusion.

4.2 Testing the model

To test the empirical relevance of the model, we make a simple VAR model with the three main variables in order to test Granger causality. This model could be sum up in a system of three autoregressive equations. The series $\varepsilon_{1t}, \varepsilon_{2t}, \varepsilon_{2t}$ are assumed to be gaussian noise with null average and constant standard deviation over time.

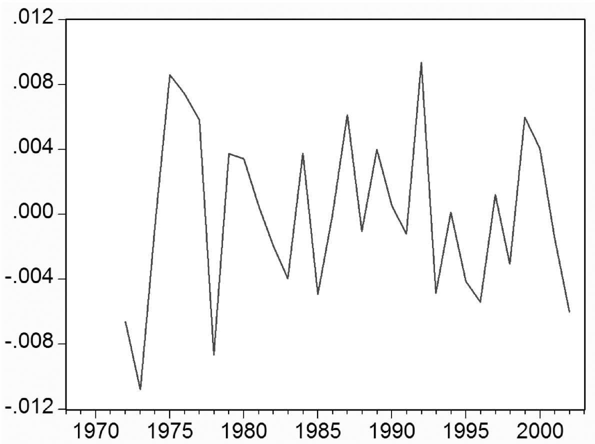
$$\begin{cases} XCL_t = \rho_1 XCL_{t-1} + \alpha_{12} OVER_{t-1} + \alpha_{13} UR_{-1} + c_1 + \varepsilon_{1t} \\ OVER_t = \rho_2 OVER_{t-1} + \alpha_{21} XCL_{t-1} + \alpha_{23} UR_{-1} + c_2 + \varepsilon_{2t} \\ UR_t = \rho_3 UR_{t-1} + \alpha_{31} XCL_{t-1} + \alpha_{32} OVER_{t-1} + c_3 + \varepsilon_{3t} \end{cases} \quad (28)$$

Next, we present the results of regression in an array with explained variables in columns and explaining ones in rows.

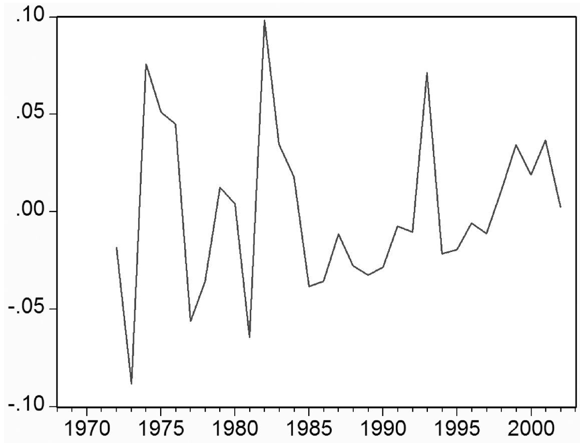
Explaining \ Explained	XCL	OVER	UR
XCL(−1)	*ns*	*ns*	*ns*
OVER(−1)	0.046 (2.7)	0.84 (6.1)	*ns*
UR(−1)	0.19 (2.4)	1.58 (2.4)	1.06 (10.1)
Intercept	0.80 (4.7)	*ns*	*ns*
adj. R^2	0.91	0.95	0.94

Table 3 : Main VAR model

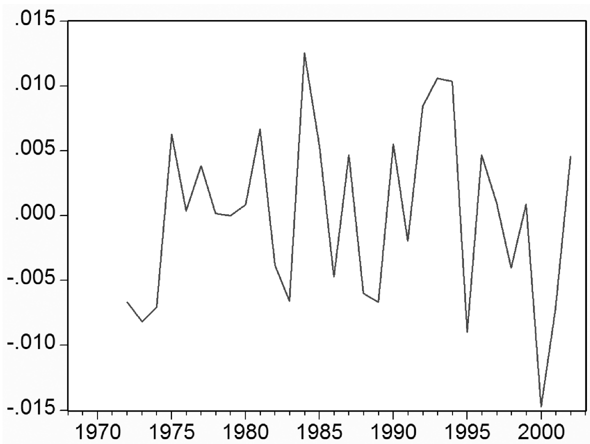
The resulting series are stationary. We can see it in the following graphs and consider the unit root tests.[11]



Residual series. Exclusion equation.



Residual series. Overeducation exclusion.



Residual series. Unemployment rate equation.

Several tests	Resid XCL	Resid OVER	Resid UR
Dickey Fuller	-5.01***	-5.6***	-5.0***
DF - GLS	-4.2***	-5.6***	-4.7***
Phillips Perron	-6.2***	-5.8***	-5.0***

Table 4 : Different Unit root tests[12].

Overeducation is a measure of the share of graduate workers in the unskilled sector and seems to increase exclusion here.The overall unemployment rate has a bad effect on exclusion too. But exclusion seems not to influence overeducation or unemployment in return.

[11] These tests have been made for every regression we present in this paper. Results are always satisfying. We present it in the first model as an example. Other results for any model could be given on demand.

[12] The three stars indicate the rejection of the unit root hypothesis at the 1% threshold.

These findings are consistent with our theoretical model. We notice that unemployment raises overeducation, which is also consistent with the theory. When jobs become scarce, graduate workers get a higher advantage on the labor market. So workers invest more in education to protect themselves of unemployment and become less reluctant to accept an unskilled job. We can add a techological change variable in order to check that these relations are not biased by technology.

The results appear a little stronger. The multiplier and its t-Student are higher. But the sigificance of this new variable is weak and the equations remain quite identical.

	XCL	OVER	UR
XCL(−1)	*ns*	*ns*	*ns*
OVER(−1)	0.051 (3.1)	0.88 (6.5)	*ns*
UR(−1)	0.19 (2.4)	1.52 (2.4)	1.05 (10.3)
Intercept	0.94 (5.2)	*ns*	*ns*
TEK	−0.12 (1.8)	*ns*	*ns*
adj. R^2	0.92	0.95	0.95

Table 5 : Var model with technological change.

4.3 Single equations

Single MCO regressions show a highly significant impact of overeducation on exclusion, whatever the index chosen for overeducation. Differential wage (DWS) has also a significant impact (except with statistical definition of overeducation OAS) and exhibits the expected sign. The unemployment rate is not significant.

dep. var	XCL(−1)	DWS(−1)	OVER(−1)	OAF(−1)	OAS(−1)	Intercept	adj. R^2	Sample
XCL	– (*ns*)	−0.034 (3.9)	0.064 (7.34)	–	–	1.06 (44.4)	0.92	72-02
XCL	– (*ns*)	−0.055 (2.5)	0.063 (6.8)	–	–	1.10 (22.8)	0.83	82-02
XCL	– (*ns*)	−0.065 (2.2)	–	0.012 (5.2)	–	1.16 (19.4)	0.69	82-02
XCL	– (*ns*)	– (*ns*)	–	–	0.031 (6.8)	1.0 (137)	0.70	82-02

Table 6 : Autoregressive estimations of exclusion, all workers.

Results are similar among the young workers and we note that the multipliers of overeducation on exclusion are higher, which indicate that young unskilled workers are more affected by overeducation than the other. However, the impact of relative wages is opposite. Higher wage inequalities between skilled and unskilled jobs are linked to a higher discrimination between graduates and non graduates. This could mean that the difficulties of young workers to find a skilled job has no influence on the wage bargaining, which is coherent because young workers are outsiders. On the other side, a rise in wage inequalities could prevent the recruiters from hiring young people (which means unexperienced) unskilled workers and then push up young unskilled exclusion. The unemployment rate is not significant.

dep. var	XCLY(−1)	DWS(−1)	OVER(−1)	OAF(−1)	OAS(−1)	Intercept	adj. R^2	Sample
XCLY	0.67 (5.5)	− (ns)	0.11 (2.5)	−	−	0.28 (2.7)	0.97	72-02
XCLY	0.52 (6.5)	0.20 (6.1)	0.18 (5.1)	−	−	− (ns)	0.95	82-02
XCLY	0.67 (7.5)	0.18 (3.8)	−	0.022 (2.7)	−	− (ns)	0.90	82-02
XCLY	0.69 (5.9)	0.36 (4.1)	−	−	0.063 (2.9)	−0.43 (2.5)	0.91	82-02

Table 7 : Autoregressive estimations of exclusion, young workers.

Further estimations are now necessary for finding out the direction of the causality.

4.4 VAR model and Granger Causality test

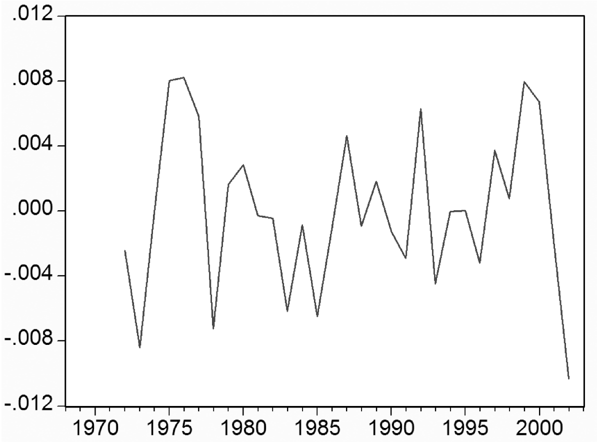
4.4.1 Overall exclusion

To identify the direction of the causality we make simple VAR models with exclusion, wage inequalities and our measure of overeducation. We had the unemployment rate (UR), when this variable has a significant impact on exclusion, which is hardly ever effective. We present here the VAR model with overall exclusion and full sample overeducation. The model is similar with other variables.

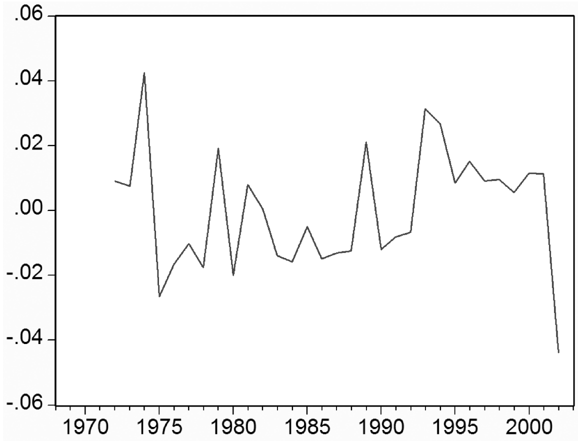
	XCL	DWS	OVER
XCL(-1)	−0.028 (0.1)	1.58 (2.1)	−1.18 (0.7)
DWS(-1)	−0.035 (3.0)	0.92 (21.2)	−0.14 (1.3)
OVER(-1)	0.066 (4.1)	−0.15 (2.5)	0.96 (6.7)
Intercept	1.09 (5.1)	−1.4 (1.7)	1.57 (0.8)
Adj. R^2	0.92	0.99	0.94

Table 8 : Var model with wage differential

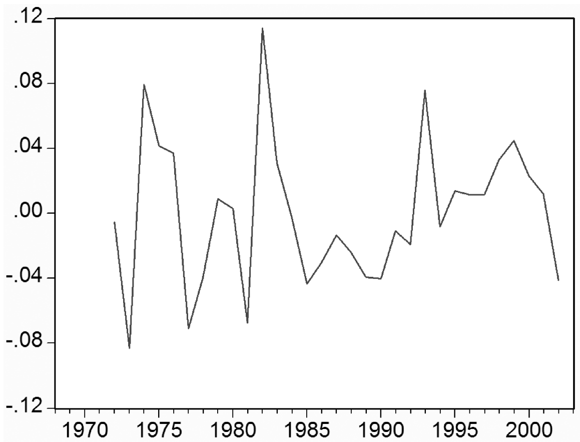
As we can see, overeducation has an important explanatory power on exclusion. The sign of the multiplier is positive, which is consistent with our theoretical model. Wage inequalities between skilled and unskilled workers is well explained by all variables. Overeducation lowers wage inequalities, which is consistent with the mincerian theory. Moreover, wage inequalities bring down exclusion, which is also logical. A higher wage differential represents for an unemployed skilled worker a higher cost of opportunity, which could make him more reluctant to accept an unskilled job. Indeed higher wage inequalities lower the competition between unskilled and overeducated workers on the unskilled job market and then decrease exclusion. The resulting series are stationary as we can see in the following graphs and the unit root tests.



Residual series. Exclusion equation.



Residual series. Wage differential equation.



Residual series. Overeducation equation.

Residual series	XCL	DWS	OVER
GLS-ERS Stat.	3.90***	4.59***	5.23***

Table 9 : Unit root test for the residual series of the previous VAR model.

We can build similar models with others indicators for overeducation. We use here Granger causality tests to check the results. The following tab sums up the values of partial multipliers between overeducation and exclusion and indicates the probabilities of rejection of the no Granger causality hypothesis between those variables.[13]

Overeducation var.	OVER	OVER	OAF	OAS
Overeducation → Exclusion	0.066***	0.067***	0.013***	0.022
Exclusion → Overeducation	-1.18	3.4**	2.8	4.4
Sample	1971-2002	1982-2002	1982-2002	1982-2002

[13] To estimate this p.value, we used χ^2 tests.

Table 10 : Multipliers and threshold probabilities of rejection of the no Granger causality test[14]

The Granger causality study reveals that overeducation has a strong impact on exclusion and wage inequalities.

4.4.2 Youngest workers exclusion

Then we could do the same exercise with exclusion for the youngest workers. So we build several VAR models with our three different measures of overeducation and we run Granger causality tests.

Overeducation var.	OVER	OVER	OAF	OAS
Overeducation → Exclusion	0.11***	0.18***	0.02**	0.063***
Exclusion → Overeducation	-0.024	-0.66	0.81	0.40
Sample	1971-2002	1982-2002	1982-2002	1982-2002

Table 11 : Multipliers and threshold probabilities of rejection of the no Granger causality test

The results indicate that there has been an increasing impact of overeducation on the youngest workers exclusion. If we compare the multipliers of this effect on both overall and young people exclusion, we see that the impact of overeducation is much higher among the young workers. The effect is very significant for every measure of overeducation. The young people are surely the first victims of this phenomenon, which causes the rejection of the non graduate people out of the labor force.

In addition to that, Granger causality study shows up that the differential wage has truly a positive impact on exclusion for the all labor force whereas it has no influence at all among the young workers. As they are outsiders, young workers do not influence the wage barganing and wage evolution could not attenuate the labor market failure about education.

4.5 Long-run relation between exclusion, wage inequalities and overeducation

The series we use are I(1) and present great interconnections. Although the sample is quite short, there might be a cointegration relation between those variables. However, Johansen tests for cointegration are not satisfying for both overall and youth exclusion[15]. We could nevertheless estimate directly a long-run relation as follows.

$$XCL = -\underset{(4.5)}{0.038}DWS + \underset{(7.4)}{0.063}OVER + \underset{(44)}{1.07} + r_t \qquad (29)$$

$$\text{adj } R^2 = 0.93 \quad , \quad DW = 1.7$$

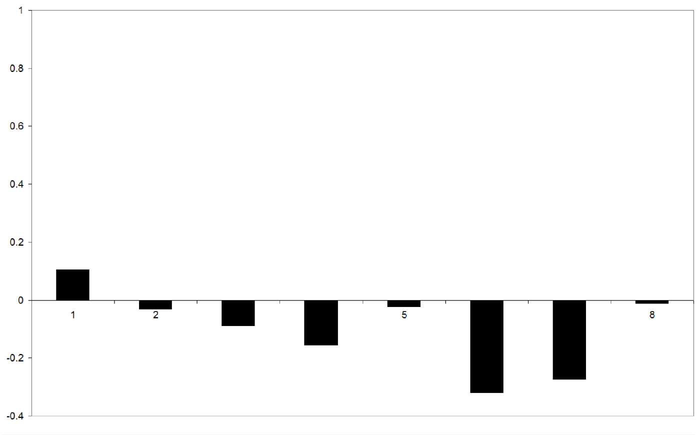
The residual series r_t seems to be stationary, as we can see on the graph, correlogram and unit test root. Exclusion, differential wage for skilled and unskilled workers and overeducation might be cointegrated series.

Null Hypothesis : r_t has a unit root	
Elliott-Rothenberg-Stock DF-GLS test statistic	-4.561588***

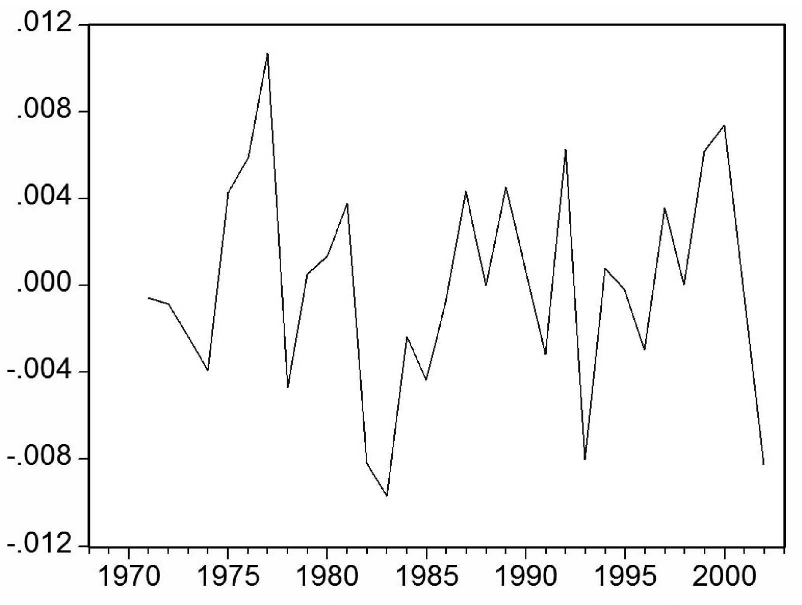
[14] See note 12.

[15] Both trace and max eigenvalues tests for cointegration exhibit lack of cointegration relations.

Table 12 : Unit root test for the residual of cointegration relation



Partial autocorrelations of the residual series r_t,
France



Cointegration equation residual.

If we introduce this long-run relation into an error correction model for exclusion, we could find that this long-run relation impacts the short term evolution of exclusion. Moreover, technological change seems to lower the exclusion of the unskilled workers in the short run. This effect could be seen as illogical if we consider that technological change destroys unskilled jobs and then reduces the employability of unskilled workers. But when the share of overeducated workers is high as in the French context, there are more unskilled jobs than unskilled workers and technological change plays a positive role on exclusion by creating skilled job and reducing overeducation. These empirical findings support the relevance of our previous results.

$$d(XCL) = -\underset{(5.6)}{1.02}r_t - \underset{(2.9)}{0.33}d\big(TEK(-1)\big) + \varepsilon_t \tag{30}$$

$$\text{adj R}^2 = 0.54 \quad , \quad DW = 1.64$$

4.6 Testing the demographic hypothesis

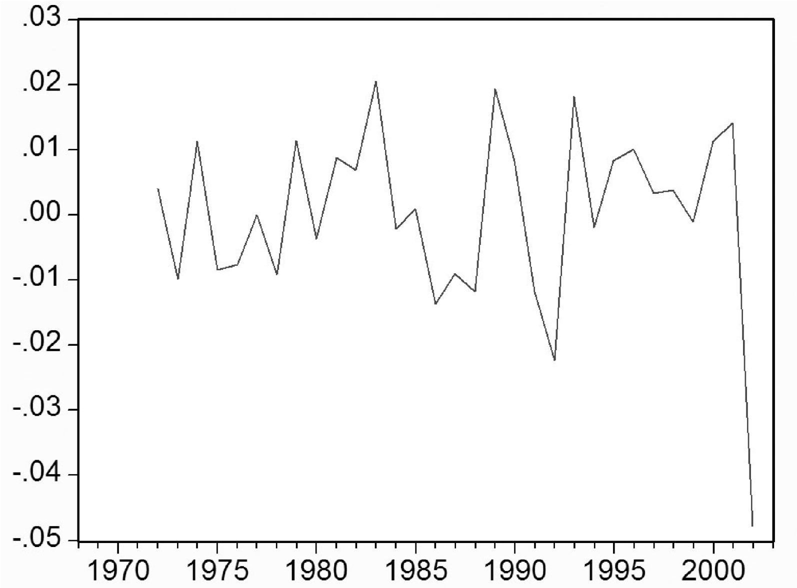
The components of the labor force have much moved since the 70's. The "baby boom" generations had temporary increased the share of young workers whereas the sharp rise of school attainment had pushed up the weight of graduate participants. Because of Mincer's evidence which links wage to age, these demographic trends should have impacted the evolution of relative compensations between skilled and unskilled jobs, in the case where more educated workers could have access to more qualified jobs. In this context, less young workers among the less educated population should raise the average age and then the wages of the unskilled job holders. In the opposite, more educated young workers should decrease the average wages in skilled occupations. As these evolutions are not monotonic and might work one against the other, a single general indicator, like the average age of the labor force could not describe these phenomena correctly. Consequently we introduce five variables SY_i which measure the relative share of the young among the workers of the ith level of education. Here we refer to primary level schooling (level 1), short secondary school (level 2), vocational secondary school (level 3), long secondary school (4) and higher education (5). If we try to regress the differential wage indicator on these variables, we obtain :

$$DWS = \underset{(2.4)}{0.34}DWS(-1) + \underset{(2.0)}{1.00}SY_1(-1) + \underset{(3.6)}{0.78}SY_2(-1) - \underset{(3.3)}{0.73}SY_3(-1) - \underset{(1.7)}{0.34}SY_4(-1) + \underset{(2.1)}{0.94}SY_5(-1) + \underset{(4.8)}{1.15} + \eta_t \tag{31}$$

$$R^2 \; adj = 99.9\%$$

This equation is very relevant and the residual series is stationary. If we except SY_4, all terms are significant. The impact of low level confirms the theory. A decreasing unskilled young labor force has a negative impact on wage inequalities. The vocational level pushes up inequalities, which is not illogical because most of the workers issued from this level work as self-employed and not as unskilled employees. The impact of level 4[16] on wage inequalities is negative but insignificant. Moreover, the sign before $SY5$ is positive. This is not consistent with the main theory and may indicate that these young workers are employed in unskilled jobs and then suffer from overeducation.

[16] This level corresponds to the end of secondary school.



The resulting series η_t.

Null Hypothesis : η_t has a unit root	
Elliott-Rothenberg-Stock DF-GLS test statistic	-4.561588***

Table 13 : Unit test root for the residual η_t relation

As relative wage mostly depends on demographic variables, we could try to replace the DWS variable by the SY_i in our previous VAR models and test for Granger causality. In each case, for all and young workers, only one demographic variable is significant. The signs are the ones we excepted, it is negative for low level of schooling and positive for high levels. All multipliers are very significant and the p.value of the Granger causality tests are always beyond 1%. The adjusted R^2 statistics are quite similar to the previous specification. In addition to that, a full analysis of Granger causality indicates that neither SY_2 nor SY_4 have an influence on overeducation. Symmetrically, neither overeducation nor exclusion seems to influence these demographic variables.

Type of exclusion	OVER	SY_1	SY_2	SY_3	SY_4	SY_5	adj. R^2 for XCL(Y) in VAR
XCL	0.05***	– (ns)	−0.07***	– (ns)	– (ns)	– (ns)	0.92
XCLY	0.17***	– (ns)	– (ns)	– (ns)	0.25***	– (ns)	0.97
Sample							*1971-2002*

Table 14 : Multipliers in VAR models and threshold probabilities of rejection of the no Granger causality test

We could then conclude that the effect of differential wage between occupations on exclusion is mostly due to demographic evolutions, which are in fact related to the educational boom. Once more the overall unemployment level is not significant to explain exclusion. Eventually the rise of educational attainment that France has experienced since the 70's had increased indirectly the exclusion of less qualified workers through two channels. First, by increasing the weight of old workers in the unskilled occupations, the educational boom had induced a huge rise of the average wage and then cost of unskilled jobs. This prevents the younger and then less productive unskilled workers from entering the labor market. Second, by pushing up overeducation, the educational boom had increased the competition between skilled and unskilled workers for unskilled jobs.

5 Conclusion

Sharp evolution of schooling seems to have in France a bad impact on job access inequalities. As the economy has not been able to absorb the huge amount of graduates, France has known an increasing overeducation. According to theoretical predictions and to other countries experience, this has induced a rise in low-skilled unemployment much higher than average unemployment. As one of the roles of the educational system is to reduce inequalities, this fact appears as a serious problem. Moreover, dynamics of differential wage between occupations, which appeared as directly caused by the school attainment rise, has increased this phenomenon. The reduction of wage inequalities between occupations carried out indeed an increase of unskilled workers exclusion. The educational policy France has experienced since the 70's has then enabled to reduce wage inequalities within the employed workers, but prevented the more vulnerable participants of the labor force, like the youngest and the less qualified ones, from easily getting jobs.

We could add that in these conditions, such a sharp educational rise, involving higher inequalities on job access, requires a satisfying social protection, especially toward the lowest skilled and youngest workers, who can suffer from long unemployment. This problem is all the more serious as long-lasting unemployment could rapidly leads to social exclusion. These facts might mean that in order to increase growth, the French social protection should not be lowered before the society reconsiders its overall educational policy.

6 Appendices

6.1 Lemma

With any v, $x < v$, δ, we always have :

$$f(t^*) - \frac{p^*}{q^*} f(t^* + \delta) < 0 \tag{32}$$

Proof
As we know that : $p^* = 1 - F(t^*)$ and $q^* = 1 - F(t^{'*})$, we have

$$f(t^*) - \frac{p^*}{q^*} f(t^* + \delta) < 0 \Leftrightarrow \frac{f(t^*)}{1 - F(t^*)} < \frac{f(t^{'*})}{1 - F(t^{'*})} \tag{33}$$

We define the function $J(x)$ as :

$$J(x) = \frac{f(x)}{1 - F[x]} \tag{34}$$

$$\frac{dJ}{dx} = \frac{f(x)}{(1 - F(x))^2}[-x(1 - F(x)) + f(x)] \tag{35}$$

We pose :

$$L(x) = -x(1 - F(x)) + f(x) \tag{36}$$

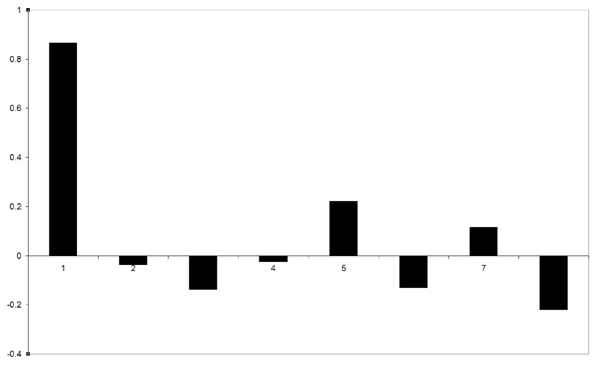
$$\frac{dL}{dx} = -1 + F(x) + xf(x) - xf(x) = -(1 - F(x)) < 0 \quad (37)$$

As we have :

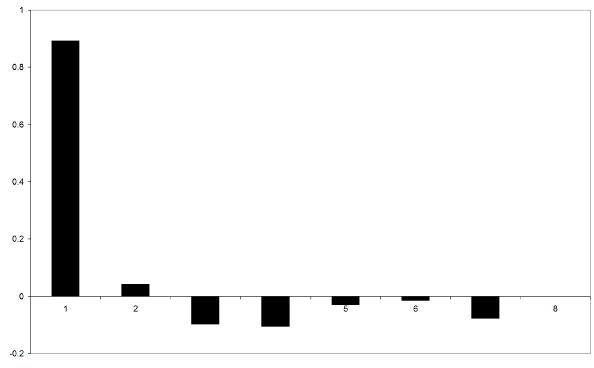
$$lim_{x \to \infty} L(x) = 0 \quad (38)$$

and L(x) strictly decreasing, we can be sure that $L(x) > 0$. Thus we have, $\frac{dJ}{dx} > 0$ and $J(x)$ is increasing. As we have : $p^* > q^* \Rightarrow t^* < t^{'*} \Rightarrow J(t^*) < J(t^{'*})$.

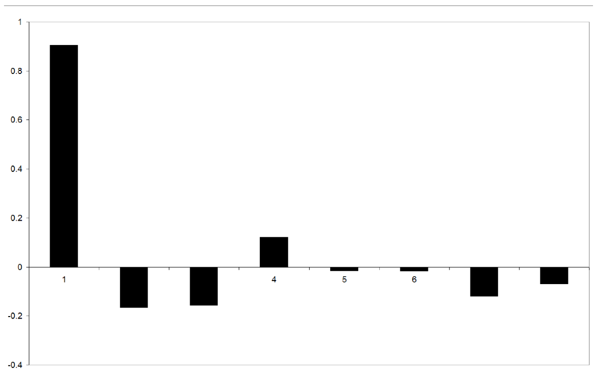
6.2 Correlograms



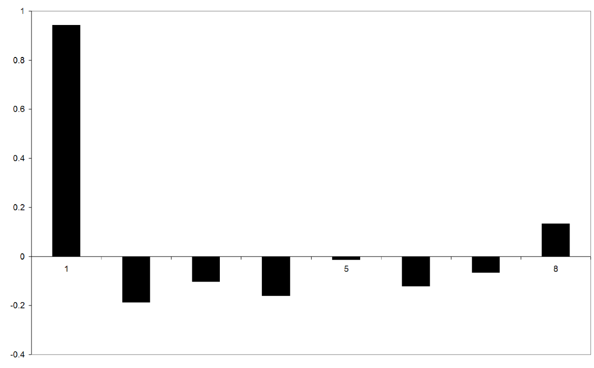
Partial autocorrelations. Exclusion, France. 1971 - 2002



Partial autocorrelations. Wage differential, France 1971 - 2002



Partial autocorrelations. Overeducation, France 1971 - 2002



Partial autocorrelations. Unemployment rate, France 1971 - 2002

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