Age at school entry, accumulation of human capital and educational guidance: the case of France[1].

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Abstract

The paper proposes an econometric analysis that aims at evaluating the impact of age at primary school entry on human capital accumulation and educational guidance in France.

There is now a large amount of literature on the influence of age at school entry on educational and labour market outcomes. These works provide mixed empirical evidence. Yet, no study deals with *the specific impact of age at school entry* in primary school on some educational outcomes, for the case of France. However, if the legal moment to enter primary school is September of the civil year when a child is 6, there exist many dispensation cases in the French education system, which allows for early or late entry at primary school. In addition, among children who enter regularly at primary school, some are older than others because there may be some substantial differences in birth month. These two features provide a natural experiment which allows for important variations in age at school entry measured in months.

To test the impact of age at school entry on both human capital accumulation and educational guidance for the French case, we use cross-section micro data from the 'Training and Occupational Skills' surveys (*Formation et Qualification Professionnelle*, INSEE, 1993 and 2003). We use instrumental variable approach (2SLS or instrumental variables probit) to take into account possible unobserved individual heterogeneity. For the whole sample, we find no impact on certain educational outcomes: years of schooling, level of diploma. But we find an impact on the probability to repeat at least a year. We also find evidence that the age at school entry has an impact on the type (*i.e.* vocational *vs* 'general') of pursued education or obtained diploma. These findings suggest that the effective age at school entry has an impact on the educational guidance of an individual. We also conduct separated regression on sub-samples of women and men which qualify these results.

Keywords: Human capital, Age at school entry, Education Systems, Instrumental variables
Classification JEL: I21, J13, J24

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1. Introduction

The paper proposes an empirical analysis that aims at evaluating the impact of age at primary school entry on educational outcomes (proxies for human capital and indicators for educational guidance) in France.
Mixed evidence is found in empirical studies focusing on the impact of age at school entry on both educational and labour market outcomes (*e.g.* Fredriksson and Öckert, 2005; Kawaguchi, 2009). This mixed evidence probably largely comes from individual heterogeneity not always taken into account, and/or countries-specific effects. We propose in our paper to re-assess this subject for the case of France, by analysing the impact of age at primary school entry on human capital accumulation and educational guidance.
In France, the regular 'timing' to enter primary school is the September of the civil *year* when the child gets his 6 years. This entry comes normally (but not mandatory) after 3 years in pre-primary school. Yet, young children may not enter "regularly": they may obtain dispensation to enter in primary school later, or even earlier. In addition, among children who enter regularly at primary school, some are older than others because there may be some substantial differences in birth month. These two features provide a natural experiment which allows for important variations in age at school entry measured in months.
The potential impact of age at school entry on educational outcomes is a relevant question for at least three reasons: *(i)* the importance of the legal age of entry in primary school (and the possible seasonality of entry at school); *(ii)* the age at school entry could have an effect on the type of initial education pursued by an individual; *(iii)* if there is an impact of the age of entry on some educational outcomes, age at school entry is likely to have some effects on transitions to work. Indeed, the diploma is a good predictor of the individual's socio-professional category.

To observe the impact of age at school entry on educational outcomes, we use cross-section micro data coming from the 'Training and Occupational Skills' surveys (*Formation et Qualification Professionnelle*, 1993 and 2003) provided by the INSEE (French National Institute for Statistics and Economic Studies), which allow us to have a large sample (around 40,000 individuals).
Different measures of human capital are used in our econometric estimations. First, we successively use as (individual) human capital indicator the number of years of education, the level of diploma after initial education, and an indicator for possible repeated years during scholarship (Fertig and Kluve, 2005). Then, we analyse the impacts of age at school entry on other educational outcomes (vocational *vs* general education or diploma).
We successively use two econometric approaches: *(i)* first, we estimate "simple" models by OLS or Maximum likelihood (according to the type of considered outcome); *(ii)* second, we use instrumental variable approaches (2SLS, instrumental variables probit) to take account for a likely endogeneity of the "age at school entry in primary school" variable.
Our econometric analysis based on French data shows no impact of the age of entry at school on some educational outcomes like the number of years of schooling or the level of diploma. We also show that the age at school entry has an effect: *(i)* on the probability to repeat at least one year during scholarship; *(ii)* on the *type* (vocational *vs* 'general' education) of education/diploma pursued. Hence, we find evidence for effects of the age at school entry on educational trajectories. We also conduct separated regressions on sub-samples of women and men which qualify the found results.

Section 2 presents the literature related to the effects of the impact of age at school entry on educational and labour market outcomes, then deals with the age at primary school entry in

the French education system. The used data are presented in section 3, as well as some descriptive statistics. Section 4 deals with the econometric strategies. Results are presented and discussed in section 5. Section 6 concludes.

2. The impacts of age at school entry: the literature, and the French case

2.1. The literature

The literature related with the effect of age at school entry provides mixed evidence on both *schooling and labour market outcomes*. In the literature, "absolute age effect" is distinguished from the "relative age effect" (see *e.g.* Stipek, 2002). The "absolute age effect" is the effect, for example, to be *6* years old and not *7* years old when starting at school (maturity coming from the aging). The "relative age effect" is relative to *peers*: children who are young when they start school have the disadvantage of being among the *youngest* in the class. The persistence of disadvantages for the youngest children inside a class (notably, in terms of academic results) is usually perceived as the proof of existence of relative age effects[2].

First, most of the literature focuses on the impact of age of entry at school on *schooling outcomes* (*i.e.,* academic results and educational attainment).
A strand of this literature shows that older students perform better at school in terms of academic results or performance on test scores. Most of the recent studies use an instrumental variable approach to analyse this link. For example, Bedard and Dhuey (2006) show with "Tests in Sciences" data for OECD countries that age has a positive impact on children's academic results. Black *et al.* (2008) find on Norwegian data that school starting age has a small positive effect on IQ scores measured at age 18. For France, Grenet (2010) finds that the age (at different dates of the scholarship) has a positive effect on academic results.
Another strand of this literature focuses on the impact of age on educational attainment and provides mixed results. Using US data, Angrist and Krueger (1990) show that older entrants on primary school achieve lightly lesser level of education, because of compulsory attendance school entry. Summarizing US studies, Stipek (2002) insists on the fact that age of entry is not a significant predictor of education attainment, even if some short run effect may exist. Surveying studies on the impacts of age, Fredriksson and Öckert (2005) stressed that children with non-delayed entry at school obtain better schooling outcomes (*e.g.* do better at school and have more education). The authors point out that this may come from an unobserved heterogeneity bias, due to omitted variables that are not measurable, as ability level. On Swedish data and by using an instrumental approach, these authors find that children starting school at an older age have better school outcomes (education attainment, academic results). Using the Young Adult Longitudinal Survey (Germany, 1991-1995), Fertig and Kluve (2005) find a negative relation between age at school entry and schooling outcomes (number of drops out, final level of education). Yet, using an instrumental variable approach to capture potential heterogeneity, they find no impact of age at school entry: this shows likely selection (by ability) effects. Bauer and Riphahn (2006) test with Swiss data whether or not intergenerational educational mobility is affected by the time at which pupils are first streamed in secondary school. Late tracking significantly affects mobility and reduces the relative advantage of children of better educated parents. The same authors also evaluate the

[2] Note that being 'younger' may also be associated with advantages. Indeed, parents may want to help more their children if they are younger, and these children may also take benefit of their younger age if they learn more at home than at school (Black *et al.*, 2008).

effect of age at school entry on intergenerational transmission of human capital (Bauer and Riphahn, 2009) and find that early age at school entry reduces the relative advantage of children of better educated parents. Black *et al.* (2008) on Norway data find that school starting age has at best, very small impacts on completed years of education for men or women. Grenet (2010) finds on French data that age has an impact on educational trajectories.

Second, few papers insist on the impact of the age of entry at school *on labour market outcomes*. For example, Angrist and Krueger (1991) focus on the impact of season of birth on schooling and earnings, and find that one extra year of schooling enhances earnings by 9,2%. More recently, Dobkin and Ferreira (2007) show that the youngest among 'regular' pupils exhibit lower academic performance, but similar labour market outcomes (wages or the probability of employment). Using data from Japan, Kawaguchi (2009) finds positive effects of being older (but regular-entrant) in a cohort both on educational attainment and earnings. These results indicate "relative age effects", as recognized in the literature (Thompson, 1971; Lien *et al.*, 2005). Grenet (2010) finds very little gap in earnings for individuals born in the last months of a given year relatively to others.

In conclusion, mixed evidence is found in empirical studies focusing on the impact of age at school entry on both educational and labour market outcomes. This mixed evidence probably largely comes from individual heterogeneity that is not always taken into account, and/or countries-specific effects.

2.2. French education system and age at school entry

In France, the regular 'timing' to enter primary school is September of the civil *year* when the child is 6 years old. This entry comes normally (but not mandatory) after 3 years in pre-primary school. Yet, young children may not enter "regularly": they may obtain dispensation to enter in primary school lately, or even earlier. In addition, among children who enter regularly at primary school, but from different birth month, some specific effects may occur ("relative age effect"). Age may impact educational or labour market outcomes by many channels, including 'intellectual maturity' ("absolute age effects"), or selection effects (children with higher abilities may enter earlier at school). Finally, it is important to take into account a possible impact of age at school entry on human capital formation and other educational outcomes through 'cohort effect' (influence of a specific year of birth).
Few works have studied the impact of birth month on various outcomes for France, as surveyed in Grenet (2008). Yet, to our knowledge, no study has dealed with the specific impact of age at school entry in primary school. Indeed, Grenet (2010) analyses the effects of the age (in months) in the French education system at different moments of the scholarship of an individual, mainly on her academic performances (test scores) and on her educational trajectories. Hence, Grenet (2010) studies a "test age" effect while we focus on an "age at school entry" effect; moreover, contrary to our paper, this work doesn't analyse the impacts on human capital levels (levels of diploma, years of schooling).
In our study, we take into account two important features, which form a natural experiment provided by: *(i)* non-regular entries in primary school (*i.e.*, early of late entry according to the normal 'legal' age) which renders substantial difference of age at primary school entry between students, *(ii)* differences in birth month. For a theoretical range for age at school entry from 69 to 80 months, the non-regular entries extend the range for this age at school entry from at least ± 1 year (for a delayed or early entry from one year), so ± 12 months. Hence, this natural experiment provides substantial variations in age at school entry measured

in months (from at least 57 to 92 months), and permit us to test for the specific impact of 'detailed' age at school entry on various educational outcomes.
To observe the impact of age at primary school entry on educational outcomes, three different measures of human capital are firstly used in our econometric estimations: the number of years of education (after corrections for possible repeated years or breaks during scholarships), the level of diploma after initial education, and a dummy variable to indicate possible repeated years during the scholarship (Fertig and Kluve, 2005). We then focus on the impact of age at school entry on two other educational outcomes which reflect educational guidance: vocational *vs* general education, and vocational *vs* general diploma.

3. Data and stylised facts

3.1. Data in use and empirical strategy

The 'Training and Occupational Skills' surveys
The 'Training and Occupational Skills' surveys, or *Formation et Qualification Professionnelle* (FQP) surveys are conducted by the French National Institute for Statistics and Economic Studies (INSEE). FQP surveys provide cross section data. They contain rich information on the occupational status of a representative sample of the population at the time of the survey and five years prior. They also provide information on the educational formation and social mobility between two generations of individuals. Since 1964, these surveys have been conducted following each Population Census. The last one was carried out in 2003. Since 1993, the FQP survey includes individuals aged 20 to 64 and is built using a sample of about 40,000 households that are randomly selected as part of the "master sample" constructed by the INSEE from the Population Census.
FQP is the only source of data providing information on both individual *and* parental level in terms of socio-professional category *and* education for the French Case. Therefore, it corresponds to a pertinent source of data to use it to evaluate the impact of age at school entry on schooling outcomes while controlling for educational and social origin.

The final sample
In FQP surveys, some individuals are still in school at the time the survey is conducted, so have not their completed year of schooling or diploma. We take this fact into account, to avoid to introduce some bias in our estimations of educational outcomes equations. A selection model could be estimated (Heckman, 1979), but such a process implies modelling the probability that the individual will complete her studies. In other words, this requires an estimation of the selection equation: it is necessary to determine instruments that determine this probability without explaining the final education level of the individual. Finding such instruments is often difficult (Cameron and Trivedi, 2005). To address this problem, we choose an alternative solution that consists in dropping from our sample all the individuals who are less than 30 years old. Indeed, by the age of 30, the majority of the population has completed formal education. As this criterion is exogenous, no selection bias arises.
In addition and as suggested by Grenet (2010), attention should be paid to the country of birth for the individuals in our sample. Indeed, for a substantial share of the population born abroad and living in France, only the year of birth is known (*i.e.*, birth day and birth month are unkwnown). In this case, the French administration attributes 'January' as default birth month. Hence, the month of January could be artificially over-represented in our sample for surveyed individuals born abroad, and a potential bias could apply in our analysis. As a consequence, we limit our sample to individuals who are French born, or born in France.

After these two adjustments, our database consists in a compilation of data from two (cross-sectional) surveys, FQP 1993 and FQP 2003.

3.2. Main variables

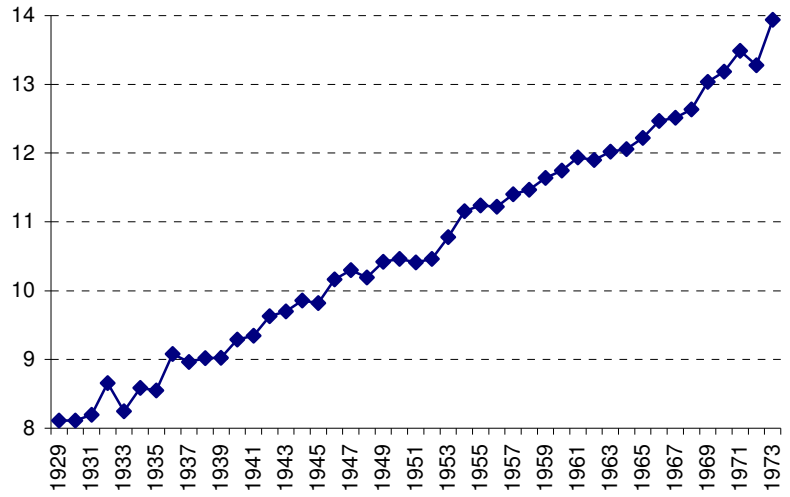
Dependant variables
We successively consider 5 different educational outcomes for an individual as dependant variables: the number of completed years of schooling[3], the level of the highest diploma[4], an indicator for having repeated at least a year during the scholarship, and an indicator for the type (*i.e.*, vocational or general) of pursued *education* or *diploma*.

Variables of interest and control variables
Our main variable of interest is the age at school entry, measured in months (see sub-section 2.2.). We also consider some traditional variables used in the human capital literature as control variables in our regressions: the parental human capital, social origin[5], gender, the number of siblings, the year of birth to control for "cohort effects".

3.3 Descriptive statistics

Figure 1 displays the average years of schooling by cohort in our sample. The profile of the figure is quite different from that for average years of schooling[6] by cohort in Angrist and Krueger (1991) which exhibits a slight inverted 'U'-shape for US data on 1930-1960 period. A continuous rise in average years of schooling is observed on the 1929-1973 period for the French Case. Hence, no specific passed law (school finishing or starting laws) in the French education system seems to clearly have an importance on completed school years.

Figure 1. Average years of schooling by birth cohort in France (1929-1973)



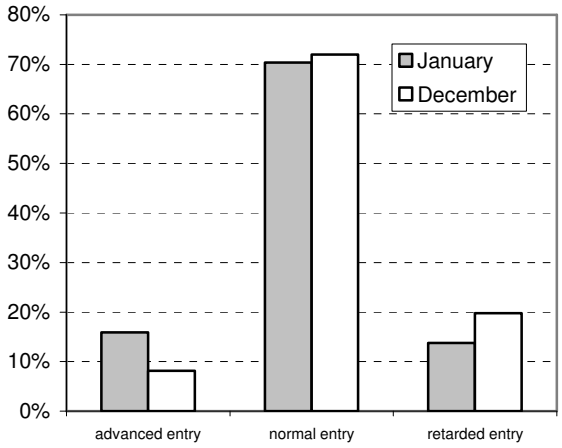
Sources: FQP surveys (INSEE; 1993, 2003). Computations from the author.

[3] The number of completed years of schooling is *corrected for repeated years or possible breaks during scholarship*.
[4] It is simply noted 'level of diploma' in the rest of the document
[5] We use the father's socio-professional category. Note that socio-professional category may be used as a relevant proxy for parental income as it is highly correlated with income and very stable in the long run (Nickell, 1982; Ermish et Francesconi, 2002; Johnson, 2002).
[6] Angrist and Krueger (1991)'s figure has the particularity to show average age of schooling by *quarterly* birth cohort.

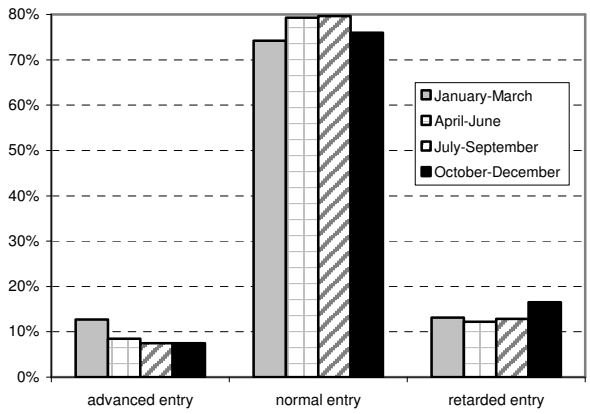
Figures 2a and 2b provide descriptive statistics for the whole sample on the distribution of the "type" of entry at primary school, *i.e.* early (before the legal/"normal" year), normal or delayed (after the "normal" year") entry at school according to the individual's year of birth. Both figures provide evidence that the more the individual is born "late" on a given year, the lower her/his probability to enter early, and the higher his probability to enter lately. This may be observed by comparing two "extreme" birth months (January and December, see Figure 2a), or for different quarters of birth (Figure 2b).

Figures 2a. and 2b.

Early, normal or late entry for individuals born in January and December



Early, normal or late entry for individuals according to the group of birth month



Sources: FQP surveys (INSEE; 1993, 2003). Computations from the author.

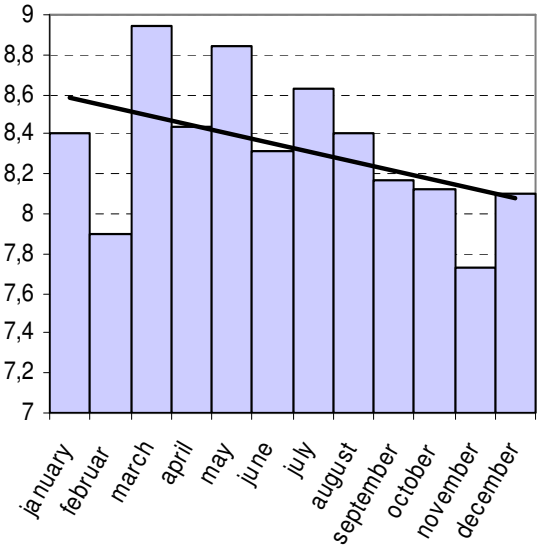
The distribution of the individuals according to the birth month is quite unequal in our sample (Figure 3a), with, basically, a decreasing temporal trend. It reflects the seasonality in the birth month in the French society (Régnier-Loilier and Rohrbasser, 2011). Let us now observe the distribution of the theoretical age at school entry according to the birth month (from 69 months to 80 months[7]): a 'global' (but not monotonous) inverse trend may be observed[8] (Figure 3b).

[7] Entry at primary school takes place in September in France, *the year when the individual gets 6 years old*. Hence, individuals born in September should legally enter at primary school when they are 6 years old (6 complete years, or 6 x 12 = 72 months), those who are born in January are 80 months old (6 full years plus 9 months, or (6 x 12) + 8= 80), those who are born in December are 69 months old (6 full years less three months, or (6x12) - 3 =69, *etc*.).

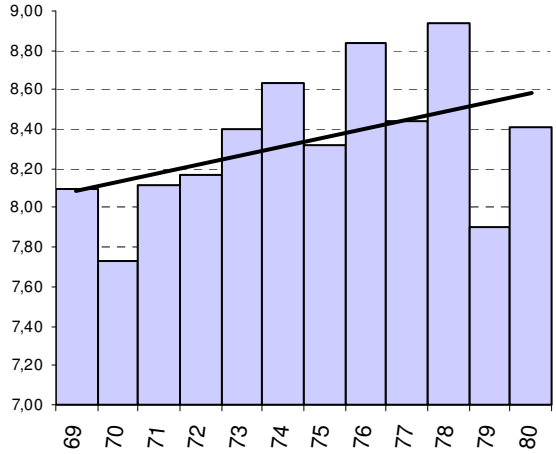
[8] The two figures are symmetric, as children who are born in the last months are (theoretically) the youngest students in a given class, and those born in the first months the oldest students.

Figures 3a and 3b.

Distribution of individuals according to the birth month



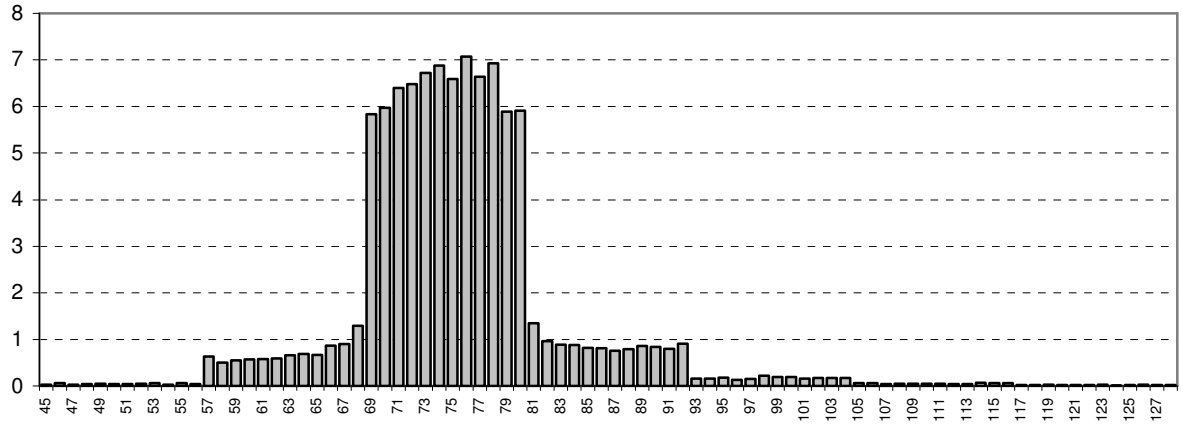
Distribution of the theoretical (legal) age of entry (in months) in primary school



Sources: FQP surveys (INSEE; 1993, 2003). Computations from the author.

Figure 4 displays distribution for effective age at school entry: most of the individuals in our sample actually enter at school between 57 and 92 months. Individuals are quite symmetrically distributed according to their effective age of entry, around a 'virtual' axis standing at around an age from 75 months. We also verify that a very large share of the sample has entered primary school regularly[9] (69 to 80 months old), with a one-year advance (57 to 68 months old), or with a one-year delay (81 to 92 months old).

Figure 4. Distribution of the effective age of entry (in months) in primary school



Sources: FQP surveys (INSEE; 1993, 2003). Computations from the author.

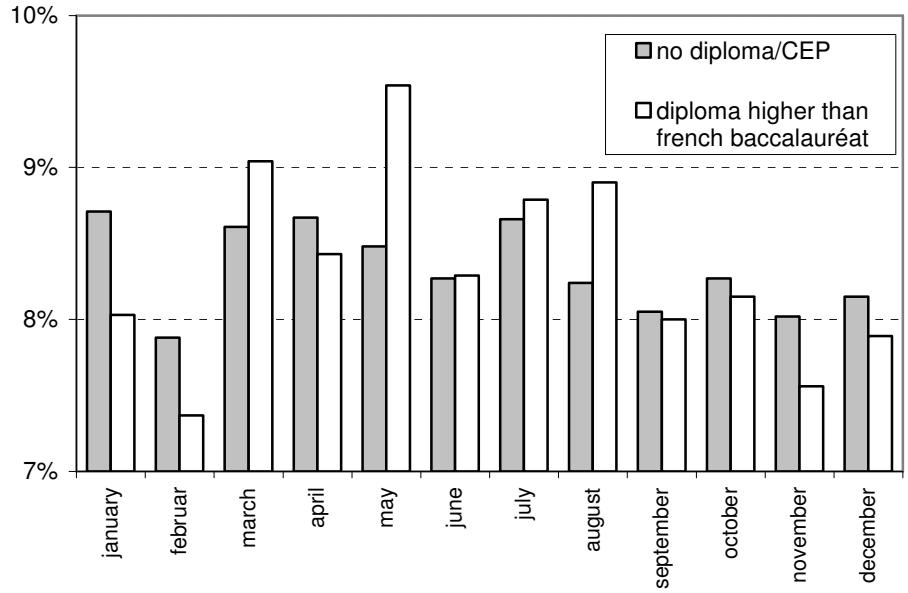
Figure 5 below presents the distribution of diploma[10] according to the birth month in our sample. No evident conclusion may be drawn from this figure, but individuals with lower

[9] Note that the distribution of the individuals belonging to this 'type' of entry is quite similar to that of the individuals in Figure 3b, with a profile as a 'S' 'stretched' on the right.

[10] Principal levels of diploma in France are exposed in Annexe A1.

diploma appear to be more frequently born in the last months of a year, relatively to those who have higher diploma (*i.e.*, higher than French baccalauréat[11]).

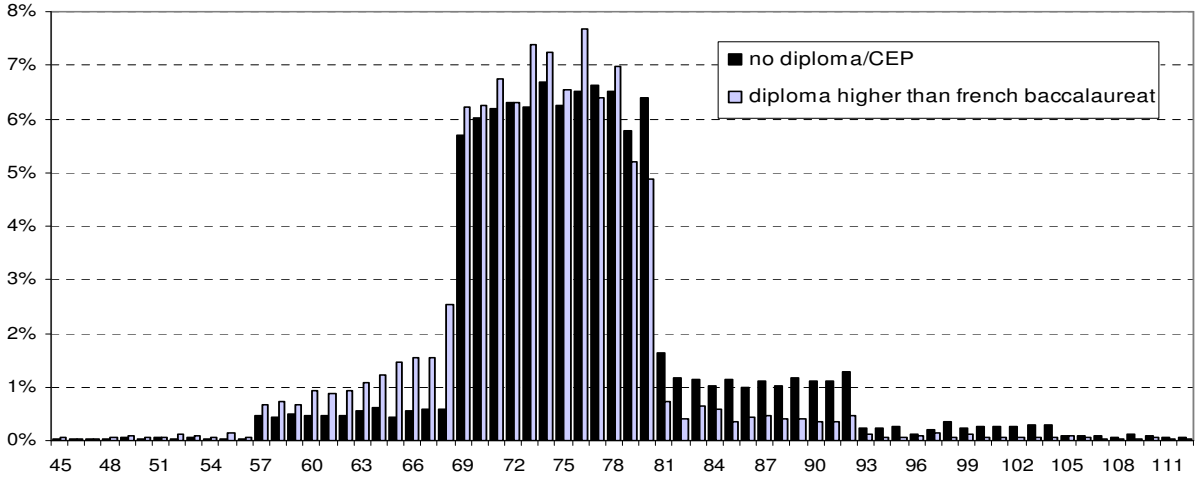
Figure 5. Distribution of diploma according to the birth month



Sources: FQP surveys (INSEE; 1993, 2003). Computations from the author.

Figure 6 provides a similar comparison based on the surveyed individuals' *age at school entry in months*. It appears clearly that on average in our sample, individuals with lower diploma have less frequently entered early, or normally, at school (age: 57 to around 79 months)[12]. Furthermore, the same statistics computed for two sub-samples (*1929-1951* and *1952-1973* cohorts, see figures A.2. and A.3 in Appendix) exhibit very similar patterns.
Moreover, there is negative association, in average in the sample, between the number of years of schooling[13] and the age at school entry measured in months (Figure 7).

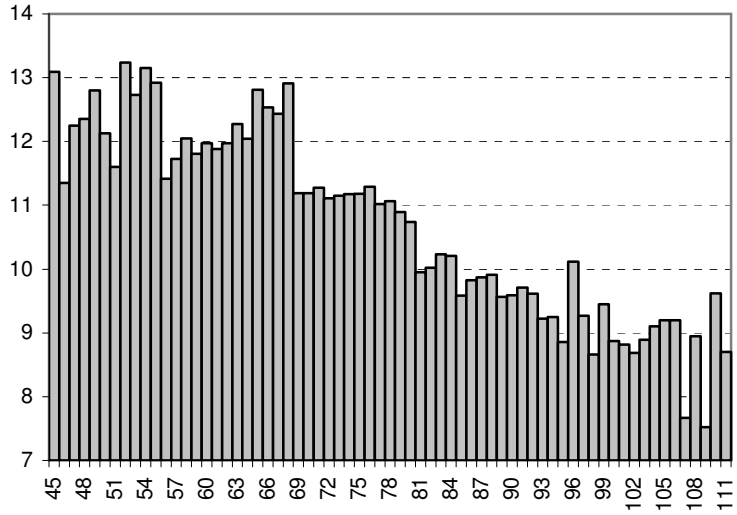
Figure 6. Distribution of individuals from extreme levels of education attainment according to their age at school entry (in months)



Sources: FQP surveys (INSEE; 1993, 2003). Computations from the author.

[11] The French baccalauréat is equivalent to a A-level grade.
[12] Hence, these individuals have more frequently experienced a late entry at school at school lately (age: older than 81 months).
[13] It corresponds to the years of schooling *corrected for repeated years or possible breaks during scholarship*.

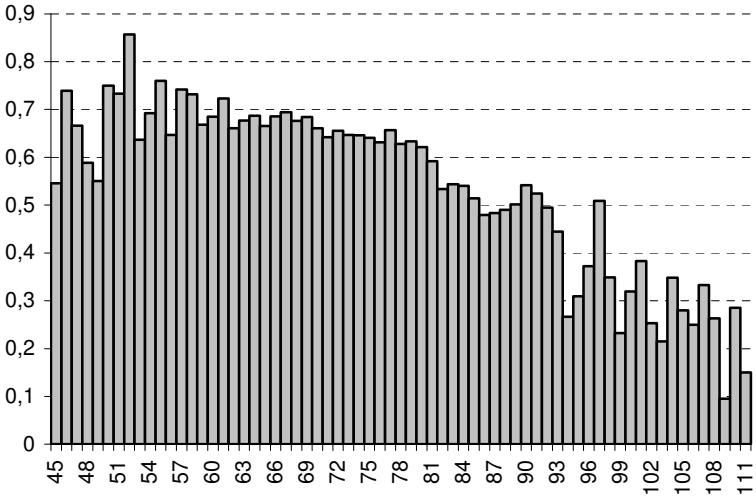
Figure 7. Average years of schooling according to the age at school entry (in months)



Sources: FQP surveys (INSEE; 1993, 2003). Computations from the author.

Finally, the Figure 8 presents the average probability to repeat at least a year during scholarship, according to the age at school entry measured in months. No clear stylized fact may be inferred from this figure, as the relationship seems to be from 'quadratic form', taking the form of an inverted-U-shape with a maximum for an age by around 70 months, 'deformed' on the right. Additionally, we shall note that surveyed individuals who experience non-delayed entry present a higher probability to repeat at year during their scholarship, on average[14]. Note that in France, the proportion of children who have repeated at least a year during their scholarship has fallen but remains high[15] (Caille, 2004), and higher than in every other OECD country (OCDE, 2003).

Figure 8. Probability to repeat at least a year during scholarship according to the age at school entry (in months)



Sources: FQP surveys (INSEE; 1993, 2003). Computations from the author.

[14] Indeed, the probability to repeat at least a year is 68 % for early entry at school, 64% for normal entry, and 47% for delayed entry in the sample.

[15] Caille (2004) notes that 67 % of the children who entered the '*sixième'* grade (first grade in secondary school) in 1989 have repeated a year at least one time during their pre-college scholarship.

The descriptive statistics on our sample give some guidelines or suggestions to conduct our econometric analysis. First, older people at school entry tend to be less skilled in terms of initial formation, on average, but this evidence may be misleading because of heterogeneity bias: the econometric analysis (*i.e.*, instrumental variable approach) shall correct for this potential bias. Second, the month of birth isn't sufficient to study the impact of age on educational outcomes; the year of birth (cohort effect) should be a relevant factor as a continuous rise in average years of schooling is observed on the 1929-1973 period. Finally, to use a measure for age at school entry in months is pertinent for the empirical specification as important variation is observed for this indicator.

4. Empirical strategy

We conduct two main types of regressions: *(i)* 'simple' regressions by ordinary least squares (OLS) or maximum likelihood (ML), *(ii)* regressions with instrumental variables.

4.1. The naive approach: OLS or ML

We estimate some production functions for educational outcomes. In these functions, our explained variable is a human capital indicator. Our interest variables are *different measures of the effective age at primary school entry*. We also insert some traditional variables used in the human capital literature as control variables in our estimated equations (see section 3.2).

The dependant variable, indicator of human capital, may be of three types: *(i)* numerical for the years of schooling, *(ii)* polytomous for the level of diploma, *(iii)* binomial for the dummy to 'have repeated at least a class', for the dummy to have pursued a vocational (rather than 'general) education, for the dummy to have obtained a vocational (rather than 'general) diploma.

In the first case, human capital is proxied by the years of schooling completed by an individual. The following equation is estimated:

$$h_i = \overline{\delta} + \alpha.y_i + \beta.a_i + \sum_{v=1}^{k} \gamma_v x_{i,v} + \varepsilon_i \qquad (1)$$

In equation (1), a_i stands for an indicator of age at school entry, h_i for the individual's human capital, and y_i for his parent's human capital. The $x_{i,v}$ variables represent other control variables related to the individual. Equation (1) is estimated by OLS.

In the second case, the level of diploma is used as proxy for individual human capital. The level of human capital is used as a latent variable within the framework of an ordered polytomous model, where the explained variable is the *level of the highest diploma of the individual.* Hence, we consider an ordered logit-probit model. In the latter model, the explained variable is discrete with the seven ordered modalities: the first refers to the French lowest level of diploma; the last refers to the French highest level of diploma (see Table A.1 in Appendix for details). The dependant variable of our ordered polynomial model is the level of the highest diploma h_i of the individual and is defined as follows (relation (2) :

$$h_i = \begin{cases} 1 \quad \text{for} \quad h_i^* < \alpha_1 \\ 2 \quad \text{for} \quad \alpha_1 \leq h_i^* < \alpha_2 \\ \dots \\ 6 \quad \text{for} \quad \alpha_5 \leq h_i^* < \alpha_6 \\ 7 \quad \text{for} \quad h_i^* \geq \alpha_6 \end{cases} \qquad (2)$$

The α_z s (z = 1, ..., 6) correspond to thresholds for the latent variable h_i^* that corresponds to the level of human capital that is accumulated by individual *i*. Since h_i^* is unobserved, we model h_i^* as such:

$$h_i^* = \beta X_i + \varepsilon_i \quad , \qquad (3)$$

where X_i represents a vector of explanatory variables (the same as those that are used to estimate equation (1)).
The model is estimated by maximum likelihood.

In the third case, the considered variables of educational outcomes are a dummy to 'have repeated at least a class' [1], a dummy to have pursued a vocational (rather than 'general) education [2], or a dummy to have obtained a vocational (rather than 'general) diploma [3]. These different educational outcomes are successively used as proxy for human capital. The level of human capital is used as a latent variable within the framework of a binomial model, where the explained variable is dummy [1], [2] or [3]. Hence, three binomial logit-probit models are considered. The dependant variable in these models is the dummy h_i, 'to have repeated at least a year during scholarship' for an individual and is defined as follows:

$$h_i = \begin{cases} 0 \quad \text{if } h_i^* < \alpha_0 \\ 1 \quad \text{if } h_i^* \geq \alpha_0 \end{cases} \qquad (4)$$

α_0 is the threshold for the latent variable h_i^* that corresponds to the educational outcomes of the individual *i*. Since h_i^* is unobserved, we model h_i^* as such:

$$h_i^* = \beta X_i + \varepsilon_i \ , \qquad (5)$$

where X_i represents a vector of explanatory variables (the same as those that are used to estimate equations (1) and (3)).
Equation (5) is estimated by maximum likelihood (for the defined outcomes [1], [2] and [3]).

4.2. Instrumental variables regressions

To take into account for possible endogeneity of our main variable of interest due to unobserved individual heterogeneity, some regressions are conducted with the use of an instrumental variable approach.
Indeed, it is very likely possible that a large share of the negative association between age at school entry and educational outcomes in our sample (*e.g.* figure 7) comes from unobserved individual heterogeneity corresponding to selection effects (Fredriksson and Öckert, 2005; Fertig and Kluve, 2005). Late entries at school may be associated with lower levels of human capital because less mature or less able children enter later at school. Individual heterogeneity from other sources may also apply: hence, we decide to endogenize our main variable of

interest (the age measured in *months*) and test its impact on educational outcomes by using an instrumental variable (IV) approach.

The instrument

To conduct IV regressions, we have to determine an instrument to render endogenous our variable of interest. Our instrument is the theoretical age at school entry, where an individual should 'normally' enter primary school, measured in months[16] (*e.g.* Fredriksson and Öckert, 2005; Fertig and Kluve, 2005). This instrument depends only of the birth month of the individual. Two assumptions are required for the validity of an instrument (Cameron and Trivedi, 2005): *(i)* the instrument is not a regressor in the model explaining the final outcome *(exogeneity), (ii)* there is some association between the instrument and the variable being instrumented *(correlation).* This second assumption is very likely to be met, as most of the individuals in our sample actually enter at school between 57 and 92 months, *i.e.* enter at the age they should enter according to the school regulation (*cf.* figure 4). It seems harder to conclude about the *first assumption:* the instrument should be exogenous, *i.e.* not correlated with what we may consider as the main source of heterogeneity, student's unobserved ability. However, the 'theoretical' age at school entry in primary school totally depends on the administrative regulation of entry at primary school, which is binding for all children who are 6 years old since the *Jules Ferry Laws* on compulsory primary school (1882). Hence, as the primary school regulation has not changed during the sample period (1929-1973), theoretical age of entry may be viewed as exogenous, as long as family planning does not react to this regulation[17]. In addition, as noted in sub-section 3.3, Figure 1 suggests that non specific law in the French education system seems to have an importance on completed years of schooling. Furthermore, as we include in our regressions some controls for the social origin of an individual (parental education and socio-professional categories, see *supra*), possible harmful effects of the violation of the exogeneity assumption of the instrument are likely to be attenuated.

IV methods

For all types of considered educational outcomes (*i.*e., for numerical, multinomial and binomial dependent variables), we proceed to instrumental variables estimations by two-stage least squares estimations (2SLS). Indeed, 2SLS remains a robust method to use even for dichotomous or ordered dependant variable: *"even if the underlying second-stage relationship is nonlinear, linear variables estimates such as two-stage least squares typically capture an average effect of economic interest analogous to the LATE* [local average treatment effect] *parameter for dummy endogenous regressors"* (Angrist and Krueger, 2001, p. 80). Consider the following equations:

$$a_i = \overline{\gamma} + \psi.l_i + \eta_i \ , \qquad (6)$$

$$h_i = \overline{\delta} + \alpha.y_i + \beta.a_i + \sum_{v=1}^{k} \gamma_v x_{i,v} + \varepsilon_i \qquad (7)$$

[16] This instrument is very similar to that used by Beddar and Dhuey (2006) which instrument the age at school entry by a variable corresponding to the distance measured in months between the individual's birth month and the December month. Indeed, our instrument = 69 + this instrument (the instruments are linked by an affine function). Hence, to conduct regressions with this last instrument would provide exactly the same result that with our instrument. See also Fertig and Kluve (2005) for a discussion about the use of the instrument "age at school entry according to the regulation".

[17] In this case, and as suggested by Fertig and Kluve (2005), this assumption would only be violated at the condition that high ability parents have high-ability children and plan to make them enter at school according to the normal 'date' of entry.

where equation (6) endogenizes the age at school entry a_i with the instrument 'theoretical' age at school entry, l_i.
In a first step, equation (6) is estimated by OLS. It permits to get estimates $\hat{\boldsymbol{a}}_{\boldsymbol{i}}$ of a_i. In a second step, equation (7) is also estimated by OLS: we regress h_i on $y_i(-1)$, $\hat{\boldsymbol{a}}_{\boldsymbol{i}}$ and $x_{i,v}$ regressors.

In addition and for robustness check, for the educational outcomes that are binary variables (dummy to have repeated a year, dummy to have pursued a vocational education, dummy to have obtained a vocational diploma), we also conduct instrumental variable probit estimations by using maximum likelihood (ML) in second stage. In this two-steps method, the first step is the same that in 2SLS: equation (4) is estimated by OLS, which permits to get estimates $\hat{a}_i$ of a_i. The second step corresponds to a regression of h_i on the estimated $\hat{a}_i$ and on the control variables, by using ML.

We successively present the econometric regressions as follow: *(i)* regressions for the following educational outcomes: years of schooling, level of diploma, dummy to have repeated a year, then, *(ii)* regressions for the other outcomes (dummy to have pursued a vocational education, or a dummy to have obtained a vocational diploma). We also present results for regressions on sub-samples of men and women.

5. Results

5.1. The impact of age at school entry on the 'years of schooling', 'level of diploma', and 'probability to repeat a grade during scholarship' outcomes

We firstly test the impact of the month of birth and of the impact of age *in years* on educational outcomes.
The results show a negative impact of the age in years for the year he enters at school on both level of diploma and years of education, and on the probability to repeat at least a year during the scholarship (Table 1, estimations (1), (2) and (3)). Note that the age in years may correspond to a proxy for the timing of school entry (retarded, normal of delayed entry (*cf. infra*).
We find no significant *impact of the birth month* on the level of diploma and on the years of schooling (Table 1, estimations (4) to (6)). But we find a positive impact of the birth month on the probability to repeat a year, *i.e.* younger children from a given year have a higher probability to experience it (there exists a disadvantage for individuals who belong to the last months of a cohort).

Finally, we find negative impacts of the age at school entry when the age is *measured in months* on educational outcomes (Table 1, estimations (7) to (9)). In other terms, the older an individual enters at school the less he accumulates human capital, and the more she tends to repeat at least one year during her scholarship.

Table 1. Impact of age in years, month of birth and age in months at school entry on different educational outcomes

		(1) OLS	(2) ML	(3) ML	(4) OLS	(5) ML	(6) ML	(7) OLS	(8) ML	(9) ML
Explained variable		Number of years of education (log.)	Level of diploma	To have repeated at least a year	Number of years of education (log.)	Level of diploma	To have repeated at least a year	Number of years of education (log.)	Level of diploma	To have repeated at least a year
					Intercept (s)					
Level of parents education (columns (1), (2) and (3) : log)		0.2226***	0.1821***	-0.0108**	0.2282***	0.1841***	-0.0061	0.2223***	0.1819***	-0.0108***
		(0.0052)	(0.0046)	(0.0051)	(0.0053)	(0.0046)	(0.0050)	(0.0052)	(0.0047)	(0.0051)
Variables of interest	**Age in years at school entry**	**-0.0587*** (0.0023)**	**-0.2427*** (0.0173)**	**-0.4428*** (0.0183)**	**-** **-**	**-** **-**	**-** **-**	**-** **-**	**-** **-**	**-** **-**
	Month of birth	**-** **-**	**-** **-**	**-** **-**	**0.0003 (0.0003)**	**-0.0022 (0.0027)**	**0.0143*** (0.0030)**	**-** **-**	**-** **-**	**-** **-**
	Age at school entry (in months)	**-** **-**	**-** **-**	**-** **-**	**-** **-**	**-** **-**	**-** **-**	**-0.0042*** (0.0001)**	**-0.0166*** (0.0012)**	**-0.0343*** (0.0013)**
Year of birth		0.0083***	0.0318***	0.0055***	0.0086***	0.0331***	0.0083***	0.0084***	0.0320***	0.0058***
		(0.0001)	(0.0010)	(0.0055)	(0.0001)	(0.0010)	(0.0010)	(0.0001)	(0.0010)	(0.0010)
Be a woman		-0.0072***	-0.0646***	-0.1148***	-0.0063**	-0.0599***	-0.1068***	-0.0071***	-0.0639***	-0.1149***
		(0.0025)	(0.0190)	(0.0213)	(0.0025)	(0.0190)	(0.0212)	(0.0025)	(0.0190)	(0.0213)
Social origin	Farmer	Ref.	Ref.	Ref.	Ref.	Ref.	Ref.	Ref.	Ref.	Ref.
	Store keeper	0.0888*** (0.0050)	0.4932*** (0.0365)	-0.0365 (0.0406)	0.0884*** (0.0051)	0.4878*** (0.0365)	-0.0384 (0.0403)	0.0890*** (0.0050)	0.4933*** (0.0365)	-0.0361 (0.0406)
	Executive	0.2160***	1.3670***	-0.2157***	0.2166***	1.3630***	-0.2096***	0.2165***	1.3680***	-0.2139***
		(0.0059)	(0.0499)	(0.0525)	(0.0060)	(0.0501)	(0.0519)	(0.0059)	(0.0500)	(0.0525)
	Intermediate worker	0.1248***	0.7295***	-0.0498	0.1239***	0.7234***	-0.0570	0.1242***	0.7270***	-0.0553
		(0.0048)	(0.0374)	(0.0419)	(0.0049)	(0.0374)	(0.0416)	(0.0048)	(0.0374)	(0.04201)
	Employee	0.0742***	0.3645***	-0.0391	0.0714***	0.3520***	-0.0586	0.0741***	0.3627***	-0.0396
		(0.0050)	(0.0371)	(0.0419)	(0.0051)	(0.0369)	(0.0416)	(0.0050)	(0.0370)	(0.0420)
	Blue collar worker	-0.0109***	-0.1820***	0.0454	-0.0144***	-0.1946***	0.0184	-0.0115***	-0.1846***	0.0415
		(0.0036)	(0.0272)	(0.0305)	(0.0037)	(0.0271)	(0.0304)	(0.0036)	(0.0272)	(0.0305)
Number of brothers and sisters		-0.0190***	-0.1430***	0.0184***	-0.0194***	-0.1439***	0.0151***	-0.0191***	-0.1433***	0.0180
		(0.0005)	(0.0045)	(0.0047)	(0.0005)	(0.0045)	(0.0047)	(0.0005)	(0.0045)	(0.0047)
R-Square		0.39	-	-	0.38	-	-	0.39	-	-
Number of individuals		38339	38339	38339	38838	38838	38838	38838	38838	38838

Sources: FQP surveys (INSEE; 1993, 2003). Computations from the author under Stata.
Notes: ***,** and * stand for significance (respectively at a 1%, 5% or 10% level). Standard errors stand within parentheses.

We conduct other estimations, where we focus on the impact of early, late or "normal" entry at school according to the legal timing (Table 2).
Early entry has a positive impact on educational outcomes while symmetrically, delayed entry has a negative impact on educational outcomes, relatively to "normal entry". This corroborates the results we find for the impact of the age at school entry measured in years.

Table 2. Impact of regular *vs* non-regular entry at school on educational outcomes

		(1) OLS	(2) ML	(3) ML
Explained variable		Number of years of education (log.)	Level of diploma	To have repeated at least a year
Intercept (s)				
Level of parental education (column (1) : log)		0.2226*** (0.0052)	0.1811*** (0.0046)	-0.0097 (0.0051)
Variables of interest	**Normal age of entry at school**	**Ref.**	**Ref.**	**Ref.**
	Early entry at school	**0.0773*** (0.0046)**	**0.4784*** (0.0354)**	**0.2324*** (0.0388)**
	Delayed entry at school	**-0.0650*** (0.0039)**	**-0.2449*** (0.0292)**	**-0.6792*** (0.0309)**
Year of birth		0.0084*** (0.0001)	0.0324*** (0.0010)	0.0049*** (0.0010)
Be a woman		-0.0075*** (0.0025)	-0.0668*** (0.0190)	-0.1162*** (0.0213)
Social origin	Farmer	Ref.	Ref.	Ref.
	Store keeper	0.0890*** (0.0050)	0.4981*** (0.0366)	-0.0396 (0.0406)
	Executive	0.2150*** (0.0059)	1.3642*** (0.0500)	-0.2188*** (0.0524)
	Intermediate worker	0.1251*** (0.0048)	0.7354*** (0.0375)	-0.0529 (0.0419)
	Employee	0.0740*** (0.0050)	0.3688*** (0.037)	-0.0474 (0.0419)
	Blue collar worker	-0.0107*** (0.0036)	-0.1752*** (0.0272)	0.0365 (0.0305)
Number of brothers and sisters		-0.0191*** (0.0005)	-0.1432*** (0.0045)	0.0178*** (0.0047)
R-Square		0.39	-	-
Number of individuals		38339	38213	38339

Sources: FQP surveys (INSEE; 1993, 2003). Computations from the author under Stata.
Notes: ***,** and * stand for significance (respectively at a 1%, 5% or 10% level). Standard errors stand within parentheses.

These first results tend to confirm the negative link between age at school entry and human capital indicators found in the descriptive statistics (see sub-section 3.3): the older an individual enters at school, the less she will accumulate human capital, *ceteris paribus*. In addition, we find that the older she is, the more the probability she repeats at least a year during the scholarship,

But in the empirical analysis so far, we have considered so far the age at school entry as *exogenous*. However, we suspect individual heterogeneity which may have important bias in the estimated regressions so far (see section 4.2.). Hence, we now conduct some instrumental variable (IV) estimations. Hausman test confirms endogeneity for the 'age at school entry'

variable[18]. With an IV approach, we don't find anymore impact of the age (in months) at school entry on the level of diploma or years of schooling (Table 3, estimations (1) and (2)). These results suggest that unobserved heterogeneity explained the significance of the (negative) impact of the age in months at school entry in previous estimations. In other terms, the previously obtained effects were so far the result of endogeneity due to ability, *i.e.* the younger are the best students and the older are such because they are the less good ones. The instrumentation permits to erase the effects of "ability" and to focus on the effects of "maturity".

In addition, we also find, that *the age in months has a negative impact on the probability to repeat at least a year during the scholarship* (Table 3, estimations (3), (4) and (5)), as in previous (non-IV) estimations: being older offers better chances not to repeat a year during the scholarship[19].

Table 3. Instrumental variable estimations of the impact of age at school entry on educational outcomes

		(1) 2SLS	(2) 2SLS	(3) 2SLS	(4) IV (ML)
Explained variable		Number of years of education (log.)	Level of diploma	To have repeated at least a year	
Intercept (s)					
Level of parents education (column (1): log)		0.2277*** (0.0053)	0.1625*** (0.0040)	-0.0019* (0.0011)	-0.0052* (0.0031)
Age of entry at school in months (instrumented)		**-0.0004 (0.0004)**	**0.0018 (0.0025)**	**-0.0038*** (0.0018)**	**-0.0102*** (0.0021)**
Year of birth		0.0089*** (0.0001)	0.0228*** (0.0008)	0.0016*** (0.0002)	0.0043*** (0.0006)
Be a woman		-0.0063** (0.0025)	-0.0498*** (0.0152)	-0.0255*** (0.0049)	-0.0683*** (0.0131)
Social origin	Farmer	Ref.	Ref.	Ref.	Ref.
	Store keeper	0.0915*** (0.0051)	0.3805*** (0.0301)	-0.0086 (0.0093)	-0.0238 (0.0250)
	Executive	0.2096*** (0.0061)	1.1657*** (0.0428)	-0.0500*** (0.0123)	-0.1322 (0.0323)
	Intermediate worker	0.1259*** (0.0049)	0.5977*** (0.0315)	-0.0127 (0.0096)	-0.0344*** (0.0257)
	Employee	0.0748*** (0.0051)	0.2555*** (0.0302)	-0.0115 (0.0097)	-0.0312 (0.0258)
	Blue collar worker	-0.0119*** (0.0037)	-0.1880*** (0.0202)	0.0069 (0.0070)	0.0184 (0.0188)
Number of brothers and sisters		-0.0196*** (0.0005)	-0.1012*** (0.0030)	0.0037*** (0.0010)	0.0101*** (0.0029)
R-Square		0.38	0.28	0.02	-
Number of individuals		38338	38212	38338	38338
Hausman statistic		101.40	37.43	30.55	-
P-value		0.000	0.000	0.000	-

Sources: FQP surveys (INSEE; 1993, 2003). Computations from the author under Stata.
Notes: ***, ** and * stand for significance (respectively at a 1%, 5% or 10% level). Standard errors stand within parentheses.
Instrument: theoretical age in months at school entry according to the individual's date of birth.
IV (ML): Maximum likelihood estimator is used in second stage.

[18] Indeed, the Hausman statistic and the associated P-value show that we cannot accept the 'null hypothesis' H_0 of exogeneity of this variable (*cf.* table 3).

[19] Nevertheless, we shall note that the coefficient associated to the IV estimation is smaller to that of the maximum likelihood estimation.

As a conclusion, estimations so far indicate that age at primary school entry has no impact on the years of schooling or the level of diploma (this last result is similar to that of Fertig and Kluve, 2005). But it has a significant impact on the probability to repeat a year.

5.2. The impact of age at school entry on 'type of education / diploma' outcomes

We now test the possible impacts of age at school entry on the educational guidance. Indeed, the effect of age could take the form of decisions of orientation during scholarship. So, we choose to measure the impact of age at school entry on two other outcomes: *the probability to have attended a vocational education* and *the probability to have a vocational diploma (or low diploma)* [20] *rather that a general diploma* (see *supra*).
Regressions for these educational outcomes are now conducted, by using non-IV, then IV approaches. As in our previous regressions, we use in the IV regression the theoretical age at school entry of an individual as an instrument for the 'age at school entry'. The estimates are reported in Table 4 (estimations (1) to (8)).
We find a significant impact of age at school entry on both of the outcomes whatever the approach (non-IV or IV). Once again, Hausman test confirms endogeneity for the 'age at school entry' variable[21]. Moreover, we find that estimations with *or* without the use of instrumental variable for our main variable of interest give opposite effects. More precisely, the results for the IV estimates indicate a *significant and positive impact of the age in months on the probability to pursue general training* or *to get a general (or 'at least equal to baccalauréat') diploma*. Once again, we find evidence that the IV method remove endogeneity bias due to individual differences in ability: the fact that age influences positively the two outcomes "probability to attend a general education" and "probability to have a general diploma" indicates a 'maturity' effect.

These results suggest that the age at school entry has an effect on the type of studies made during the scholarship, or, in other terms, operates through the educational guidance choices made during scholarship. This corroborates some of the results of Grenet (2010) on the French case, but on a different set of data and, partly, on other outcomes (see sub-section 2.2.).

[20] *For this last variable*, we add to the 'vocational diploma' category the diplomas that are equal or inferior to Brevet. In addition, students who have a vocational diploma but who have also obtained a *general* diploma from 'baccalauréat' level (or higher) belong to the 'general diploma' category. It permits to take into account low categories of diploma, and also, for the sake of simplicity, to keep 'two' categories, which allows better comparison between the results for this variable ('type of diploma') and those with the variable 'type of education pursued'.
[21] Indeed, the Hausman statistic and the associated P-value show that we cannot accept the 'null hypothesis' Ho of exogeneity of this variable (see table 4).

Table 4. Impact of age in months at school entry on educational trajectories during scholarship

		(1) ML	(2) ML	(3) 2SLS	(4) IV (ML)	(6) 2SLS	(7) IV (ML)
Explained variable		*To have attended a general education [1]*	*To have obtained a 'general' diploma [2]*	*To have attended a general education [1]*		*To have obtained a 'general' diploma [2]*	
				Intercept			
Level of parents education		0.0782***	0.2068***	0.0185***	0.0497***	0.0386***	0.1219***
		(0.0052)	(0.2576)	(0.0008)	(0.0032)	(0.00107)	(0.0033)
Age of entry at school in months		**-0.0036*** (0.0013)**	**-0.0259*** (0.0019)**	**-** -	**-** -	**-** -	**-** -
Age of entry at school in months (instrumented)		**-** -	**-** -	**0.0042*** (0.0008)**	**0.0113*** (0.0026)**	**0.0016*** (0.0006)**	**0.0061** (0.0025)**
Year of birth		-0.0558***	0.0152***	-0.0125 ***	-0.0331***	0.0020***	0.0104***
		(0.0011)	(0.0014)	(0.0002)	(0.0007)	(0.0002)	(0.0008)
Be a woman		0.2387***	0.2576***	0.0555***	0.1491***	0.0366***	0.1454***
		(0.0214)	(0.0276)	(0.0048)	(0.0131)	(0.0038)	(0.0155)
Social origin	Farmer	Ref.	Ref.	Ref.	Ref.	Ref.	Ref.
	Store keeper	-0.0245***	0.5009***	-0.0008	-0.0174	0.0785***	0.2857***
		(0.0402)	(0.0503)	(0.0125)	(0.0248)	(0.0078)	(0.0284)
	Executive	0.5823***	1.3854***	0.1300***	0.3423***	0.2952***	0.8296***
		(0.0563)	(0.0613)	(0.0123)	(0.0339)	(0.0110)	(0.0355)
	Intermediate worker	0.0436***	0.7296***	0.0097 **	0.0239	0.1395***	0.4280***
		(0.0423)	(0.0501)	(0.0098)	(0.0259)	(0.0084)	(0.0286)
	Employee	-0.1578***	0.3060***	-0.0398 ***	-0.1060***	0.0374***	0.1606***
		(0.0420)	(0.0536)	(0.0097)	(0.0258)	(0.0078)	(0.0300)
	Blue collar worker	-0.2375***	-0.4189***	-0.0584 ***	-0.1565***	-0.0547***	-0.2402***
		(0.0296)	(0.0450)	(0.0068)	(0.0184)	(0.0048)	(0.0241)
Number of brothers and sisters		0.0402***	-0.1652***	0.0083***	0.0234***	-0.0166***	-0.0905***
		(0.0046)	(0.0076)	(0.0010)	(0.0028)	(0.0007)	(0.0041)
R-Square		-	-	0.08	-	0.21	-
Number of individuals		38338	38338	38338	38338	38338	38338
Hausman statistic		-	-	46.46	-	69.38	-
P-value		-	-	0.000	-	0.000	-

Sources: FQP surveys (INSEE; 1993, 2003). Computations from the author under Stata.

Notes: ***, ** and * stand for significance (respectively at a 1%, 5% or 10% level). Standard errors stand within parentheses.

Instrument: theoretical age in months at school entry according to the individual's date of birth.

IV (ML): Maximum likelihood estimator is used in second stage.

[1] To have attended (only) a general training (0=vocational training, 1= no vocational training).

[2] To have obtain a 'general' diploma (0= vocational diploma or "Brevet"/equivalent or lower diploma, 1=general education (or *general* "baccalauréat" or higher diploma).

5.3. Differentiated estimations on sub-samples of women and men

For robustness check, we run instrumental variable estimations of the impact of age at school entry on educational outcomes for women and men[22].
First, table 5 (p.21) presents the estimations for the following educational outcomes: numbers of years of schooling, level of diploma, probability to repeat at least a year. We find for both women and men that age at school entry, once instrumented, has no impact on the number of years of schooling. We also find that age at school entry has a (positive) impact on the level of diploma, *only for men*. Finally, age at school entry negatively impacts the probability to repeat at least a year during scholarship, for both women and men.

Second, table 6 (p.22) presents the estimations for the following educational outcomes: probability to get a general (*vs* vocational) diploma and probability to pursue general (*vs* vocational) education. Our results show that age at school entry (once instrumented) has a positive impact on the probability to attend a general education. In addition, this effect seems larger for women. We also find that age at school entry (once instrumented) has a positive impact on the probability to obtain a general diploma *only for women*.

Hence, the results for the instrumental variables estimations on the impact of age at school entry for sub-samples of women and men differ from that of the whole sample estimations in two dimensions: *(i)* age at school entry has an impact on the level of diploma *for men, (ii)* age at school entry has a positive impact on the probability to obtain a general diploma *only for women*.
On Norway data, Black *et al.* (2008) observe sub-samples of women and men: they find no effect of age at school entry on completed years of schooling for men, and little evidence for women, while we find no effect on years of schooling for women and men. Hence, these two sets of results seem compatible.

[22] Indeed, Hausman tests confirm endogeneity for the 'age at school entry' variable (see tables 5 and 6).

Table 5. Instrumental variable estimations of the impact of age at school entry on first educational outcomes (sub-samples of women and men)

		(1) 2SLS		(2) 2SLS		(3) 2SLS		(4) IV (ML)	
Explained variable		Number of years of education (log.)		Level of diploma		To have repeated at least a year			
		men	women	men	women	men	women	men	women
					Intercept (s)				
Level of parents education (column (1): log)		-0.0003*** (0.0006)	0.0272*** (0.0008)	0.1570*** (0.0061)	0.1683*** (0.0054)	0.0003 (0.0016)	-0.0041** (0.0016)	0.0009*** (0.0045)	-0.0107** (0.0043)
Age of entry at school in months (instrumented)		**-0.0003 (0.0006)**	**-0.0004 (0.0005)**	***0.0061**** **(0.0036)**	**-0.0022 (0.0034)**	**-0.0049** (0.0011)**	**-0.0027** (0.0011)**	**-0.0132*** (0.0031)**	**-0.0074** (0.0030)**
Year of birth		0.0078*** (0.0002)	0.0100*** (0.0001)	0.0146*** (0.0012)	0.0302*** (0.0010)	0.0014*** (0.0003)	0.0018*** (0.0003)	0.0038*** (0.0010)	0.0048*** (0.0009)
Social origin	Farmer	Ref.	Ref.	Ref.	Ref.	Ref.	Ref.	Ref.	Ref.
	Store keeper	0.10584*** (0.0075)	0.0773*** (0.0069)	0.4365*** (0.0450)	0.3266*** (0.0403)	-0.0110*** (0.0135)	-0.0071 (0.0130)	-0.0300*** (0.0363)	-0.0200 (0.0344)
	Executive	0.2387*** (0.0090)	0.1809*** (0.0082)	10.2912*** (0.0643)	10.0415*** (0.0566)	-0.0350*** (0.0173)	-0.0654*** (0.0174)	-0.0947*** (0.0465)	-0.1701*** (0.0452)
	Intermediate worker	0.1484*** (0.0071)	0.1046*** (0.0067)	0.7167*** (0.0472)	0.4881*** (0.0418)	-0.0048*** (0.0138)	-0.0206 (0.0135)	-0.0129*** (0.0373)	-0.0553 (0.0356)
	Employee	0.0887*** (0.0074)	0.0616*** (0.0069)	0.2980*** (0.0449)	0.2175*** (0.0406)	-0.0182*** (0.0139)	-0.0062 (0.0135)	-0.0494*** (0.0374)	-0.0173 (0.0358)
	Blue collar worker	0.0082*** (0.0053)	-0.0311*** (0.0051)	-0.1139*** (0.0296)	-0.2571*** (0.0276)	0.0061 (0.0100)	0.0070 (0.0098)	0.0168 (0.0272)	0.0180 (0.0261)
Number of brothers and sisters		-0.01820*** (0.0008)	-0.0209*** (0.0007)	-0.0962*** (0.0046)	-0.1052*** (0.0040)	0.0037*** (0.0015)	0.0036 (0.0014)	0.0102** (0.0042)	0.0097** (0.0039)
R-Square		0.3463	0.4075	0.2415	0.3153	0.0176	0.0140	-	-
Number of individuals		18312	20026	18246	19966	18312	20026	18312	20026
Hausman statistic		49.10	52.46	27.65	11.44	9.02	22.58	-	-
P-value		0.000	0.000	0.000	0.0007	0.0027	0.000	-	-

Sources: FQP surveys (INSEE; 1993, 2003). Computations from the author under Stata.
Notes: ***, ** and * stand for significance (respectively at a 1%, 5% or 10% level). Standard errors stand within parentheses.
Instrument: theoretical age in months at school entry according to the individual's date of birth.
IV (ML): Maximum likelihood estimator is used in second stage.

Table 6. Instrumental variable estimations of the impact of age in months at school entry on educational trajectories during scholarship (sub-samples of women and men)

		(1) 2SLS		(2) IV (ML)		(3) 2SLS		(4) IV (ML)	
Explained variable		*To have attended a general education [1]*				*To have obtained a 'general' diploma [2]*			
		men	women	men	women	men	women	men	women
		Intercept (s)							
Level of parents education (column (1): log)		0.0191*** (0.0017)	0.0183*** (0.0016)	0.0523*** (0.0047)	0.0480*** (0.0044)	0.0363*** (0.0015)	0.0408*** (0.0015)	0.1179*** (0.0049)	0.1262*** (0.0046)
Age of entry at school in months (instrumented)		**0.0022** (0.0011)**	**0.0061*** (0.0011)**	**0.0061** (0.0031)**	**0.0160*** (0.0029)**	***0.0013*** (0.0008)**	**0.0019** (0.0009)**	***0.0055*** (0.0037)**	**0.0067* (0.0035)**
Year of birth		-0.0149*** (0.0003)	-0.0104*** (0.0003)	-0.0405*** (0.0010)	-0.0268*** (0.0009)	0.0007*** (0.0002)	0.0031*** (0.0002)	0.0055*** (0.0011)	0.0145*** (0.0010)
Social origin	Farmer	Ref.	Ref.	Ref.	Ref.	Ref.	Ref.	Ref.	Ref.
	Store keeper	-0.0156 (0.0132)	0.0015 (0.0132)	-0.0416 (0.0363)	0.0018 (0.0341)	0.0843*** (0.0110)	0.0716*** (0.0111)	0.34261*** (0.0424)	0.2361*** (0.0386)
	Executive	0.1215*** (0.0176)	0.1358*** (0.0176)	0.3224*** (0.0486)	0.3556*** (0.0474)	0.3186*** (0.0158)	0.2721*** (0.0155)	0.9221*** (0.0511)	0.7451*** (0.0496)
	Intermediate worker	0.0013 (0.0137)	0.0173 (0.0139)	0.0060 (0.0375)	0.0404 (0.0358)	0.1662*** (0.0120)	0.1144*** (0.0118)	0.5464*** (0.0421)	0.3237*** (0.0390)
	Employee	-0.0339** (0.0136)	-0.0459*** (0.0137)	-0.0907** (0.0375)	-0.1202*** (0.0355)	0.0570*** (0.0110)	0.0190* (0.0111)	0.2551*** (0.0443)	0.0789* (0.0410)
	Blue collar worker	-0.0704*** (0.0095)	-0.0483*** (0.0098)	-0.1941*** (0.0265)	-0.1266*** (0.0255)	-0.0359*** (0.0065)	-0.0727*** (0.0071)	-0.1665*** (0.0362)	-0.3050*** (0.0325)
Number of brothers and sisters		0.0072*** (0.0015)	0.0100 (0.0014)	0.0201*** (0.0042)	0.0264*** (0.0038)	-0.0156*** (0.0010)	-0.0175*** (0.0010)	-0.0905*** (0.0062)	-0.0909*** (0.0055)
R-Square		0.1076	0.0492	-	-	0.2067	0.2166	-	-
Number of individuals		18312	20026	18312	20026	18312	20026	18312	20026
Hausman statistic		7.35	46.56	-	-	30.25	39.08	-	-
P-value		0.0067	0.000	-	-	0.000	0.000	-	-

Sources: FQP surveys (INSEE; 1993, 2003). Computations from the author under Stata.

Notes: ***, ** and * stand for significance (respectively at a 1%, 5% or 10% level). Standard errors stand within parentheses.

Instrument: theoretical age in months at school entry according to the individual's date of birth.

IV (ML): Maximum likelihood estimator is used in second stage.

[1] To have attended (only) a general training (0=vocational training, 1= no vocational training).

[2] To have obtain a 'general' diploma (0= vocational diploma or "Brevet"/equivalent or lower diploma, 1=general education (or *general* "baccalauréat" or higher diploma).

5.4. Discussion

The main results of the IV estimations for all educational outcomes are summed up in table 7. With an IV approach, we found on the *whole sample* that age at school entry: *(i)* has no impact on the number of completed years of schooling or on the level of diploma, *(ii)* has a negative impact on the probability to repeat at least a year during scholarship, *(iii)* has a negative impact on the probability to pursue a 'vocational' education' or to get a vocational diploma. Once ability is taken into account, the remaining measured effects are those of 'maturity'. Hence, the results show that those maturity effects have no incidence on the educational attainment of an individual, but act on her educational trajectories or on the guidance choices that she makes during her scholarship (probability to repeat some grades, type of pursued education). In addition, separated estimations on sub-samples of women and men show two main features: *(i)* age at school entry has an impact on the level of diploma *for men, (ii)* age at school entry has a positive impact on the probability to obtain a general diploma *only for women*.

Table 7. The impact of age on various educational outcomes: main results of the IV estimations

Educational outcome	*Whole sample*		*Differentiated results on sub-samples of women and men?*
	Younger students at school entry	*Older students at school entry*	
Years of schooling	*no effect*		*no*
Level of diploma	*no effect*		*Yes; an effect seems to apply for men*
Probability to repeat at least a year	+	-	*no*
Probability to pursue vocational education	+	-	*no*
Probability to get a vocational diploma	+	-	*Yes; the effect seems to apply only for women*

In a comparison perspective, the Table 8 sums up the main results of the recent studies using instrumental variables approach on the effects of age at school entry (including those of the present paper, Fertig and Kluve [2005] and Fredrikkson and Öckert [2005]) or on the effects of age at different moments during scholarship (Grenet, 2010), on several educational outcomes. Our results are compatible with those of Grenet (2010), and partially with those of Fertig and Kluve (2005), which also finds no impact on the probability to repeat a class. Finally, we find no effect on educational attainment, contrary to Fredriksson and Öckert (2005).

In addition, as we noted above, our results for estimations on sub-samples of women and men are compatible with that of Black *et al.* (2008): they find that school starting age has at best very small impacts on completed years of education for men or women, while we find no effect on years of schooling for women or men.

Table 8. Comparison of the main results of the literature (IV approach): the effects of age (in months) on educational outcomes

Study	Country	Impact on …		
		Educational attainment	Probability to repeat a grade during scholarship	Probability to pursue vocational education
This study	France	Ø	-	-
Grenet (2010)	France		-	-
Fertig and Kluve (2005)	Germany	Ø	Ø	
Fredriksson and Öckert (2005)	Sweden	+		

Finally, the literature distinguishes relative age effects from absolute effects by the persistence of disadvantages for the younger students inside a given class or a given cohort. Our study may bring some indications for the existence for such effects, for the French case. How could one interpret our own results in terms of absolute/relative age effects? On the one hand, the absence of effects of the age at school entry on *educational attainment* (years of schooling, level of diploma) suggests no relative age effects on those outcomes, and so possible absolute age effects. On the other hand, we find some effects on *educational trajectories* (probability to repeat a grade, probability to pursue vocational). It is unclear that these last results indicate relative age effects, as the phenomenon of repeating a class and the choices of educational guidance are totally or hardly reversible: it could confirm the existence of absolute age effects, as those effects may correspond to an 'response' to a given situation at a specific moment of the scholarship (low academic results at this moment, *etc*.). Hence, our results as a whole would give credits to the existence of absolute age effects rather than relative age effects[23].

6. Conclusion

The goal of our paper was to test the impact of the age at primary school entry on educational outcomes on the French case. To conduct our econometric analysis, we use cross section micro data from the 'Training and Occupation Skills' (*Formation et Qualification Professionnelle*, INSEE, 1993 and 2003) surveys, the only French source of data providing both educational *and* socio-professional information on surveyed individuals and their parents.

Using an instrumental variable approach, we find no impact of the age at primary school entry measured in months on certain educational outcomes: years of schooling, level of diploma. This suggests, for these outcomes, that significant impacts that were found with OLS or maximum likelihood estimations were mainly driven by differences in ability. But we find an impact on the probability to repeat at least one year. We also find that age at school entry has an impact on the type of education pursued (vocational *vs* general education) and on the type of diploma received during scholarship. Hence, we find evidence that age at school entry seems to mainly act through educational trajectories or through guidance choices. We also

[23] However, we shall note that relative effects are more easily identified through an analysis on academic results.

conducted separated regressions on sub-samples of women and men, which qualify these results, and suggest the existence of 'maturity' effects of age at school entry.
Through the intermediation of the type of accumulated human capital, there could be an impact on the professional situation, transitions/trajectories on the labour market and earnings for the concerned individuals. Therefore, it would be interesting to test those potential effects.
Finally, as the age at school entry has an impact on certain outcomes, compulsory school laws have a likely effect, or could have a substantial effect according to their content. Moreover, some possible public action/support to prevent some potential harmful effects of being younger (those who are born in the last months of a given year, or who have entered lately at primary school) could also take the form of specific 'attention' or courses provided to some of the younger students inside a given class. These actions could occur systemically in the first years of the primary school for some targeted populations.

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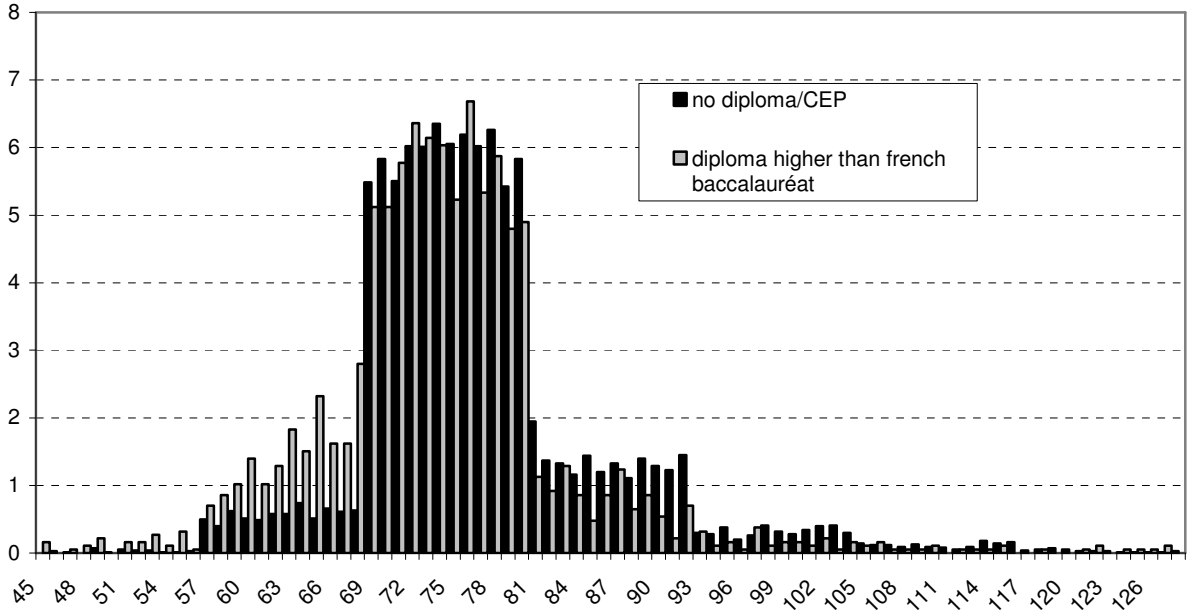
Appendix

Table A.1. French levels of education

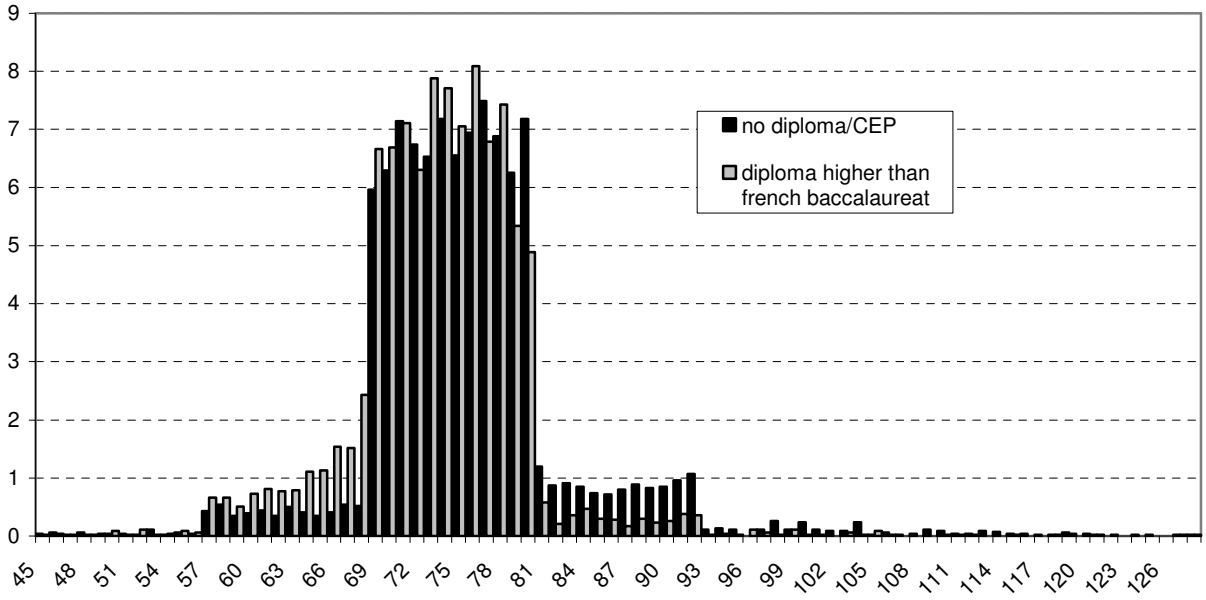
Level of education (INSEE)	Corresponding diploma	Equivalent number of years of education	Theoretical cumulative number of years of education
VI	*No diploma*	-	5
	CEP (Certificat d'études primaires)	*(5 years in primary school)*	
V bis	*BEPC, brevet et diplôme du même niveau*	*(3 years before the French baccalauréat (so-called "3ème générale")*	9
V	*CAP, BEP*	*(2 years after the "3ème générale")*	11
IV	*BAC, bac professionnel*	*French diploma "brevet professionnel, brevet de maîtrise, de compagnon, brevet d'enseignement industriel". Equivalent to a 'A-level' grade.*	12
III	*Bac + 2 (DUT, BTS, DEUG…)*	*2 years in 'preparatory' schooling (so-called "école préparatoire en équivalence, propédeutique, DUEL")*	14
II	*Bac + 3 / Bac+4 (Licence/Maîtrise)*	*French diplomas to teach in the secondary school (so-called "CAPES, CAPET")*	16
I	*Bac +5, Magistère, diplôme d'ingénieur, d'école de commerce*	*Other French diplomas to teach: French "agrégation", Ph.-D, Medicine Ph.-D*	17

Figure A.2. Distribution of individuals from extreme levels of education attainment according to their age at school entry (in months), *1929-1951 cohorts*



Sources: FQP surveys (INSEE; 1993, 2003). Computations from the author.

Figure A.3. Distribution of individuals from extreme levels of education attainment according to their age at school entry (in months), *1952-1973 cohorts*



Sources: FQP surveys (INSEE; 1993, 2003). Computations from the author.