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ABSTRACT

Birth Order and Sibship Sex Composition as Instruments in the Study of Education and Earnings*

This paper presents an empirical study of birth-order and sibship sex-composition effects on educational achievement, and uses these variables as instruments to estimate returns to education, with the help of a rich set of individual data. Our sample includes more than 12,000 men and 10,000 women, who all left school in 1992, in France. The wages and educational achievements of individuals, as well as many aspects of family background, including birth order, number of sisters and brothers, are observed. An Ordered Probit model explains educational achievements. Sibship sex composition is shown to have an impact. Brothers and sisters have significant, non-negligible and different effects on educational achievement. A higher number of siblings has a negative effect in general, holding birth order constant, except when parents belong to the highest occupational groups; in other words, it is good to have many brothers and sisters if one's parents are well-to-do (the 'rich daddy effect'). On average, girls suffer significantly more from an additional brother than boys. Birth-order effects are both significant and substantial, even when many controls are included in the regressions. A high rank among siblings is detrimental for educational attainment (all other things equal), except in the case of fatherless children. Finally, a two stage method is used to estimate log-wage equations, taking care of education endogeneity, using birth order and the number of siblings as instruments. The OLS estimates of returns to education are biased downwards, when females are considered, but do not seem to be biased in the male sub-sample, given that many controls have been added in the wage equation.

JEL Classification: I2, J12, J16 and J24
Keywords: birth order, earnings, education, family, siblings and sibship sex composition

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1. Introduction

In the following, we present an econometric study of birth-order, family size, and sibship sex composition effects on educational achievement and wages, using a rich data set including more than 12,000 men and 10,000 women who all left school in 1992, in France. Education is measured by means of a finite number of "levels", representing crucial steps on the educational achievement ladder. We control for parental occupation, parental education, and other variables such as the parent's immigrant status, and estimate the effect of the number of sisters, number of brothers, and birth order on the probabilities of educational achievement, by means of an Ordered Probit model. Even if many controls are introduced in the regressions, the effect of family size is significant and negative, except for the highest socio-economic groups, for which it is positive (but the effect of an additional sibling is moderate). We find that the number of sisters and number of brothers do not have significantly different effects on men taken separately. Thus, in essence, total family size is the only thing that matters for men. Yet, the effect of an additional brother is significantly more detrimental to women than to men. And finally, an additional brother is more detrimental to women than an additional sister.

We also find that birth-order effects are significant, negative, and substantial; on average, they have approximately the same influence on men and women. To check for robustness of these results, we used the individuals' age at junior high-school entry as a dependent variable, and found significant but paradoxically positive effects of birth order on age at high school entry (i.e., later born children on average enter junior high school sooner than the elder brothers and sisters), while family size remains a negative factor.

We have then tried to break up the average effect and estimated birth-order and family size coefficients within parental occupational status categories, by means of additional interaction terms. We then find that in the highest occupational categories — that are presumably also the wealthiest —, an additional sibling has a positive effect, all other things equal, while at the same time, a higher rank is still significantly detrimental in the educational achievement regression. To sum up, if your daddy's rich, on average, it's good to have more brothers and sisters, holding your birth rank constant, that is, if you have more younger siblings. These results are very significant in the case of sons (but less clearly so for daughters).

Another new result is that if the children are fatherless orphans, birth-order effects are completely reversed: later born children have significantly better chances of educational success. In this special case, having more siblings is still a bad signal, but being born with a higher rank — i.e., having more older siblings— is a good thing, counteracting the detrimental effects of numerous siblings.

We finally turn to the study of wages and use birth-order and number-of-siblings indicators as instruments in a Two-Stage estimation of returns to education. We find that OLS estimates of returns to education are essentially unbiased in the case of males, given that we introduce many controls in the log-wage regressions, while in contrast, there is a significant, and negative "ability bias" in the female sub-sample. We propose an interpretation of these results after a discussion of the related literature.

Literature and interpretations

Studies of the effects of birth order on education have been limited by the absence of appropriate data sets, and the theory of these effects is still highly conjectural. Our data is thus an opportunity to learn more about these phenomena. Birth order, family size, and sibship sex composition have attracted the attention of psychologists, sociologists and economists. The dominant economic theory, inspired by the pioneering work of Becker (e.g. Becker (1960), Becker and Lewis (1973), Becker and Tomes (1976), Hanushek (1992)) suggests that families try to allocate parental resources optimally and face a trade-off between the quantity and the "quality" of their children. These theories easily explain a negative relation between educational achievement and total family size; they can be generalized to explain the presence of birth order effects (see Behrman and Taubman (1986)). Children compete for the attention and resources of their parents. It might well be that the oldest child benefits from more parental attention at a critical early age, helping him or her to acquire more schooling. The spacing of children might then also be an important factor. This "resource dilution" model is also discussed in the sociological literature (see e.g., Powell and Steelman (1993)).

A competing theory, called the "confluence model" has been developed by Zajonc (1976), and other psychologists (see also Zajonc and Mulally (1997)). According to this theory, a child's intellectual development depends on the average intelligence of all family members; as a consequence, in the presence of many young children, the family's average intelligence is lower, and tends to reduce or limit the child's intellectual development. Birth-order effects stem from the fact that older children learn more from teaching younger children than the latter gain from being helped by their older siblings. This would explain the performance drop of the last born (who cannot teach something to a younger sibling).

The negative effect of family size on children is a well-known and well-documented fact (see e.g., Blake (1989)). The effects of sibship sex composition, and differential effects of family size on sons and daughters —let alone their mere existence—, are less well understood. Butcher and Case (1994) find that women raised with more brothers do significantly better than those raised with sisters; these results have been questioned by Kaestner (1997), and Hauser and Kuo (1998), who find no systematic effect of gender composition on educational attainment. Conley (2000) explores a "revised sex minority hypothesis", according to which it is more advantageous to have additional siblings of the same sex. Using PSID data, he finds that an additional sister decreases a woman's years of schooling less than an additional brother, which directly contradicts Butcher and Case (1994). Our data shows statistically significant sex composition effects in the case of girls. To be more precise, our results corroborate Conley's sex minority hypothesis: additional brothers reduce women's educational achievement significantly more than they reduce men's achievements, on average. In contrast, additional sisters seem to have the same effect on men and women. The fact that the estimated marginal impact of family size is moderate, when various family background characteristics, including birth-order dummies, are used as controls, confirms the important recent results of Black, Devereux and Salvanes (2005), but our family size effects are nevertheless significant and non-negligible.

Birth order effects have been estimated by a limited number of researchers (see e.g., Behrman and Taubman (1986), Hanushek (1992)). There is a recent renewal of interest

for this difficult question (see Conley (2004)), and birth order effects have recently been estimated by Iacovou (2001) on British data, and by Black, Devereux and Salvanes (2005), with the help of an impressive set of Norwegian data. Both find a strong and robust birth-order impact on educational outcomes. Our findings on this point confirm and extend these results, with a number of new insights.

Our study of age at junior high school entry as a function of birth order and other variables shows a paradoxical positive effect of birth rank, since later born boys tend to enter high school sooner than the first born. This puzzling effect seems to lend support to household human-capital production approaches, insofar as it can be explained by the idea of "learning by doing": more mature parents would know better how to prepare their younger children for high school. But the finding also lends support to Zajonc's "confluence model", because older brothers and sisters might have helped the younger ones in basic learning, or created a stimulating atmosphere. In any case, there is a drop in the overall achievement of the high-rank (i.e. last born) children. Younger boys enter junior high school sooner, but fare less well than the elder at the end. The timing of birth-order effects seems to be complex, and deserves further research.

Our results do not contradict the Beckerian view, at least not a sufficiently sophisticated version of it. Our finding that the impact of family size on educational outcomes varies with the parents' occupational status (the "rich daddy effect") is compatible with the presence of a quality-quantity trade-off. But, as emphasized by Black *et al.* (2005), the inequalities generated among siblings by birth order raise important unresolved questions. All the theories discussed above might be simultaneously true, but, due to data limitations, it is hard to break up the observed net result into contributing forces. Our results on the "missing father" case show that there is a complex sibship-composition and birth-order arithmetic that is worth studying.

Finally, many recent studies have used instrumental variables to estimate returns to education in earnings equations (see the recent surveys of Card (1999), Harmon *et al.* (2003) and Krueger (2003)); to the best of our knowledge, the approach proposed below, involving the use of birth-order and family size variables as the only instruments, is new.

In the following, Section 2 describes the data. Section 3 presents the results relative to the impact of family size and birth order on educational achievement. Section 4 presents the Two-Stage estimations of returns to education, where birth order and family size are the only instruments.

2. The Data

To realize the estimations presented below, we used "Génération 92", a large scale survey conducted in France. The survey and associated data base have been produced by the CEREQ (*Centre d'Etudes et de Recherches sur les Qualifications*), a public research agency, working under the aegis of the Ministry of Education[1]. Génération 92 is a sample of 24,665 young workers of both sexes, whose education levels range from the lowest (i.e., high school dropouts) to graduate studies, and who graduated in a large array of sectors

[1] Several articles and descriptive statistics, concerning various aspects of the survey, are available at www.cereq.fr.

and disciplines. Observed individuals have left the educational system between January 1rst and December 31rst, 1992[2]. Sampled individuals did not return to school for more than one year after 1992, and they had not left school before 1992[3]. The labor market experience of these individuals is observed and recorded during 5 years, until 1997. The survey provides detailed observations of individual employment and unemployment spells, of wages and occupation types, as well as geographical locations of jobs. The personal labor market history of survey respondents has been literally reconstructed by means of interviews, month after month, during the period 1993-1997.

The individual's highest education level (reached in 1992) is also observed. For the purpose of estimation, we have merged education levels into 5 categories, 1) the high school dropouts; 2) the vocational high school degree holders[4]; 3) those who reached the French equivalent[5] of grade 12; 4) those who completed two years of college[6]; 5) those who completed 4 years of college and more. Table 2.1 shows the empirical distribution of educational levels in the sample. The survey also provides the age at which individuals entered junior high school[7]. Table 2.2. shows the overall averages of school-leaving ages, given educational achievement, and the mean "age at grade 6 entry".

The survey provides information on family background: the father's and the mother's occupation, the father's and the mother's educational attainments. We know if the parents are unemployed, inactive, retired or deceased, and if parents are immigrants. Are also observed: the number of sisters, the number of brothers, the individual's rank among siblings (i.e. birth order), and gender. Table 2.3. gives the distributions of the number of brothers, the number of sisters, and of birth order in the sample.

The mother's and father's occupations are observed separately, and fall in one of the following 7 categories: 1) Farmers; 2) Craftsmen, Tradesmen and Owners-Managers; 3) Executives, Doctors, Lawyers, Engineers and Teachers; 4) Middle Managers, Technicians; 5) White Collars; 6) Blue Collars; 7) Missing observations. Mother's and father's education are also observed separately and fall in 6 categories: 1) No qualification; 2) Elementary school certificate[8]; 3) Vocational high school degree; 4) High school degree (*baccalauréat*); 5) Went to college; 6) Missing. We introduce all these controls in the education and in the

[2] To fix ideas, the number of inhabitants of France who left school for the first time in 1992 is estimated to be of the order of 640,000.

[3] Except for compulsory military service, illness, or pregnancy.

[4] i.e., the so-called *Certificats d'Aptitude* and *Brevet d'Etudes Professionnelles.*

[5] The French *classe terminale* is the equivalent of grade 12 in the US.

[6] To be admitted in the *universités* (i.e., colleges), these students necessarily hold a national high school diploma, called *baccalauréat.* In addition, those who passed the exam at the end of the first two college years (i.e., "grade 14") receive a diploma called DEUG (i.e., *Diplôme d'Etudes Universitaires Générales*, which is more or less the equivalent of an Associate's Degree in the US), or DUT (i.e., *Diplôme Universitaire de Technologie*, which is a kind of vocational Associate's degree).

[7] i.e., the *sixième* is the equivalent of grade 6 in the US. In France, junior high school starts with the equivalent of grade 6.

[8] There exists in France an elementary school certificate (*Certificat d'Etudes Primaires*) which is becoming rare nowadays, but used to be very important in the past.

earnings equations.

There are strong family-background (or "social selection") effects in the data, as shown in Table 2.4., displaying the distribution of achievement conditional on the father's occupation, for males and females separately. It is, for instance, very clear that the probability of completing 4 years of college decreases when we go down (a certain conventional definition of) the occupational or social hierarchy, while the proportion of high-school dropouts simultaneously increases.

Finally, to estimate returns to education, we constructed three wage variables with the help of the data. In the following, we present results obtained with these three different definitions of an individual's wage. Each individual's job market experience is an array of data including a number of jobs, with their corresponding wages and durations in months, and unemployment spells, again with a length in months. We rely on a single, scalar index of "wage" for each worker. The first is simply the arithmetic average of the wages earned during employment spells, weighted by their respective spell durations. This variable is simply called *wage* in the following; it ignores the length of unemployment spells and the difficulties faced by the individual to find a stable (and well-paid) job. To take the probability of unemployment into account, as well as to capture the effect of job instability on average earnings, we employed a second index, defined as the average earnings of the individual. To compute this average, wages and unemployment benefits have been weighted by the corresponding employment or unemployment spell durations[9]. This second variable is called *earnings* in the following. Finally, taking the point of view that many workers search for the appropriate job, or the appropriate "match" with an occupation or a firm, and make some mistakes during the first years of their career, we also studied the maximal wage rate obtained during the observation period by an individual. This maximal wage is called *wmax* in the following, and can be viewed as an indicator of the value of a worker's human capital. This view is maybe too optimistic, because a worker could start with a high wage and then loose ground, or get a well-paid job for a short period by chance. Nevertheless, in the data, the maximal wage rate very often corresponds to the last job obtained by the worker in the observation period, so that it seemed to us interesting to use it as a dependent variable in some regressions. Figures 1, 2, and 3 depict the distributions of *earnings*, *wages* and *wmax*, respectively, for males and females.

3. Birth Order, Family Size and Education

Before we start the regression work, an important preliminary question is whether birth order and the number of siblings stand a chance of explaining something, given our data. The answer is yes: Table 3.1 shows the empirical probabilities of reaching a given education level, conditional on the number of brothers, and on the number of sisters. Table 3.2. shows the empirical probabilities of reaching a given education level, conditional on birth order; we computed the empirical frequencies separately for men (Table 3.2.a) and for women (Table 3.2.b); we also separated the only child from the first born (with siblings); the rest

[9] A worker is eligible for unemployment benefits if he or she has worked in the recent past. Students thus get zero before their first job. The unemployment benefits are roughly a half of the lost job's wage.

is self-explanatory. It is very clear that the higher the child's rank among siblings, the lower her (his) chances of completing 4 years of College, and the higher his (her) chances of getting a (secondary) vocational degree. A higher rank also increases the probability of becoming a high school dropout. But these observed effects could be due to correlations between the number of children and parental income or parental education, and without further investigation, it is not clear that "pure" birth-order effects can be isolated in multiple regression analysis.

The next step is to use the five education levels described above, the hierarchy of which is unambiguous and natural, to run an Ordered Probit, estimating the probabilities of reaching these five levels, conditional on observed characteristics. We have done this for men and women separately. The explanatory variables are: parental occupation and parental education dummies; indicators of the father's and the mother's employment status (employed, unemployed, retired, or deceased); indicators of the number of brothers from 0 to 4 and more; indicators of the number of sisters from 0 to 4 and more; birth-order dummies (only children being the reference group); and immigrant status of the parents (i.e., dummies indicating if one parent is an immigrant, and if both parents are immigrants).

Table 3.3a gives the results obtained with the sub-sample of males, and Table 3.3b the corresponding results for the female sub-sample.

3.1. Parental Education and Occupation

It is a huge advantage to be the son (or the daughter) of executives and of highly educated parents. This is a well-documented empirical fact that comes out very clearly in our data: the more educated the parents, the "higher" their occupational (or social) status, the higher the chances of reaching the highest educational levels.

Maybe less well-known are the impacts of a retired father, and of an inactive mother. It seems that it is really good news to have an old father, when it comes to predict educational achievement. To a lesser extent, an inactive mother is also a good thing. Having a retired father would more than make up for the fact that he is a white collar without an education (as compared with an active executive), when we consider the chances of reaching a higher education level. Is it due to the fact that the father's presence at home is a blessing? Or is it the father's maturity? This question certainly deserves further work.

When both parents are immigrants, controlling for everything else, the probabilities of success are significantly higher. We take this result as showing that our other family-background variables are good controls, so that we isolate the likely "pure" effect of being an immigrant's son (daughter): it makes children work harder in school[10].

3.2. Family Size and Sibling Sex Composition

We find that the number of sisters and the number of brothers are both significant, with a significant negative effect on probabilities of educational success. Remark that instead of using a number-of-brothers (resp. sisters) variable taking integer values 0, 1, 2, etc, we

[10] Note that the bulk of the immigrants in the sample are Africans, North-Africans, and Muslims.

use dummies indicating when the number of brothers (resp. sisters) is equal to 1, 2, 3, or 4 and more. This has the important advantage of not constraining the marginal impact of a sibling as the usual procedure would do; and indeed we find that the marginal effect of a brother (or a sister) is not a constant. The sisters and brothers variables have roughly parallel negative effects on young men and women. The number of brothers is clearly more detrimental to women, as compared to the effect of brothers on men.

Tests show that coefficients of the number-of-brothers variables are not significantly different from the corresponding number of sisters coefficient in the male sub-sample (except the case of a single brother, which is different from a single sister). But the coefficients are in essence equal, and we conclude that in the case of men, the only thing that really matters is family size (the total number of siblings). If we consider the female sub-sample now, the coefficients of numbers-of-sisters and numbers-of-brothers variables do not seem to differ much at first glance, except in the case of three brothers (or three sisters).

Yet, the effect of siblings on women are significantly different from that of siblings on men, and the effect of brothers on women is significantly different. If we use an integer-valued variable for the number of siblings instead of the dummies, the coefficient of the number of brothers is around $-.05$ for men and $-.10$ for women; the coefficient of the number of sisters is -0.06 for men and -0.08 for women. Given the standard deviations, these differences are significant, but only in the case of the numbers-of-brothers. To be sure that there are gender differences in the the impact of siblings, we ran the same Ordered Probit, with the same controls as in tables 3.3a and 3.3b, but using the entire sample (22,524 observations), and adding an indicator for women, and interactions of the number of sisters, number of brothers, and birth order variables with the women's indicator — men being the reference group. Table 3.4. shows the coefficients of these interaction variables and the associated t-statistic values. For an easy comparison, Table 3.5 gives the coefficients and t-statistics of the same variables in the separate Ordered Probit regressions of Tables 3.3a and 3.3b: these sub-sample regressions are less constrained because the coefficients of all controls are free to vary with gender, but the results are in fact very close. We find that *the effect of the number of brothers on women's education is stronger than the corresponding effect of brothers on men*, and we now (from the test of Table 3.4) that the difference is significant. This partially confirms Conley's "reverse sex minority hypothesis". Women suffer more from their brothers than men. However, additional sisters do not seem to harm women more than men.

3.3. Birth Order

Now, given that we control for parental education and occupation, for immigrant status, for the presence of a retired father and for family size, are birth-order effects on educational achievement significant? The answer is again yes. These effects are significant; they are substantial and negative; they increase (in absolute value) with the child's rank. The preceding claims are true for men as well as for women. Table 3.5. summarizes the estimated coefficient of family size and birth-order variables. Being the fifth child of an executive puts a boy on an equal footing with the only child (son) of farmers, in terms of chances of educational achievement, *ceteris paribus*.

To get a more concise and possibly more striking idea of birth order effects, using the males sub-sample, we estimated a simple Probit, giving the probability of reaching higher education, and got the following differential effects: each additional sibling decreases the probability of reaching higher education by 3%, independently of birth-order. As compared to the only child, ceteris paribus, the probability of higher education of a first born (which is not the only child) is reduced by a further 3.8%; that of a second born by 2.7%; chances of higher education are reduced by 5% for a third child, 6.3% for a fourth child, and 13.7% for a son with rank higher than 4 (all underlying Probit coefficients being of course significant and negative). The corresponding percentage increase of the same probability, due to the fact that parents belongs to the "executive" group is +22% (relative to a white-collar parents reference).

3.3.1. Robustness Check 1: Age at Junior High School Entry

To check for robustness of these results, we estimate an Ordered Probit with the same explanatory variables, but using the individual's age at grade 6 entry instead of educational achievement. The age at the beginning of junior high school is recognized as a highly endogenous variable by many authors (see e.g. Carneiro and Heckman (2003)). We have chosen five qualitative values of the variable here: below 10, 11, 12, 13, and more than 13 years of age. The results are reported on Table 3.6a for men and Table 3.6b for women. The effects of parental education and occupation are parallel, except that the positive factors now appear with a negative coefficient, meaning a reduction of the age at junior high school entry. Being the son (daughter) of immigrants increases the age at JHS entry. The number of sisters and number of brothers are significant, and with non-negligible, positive coefficients. Again, it seems that only total family size matters for men, but that girls suffer from the presence of brothers, which delay high school entry more than sisters.

Finally, birth-order dummies are still significant in the case of boys, but the coefficients have a surprising negative sign. This seems to indicate that the higher one's birth rank, the younger the age at JHS entry. The "trickle-down" theory of skill transmission among siblings (from elder to younger brothers or sisters) might be a possible explanation for this finding (this, again, is a topic for further research). The younger brothers would poach on the elder's preserves; it seems that the youngest benefit from a kind of "family know-how", or from neighborhood externalities produced by siblings, within the family. These effects, alas, are not well estimated in the case of girls, but we believe that they do exist and have a negative sign too. If that is true, then, the disadvantage of the younger sibling, given family size, would be realized later in the teens.

3.3.2. Robustness Check 2: Interactions with Father's Occupational Status

To provide a further check of the robustness of birth-order effects, we have re-estimated the Ordered Probit with education levels, but with additional interaction dummies, on the entire sample. We let the father's occupation interact with the number of sisters, the number of brothers and birth-order dummies in the case of Farmers (merged with Craftsmen and Shop-Keepers), Middle Managers, Executives, and "Missing father occupation", the reference category being the Blue and White collars merged together. Detailed results are reported in Table 3.7, for the complete sample. Tables 3.8 and 3.9 report the interaction results and permit an easy comparison of the results for Males, Females, and the entire

sample, displaying the interaction variables coefficients for the number of siblings and birth order, respectively. We still find that the number of brothers, number of sisters and birth order dummies are highly significant, with nice patterns (at the top of the Tables). Interaction terms are not all significant with some striking exceptions. The novelty in Table 3.8 is that coefficients are negative for the reference, but they are significant and *positive* when the father is an executive (or highly educated professional, such as an engineer, teacher or lawyer). The coefficients are also positive, but less significant, for the son of a middle manager. The impacts of brothers (or sisters) in these (presumably well-to-do) families is unambiguously positive. If we use integer-valued variables for the numbers of siblings in the regressions instead of the indicators, we find that in these families, the impact of an additional brother is $+.07$, whereas it is around $-.10$ for the son of a white collar worker. Note that these results are true when birth rank is held constant. So, indeed, it helps to have many younger brothers and sisters, but provided your daddy's rich. A possible explanation for this result, apart from the obvious fact that occupational status and income are correlated, might also be that in these relatively richer families, the number of children is itself highly correlated with income, because of the quality-quantity trade-off. In other words, highly educated and professional parents choose to have many children when they also have the money (and of course, want only high-quality children).

Next, Table 3.9 shows that, conditional on the above described family size effects, educational achievement decreases when birth order increases, but essentially, the executives' category is not significantly different from the reference in this respect. The striking result in Table 3.9 is related to the "missing father occupation" category. This category contains 8% of the entire sample, and it contains 100% of the deceased fathers. We find that 60% of the individuals with a "missing father occupation" are in fact orphans (they also have a deceased father). We suspect that the rest of the category might include other kinds of fatherless monoparental families. The unambiguous conclusion is that, in this category of fatherless children, a higher birth rank helps significantly. This is true for men as well as for women: the higher the rank, the higher the chances. While having numerous siblings is very bad in these families (as shown by Table 3.8), it is relatively less bad if the individual has many elder brothers and sisters. An obvious interpretation might be that the elder brothers and sisters help the younger ones, help the mother, and act as a substitute for the missing father.

We conclude that birth-order effects are substantial, statistically significant, and negative, except when the child is fatherless — in this special case, birth-order effects are statistically significant and positive.

4. Two-Stage Estimation of Returns to Education

We now turn to the estimation of log-wage equations, using birth order and number of siblings as the only instruments for educational outcomes. We use a wage equation with dummy variables indicating "education levels". Recall that we consider five such levels: 0) high school dropouts; 1) vocational high school certificate; 2) finished high school (grade 12); 3) two years of college; 4) four years of college and more. These dummies are viewed as endogenous, and modeled as determined by an Ordered Probit structure, as estimated in Section 3. A Two-Stage estimation procedure à la Heckman is possible here, to take

care of education level endogeneity. Let $y_i = \ln(w_i)$ be the dependent variable, where w_i can be any of our three earnings indices. The wage equation is specified as follows,

$$y_i = X_{i0}\beta_0 + \sum_{s=1}^{s=4} \chi_{is} f_s + \nu_i, \tag{1}$$

where i indexes observations; X_0 is a vector of controls, including a constant; β_0 a parameter vector; χ_{is} are dummies, i.e., $\chi_{is} = 1$ if individual i leaves school at level s exactly, and $\chi_{is} = 0$ otherwise; the f_s represent the value of schooling level s; and finally, ν is a random error term interpreted as unobservable "labor market ability". For future reference, define, for $s = 2, 3, 4$, the skill premia,

$$\Delta f_s = f_s - f_{s-1}. \tag{2}$$

School-leaving is determined by a latent variable z_i, defined as,

$$z_i = X_{i1}\beta_1 + \epsilon_i, \tag{3}$$

where X_{i1} is a vector of instruments and controls, β_1 is the associated parameter vector, to be estimated, and ϵ is an error term, interpreted as "school ability". School level is determined by z through an ordered discrete choice structure. Let k_s denote cut parameters, or thresholds, to be estimated. We assume the following,

$$\Pr(\chi_{is} = 1) = \Pr(s_i = s) = \Pr(k_s \leq z_i \leq k_{s+1}), \tag{4}$$

and conventionally, we set $k_0 = -\infty$ and $k_5 = +\infty$. Ability terms (ν, ϵ) are assumed bivariate normal, with mean 0 and variance-covariance matrix

$$\begin{pmatrix} \sigma^2 & \sigma\rho \\ \sigma\rho & 1 \end{pmatrix}. \tag{5}$$

We set $E(\epsilon^2) = 1$ to ensure identification, and ρ is the correlation coefficient of ability terms. To obtain a complete specification, we choose the variables appearing in X_0 and X_1. In X_1, the determinants of schooling are parental education, parental occupation, parental "employment" status (unemployed, deceased, etc.), immigrant status, number of sisters, number of brothers, birth order dummies. Controls introduced in the log-earnings equation, i.e., X_0, include: parental occupation, parental education, parental employment, and job location dummies[11]. So, the only variables excluded from the wage equation are the numbers of brothers and sisters, and birth-order indicators. This means that these variables are the only instruments used to estimate returns to education here.

Let ϕ denote the density of the normal $\mathcal{N}(0, 1)$ distribution, and Φ denote the associated normal c.d.f. If we define H_i as follows,

$$H_i = \sum_{s=1}^{s=4} \chi_{is} \frac{\phi(k_s - X_{i1}\beta_1) - \phi(k_{s+1} - X_{i1}\beta_1)}{\Phi(k_{s+1} - X_{i1}\beta_1) - \Phi(k_s - X_{i1}\beta_1)}, \tag{6}$$

[11] The location is that of the last job observed, which is very often also the best job, in terms of pay.

the log-earnings equation can be rewritten,

$$y_i = X_{0i}\beta_0 + \sum_{s=1}^{s=4} \chi_{is} f_s + \rho\sigma H_i + \zeta_i, \tag{7}$$

where ζ_i is a normal random variable with a zero mean. See the appendix for details of the derivation of this formulation.

Two-stage estimation now goes as follows. First estimate the β_1 and k_s parameters using the standard Ordered Probit method. Substitute the estimations $\hat{\beta}_1$ and $\hat{k}_s$ in H_i to construct the new variable $\hat{H}_i$. Use $\hat{H}_i$ as an additional regressor in OLS estimations of the log-earnings equation, as shown in (7). The estimated coefficient of $\hat{H}_i$ is the estimated value of $cov(\nu, \epsilon) = \rho\sigma$.

Detailed results are reported on Table 4.1a for males and Table 4.1b for females. Table 4.2. permits an easy comparison of the returns to "education levels" f_s, for males, females, the three different earnings statistics described above, and 2 different estimation methods. All the coefficients are very significant (and standard errors, around .05, are not reported). We find that the endogeneity problems are weak in the case of males, and that OLS and Two-Stage estimation coefficients are quite close. This must in part be due to the fact that we introduced many controls in the equations (see further comments below). In the female sub-sample, the differences between OLS and Two-Stage estimates are non-negligible, and it appears that OLS estimates are typically biased downwards. This is in line with the findings of many others, with Instrumental Variable estimators (on these questions, see again Card (1999), Harmon *et al.* (2003), Carneiro and Heckman (2003)).

With this model, to get an idea of the value of returns to education per year, it is necessary to compute the values of $\Delta f_s/\Delta d_s$ where d_s is the average number of years needed to reach level s in the sample (see Table 2.2.) and Δd_s is the average additional number of years needed to jump from level $s-1$ to level s. Table 4.3 shows these values. Returns to education are quite high, and most notably the returns to the first two years of College. They are higher for women than for men (which is often the case in this type of study). The returns to log-earnings are particularly high: this is due to the fact that earnings take unemployment spells into account, and a degree happens to be an excellent protection against unemployment in the early career years. So, returns to education are magnified when expressed in terms of "earnings", that take the probability of unemployment into account. The values in the log-wage and log-wmax columns of Table 4.3 are closer to usual estimates of returns to education, in many countries, ranging between 5 ad 15 percent for men.

Does the Two-Stage procedure (and the associated instrumentation by birth order and number of siblings) reveal a strong ability bias? Such a bias is present if the coefficient of Heckman's correction variable $\hat{H}$, that is, $\rho\sigma$, is nonzero. Because in this case, the error term in the education equation is correlated with the error term in the wage equation. Table 4.4. compares the estimated values of ρ and $\rho\sigma$ in the 6 different samples. According to our specification and data, there is no ability bias in the case of men, for $\rho\sigma$ is non-significant. The estimated $\rho\sigma$ is small and positive in the men's log-wages and log-wmax regressions. By contrast, there is a significant ability bias in the case of women: ρ is paradoxically negative, around -.15 when wages are considered. A possible explanation for this negative

correlation is the fact that, in the case of women, there is a greater heterogeneity of hours worked (more occurrences of part-time work) that is not well-measured by our data, and female labor-force participation is not modeled here. Some unobserved factors tend to make young women simultaneously study more and work less (and/or search less for good jobs). Since educated women also tend to earn higher wages, it must be that returns to education are higher for women, and that they are underestimated by ordinary least squares.

To sum up, the use of birth-order and number-of-siblings variables as instruments yields non-trivial results. If instrumentation had no effect on the estimates in the female sub-sample, we would have no instance of a case in which our kind of instrumental variable estimation matters. The fact that OLS and IV results do not differ much in the case of men says probably only that in their case, introducing sufficiently many controls in the wage and education equations is enough to obtain reliable estimations of the returns to education, and as a result, we find at best a small, standard, and negligible "ability bias". But the controls are not good enough in the case of women, there are hidden characteristics that negatively affect earnings, and at the same time positively affect education, and we find a "paradoxical", negative "ability bias".

Some connections with the earlier literature

Pioneering work on returns to education has been done in the seventies by various distinguished French economists and sociologists, e.g., Riboud (1978), Eicher and Lévy-Garboua (1979). Work using panel data and IV methods has started later. For instance, Bouhmadi and Plassard (1992) use parental education and the number of siblings as instruments to compute 2SLS estimations; their 2SLS estimate of returns to years of education is 11.3% (while the corresponding OLS figure is 8.7%). Goux and Maurin (1994) apply panel data methods to the French FQP 93 survey, and show the importance of the diploma certification effects in France. In a study of yet another source of French panel data (the DADS, i.e., employers' yearly compulsory reports relative to wages), Guillotin and Sevestre (1994) find a strong effect of instrumentation; their IV estimation of the years of schooling coefficient ranges from 15 to 19%. To the best of our knowledge, the data used in the present article had not been employed before to estimate returns to education. Our numerical results are in line with classic findings in this type of research, both in France and in other countries (see Psacharopoulos (1985)), but they are obtained with the help of a much richer data set than many studies.

6. Conclusion

We have studied family determinants of educational achievement in a large sample of young men and women, and find that the individual's number of siblings and birth order are significant determinants of his (her) chances of educational achievement. Using an Ordered Probit model to explain individual educational achievements, we found that the number of brothers and the number of sisters are significant variables with a negative effect on education, except in the highest social-status families. The impact of an additional brother is in essence the same as the impact of an additional sister in the case of men. But an additional brother is significantly more detrimental to women's educational achievement

than it is for men. It is good to have many siblings, but only if one's father is a highly educated professional: this is the "rich daddy" effect. The impact of a higher rank among siblings is generally negative and significant, and estimated birth-order effects are non-negligible: their magnitude can be compared to that of the important parental education or parental occupation effects on educational success. Birth order effects are shown to be significant and non-negligible also when the explained variable is the age at junior-high-school entry. Birth-order effects on educational success are generally negative, except in the case of fatherless children, who benefit from the presence of elder brothers and sisters. We conclude that substantial inequalities in the probabilities of reaching the higher education levels are generated, among siblings, by family contributions to children's human capital accumulation, as shown by birth order effects.

We have then studied the returns to education with the help of a wage equation, in which educational outcomes are endogenous dummy variables, using the Ordered Probit model as a fist-stage regression explaining these education levels. The only instruments used for education are the number of siblings and birth order indicators. Two-Stage estimation of this model yields higher returns to education than with OLS estimation in the case of women. We find that unobservable "school ability" and "labor market ability" variables are negatively correlated in the female student population, but not in the male population. These results, which are based on an exceptional data set, shed new light on a number of aspects of the debate about sibship sex composition and birth order effects, in Family and Education Economics.

7. Appendix. Details of Estimation Method

With (3) above, we obviously get,

$$\Pr(s_i = s) = \Pr(k_s - X_{i1}\beta_1 \leq \epsilon_i \leq k_{s+1} - X_{i1}\beta_1). \qquad (A1)$$

To estimate this model with the help of a Two-Stage method à la Heckman, remark that,

$$E[y_i \mid X_i, s = s_i] = X_{0i}\beta_0 + f_{s_i} + E[\nu_i \mid X_i, s = s_i]. \qquad (A2)$$

But, given that, under normality and using (5), ν_i can be decomposed as follows,

$$\nu_i = \rho\sigma\epsilon_i + \xi_i, \qquad (A3)$$

where ξ_i is normal with a zero mean and independent of ϵ_i. Using the properties of normal random variables and the linearity of expectation operators, we get,

$$\begin{aligned} E[\nu_i \mid X_i, s = s_i] = \\ \rho\sigma E[\epsilon_i \mid X_i,\, k_s - X_{i1}\beta_1 \leq \epsilon_i \leq k_{s+1} - X_{i1}\beta_1] = \\ \rho\sigma \frac{\phi(k_s - X_{i1}\beta_1) - \phi(k_{s+1} - X_{i1}\beta_1)}{\Phi(k_{s+1} - X_{i1}\beta_1) - \Phi(k_s - X_{i1}\beta_1)}, \end{aligned} \qquad (A4)$$

where ϕ is the density of the normal distribution $\mathcal{N}(0,1)$ and Φ is the associated c.d.f. Equations (6) and (7) immediately follow from this (see Heckman (1978), Lee (1983), Maddala (1983)).

8. References

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Table 2.1 : Completed schooling

		Males		Females	
level	**s**	**numbers**	**%**	**numbers**	**%**
high school dropouts	0	811	7%	612	6%
vocational degree	1	4805	39%	3413	34%
high school graduates (grade 12)	2	2729	22%	2499	25%
two years of College	3	2030	16%	1724	17%
four years of College	4	1992	16%	1909	19%

Table 2.2 : Schooling duration (mean and standard deviation)

	Males		Females	
	mean	**s.d.**	**mean**	**s.d.**
Age while entering grade 6	11.2	1.4	11.1	1.3
duration d0, (high school dropouts)	17.7	1.4	17.7	1.3
duration d1, (vocational degree)	19.1	1.1	19.2	1.2
duration d2, (high school graduates)	20.8	1.4	20.6	1.4
duration d3, (two years of College)	22.0	1.5	21.7	1.6
duration d4, (four years of College)	24.7	2.2	24.2	2.3

Table 2.3 : Distribution of the number of siblings and of birth order

	Males		Females		All	
	numbers	**%**	**numbers**	**%**	**numbers**	**%**
Number of brothers						
0	3522	28%	2714	27%	6236	28%
1	5294	43%	4455	44%	9749	43%
2	2306	19%	1925	19%	4231	19%
3	706	6%	643	6%	1349	6%
4 or more	539	4%	420	4%	959	4%
Number of sisters						
0	3751	30%	3169	31%	6920	31%
1	5329	43%	4089	40%	9418	42%
2	2168	18%	1829	18%	3997	18%
3	678	5%	650	6%	1328	6%
4 or more	441	4%	420	4%	861	4%
Birth Order						
Only child	4459	36.1%	3470	34.2%	7929	35.2%
First	3970	32.1%	3293	32.4%	7263	32.2%
2nd	2055	16.6%	1771	17.4%	3826	17.0%
3rd	905	7.3%	778	7.7%	1683	7.5%
4th	438	3.5%	344	3.4%	782	3.5%
5th and higher	540	4.4%	501	4.9%	1041	4.6%

Table 2.4 : Probability of education level conditional on father's occupation

	(a) Males					
	Education Level					
Father occupation	High school dropouts	Vocational degree	Grade 12	Two years of college	Four years of college	Total
Executives, doctors, lawyers, engineers, teachers	**2%**	15%	22%	19%	**42%**	100%
Middle management, technicians	**4%**	28%	24%	24%	**21%**	100%
Craftsmen, shopkeepers, owners-managers	**6%**	41%	24%	15%	**14%**	100%
Farmers	**4%**	32%	30%	23%	**11%**	100%
White collars	**7%**	42%	23%	18%	**10%**	100%
Blue collars	**9%**	53%	19%	12%	**7%**	100%
Missing observations	7%	39%	22%	16%	16%	100%

	(b) Females					
	Education Level					
Father occupation	High school dropouts	Vocational degree	Grade 12	Two years of college	Four years of college	Total
Executives, doctors, lawyers, engineers, teachers	**1%**	11%	18%	21%	**49%**	100%
Middle management, technicians	**4%**	26%	26%	21%	**24%**	100%
Craftsmen, shopkeepers, owners-managers	**5%**	32%	25%	18%	**19%**	100%
Farmers	**3%**	29%	25%	26%	**17%**	100%
White collars	**5%**	37%	28%	18%	**12%**	100%
Blue collars	**9%**	45%	26%	12%	**8%**	100%
Missing observations	11%	37%	22%	12%	18%	100%

Figure 1 : Distribution of earnings; gender comparison

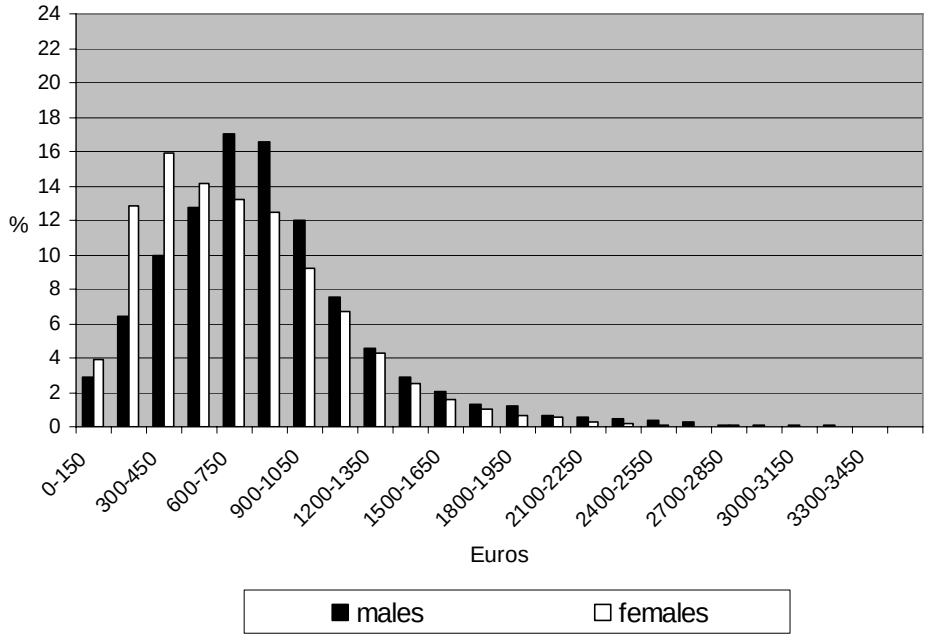

Figure 2 : Distribution of wages; gender comparison

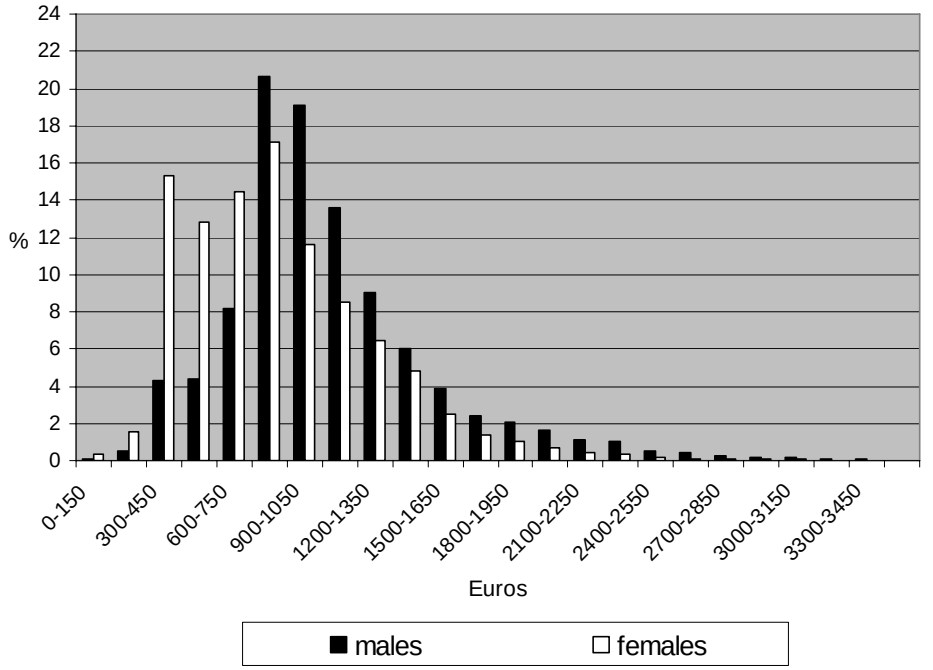

Figure 3 : Distribution of maximum wage; gender comparison

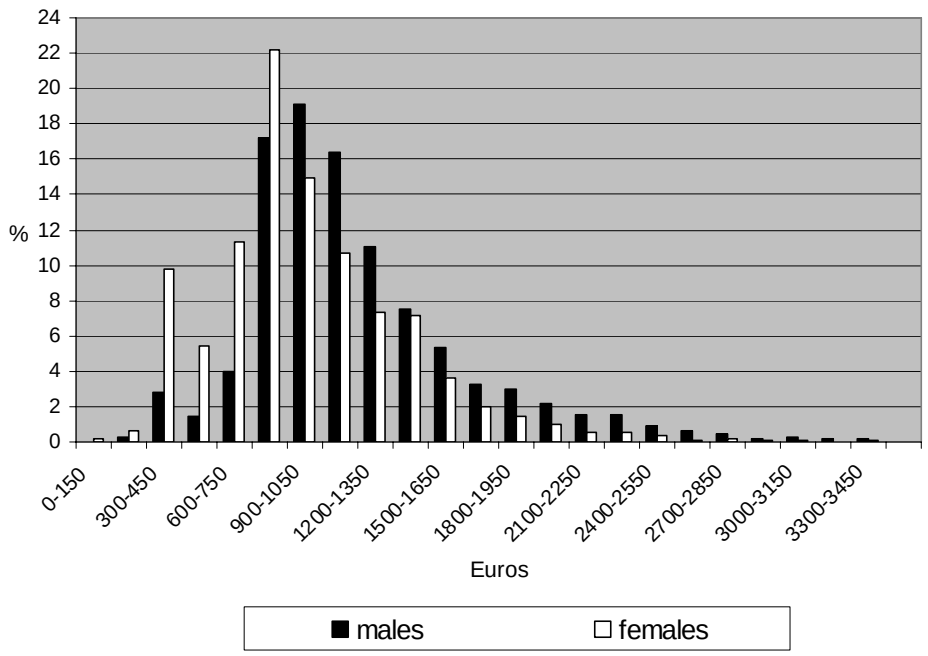

Table 3.1 : Probability of education level conditional on the number of brothers or sisters

(a) Males						
	Education Level					
	High school dropouts	Vocational degree	Grade 12	Two years of college	Four years of college	Total
Number of brothers						
0	**6%**	36%	24%	18%	**17%**	100%
1	**6%**	37%	23%	17%	**17%**	100%
2	**7%**	42%	20%	15%	**16%**	100%
3	**10%**	49%	17%	13%	**11%**	100%
4 or more	**14%**	50%	17%	10%	**9%**	100%
Number of sisters						
0	**5%**	37%	23%	18%	**18%**	100%
1	**6%**	38%	22%	17%	**17%**	100%
2	**7%**	41%	22%	15%	**14%**	100%
3	**13%**	41%	18%	14%	**14%**	100%
4 or more	**15%**	56%	13%	8%	**8%**	100%

(b) Females						
	Education Level					
	High school dropouts	Vocational degree	Grade 12	Two years of college	Four years of college	Total
Number of brothers						
0	**5%**	30%	23%	20%	**23%**	100%
1	**5%**	32%	26%	18%	**20%**	100%
2	**6%**	38%	24%	15%	**17%**	100%
3	**11%**	42%	25%	11%	**10%**	100%
4 or more	**15%**	45%	25%	9%	**7%**	100%
Number of sisters						
0	**4%**	31%	26%	18%	**21%**	100%
1	**5%**	33%	24%	18%	**20%**	100%
2	**7%**	35%	25%	15%	**17%**	100%
3	**8%**	40%	25%	13%	**14%**	100%
4 or more	**16%**	45%	24%	8%	**7%**	100%

Table 3.2 : Probability of education level conditional on birth order

(a) Males						
	Education Level					
Birth Order	High school dropouts	Vocational degree	Grade 12	Two years of college	Four years of college	
Only child	6%	**35%**	24%	17%	**18%**	100%
First	6%	**39%**	22%	17%	**16%**	100%
2nd	6%	**39%**	22%	17%	**16%**	100%
3rd	8%	**44%**	21%	17%	**11%**	100%
4th	10%	**47%**	18%	13%	**12%**	100%
5th and higher	14%	**55%**	15%	9%	**7%**	100%

(b) Females						
	Education Level					
Birth Order	High school dropouts	Vocational degree	Grade 12	Two years of college	Four years of college	
Only child	5%	**28%**	25%	19%	**23%**	100%
First	5%	**33%**	25%	18%	**19%**	100%
2nd	6%	**37%**	23%	16%	**17%**	100%
3rd	7%	**39%**	25%	15%	**15%**	100%
4th	10%	**42%**	26%	11%	**12%**	100%
5th and higher	14%	**46%**	26%	9%	**5%**	100%

Table 3.3 a : Ordered probit. Males

Education levels (s)	Coeff.	Std. dev.	t	P>|t|
Father's occupation				
Farmer	0.2048	0.0631	3.25	0.001
Craftsman	0.0423	0.0380	1.11	0.265
Executive	0.5091	0.0387	13.15	0.000
Middle Manager	0.2962	0.0382	7.75	0.000
White Collar. **Reference group**				
Blue Collar	-0.1550	0.0293	-5.28	0.000
Observation Missing	-0.0584	0.0977	-0.60	0.550
Mother's occupation				
Farmer	0.1014	0.0691	1.47	0.142
Craftsman	0.0433	0.0531	0.82	0.415
Executive	0.2045	0.0491	4.17	0.000
Middle Manager	0.1547	0.0496	3.12	0.002
White Collar. **Reference group**				
Blue Collar	-0.1928	0.0319	-6.04	0.000
Observation Missing	-0.0484	0.0317	-1.53	0.127
Father's education				
Without Qualification. **Reference group**				
Elementary Certificate	0.1617	0.0345	4.69	0.000
Vocational Degree	0.1046	0.0361	2.90	0.004
High School Degree	0.3840	0.0500	7.67	0.000
College	0.6375	0.0524	12.17	0.000
Observation Missing	-0.2802	0.0509	-5.51	0.000
Mother's education				
Without Qualification. **Reference group**				
Elementary Certificate	0.1962	0.0308	6.37	0.000
Vocational Degree	0.1621	0.0378	4.29	0.000
High School Degree	0.3254	0.0449	7.25	0.000
College	0.4599	0.0590	7.79	0.000
Observation Missing	-0.2030	0.0491	-4.13	0.000
Father's employment status				
Employed. **Reference group**				
Unemployed or Inactive	0.0280	0.0504	0.56	0.579
Retired	0.6600	0.0363	18.18	0.000
Deceased or Observation Missing	0.2841	0.1035	2.74	0.006
Mother's employment status				
Employed. **Reference group**				
Unemployed, inactive or retired	0.1219	0.0257	4.74	0.000
Deceased or Observation Missing	-0.1607	0.0734	-2.19	0.029
Number of brothers				
0. **Reference group**				
1	-0.0374	0.0270	-1.39	0.165
2	-0.1079	0.0349	-3.10	0.002
3	-0.1869	0.0521	-3.59	0.000
4 or more	-0.2369	0.0632	-3.75	0.000
Number of sisters				
0. **Reference group**				
1	-0.0989	0.0265	-3.73	0.000
2	-0.1158	0.0355	-3.26	0.001
3	-0.1495	0.0536	-2.79	0.005
4 or more	-0.2990	0.0688	-4.35	0.000
Birth Order				
Only child. **Reference group**				
First	-0.0601	0.0237	-2.54	0.011
2nd	-0.0491	0.0313	-1.57	0.117
3rd	-0.1346	0.0455	-2.96	0.003
4th	-0.1341	0.0636	-2.11	0.035
5th and higher	-0.3189	0.0723	-4.41	0.000
Immigrants				
Both parents French citizens. **Reference group**				
One parent is an immigrant	0.0124	0.0387	0.32	0.748
Both parents are immigrants	0.1177	0.0379	3.10	0.002
_cut1	-1.4337	0.0513		
_cut2	0.1423	0.0493		
_cut3	0.8079	0.0496		
_cut4	1.4479	0.0505		
Pseudo R2	0.091			
Number of observations	12,367			
Log likelihood	-16,527			

Table 3.3 b : Ordered probit. Females

Education levels (s)	Coeff.	Std. dev.	t	P>|t|
Father's occupation				
Farmer	0.3061	0.0681	4.49	0.000
Craftsman	0.1185	0.0415	2.85	0.004
Executive	0.6209	0.0448	13.86	0.000
Middle Manager	0.2228	0.0432	5.16	0.000
White Collar. **Reference group**				
Blue Collar	-0.1205	0.0318	-3.79	0.000
Observation Missing	0.0977	0.1059	0.92	0.356
Mother's occupation				
Farmer	0.1175	0.0738	1.59	0.112
Craftsman	0.0530	0.0559	0.95	0.343
Executive	0.3317	0.0559	5.93	0.000
Middle Manager	0.1701	0.0557	3.05	0.002
White Collar. **Reference group**				
Blue Collar	-0.1836	0.0350	-5.24	0.000
Observation Missing	0.0579	0.0351	1.65	0.098
Father's education				
Without Qualification. **Reference group**				
Elementary Certificate	0.1145	0.0356	3.21	0.001
Vocational Degree	0.1051	0.0393	2.68	0.007
High School Degree	0.2754	0.0581	4.74	0.000
College	0.3790	0.0584	6.49	0.000
Observation Missing	-0.4266	0.0511	-8.35	0.000
Mother's education				
Without Qualification. **Reference group**				
Elementary Certificate	0.2858	0.0331	8.64	0.000
Vocational Degree	0.3033	0.0413	7.35	0.000
High School Degree	0.6004	0.0522	11.51	0.000
College	0.6697	0.0672	9.97	0.000
Observation Missing	0.0320	0.0538	0.60	0.552
Father's employment status				
Employed. **Reference group**				
Unemployed or Inactive	-0.0478	0.0514	-0.93	0.352
Retired	0.6948	0.0398	17.47	0.000
Deceased or Observation Missing	0.1024	0.1114	0.92	0.358
Mother's employment status				
Employed. **Reference group**				
Unemployed, inactive or retired	0.0581	0.0281	2.07	0.039
Deceased or Observation Missing	-0.1724	0.0792	-2.18	0.029
Number of brothers				
0. **Reference group**				
1	-0.1149	0.0301	-3.82	0.000
2	-0.2023	0.0389	-5.20	0.000
3	-0.4160	0.0555	-7.50	0.000
4 or more	-0.3987	0.0719	-5.55	0.000
Number of sisters				
0. **Reference group**				
1	-0.0958	0.0290	-3.30	0.001
2	-0.1511	0.0380	-3.98	0.000
3	-0.1930	0.0547	-3.53	0.000
4 or more	-0.4130	0.0698	-5.91	0.000
Birth Order				
Only child. **Reference group**				
First	-0.0848	0.0264	-3.21	0.001
2nd	-0.1060	0.0341	-3.11	0.002
3rd	-0.1289	0.0491	-2.63	0.009
4th	-0.1274	0.0698	-1.83	0.068
5th and higher	-0.2338	0.0756	-3.09	0.002
Immigrants				
Both parents French citizens. **Reference group**				
One parent is an immigrant	0.0432	0.0442	0.98	0.328
Both parents are immigrants	0.1123	0.0412	2.72	0.006
_cut1	-1.5447	0.0562		
_cut2	-0.0649	0.0536		
_cut3	0.6834	0.0538		
_cut4	1.3186	0.0547		
Pseudo R2	0.101			
Number of observations	10,157			
Log likelihood	-13,659			

Table 3.4 : Coefficients of number of siblings and birth order interacted with gender

		All	
	s. g.	**Coeff.**	**t**
Number of brothers			
0. **Reference group**	***Yes***		
1		-0.0351	-1.31
2		-0.1017****	-2.95
3		-0.1776****	-3.45
4 or more		-0.2288****	-3.68
Number of brothers * Female			
0. **Reference group**	***Yes***		
1		-0.0818***	-2.05
2		-0.1040***	-2.04
3		-0.2466****	-3.32
4 or more		-0.1764**	-1.91
Number of sisters			
0. **Reference group**	***Yes***		
1		-0.0964****	-3.66
2		-0.1063****	-3.03
3		-0.1358***	-2.57
4 or more		-0.2858****	-4.22
Number of sisters * Female			
0. **Reference group**			
1		-0.0014	-0.04
2		-0.0522	-1.03
3		-0.0656	-0.88
4 or more		-0.1374*	-1.44
Birth Order			
Only child. **Reference group**	***Yes***		
First		-0.0573***	-2.43
2nd		-0.0475*	-1.53
3rd		-0.1327****	-2.95
4th		-0.1304***	-2.07
5th and higher		-0.3168****	-4.45
Birth Order * Females			
Only child. **Reference group**			
First		-0.0303	-0.86
2nd		-0.0627	-1.38
3rd		0.0003	0.00
4th		-0.0061	-0.07
5th and higher		0.0762	0.75

Comment: **** statistically significant at the 1% level
*** statistically significant at the 5% level
** statistically significant at the 10% level
* statistically significant at the 15% level
s.g. means that the group of variables is significant.

Table 3.5 : Coefficients of birth order and number of siblings in separate regressions

	Males		Females	
	Coeff.	**t**	**Coeff.**	**t**
Number of brothers				
0. **Reference group**				
1	-0.0374	-1.39	-0.1149****	-3.82
2	-0.1079****	-3.10	-0.2023****	-5.20
3	-0.1869****	-3.59	-0.4160****	-7.50
4 or more	-0.2369****	-3.75	-0.3987****	-5.55
Number of sisters				
0. **Reference group**				
1	-0.0989****	-3.73	-0.0958****	-3.30
2	-0.1158****	-3.26	-0.1511****	-3.98
3	-0.1495****	-2.79	-0.1930****	-3.53
4 or more	-0.2990****	-4.35	-0.4130****	-5.91
Birth Order				
Only child. **Reference group**				
First	-0.0601***	-2.54	-0.0848****	-3.21
2nd	-0.0491*	-1.57	-0.1060****	-3.11
3rd	-0.1346****	-2.96	-0.1289****	-2.63
4th	-0.1341***	-2.11	-0.1274**	-1.83
5th and higher	-0.3189****	-4.41	-0.2338****	-3.09

Comment: **** statistically significant at the 1% level
*** statistically significant at the 5% level
** statistically significant at the 10% level
* statistically significant at the 15% level

Table 3.6 a : Ordered probit. Males

Age at grade 6 entry	Coeff.	Std. dev.	t	P>|t|
Father's occupation				
Farmer	-0.1093	0.0690	-1.58	0.113
Craftsman	-0.1018	0.0413	-2.47	0.014
Executive	-0.2906	0.0428	-6.79	0.000
Middle Manager	-0.1811	0.0421	-4.30	0.000
White Collar. **Reference group**				
Blue Collar	0.1093	0.0314	3.48	0.000
Observation Missing	0.0858	0.1045	0.82	0.412
Mother's occupation				
Farmer	-0.0880	0.0760	-1.16	0.247
Craftsman	0.0087	0.0577	0.15	0.880
Executive	-0.1765	0.0537	-3.29	0.001
Middle Manager	-0.0564	0.0542	-1.04	0.298
White Collar. **Reference group**				
Blue Collar	0.0955	0.0339	2.82	0.005
Observation Missing	0.0176	0.0339	0.52	0.603
Father's education				
Without Qualification. **Reference group**				
Elementary Certificate	-0.1223	0.0368	-3.32	0.001
Vocational Degree	-0.0827	0.0384	-2.16	0.031
High School Degree	-0.3313	0.0549	-6.03	0.000
College	-0.4149	0.0570	-7.28	0.000
Observation Missing	0.1053	0.0533	1.98	0.048
Mother's education				
Without Qualification. **Reference group**				
Elementary Certificate	-0.2142	0.0330	-6.49	0.000
Vocational Degree	-0.1672	0.0407	-4.11	0.000
High School Degree	-0.3756	0.0491	-7.66	0.000
College	-0.5322	0.0645	-8.25	0.000
Observation Missing	-0.0140	0.0514	-0.27	0.785
Father's employment status				
Employed. **Reference group**				
Unemployed or Inactive	0.0054	0.0531	0.10	0.920
Retired	-0.2336	0.0387	-6.03	0.000
Deceased or Observation Missing	-0.0922	0.1105	-0.84	0.404
Mother's employment status				
Employed. **Reference group**				
Unemployed, inactive or retired	-0.0110	0.0276	-0.40	0.690
Deceased or Observation Missing	0.0302	0.0779	0.39	0.698
Number of brothers				
0. **Reference group**				
1	0.1404	0.0291	4.83	0.000
2	0.2428	0.0373	6.51	0.000
3	0.4336	0.0546	7.95	0.000
4 or more	0.4563	0.0653	6.98	0.000
Number of sisters				
0. **Reference group**				
1	0.1209	0.0285	4.24	0.000
2	0.2207	0.0379	5.82	0.000
3	0.3308	0.0563	5.88	0.000
4 or more	0.4215	0.0708	5.95	0.000
Birth Order				
Only child. **Reference group**				
First	0.0030	0.0256	0.12	0.906
2nd	-0.0957	0.0336	-2.85	0.004
3rd	-0.1210	0.0482	-2.51	0.012
4th	-0.2102	0.0666	-3.15	0.002
5th and higher	-0.2510	0.0747	-3.36	0.001
Immigrants				
Both parents French citizens. **Reference group**				
One parent is an immigrant	-0.0406	0.0416	-0.98	0.329
Both parents are immigrants	0.1211	0.0395	3.07	0.002
_cut1	-1.9168	0.0560		
_cut2	0.4210	0.0526		
_cut3	1.4587	0.0542		
_cut4	2.1217	0.0584		
Pseudo R2	0.0645			
Number of observations	12,367			
Log likelihood	-11,698			

Table 3.6 b : Ordered probit. Females

Age at grade 6 entry	Coeff.	Std. dev.	t	P>|t|
Father's occupation				
Farmer	-0.2481	0.0753	-3.29	0.001
Craftsman	-0.0479	0.0459	-1.04	0.297
Executive	-0.3423	0.0496	-6.91	0.000
Middle Manager	-0.1592	0.0481	-3.31	0.001
White Collar. **Reference group**				
Blue Collar	0.0514	0.0347	1.48	0.139
Observation Missing	0.0235	0.1140	0.21	0.837
Mother's occupation				
Farmer	0.1000	0.0814	1.23	0.219
Craftsman	-0.0521	0.0623	-0.84	0.403
Executive	-0.3211	0.0606	-5.30	0.000
Middle Manager	-0.1769	0.0614	-2.88	0.004
White Collar. **Reference group**				
Blue Collar	0.1525	0.0378	4.03	0.000
Observation Missing	-0.0283	0.0381	-0.74	0.458
Father's education				
Without Qualification. **Reference group**				
Elementary Certificate	-0.0644	0.0390	-1.65	0.099
Vocational Degree	-0.0532	0.0429	-1.24	0.215
High School Degree	-0.1631	0.0641	-2.55	0.011
College	-0.3034	0.0639	-4.75	0.000
Observation Missing	0.1946	0.0544	3.58	0.000
Mother's education				
Without Qualification. **Reference group**				
Elementary Certificate	-0.3306	0.0361	-9.17	0.000
Vocational Degree	-0.2578	0.0452	-5.71	0.000
High School Degree	-0.5026	0.0575	-8.74	0.000
College	-0.5029	0.0729	-6.90	0.000
Observation Missing	-0.0742	0.0573	-1.30	0.195
Father's employment status				
Employed. **Reference group**				
Unemployed or Inactive	0.0860	0.0547	1.57	0.116
Retired	-0.2757	0.0429	-6.43	0.000
Deceased or Observation Missing	-0.0075	0.1196	-0.06	0.950
Mother's employment status				
Employed. **Reference group**				
Unemployed, inactive or retired	-0.0286	0.0306	-0.93	0.350
Deceased or Observation Missing	-0.0144	0.0850	-0.17	0.865
Number of brothers				
0. **Reference group**				
1	0.1282	0.0328	3.91	0.000
2	0.2058	0.0422	4.87	0.000
3	0.3379	0.0593	5.70	0.000
4 or more	0.5983	0.0756	7.92	0.000
Number of sisters				
0. **Reference group**				
1	0.1066	0.0317	3.36	0.001
2	0.2032	0.0412	4.93	0.000
3	0.2660	0.0586	4.54	0.000
4 or more	0.3877	0.0733	5.29	0.000
Birth Order				
Only child. **Reference group**				
First	0.0390	0.0290	1.35	0.178
2nd	-0.0167	0.0371	-0.45	0.652
3rd	-0.0607	0.0531	-1.14	0.253
4th	-0.0692	0.0743	-0.93	0.352
5th and higher	-0.2150	0.0798	-2.70	0.007
Immigrants				
Both parents French citizens. **Reference group**				
One parent is an immigrant	-0.0779	0.0480	-1.62	0.105
Both parents are immigrants	0.1345	0.0437	3.08	0.002
_cut1	-1.8451	0.0613		
_cut2	0.5187	0.0582		
_cut3	1.5851	0.0604		
_cut4	2.2280	0.0663		
Pseudo R2	0.0719			
Number of observations	10157			
Log likelihood	-9111			

Table 3.7 : Ordered probit with interaction dummies. Complete sample.

Education levels (s)	Coeff.	Std. dev.	t	P>|t|
Gender				
Male. Reference group				
Female	0.1520	0.0145	10.47	0.000
Father's occupation				
Farmer	0.1666	0.0772	2.16	0.031
Craftsman	-0.0196	0.0667	-0.29	0.769
Executive	0.2465	0.0733	3.36	0.001
Middle Manager	0.2138	0.0841	2.54	0.011
White Collar. **Reference group**				
Blue Collar	-0.1376	0.0216	-6.36	0.000
Observation Missing	0.1324	0.1122	1.18	0.238
Mother's occupation				
Farmer	0.0859	0.0513	1.68	0.094
Craftsman	0.0523	0.0385	1.36	0.174
Executive	0.2714	0.0369	7.35	0.000
Middle Manager	0.1636	0.0370	4.42	0.000
White Collar. **Reference group**				
Blue Collar	-0.1893	0.0236	-8.02	0.000
Observation Missing	0.0011	0.0235	0.05	0.963
Father's education				
Without Qualification. **Reference group**				
Elementary Certificate	0.1370	0.0248	5.53	0.000
Vocational Degree	0.0974	0.0265	3.67	0.000
High School Degree	0.3382	0.0378	8.95	0.000
College	0.5196	0.0390	13.34	0.000
Observation Missing	-0.3470	0.0361	-9.62	0.000
Mother's education				
Without Qualification. **Reference group**				
Elementary Certificate	0.2337	0.0225	10.37	0.000
Vocational Degree	0.2210	0.0279	7.93	0.000
High School Degree	0.4339	0.0340	12.77	0.000
College	0.5296	0.0444	11.92	0.000
Observation Missing	-0.1044	0.0362	-2.88	0.004
Father's employment status				
Employed. **Reference group**				
Unemployed or Inactive	-0.0078	0.0360	-0.22	0.829
Retired	0.6898	0.0270	25.54	0.000
Deceased or Observation Missing	0.1888	0.0759	2.49	0.013
Mother's employment status				
Employed. **Reference group**				
Unemployed, inactive or retired	0.0925	0.0190	4.87	0.000
Deceased or Observation Missing	-0.1541	0.0539	-2.86	0.004
Number of brothers				
0. **Reference group**				
1	-0.0954	0.0282	-3.39	0.001
2	-0.2077	0.0354	-5.86	0.000
3	-0.2939	0.0500	-5.87	0.000
4 or more	-0.3889	0.0607	-6.40	0.000
Number of sisters				
0. **Reference group**				
1	-0.1229	0.0274	-4.49	0.000
2	-0.1678	0.0353	-4.76	0.000
3	-0.2315	0.0509	-4.55	0.000
4 or more	-0.3617	0.0625	-5.79	0.000

Number of brothers * Father occupation				
Number of sisters * Father occupation				
Number of brothers * Farmer or Craftsman				
0. **Reference group**				
1	0.0175	0.0542	0.32	0.746
2	0.1180	0.0692	1.70	0.088
3	-0.0190	0.1028	-0.19	0.854
4 or more	0.2552	0.1321	1.93	0.053
Number of sisters * Farmer or Craftsman				
0. **Reference group**				
1	0.0582	0.0524	1.11	0.267
2	0.0952	0.0694	1.37	0.170
3	0.2387	0.1033	2.31	0.021
4 or more	0.0707	0.1394	0.51	0.612
Number of brothers * Executive				
0. **Reference group**				
1	0.2353	0.0596	3.95	0.000
2	0.3372	0.0804	4.19	0.000
3	0.3223	0.1430	2.25	0.024
4 or more	0.6303	0.2013	3.13	0.002
Number of sisters * Executive				
0. **Reference group**				
1	0.2117	0.0589	3.60	0.000
2	0.3293	0.0819	4.02	0.000
3	0.4731	0.1346	3.51	0.000
4 or more	0.3808	0.2264	1.68	0.093
Number of brothers * Middle Manager				
0. **Reference group**				
1	0.0180	0.0694	0.26	0.795
2	0.1747	0.0956	1.83	0.068
3	-0.0255	0.1480	-0.17	0.863
4 or more	0.3345	0.2098	1.59	0.111
Number of sisters * Middle Manager				
0. **Reference group**				
1	0.1149	0.0687	1.67	0.094
2	0.0220	0.0940	0.23	0.815
3	0.1792	0.1606	1.12	0.265
4 or more	0.1209	0.2356	0.51	0.608
Number of brothers * Observation Missing				
0. **Reference group**				
1	-0.1215	0.0767	-1.58	0.113
2	-0.1993	0.0959	-2.08	0.038
3	-0.3650	0.1268	-2.88	0.004
4 or more	-0.3719	0.1504	-2.47	0.013
Number of sisters * Observation Missing				
0. **Reference group**				
1	-0.3042	0.0744	-4.09	0.000
2	-0.2864	0.0950	-3.01	0.003
3	-0.4129	0.1254	-3.29	0.001
4 or more	-0.5462	0.1458	-3.75	0.000

Birth Order				
Only child. **Reference group**				
First	-0.0839	0.0250	-3.36	0.001
2nd	-0.0740	0.0318	-2.33	0.020
3rd	-0.1466	0.0450	-3.26	0.001
4th	-0.1918	0.0622	-3.08	0.002
5th and higher	-0.2735	0.0675	-4.05	0.000
Birth Order * Father occupation				
Birth Order * Farmer or Craftsman				
Only child. **Reference group**				
First	0.0490	0.0482	1.02	0.309
2nd	-0.0428	0.0618	-0.69	0.488
3rd	-0.0104	0.0879	-0.12	0.905
4th	0.0957	0.1301	0.74	0.462
5th and higher	-0.2164	0.1449	-1.49	0.135
Birth Order * Executive				
Only child. **Reference group**				
First	-0.0230	0.0508	-0.45	0.650
2nd	-0.0984	0.0699	-1.41	0.159
3rd	-0.1095	0.1130	-0.97	0.333
4th	-0.0510	0.1975	-0.26	0.796
5th and higher	-0.5065	0.2225	-2.28	0.023
Birth Order * Middle Manager				
Only child. **Reference group**				
First	-0.0445	0.0588	-0.76	0.449
2nd	-0.1442	0.0832	-1.73	0.083
3rd	-0.0989	0.1277	-0.77	0.439
4th	-0.1108	0.1928	-0.58	0.566
5th and higher	-0.5292	0.2305	-2.30	0.022
Birth Order * Observation Missing				
Only child. **Reference group**				
First	0.1771	0.0744	2.38	0.017
2nd	0.3584	0.0900	3.98	0.000
3rd	0.4203	0.1162	3.62	0.000
4th	0.6572	0.1455	4.52	0.000
5th and higher	0.8319	0.1634	5.09	0.000
Immigrants				
Both parents French citizens. **Reference group**				
One parent is an immigrant	0.0281	0.0291	0.97	0.333
Both parents are immigrants	0.1251	0.0280	4.47	0.000
_cut1	-1.4737	0.0445		
_cut2	0.0643	0.0431		
_cut3	0.7674	0.0433		
_cut4	1.4051	0.0438		
Pseudo R2	0.0968			
Number of observations	22524			
Log likelihood	-30182			

Table 3.8 : Coefficients of number of brothers or sisters interacted with father occupation

	All			Males			Females		
	g. s.	**Coeff.**	**t**	**g. s.**	**Coeff.**	**t**	**g. s.**	**Coeff.**	**t**
Number of brothers									
0. **Reference group**	***Yes***			***Yes***			***Yes***		
1		-0.0954****	-3.39		-0.1093****	-2.87		-0.0837***	-1.99
2		-0.2077****	-5.86		-0.2125****	-4.44		-0.2075****	-3.92
3		-0.2939****	-5.87		-0.2330****	-3.40		-0.3721****	-5.05
4 or more		-0.3889****	-6.40		-0.4095****	-5.10		-0.3749****	-4.02
Number of sisters									
0. **Reference group**	***Yes***			***Yes***			***Yes***		
1		-0.1229****	-4.49		-0.1631****	-4.35		-0.0792***	-1.97
2		-0.1678****	-4.76		-0.1678****	-3.47		-0.1756****	-3.39
3		-0.2315****	-4.55		-0.2604****	-3.69		-0.2060****	-2.80
4 or more		-0.3617****	-5.79		-0.2826****	-3.20		-0.4424****	-4.97
Number of brothers * Father occupation.									
Number of sisters * Father occupation.									
Number of brothers * Farmer or Craftsman									
0. **Reference group**				***Yes***					
1		0.0175	0.32		0.0525	0.71		-0.0184	-0.23
2		0.1180**	1.70		0.1537*	1.64		0.0804	0.78
3		-0.0190	-0.19		-0.0908	-0.63		0.0559	0.38
4 or more		0.2552**	1.93		0.4081***	2.26		0.0702	0.36
Number of sisters * Farmer or Craftsman									
0. **Reference group**									
1		0.05816	1.11		0.1694***	2.36		-0.0724	-0.93
2		0.09517	1.37		0.0474	0.49		0.1480*	1.47
3		0.23874***	2.31		0.2700**	1.80		0.1953	1.36
4 or more		0.07065	0.51		-0.0090	-0.05		0.1203	0.60
Number of brothers * Executive									
0. **Reference group**	***Yes***			***Yes***					
1		0.2353****	3.95		0.3474****	4.42		0.0824	0.90
2		0.3372****	4.19		0.4162****	3.92		0.2366**	1.91
3		0.3223***	2.25		0.4867***	2.59		0.0549	0.25
4 or more		0.6303****	3.13		0.7332****	2.77		0.5566**	1.77
Number of sisters * Executive									
0. **Reference group**	***Yes***			***Yes***					
1		0.21165****	3.60		0.3108****	3.98		0.0925	1.03
2		0.32934****	4.02		0.3765****	3.44		0.2607***	2.09
3		0.47308****	3.51		0.6036****	3.32		0.2787	1.37
4 or more		0.38083**	1.68		0.2508	0.75		0.4731*	1.49
Number of brothers * Middle Manager									
0. **Reference group**									
1		0.0180	0.26		0.1072	1.14		-0.1065	-1.02
2		0.1747**	1.83		0.2812***	2.20		0.0213	0.15
3		-0.0255	-0.17		0.2148	1.02		-0.2311	-1.09
4 or more		0.3345*	1.59		0.7997***	2.44		-0.0028	-0.01
Number of sisters * Middle Manager									
0. **Reference group**									
1		0.1149**	1.67		0.1605**	1.71		0.0550	0.54
2		0.0220	0.23		0.0992	0.75		-0.0442	-0.33
3		0.1792	1.12		0.4048**	1.82		-0.0962	-0.41
4 or more		0.1209	0.51		0.3136	0.92		0.0010	0.00
Number of brothers * Observation Missing									
0. **Reference group**	***Yes***						***Yes***		
1		-0.1215*	-1.58		0.0902	0.86		-0.3660****	-3.23
2		-0.1993***	-2.08		0.0134	0.10		-0.4441****	-3.17
3		-0.3650****	-2.88		-0.1316	-0.74		-0.6177****	-3.41
4 or more		-0.3719***	-2.47		0.0178	0.09		-0.9027****	-3.88
Number of sisters * Observation Missing									
0. **Reference group**	***Yes***			***Yes***			***Yes***		
1		-0.3042****	-4.09		-0.3380****	-3.33		-0.2469***	-2.25
2		-0.2864****	-3.01		-0.2142*	-1.63		-0.3316***	-2.39
3		-0.4129****	-3.29		-0.2168	-1.20		-0.5469****	-3.10
4 or more		-0.5462****	-3.75		-0.6746****	-3.35		-0.4041**	-1.90

Table 3.9 : Coefficients of birth order interacted with father occupation

	All			Males			Females		
	g. s.	**Coeff.**	**t**	**g. s.**	**Coeff.**	**t**	**g. s.**	**Coeff.**	**t**
Birth Order									
Only child. **Reference group**	***Yes***			***Yes***			***Yes***		
First		-0.0839****	-3.36		-0.0821***	-2.42		-0.0859***	-2.32
2nd		-0.0740***	-2.33		-0.0602	-1.38		-0.0852**	-1.83
3rd		-0.1466****	-3.26		-0.1351***	-2.21		-0.1658***	-2.48
4th		-0.1918****	-3.08		-0.2401****	-2.81		-0.1243	-1.36
5th and higher		-0.2735****	-4.05		-0.2398***	-2.55		-0.3012****	-3.08
Birth Order * Father occupation									
Birth Order * Farmer or Craftsman									
Only child. **Reference group**									
First		0.0490	1.02		0.0821	1.26		-0.0019	-0.03
2nd		-0.0428	-0.69		-0.0161	-0.19		-0.0822	-0.91
3rd		-0.0104	-0.12		-0.0144	-0.12		-0.0220	-0.17
4th		0.0957	0.74		0.2925*	1.64		-0.1499	-0.78
5th and higher		-0.2164*	-1.49		-0.3120*	-1.54		-0.1207	-0.58
Birth Order * Executive									
Only child. **Reference group**									
First		-0.0230	-0.45		-0.0222	-0.33		-0.0306	-0.39
2nd		-0.0984	-1.41		-0.1107	-1.19		-0.0854	-0.80
3rd		-0.1095	-0.97		-0.2222*	-1.52		0.0803	0.44
4th		-0.0510	-0.26		0.0181	0.07		-0.1602	-0.48
5th and higher		-0.5065***	-2.28		-0.5890**	-1.94		-0.3924	-1.16
Birth Order * Middle Manager									
Only child. **Reference group**									
First		-0.0445	-0.76		-0.0038	-0.05		-0.1026	-1.14
2nd		-0.1442**	-1.73		0.0041	0.04		-0.3578****	-2.87
3rd		-0.0989	-0.77		-0.1258	-0.71		-0.0707	-0.38
4th		-0.1108	-0.58		-0.2944	-1.14		0.0201	0.07
5th and higher		-0.5292***	-2.30		-1.0479****	-3.18		-0.1076	-0.33
Birth Order * Observation Missing	***Yes***			***Yes***			***Yes***		
Only child. **Reference group**									
First		0.1771***	2.38		0.1393	1.36		0.2475***	2.26
2nd		0.3584****	3.98		0.2961***	2.41		0.4215****	3.16
3rd		0.4203****	3.62		0.3181***	1.97		0.5042****	3.00
4th		0.6572****	4.52		0.6364****	3.18		0.5982****	2.80
5th and higher		0.8319****	5.09		0.5273***	2.35		1.1946****	4.96

Comment: g. s. means that the group of variables is significant (Chi2 test).

**** statistically significant at the 1% level
*** statistically significant at the 5% level
** statistically significant at the 10% level
* statistically significant at the 15% level

Table 4.1 a : Log-wage equation with Heckman covariate. Males

Log-wages	Coeff.	Std. dev.	t	P>|t|
Constant	8.4544	0.0461	183.38	0.000
$\rho\sigma$	0.0379	0.0251	1.51	0.131
Completed Education				
High school dropouts. **Reference group**				
Vocational degree	0.1715	0.0365	4.71	0.000
Grade 12	0.2208	0.0589	3.75	0.000
Two years of college	0.4085	0.0743	5.50	0.000
Four years of college	0.6266	0.0972	6.45	0.000
Father's occupation				
Farmer	-0.0268	0.0205	-1.31	0.191
Craftsman	0.0255	0.0121	2.12	0.034
Executive	0.0404	0.0167	2.43	0.015
Middle Manager	0.0360	0.0139	2.59	0.010
White Collar. **Reference group**				
Blue Collar	0.0076	0.0100	0.76	0.448
Observation Missing	-0.0203	0.0308	-0.66	0.510
Mother's occupation				
Farmer	0.0121	0.0220	0.55	0.582
Craftsman	0.0137	0.0168	0.82	0.413
Executive	0.0253	0.0157	1.61	0.107
Middle Manager	0.0054	0.0159	0.34	0.736
White Collar. **Reference group**				
Blue Collar	0.0142	0.0109	1.30	0.192
Observation Missing	0.0025	0.0101	0.25	0.804
Father's education				
Without Qualification. **Reference group**				
Elementary Certificate	0.0026	0.0115	0.22	0.823
Vocational Degree	0.0097	0.0117	0.83	0.407
High School Degree	0.0420	0.0182	2.31	0.021
College	0.0544	0.0214	2.54	0.011
Observation Missing	-0.0701	0.0170	-4.13	0.000
Mother's education				
Without Qualification. **Reference group**				
Elementary Certificate	0.0066	0.0108	0.61	0.544
Vocational Degree	0.0107	0.0127	0.85	0.398
High School Degree	0.0041	0.0161	0.25	0.801
College	0.0328	0.0208	1.58	0.114
Observation Missing	0.0151	0.0158	0.96	0.340
Father's employment status				
Employed. **Reference group**				
Unemployed or Inactive	-0.0605	0.0158	-3.84	0.000
Retired	-0.0067	0.0164	-0.41	0.681
Deceased or Observation Missing	-0.0090	0.0328	-0.28	0.783
Mother's employment status				
Employed. **Reference group**				
Unemployed, inactive or retired	-0.0037	0.0082	-0.46	0.648
Deceased or Observation Missing	-0.0371	0.0232	-1.60	0.110
Immigrants				
Both parents French citizens. **Reference group**				
One parent is an immigrant	-0.0270	0.0121	-2.22	0.026
Both parents are immigrants	-0.0380	0.0119	-3.20	0.001
Job location (region)				
Rest of France. **Reference group**				
Paris (75)	0.1453	0.0148	9.79	0.000
Paris suburbs (77) Melun	0.1187	0.0273	4.34	0.000
Paris suburbs (78) Versailles	0.1611	0.0218	7.40	0.000
Paris suburbs (91) Evry	0.1373	0.0233	5.89	0.000
Paris suburbs (92) Nanterre	0.1597	0.0174	9.20	0.000
Paris suburbs (93) Saint-Denis	0.1072	0.0258	4.16	0.000
Paris suburbs (94) Créteil	0.1377	0.0265	5.20	0.000
Paris suburbs (95) Cergy-Pontoise	0.1088	0.0267	4.07	0.000
Marseilles (13)	-0.0126	0.0231	-0.55	0.585
Toulouse (31)	-0.0047	0.0240	-0.20	0.845
Lyons (69)	0.0445	0.0179	2.48	0.013
Nice (06)	0.0152	0.0284	0.53	0.594
Lille (59)	-0.0335	0.0141	-2.37	0.018
Foreign Countries	0.2264	0.0214	10.55	0.000
R-squared	0.358			
Root MSE	0.338			
Number of observations	12,367			

Table 4.1 b : Log-wage equation with Heckman covariate. Females

Log-wages	Coeff.	Std. dev.	t	P>|t|
Constant	8.0324	0.0468	171.66	0.000
$\rho\sigma$	-0.0435	0.0246	-1.77	0.077
Completed Education				
High school dropouts. **Reference group**				
Vocational degree	0.2101	0.0361	5.82	0.000
Grade 12	0.3673	0.0575	6.39	0.000
Two years of college	0.7144	0.0724	9.87	0.000
Four years of college	0.9739	0.0950	10.25	0.000
Father's occupation				
Farmer	-0.0553	0.0251	-2.20	0.028
Craftsman	0.0148	0.0151	0.98	0.328
Executive	0.0149	0.0206	0.72	0.470
Middle Manager	0.0079	0.0163	0.48	0.630
White Collar. **Reference group**				
Blue Collar	-0.0076	0.0119	-0.64	0.522
Observation Missing	0.0057	0.0377	0.15	0.879
Mother's occupation				
Farmer	0.0379	0.0265	1.43	0.152
Craftsman	0.0255	0.0201	1.27	0.204
Executive	0.0104	0.0203	0.51	0.608
Middle Manager	-0.0052	0.0199	-0.26	0.792
White Collar. **Reference group**				
Blue Collar	0.0130	0.0132	0.99	0.324
Observation Missing	-0.0213	0.0124	-1.72	0.086
Father's education				
Without Qualification. **Reference group**				
Elementary Certificate	0.0071	0.0132	0.53	0.593
Vocational Degree	0.0130	0.0145	0.90	0.371
High School Degree	0.0452	0.0217	2.08	0.037
College	0.0192	0.0222	0.87	0.386
Observation Missing	0.0240	0.0200	1.20	0.232
Mother's education				
Without Qualification. **Reference group**				
Elementary Certificate	-0.0093	0.0137	-0.68	0.495
Vocational Degree	-0.0201	0.0166	-1.21	0.226
High School Degree	-0.0150	0.0230	-0.65	0.516
College	-0.0016	0.0269	-0.06	0.953
Observation Missing	-0.0178	0.0191	-0.93	0.352
Father's employment status				
Employed. **Reference group**				
Unemployed or Inactive	-0.0095	0.0184	-0.52	0.605
Retired	-0.0569	0.0180	-3.15	0.002
Deceased or Observation Missing	-0.0454	0.0396	-1.15	0.252
Mother's employment status				
Employed. **Reference group**				
Unemployed, inactive or retired	-0.0252	0.0099	-2.55	0.011
Deceased or Observation Missing	-0.0009	0.0283	-0.03	0.973
Immigrants				
Both parents French citizens. **Reference group**				
One parent is an immigrant	-0.0144	0.0157	-0.92	0.357
Both parents are immigrants	-0.0128	0.0146	-0.87	0.383
Job location (region)				
Rest of France. **Reference group**				
Paris (75)	0.2173	0.0167	13.05	0.000
Paris suburbs (77) Melun	0.1088	0.0362	3.00	0.003
Paris suburbs (78) Versailles	0.2140	0.0279	7.68	0.000
Paris suburbs (91) Evry	0.2385	0.0302	7.91	0.000
Paris suburbs (92) Nanterre	0.2711	0.0230	11.81	0.000
Paris suburbs (93) Saint-Denis	0.2246	0.0326	6.89	0.000
Paris suburbs (94) Créteil	0.1811	0.0342	5.30	0.000
Paris suburbs (95) Cergy-Pontoise	0.2372	0.0345	6.87	0.000
Marseilles (13)	-0.0199	0.0271	-0.73	0.463
Toulouse (31)	-0.0534	0.0331	-1.61	0.107
Lyons (69)	0.0545	0.0258	2.11	0.035
Nice (06)	0.1015	0.0341	2.97	0.003
Lille (59)	-0.0256	0.0179	-1.43	0.152
Foreign Countries	0.2391	0.0285	8.40	0.000
R-squared	0.403			
Root MSE	0.382			
Number of observations	10,157			

Table 4.2 : Comparison of returns to education levels

	log-wages		log-earnings		log-wmax	
	OLS	**Heckman**	**OLS**	**Heckman**	**OLS**	**Heckman**
Males						
f1	0.2230	0.1715	0.3889	0.4156	0.1732	0.1542
f2	0.3072	0.2208	0.4785	0.5234	0.2521	0.2202
f3	0.5185	0.4085	0.7310	0.7881	0.4405	0.3999
f4	0.7715	0.6266	1.0136	1.0889	0.6873	0.6338
Females						
f1	0.1538	0.2101	0.4122	0.5643	0.1522	0.2139
f2	0.2705	0.3673	0.5498	0.8110	0.2585	0.3644
f3	0.5907	0.7144	0.9765	1.3104	0.5250	0.6604
f4	0.8092	0.9739	1.1670	1.6115	0.7295	0.9097

Table 4.3 : Comparison of returns to education levels (per year)

	log-wages		log-earnings		log-wmax	
	OLS	**Heckman**	**OLS**	**Heckman**	**OLS**	**Heckman**
Males						
$\Delta f2/\Delta d2$	0.050	0.029	0.053	0.063	0.046	0.039
$\Delta f3/\Delta d3$	0.124	0.110	0.149	0.156	0.111	0.106
$\Delta f4/\Delta d4$	0.149	0.128	0.166	0.177	0.145	0.138
Females						
$\Delta f2/\Delta d2$	0.083	0.112	0.098	0.176	0.076	0.108
$\Delta f3/\Delta d3$	0.229	0.248	0.305	0.357	0.190	0.211
$\Delta f4/\Delta d4$	0.156	0.185	0.136	0.215	0.146	0.178

Table 4.4 : Estimated values of ρ and $\rho\sigma$

	Males			Females		
	ρ	$\rho\sigma$	t	ρ	$\rho\sigma$	t
Log-wages	0.1122	0.0379	1.51	-0.1139	-0.0435	-1.77
Log-earnings	-0.0342	-0.0197	-0.46	-0.2026	-0.1174	-3.15
Log-maximum wages	0.0437	0.0140	0.59	-0.1323	-0.0476	-2.06