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FAMILY INCOME AND CHILDREN'S EDUCATION: USING THE NORWEGIAN OIL BOOM AS A NATURAL EXPERIMENT

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Family income and children's education: Using the Norwegian oil boom as a natural experiment.

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Abstract

Parental income is positively correlated with children's educational attainment. This paper addresses the causality of this observed link. We have a unique data set for Norwegians born in the period from 1968-1973, with a measure of permanent family income from the children are 0-20 years old. This enables us to look at the long term effect of family income on children's educational attainment. The Norwegian oil shock in the 1970s and 1980s is used as an instrument, since this - in some regions, but not in others - implied a general increase in income that was unrelated to education. This variation in income is used to estimate the causal effect of family income on children's educational attainment. We find no causal relationship between family income and children's educational attainment. This result is robust to different specification tests.

JEL Classification: I2, J13, J62

Keywords: Mobility, Instrumental Variables, Income and Education

1   Introduction

Family income is positively correlated with children's educational attainment. This can be observed from data for countries all over the world. The main question researchers ask themselves is whether the observed correlation is due to nature, nurture or a combination of these two extremes. Is the link between parental income and children's educational attainment casual, or is the observed link mostly a story of selection into education?

Earlier literature has not been clear on these matters, indicating that much more research is required. Shea (2000) analyses the effects family income has on children's educational attainment and finds that parent's money does not matter for children's educational attainment. Some newer papers (Blanden and Gregg (2004), Oreopoluos, Page and Stevens (2005)) on the other hand, find that there exists a small causal effect of family income for children's outcomes later in life. These different results (see Maurin (2002) for an overview) stem from different sources of data and different methods used to investigate the problem of causality.

In this paper we investigate the link between family income and children's educational attainment controlling for different observable parental and child characteristics. An important variable that we cannot observe is parental abilities. There might be differences in parent's abilities to generate income that are transferred to their children and generate the observed correlation between family income and children's educational attainment. Ideally, we should include a proxy for ability in the regression equation for children's educational attainment. Since we do not have a good proxy variable for ability in the data set, the instrumental variable approach is used to identify the link between family income and children's educational attainment. As an instrument, we use the oil shock in Norway in the 1970s and 1980s to make the family income exogenous to variations in parental abilities. We compare two counties in Norway, Rogaland which was strongly affected by the shock, and Sør-Trøndelag which did not experience any observed early effects from the shock. Sør-Trøndelag was chosen as a reference county because the size of the two counties' main cities Stavanger and Trondheim is approximately the same, and because Sør-

Trøndelag is so far from Rogaland that there should be little correlation as regards the effect of the oil shock. The oil shock increased the income of families living in Rogaland significantly compared to families living in Sør-Trøndelag. The increased income was independent of abilities since it was due to a shock in the economy whose effects depended on geography, and not on skills and abilities, at least in the early years.

We have a data set tracking families back to 1968 and including information on income and education for the entire Norwegian population. The permanent income is measured as average family income from the child is 0-20 years old. This is a unique measure of permanent income based on reliable Norwegian data sources. The average family income in Rogaland and Sør-Trøndelag from 1968-1999 was around the average total Norwegian family income in this period. This means that we can study a selection of families in Norway that is not only low income families[1], but also average and high income families. This is important in an investigation of causation versus selection, and also if we are to make policy suggestions that benefit the whole population. In deciding to increase the level of education in society, politicians often base their choice on the spillover effects that higher education gives to later generations.

The main results show that family income does not matter directly for children's educational attainment. Even though the OLS results show clear effects of family income on children's educational attainment the instrumental variable results are mostly negative, close to zero and insignificant. This suggests that the positive link between family income and children's educational attainment is mainly due to selection into education and not causation. This selection process can come from hereditary factors, cultural factors, or from other familybackground factors linked to parental education levels.

The paper is organized as follows: Section 2 presents an overview of relevant income and education literature. Section 3 describes the data and gives information about the variables we use in the empirical analysis. Section 4 describes the

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[1] As opposed to Black et al. (2005) who used the Norwegian school reform in the 1960s, which affected only those with 9 years or less of education.

instrument in more detail, while Section 5 presents the identification strategy used in this paper. Section 6 presents the results of the estimations, and Section 7 incorporates different specification tests to verify the results. Finally Section 8 presents conclusions and a discussion of why family income does not matter for children's educational attainment.

2   Previous Literature

Running an OLS regression on children's educational attainment with respect to parental income and education confirms the observable high correlation between these variables. This has lead many researchers to conclude that there exists a causal relationship and that we observe transmission of income and education through generations. But the observed high correlations give no evidence of causal relationships. As Solon (1999) concludes in his chapter on intergenerational mobility in the labor market; *"Unfortunately, we remain fairly ignorant about the causal processes underlying the intergenerational transmission of earnings. . . does parental income matters so much as it does because high-income parents are able to invest more in their children's human capital, or because the genetic or cultural traits that contributed to the parents' high earnings are passed on to the children?"* These questions regarding intergenerational transmission of income andeducation, and the direct effect of family income on children's educational attainment, are pressing ones.

There is an extensive literature both on the intergenerational transmission of income and education[2]. The received literature on the direct effect of family income on children's educational attainment is more limited. This is an important research area because while parental education is normally already determined when the children grow up, income can change drastically during the children's adolescence. Independent of parental educational attainment and abilities, family income may increase due to shocks to the economy, luck in the labor market or through other transitory income shocks. How these income changes then affect the children's

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[2]See Solon (1999) for a review of the income literature and Black et al. (2005) for a review of the education literature.

educational attainment can have important policy relevance. To aid policy we need to know the effects such policies will have on individual income and education. Should we focus higher education policy on lower tuition fees and scholarships or should we aim policies at earlier periods when the children's cognitive and non-cognitive skills are yet to be shaped? The latter type of policy may be too costly if most of the intergenerational transmission we observe is due to inherited abilities.

Shea (2000) finds negligible effects of parent income on children's skills. By using father's union status, industry and job loss he hopes to find exogenous effects that are correlated with parental income, but uncorrelated with ability. He concludes that parent income has a negligible impact on children's human capital for most families. Maurin (2002) claims that the IV effects reported in Shea often are very poorly estimated, due to too few observations and weak instruments. Most of the confidence intervals for his IV results may also include the OLS results. Carneiro and Heckman (2002) criticise Shea for interpreting his estimates as evidence against credit constraints in schooling since his measure of permanent family income is over a period of 20 years and not split up in smaller income streams. Blanden and Gregg (2004) review different approaches to estimating the effect of family income on children's educational attainment for Britain. They find some effect of family income, but the effects are rather small. However, they show that also small income effects can generate large educational inequalities when income inequalities are wide. Among the models they investigate, they use the sibling fixed effect estimator, assuming that ability levels are the same for all siblings. This assumption is debatable, since siblings differ in their educational attainment and ability levels (see Ermisch and Francesconi (2001) for a discussion of problems using siblings estimators). Another interesting approach is given by Oreopoluos, Page and Stevens (2005). They look at how worker displacements lead to a long-lasting decline in family income. The estimates are driven by the families at the bottom of the income distribution. They control for income before the displacement took place, but there might be other crucial differences between the families exposed to worker displacements and the other families that they do not account for. Chevalier, Harmon, O'Sullivan and Walker (2005) use two different instruments, one for explaining parental education

and one for family income. They use fathers' union membership as an instrument for father's income and the British School Reform in the 1960s as an instrument for parental education. They are then able to investigate the intergenerational transmission of education both with respect to parental education and income. They find that parental education becomes insignificant and permanent income matters much more than when using OLS estimation. One of the problems using the school reform as an instrument is that it is only relevant for the lower distribution of educational attainment. This eliminates a large part of the population from the empirical analysis. Chevalier et al suffer the same problems as Shea (2000) with using fathers' union membership as an instrument.

In the empirical analysis on the causal effects of parental income on children's education, we include a greater variety of the population when using the oil shock in Norway as an instrument to explain parental income. Also our instrument for family income, the Norwegian oil shock in the 1970s and 1980s, is highly correlated with family income and independent of ablities. We have a unique opportunity to contribute to the existing literature on causality and selection into education.

3 Data

We have a data set comprising the entire population of Norwegians born in the period from 1968-1973. It contains both administrative data collected from Statistics Norway and data collected from the censuses in 1960, 1970 and 1980. We follow the cohorts from birth until 2002. The analysis will focus on the individual's years of education and how this is related to different family factors such as parental education and income. We have a unique data set with information about parent income from 1968-1999, both parents' and children's education history, marital status, number of siblings, parents' employment status and age and the county and municipality they grew up in. All of the data is linked by personal identity codes. We have deleted around 20 % of the data because of missing data, mainly as a result of missing parental identification numbers and too few observations for families with non-Norwegian citizenship. The original data set consisted of 417 644 observations,

while my net data set has 330 918 observations.

My main variables are family income, education variables, number of siblings, parent's age, marital status and municipality information. Table 1 gives an overview of the variables used in the regressions.

The educational attainment for both parents and children is taken from Statistics Norway. These data are reported by the educational institutions directly to Statistics Norway, which means that there is very little measurement error in these data. The number of individuals in family, municipality of residence, marital status and age are all taken from the administrative data base and linked to the censuses in 1960, 1970 and 1980. This should ensure accurate information, since these sources are reliable and do not involve individual self-reporting. There are data for both fathers' and mothers' income streams from 1968-1999. We add mother's and father's income into one variable, family income.[3] We take the logarithm of family income after having calculated the average income streams in order to be able to compare education and family income easier in the empirical analysis. The data are from the pension register taken from the public social security program in Norway starting in 1968. Income includes wages and income from business activity before tax, including taxable income such as unemployment benefits, disability benefits and sickness benefits. We both discount and deflate the family income, because we look at a long-term perspective of 20 years. We also deflate the income to real 1999 income by using the average yearly consumer price index taken from Statistics Norway. A 3% discount rate is used to discount the income down to 1967, the year before the first cohort children were born.[4] We control for marital status by adding a dummy variable that is 1 if the mother is married in 1980 and 0 otherwise.

It is important to work with large samples when using the instrumental variable approach, because the instrumental variable is consistent, though not necessarily unbiased. Selecting the segment of the 1968-1973 cohorts born in Rogaland and

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[3]At least one of the parents is the biological parent. We match the child with its mother and father using a household id. This means that we measure family income as total resources of the household the child lives in.

[4]This follows the same approach for discounting as in Carneiro and Heckman (2003).

Sør-Trøndelag gives 15628 observations, 8832 children born in Rogaland and 6796 born in Sør-Trøndelag. There might be a problem that families move away from or to Rogaland and Sør-Trøndelag in the 1970s, thus we only use the data for families living in these counties from the year the children were born until at least 1980. This ensures that we can compare the families actually living in Rogaland, who were thus exposed to the oil shock, with the families living in Sør-Trøndelag.[5]

Table 2a provides descriptive statistics for all of the children in the final sample. Table 2b gives the information for the families living in Rogaland and Table 2c for the families living in Sør-Trøndelag. We see that the variables for families in Rogaland and Sør-Trøndelag are mostly equal, except for some differences for fathers' education. The most striking difference is the difference in average family income of about 20 000NOK.[6]

4   The Instrument: The Norwegian Oil Boom

Ability is an omitted variable in my regression analysis. We do not have data that can describe the children's or parents' abilities. There exists an upward bias because of the positive correlation between parent's abilities and the family characteristics if parent's observable skills are not included. The reason for this is the positive correlation between family income and abilities that are transmitted across generations. Thus we need an instrument that is highly correlated with family income but uncorrelated with the omitted variable, ability. The oil shock in Norway in the 1970s serves as an instrument to explain parental income. This oil shock can be seen as a unique natural experiment[7] in which the families in Rogaland experienced increased overall family income compared to families in Sør-Trøndelag. This shock is exogenous to ability and parent's educational attainment, although it increased family incomes significantly.

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[5]Since very few families in Noway in the 1970s and 1980s move between counties there seem to be few selection problems in excluding these families.

[6]Income is measured in 1999 NOK. 1NOK=6.46USD (22.01.07)

[7]See Maurin and McNally (2005) for an interesting natural experiment using the French Student Revolution in 1968 as an instrument for parental education.

At the end of 1969 there was a major oil discovery in the North Sea, and on 1 June 1970 the public was informed about these findings. The Norwegian oil adventure had begun. The oil shock provided a huge boost to the entire Norwegian economy, but Rogaland was first and most strongly influenced, since the main oil production in the relevant period was located off the coast here. Before Norway discovered the huge oil supply in the North Sea, Rogaland was a normal Norwegian county whose main economic activity centered around fish and agriculture. When oil was discovered, Norway decided to build its main oil base in Stavanger, the largest city in Rogaland. Statoil and the Norwegian Petroleum Directorate have had offices there since 1972. By locating here, the politicians in Norway made Stavanger the main oil capitol of Norway and soon other oil companies also located in Stavanger. People were hired from all over the country, but the main effect can be seen for families living in and around Stavanger. The shock influenced both low and high income families in Rogaland. Often individuals with less education were hired to do the basic work with the oil production in the North Sea, while more educated individuals, often engineers, worked in the oil companies located in and around Stavanger. When we study the income distribution of the families in 1968 and compare it to the family income in the 1970s and 1980s it is actually the low income families that experience the largest increase in family income. This demonstrates that most families in Rogaland did experience effects of the oil shock. Hence the instrument should work for the whole income distribution of the families in Rogaland.

If we are certain to use the oil shock as an instrument, it must satisfy given criteria. Firstly, the oil shock should be uncorrelated with parental abilities. It is not possible to test this since parental abilities are unobserved, but this should be the case since the increased income seems independent of abilities. The effects of the shock depended on geography and not necessarily skills and abilities, at least in the early years. Secondly, there should be little correlation between the oil shock and the children's educational attainment after controlling for family income. There is some geographical variation between Rogaland and Sør-Trøndelag[8] that cannot be related

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[8]Children from Sør-Trøndelag have on average 0.13 years more education than children from Rogaland. This difference is persistent when controlling for family income both before, under and

to the oil boom, but this educational variance is stable over time. Thirdly, there should be a clear correlation between family income and living in Rogaland in the 1970s. When regressing the dummy variable, Rogaland, on family income, we find that the families here have more than 11% higher income than families living in Sør-Trøndelag when other observable family characteristics are accounted for. This can be seen in Table 1 and Figure 1. In the years from 1975-1985 the families in Rogaland had on average 20 000NOK- 30 000NOK[9] more in annual income than families living in Sør-Trøndelag. Both in the years before and after the oil shock, the average family income is more similar with an average family income of around 10 000NOK more in Rogaland than in Sør-Trøndelag. Figure 2 illustrates the percentage difference in family income between families in Rogaland and Sør-Trøndelag after controlling for differences prior to the oil boom. We see clearly that family income increased significantly in Rogaland compared to Sør-Trøndelag. In Figure 3 we compare the two biggest cities in the counties, Stavanger and Trondheim. Here the families have approximately the same average family income both before 1975 and after 1985, while under the period of the oil shock the families in Stavanger had 10 000NOK-20 000NOK more in average family income than families in Trondheim. Lastly, the data for families living in Rogaland and Sør-Trøndelag should be as similar as possible in all the explanatory variables so that we can rule out that there are other differences between Rogaland and Sør-Trøndelag that drive the results. One of the most important variables is children's years of education. We see in figure 4 that the educational attainment for children in Rogaland and Sør-Trøndelag is similar. For each level of educational attainment the percentage of children from Rogaland and Sør-Trøndelag is approximately the same. In addition, when regressing the instrument on parental education, while controlling for family income, no significant differences are found in parental education between Rogaland and Sør-Trøndelag, except for a small difference for fathers[10].

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after the oil shock, so the variation in children's educational attainment seems uncorrelated with the oil shock.

[9]Income is measured in 1999 NOK. 1NOK=6.46USD (22.01.07)

[10]This difference is not correlated with the oil boom since father's educational attainment is already determined in the 1970s.

In sum, the oil shock in Norway in the 1970s and 1980s seems to satisfy all the criteria for a good instrumental variable.

5   Identification Strategy

In order to identify the causal effects of family income on children's educational attainment, we need to find variations in family income that are exogenous to both the parents' and children's skills. By using the oil shock in Norway in the 1970s and 1980s that boosted the income of the families living in Rogaland, compared to families in Sør-Trøndelag, we hope to find results that can show this link.

The model is given by the following equations:

$$E_{i,child} = \beta_0 + \beta_1 I_{73-88} + \beta_2 I_{68-70} + \beta_3 E_p + \beta_4 M + \beta_5 S + \beta_6 AGE_p + \beta_7 \lambda_c + \varepsilon_i \quad (1)$$

$$I_{73-88} = \delta_0 + \delta_1 ROG + \delta_2 I_{68-70} + \delta_3 E_p + \beta_4 M + \delta_5 S + \delta_6 AGE_p + \delta_7 \lambda_c + \nu_i \ , \quad (2)$$

I_{73-88} is the average family income between 1973 and 1988, when the children in the sample are between 0 and 20 years old. I_{68-70} is the average family income between 1968 and 1970. We need to control for this to capture differences in family income that are not related to the oil boom. The education of the parents', E_p, is a personal characteristic that may affect the children's education and therefore must be controlled for. We also control for marital status of the mother in 1980, M, number of siblings, S, parental age, AGE_p, and cohort, λ_c. We use the instrumental variable method (IV) to estimate this model. Equation 2 is the first stage where ROG serves as an instrument variable for permanent family income. Since we mainly do these regressions for the families living in Rogaland and Sør-Trøndelag, we do not control for county-specific effects.

6 Results

The first stage results for the full sample are given in Table 3a and the OLS results and IV results in Table 3b. We observe from the first stage results that living in Rogaland affects the permanent family income positively and significantly. Living in Rogaland increases the permanent family income by 7.5% compared to living in the rest of Norway. As discussed in Section 4, most of this can be related to the oil shock in the 1970s and beginning of 1980s. From Table 3b we observe that the OLS results for the whole sample give a clear and positive effect of family income on children's educational attainment. The estimates suggest that increasing family income by 10% increases children's level of education by approximately 0.1 %. This is not a huge effect, but if the effect is causal it can be the crucial difference between taking higher education or not for some of the children at the margin.[11] One reason why the effect of income is relatively small in Norway is the compressed income distribution. Hence the effect of income becomes relatively small: but still the effect exists. This holds true when controlling for family factors such as parental education, marital status, and age, number of siblings and cohorts. The most interesting results are given in Column 2 in Table 3b. Here the IV results show that permanent family income is statistically insignificant. The standard errors are larger than for the OLS results, but this finding suggest that family income means much less for children's education than the OLS results imply. We confirm this by performing a Hausman test, rejecting the null hypothesis that the OLS results and the IV results are similar. The difference between OLS and IV is statistically significant at a 5% level, suggesting that permanent family income does not matter or matters very little for children's level of education.

By using Sør-Trøndelag as a reference county we expect to find more precise first- and secondstage results. As seen in Table 4a, living in Rogaland compared to Sør-Trøndelag increases the family income by 11.4%. The OLS results are almost identical to the results for the full sample. The IV results are, as expected,

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[11]See Blanden and Gregg (2004) for an illustration of the impact of small income changes for educational inequalities.

more precise, and the difference between OLS and IV here is statistically significant at a 1% level. This means that we cannot find a causal relationship between children's education and family income. Children mostly inherit their skills and abilities through genes or culture or from other family factors, such as parental education. This corresponds to Shea's (2000) results.

These findings are not typical for the income and education literature.[12] Often the IVs are significantly larger than the OLS results. For the impact of family income on children's educational attainment this has been interpreted as a credit constraint into higher education, meaning that the education level is higher for the marginal child than the average child in the sample. Since we use the family income for the whole childhood period, we have to be careful to interpret the results as evidence against credit constraints. But by using the instrument only for family income when the children are 18 to 20 years old (1986-1992), we confirm the results with some higher measurement errors due to the fact that the oil shock in this later period is not that persistent anymore. Thus we can say that our results seem to be consistent with no or few credit constraints in higher education in Norway. This makes sense, since higher education is free in Norway, and there is a system of universal student loans and grants.

We control for differences in family income prior to the oil shock by including average family income from 1968-1970. From Figure 1, we saw that there are some differences in family income between Rogaland and Sør-Trøndelag also in the two years before the oil shock[13]. By controlling for this difference we feel confident that we control for other effects that may have widened the gap between family income in Rogaland and Sør-Trøndelag.

Parental education is treated as an exogenous variable. Since parental education is positively correlated with parental abilities, we might worry that the dummy for college biases our results upwards. Since we do not have the data to account for the endogeniety of parental education we have to trust the results in Black et al. (2005), who present evidence against a causal relationship between parent and

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[12]See Carneiro and Heckman (2002) for a discussion on IV estimations and credit constraints.

[13]I do not have precise data prior to 1968.

child educational attainment. The other reason why we do not worry about the endogeniety of parental education is that parental education is almost the same for the families in Rogaland and Sør-Trøndelag. When regressing the instrument on parental education there are no significant differences between Rogaland and Sør-Trøndelag, controlling for other observable effects. Also marital status may be correlated with parental abilities. From the regressions, we see that the average child takes more education when the mother is married in 1980. This estimation might be endogenous if abilities are correlated with marital status. Again we regress the instrument on the marital status variable and find no significant difference between Rogaland and Sør-Trøndelag.

All the regressions are done for the pooled sample, but it might be that family income affects girls and boys differently. We check for this by estimating Equation 1 and 2 separately for boys and girls. The effect of family income on children's educational attainment is still insignificant. The IV estimate is lower for girls than for boys, but the difference between OLS and IV is significant at 1% for girls and 5% for boys.[14]

7 Specification Tests

We have performed different specification tests in order to verify the results presented in this paper.

7.1 Sample selection

One might worry that families in Rogaland and Sør-Trøndelag could be different from other families in Norway. Is it plausible to generalize the results to the entire population? As mentioned previously, families in Rogaland do not differ much, on average, from the general family in Norway, including the income variable. This can be seen in Table 2a and 2b. We may thus assume that their actions when family income is increased can be generalized to the Norwegian population.

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[14]The results are not reported here because they are similar to the other results.

Why do we compare the families in Rogaland with families in Sør-Trøndelag? The reason is simple. The first stage results are much more precise when comparing Rogaland to a county that is as far away as Sør-Trøndelag[15], but in which families have many of the same characteristics as those in Rogaland. This allows us to better isolate the effect of the oil shock. We also compare Rogaland to all other Norwegian counties and observe a general pattern. We observe that Rogaland, compared to most of the counties, had a significantly higher family income in the 1970s and 1980s, the only exceptions were Oslo and Akershus[16]. This is expected since Oslo is the city that should also experience effects of the oil shock. Since Oslo is also Norway's capital, income growth may be greater here compared to other counties. Even though family income increased due to the oil shock in Rogaland, other factors might have contributed to an even larger increase in family income in and around Oslo. One important such "other factor" could be an ongoing urbanization process in Oslo. We verify the earlier results for the full sample and the selected sample by performing the same regressions as before with more counties as reference counties. The only criterion is that the correlation between family income and living in Rogaland compared to the other county must be at least 10%. This ensures that the instrument works properly. Eleven counties survived this criterion, Sør-Trøndelag, Hedmark, Oppland, Telemark, Aust-Agder, Sogn og Fjordane, Møre og Romsdal, Nord-Trøndelag, Nordland, Troms and Finnmark.[17] The OLS and IV results are presented in Table 5a and 5b. We confirm our previous results and again the difference between OLS and IV is statistically significant at a 1% level. We see that the results are even more precise than earlier.

7.2   Using only father's income as explanatory variable

We wish to test whether it is family income in general that is correlated with children's educational attainment or whether it is the father's income that drives the

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[15] The distance between Rogaland and Sør-Trøndelag is approximately 580 km.

[16] Akershus is the county surrounding the Norwegian capital, Oslo.

[17] Those countries that did not survive the criterion are largely located near Oslo or are neighbors to Rogaland.

results. In the 1970s and 1980s many women did not participate in the labor market. Also, the oil industry is typically dominated by men. Thus, we might expect that the oil shock may have affected fathers' income more than mothers' income. We test this by regressing the dummy variable, Rogaland, on both fathers' and mothers' income from 1973 to 1988. The results here demonstrates that living in Rogaland compared to Sør-Trøndelag increased father's income significantly and more than when family income in total is considered. In this period, mother's income is actually reduced. Using Rogaland as an instrument for each parent's income separately, we verify our results that income does not affect children's educational attainment. For father's income the results are even more precise than the results for family income in general, since excluding the mother's income increases the precision of the instrument. Both the first stage results, OLS results and the IV results can be seen in table 6a and 6b. The results do not make sense for mothers since the instrument does not work properly.

7.3   The family income variable

We have chosen to use average family income from the period 1973 to 1988. These are the years when the children in the sample were between 0 and 20 years old. We use this long time-span to ensure that we test for permanent family income and not only a short period of the children's adolescence. This is one of the advantages of the data set. We can split income into any period of the child's adolescence, thus testing for both short term income and long term income. We change the family income variable into shorter periods to test for short term constraints. Family income is not significant in any of the short family income periods. In some periods, the standard errors are larger, but all the results reject that OLS and IV are similar at a 5% level. These results suggest that there are no credit constraints, or at least few, in higher education in Norway.

We perform a test in which we regress the dummy variable for Rogaland on average family income between 1968 and 1970, the years prior to the oil boom. The effect is positive, but significantly smaller than for the period 1973-1988. When

using Rogaland as an instrument for the family income between 1968 and 1970, the results do not make sense. This we see as a positive test for the instrument since there should be no differences in family income (1968-1970) between Rogaland and Sør-Trøndelag, related to the oil boom and hence the instrument should not work.

7.4   Nonlinear effects

It might be that families from the lower end of the income distribution still have a significant impact of family income on children's educational attainment, but that the effect disappears when aggregated with all the families in the sample. We check this by running the same procedure as before for the families in Rogaland and the reference counties having family income in 1968 (before the oil shock) at the lower end of the income distribution. We estimate the same equations as earlier for the 25% lowest income families in 1968. The results of this analysis are given in Table 7a and 7b. The oil shock still has a significant impact on these families living in Rogaland compared to the families in the preferred reference counties, and the instrumental variable confirms the earlier results. Family income does not directly affect children's educational attainment.[18]

8   Conclusion

This paper has sought to provide new evidence on the causal link between family income and children's education. By using a unique Norwegian data set we have been able to address the causality of the observed link between family income and children's educational attainment. The OLS results show a clear, positive relationship between permanent family income and children's education after controlling for observable family background variables. The effect of parental education is clearly stronger, but controlling for parental education still makes permanent family income

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[18]We also did the same test for the 25% highest income families in 1968 to check for nonlinear effects at the top of the income distribution. There were no significant differences between these families and the average family in the sample.

significant. This corresponds to earlier research on family factors and children's education. The main question is whether family income is a causal factor for children's educational attainment. The oil shock in Norway in the 1970s and 1980s constitutes a good instrumental variable for family income, since it is highly correlated with family income for families living in Rogaland, but uncorrelated with ability and parent's educational attainment. This variation in income is used to estimate the causal effect of family income on children's educational attainment.

The results indicate no causal relationships between family income and children's educational attainment. These results are robust across our control groups, the families living in Sør-Trøndelag, and we confirmed the results by comparing Rogaland to the full sample and other representative counties in Norway. This indicates that family income does not matter for children's educational attainment. This is in line with the results in Shea (2000), while some other studies (see Chevalier et al. (2005) and Oreopoulos et al. (2005)) have come to the opposite conclusion.

The question that follows is why family income matters so little for children's education in Norway. One reason could be that we have perfect capital markets in Norway so that families can borrow against their children's educational attainment. This may be the case for high income families, but is unlikely for low income families. Another reason could be that Norway has very high public investment in children. The Norwegian welfare state has been very successful in recent decades and all students in higher education are eligible for grants and subsidies from the Government to finance their education. This makes it easier to take higher education in Norway than in many other countries. It might be that family income would have an impact on children's educational attainment if all of these Government interventions were removed.[19]

Both the argument for capital markets and public investment in children can explain some of the reason why parent's income has a small, observed effect on children's educational attainment. But since we still observe some correlation between family income and children's educational attainment, other mechanisms or channels may be equally important. There might be other environmental factors that shape

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[19]We do not have access to data before these Government interventions started in the 1950s

our cognitive and non cognitive skills that we have not included in the empirical analysis. The observed correlation between parental income and children's education can be genetic or related to cultural factors. Children inherit parents' skills, thus a child from a high income family has a higher probability of ending up with higher educational attainment than a child from a low income family. This is what we call the selection process into higher education. Of course, parental education may also affect the children's education. If parental education is a causal factor, the observed correlation between family income and children's educational attainment may work through this channel, since hmore highly educated people also have higher average income. As previously mentioned, we do not have observations to account for the endogeniety of parental education, but Black et al. (2005) have given evidence that parental education also affects children's education mainly through hereditary- and cultural factors

From this study we have been able to isolate one of the family background factors that have been given a causal interpretation for children's educational attainment in many previous studies. By ruling out family income as a direct effect of children's education we have come closer to understanding the intergenerational transfer of family background. Newer studies for Scandinavian, British and US data (Black et al. (2005), Björklund, Ginther and Sundström (2004)) also rule out other family background factors, such as parental education and marital status, as causal factors. We do see a wave of studies moving away from causality of family background factors towards explaining more long-term family background and selection effects as important determinates of education. This might have new implications for policies which have based their programs on causal interpretations of family income, parental education and marital status.

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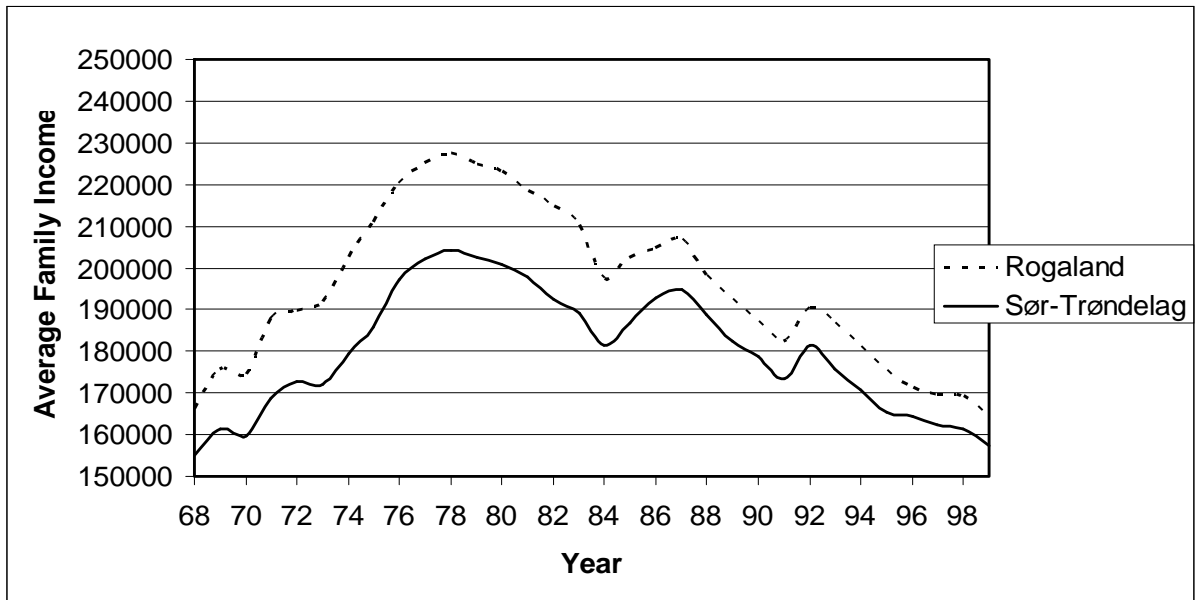
Appendix

Figure 1: Average Family Income 1968-1999

Figure 2: $\Delta\%$ in family income between Rogaland and Sør-Trøndelag after controlling for differences in family income in 1968
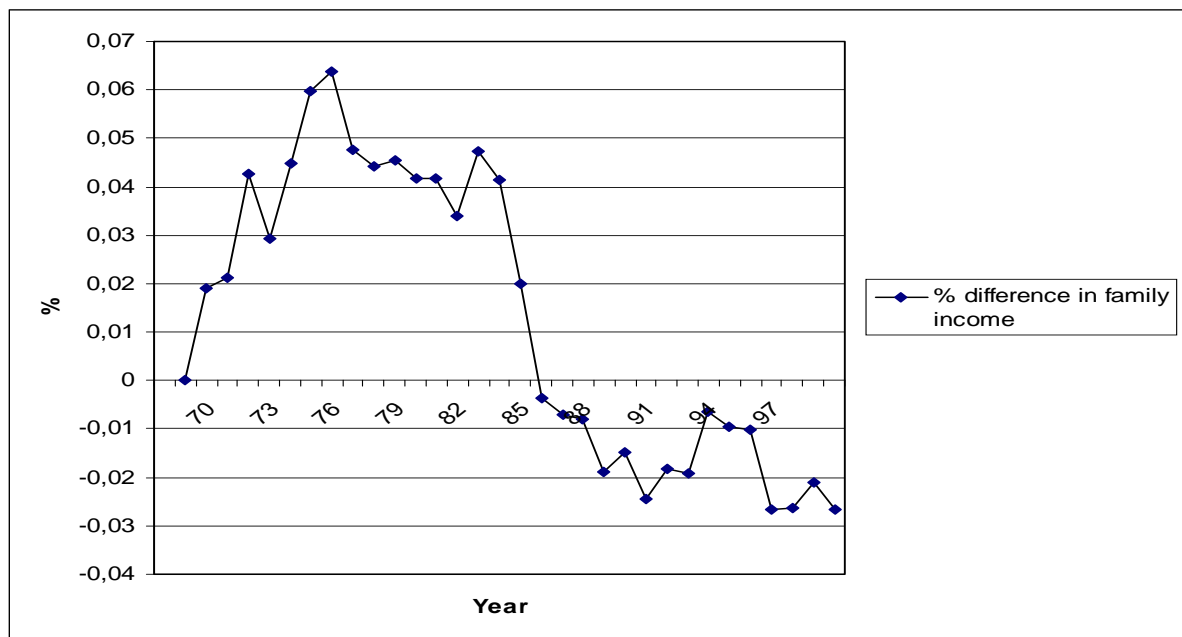
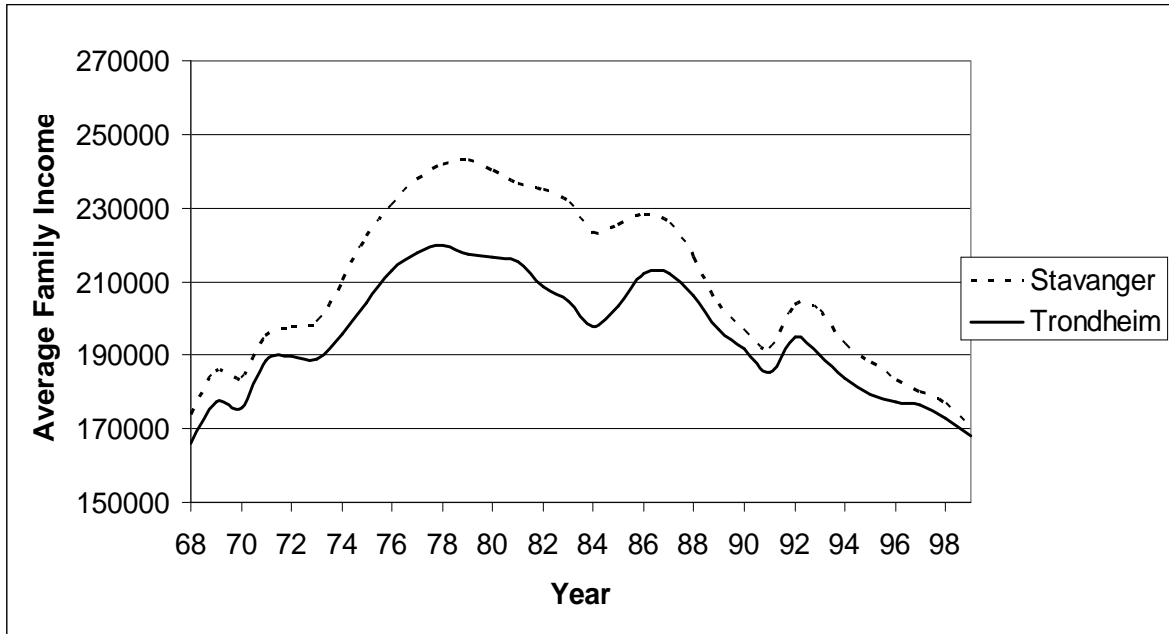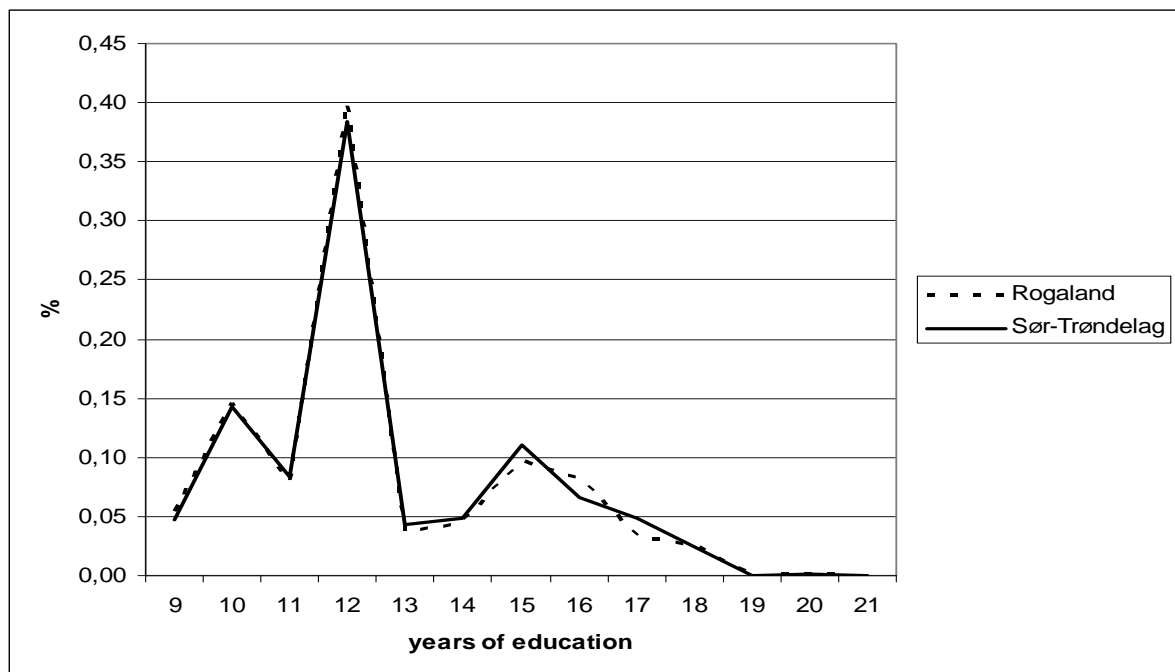**Figure 3: Average Family Income in Stavanger and Trondheim**

Figure 4: Average years of education in %

Table 1: Variable Description

Children's education	= measured in years of obtained higher education
Family income (73-88)	= average family income when the children are between 0-20 years old, measured in NOK (1NOK=6.46USD per 22.01.07)
Family income (68-70)	= average family income prior to the oil boom
College mother	= 1 if mother has gone to college, 0 otherwise
College father	= 1 if father has gone to college, 0 otherwise
Married	= 1 if mother was married in 1980, 0 otherwise
Age father	= Age of father in 1970
Age mother	= Age of mother in 1970
0 sibling	= 1 if individual has 0 sibling, 0 otherwise
1 sibling	= 1 if individual has 1 sibling, 0 otherwise
2 siblings	= 1 if individual has 2 siblings, 0 otherwise
3 siblings	= 1 if individual has 3 siblings, 0 otherwise
4 siblings	= 1 if individual has 4 siblings, 0 otherwise
Cohort68	= 1 if child was born in 1968
Cohort69	= 1 if child was born in 1969
Cohort70	= 1 if child was born in 1970
Cohort71	= 1 if child was born in 1971
Cohort72	= 1 if child was born in 1972
Cohort73	= 1 if child was born in 1973
Rogaland	= 1 if family lived in Rogaland between 1960 and 1980

Table 2a: Descriptive Statistics, Full Sample (N=330918)

Variable	Mean	Std.Dev.	Min.	Max.
Age	31.5545	1.6926	29	34
Years of education	12.7234	2.3268	9	21
Father, college degree	0.1846	-	0	1
Mother, college degree	0.1005	-	0	1
Age, Father (1970)	28.6312	6.5434	16	58
Age, Mother (1970)	25.6888	5.5371	16	45
Married (1980)	0.9209	-	0	1
Family Income 1968-1970	174518	80775.6	0	628251
Family Income 1973-1988	206287.6	71516.3	105.5	1362363

Table 2b: Descriptive Statistics, Rogaland (N=8832)

Variable	Mean	Std.Dev.	Min.	Max.
Age	31.5399	1.7101	29	34
Years of education	12.5451	2.2603	9	21
Father, college degree	0.1183	-	0	1
Mother, college degree	0.0611	-	0	1
Age, Father	28.6815	7.1005	16	56
Age, Mother	25.8182	6.2639	16	45
Married (1980)	0.9449	-	0	1
Family Income 1968-1970	171965.7	73537.9	0	552580.2
Family Income 1973-1988	211262.5	63918.5	455.0	677947

Table 2c: Descriptive Statistics, Sør-Trøndelag (N=6796)

Variable	Mean	Std.Dev.	Min.	Max.
Age	31.5144	1.7214	29	34
Years of education	12.6305	2.2787	9	21
Father, college degree	0.1658	-	0	1
Mother, college degree	0.0614	-	0	1
Age, Father	28.3221	6.8147	16	56
Age, Mother	25.2621	5.8722	16	45
Married (1980)	0.9123	-	0	1
Family Income 1968-1970	159412.2	79270.9	0	528745
Family Income 1973-1988	191774.9	64978.8	1291.5	594259

Table 3a: First stage results, full sample

Family Income (73-88)	Coefficient (std. error)
Rogaland	0.0747* (0.0036)
College mother	0.2338* (0.0021)
College father	0.2865* (0.0021)
Observations (N)	330918

*-significant at 1 % level. Family income (68-70), cohort dummies, siblings and age and marital status of parent's included.

Table 3b: OLS and IV results, full sample

Children's education in years	Coefficient (std. error) OLS	Coefficient (std. error) IV
Family income (73-88)	0.9001* (0.0112)	-0.4286 (0.3143)
Family income (68-70)	-0.0229* (0.0021)	0.0279* (0.0122)
College mother	1.0745* (0.0138)	1.3844* (0.0746)
College father	1.1995* (0.0110)	1.5791* (0.0904)
Married	0.7492* (0.0167)	0.9087* (0.0414)
Age mother	0.0253* (0.0012)	0.0391* (0.0035)
Age father	0.0051* (0.0010)	-0.0107* (0.0039)
1 sibling	0.0790* (0.0147)	0.0408* (0.0175)
2 siblings	-0.0557* (0.0152)	-0.1588* (0.0289)
3 siblings	-0.2500* (0.0180)	-0.4340* (0.0472)
4 siblings	-0.4017* (0.0223)	-0.7429* (0.0838)
Observations (N)	330918	330918

*-significant at 1 % level. Cohort dummies included.

Table 4a: First stage results, (Rogaland and Sør-Trøndelag)

Family Income (73-88)	Coefficient (std. error)
Rogaland	0.1136* (0.0053)
College mother	0.2433* (0.0115)
College father	0.2560* (0.0080)
Observations (N)	15628

*-significant at 1 % level. Family income (68-70), cohort dummies, siblings and age and marital status of parents included.

Table 4b: OLS and IV results, (Rogaland and Sør-Trøndelag)

Children's education in years	Coefficient (std. error) OLS	Coefficient (std. error) IV
Family income (73-88)	0.9611* (0.0506)	-0.1850 (0.2893)
Family income (68-70)	-0.0261* (0.0088)	0.0109 (0.0132)
College mother	1.2230* (0.0763)	1.5095* (0.1083)
College father	1.2121* (0.0540)	1.4926* (0.0922)
Married	0.7305* (0.0798)	0.8978* (0.0923)
Age mother	0.0227* (0.0057)	0.0354* (0.0067)
Age father	0.0070 (0.0049)	-0.0075 (0.0063)
1 sibling	-0.0549 (0.0707)	-0.0595 (0.0718)
2 siblings	-0.2674* (0.0707)	-0.3140* (0.0743)
3 siblings	-0.5270* (0.0832)	-0.6128* (0.0875)
4 siblings	-0.6414* (0.1007)	-0.8143* (0.1120)
Observations (N)	15628	15628

*-significant at 1 % level. Cohort dummies included.

Table 5a: First stage results, (Rogaland, Sør-Trøndelag, Hedmark, Opp-land, Telemark, Aust-Agder, Sogn og Fjordane, Møre og Romsdal, Nord-Trøndelag, Nordland, Troms and Finnmark)

Family Income (73-88)	Coefficient (std. error)
Rogaland	0.1412* (0.0040)
College mother	0.2716* (0.0067)
College father	0.2619* (00048)
Observations (N)	62911

*-significant at 1 % level. Family income (68-70), cohort dummies, siblings and age and marital status of parents included.

Table 5b: OLS and IV results, (Rogaland, Sør-Trøndelag, Hedmark, Opp-land, Telemark, Aust-Agder, Sogn og Fjordane, Møre og Romsdal, Nord-Trøndelag, Nordland, Troms and Finnmark)

Children's education in years	Coefficient (std. error) OLS	Coefficient (std. error) IV
Family income (73-88)	0.8963* (0.0238)	-0.2017 (0.1725)
College mother	1.1485* (0.0406)	1.4505* (0.0625)
College father	1.1350* (0.0298)	1.4259* (0.0545)
Married	0.7348* (0.0382)	0.8685* (0.0440)
Observations (N)	62911	62911

*-significant at 1 % level. Family income (68-70), cohort dummies, siblings and parents' age included.

Table 6a: First stage results, father's income, (same 12 counties as in Table 5a)

Father's Income (73-88)	Coefficient (std. error)
Rogaland	0.1936* (0.0052)
College mother	0.0318* (0.0086)
College father	0.2716* (0.0063)
Observations (N)	62876

*-significant at 1 % level. Family income (68-70), cohort dummies, siblings and age and marital status of parents included.

Table 6b: OLS and IV results, father's income, (same 12 counties as in Table 5a)

Children's education in years	Coefficient (std. error) OLS	Coefficient (std. error) IV
Father's income (73-88)	0.5403* (0.0187)	-0.1553 (0.1345)
College mother	1.3669* (0.0403)	1.4021* (0.0413)
College father	1.2077* (0.0298)	1.4201* (0.0506)
Married	0.7403* (0.0384)	0.8737* (0.0465)
Observations (N)	62876	62876

*-significant at 1 % level. Family income (68-70), cohort dummies, siblings and parents age included.

Table 7a: First stage results, the lowest quartile of the income distribution, (same 12 counties as in Table 5a)

Father's income (73-88)	Coefficient (std. error)
Rogaland	0.1561* (0.0144)
College mother	0.0574* (0.0184)
College father	0.3042* (0.0133)
Observations (N)	15215

*-significant at 1 % level. Family income (68-70), cohort dummies, siblings and age and marital status of parents included.

Table 7b: OLS and IV results, the lowest quartile of the income distribution, (same 12 counties as in Table 5a)

Children's education in years	Coefficient (std. error) OLS	Coefficient (std. error) IV
Fathers' income (73-88)	0.4489* (0.0313)	-0.2817 (0.3610)
College mother	1.4386* (0.0715)	1.4724* (0.0757)
College father	1.1740* (0.0526)	1.3379* (0.1231)
Married	0.7538* (0.0681)	0.8711* (0.1051)
Observations (N)	15215	15215

*-significant at 1 % level. Family income (68-70), cohort dummies, siblings and parents age included.

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