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Nature and Nurture in the Intergenerational Transmission of Socioeconomic Status:

Evidence from Swedish Children and Their Biological and Rearing Parents

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Abstract

This study uses an extraordinary Swedish data set to explore the sources of the intergenerational transmission of socioeconomic status. Merging data from administrative sources and censuses, we investigate the association between sons' and daughters' socioeconomic outcomes and those of their biological and rearing parents. Our analysis focuses on children raised in six different family circumstances: raised by both biological parents, raised by the biological mother without a stepfather, raised by the biological mother with a stepfather, raised by the biological father without a stepmother, raised by the biological father with a stepmother, and raised by two adoptive parents. Relative to the existing literature, the most remarkable feature of our data set is that it contains information on the biological parents even when they are not the rearing parents. We specify a simple additive model of pre-birth (including genetic) and post-birth influences and examine the model's ability to provide a unified account of the intergenerational associations in all six family types. Our results suggest substantial roles for both pre-birth and post-birth factors.

Nature and Nurture in the Intergenerational Transmission of Socioeconomic Status: Evidence from Swedish Children and Their Biological and Rearing Parents

1. Introduction

Over the last two decades, a growing empirical literature has demonstrated that the intergenerational transmission of economic status is stronger than we used to believe (Solon, 1999 and forthcoming). Now we need to learn more about *why* intergenerational transmission is as strong (and as weak) as it is – that is, we need to find out more about the causal processes underlying the observed statistical associations between parents' and children's socioeconomic outcomes.

The theoretical literature (for example, Becker and Tomes, 1979 and 1986; Solon, 2004) recognizes that *many* causal processes are at work. Higher-income parents have greater wherewithal to invest in their children's education, health, and so forth. Beyond conscious decisions to invest in their children's human capital, parents (as well as other relatives and neighbors) also may influence children's economic outcomes through "cultural inheritance," for example, through the examples they set for work effort, learning, interpersonal interactions, etc. And, in addition to these environmental influences, parents transmit to their children genetic traits that may foster or impede economic success.

Even at the very broad-brush level of nature vs. nurture, it is notoriously difficult to sort out these causal processes with the "observational" data available to us. One promising, though problematic, approach is to contrast the parent-child associations in socioeconomic outcomes across family types with different degrees of environmental and genetic connectedness. For example, if adopted children were assigned to biologically unrelated adoptive parents in a purely random fashion, then any statistical association of outcomes between the adoptive children and parents would have to stem solely from environmental causes.

Indeed, several researchers already have studied adoptive families' intergenerational associations in education or income. Taken together, the results in Scarr and Weinberg (1994), Sacerdote (2000), Das and Sjogren (2002), Plug (2004), and Plug and Vijverberg (2005) do suggest a positive association between children's and parents' education and income in adoptive families, and the association is statistically significant when the sample sizes are large enough. On the other hand, the intergenerational associations observed in samples of adoptive families often are distinctly smaller than those typically observed in general samples, in which most of the rearing parents are also biological parents.[1]

As the authors of some of these studies have emphasized, intergenerational associations in adoptive families do not identify just environmental effects if adoptions are subject to "selective placement." Scarr and Weinberg (1994, p. 321), for example, note that "adoption agencies often place infants selectively by matching natural and adoptive parent characteristics, such as education, occupation, and impressions about intelligence." In that case, if the genetic influence of the biological parents is not accounted for, statistical associations between the outcomes of adopted children and their adoptive parents could reflect a combination of the adoptive parents' environmental influences and the correlated genetic inheritance.

Two recent studies have dealt with this issue in different ways. Sacerdote (forthcoming) studies a particular adoptees subpopulation (Korean-born children adopted into U.S. families through Holt International Children's Services) within which the placements were approximately random. He still finds a significantly positive (but small) association in the education of the adoptees and their adoptive mothers. He also finds a considerably larger association for some of

[1] Björklund and Chadwick (2003) report a similar result for Swedish "nonbiological fathers," who include stepfathers as well as adoptive fathers. A large literature has studied adoptive families' intergenerational associations in other outcomes, such as IQ and personality traits. Another relevant literature has studied correlations among siblings with varying degrees of genetic and environmental connectedness (see Björklund, Jäntti, and Solon, 2005, and the references therein).

the same mothers and their biological children, but it is hard to tell what to make of the latter result given the endogeneity of these mothers' decisions to adopt.

Using a large Swedish data base, Björklund, Lindahl, and Plug (forthcoming) take an alternative approach. Exploiting their unusual access to information on the biological as well as the adoptive parents, they directly account for characteristics of the biological parents. For example, they estimate a regression equation for adopted children's years of education in which the explanatory variables include the years of education of all four parents – the biological mother and father and the adoptive mother and father. In this "horse race" among parental variables, all the horses place, in the sense that all the coefficient estimates are positive (usually significantly so). The coefficient estimates for the biological mother and father are respectively 0.101 and 0.094, and those for the adoptive mother and father are 0.021 and 0.094. These results and others in the paper are suggestive of roles for both nature and nurture in the determination of education and income.

When Björklund, Lindahl, and Plug estimate the intergenerational education regression for children raised by their biological parents, the coefficient estimates are 0.158 for the mother and 0.170 for the father. These estimates might be construed as combining the effects of nature and nurture. An intriguing pattern is that the 0.158 estimate for the mother who rears her biological child is fairly close to the 0.122 (0.101 + 0.021) sum of the estimates for the biological and adoptive mothers of an adopted child. Similarly, the 0.170 estimate for the father who rears his biological child is close to the 0.188 (0.094 + 0.094) sum of the estimates for the two fathers of an adopted child.

Reacting to this pattern, the present paper explores the possibility that an almost absurdly simple model of additive pre-birth and post-birth parental effects can account for intergenerational associations in socioeconomic status across a variety of family types. Using the same extraordinary Swedish data set used by Björklund, Lindahl, and Plug, we analyze intergenerational associations not only for adoptive children and children raised by their biological mother and father, but also for four other samples in which the children were raised by one biological parent with the other absent at least some of the time, with or without a stepparent in the household.

Section 2 of the paper describes the data set. Section 3 overviews our model and estimation methods. Section 4 presents estimates of intergenerational regression equations for all six family types and then fits a unified model to the constellation of regression results. Section 5 summarizes our findings.

2. Data

Our data set merges information from several registers held by Statistics Sweden. We start with two basic samples from Statistics Sweden's population register. The first is a 20 percent random sample of all non-adopted persons born in Sweden between January 1962 and September 1965. The second consists of all adopted persons born in Sweden during that time period. We draw only those adopted by both a mother and father, so stepchild adoptions are not included in our adoptees sample.[2] In both samples, we use only individuals alive and living in Sweden as of 1999.

The adoption information in the population register comes from Sweden's judicial adoption process. Björklund, Lindahl, and Plug (forthcoming) provide a detailed discussion of that process, the essentials of which we summarize here. Each adoption decision was made by a Swedish court after a formal application by the adoptive parents. In each case, the court was advised by a local social agency, which had done a careful investigation of the suitability of the adoptive parents. An adopted child had the same legal status vis-à-vis the adoptive parents, for

[2] In the cohorts born in Sweden during 1962-1965, around 1,000 children a year were adopted by both a mother and father. In subsequent years, this number fell rapidly, and international adoptions began to replace adoptions of native-born children.

example in terms of inheritance, as a biological child, and all formal connections with the biological parents were broken. Typically, the new-born child was initially placed at a special nursery shortly after delivery, and was placed in the adoptive family's home during the child's first few months. The information and criteria used by the local agencies to match adoptive parents and children most likely generated some positive correlation between the adoptive and biological parents in characteristics like physical appearance and socioeconomic background.[3] Thus, unlike Sacerdote (forthcoming), we cannot claim statistical independence between the adoptive and biological parents' socioeconomic status and will need to account explicitly for both.

To identify the six family types we analyze, we need to know the parents of the persons in the two samples. For this purpose, we use two sources provided by Statistics Sweden. The first is the so-called Multi-Generation Register developed by Statistics Sweden for research purposes. This register contains information about biological and adoptive parents of the Swedish population. Thanks to this register, unlike most analyses of adopted children, ours includes information on the adoptees' biological parents, which the register drew from the legal adoption process. For about 40 percent of adoptees, however, information on the biological father is missing because he was not identified. Björklund, Lindahl, and Plug (forthcoming) report that estimated regressions of adoptees' years of education on adoptive and biological mothers' years of education are very similar between a full sample and a sample restricted to cases for which the biological fathers are known. The second source is the censuses conducted by Statistics Sweden in October/November of 1965, 1970, and 1975. From these censuses, we can identify the child's rearing parents as of those dates. Whenever the "census mother" or "census father" is neither a biological nor adoptive parent, we label that parent as a stepparent.

[3] Björklund, Lindahl, and Plug (forthcoming) report a 0.14 correlation in years of education between the adoptive and biological mothers, and also between the adoptive and biological fathers.

Based on this information, we create samples of six family types (chosen to provide large enough sample sizes to enable meaningful estimates). The six types are:

1. Child reared in 1965, 1970, and 1975 by biological mother and father.
2. Biological mother present in the child's household in all three censuses, biological father absent at least once, and no stepfather ever present.
3. Biological mother present in all three censuses, biological father absent at least once, and stepfather present at least once.
4. Biological father present in all three censuses, biological mother absent at least once, and no stepmother ever present.
5. Biological father present in all three censuses, biological mother absent at least once, and stepmother present at least once.
6. Child reared in 1965, 1970, and 1975 by adoptive mother and father.

In this study, we measure rearing and biological parents' socioeconomic status with their years of education. We are reluctant to measure mothers' status by their income or earnings because of women's variable attachment to the paid labor force. This is an especially important concern for our analysis because, during our sample period for adoptions, the local agencies judged prospective adoptive parents to be more suitable if the mother could stay home to care for the child. Our parental education information comes from the 1970 census and Statistics Sweden's 1990 education register. The latter was originally based on the 1970 census data, but was updated by degree information from schools. When the education information differs between the 1990 register and the 1970 census, we use the higher of the two. Like Björklund, Lindahl, and Plug (forthcoming), we assign years of education according to seven categories: 7 for (old) primary school, 9 for (new) compulsory schooling, 11 for short high school, 12 for long high school, 14 for short university, 15.5 for long university, and 19 for Ph.D.

For the offspring generation, we assign years of education in the same way, with the education categories based on Statistics Sweden's 1999 education register. We also analyze the offspring's 1999 earnings and income, as recorded by Statistics Sweden from tax records. The earnings variable consists of income from work, including self-employment and sickness benefits. The income variable consists of earnings plus some taxable transfers like unemployment benefits and pensions as well as capital income and realized capital gains. We exclude earnings or income observations below SEK 10,000 (about USD 1,200). In 1999, the offspring are 34-37 years old, an age range in which log current income variables as proxies for log long-run income are subject to approximately classical measurement error.[4]

Table 1 displays the sample means and standard deviations of these variables for sons, daughters, and parents in the "balanced" samples for which all the variables are available. The table reveals patterns familiar from previous studies. The best average outcomes for children appear for those raised by both biological parents. Among the various types of parents, the biological parents of adopted children show relatively low average education, and adoptive parents have high average education.

3. Statistical Models and Estimation Methods

If everyone were reared by one mother and one father, a simple and easily interpreted model of the intergenerational transmission of socioeconomic status would be

(1) $$y_i = \beta_m B_{mi} + \beta_f B_{fi} + \alpha_m R_{mi} + \alpha_f R_{fi} + \gamma' D_i + \varepsilon_i$$

where y_i is a measure of the socioeconomic status of individual i, B_{mi} and B_{fi} are measures of the socioeconomic status of individual i's biological mother and father, R_{mi} and R_{fi} are measures of the socioeconomic status of the rearing mother and father (who may or may not be

[4] Haider and Solon (forthcoming) and Böhlmark and Lindquist (forthcoming).

the biological parents), D_i is a vector of dummy variables for family types (e.g., to allow for a shift in the conditional mean of y_i if individual i is raised by adoptive rather than biological parents[5]), and ε_i is an error term orthogonal to the explanatory variables.

For an adopted child (in our family type 6), the four parental variables pertain to four distinct parents. With the biological parents' socioeconomic status separately controlled for, the α coefficients for the adoptive parents' socioeconomic status are meant to reflect post-birth environmental influences associated with growing up with the adoptive parents. With the adoptive parents' socioeconomic status separately controlled for, the β coefficients for the biological parents' socioeconomic status are meant to reflect pre-birth influences, including genetic factors as well as the prenatal environment.

For a child raised by both biological parents (in our family type 1), there are only two distinct parental variables, one for the mother and one for the father. If equation (1) is taken literally, the coefficient of the mother's socioeconomic status variable becomes the sum $\beta_m + \alpha_m$, which combines the mother's pre-birth and post-birth influences, and the coefficient of the father's socioeconomic status $\beta_f + \alpha_f$ combines his pre-birth and post-birth influences.

This linearly additive model's characterization of intergenerational status transmission is almost absurdly simplistic. For example, it completely ignores all the interactions of nature and nurture discussed by Ridley (2003). Nevertheless, the results from Björklund, Lindahl, and Plug (forthcoming) that we discussed in section 1 suggest the possibility that this very simple model may do a decent job of characterizing intergenerational transmission of certain socioeconomic variables, at least for Swedes born in 1962-1965. In the next section, we explore that possibility with evidence from all six family types for which we have useful sample sizes.

[5] There is a large literature on differences in child outcomes across family structures. See, for example, McLanahan and Sandefur (1994) and Biblarz and Raftery (1999).

Our empirical analysis proceeds in two stages. In the first stage, for sons and daughters separately, we perform ordinary least squares (OLS) estimation of regressions of child's adult socioeconomic status on all parents' socioeconomic status for each of the six family types separately. For example, for family type 3, we estimate a regression of the child's outcome on the socioeconomic status variables for the biological mother, the at-least-sometime-absent biological father, and the stepfather. In the first stage, we estimate the regressions separately for each family type, without imposing the restrictions from equation (1), in order to provide a transparent view of the empirical intergenerational associations for each family type.

In the second stage, we put the model in equation (1) to work. In particular, taking the first-stage coefficient estimates as the data, we use minimum distance methods to fit the parameters from a generalized version of model (1) to these data. The generalization of the model is needed to deal with the complications that some children are raised by only one parent and some experience changes of rearing parents during the course of their childhood. Thus, in family type 3 for example, we will model the coefficients for the biological father and stepfather respectively as $\beta_f + \rho_{3B}\alpha_f$ and $\rho_{3R}\alpha_f$. The point of the additional ρ parameters is to recognize that these not-always-present fathers may have different post-birth influences than the rearing fathers in family types 1 (biological) and 6 (adoptive), who are present in all the observation periods.

The purpose of the model-fitting exercise is not to ascertain whether the generalized version of equation (1) is the true data-generating process for children's socioeconomic outcomes. We know it is not. The point is to assess whether the model delivers a serviceable approximation to the intergenerational associations actually observed. If it does, then the estimated parameters of the admittedly simplistic model may serve as useful statistics for summarizing the pre- and post-birth components of intergenerational status transmission.[6]

4. Empirical Results

Starting with first-stage regressions, table 2 displays the coefficient estimates from applying OLS to regressions of son's or daughter's years of education on the years of education of all the child's parents. To account for cohort and life-cycle effects, the regressions also include controls for the ages of both the children and the parents. In the regression for sons raised by both biological parents (family type 1), the coefficient estimates are 0.172 (with estimated standard error 0.005) for mother's education and 0.197 (0.005) for father's education. For adopted sons (family type 6), the coefficient estimates are respectively 0.105 (0.036) and 0.121 (0.033) for the biological mother and father and 0.056 (0.032) and 0.078 (0.030) for the adoptive mother and father. The table also reports results for the sons' other four family types and the corresponding results for daughters.

Inspection of the table reveals several striking patterns. First, relatively large coefficient estimates appear for biological parents who rear their children. This is to be expected as these coefficients reflect the combination of pre-birth and post-birth influences. Second, the coefficient estimates for biological parents are substantial even for biological parents who are partly or completely absent from the post-birth environment. This pattern is suggestive of substantial pre-birth (including genetic) influences.[7] Third, the table also contains indications of

[6] Similarly, in our analysis of siblings' earnings correlations in Björklund, Jäntti, and Solon (2005), we estimated several variants of a simple variance components model. One of those variants allowed for correlation between nurture and nature effects because we figured that individuals with genes conducive to high earnings also might tend to enjoy advantageous environments. Somewhat to our surprise, we found that allowing for such correlation did not improve the model's fit much at all, and the estimated correlations were insignificantly *negative*. Our conclusion was not that nature-nurture correlation is utterly nonexistent, but rather that modeling it turned out in this instance to be inessential for achieving a useful empirical decomposition of nature and nurture effects.

[7] Björklund, Lindahl, and Plug (forthcoming) argue that the tendency for the coefficient estimates to be as large for non-rearing biological fathers as for non-rearing biological mothers can be construed as evidence that the pre-birth influences come mostly from genetic factors rather than the pre-birth environment in the mother's womb.

important post-birth environmental influences. The coefficient estimates for non-biological rearing parents are almost always positive and usually statistically significant. Also, the coefficient estimates tend to be larger for biological parents who raise their children than for non-rearing biological parents. Finally, many comparisons of coefficient estimates offer some hope that a model like that in equation (1) might provide an adequate approximation to the empirical patterns. For example, the coefficient estimates for biological parents who raise their children are fairly similar across different family types, and they also are fairly close to the sums of the coefficient estimates for the biological and rearing parents in the adoptive families.

Table 3 presents the results from parallel analyses with the sons' and daughters' log earnings in 1999 as the dependent variable.[8] The broad-brush patterns are similar to those for education in table 2, but the estimated coefficients are less precisely estimated (relative to the magnitudes of the coefficient estimates) and are considerably less stable. Thus, for example, negative coefficient estimates appear more frequently in table 3, especially for daughters, but they are not significantly different from zero, and often their 95 percent confidence intervals contain substantial positive values. Perhaps a single year's earnings information is not a sufficiently reliable indicator of socioeconomic status. This may be especially so for women in the 33-37 age range, given their variable attachment to the paid labor force.[9] In analyses not reported in the tables, we also have estimated regressions for log individual income and a quite messy and imperfect version of log family income. In their broad-brush patterns and their imprecision, the results are similar to those in table 3.

We have noted several patterns in the regression results, but how can we achieve a succinct quantitative summary of those patterns? One approach is to proceed to our second stage

[8] As the comparison of sample sizes makes clear, the analyses in tables 2 and 3 are based on the exact same samples. We can slightly increase the sample sizes for our education regressions in table 2 by adding observations excluded from table 3 because the earnings variable is less than SEK 10,000. Doing so produces almost no change from the results reported in table 3.

– the fitting of the generalized version of equation (1) to the estimated regression coefficients. The generalized model is fully detailed in table 4, which shows the model's parameterization of each coefficient estimated in the regression tables. As in equation (1), the β parameters represent pre-birth influences, and the α parameters represent post-birth influences of always-present rearing parents. The generalization beyond equation (1) is the addition of the six ρ parameters, which allow the post-birth influences of stepparents and sometime-absent biological parents to differ from the α post-birth influences of always-present rearing parents and the assumed zero post-birth influences of never-present biological parents. As the table shows, the model characterizes the 16 regression coefficients with 10 parameters, so the model is overidentified.

We use a minimum distance approach to fit the model's parameters to the estimated regression coefficients. In particular, the results in tables 5 and 6 are based on a weighted nonlinear least squares procedure that minimizes a weighted sum of squared discrepancies between the 16 estimated regression coefficients and the fitted values based on the 10 parameters. The 16 observations in this second-stage regression are weighted inversely to their standard error estimates from the first stage. For example, because our type 1 sample of sons raised by both biological parents contains almost 30,000 individuals, the estimated coefficients from their education regression have estimated standard errors of only about 0.005. The type 5 sample of sons raised by their biological fathers and stepmothers contains fewer than 300 individuals, so the estimated standard errors of the estimated regression coefficients are an order of magnitude larger than those from the type 1 sample. The weighting in our second-stage estimation appropriately recognizes that the type 1 coefficient estimates are much more precise

[9] Böhlmark and Lindquist (forthcoming) report that, for Swedes born in 1948-1950, the reliability ratios for log annual earnings observed in the mid thirties as a proxy for log lifetime earnings are less than 0.5 for men and less than 0.3 for women.

and informative, and therefore our fitted parameter values are much more influenced by the type 1 estimates.[10]

Table 5 reports the estimated parameter values for sons and daughters, and table 6 shows how well the first-stage estimates of regression coefficients are matched by the fitted model. The first and third columns of numbers in table 6 list exactly the same estimated regression coefficients (and associated standard error estimates) as were displayed in table 2. The second and fourth columns list the corresponding fitted values from the model. The asterisked values are guaranteed to fit exactly because of the free ρ parameters. And the fitted values shown in the first two rows for the type 1 families fit extremely well by design: because our second-stage estimation places very heavy weights on those observations, it sees to it that those fits are close. What is more interesting for assessing the model's performance is the fit of the unasterisked values from the fourth row down. One could read those results as half-full or half-empty, but our view is that, given the extreme simplicity of the linearly additive model, it fits the data surprisingly well. In most instances, the match between the estimated coefficient and the fitted value is fairly close, especially as compared to the estimated coefficient's standard error estimate.

Taking the model as providing an adequate approximation to the empirical intergenerational associations, what can we learn from the model's estimated parameters in table 5? Most of the ρ parameters, which rescale the stepparents' and sometime-absent biological parents' post-birth influences relative to those of always-present parents, are estimated with poor precision, but most are estimated to lie between 0 and 1 as one might expect. Of more central interest to our study are the estimates of the β and α parameters, which respectively represent

[10] We also have used an "optimal minimum distance" procedure that takes account of the nonzero covariances among estimated coefficients within the same regressions. The results are similar to the "diagonally weighted" results we report in tables 5 and 6. By emphasizing the diagonally weighted results, we are focusing on the model's goodness of fit for the estimated regression coefficients, instead of for linear combinations of those estimated

the pre-birth (including genetic) and post-birth components of intergenerational status transmission. All eight of those parameter estimates in table 5 are positive, most are quite substantial, and all but one are significantly greater than zero at conventional levels of statistical significance.

These results formalize the eyeball impressions we previously drew from the tables of estimated regression coefficients. The adult socioeconomic status of Swedes born between 1962 and 1965 appears to be positively associated with the socioeconomic status of both their biological parents and their rearing parents, when those parents are not the same as each other as well as when they are. Accordingly, our paper is entitled "Nature and Nurture," not "Nature vs. Nurture." We see no logical or empirical need to choose between the two. Our evidence suggests substantial importance for both.

5. Summary

Why is socioeconomic status correlated between parents and children? Our paper seeks clues from an extraordinary data set with intergenerational information on a large sample of Swedish families. Our sample contains individuals raised by both biological parents, by adoptive parents, or by one biological parent with or without a stepparent. Relative to previous studies, the most unusual and valuable feature of our data set is that it contains information on the socioeconomic status of biological parents even when they are not the rearing parents.

We initially characterize the intergenerational transmission of socioeconomic status in terms of regressions of offspring's status on the status of all parents, biological and rearing. Then we summarize the results within the framework of a simple additive model of pre-birth

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coefficients. Our standard error estimates in table 5 take into account the nonzero covariances among estimated coefficients.

(including genetic) and post-birth environmental factors. Our results suggest important roles for both types of factors.

Table 1. Sample means (and standard deviations) by family type

	Type 1	Type 2	Type 3	Type 4	Type 5	Type 6
Sons samples						
Son's years of education	12.13 (2.30)	11.67 (2.16)	11.50 (2.15)	11.47 (2.14)	11.57 (2.20)	11.67 (2.01)
Son's log earnings	12.32 (0.61)	12.20 (0.68)	12.18 (0.67)	12.21 (0.61)	12.17 (0.68)	12.19 (0.72)
Son's log income	12.40 (0.51)	12.32 (0.55)	12.29 (0.53)	12.31 (0.50)	12.28 (0.54)	12.33 (0.52)
Biological father's years of education	9.98 (3.20)	10.03 (3.11)	9.56 (2.83)	9.57 (3.01)	10.07 (3.21)	9.32 (2.53)
Biological mother's years of education	9.89 (2.87)	10.13 (2.85)	9.98 (2.63)	9.55 (2.66)	9.94 (2.95)	9.36 (2.49)
Step/adoptive father's years of education			9.84 (2.87)			10.24 (3.21)
Step/adoptive mother's years of education					10.61 (2.82)	9.87 (3.00)
Number of observations	28,417	2,657	1,473	807	272	569
Daughters samples						
Daughter's years of education	12.39 (2.14)	11.84 (2.13)	11.59 (2.03)	11.66 (1.91)	11.96 (2.04)	11.93 (1.99)
Daughter's log earnings	11.89 (0.63)	11.78 (0.70)	11.79 (0.68)	11.75 (0.71)	11.83 (0.71)	11.80 (0.70)
Daughter's log income	12.04 (0.48)	11.98 (0.52)	11.99 (0.49)	11.97 (0.51)	12.00 (0.57)	12.00 (0.46)
Biological father's years of education	9.96 (3.18)	9.91 (3.09)	9.63 (2.85)	9.30 (2.84)	10.23 (3.53)	9.17 (2.57)
Biological mother's years of education	9.86 (2.87)	10.09 (2.77)	9.92 (2.64)	9.46 (2.66)	10.01 (3.02)	9.53 (2.47)
Step/adoptive father's years of education			9.86 (2.82)			10.53 (3.30)
Step/adoptive mother's years of education					10.51 (3.10)	9.76 (3.12)
Number of observations	26,684	2,662	1,569	720	186	495

Notes: As detailed in the text, the six family types are: (1) reared by biological mother and father, (2) reared by biological mother with no stepfather, (3) reared by biological mother with stepfather, (4) reared by biological father with no stepmother, (5) reared by biological father with stepmother, and (6) reared by adoptive mother and father.

Table 2. Estimated coefficients in regressions of child's years of education on parents' years of education

	Type 1	Type 2	Type 3	Type 4	Type 5	Type 6
Sons samples						
Biological father's years of education	0.197 (0.005)	0.187 (0.013)	0.146 (0.020)	0.160 (0.027)	0.253 (0.042)	0.121 (0.033)
Biological mother's years of education	0.172 (0.005)	0.163 (0.015)	0.139 (0.022)	0.144 (0.031)	0.146 (0.044)	0.105 (0.036)
Step/adoptive father's years of education			0.101 (0.020)			0.078 (0.030)
Step/adoptive mother's years of education					0.059 (0.047)	0.056 (0.032)
Number of observations	28,417	2,657	1,473	807	272	569
Daughters samples						
Biological father's years of education	0.153 (0.004)	0.157 (0.013)	0.117 (0.018)	0.108 (0.027)	0.182 (0.051)	0.062 (0.035)
Biological mother's years of education	0.166 (0.005)	0.175 (0.015)	0.141 (0.020)	0.143 (0.029)	0.076 (0.056)	0.088 (0.038)
Step/adoptive father's years of education			0.070 (0.019)			0.106 (0.032)
Step/adoptive mother's years of education					0.040 (0.050)	-0.007 (0.034)
Number of observations	26,684	2,662	1,569	720	186	495

Notes: Numbers in parentheses are estimated standard errors. Every regression includes a linear age control for the children (who are in the 34-37 age range in 1999) and quadratic controls for the birth year of each parent. As detailed in the text, the six family types are: (1) reared by biological mother and father, (2) reared by biological mother with no stepfather, (3) reared by biological mother with stepfather, (4) reared by biological father with no stepmother, (5) reared by biological father with stepmother, and (6) reared by adoptive mother and father.

Table 3. Estimated coefficients in regressions of child's 1999 log earnings on parents' years of education

	Type 1	Type 2	Type 3	Type 4	Type 5	Type 6
Sons samples						
Biological father's years of education	0.0181 (0.0013)	0.0160 (0.0046)	0.0201 (0.0067)	0.0064 (0.0084)	0.0164 (0.0152)	0.0203 (0.0123)
Biological mother's years of education	0.0162 (0.0015)	0.0119 (0.0051)	0.0087 (0.0074)	0.0204 (0.0093)	0.0149 (0.0159)	0.0273 (0.0133)
Step/adoptive father's years of education			0.0217 (0.0067)			0.0106 (0.0112)
Step/adoptive mother's years of education					0.0301 (0.0168)	-0.0184 (0.0118)
Number of observations	28,417	2,657	1,473	807	272	569
Daughters samples						
Biological father's years of education	0.0159 (0.0014)	0.0206 (0.0048)	0.0067 (0.0066)	0.0314 (0.0106)	0.0275 (0.0195)	-0.0100 (0.0128)
Biological mother's years of education	0.0152 (0.0016)	0.0063 (0.0054)	0.0107 (0.0073)	-0.0013 (0.0113)	-0.0190 (0.0214)	0.0219 (0.0138)
Step/adoptive father's years of education			0.0104 (0.0068)			0.0191 (0.0118)
Step/adoptive mother's years of education					-0.0040 (0.0192)	-0.0200 (0.0124)
Number of observations	26,684	2,662	1,569	720	186	495

Notes: Numbers in parentheses are estimated standard errors. Every regression includes a linear age control for the children (who are in the 34-37 age range in 1999) and quadratic controls for the birth year of each parent. As detailed in the text, the six family types are: (1) reared by biological mother and father, (2) reared by biological mother with no stepfather, (3) reared by biological mother with stepfather, (4) reared by biological father with no stepmother, (5) reared by biological father with stepmother, and (6) reared by adoptive mother and father.

Table 4. Parametric model for intergenerational regression coefficients

	Type 1	Type 2	Type 3	Type 4	Type 5	Type 6
Biological father's years of education	$\beta_f + \alpha_f$	$\beta_f + \rho_{2B}\alpha_f$	$\beta_f + \rho_{3B}\alpha_f$	$\beta_f + \alpha_f$	$\beta_f + \alpha_f$	β_f
Biological mother's years of education	$\beta_m + \alpha_m$	$\beta_m + \alpha_m$	$\beta_m + \alpha_m$	$\beta_m + \rho_{4B}\alpha_m$	$\beta_m + \rho_{5B}\alpha_m$	β_m
Step/adoptive father's years of education			$\rho_{3R}\alpha_f$			α_f
Step/adoptive mother's years of education					$\rho_{5R}\alpha_m$	α_m

Notes: As detailed in the text, the six family types are: (1) reared by biological mother and father, (2) reared by biological mother with no stepfather, (3) reared by biological mother with stepfather, (4) reared by biological father with no stepmother, (5) reared by biological father with stepmother, and (6) reared by adoptive mother and father.

Table 5. Estimated model parameters based on education regressions

	Sons	Daughters
β_f	0.120 (0.023)	0.054 (0.024)
β_m	0.110 (0.024)	0.134 (0.026)
α_f	0.077 (0.023)	0.099 (0.024)
α_m	0.060 (0.024)	0.031 (0.026)
ρ_{2B}	0.86 (0.19)	1.04 (0.14)
ρ_{3B}	0.33 (0.33)	0.65 (0.21)
ρ_{3R}	1.31 (0.46)	0.71 (0.26)
ρ_{4B}	0.57 (0.54)	0.27 (1.12)
ρ_{5B}	0.60 (0.76)	-1.90 (3.04)
ρ_{5R}	0.99 (0.88)	1.32 (1.98)

Notes: Numbers in parentheses are estimated standard errors.

Table 6. Comparison of coefficient estimates from education regressions and values fitted by model

	Sons			Daughters	
Parental education variable	Coefficient estimate	Fitted value		Coefficient estimate	Fitted value
Type 1: Biological father's years of education	0.197 (0.005)	0.197		0.153 (0.004)	0.152
Type 1: Biological mother's years of education	0.172 (0.005)	0.170		0.166 (0.005)	0.165
Type 2: Biological father's years of education	0.187 (0.013)	0.187*		0.157 (0.013)	0.157*
Type 2: Biological mother's years of education	0.163 (0.015)	0.170		0.175 (0.015)	0.165
Type 3: Biological father's years of education	0.146 (0.020)	0.146*		0.117 (0.108)	0.117*
Type 3: Biological mother's years of education	0.139 (0.022)	0.170		0.141 (0.020)	0.165
Type 3: Stepfather's years of education	0.101 (0.020)	0.101*		0.070 (0.019)	0.070*
Type 4: Biological father's years of education	0.160 (0.027)	0.197		0.108 (0.027)	0.152
Type 4: Biological mother's years of education	0.144 (0.031)	0.144*		0.143 (0.029)	0.143*
Type 5: Biological father's years of education	0.253 (0.042)	0.197		0.182 (0.051)	0.152
Type 5: Biological mother's years of education	0.146 (0.044)	0.146*		0.076 (0.056)	0.076*
Type 5: Stepmother's years of education	0.059 (0.047)	0.059*		0.040 (0.050)	0.040*
Type 6: Biological father's years of education	0.121 (0.033)	0.120		0.062 (0.035)	0.054
Type 6: Biological mother's years of education	0.105 (0.036)	0.110		0.088 (0.038)	0.134
Type 6: Adoptive father's years of education	0.078 (0.030)	0.077		0.106 (0.032)	0.099
Type 6: Adoptive mother's years of education	0.056 (0.032)	0.060		-0.007 (0.034)	0.031

Notes: The fitted values with asterisks are guaranteed to fit exactly because of the free ρ parameters. As detailed in the text, the six family types are: (1) reared by biological mother and father, (2) reared by biological mother with no stepfather, (3) reared by biological mother with stepfather, (4) reared by biological father with no stepmother, (5) reared by biological father with stepmother, and (6) reared by adoptive mother and father.

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