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The Nature and Nurture of Economic Outcomes

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The relative importance of biology and environment is one of the oldest and most prominent areas of scientific inquiry and has been examined by researchers as diverse as David Hume (1748), Charles Darwin (1859), and Sigmund Freud (1930). Social scientists are particularly interested in the degree to which family and neighborhood environmental factors influence a child's educational attainment and earnings.

The stakes in this debate are quite high and far-reaching. As Richard Herrnstein and Charles Murray (1994) point out, the effectiveness of anti-poverty and pro-education policies is largely dependent on the degree to which environment matters. Any claim of treatment effects from different family structures, different teachers, different peers, or different neighborhoods needs as a pre-condition that some aspects of environment are important to long-term outcomes. Attempts to understand the root causes of income inequality often involve trying to sort out the effects of family background from the effects of genetic endowments (see e.g., Zvi Griliches and William Mason, 1972; Christopher Jencks, 1972).

In this paper I use data on adoptees to identify the causal effect from being adopted into a high-socioeconomic-status (SES) family versus a lower-SES family. I examine a range of outcomes including educational attainment, marital status, test scores, and the selectivity of college attended.

I. Some Context

Most modern research on the relative importance of genes and environment has been performed by behavioral geneticists, including John Loehlin et al. (1982) and John DeFries et al. (1994). The vast majority of these papers focus on decomposing the variance of children's outcomes into variance in genetic endowments, variance in shared environment (i.e., shared within a family), and variance in individual specific environment (which is the unexplained residual). The outcomes considered generally include IQ scores, other achievement tests, and scores on personality tests. The data sets employed generally use variation within siblings, within adopted siblings, or within fraternal and identical twins to identify the parameters in the variance decomposition.

This literature has two features which may surprise most economists. First, performing this variance decomposition requires imposing strong functional-form assumptions on how genes and shared environment combine to cause child outcomes. The standard model assumes that child outcomes are a linear and additive function of genes, shared environment, and individual environment. There is no allowance for the interaction between genes and environment or the role of the child's genes in endogenously determining the child's environment as in William Dickens and James Flynn (2001). Thus, when researchers estimating the model find little role for shared environment in determining IQ it is possible that this apparently strong result stems in part from the functional form imposed.

A second feature of the existing literature is that it tends to focus exclusively on IQ and personality tests and neglects some of the outcomes that most interest economists, including earnings, educational attainment, and occupation.[1] This hole in the literature has been recognized by several authors, and in addition to the results presented below there are several working papers addressing the subject, including Sacerdote (2000), Eric Plug and Wim Vijverberg (2000), Anders Bjorkland et al. (2001), and Matali Das and Tanja Sjogren (2002).

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[1] Two notable exceptions to this statement are the studies of Jere Behrman and Paul Taubman (1989) and Barbara Maughan et al. (1998).

In the results below I focus on educational and labor-market outcomes, and I avoid the assumptions needed to perform a full decomposition of the variance of outcomes into genetic and environmental components. Instead, I identify the average causal effect on child outcomes from a very large shift in family environment. I argue that in certain cases adoption can be thought of as a natural experiment in which children are randomly assigned to different family backgrounds, without regard to a child's particular genetic endowment. Knowledge of the assignment process in my two data sets and empirical checks provide support for this assumption.

Given random assignment, the adoptees' genetic endowments and all other pre-adoption characteristics are orthogonal to the income and socioeconomic status of the adoptive families. Hence, I can simply regress children's outcomes on adoptive-family characteristics and identify the causal effect from being assigned to a family of a particular type.

TABLE 1—HOLT INTERNATIONAL SAMPLE, REGRESSION OF ADOPTEE OUTCOMES ON HOMETOWN CHARACTERISTICS

Variable	(i) No college	(ii) Acceptance ratio of college[c]	(iii) Two- vs. four-year college	(iv) Math SAT >500[d]
A. *Mean, Dependent Variable (SD):*				
Adoptees	0.052	73.00	0.247	76.223
	(0.222)	(17.41)	(0.432)	(17.500)
B. *Coefficients from Regressions (SE):*				
Log(income)[a]	−0.098*	−13.883*	−0.056	1.295
	(0.040)	(3.916)	(0.083)	(4.409)
Log(population)[b]	−0.005	−0.214	−0.004	−0.276
	(0.006)	(0.625)	(0.014)	(0.723)
Constant		221.724		65.340
		(41.599)		(47.442)
R^2:	0.07	0.06	0.00	0.00
N:	290	188	275	157

Notes: Columns (ii) and (iv) report ordinary least-squares (OLS) results; columns (i) and (iii) are probits with $\partial y/\partial x$ reported.

[a] Log of median family income in hometown.

[b] Log of population in hometown.

[c] Acceptance ratio for four-year institutions.

[d] Percentage of admitted candidates with math SAT >500 (four-year colleges only).

* Statistically significant at the 5-percent level.

Sources: The list of graduates is from Holt International's *HI Families* magazine (1998–2000). Median family income for city or place is from the 1990 Census. Acceptance ratios and SAT measures are from *Peterson's Guide to Colleges.*

II. Data and Results

My first data set consists of Korean adoptees placed by Holt International. Holt is the United States' largest placement agency for international adoptees and currently places almost 1,000 children per year. Holt was the first agency to begin placing Korean children with U.S. families during the 1950's. Korean adoptees accounted for 80 percent or more of Holt's placements from the 1950's through the 1980's. Most children are age 0–3 at time of adoption.

I have data on a small cross section of about 300 Korean adoptees who graduated from high school during 1998–2000. These are children whose parents wrote to Holt's *HI Families* magazine with a report of the child's high-school graduation and plans for work or postsecondary education. I have data on whether the adoptee plans to work or attend college (and if so, which college) and on the adoptee's hometown. I match the college or university with acceptance ratios and SAT information from Peterson's Guide to Colleges. I match the adoptee's hometown to census data on median family income, population, and percentage of population with a bachelor's degree (results not shown here).

There is strong evidence that these adoptees are assigned to families in a random manner. Adoptive families at Holt do not select their adopted child. Instead, Holt first qualifies each family using an extensive written application, several interviews, and a home study. The families are then assigned children on a first-come, first-served basis. Adoptive families have no information on child or biological parent background, which eliminates the possibility of the family engaging in selection.

Table 1 presents results for the Holt Data. In column (i) the dependent variable is a dummy variable which equals 1 if the adoptee has no intention to attend college in the next year and 0 if the adoptee plans to attend a two- or four-year college. The mean of the "no college" dummy variable is 0.05 in a sample of 290 adoptees. Column (i) shows a probit of "no college" on the log of median family income for the adoptee's hometown and log(population). A doubling of median family income is associated with a 10-percent decrease in the probability of having "no college" status. The coefficient has a t statistic of 2.45, and the size of the effect is

large relative to the mean of the dependent variable.

In column (ii), I limit the sample to adoptees attending a four-year college that reports an acceptance ratio in *Peterson's Guide to Colleges.* The acceptance ratio is defined as the number of acceptances divided by the number of applications and is reported annually. I regress the acceptance ratio of the adoptee's intended college on log(median family income) and log(population) for the adoptee's hometown. The coefficient on log(median family income) is −13.88 and is highly statistically significant. A doubling of median family income is associated with nearly a 1-standard-deviation increase in the selectivity of the adoptee's institution.

In column (iii), I create a dummy to distinguish between adoptees attending two- versus four-year colleges. Column (iii) shows that the dummy is relatively uncorrelated with median family income, though it has the expected sign. Column (iv) limits the sample to four-year colleges listed in *Peterson's Guide to Colleges.* The dependent variable is the percentage of admitted candidates with a math SAT score above 500. The regressions show that this measure of college selectivity is not correlated with median family income or population of the adoptee's hometown.

These results indicate that the socioeconomic status of the adoptive family (as measured by hometown median income) has a large impact on whether or not the adoptee attends college upon graduating from high school and on which college is attended. This seemingly commonsense finding contrasts somewhat with findings of other researchers. For example, in their work comparing fraternal and identical twins and their offspring, Behrman and Taubman (1989) find that shared environment explains very little of the variance in schooling.

My second data set consist of adoptees within the British National Child Development Survey (NCDS). The NCDS study is a longitudinal panel, which began as an infant mortality study in 1958. The initial sample included all children born during a single week in Britain in March 1958. The most recent wave that I use was collected in 1981, when the subjects were age 23.

I have a base sample of 128 adoptees, and details on the sample are available in Sacerdote (2000). Most of the adoptees are illegitimate children who were placed with an adoptive mother and father at birth or within three months of birth. The average age of the birth mother is 24.3 years, and 20 percent of the birth mothers smoked during pregnancy. Sixty percent of the children are boys, and 98 percent are white.

For the adoptive parents, I have data on the father's years of education and an index of socioeconomic status that is based on the father's occupation. This index ranges from 1 to 11 and has a mean of 6.8. A score of 11 is given to white-collar managers in large firms; a 6 is for junior nonmanual workers, and a 1 is for unskilled manual workers.[2]

I also have a large comparison sample of 7,981 children in the NCDS who were raised by their birth parents. I limit the sample to children who were living with both parents from birth through age 11 or longer. The comparison children are quite similar to the adoptees on several dimensions. The mean reading scores at age 7 are similar, and both samples are mostly white. The birth mothers are older in the comparison sample than in the adoptee sample.

My analysis consists of regressing the outcomes for the adoptees on characteristics of the adoptive parents. As with the analysis of the Holt data, the key identifying assumption is that the adoptees are assigned randomly or quasi-randomly to adoptive parents. Results in Sacerdote (2000) show that adoptive-family socioeconomic status is uncorrelated with birth mother's SES, birth mother's smoking status, or child's birthweight.

Table 2 contains the results for the NCDS data. Each of the four columns in Table 2 contains a separate outcome (dependent) variable. The first two rows show the mean and standard deviation of the dependent variable for the adoptee and comparison samples. The next four rows show ordinary least-squares (OLS) coefficients and standard errors from four separate regressions of the dependent variable on adopted family's socioeconomic status (SES), adoptive father's years of education, compari-

[2] NCDS actually coded this variable with 1 being the highest income category, but I reversed the coding so that 11 is highest category and 1 is the lowest.

TABLE 2—NATIONAL CHILD DEVELOPMENT SURVEY DATA FOR ADOPTEES AND NON-ADOPTEES, REGRESSION COEFFICIENTS OF CHILD OUTCOMES ON PARENT CHARACTERISTICS

Variable	(i) NFER reading test, age 16	(ii) College (0–1), age 23	(iii) Family income, age 23	(iv) Married (0–1), age 23
A. *Mean Dependent Variable (SD):*				
Adoptees	27.262	0.402	110.753	0.411
	(5.235)	(0.492)	(55.683)	(0.494)
Comparison[a]	25.882	0.381	117.388	0.462
	(6.704)	(0.486)	(60.524)	(0.499)
B. *Regression Coefficients:*				
Adoptive family's SES	0.334*	0.032*	−0.982	−0.058*
	(0.081)	(0.015)	(1.003)	(0.012)
Adoptive father's education	0.110	0.048	0.393	−0.041
	(0.338)	(0.037)	(4.863)	(0.038)
Comparison family's SES	0.548*	0.037*	1.695*	−0.018*
	(0.087)	(0.007)	(0.377)	(0.002)
Comparison father's education	0.833*	0.070*	1.652*	−0.035*
	(0.057)	(0.010)	(0.330)	(0.004)
C. *Difference in Coefficients, Comparison–Adoptive (SE):*				
SES	0.214	0.005	2.677	0.040**
	(0.143)	(0.012)	(1.015)	(0.016)
Fathers' education	0.723	0.022	1.259	0.006
	(0.431)	(0.033)	(3.425)	(0.035)

Notes: Column (i) reports results for reading comprehension exams constructed by the National Foundation for Educational Research for use in the British National Child Development Survey (NCDS). Column (ii) reports results for an indicator variable for "college," which codes as 1 any graduate of a university, technical college, teaching college, or nursing college. All regressions include controls for race, gender, and region of birth. In panel (B), each coefficient is from a separate regression: child's outcome $= \alpha + \beta$ (parent characteristic) $+ \gamma$ (dummy for male) $+ \delta$ (dummy for white) $+ \pi$ (ten dummies for region). Panel (C) shows the differences between coefficients for control and adopted children. Sample sizes for comparison children: 7,981 children for SES regressions and 6,482 for father's education regressions. Sample sizes for adopted children: 128, 107, 112, and 112, respectively, for SES regressions; 81 for father's education regressions.

[a] Comparison children are defined as children who lived with both biological parents until at least age 18.

* Statistically significant at the 5-percent level.

son family's SES, and comparison father's years of education, respectively. The regressions also include controls for child's sex, child's race, and dummies for child's region of birth.

Column (i) examines the child's score on the National Foundation for Educational Research reading test, which was administered at age 16. The mean score for the adoptees is 27.3 with a standard deviation of 5.2 points. The coefficient on adoptive family's SES is 0.33 and is significant at the 5-percent level. A one-standard-deviation increase in SES is associated with a 0.19 standard deviation increase in the reading score. For the comparison children, the coefficient on family SES is larger, at 0.55.

Columns (ii)–(iv) examine the reduced-form effect of family environment on college attendance, income, and marital status. College attendance here is defined very broadly to include university, technical schools, and nursing and teaching schools.

Column (ii) is a probit using the dummy for college attendance as the dependent variable (partial derivatives are reported). For the adoptees, the partial derivative on adoptive family SES is 0.032. A one-standard-deviation increase in family SES is associated with a 9.3-percent increase in the probability of attending college. This is a 23-percent increase in probability if measured at the means. The corresponding coefficient for the comparison group is similar at 0.037. Based on the results, one cannot reject the hypothesis that the effect of nurturing parents' SES on child's college attendance is just as large for adoptees as for children raised by both of their biological parents. The coefficient on father's years of education is not significant for the adoptees, but it is for the comparison group.

In column (iii), I show that adoptive family SES has no measurable effect on family income at age 23. It is certainly possible that lifetime incomes of the adoptees are affected by the SES of their adoptive parents, but a snapshot at age 23 does not pick this up.

In column (iv), there is a large effect of adoptive-family SES on marital status. Higher family SES makes a child less likely to be married at a young age. I find that the effect is similar for adopted men and women (results not shown here). A one-standard-deviation increase in SES is associated with a 17-percent decrease in the probability of being married at age 23.

III. Conclusion

In this paper, I use data on adoptees to measure causal effects on children's outcomes from being raised in a high-education or high-SES family. My key identifying assumption is the random assignment of adoptees to families. I ' find that being raised in a high-SES family (or in a high-income town) greatly increases the

probability that a child will attend college and increases the selectivity of the college attended. I also find that adoptees raised in high-SES families are much less likely to be married at a young age. In the NCDS data, the effect of the nurturing parent's SES on the child's college attendance is similar for adoptees and nonadoptees. In results reported here and in Sacerdote (2000), there is some evidence that the effect of family environment may be greater on educational attainment than for test scores. These findings support the notion that environment can be incredibly potent in determining children's outcomes and that environment's potency may vary with the outcome considered.

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