The Wages of Sinistrality: Appendix

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1 Data and Determinants of Handedness

1.1 Data sets

I use five longitudinal data sets, three from the US and two from the UK. All five contain information on handedness, as well as measures of cognitive skill and other evidence of human capital accumulation.

The American data sets are three cohorts of the National Longitudinal Survey of Youth. The NLSY79 is a nationally representative sample of youth ages 14-22 when first interviewed in 1979. Interviews were conducted annually through 1994 and are now conducted biennially. The NLSY97 is a nationally representative sample of youth ages 12-17 when first interviewed in 1997. Interviews are conducted annually. In the most recent interview waves available, NLSY79 respondents are 43-51 years old and NLSY97 respondents are 24-29 years old.

The third American data set is the NLSY Children and Young Adults (NLSC), which follows all children born to the women in the NLSY79. Interviews of these children have been conducted biennially since 1986. Unlike the other data sets used in this paper, the NLSC interviews multiple siblings from the same family, allowing within-family analysis of the effect of handedness. Longer term outcomes are, however, harder to explore in the NLSC because many of the children followed were born too recently to have completed schooling or entered the labor market. For all three American data sets, I use only the nationally representative cross-sectional samples and omit the minority, economically disadvantaged and military oversamples.

The two British data sets are the National Child Development Study (NCDS58), which follows over time all people born in Great Britain in one week in March 1958, and the British Cohort Study (BCS70), which follows all people born in Great Britain in one week in April 1970. Both data sets begin at birth and subjects are subsequently interviewed about every five years through the present.

1.2 Measuring handedness

Each of the five data sets asks somewhat different questions regarding handedness. The NLSY79 asked its subjects once in 1993, when they were 28-36 years old: "Were you born naturally left-handed or right-handed?" The NLSY97 asked its subjects twice in 2001 and 2002, when they were 16-22 years old: "Are you left-handed or right-handed?" Every survey year since 1996, the NLSC has asked three questions of the mothers of 2-14 year-olds: Which hand does the child use when brushing teeth, when throwing a ball, and when writing? Youths older than 14 were directly asked these same questions in 1996 and 1998 and each was also asked, "As a child, were you ever forced to change the hand with which you write?"

The NCDS58 explored handedness at ages 7, 11 and 16. At age 7, each mother was asked to state her child's handedness. Interviewers also recorded which hand each child used to throw a crumpled paper ball and to draw a cross. At age 11, each mother was again asked to state her child's handedness and was then specifically asked which hand her child uses to write. Interviewers also recorded which hand each child used to throw a ball. At age 16, each youth was asked with which hand he or she writes best.

The BCS70 explored handedness at ages 10 and 16. At age 10, interviewers recorded which hand each child used to pick up a ball and to mime combing his or her hair. Each child was also asked which hand he or she uses to write. At age 16, each youth is asked which hand he or she uses to write a letter, throw a ball, hold a racket, hold the top of a broom to sweep, hold the top of a shovel, hold a match when striking it, hold scissors, deal playing cards, hammer a nail and unscrew the lid of a jar.

For each question asked about handedness across all five data sets, I assign a value of 1 to answers that clearly favor the left hand (such as "always left" or "usually left") and a value of 0 to answers that clearly favor the right hand. I assign a value of 0.5 to answers indicating mixed-handedness or a lack of hand preference. To construct a continuous measure of left-handedness, I compute for each year the mean response to handedness questions and then compute the mean of these values across all years. This weights each year equally, regardless of how many handedness questions were asked that year. I exclude from the samples individuals for whom I can not construct any measure of handedness.[1]

The distribution of this continuous measure of handedness is shown for each study in Figure 1. In all of the samples, except for the NLSY97, the distribution of left-handedness is clearly concentrated at the extremes, so that most individuals can be easily categorized as right- or left-handed. The mass in the middle of the NLSY97 distribution is due largely to 341 individuals who claim to be right-handed in one year and left-handed in the other. To construct a binary measure of left-handedness, I round this continuous measure to the nearest integer. This implies that some mixed-handed individuals are categorized as left-handed. I later show that my central results are not sensitive to changes in the definition of left-handedness. Also, in the NLSC, 37 youths report currently preferring their right hand but also report having been forced to switch handedness earlier in life. I categorize these youths as left-handed. For family fixed effects analysis, I then create a subsample of the NLSC called NLSC-FE, which is limited to children from families with at least one left-handed and at least one right-handed child.

1.3 Summary statistics

Table 1 shows the mean values of selected variables from the six samples used in this study. Panel (A) lists the basic controls included in subsequent regressions in the paper. Individuals in the NLSY97 sample range from 25 to 29 years old as of the most recent wave, while the remaining three studies' subjects are all observable through at least their mid-30s. The average individual in the NLSC is 20 years old at the most recent wave in 2008, so that long run outcomes such as college graduation and labor market earnings are not yet observable for the majority of the sample.

In nearly all of the samples, the rate of left-handedness is a remarkably consistent 11% to 13%, well within the range observed in studies of other populations. This suggests that the constructed measure of handedness is fairly accurate. The 16% rate of left-handedness in the NLSY97 is largely due to categorizing the large mass of mixed-handed individuals as left-handed. The rate of left-handedness is substantially higher in the NLSC-FE due to the exclusion of families without left-

[1]The fraction of individuals for whom I can successfully measure handedness is 86% in the NLSC, 91% in the NLSY79, 92% in the NLSY97, 90% in the NCDS58, and 74% in the BCS70. Nearly all missing handedness measures stem from attrition prior to the wave in which handedness questions were asked.

handed children.

In all of the studies, I observe gender, birth order, mother's age at birth and mother's education. I observe race in the US studies. Various measures of infant health are recorded in the NLSC and the UK studies, including birthweight and indications of infant health challenges around the time of birth.[2] Because the NLSC children can be connected to their mothers in the NLSY79, I can construct a dummy for each child indicating whether his or her mother was left-handed. The NLSC-FE sample is similar to the full NLSC sample in nearly all covariates except that the fixed effects sample has a higher proportion of blacks and those with left-handed mothers.

Panel (B) shows selected outcomes, the construction of which will be discussed in more detail below. For all six samples, I observe a measure of cognitive skill that I transform into an age-normed Z-score, as well as an indicator for having behavioral problems. For the samples in which I observe individuals into adulthood, I observe educational attainment and hourly wages as measured in 2009 dollars or pounds sterling. Below panel (B) are listed each sample's size, which refers to the number of individuals for whom handedness is observed. Most outcomes are observed for smaller numbers of individuals due to attrition and missing data.

1.4 Determinants of handedness

Table 2 shows the estimated coefficients from linear probability models represented by equations 1 and 2 below:

$$lefty_{ij} = \alpha + \beta X_{ij} \qquad + \epsilon_{ij} \tag{1}$$

$$lefty_{ij} = \alpha + \beta X_{ij} + \mu_j + \epsilon_{ij} \tag{2}$$

where $lefty$ indicates left-handedness for individual i from family j, X is a vector of explanatory variables and μ are family fixed effects. Column (1) uses the full NLSC sample, column (2) uses the fixed effects sample but omits the fixed effects, and column (3) uses the fixed effect and includes

[2]For the NLCS samples, the dummy for birth complications indicates that the child remained in the hospital for more than a week after being born. For the UK samples, it indicates that the birth was a breech birth or that forceps or a vacuum were used during delivery.

the fixed effects. Column (4) pools the US adult samples represented individually in columns (5) and (6), weighting observations so that each sample contributes equally to the pooled regression. Column (7) pools the UK data sets represented individually in columns (8) and (9), with the same weighting scheme. Subsequent regression tables in this paper have a similar structure.

The relationships between the covariates and the probability of being left-handed are fairly consistent across samples. Maternal education and age at birth have little predictive power. Conversely, gender and maternal left-handedness and infant health are strongly related to left-handedness, consistent with previous studies. Across the samples, women are roughly three percentage points less likely than men to be left-handed. Rates of left-handedness range from 9-15% for females and from 12-18% for males. In column (3), the gender difference is an even greater 15 percentage points because the base rate of left-handedness in males in the fixed effects sample is 42%. Column (1) shows that children with left-handed mothers are five percentage points more likely to be left-handed themselves (about 16% of such children are left-handed). This strongly suggests a genetic component of left-handedness, though I can not reject the possibility that left-handed mothers may influence their children's handedness through their own behavior.

Other evidence strongly suggests an environmental component of left-handedness. In the UK data sets, lower birthweight babies are more likely to be left-handed, with each additional pound at birth associated with a 0.6 percentage point decrease in the rate of left-handedness. The NLSC birthweight coefficients are also negative but the smaller sample sizes render the estimates less precise. In these same samples, complications around the time of birth also increase the rate of left-handedness. US babies that remain more than a week in the hospital post-birth are five percentage points more likely to be left-handed, while UK babies whose labors were complicated are 1.5 percentage points more likely to be left-handed. At the bottom of each column is reported the p-value from an F-test of the joint significance of birthweight and birth complications, the two measures of infant health. In the NLSC and UK samples, the infant health measures are at least marginally jointly significant predictors of left-handedness. The NLSC and US samples also suggest that black children are two to three percentage points more likely to be left-handed than white children. Given that black infants in the US have substantially worse health at birth than do white infants and that these data lack extensive information on fetal and infant health, race may be serving as a proxy for unobserved fetal and infant health measures. I turn now to a discussion of the impact of handedness on human capital accumulation.

2 Human Capital Accumulation

2.1 Cognitive skills

The main measures of cognitive ability come from math and reading comprehension tests administered in all of the studies. The NLSC administered Peabody Individual Achievement Tests in each wave for each subject between the ages of 5 and 14. The NLSY79 and NLSY97 both administered in a single wave the Armed Services Vocational Aptitude Battery (ASVAB), at ages 17-24 in the NLSY79 and ages 14-19 in the NLSY97. The NCDS58 administered math and reading tests at ages 7, 11, and 16. The BCS70 administered a math test at age 10 and reading comprehension tests at ages 5 and 10. Raw math and reading comprehension scores were standardized by age within each study, averaged across multiple ages for individuals tested more than once, then standardized again within each study. A cognitive ability Z-score was then constructed as the standardized average of the math and reading Z-scores.

Table 3 shows the difference in cognitive skills between lefties and righties conditional on the set of covariates listed in table 2 and its notes. The estimating equations look like:

$$Y = \alpha + \beta lefty_{ij} + \gamma X_{ij} \qquad + \epsilon_{ij} \tag{3}$$

$$Y = \alpha + \beta lefty_{ij} + \gamma X_{ij} + \mu_j + \epsilon_{ij} \tag{4}$$

where Y is the outcome of interest, $lefty$ indicates left-handedness for indidividual i from family j, X is a vector of explanatory variables and μ are family fixed effects. In all of the samples except the NLSY79, lefties show statistically significantly lower cognitive skills than righties. The top row of coefficients implies that lefties have overall cognitive skills 0.11 standard deviations lower than righties in the NLSC. The point estimate of the gap between left- and right-handed siblings is an even larger 0.16 standard deviations. The NLSY79 is the only one of the samples in which the cognitive difference between lefties and righties, though negative, is too small to be statistically significant. The cognitive gap in the NLSY97 is nearly identical to that in the NLSC, and the gap in the British samples is about 0.06-0.08 standard deviations. The second and third rows of table 3, which analyze math and reading scores separately, show that the cognitive gap between lefties and righties is nearly identical across the two subjects. This suggests that, even if differential language processing is responsible for these cognitive gaps, such differences affect math and reading skills similarly.

One popular claim about lefties is that they are more likely to be highly talented, perhaps because of increased creativity. This claim suggests that aspects of the cognitive skill distribution other than the mean are worth exploring. To do this, I plot in figure 2 kernel density estimates of the full distribution of cognitive skill for the NLSC and the pooled US and UK samples. There is no visual evidence that lefties are overrepresented at the upper end of the distribution and generally strong evidence that they are overrepresented at the lower end. The third and fourth rows of table 3 test this by using as outcomes indicators for being in the top and bottom 10% of the cognitive skill distribution. Consistent with the plotted densities, lefties are 2-4 percentage points more likely to be in the bottom 10% of the distribution. In all samples but the NCDS58, lefties are 1-2 percentage points less likely to be in the top 10% of the distribution, though those differences are not often statistically significant. Tests of the probability of being in the top 5% or 1% of the distribution show similar results. There is no evidence that lefties are more likely to be highly talented, at least by this measure of cognitive skill.

Further evidence of cognitive gaps come from tests administered in only some of the studies. In the NLSY79 and NLSY97, part of the ASVAB consisted of a coding speed test in which subjects match words to numbers based on a key. Given that the task requires nearly no prior knowledge and that subjects have only seven minutes to complete as many matches as possible, the test is thought to measure raw mental speed or fluid intelligence. By this measure, lefties in both samples score roughly a tenth of a standard deviation worse than righties. Though the math and reading scores suggest that the NLSY79 is the only sample in which lefties and righties have similar cognitive skills, the difference in coding speeds suggests that even in that sample there are cognitive differences between the two groups. The British studies also administered a test requiring little prior knowledge. Children ages 4-7 were given the Copying Designs test, in which they were shown images of circles, crosses, and other shapes and asked to copy those designs on a sheet of paper. Lefties scored 0.12 standard deviations worse on this test than righties. Both the coding speed and copying designs results suggest that the observed cognitive gaps are not only about acquired knowledge itself but also about deeper cognitive skills that may contribute to the acquisition of knowledge.

2.2 Disabilities

Before turning toward long-run measures of human capital, I first explore factors other than cognitive skills that might also affect such long-run outcomes. Given that previous studies have found left-handedness to be associated with a variety of impairments and behavioral problems, I construct measures of a number of such factors. All of the samples except the BCS70 contain a binary measure of whether the subject suffers from an emotional or behavioral problem. Three of the studies also contain continuous measures of behavioral problems reported by a parent, the Behavior Problems Index in the NLSC, the Bristol Social Adjustment Guide in the NCDS58, and the Rutter Scale in the BCS70. I construct an indicator for having a behavior problem that takes a value of one if either the binary measure equals one or if the age-standardized continuous measure falls in the top 5% of the distribution. The first row of table 4 shows strong evidence that lefties are more likely to have behavior problems. The NLSC sample suggests that lefties are 3.5 percentage points more likely to have behavior problems than righties, a difference that grows to 4.9 percentage points when comparing left- and right-handed siblings. Given that roughly 8 percent of righties in the NLSC samples have behavior problems, this implies that lefties are about 50 percent more likely than righties to have such problems. The pooled US and UK samples also show statistically significant differences, with lefties in those samples about 1.5 percentage points more likely to have behavior problems. Though the magnitudes of these differences vary across samples, likely due to different question wording and ages at interviews, the estimates clearly indicate increased behavioral problems among lefties.

Previous research has suggested that left-handedness is unusually common among mentally retarded individuals. This fact is cited in support of the theory of pathological left-handedness, the idea that some left-handedness can be thought of as brain damage, perhaps due to fetal trauma. Each of the data sets used in this paper allow construction of an indicator for mental retardation, either through parental reporting, self-reporting, or interviewers' observations of the subject. In all of the samples, a high proportion of the mentally retarded individuals are left-handed. In the most extreme case, seven of the eight mentally retarded children in the NLSC-FE are left-handed. The second row of table 4 shows that lefties are consistently about one percentage point more likely to be mentally retarded than righties. Given the low rate of mental retardation in these samples, this represents a very large percentage increase even though the absolute number of mentally retarded lefties is quite small.

Given the biological evidence that lefties process language differently than righties, I construct two further measures of disability related to language. The first is an indicator for having a speech problem, such as a stutter or other speech impairment. In the NLSC and UK samples, lefties are 1-2 percentage points more likely to have such speech problems. The second measure is an indicator for having a learning disability, questions about which often mention dyslexia specifically. In both the NLSC samples and the NLSY97 sample, lefties are 2-3 percentage points more likely to report a learning disability than righties, a proportional increase of more than 35 percent. Finally, the NLSC and BCS administered to children ages 7-11 a digit span test to find the maximum number of digits a subject could memorize and recite forward (in both studies) or backward (in the NLSC only). There is little evidence that lefties are worse at reciting digit lists in the forward direction, which is generally considered a test of short-term auditory memory. Lefties are, however, substantially worse at reciting the digits backwards, which is thought to measure the child's ability to manipulate verbal information in temporary storage.[3] This inability to reverse the order of a list may be further evidence of a dyslexia-like impairment or other difficulties with language processing.

[3]See p. 103 of the June 2009 version of the "'NLSY79 Child & Young Adults Data Users Guide"'.

2.3 Education, Occupation and Earnings

Table 5 shows differences in educational attainment and occupational characteristics between lefties and righties for all samples but the NLSC, in which many respondents have not yet completed their educations. For comparability across the American and British data sets, educational attainment is defined by the mutually exclusive categories of high school dropout, high school graduate and college graduate. In the US samples, I construct these using the maximum level of education reported within ten years of the start of the study, at which point subjects were in their mid-twenties to early thirties. Those reporting at least 12 years of education are considered high school graduates and those reporting at least 16 years are considered college graduates. In the British studies, subjects were asked at age 33-34 for their highest academic qualification. Those with O-levels or higher are considered high school graduates and those with qualifications beyond A-levels are considered college graduates.

In panel (A), the evidence suggests somewhat lower educational attainment for lefties in both the US and the UK. The pooled US estimates suggest that lefties are 2.8 percentage points less likely to complete college than righties. Given that 26% of righties in this sample complete college, this represents more than a 10% difference in the rate of college completion, a magnitude that is similar across the NLSY79 and NLSY97. In the UK samples, lefties are 1.3 percentage points more likely to drop out of high school, a difference that is marginally significant.

Panel (B) exploits the fact that all of the data sets record individuals' occupations, coded by a standardized scheme. I construct three mutually exclusive categories of professional/managerial occupations, other occupations, and missing occupation. In the US samples, lefties are significantly less likely to have professional or managerial occupations, likely due in part to their lower rate of college completion. Also striking is that lefties are substantially more likely to be missing occupational information. This is not due to differential attrition from the data set but instead from the fact that lefties are more likely not to report having any occupation at all, even over multiple waves. A similar but weaker pattern is seen in the UK samples.

In panel (C), I take advantage of the US Department of Labor's Occupational Information Network (ONET), which contains measures of various abilities required by each occupation in the

Standard Occupational Classification scheme. ONET groups such abilities into four categories: cognitive, psychomotor, physical and sensory. Each category contains multiple sub-abilities, the importance of which to each occupation is measured on a scale from 1 to 5. For each occupation, I construct a measure of cognitive ability from the mean of all cognitive sub-abilities and a measure of manual ability by averaging all sub-abilities that mention hands, including "'arm-hand steadiness,"' "'finger dexterity,"' "'manual dexterity"' and "'wrist-finger speed."' I standardize all of these occupational ability measures across the population of individuals for whom I observe occupation.

Consistent with the gaps in cognitive test scores, panel (C) shows that lefties in the US work in occupations requiring 0.08 standard deviations less cognitive ability. This gap is larger and more precisely estimated in the NLSY97 than the NLSY79, which may be due to measurement error stemming from the two crosswalks needed to connect the NLSY79 occupational coding scheme to the more modern ONET scheme. A nearly identical gap is found if I construct the cognitive ability measure from the two sub-abilities that plausibly measure creativity, namely "'originality"' and "'inductive reasoning"'. Lefties work in occupations requiring less, not more, creativity than righties. Finally, if lefties are at a disadvantage due to the fact that they use different hands to work, such a disadvantage is not apparent in occupational choice. Lefties work in occupations requiring more 0.06 standard deviations more manual ability than righties. These occupational ability measures strengthen the case that the primary disadvantage of being a lefty involves cognitive deficits, not manual ones.

Long-run earnings outcomes are available for all studies but the NLSC, many of whose subjects are too young to observe such outcomes as of the most recent wave. I construct annual earnings in a way that makes the US samples comparable to each other and the UK samples comparable to each other. Because NLSY97 subjects were ages 25-29 at the last wave of interviews, in both the NLSY79 and NLSY97 I define the relevant value as the last non-missing value observed from ages 25-29. In the British studies, I construct earnings at age 33-34 for all respondents reporting earnings, including full-time workers, part-time workers and the self-employed. The constructed distributions includes non-working individuals as having zero earnings or wages. US and UK wages are expressed in 2009 dollars and pounds sterling respectively.

I plot in figure 3 kernel density estimates of the distribution of annual earnings for the pooled US and UK samples, limiting the sample to males to avoid the confounding correlation between gender and handedness. In the US sample, lefties are clearly represented at higher rates than righties at the low end of the income distribution from $0-10,000 and represented at lower rates at the middle to high end of the distribution. A similar though somewhat noisier pattern is apparent in the UK sample.

Table 6 quantifies these differences, showing large and statistically significant earnings gaps between lefties and righties across nearly all of the samples. Panel (A) considers males and females together. In the top row, which uses the logarithm of earnings as the dependent variable, I bottom code low earnings in order to include those with zero earnings and to reduce the sensitivity of the specification to the presence of those with very low non-zero earnings. In the US samples, I assign earnings of $3,000 to anyone with $0-3,000 in earnings. In the UK samples, I assign earnings of £2,000 to anyone with £0-2,000 in earnings. These estimates suggest that lefties earn a large and highly statistically significant 12.8 percent less than righties in the pooled US sample, the average of a 10.5 percent gap in the NLSY79 and a 14.4 percent gap in the NLSY97. The highly significant 6.6 percent gap observed in the pooled UK sample is an average of the 11.6 percent gap in the BCS70 and a statistically insignificant 1.9 percent gap in the NCDS58.

The second row shows that US lefties earn nearly $1,800 less than righties, or 7% less than righties' mean earnings of $24,400. In the UK sample, lefties earn over £900 less than righties, or 5% less than righties' mean earnings of £19,700. To check that these gaps are not due to outliers or to miscoding of individuals with unusually low or high wages, I run quantile regressions in the third row to check the gap in the median earnings between lefties and righties. The gap in median earnings is even larger than the mean gap in nearly all of the samples. Consistent with estimates from the logarithmic specification, the median lefty in the NLSY79, NLSY97 and BCS70 earning 10-12% less than the median righty. The final row of table 6 uses as an outcome an indicator for individuals with annual earnings below $3,000 or £2,000, the majority of whom have zero earnings. In all samples but the NCDS58, lefties are 4.2 percentage points, or more than 25%, more likely to have low earnings. This is consistent with visual evidence from plots of the earnings distributions. Panels (B) and (C) separate the samples by gender. The pooled samples suggest that both males and females exhibit earnings gaps by handedness. In the US, these gaps are larger for females, though not significantly so.

The magnitude of these gaps are economically substantial. As table 9 shows, the handedness gap in cognitive skill is one-tenth as large as the black-white gap. In college completion and annual earnings, the handedness gap is about one-third as large as the black-white gap. The handedness gap in earnings is roughly twice the size of the effect of an additional year of maternal education. Taken as a whole, these results provide strong evidence of a statistically and economically significant gap in earnings between lefties and righties. This gap is due in part to a substantially higher likelihood of lefties having little or no earnings at all, which is consistent with the increased rate at which lefties also report having no occupation.

2.4 Robustness and heterogeneity

I test the robustness of the estimated gaps in cognitive skills and earnings in table 7. In panel (A), the first row replicates the first row of table 3, which will serve as a baseline. The second row changes the explanatory variable from a binary measure of left-handedness to the continuous measure from which that binary measure was originally constructed, as described previously. This has little impact on the estimated cognitive skill gaps, suggesting that the results are not driven by imposing a binary definition of handedness. The third row uses the binary measure of handedness but eliminates from the sample mixed-handed individuals, those for whom the continuous measure of handedness is between one-third and two-thirds. This slightly shrinks the estimated gaps, suggesting that mixed-handers have even lower cognitive skills than do lefties. The sample of mixed-handers is, however, generally too small to be able to investigate in more depth. Finally, the fourth row of the table removes from the sample individuals identified as mentally retarded in order to check whether the gaps are being driven by the extreme version of pathological left-handedness discussed above. This also has little impact on the estimated gaps, largely because the number of such individuals is quite small in these samples. Panel (B) performs the same robustness checks estimating median gaps in annual earnings. Nearly all of these estimates are robust to these alternate specifications, with the exception that removing mixed-handed individuals from the BCS70 greatly reduces the earnings gap. Overall, this evidence suggests that the magnitude of the cognitive skill and earnings gaps are not very sensitive to the precise definition of handedness nor the inclusion of mentally retarded individuals.

Given that left-handedness has both genetic and environmental origins, Table 8 attempts to determine whether genetic lefties and environmental lefties seem different. Panel (A) divides lefties into those with good infant health, who were born with neither complications nor low birthweight, and those with poor infant health, who were born with either complications or low birthweight. Though this method of dividing the sample is crude, those with good infant health are more likely to be left-handed due to genetics and those with poor infant health are more likely to be left-handed due to environmental causes such as health shocks. The first three columns suggest little difference in the cognitive skill gap by infant health status. In column (4), however, the earnings gap in the UK sample is indistinguishable from zero for those born with good health but strongly negative for those born in poor health. This could be evidence that left-handedness is picking up aspects of poor infant health that are not adequately captured by the measures available in these data sets.

The NLSC provides another way to potentially separate the two types of left-handedness. Lefties born to left-handed mothers are more likely than other lefties to carry left-handed genes, so panel (B) interacts the individual's left-handedness with maternal left-handedness. The main coefficients in columns (1) and (2) suggest that lefties born to right-handed mothers have 0.15-0.19 standard deviations lower cognitive skill than righties. Lefties born to left-handed mothers exhibit, however, no statistically significant cognitive skill deficits. This could be evidence that left-handedness of genetic origin is substantially less associated with human capital deficits than left-handedness of environmental origin. Alternatively, this could suggest that left-handed children benefit from being raised by left-handed mothers, perhaps because those mothers model the physical act of writing or perform other cognitive tasks in styles that match their children's capacities more closely.

Figure 1: Distribution of Left-Handedness

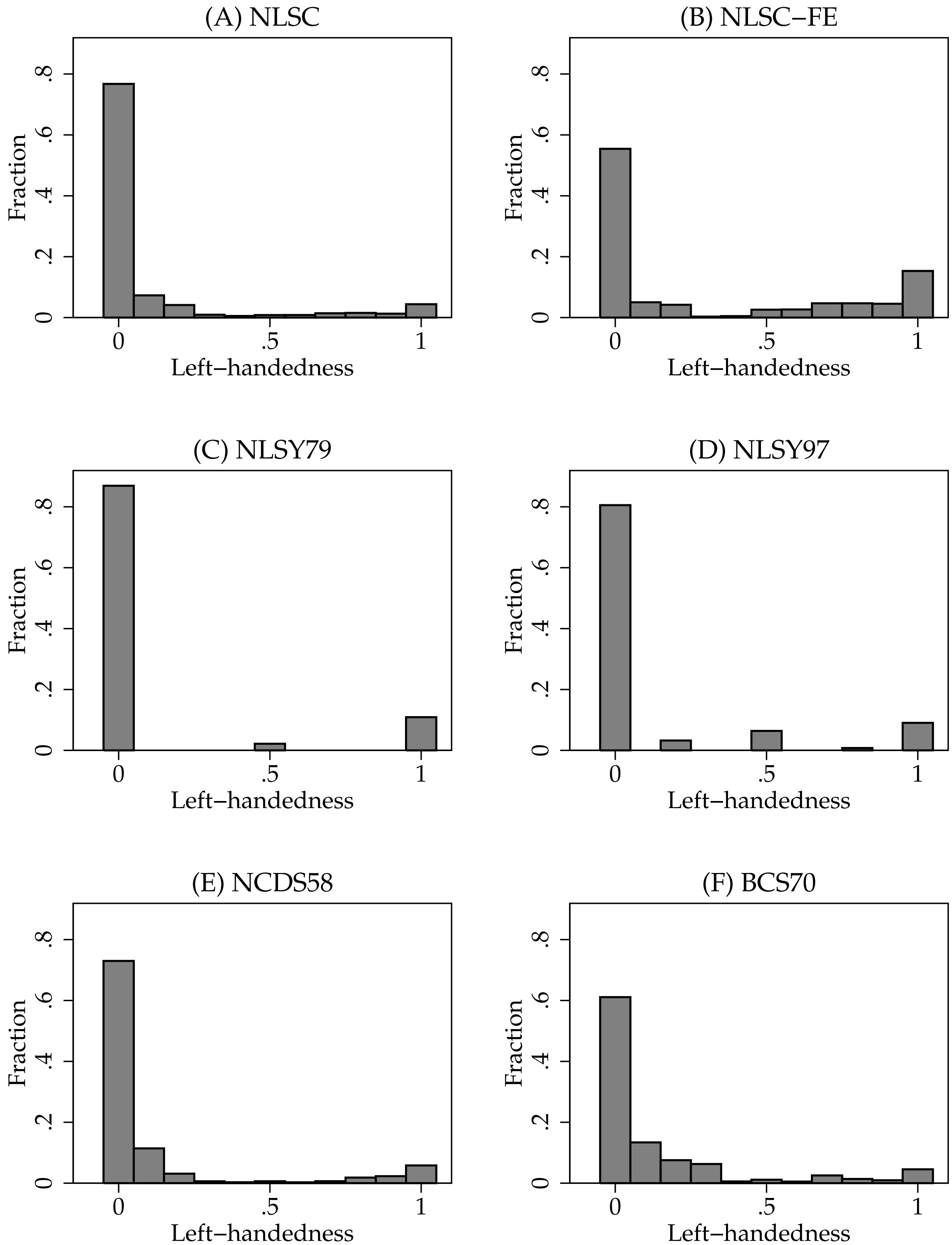

Figure 2: Cognitive Skill Distribution by Handedness

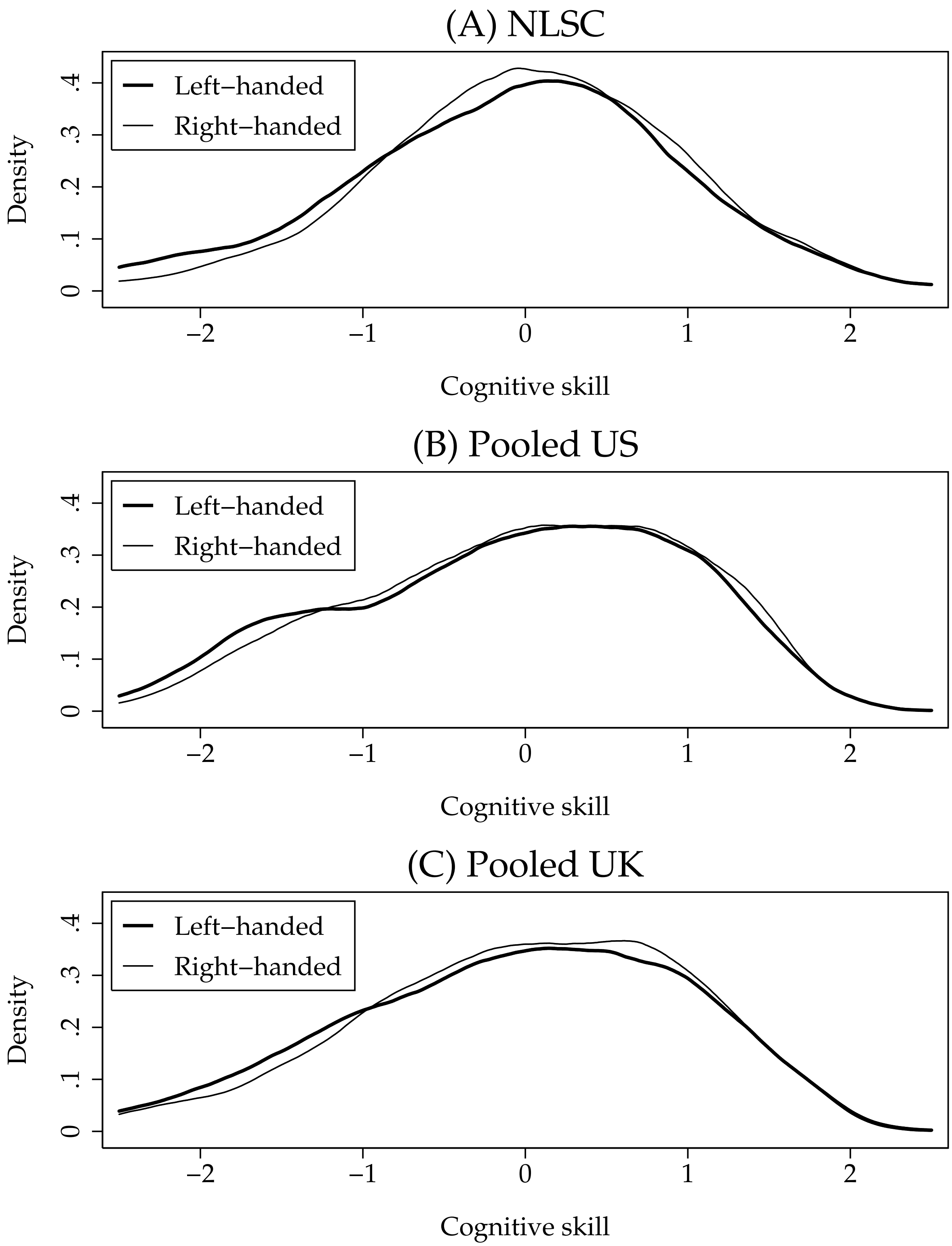

Figure 3: Male Earnings Distribution by Handedness

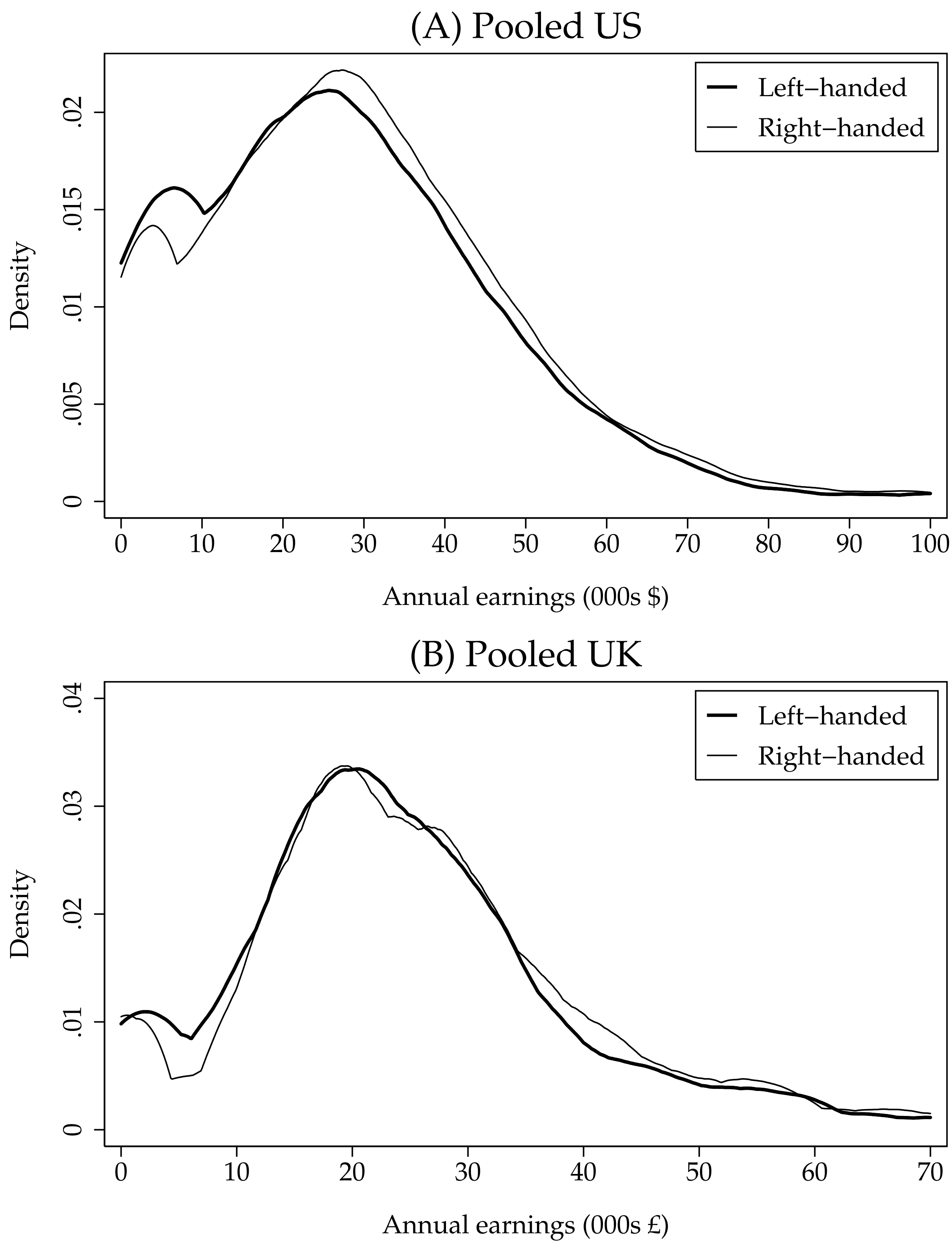

Table 1: Summary Statistics

	(1) NLSC	(2) NLSC-FE	(3) NLSY 1979	(4) NLSY 1997	(5) NCDS 1958	(6) BCS 1970
(A) Controls						
Year of birth	1987.73	1987.66	1960.65	1982.06	1958.00	1970.00
Left-handed	0.11	0.37	0.13	0.16	0.11	0.11
Female	0.49	0.49	0.52	0.49	0.48	0.49
Birth order	1.95	2.25	2.92	1.77	2.32	2.16
Mother's age at birth	26.66	26.59	26.02	25.67	27.42	25.88
Mother's education	13.05	12.95	11.57	12.80	9.50	9.72
Black	0.14	0.19	0.12	0.16	.	.
Hispanic	0.08	0.07	0.07	0.14	.	.
Mother left-handed	0.11	0.15	.	.	.	.
Birthweight (lbs)	7.37	7.33	.	.	7.31	7.27
Birth complications	0.05	0.06	.	.	0.09	0.10
(B) Outcomes						
Cognitive skill	0.00	-0.14	0.00	0.00	0.00	0.00
Behavior problem	0.08	0.09	0.08	0.06	0.06	0.05
Learning disability	0.04	0.06	.	0.09	.	0.01
High school dropout	.	.	0.13	0.18	0.16	0.14
High school graduate	.	.	0.64	0.48	0.32	0.27
College graduate	.	.	0.22	0.29	0.18	0.21
Annual earnings (000s)	.	.	23.95	24.52	17.06	22.32
N	4,956	1,234	5,532	6,183	16,712	13,863

Notes: Mean values of each variable are shown by sample.

Table 2: Determinants of Left-Handedness

	(1) NLSC OLS	(2) NLSC-FE OLS	(3) NLSC-FE FE	(4) Pooled US	(5) NLSY 1979	(6) NLSY 1997	(7) Pooled UK	(8) NCDS 1958	(9) BCS 1970
Female	-0.032***	-0.096***	-0.151***	-0.028***	-0.025***	-0.031***	-0.026***	-0.034***	-0.017***
	(0.009)	(0.029)	(0.051)	(0.007)	(0.009)	(0.009)	(0.004)	(0.005)	(0.006)
Mother's age at birth	0.002	0.008**	0.078	0.001	0.001	0.001	-0.000	-0.001	-0.000
	(0.002)	(0.003)	(0.061)	(0.001)	(0.001)	(0.001)	(0.000)	(0.001)	(0.001)
Mother's education	-0.002	-0.003		0.001	0.000	0.001	-0.000	0.000	-0.001
	(0.002)	(0.004)		(0.001)	(0.002)	(0.002)	(0.001)	(0.002)	(0.002)
Black	0.029**	0.012		0.019*	0.025*	0.014			
	(0.014)	(0.019)		(0.010)	(0.015)	(0.014)			
Hispanic	-0.022	-0.036*		0.009	-0.015	0.021			
	(0.015)	(0.022)		(0.012)	(0.019)	(0.015)			
Birthweight (lbs)	-0.002	-0.004	-0.021				-0.006***	-0.008***	-0.004
	(0.004)	(0.010)	(0.026)				(0.002)	(0.002)	(0.002)
Birth complications	0.051**	0.091	0.122				0.017**	0.018*	0.016*
	(0.024)	(0.058)	(0.112)				(0.007)	(0.009)	(0.009)
Mother left-handed	0.049***	0.025							
	(0.015)	(0.018)							
R^2	0.019	0.070	0.135	0.006	0.004	0.005	0.003	0.004	0.002
N	4,956	1,234	1,234	11,715	5,532	6,183	29,515	16,712	12,803
p (infant health)	0.055	0.175	0.277	.	.	.	0.000	0.000	0.077

Notes: Heteroskedasticity robust standard errors, clustered by mother in US samples, are reported in parentheses (* p<.10 ** p<.05 *** p<.01). Each column is an OLS regression of a left-handedness indicator on the set of controls shown, as well as year of birth dummies, birth order dummies, and dummies for missing birth order, maternal education, birthweight, and maternal left-handedness.Column (3) includes mother fixed effects. Columns (4) and (7) are weighted so that each sub-sample contributes equally to the estimates. Also shown is the p-value from an F-test of the joint significance of birthweight and birth complications.

Table 3: Cognitive Skills

	(1) NLSC OLS	(2) NLSC-FE OLS	(3) NLSC-FE FE	(4) Pooled US	(5) NLSY 1979	(6) NLSY 1997	(7) Pooled UK	(8) NCDS 1958	(9) BCS 1970
Cognitive skill	-0.106**	-0.120**	-0.162***	-0.071***	-0.034	-0.096***	-0.068***	-0.054**	-0.083***
	(0.044)	(0.047)	(0.058)	(0.025)	(0.035)	(0.035)	(0.019)	(0.024)	(0.030)
Math score	-0.097**	-0.099**	-0.136**	-0.065**	-0.022	-0.097***	-0.066***	-0.047**	-0.087***
	(0.045)	(0.049)	(0.061)	(0.025)	(0.036)	(0.036)	(0.019)	(0.024)	(0.030)
Reading score	-0.094**	-0.111**	-0.158***	-0.066***	-0.040	-0.082**	-0.061***	-0.052**	-0.069**
	(0.043)	(0.047)	(0.059)	(0.025)	(0.036)	(0.035)	(0.019)	(0.024)	(0.030)
Bottom 10%	0.034**	0.030*	0.036	0.034***	0.024*	0.041***	0.024***	0.019**	0.029***
	(0.015)	(0.018)	(0.022)	(0.009)	(0.012)	(0.012)	(0.006)	(0.008)	(0.010)
Top 10%	-0.009	-0.016	-0.023	-0.018**	-0.015	-0.019*	-0.002	0.006	-0.011
	(0.013)	(0.016)	(0.020)	(0.008)	(0.011)	(0.011)	(0.006)	(0.007)	(0.009)
N	4,679	1,171	1,171	10,386	5,290	5,096	27,449	16,608	10,841
Coding speed				-0.120***	-0.095***	-0.132***			
				(0.026)	(0.035)	(0.038)			
N				10,316	5,290	5,026			
Copying designs							-0.118***	-0.112***	-0.128***
							(0.020)	(0.026)	(0.030)
N							25,746	14,723	11,023

Notes: Heteroskedasticity robust standard errors, clustered by mother in US samples, are reported in parentheses (* p<.10 ** p<.05 *** p<.01). Each coefficient comes from a regression of the outcome on a left-handedness indicator and the other controls as described in table 2. The cognitive, math, reading, coding speed and copying designs outcomes are Z-scores standardized by age. The top and bottom 10% outcomes are binary variables.

Table 4: Disabilities

	(1) NLSC OLS	(2) NLSC-FE OLS	(3) NLSC-FE FE	(4) Pooled US	(5) NLSY 1979	(6) NLSY 1997	(7) Pooled UK	(8) NCDS 1958	(9) BCS 1970
Behavior problem	0.035**	0.044***	0.049**	0.017**	0.016	0.016*	0.013***	0.015**	0.011
	(0.014)	(0.017)	(0.021)	(0.007)	(0.012)	(0.009)	(0.005)	(0.007)	(0.007)
μ_R	0.077	0.077	0.077	0.071	0.082	0.060	0.055	0.059	0.051
N	4,799	1,197	1,197	11,188	5,005	6,183	25,624	14,592	11,032
Mentally retarded	0.009*	0.013**	0.013**	0.007**	0.008	0.005	0.011***	0.010***	0.014**
	(0.005)	(0.005)	(0.007)	(0.003)	(0.006)	(0.003)	(0.004)	(0.003)	(0.006)
μ_R	0.004	0.001	0.001	0.010	0.017	0.003	0.023	0.008	0.038
N	4,793	1,196	1,196	11,715	5,532	6,183	26,231	14,449	11,782
Speech problem	0.018**	0.018**	0.020*			0.004	0.014**	0.019**	0.009
	(0.007)	(0.008)	(0.011)			(0.007)	(0.007)	(0.009)	(0.011)
μ_R	0.012	0.015	0.015			0.034	0.159	0.159	0.159
N	4,793	1,196	1,196			6,183	29,418	16,658	12,760
Learning disability	0.022**	0.024*	0.027			0.031***			0.006
	(0.011)	(0.013)	(0.017)			(0.011)			(0.005)
μ_R	0.042	0.049	0.049			0.088			0.014
N	4,793	1,196	1,196			6,183			8,785
Digit span: forward	0.004	-0.040	-0.094						-0.020
	(0.049)	(0.057)	(0.071)						(0.031)
N	4,487	1,124	1,124						10,518
Digit span: backward	-0.107**	-0.151**	-0.203***						
	(0.049)	(0.061)	(0.077)						
N	4,488	1,123	1,123						

Notes: Heteroskedasticity robust standard errors, clustered by mother in US samples, are reported in parentheses (* p<.10 ** p<.05 *** p<.01). Each coefficient comes from a regression of the outcome on a left-handedness indicator and the other controls as described in table 2. All outcomes are binary except for the digit span scores, which are Z-scores standardized by age. Below each coefficient on a binary outcome is the mean of that outcome for right-handed individuals.

Table 5: Educational Attainment and Occupational Characteristics

	(1) Pooled US	(2) NLSY 1979	(3) NLSY 1997	(4) Pooled UK	(5) NCDS 1958	(6) BCS 1970
(A) Educational attainment						
College graduate	-0.028***	-0.019	-0.034**	-0.008	-0.005	-0.012
	(0.010)	(0.015)	(0.014)	(0.007)	(0.009)	(0.011)
μ_R	0.256	0.221	0.292	0.195	0.176	0.214
High school dropout	0.004	0.002	0.006	0.013*	0.010	0.016
	(0.009)	(0.013)	(0.013)	(0.007)	(0.009)	(0.010)
μ_R	0.155	0.130	0.181	0.152	0.162	0.143
N	11,715	5,532	6,183	29,515	16,712	12,803
(B) Occupational categories						
Professional/managerial	-0.038***	-0.022	-0.050***	-0.016**	-0.011	-0.023*
	(0.010)	(0.015)	(0.014)	(0.008)	(0.010)	(0.012)
μ_R	0.239	0.211	0.269	0.240	0.228	0.253
Missing occupation	0.032***	0.025**	0.037***	0.013	-0.001	0.028*
	(0.009)	(0.010)	(0.013)	(0.009)	(0.012)	(0.014)
μ_R	0.100	0.052	0.150	0.430	0.371	0.488
N	11,715	5,532	6,183	29,515	16,712	12,803
(C) Occupational skills						
Cognitive	-0.079***	-0.050	-0.097***			
	(0.028)	(0.041)	(0.037)			
Manual	0.057**	0.053	0.055			
	(0.027)	(0.038)	(0.038)			
N	10,187	5,141	5,046			

Notes: Heteroskedasticity robust standard errors, clustered by mother in US samples, are reported in parentheses (* p<.10 ** p<.05 *** p<.01). Each coefficient comes from a regression of the outcome on a left-handedness indicator and the other controls as described in table 2. All outcomes in panels (A) and (B) are binary and below each coefficient is the mean of that outcome for right-handed individuals. All outcomes in panel (C) are Z-scores standardized across the sample.

Table 6: Annual Earnings

	Pooled US (1)	NLSY 1979 (2)	NLSY 1997 (3)	Pooled UK (4)	NCDS 1958 (5)	BCS 1970 (6)
(A) All						
Ln(earnings)	-0.128***	-0.105***	-0.144***	-0.066***	-0.019	-0.116***
	(0.026)	(0.037)	(0.036)	(0.024)	(0.025)	(0.040)
Mean earnings	-1.795***	-1.173*	-2.236***	-0.919**	-0.512	-1.335**
	(0.504)	(0.704)	(0.715)	(0.379)	(0.385)	(0.676)
μ_R	24.402	24.028	24.789	19.720	17.008	22.415
Median earnings	-2.667***	-2.504***	-2.837***	-0.651*	0.017	-2.034***
	(0.527)	(0.750)	(0.864)	(0.345)	(0.344)	(0.659)
μ_R	22.425	22.123	22.934	16.591	14.779	20.339
Low earnings	0.042***	0.042***	0.042***	0.018**	-0.004	0.042***
	(0.010)	(0.014)	(0.014)	(0.009)	(0.010)	(0.015)
μ_R	0.136	0.128	0.144	0.163	0.134	0.192
N	10,916	5,481	5,435	17,833	10,488	7,345
(B) Males						
Ln(earnings)	-0.098***	-0.059	-0.126***	-0.062**	-0.048	-0.077
	(0.034)	(0.049)	(0.047)	(0.028)	(0.030)	(0.050)
Median earnings	-1.675**	-0.879	-2.355*	-0.924**	0.020	-2.140***
	(0.776)	(0.936)	(1.252)	(0.413)	(0.423)	(0.762)
μ_R	27.446	28.031	26.604	23.710	20.919	28.265
N	5,433	2,653	2,780	8,645	5,197	3,448
(C) Females						
Ln(earnings)	-0.159***	-0.153***	-0.160***	-0.074*	0.014	-0.154**
	(0.039)	(0.055)	(0.054)	(0.039)	(0.043)	(0.063)
Median earnings	-2.917***	-2.248*	-2.708**	-0.431	0.184	-1.602
	(0.727)	(1.227)	(1.203)	(0.439)	(0.513)	(1.016)
μ_R	17.860	16.849	19.000	8.627	7.352	10.854
N	5,483	2,828	2,655	9,188	5,291	3,897

Notes: Heteroskedasticity robust standard errors, clustered by mother in US samples, are reported in parentheses (* $p<.10$ ** $p<.05$ *** $p<.01$). Each coefficient comes from a regression of the outcome on a left-handedness indicator and the other controls as described in table 2. Median impacts are estimated with quantile regressions. μ_R represents the mean or median of the given outcome for right-handed individuals.

Table 7: Robustness to Alternate Measures of Left-Handedness

	(1) NLSC OLS	(2) NLSC-FE OLS	(3) NLSC-FE FE	(4) Pooled US	(5) NLSY 1979	(6) NLSY 1997	(7) Pooled UK	(8) NCDS 1958	(9) BCS 1970
(A) Cognitive score									
Left-handed	-0.106**	-0.120**	-0.162***	-0.071***	-0.034	-0.096***	-0.068***	-0.054**	-0.083***
	(0.044)	(0.047)	(0.058)	(0.025)	(0.035)	(0.035)	(0.019)	(0.024)	(0.030)
Left-handedness	-0.136***	-0.133**	-0.174**	-0.074***	-0.021	-0.124***	-0.094***	-0.086***	-0.102***
	(0.051)	(0.057)	(0.070)	(0.028)	(0.037)	(0.042)	(0.021)	(0.026)	(0.035)
Clearly left-handed	-0.114**	-0.117**	-0.155**	-0.059**	-0.008	-0.107**	-0.046**	-0.043*	-0.048
	(0.049)	(0.053)	(0.068)	(0.029)	(0.038)	(0.043)	(0.021)	(0.025)	(0.036)
Not mentally retarded	-0.095**	-0.103**	-0.147***	-0.066***	-0.029	-0.091***	-0.057***	-0.040	-0.072**
	(0.043)	(0.046)	(0.055)	(0.025)	(0.035)	(0.034)	(0.019)	(0.025)	(0.030)
(B) Annual earnings									
Left-handed				-2.667***	-2.504***	-2.837***	-0.651*	0.017	-2.034***
				(0.527)	(0.750)	(0.864)	(0.345)	(0.344)	(0.659)
Left-handedness				-2.752***	-2.368***	-3.114***	-0.618*	-0.000	-2.148***
				(0.595)	(0.768)	(1.031)	(0.373)	(0.381)	(0.764)
Clearly left-handed				-2.234***	-2.107**	-2.579***	-0.296	0.182	-1.237
				(0.562)	(0.876)	(0.977)	(0.378)	(0.337)	(0.865)
Not mentally retarded				-2.479***	-2.297***	-2.718***	-0.654*	0.034	-2.192***
				(0.528)	(0.817)	(0.843)	(0.393)	(0.301)	(0.718)

Notes: Heteroskedasticity robust standard errors, clustered by mother in US samples, are reported in parentheses (* $p<.10$ ** $p<.05$ *** $p<.01$). Each coefficient comes from a regression of the outcome on a measure of left-handedness and the other controls as described in table 2. The first row of each panel is the baseline specification found in tables 3 and 6. The second row of each panel replaces the left-handedness indicator with a continuous measure of handedness. The third row of each panel uses the left-handedness indicator but excludes mixed-handed individuals. The fourth row of each panel uses the left-handedness indicator but excludes mentally retarded individuals.

Table 8: Heterogeneity in Cognitive and Earnings Gaps

	NLSC	NLSC-FE	Pooled UK	
	Cognitive skill	Cognitive skill	Cognitive skill	Annual earnings
	(1)	(2)	(3)	(4)
(A) By infant health				
Left-handed * poor infant health	-0.166	-0.171	-0.064	-3.290***
	(0.149)	(0.252)	(0.049)	(0.877)
Left-handed * good infant health	-0.100**	-0.160***	-0.069***	-0.501
	(0.045)	(0.057)	(0.020)	(0.417)
Good infant health	0.025	-0.128	0.114***	0.281
	(0.083)	(0.294)	(0.034)	(0.654)
p	0.666	0.967	0.930	0.004
(B) By maternal handedness				
Left-handed * righty mom	-0.152***	-0.187***		
	(0.049)	(0.068)		
Left-handed * lefty mom	0.136	-0.034		
	(0.084)	(0.097)		
Lefty mom	-0.091*			
	(0.054)			
p	0.003	0.213		
N	4,679	1,171	27,449	17,833

Notes: Heteroskedasticity robust standard errors, clustered by mother in US samples, are reported in parentheses (* p<.10 ** p<.05 *** p<.01). Each pair of coefficients comes from a regression of the outcome on a left-handed indicator, an indicator for the characteristic highlighted in the panel (not shown), the interaction of those two, and the controls as described in the notes to table 2.

Table 9: Comparison to Other Gaps in the Pooled US Sample

	(1) Cognitive skill	(2) College graduate	(3) Annual earnings
Left-handed	-0.070***	-0.029***	-1.793***
	(0.025)	(0.010)	(0.504)
Female	0.143***	0.048***	-9.187***
	(0.017)	(0.008)	(0.342)
Black	-0.731***	-0.085***	-6.622***
	(0.028)	(0.010)	(0.481)
Hispanic	-0.267***	-0.013	-1.544***
	(0.037)	(0.013)	(0.586)
Mother's education	0.118***	0.046***	0.952***
	(0.004)	(0.002)	(0.076)
N	10,386	11,715	10,916

Notes: Heteroskedasticity robust standard errors, clustered by mother, are reported in parentheses (* p<.10 ** p<.05 *** p<.01). Each column is a regression of the outcome on a left-handedness indicator and the other controls as described in table 2, using the pooled US sample.

Table 10: Explaining The Earnings Gap in the Pooled US Sample

	(1) Baseline	(2) + cognitive controls	(3) + disability controls	(4) + education controls
Left-handed	-1.795***	-1.284***	-1.147**	-1.155**
	(0.504)	(0.490)	(0.486)	(0.478)
Cognitive skill		4.233***	4.042***	2.334***
		(0.245)	(0.244)	(0.254)
Coding speed		1.667***	1.520***	1.357***
		(0.221)	(0.220)	(0.217)
Behavior problem			-6.462***	-5.932***
			(0.601)	(0.592)
High school graduate				5.706***
				(0.427)
College graduate				12.253***
				(0.625)
R^2	0.120	0.177	0.188	0.213
N	10,916	10,916	10,916	10,916

Notes: Standard errors are reported in parentheses (* p<.10 ** p<.05 *** p<.01). Each column is a regression of annual earnings on a left-handedness indicator and the other controls as described in table 2, using the pooled US sample. The first column replicates column (1) in the second row of table 6. The subsequent columns add controls for cognitive skills, disabilities and educational attainment. Missing values of cognitive skill and educational attainment are imputed as zeroes, with indicators for missing values also included but not shown.