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ABSTRACT

Like Father, Like Son? A Note on the Intergenerational Transmission of IQ Scores*

More able parents tend to have more able children. While few would question the validity of this statement, there is little large-scale evidence on the intergenerational transmission of IQ scores. Using a larger and more comprehensive dataset than previous work, we are able to estimate the intergenerational correlation in IQ scores, examining not just average correlations but also how this relationship varies for different subpopulations. We find that there is substantial intergenerational transmission of IQ scores; an increase in father's IQ at age 18 of 10% is associated with a 3.2% increase in son's IQ at the same age. This relationship holds true no matter how we break the data. This effect is much larger than our estimated elasticity of intergenerational transmission of income of approximately .2.

JEL Classification: J0, I0, J1

Keywords: ability, intergenerational mobility

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1. Introduction

More able parents tend to have more able children. While few would question the validity of this statement, there is little large-scale evidence on the intergenerational transmission of IQ. Instead, research in economics has focused primarily on the intergenerational transmission of income in an effort to understand the amount of persistence in socio-economic status across generations. However, even more basic is understanding the persistence in cognitive ability as measured by IQ scores.

While this has been an open question in the literature for quite some time, the issue was brought to a head with the publication of The Bell Curve in 1994. In this book, Herrnstein and Murray argue that, in a meritocracy, we should see sorting of people by intelligence, with the more intelligent "rising to the top" and being more successful. Based on this theory, the authors conclude that groups that have been more successful are genetically superior to those that have been less successful. While this work is controversial and there is much evidence refuting it, the publication of the book did highlight the importance of understanding the intergenerational transmission of IQ and, ultimately, the need to distinguish genetic components from the environmental ones.

We believe that ours is the first attempt to use a large nationally representative dataset to calculate precise estimates of intergenerational IQ elasticities. Using our Norwegian data, we find that there is substantial intergenerational transmission of IQ; an increase in father's IQ of 10% is associated with a 3.2% increase in son's IQ at age 18. This relationship holds true no matter how we break the data. This is much larger than our estimated intergenerational transmission of income; an increase in father's income of 10% is associated with a 2.0% increase in son's income.

This note unfolds as follows. In the next section, we describe our data. We then present simple intergenerational correlations of IQ scores, first for the whole population of males and then for various subpopulations. We then turn to the intergenerational transmission of income to provide a point of reference. The final section concludes.

2. Data

Based on different administrative registers and census data from Statistics Norway, our dataset consists of the entire population in Norway and includes information on family background, age, country of birth, educational history, and employment information.[1] To this, we match extracts from the censuses in 1960, 1970 and 1980 and, for men, military records.

In this note, we are focusing on the intergenerational correlations between fathers and sons using data collected at the time of enrollment in the military, generally between the ages of 18 and 20.[2] In Norway, military service is compulsory for every able young man. Before entering the service, their medical and psychological suitability is assessed. The IQ measure is a composite score from three speeded IQ tests -- arithmetic, word similarities, and figures (see Sundet *et al*. [2004, 2005] and Thrane [1977] for details). The arithmetic test is quite similar to the arithmetic test in the Wechsler Adult Intelligence Scale (WAIS) [Sundet *et al*. 2005; Cronbach 1964]. The word test is similar to the vocabulary test in WAIS, and the figures test is similar to the Raven Progressive Matrix test [Cronbach 1964]. The composite IQ test score is an unweighted mean of the three subtests. The IQ score is reported in stanine (Standard Nine) units, a method of standardizing raw scores into a nine point standard scale with a normal distribution, a mean of 5, and a standard deviation of 2.[3] Throughout the note, we use

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[1] See Møen, Salvanes and Sørensen (2004) for a description of the data set.
[2] Unfortunately, because I Q testing is related to military conscription mandatory only for men, the IQ data we use are not collected for women in Norway.
[3] In order to categorize raw scores into stanine units, a scale is created with nine intervals, each interval representing half of a standard deviation. The 5th stanine straddles the midpoint of the distribution, covering the middle 20% of scores. Stanines 6, 7, 8, and 9 cover the top end of the distribution and 4, 3, 2, and 1 fall below the midpoint with lower scores. For scores expressed in stanines, normalizing will put 4% of the sample in the first stanine, 7% in the second, and so on through 12%, 17%, 20%, 17%, 12%, 7%, and 4%. This method of

the words IQ and IQ scores interchangeably; however, we are always referring to IQ scores and are aware that they are imperfect measures of underlying IQ.

For the fathers, we have information for those born in the 1932 and 1933 cohorts who enrolled for conscription in 1952 and 1953.[4] For the sons, the IQ data are taken from the Norwegian military records from 1984 to 2005. The tests taken by fathers in 1952 and 1953 were slightly different from those taken by their sons decades later. Also, we have information on the individual sub-tests for fathers but not for sons. In order to create comparable measures, we have aggregated the fathers' subtests in a manner so as to replicate the aggregation used in creating the IQ scores of sons.

It is important to note two measurement issues with regard to IQ scores. The first is that the IQ exam in Norway was re-normed in 1980 leading to a change in the standard deviation and a decline in the mean of 1.02 stanine points. The second issue concerns the well-known "Flynn Effect" (Flynn 1984); the secular increase in measured IQ scores among populations over time. In Norway, there have been documented gains in over time in military IQ scores from cohorts tested in the mid-1950s to cohorts tested in the mid-1990s (Sundet et al., 2004). Because of these two issues, we include year of test indicators in all regressions that include IQ.[5] We also test for differential transmission of IQ by birth order controlling for completed family size.[6]

In terms of earnings, we observe total pension-qualifying earnings reported in the tax registry for all individuals aged at least 16 years old starting in 1967. These are not topcoded and include labor earnings, taxable sick benefits, unemployment benefits, parental leave

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standardization assumes that whatever ability the test measures is evenly distributed around a central peak. The correlation between this IQ measure and the WAIS IQ has been found to be .73 (Sundet *et al*., 1988).

[4] Conscription data were available for 77.8% of all Norwegian men born in 1932 and 1933. See Rossow and Amundsen (1986) for more details.

[5] Year of test indicators will absorb both changes in measured scores due to the 1980 renorming and secular trends in IQ. While it is possible to argue that we do not, in fact, want to eliminate these secular trends, they may lead to biased estimates if fathers with higher IQs also had children at older ages. In practice, the estimates are not much affected by the inclusion of the year of test indicators.

[6] See Black, Devereux and Salvanes (2005a) for details about the construction of completed family size.

payments, and pensions. We deflate earnings using the Consumer Price Index for Norway**.** Because the earnings measure includes items like unemployment benefits, it comes close to being a measure of income as well as earnings, and we use both words interchangeably in this note.

Based on recent evidence from Haider and Solon (2006), we use measures of father's earnings when the father is 35-40, although we test the sensitivity of our results to these choices. For sons, we look at a variety of earnings measures, including their earnings between ages 30 and 32 and the most recent earnings measure we observe (so long as they are aged at least 30). Our first sons were born in 1950, so the first earnings data we use for sons is from 1980. In order to use a common sample for IQ and earnings, the youngest son we use in our analysis was born in 1970.[7] We use two types of measures of earnings, the average over the specified time period of the non-missing observations and the average over observations that are non-missing and non-zero.

Note that a great advantage of our data set over many others in the literature is that we have the population of men and can link adult children to characteristics of their parents, even in cases where the children do not live with their parents. Table 1 presents our summary statistics.

3. Intergenerational Transmission of IQ: Basic Facts

While there is a significant literature on the intergenerational transmission of IQ, much of this has been hindered by small sample sizes.[8] In a review paper, Bouchard and McGue (1981) find 14 examples of studies that report IQ correlations for father-son pairs. However, only 2843 pairings in total are used to calculate these 14 correlations and there are questions

[7] By restricting the sample to children born by 1970, we lose children born when fathers are older than 37 (1933 cohort) or 38 (1932 cohort). This constitutes 5470 observations or 18% of the sample. We have re-estimated all our IQ estimates on the full sample without this restriction and found results that are almost identical to those reported in Table 3.

[8] See Bowles and Gintis (2002) for references to some of the literature.

as to the representativeness of many of the datasets used. We have not found examples of more recent papers that calculate IQ correlations using large representative samples. In this note, we have data on the population of males in Norway and, as a result, can look not only at the overall correlation in IQ across generations but also the correlations of subpopulations in order to examine more detailed patterns in the data.

We first look at basic summary statistics and transition matrices to understand the overall relationship between a father's IQ and that of his son. Table 2 presents the transition matrix relating the IQ of the father (across the top) to the IQ of the son (down the side). It is clear is that, while there is some regression to the mean, there is a substantial amount of persistence across generations.[9] The correlation we observe between father's IQ and that of his son is .38. This is exactly the same as the weighted average of father-son IQ correlations reported by Boucher and McGue (1981), and is very close to the range of .42 to .72 documented in Bowles and Gintis (2002). [Note that their .72 correlation was observed when the average IQ score of both parents was used rather than just the IQ score of the father.]

Table 3 then presents the results when we regress son's IQ on father's IQ, both in level and log forms. The first two rows of the table show the results of regressing son's IQ and ln(son's IQ) on father's IQ and ln(father's IQ) respectively. The second column therefore represents the intergenerational elasticity of IQ. The results suggest that a 10% increase in father's IQ is associated with a 3.2% increase in son's IQ.

We also examine differences by birth order, comparing elasticities for first born and later-born children. Our own work has found significant differences in educational attainment and income by birth order using Norwegian data (see Black, Devereux, and Salvanes 2005a). More recently, we have examined the role of family size and birth order on children's IQ scores and find significant effects (see Black, Devereux, and Salvanes 2007a, b). These

[9] While the transition matrix is illuminating, it is important to note that it has not been adjusted to take account of any changes in the measurement of IQ over time.

differences could, among other things, reflect differences in parental investment, either time or resources.

Because of this differential investment, one might expect differences in intergenerational transmission by birth order. Recent work by Lindahl (2008) uses data from Sweden and examines whether there is differential intergenerational transmission of income by birth order and family size and finds that income elasticities decrease with birth order for a given family size.

Columns 3 and 4 allow the intergenerational transmission of IQ to differ for first born and later born sons. Interestingly, there is no strong evidence of large differences in the intergenerational transmission of IQ by birth order. While the estimates for the later born children are slightly higher, they are all very similar. We condition on family size (and family size interactions with father's ability and birth order) when estimating the differential effect of birth order and are thus controlling for the fact that first-borns are more likely to come from a smaller family than later-borns.

Finally, intergenerational transmission of IQ may be different based on the characteristics of the parents; this would be consistent with the recent research suggesting a relationship between the transmission of income and parents' characteristics. In order to investigate this, we break our sample by father's education, with low education being 12 or fewer years of education and high education being 13 or more years of education. These results are presented in Columns 5-8 of Table 3. In this case, we see no consistent patterns, and all estimates are centered around .3. These estimates suggest that any differences in intergenerational income transmission across the educational distribution are related to factors other than the intergenerational transmission of IQ.

4. Intergenerational Transmission of Income: Basic Facts as a Benchmark

Although we are not the first to do so, we next document the intergenerational transmission of income for our sample to provide a reference point for our IQ measure.[10] Because we have a long panel, we can be quite flexible in terms of which earnings measures we use. As a result, we define the income of fathers in four different ways: average income between 35 and 40 excluding missing values but including zeros, average income between 35 and 40 excluding missing values and zeros, average income between 35 and 55 excluding missing values but including zeros, and average income between 35 and 55 excluding missing values and zeros. We also use three measures of son's income, including the most recent non-zero earnings measured at age greater than or equal to 30 years, the average income between 30 and 32 excluding missing values but including zeros, and the average income between 30 and 32 excluding missing values and zeros.

The results from the regression of the log of son's earnings on a constant and log of father's earnings are presented in Table 4. Each column represents a different dependent variable and each coefficient is from a separate regression.[11] It is clear that the results are entirely insensitive to the different measures of father's and son's permanent income. The minimum elasticity is .19 and all of the estimates are in the .19-.23 range.[12] This is slightly higher than estimates obtained by Bratberg, Nilsen and Vaage (2005), who obtain estimates of approximately .15 for the 1950 cohort of sons (and find declining elasticities over time.) but consistent with estimates by Jantti and Osterbacka (1996) who estimate an elasticity of .22 for Finland. It is also just slightly smaller than estimates of .28 obtained by Bjørklund and Jantti (1997) for Sweden. Overall, our estimates are well within the range of other related

[10] The theoretical work in this area is based on early work by Becker and Tomes (1979, 1986). See Solon (1999) for a review.
[11] Note that, in all regressions where the most recent observation of son's earnings is used as the dependent variable, we also include age indicators.
[12] The intergenerational correlations of log income are somewhat lower than the elasticities. For example, the correlation between father's earnings 35-40 no zeros and son's earnings 30-32 no zeroes is .16. This compares with the elasticity of .20 in Table 4.

estimates. Not surprisingly, given the institutional differences in redistribution, the estimates for Scandinavian countries are smaller than estimates for the U.S. Interestingly, our estimated intergenerational transmission of IQ scores is much larger than that of income.

5. Conclusions

Using a unique population dataset that allows us to match IQ scores and earnings of two cohorts of fathers with equivalent variables for their sons, we estimate that the intergenerational correlation in IQ is about .38. This is broadly consistent with previous findings from smaller and less representative samples. Interestingly, there is little variation in this number by father's education or by birth order, despite recent evidence on differences in the intergenerational transmission of income for these subgroups.

Like previous studies using Scandinavian data, we find relatively low estimates of intergenerational income persistence, despite the fact that we average earnings over many years to allow for measurement error. Indeed, our estimates of the intergenerational transmission of income are much lower than our IQ estimates.

It is important to note some of the limitations of our estimates. First, IQ at age 18 may in part be proxying for other characteristics such as health status that correlate with IQ. Thus, we cannot draw the conclusion that an intervention aimed to increase IQ would have an effect on IQ in subsequent generations. The intergenerational elasticity has no causal interpretation whatsoever.[13]

Second, there is a random component to IQ test scores, and the same individual will not score exactly the same on two different tests on two different days. While the test-retest validity of our IQ scores has been found to be high, this is a factor that will tend to downward

[13] Black, Devereux, and Salvanes (2005b) show that in Norway the intergenerational correlation in education between parents and children appears to greatly overstate the true causal relationship.

bias estimates of IQ correlations. Similarly, any measurement error in earnings will tend to bias estimates.[14]

Another important caveat is that even when considering the direct impact of father's IQ on son's IQ, we cannot ascribe this to a purely genetic relationship. Much research has shown that IQ is malleable and is subject to both genetic and environmental influences. It has been clearly demonstrated that scores on the AFQT test in the U.S. depend to a large extent on years of schooling of the test-taker (for example, by Neal and Johnson, 1996). In addition, recent work of our own (Black, Devereux, and Salvanes, 2007a) shows that increasing family size can have a negative effect on the IQ scores of existing children, suggesting a role for parental behavior.

While this study advances the literature by matching IQ scores and earnings for large samples of fathers and sons, a remaining issue is the absence of equivalent data for mothers and daughters. Given complex patterns of assortative mating and the critical role of mothers in the human capital accumulation of children, such data will be needed to arrive at a more complete understanding of the interplay of intergenerational IQ and income processes. Given the absence of such data, we leave this for future research.

[14] Given we have very accurate administrative earnings records and we average over several years, we do not expect this particular bias to be very large.

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Table 1
Summary Statistics

	Fathers	**Sons**
Education	10.15	12.36
	(2.98)	(2.37)
IQ	5.23	5.43
	(1.90)	(1.80)
Height	176.6	179.7
	(6.04)	(6.30)
Log(Earnings)	12.19	12.37
	(.38)	(.47)
N	24,754	

For earnings, father's earnings are measured as the average of the nonzero values between the ages of 35 and 40 and son's earnings are measured as the average of the nonzero values between the ages of 30 and 32.

Table 2
Transition Matrix
Father's Ability*Son's Ability

Son's Ability	Father's Ability 1	2	3	4	5	6	7	8	9
1	39	65	80	93	61	21	21	8	1
2	66	126	199	236	221	93	18	21	4
3	98	212	356	513	442	304	133	64	10
4	160	308	588	915	925	583	291	183	57
5	108	293	584	980	1227	953	587	346	133
6	63	174	415	795	1149	993	637	469	205
7	35	79	240	500	804	778	625	499	258
8	8	41	99	194	364	448	381	415	271
9	4	4	13	90	150	157	195	222	224

Table 3
Intergenerational Transmission of Ability

					Low Father's Education		High Father's Education	
Dependent Variable	Ability	Log(Ability)	Ability	Log(Ability)	Ability	Log(Ability)	Ability	Log(Ability)
Father's Ability	.38 (.01)		.33 (.01)		.32 (.01)		.31 (.02)	
Log(Father's Ability)		.32 (.01)		.29 (.01)		.27 (.01)		.32 (.02)
Father's Ability*First Son			-.01 (.01)					
Log(Father's Ability)*First Son				-.02 (.01)				
N	24754		24754		20726		4028	

Note that all regressions include year of test indicators. Regressions with the first son interactions also include level effects as well as family size and family size interacted with first son and father's ability. Low Father's Education represents 12 or fewer years of schooling and High Father's Education represents 13 or more years.

Table 4
Intergenerational Transmission of Earnings
(Coefficients Represent Elasticities)

	Son's Earnings: Most Recent Observation	Son's Earnings 30-32	Son's Earnings 30-32 No Zeros
Father's Earnings 35-40	.22 (.01) [29486]	.22 (.01) [25624]	.20 (.01) [24814]
Father's Earnings 35-40 no zeros	.23 (.01) [29401]	.22 (.01) [25559]	.20 (.01) [24754]
Father's Earnings 35-55	.22 (.01) [28606]	.23 (.01) [24869]	.19 (.01) [24092]
Father's Earnings 35-55 No zeros	.22 (.01) [28606]	.23 (.01) [24869]	.19 (.01) [24092]

Each cell represents the coefficient when log(Son's Earnings) is regressed on log(Father's Earnings) and a constant. Regressions with son's most recent earnings observation as the dependent variable also include indicators for age at which the earnings are observed.