

# Chicago Fed Letter

## What similarities between siblings tell us about inequality in the U.S.

by *Bhashkar Mazumder, economist*

The author finds that about half of earnings inequality in the U.S. can be explained by family and community influences during childhood. He also finds that these influences have become more important in recent decades.

**How** important is family background in determining economic success in the United States? If children from wealthy families turn out to be only modestly more successful, on average, than those from less fortunate backgrounds, this might be indicative of a fairly economically mobile society with widespread opportunities. If on the other hand, family background turns out to play a

very large role in determining future economic success, it raises the question of whether there is sufficient access to opportunity for all families.

It is extremely difficult, if not impossible, to accurately measure the full set of relevant family background variables using existing datasets. It is also often extremely difficult to collect

useful information for family members from two generations. For these reasons, many researchers have used socioeconomic data on siblings as a way to try to identify the importance of family background.

If one compared the earnings or wages of two sets of randomly chosen individuals from the population, one would not expect to find any correlation between the groups. In contrast, one would probably expect to find some positive correlation if the comparison was between

pairs of siblings. Specifically, the correlation between siblings in a particular outcome measures how much of the overall variance in that outcome is due to *all* of the factors that siblings share in common—namely the same family and the same community influences (e.g., peers, schools).<sup>1</sup>

In this *Chicago Fed Letter*, I discuss some new research in which I show that the sibling correlation in economic outcomes (e.g., annual earnings) is close to 0.5. This suggests that about half of earnings inequality in the U.S. can be explained by family and community influences during childhood. To provide some context, this is roughly the same magnitude as the sibling correlation in height, a characteristic that presumably has a large genetic component. Given the multitude of factors that are involved in determining one's earnings (e.g., schooling, skills, choice of industry/occupation), one might find such a high correlation very surprising. This finding also suggests that inequalities between families persist strongly from generation to generation and that the U.S. is a less mobile society than is commonly believed. I also find that the sibling correlation has risen in recent decades suggesting that the U.S. may have become less mobile.

### Measuring *permanent* economic status

Until the 1990s the studies that attempted to measure the sibling correlation

1. Sibling correlation in economic outcomes

	Earnings	Family income	Wages	Hours
<b>Brothers</b>				
Sibling corr.	0.49	0.47	0.54	0.39
Standard error	(0.02)	(0.02)	(0.02)	(0.04)
No. of individuals	5,213	5,164	5,102	5,179
<b>Sisters</b>				
Sibling corr.	0.34	0.45	0.36	0.15
Standard error	(0.04)	(0.03)	(0.03)	(0.03)
No. of individuals	4,994	5,195	4,956	5,068

in economic outcomes typically used only a single year of annual earnings to proxy for economic status. However, as far back as the 1950s, as a result of the work of Nobel laureates Milton Friedman and Franco Modigliani, economists have understood that a one-year snapshot of income is a poor measure of one's lifetime income stream or "permanent income." In a review of studies on the sibling correlation in earnings, Gary Solon found that the average estimate of the sibling correlation from those studies that only used one-year measures of earnings was about 0.25. Solon suggests that these results are biased down by 30% to 50% and that the true sibling correlation in permanent status is probably around 0.4 or higher.<sup>2</sup> In fact, a few empirical studies in the 1990s that tried to measure permanent economic status by using multiple years of data on earnings did indeed estimate the sibling correlation to be in the 0.4 range. However, given that there are only a few estimates and that these studies used relatively small samples and different methodologies, considerable uncertainty remains about the accuracy of these estimates.

### New estimates

In a new study I estimate the sibling correlation in a variety of outcomes using the National Longitudinal Survey of Youth (NLSY).<sup>3</sup> The NLSY contains a national sample of more than 12,000 young men and women who were between 14 years old and 22 years old in 1979 and tracks these individuals through to the present. The sample includes well over 4,000 sibling pairs. By using many years of labor market data on these individuals, I am able to better measure permanent economic status. I also employ a methodology that has better statistical properties than previous approaches.<sup>4</sup> I consider four different economic outcomes: log annual earnings, log family income, log hourly wages, and log annual hours worked. I also analyze women as well as men and consider a variety of noneconomic outcomes.

The results for economic outcomes are shown in figure 1. For men, the sibling correlation in annual earnings is estimated to be 0.49 and the sibling correlation

in family income is 0.47. Interestingly, the estimate is even higher for hourly wages at 0.54. One previous study that used a much smaller sample also found that the sibling correlation was over 0.5 for wages.<sup>5</sup> This implies that more than half of the inequality in wages is due to differences between families and that less than half to factors that vary within a family.

The results for women tend to be lower. However, this is not surprising given the more varied labor force participation patterns for younger women, largely related to having and raising children. In this respect, family income, which includes spouse's income, may better capture economic status for women than their own earnings. It turns out that the estimate for the correlation in family income among sisters (0.45) is virtually identical to the correlation in family income among brothers.

In a separate study I also present new evidence showing that these estimates are significantly higher than for a cohort who entered the labor market during the 1970s. This suggests that family background has become increasingly important in determining economic success.<sup>6</sup>

### Noneconomic outcomes

The estimates of the sibling correlation for a variety of noneconomic outcomes are shown in figure 2. Of particular interest to economists are measures of human capital, because these play a central role in economic models of earnings. The sibling correlation in years of schooling is estimated to be 0.60 and the sibling correlation in the Armed Forces Qualifying Test (AFQT) is 0.62.<sup>7</sup> The high sibling correlation in human capital not only demonstrates the importance of family

background in determining education and skill levels, but also suggests that this may account for the high sibling correlation in economic outcomes.

In the study I also examine a few behavioral measures that have previously been examined in studies of neighborhood or peer effects. These include use of illegal drugs, having spent time in jail, and teenage pregnancy. The correlations are widely dispersed for these outcomes and vary by gender, but are roughly in the 0.2 to 0.3 range. I also estimate sibling correlations in certain

## 2. Sibling correlation in noneconomic outcomes

	All	Brothers	Sisters
Yrs. of schooling			
Sibling corr.	0.60	0.62	0.60
Standard error	(0.01)	(0.01)	(0.01)
No. of individuals	6,097	3,000	3,097
AFQT scores			
Sibling corr.	0.62	0.62	0.62
Standard error	(0.01)	(0.01)	(0.01)
No. of individuals	5,751	2,811	2,490
Illegal drug use			
Sibling corr.	0.27	0.30	0.37
Standard error	(0.01)	(0.02)	(0.02)
No. of individuals	5,413	2,639	2,774
Ever in jail			
Sibling corr.	0.15	0.26	0.00
Standard error	(0.04)	(0.04)	(0.09)
No. of individuals	6,111	3,003	3,108
Age of pregnancy			
Sibling corr.	–	–	0.18
Standard error			(0.02)
No. of individuals			2,495
Height			
Sibling corr.	–	0.49	0.47
Standard error		(0.02)	(0.02)
No. of individuals		2,803	2,937
Weight			
Sibling corr.	–	0.33	0.29
Standard error		(0.02)	(0.03)
No. of individuals		2,652	2,768
Body mass index			
Sibling corr.	–	0.27	0.30
Standard error		(0.02)	(0.03)
No. of individuals		2,580	2,696
Rotter scale			
Sibling corr.	0.09	0.07	0.11
Standard error	(0.02)	(0.02)	(0.02)
No. of individuals	6,053	2,974	3,079
Self esteem			
Sibling corr.	0.25	0.22	0.28
Standard error	(0.01)	(0.02)	(0.02)
No. of individuals	5,809	2,860	2,949

### 3. Contributions to brother correlation

	Contribution	%
Parent income	0.17	36
Human capital	0.25	51
Education	0.21	44
AFQT scores	0.22	45
Physical characteristics	0.03	5
Height	0.02	5
Weight	0.01	1
Body mass index	0.00	0
Illegal behavior	0.11	22
Jail	0.11	23
Illegal drug use	0.00	0
Psychological char.	0.09	20
Rotter scale	0.05	10
Self esteem	0.07	15
Occupation	0.29	59
All except occupation	0.31	65
All	0.38	80

Note: Upper bound estimates of the contribution of each factor(s) to the 0.49 brother earnings correlation.

physical characteristics. The correlations in both weight and body mass index are approximately 0.3. The estimates for the sibling correlations in height are between 0.45 and 0.5.

A few recent studies by economists have emphasized the importance of certain non-cognitive factors (e.g., personality) in determining earnings. I examine the sibling correlation in two psychological measures, the Rotter scale and an index of self-esteem. The Rotter scale measures the extent to which individuals believe that factors outside of their control determine their fate. The sibling correlation in the Rotter scale is around 0.1, while the estimates for self-esteem are between 0.2 and 0.3.

#### Accounting for the sibling correlation in earnings

While a sizable sibling correlation in earnings suggests that family background plays an important role in determining economic success, it does not point to any particular factor or policy prescription. For example, if the correlation largely reflected unequal schooling levels, then this might suggest that policymakers should focus on promoting greater educational opportunity. In order to understand which specific factors contribute the most to the sibling correlation in earnings, I undertook an additional exercise. Here, the thought experiment is to consider how

much lower the sibling correlation in earnings would be if we first removed any variation in earnings that was associated with the particular factor(s) in question. This provides an “upper bound” estimate of how much any particular factor contributes to the sibling correlation. Figure 3 shows the results of this exercise for men for several explanatory variables.

One of the most important family background characteristics to consider is the income of parents. Removing the variation in earnings associated with parental income reduces the sibling correlation in earnings from 0.49 to 0.32, or about 36%. While on the one hand this is quite large, it also leaves a large part of family background and community influences that appear to be independent of parental income.

I show that each human capital measure (years of schooling and AFQT scores) taken on its own accounts for nearly half of the sibling correlation in earnings, and both measures taken together combine for just over half of the sibling correlation. This largely confirms the idea that education and skills are of crucial importance in addressing inequality. Physical characteristics, in contrast, appear to have little effect, although height is shown to account for about 5% of the correlation. Time spent in jail has a large effect, accounting for more than 20% of the correlation between brothers. This is largely driven by the effect of jail time on hours worked. The sibling correlation in hourly wages is only reduced by 8% when accounting for jail time.

Interestingly, the two psychological measures have a non-negligible effect on the sibling correlation. Including the effects of both in conjunction lowers the sibling correlation by about 20%. Finally, I consider the effects of including information about occupation into the analysis. A long literature in sociology has emphasized occupation as an important mechanism by which economic advantages are maintained by families. On the other hand, occupation may also be thought of as an outcome that is determined by the same factors

(e.g., schooling) that determine earnings. I find that the correlation in earnings between brothers is reduced by about 60% when I include occupation. Finally, I look at all of the measures in combination. Including all of the variables except occupation can explain 65% of the sibling correlation. Adding occupation to the mix explains about 80% of the overall sibling correlation.

#### Inequality within families

The sibling correlation could still underestimate the overall role of family background if there are important ways in which families reinforce inequality among siblings within the family. Economists have developed models to explain how families divide financial resources among children, but this literature is still in its early stages. In a standard model, parents invest in each child's education to the point at which the return to the investment equals the marginal cost. More able children who generate a larger return will receive more schooling. Parents who have a strong preference for equality in the economic outcomes of their children will compensate less-gifted children with financial transfers. However, families who are financially constrained

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from making such transfers, but who nonetheless value equality, may choose to invest similar amounts in their children's schooling. One implication of this model is that we would expect to see greater sibling inequality in schooling levels and wages among wealthier families than poorer families.

Using the same data described earlier, I actually find little difference in the degree of sibling inequality in schooling levels between low- and high-income families (defined by parental income). On the other hand, I do find evidence that the variance in AFQT scores among siblings does increase with parental income up to a point. This discrepancy

might be explained by the fact that differences in education levels are easily observed and may be deemed as "unfair." For example, parents may find it difficult to justify sending only one child to college. In contrast, parents may channel other resources in more subtle ways to children based on their likelihood for success, and it could be that these differences are captured by differences in test scores. I also find some important differences in the degree of sibling inequality depending on the gender of children that are not explained by the simple theoretical models and deserve more scrutiny in future research. For example, in high-income families sisters tend to have much

more similar levels of completed schooling than brothers.

## Conclusion

I present new evidence showing that the sibling correlation in economic outcomes is about 0.5. This implies that family background accounts for half of the inequality in the U.S. The sibling correlation also appears to have risen for more recent cohorts suggesting that the U.S. may have become less economically mobile in recent decades. I also analyze sibling inequality in economic outcomes and find mixed evidence in support of economic theories of resource allocation within families.

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<sup>1</sup> The sibling correlation does not include some factors that are commonly thought of as part of family background, such as genetic traits that are *sibling specific*.

<sup>2</sup> See Gary Solon, 1999, "Intergenerational mobility in the labor market," in *Handbook of Labor Economics*, Vol. 3A, Orley C. Ashenfelter and David Card (eds.), Amsterdam: Elsevier.

<sup>3</sup> See Bhashkar Mazumder, 2004, "Sibling similarities, differences, and economic inequality," Federal Reserve Bank of Chicago, working paper, No. 2004-13.

<sup>4</sup> The correlation is computed by first estimating a variance component model using restricted maximum likelihood (REML).

Unlike analysis of variance (ANOVA), which has been used by some previous studies, REML produces consistent estimates and has a known asymptotic sampling dispersion matrix. On the other hand, REML requires imposing a distributional assumption on the data. The relevant variance components on permanent economic status (the "between" and "within" family variance components) are then used to estimate the sibling correlation.

<sup>5</sup> See Gary Solon, Mary Corcoran, Roger Gordon, and Deborah Laren, 1991, "A longitudinal analysis of sibling correlations in economic status," *Journal of Human Resources*, Vol. 26, No. 3, pp. 509-534.

<sup>6</sup> See Bhashkar Mazumder and David I. Levine, 2003, "The growing importance of family and community: An analysis of changes in the sibling correlation in men's earnings," Federal Reserve Bank of Chicago, working paper, No. 2003-24.

<sup>7</sup> The AFQT is part of the Armed Services Vocational Aptitude Battery (ASVAB) of ten tests given to applicants to the U.S. military. The AFQT score is based on four of the tests that focus on reading skills and numeracy. The AFQT was administered to nearly all respondents in the NLSY in 1980 to provide new norms for the test based on a nationally representative sample.