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A research note on how brother correlations overlap over the life course
Karlson, Kristian Bernt

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Family background consistently affects economic success across the life cycle: A research note on how brother correlations overlap over the life course

Kristian Bernt Karlson

Department of Sociology, University of Copenhagen, Copenhagen K, Denmark

Correspondence
Kristian Bernt Karlson, Department of Sociology, University of Copenhagen, Oester Farimagsgade 5, Building 16, Copenhagen K, DK-1353, Denmark.
Email: kbk@soc.ku.dk

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Abstract
Scholars of social mobility increasingly study the role of family background in shaping attainment throughout the entire life course. However, research has yet to establish whether the family characteristics influencing early career attainment are the same as those influencing late career attainment. In this research note, I apply an extended sibling correlation approach to analyze brothers' life cycle earnings and family income, using data from the U.S. National Longitudinal Survey of Youth 1979. My analysis reveals a near-perfect correlation in the family characteristics that affect attainment at early, mid, and late career stages. This finding has significant implications for how mobility scholars conceptualize the impact of family background across a career. It suggests that family background forms a single, consistent dimension in determining attainment throughout the life course. Further analysis also indicates that the imperfect relationship between current and lifetime income is exclusively driven by within-family processes.

KEYWORDS
brothers, family background, life course, life cycle, sibling correlation, social mobility
1 | INTRODUCTION

A growing literature in sociology and economics investigates how family background affects attainment over the entire life cycle. Most prominently, perhaps, scholars have begun examining whether sibling correlations in permanent income—an omnibus measure of the overall impact of family background and local community—vary over the life course (Bingley & Cappellari, 2019; Conley, 2008; Conley & Glauber, 2005; Grätz & Kolk, 2022; Mazumder, 2011). While these studies document different life cycle trends depending on the context they examine, they do not consider whether it is the same or different unmeasured family characteristics that affect income at different career stages. Even if research shows an imperfect relationship between current and lifetime income (Björklund, 1993; Haider & Solon, 2006), previous research has not examined the extent to which this relationship is governed by processes between or within families.

Determining the extent to which the same or different family characteristics shape economic attainment over the life course is crucial for how social mobility scholars conceptualize the role of family background in determining life chances: If the same family characteristics consistently affect attainment across career stages, then family background can be conceptualized as a single factor or dimension of unobserved family characteristics affecting attainment throughout the life course. In contrast, if different family characteristics have varying effects at different career stages, theories must account for why this occurs and identify the most significant aspects at each stage. Thus, empirically resolving the dimensionality of family background effects across the life course is key to research in social stratification and mobility.

In this research note, I evaluate the extent to which the unmeasured family characteristics that affect permanent income early in the career, are the same as those that affect permanent income late in the career. I use an approach based on sibling similarities recently developed in Karlson and Birkelund (2023) to estimate the overlap in between- and within-family permanent income at different lifecycle stages. Another way of thinking about this approach is that I decompose the gross product-moment (Pearson) correlation between permanent income at different career stages into components governed by unmeasured family-specific (between-family) characteristics and unmeasured individual-specific (within-family) characteristics. I apply the approach to brothers in the U.S. National Longitudinal Survey of Youth 1979, measuring permanent earnings and family income at three career stages (30s, 40s, and 50s).

The analysis shows very substantial correlations in family-specific unobservables, all above 0.93, whereas the correlations in individual-specific unobservables are much lower and in the range 0.50–0.75. Thus between-family processes contribute to raising the overall product-moment correlation in permanent income between different career stages. Analyses also show that the imperfect relationship between current income and lifetime income reported in the literature is driven solely by within-family processes. These findings support the idea that it is the same family background characteristics that affect attainment across the entire life course.

2 | DATA AND METHODS

I examine brother data from the U.S. National Longitudinal Survey of Youth 1979, which follows a sample of 14–21-year-olds in 1979 (i.e., born 1957–1964) through today (Bureau of Labor Statistics, 2019). I link brothers living in the same household at the time of the first interview and follow their annual income through 2020. I use two income measures: log earnings (comprising income from wages and self-employment) and log total net family income. From each income variable, I create three permanent income variables which are the average income from ages 30 through 39, 40 through 49, and 50 through 59. I measure all income variables in 2017 USD and following Mazumder (2008) omit those with average annual income lower than 1688.15 USD (the equivalent of 500 USD in 1979 dollars). Omitting singletons, the final sample for earnings (total family income) is 1709 (1751) brothers distributed on 774 (790) families. Replication materials can be found in the online supplement to this note.

I use the approach developed in Karlson and Birkelund (2023) who proposed using a correlated variance components model based on siblings to quantify the overlap in family unobservables in income and occupational attainment. This type of multilevel model is also known as a multivariate multilevel model (Goldstein, 1995, p. 89ff; Baldwin...
et al., 2014; Hoffman, 2019), where "multivariate" refers to multiple equations with correlated error terms. Using siblings allows me to measure the overall impact on income of all the factors that siblings share, including shared genetic make-up, shared rearing environment, mutual interactions, and local community (Solon, 1999). I refer to these factors as unmeasured family characteristics, family unobservables, or between-family errors.

In my application, I have three multilevel equations—one for permanent income in each career stage (30s, 40s, and 50s)—for which I allow the between-family and within-family errors to be correlated across the equations. Let $\text{PERM}_{ij}^{30s}$, $\text{PERM}_{ij}^{40s}$, and $\text{PERM}_{ij}^{50s}$ denote permanent log income (earnings or total net family income) at the three career stages of brother $i$ in family $j$. The multivariate multilevel model is then given by

$$
\text{PERM}_{ij}^{30s} = \mu_{ij}^{30s} + \omega_{ij}^{30s} + \varepsilon_{ij}^{30s} \\
\text{PERM}_{ij}^{40s} = \mu_{ij}^{40s} + \omega_{ij}^{40s} + \varepsilon_{ij}^{40s} \\
\text{PERM}_{ij}^{50s} = \mu_{ij}^{50s} + \omega_{ij}^{50s} + \varepsilon_{ij}^{50s}
$$

with variance-covariance matrices

$$
\omega_j \sim N\left( \begin{pmatrix} \text{VAR}(\omega_j^{30s}) & \text{COV}(\omega_j^{30s}, \omega_j^{40s}) & \text{COV}(\omega_j^{30s}, \omega_j^{50s}) \\ \text{COV}(\omega_j^{40s}, \omega_j^{30s}) & \text{VAR}(\omega_j^{40s}) & \text{COV}(\omega_j^{40s}, \omega_j^{50s}) \\ \text{COV}(\omega_j^{50s}, \omega_j^{30s}) & \text{COV}(\omega_j^{50s}, \omega_j^{40s}) & \text{VAR}(\omega_j^{50s}) \end{pmatrix} \right) \\
\varepsilon_{ij} \sim N\left( \begin{pmatrix} \text{VAR}(\varepsilon_{ij}^{30s}) & \text{COV}(\varepsilon_{ij}^{30s}, \varepsilon_{ij}^{40s}) & \text{COV}(\varepsilon_{ij}^{30s}, \varepsilon_{ij}^{50s}) \\ \text{COV}(\varepsilon_{ij}^{40s}, \varepsilon_{ij}^{30s}) & \text{VAR}(\varepsilon_{ij}^{40s}) & \text{COV}(\varepsilon_{ij}^{40s}, \varepsilon_{ij}^{50s}) \\ \text{COV}(\varepsilon_{ij}^{50s}, \varepsilon_{ij}^{30s}) & \text{COV}(\varepsilon_{ij}^{50s}, \varepsilon_{ij}^{40s}) & \text{VAR}(\varepsilon_{ij}^{50s}) \end{pmatrix} \right)
$$

where $\omega_j$ and $\varepsilon_{ij}$ are the between- and within-family errors in permanent income in the three career stages. The parameters to be estimated in this multivariate model are the six between-family variances and covariances, the six within-family variances and covariances, and three global means in permanent income (referred to as $\mu$ in the regression equations). By normalizing the covariances with the respective variances, I can obtain a correlation coefficient that expresses in a standardized way the linear relationship between any pair of errors. For example, the correlation between between-family errors in early career income and late career income is given by

$$
\frac{\text{COV}(\omega_{ij}^{30s}, \omega_{ij}^{50s})}{\sqrt{\text{VAR}(\omega_{ij}^{30s}) \text{VAR}(\omega_{ij}^{50s})}}.
$$

I am particularly interested in the magnitude of the correlation of the between-family errors, as it expresses the extent to which the unmeasured family characteristics that affect early career income also affect late career income. However, more generally, we can think of the above as a way of decomposing the gross product-moment correlation in income at different career stages into portions attributable to factors within and between families, with the gross product-moment correlation being a weighted average of the correlation within and between families. From this perspective, the approach allows us to examine the extent to which the imperfect relationship between income at different career stages mainly resides within or between families, something that never has been studied before.

I estimate the models using maximum likelihood. I also control for birth year fixed effects in all models. Moreover, in line with the existing literature, I report for each equation the sibling correlation given by
\[
\text{ICC} = \frac{\text{VAR}(\omega_j)}{\text{VAR}(\varepsilon_j) + \text{VAR}(\omega_j)}.
\]

which is a measure of the total family background effect, that is, the overall impact on income of the unobserved characteristics that make up one’s family background. As I later discuss, the major advantage of my multivariate approach, as compared to existing sibling-based approaches (e.g., Conley, 2008; Grätz & Kolk, 2022) is that I can empirically test whether the unmeasured family characteristics \((\omega_j)\) that affect income early in the career are the same as those that affect income late in the career. Existing approaches that compare sibling correlations across career stages cannot determine whether the characteristics underlying these correlations remain consistent or change over time. If the underlying family characteristics were changing, this would suggest that different aspects of family background, broadly speaking, determine attainment differently across the life course. My approach provides a method for empirically testing this hypothesis.

Building upon the main analysis outlined above, I conduct a supplemental analysis estimating the between- and within-family correlation in current, annual income at selected ages, as well as in lifetime income, which is measured as the average from ages 30 through 55. This model involves two multilevel equations and allows the between-family and within-family errors to be correlated across the two equations. This approach directly taps into the widely studied relationship between current and lifetime income, for which studies find an imperfect relationship (Björklund, 1993; Haider & Solon, 2006). Through this method, I can uncover whether between- or within-family processes primarily drive this imperfect relationship.

3 | RESULTS

Table 1 reports estimates from the multivariate multilevel model for permanent earnings and permanent family income, respectively. For earnings, I find that the brother correlation varies slightly over the career from 38% in the 30s, to 41% in the 40s, and then back to 38% in the 50s. For family income, the corresponding percentages (46%, 42%, and 43%) are slightly higher and decline slightly from the 30s to the 40s and 50s. However, considering the overlapping confidence intervals across ages and income types, the overall pattern of results is one of constancy with a brother correlation of roughly 40%.

Estimates of the correlation in between-family errors in Table 1 reveal a surprising result: All three between-family variance components in permanent earnings correlate near-perfectly across the three career stages, with coefficients higher than 0.96. I find an almost identical result for permanent family income, with coefficients higher than 0.93. These estimates show that it is the same unmeasured family (and local community) characteristics that affect permanent income across the life cycle. These results providing clear evidence of a single dimension of underlying family characteristics shaping the attainment across career stages for the population of U.S. brothers that the data represent.

Table 1 also reports the correlation in within-family errors and the gross product-moment correlation between income at the three stages. Given that the product-moment correlation can be considered a weighted average of the within and between correlations (with the brother correlations being the weights), the estimates show that the within-family part drives the differences in the product-moment correlations. In general, the product-moment correlations follow a pattern where the correlation in income for adjacent career stages (30s and 40s, and 40s and 50s) is higher than for the non-adjacent stages (30s and 50s). The same pattern, just more pronounced, holds for the within-family correlations, something that also follows from the overall correlation being a weighted average of the within and between correlations.

In Table 2, I report estimates of the correlation in between- and within-family errors from variance component models that compare current income at a given age to lifetime income across the entire life course. The estimates clearly show that the imperfect relationship between current and lifetime income is driven by within-family
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4 | CONCLUSION

In this research note, I have examined the relationship between family background and income over the life cycle with the distinct contribution of measuring the extent to which it is the same family background characteristics that shape attainment at different career stages. I can answer this question in a satisfactory way because I rely on siblings.
to capture the overall impact of family background (and local community) on labor market attainment. With data on U.S. brothers born around 1960, I find very strong support for the idea that there is one dimension of unmeasured family characteristics affecting attainment across the life course, meaning that it is the same family characteristics that shape attainment early in the career (e.g., 30s) and late in the career (e.g., 50s). My analysis also shows that even if current and lifetime income correspond only imperfectly (Haider & Solon, 2006), this imperfect relationship is not driven by between-family processes.

My findings have implications for how scholars conceptualize family background and its effects on attainment. In the sibling-based literature, scholars have put forth various hypotheses about whether family background exerts a greater influence early or late in an individual’s career (e.g., Conley, 2008; Grätz & Kolk, 2022; Warren et al., 2002). This literature thus treats family background as a unitary concept whose “effect” on labor market outcomes can change over the career. However, the literature has not considered whether the unmeasured family characteristics, which are “built in” to the total family background effect captured by the sibling correlation, also change with age. My findings suggest that, at least in the U.S. sample I analyze, family background (broadly considered) can be conceptualized as a single factor. Whether this applies to other countries remains an open question, one that future research should explore.

My findings also have implications for the literature considering how the effects of specific, observed family background characteristics vary across the life course. For example, Choi et al. (2020) report that, for men in the U.S., the effect of observed parental income on earnings and family income decline across ages 27–34 through ages 35–42 by about 12–24% (depending on birth cohorts and income definition). While this result seems to suggest that the importance of family background declines over the life course (for men), my findings point to that family background factors other than parental income grow in importance over time. These other factors must offset the declining impact of observed parental income to preserve a single dimension of family characteristics over the life course. The implication of these observations is that some aspects of family background appear to compensate (or substitute) for other aspects across the career. Although I cannot pursue this question any further here, future research could consider unpacking which family factors are involved in such compensation.

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CONFLICT OF INTEREST STATEMENT
The author has no conflicts to disclose.

DATA AVAILABILITY STATEMENT
The data that support the findings of this study are available in NLS Investigator at https://www.nlsinfo.org/investigator/pages/login. These data were derived from the following resources available in the public domain: - National Longitudinal Survey of Youth 1979, https://www.nlsinfo.org/content/cohorts/nlsy79. Replication materials posted along with this research note provide complete details on how to replicate the findings reported here.

ORCID
Kristian Bernt Karlson https://orcid.org/0000-0002-5886-2127

ENDNOTES
1 I limit my analysis to brothers given that the vast majority of sibling correlation studies has focused on brothers. Results for sisters (not reported here) are virtually similar to those for brothers in terms of the correlations in family unobservables across lifecycle stages, which are the main focus of this note.
2 Because of convergence issues for the models involving earnings, which is a result of near-perfect correlations in family unobservables, I add a small portion of random noise to the permanent earnings variable for the 50s (also see the replication materials published along with this note). Adding this noise is inconsequential for the results I report. The correlation
between the original and variable with added noise is 0.9988, and the product-moment correlation between earnings variables for the 50s on the one hand and 30s and 40s on the other differs by an extremely small amount. Moreover, adding noise will only reduce correlations, not increase them.

3 This is not confined to the sibling-based literature but pertains to the life course literature more generally (see Kerckhoff, 1993).

4 This result follows from the fact that the intergenerational correlation in, say, income, is nested in the sibling correlation framework (see Solon, 1999). The portion of the between-family variance that parental income accounts for is given by $β^2 \text{VAR}(X)$, where $X_j$ is parental income in family $j$, and $β$ is the regression coefficient of parental income (on offspring income) in a given multilevel model. Given that VAR($X_j$) is constant over the life course, declining $β$ implies that unmeasured family factors unrelated to parental income will grow in importance, given that family background constitutes one dimension across the life course.

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