Equalization or Selection? Reassessing the "Meritocratic Power" of a College Degree in Intergenerational Income Mobility*

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Abstract

Intergenerational mobility is higher among college graduates than among people with lower levels of education. In light of this finding, researchers have characterized a college degree as "the great equalizer" that levels the playing field, and hypothesized that an expansion in higher education would promote mobility because more people would benefit from the high mobility experienced by college graduates. Yet, this line of reasoning rests on the implicit assumption that the relatively high mobility observed among college graduates reflects a causal effect of college completion on intergenerational mobility, an assumption that has rarely been rigorously evaluated. This article bridges this gap. Using a novel reweighting technique, I estimate the degree of intergenerational income mobility among college graduates that is purged of selection processes that may have driven up observed mobility in this subpopulation. Analyzing data from the National Longitudinal Survey of Youth 1979, I find that once selection processes are adjusted for, intergenerational income mobility among college graduates is very close to that among non-graduates. This finding suggests that simply expanding the pool of college graduates is unlikely to boost intergenerational income mobility in the US. To promote mobility, future investment in higher education should be targeted at low-income youth.

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Introduction

Sociologists have long recognized the multiple roles of education in intergenerational mobility. On the one hand, education is seen as the prime vehicle for social reproduction, as a major portion of parental influence on children's socioeconomic standing is transmitted through education. On the other hand, education is considered as a key engine of upward mobility, as a major portion of the variation in educational attainment is independent of parental influence (Hout and DiPrete 2006). The equalizing role of education was further explicated by Hout (1984; 1988), who found that the direct influence of parental class position on children's class position is much weaker among college graduates than among workers with lower levels of education. To put it differently, social mobility is much higher among college graduates than non-graduates. Over the past two decades, this empirical pattern has been reproduced both for more recent periods in the US (Chetty et al. 2017; Pfeffer and Hertel 2015; Torche 2011) and for a number of other advanced industrial countries such as France, Sweden, Germany, and Britain (Breen 2010; Breen and Jonsson 2007; Breen and Luijkx 2007; Vallet 2004).

Given the robust empirical evidence for the relatively high mobility among college graduates, many researchers have portrayed a college degree as "the great equalizer" that levels the playing field between individuals from different socioeconomic backgrounds. For instance, Torche (2011, p. 764) wrote, "a college degree fulfills the promise of meritocracy—it offers equal opportunity for economic success regardless of the advantages of origins." Or, as put more succinctly by Hout (1988, p. 1391): "A college degree can do it." On the basis of this interpretation, Hout further hypothesized that an expansion in postsecondary education would promote mobility because more people would benefit from the high mobility experienced by college graduates (p. 1358). In recent years, stratification scholars have employed decomposition and simulation methods to quantify this "composition effect" for long-term trends in both occupational class mobility (Breen 2010; Pfeffer and Hertel 2015) and income mobility (Bloome et al. 2018).

Yet, it is one thing to observe a higher degree of intergenerational mobility among college graduates than non-graduates, but quite another to say that a college degree can

erase—or even reduce—the influence of family origin. While the former is no more than an empirical association, the latter entails a *causal* effect of college completion on intergenerational mobility. It means that for a college graduate, the influence of social origin would have been stronger if she had not attended or graduated from college; and for a non-college graduate, the influence of social origin would have been weaker if she had graduated from college. In this case, it would be legitimate to say that a college degree has an equalizing effect on intergenerational mobility, and simply expanding the pool of college graduates would have the potential to boost intergenerational mobility. On the other hand, however, the observed high mobility among college graduates might well be a result of selection into college of different types of students from different socioeconomic backgrounds. For example, college graduates from low- and moderate-income families may be more positively selected on such individual attributes as ability and motivation than those from high-income families, for whom obtaining a bachelor's degree may simply reflect a cultural norm (Hout 2012; Mare 1981). Thus, low-income college graduates would be less representative of low-income youth in general than high-income college graduates are representative of high-income youth. If such a selection process was primarily responsible for the high mobility observed among college graduates, it would be too hasty to hail the higher education system as "the great equalizer." In this case, the impact of a college expansion on intergenerational mobility would be more limited than we would otherwise expect.[1]

While mobility scholars have recognized selection processes as a potential driver of the relatively high mobility among college graduates (e.g., Torche 2011), few studies, if any, have attempted to evaluate the strength of selection effects. Given the sharply different policy implications of the causal and selection effects of college, we have no reason to stay ambiguous about their relative importance. In this study, I seek to adjudicate between these two hypotheses, which I call *equalization* and *selection*, in the context of intergenerational income mobility in the US. Toward this goal, I use data from the 1979 cohort of National Longitudinal Study of Youth (NLSY79). Compared with other surveys that have been used to study intergenerational mobility (e.g., the General Social

[1]Supplementary Material H provides a simulation study demonstrating this point.

Survey and the Panel Study of Income Dynamics), the NLSY not only has a relatively large sample size, but also provides information on a range of individual characteristics prior to college attendance, such as family structure, cognitive ability, and educational expectation, that may confound the causal effect of college graduation on intergenerational income mobility. To purge potential selection processes from the causal effect of a college degree, I employ a novel reweighting method called "residual balancing" (Zhou and Wodtke 2018), which creates a set of weights such that in the reweighted sample, observed pre-college characteristics are no longer associated with college graduation at each level of parental income. As a result, the reweighted sample allows us to directly examine whether and to what extent a college degree moderates the influence of parental income. I find that once selection processes are adjusted for, intergenerational income mobility among college graduates is very close to that among non-graduates. This finding suggests that simply expanding the pool of college graduates is unlikely to boost intergenerational income mobility in the US. To promote mobility, future investment in higher education should be targeted at low-income youth.

Does a College Degree Level the Playing Field?

The "College Premium" in Intergenerational Mobility

Education has long been considered an intervening variable in social stratification. Per the status attainment model (Blau and Duncan 1967; Featherman and Hauser 1978), origin status affects destination status not only directly but also through educational attainment. The degree of intergenerational association thus depends on (a) the effect of origin status on educational attainment, (b) the effect of educational attainment on destination status, and (c) the direct effect of origin status on destination status (net of education). In two influential studies on occupational mobility in the US, Hout (1984, 1988) fundamentally revised this mechanistic understanding of the stratification process by showing that the direct effect of origin on destination varies across educational groups. In particular, using data from the General Social Survey 1972-85, he found that the direct influence of parental

class position on children's class position was much weaker among workers who held a bachelor's degree than among those with lower levels of education. While Hout focused on occupational mobility in the US during the 1970s and 80s, similar empirical patterns have been reproduced both for more recent periods (and cohorts) in the US (Pfeffer and Hertel 2015; Torche 2011) and for a number of other advanced industrial countries such as France, Sweden, Germany, and Britain (Breen 2010; Breen and Jonsson 2007; Breen and Luijkx 2007; Vallet 2004). Moreover, the "college premium" in intergenerational mobility holds regardless of how socioeconomic status is measured. Using data from the NLSY79 and the Panel Study of Income Dynamics (PSID), Torche (2011) finds that college graduates exhibit the highest degree of intergenerational mobility not only in occupational class but also in hourly earnings and family income. More recently, using administrative data for over 30 million college students, Chetty et al. (2017) report that although access to different types of colleges varies greatly by parent income, low-income students end up earning about as much in adulthood as their high-income peers if they have attended the same college, a finding that further suggests that attending college—at least attending the same college—seems to mute the effects of family background.

While empirical evidence for the relatively high mobility among college graduates is abundant, theoretical explanations of its underlying mechanisms are relatively thin. As Torche (2011) points out, "in spite of its empirical relevance, the mechanisms leading to a weak intergenerational association among college graduates have been scarcely explored and theorized" (p. 798). In an early attempt to theorize about the relationship between industrialization and social mobility, Treiman (1970) argues that industrialization promotes equality of opportunity because it entails a process of economic rationalization, which necessarily shifts the emphasis away from ascription to achievement in the allocation of occupational positions. In this process, education plays a pivotal role because it imparts technical skills with direct occupational payoffs, broadens individuals' acquaintance with alternative possibilities, and inculcates social skills that enable them to take advantage of such opportunities. Thus, "the higher the level of education in a society, the higher the rate of exchange mobility" (p. 221). While Treiman's arguments were originally formulated to account for societal-level associations, similar lines of reasoning have been em-

ployed to explain the college premium in intergenerational mobility. For instance, Breen and Jonsson (2007) posit that college graduates are more likely to enter segments of the labor market where meritocratic selection is more prevalent, thus leaving little leeway for social network effects or other advantages associated with social origins (see also Torche 2011).

Technically, the college premium in intergenerational mobility is characterized by an interaction effect of origin status and education on destination status. This interaction effect can be alternatively interpreted as a higher "return to education" among children from disadvantaged social origins (Goldthorpe and Jackson 2008; Hout 2012). This interpretation is consistent with recent studies showing that the causal effect of a college degree on earnings is largest among people who are least likely to complete college (Brand and Xie 2010).[2] Children from low-income families are less likely than children from high-income families to complete college, but they may benefit more from completing college than their high-income peers (Attewell and Lavin 2007; Bowen and Bok 2000; Dale and Krueger 2011; Maurin and McNally 2008). Compared with how they would have fared without college, low-income children may gain more productivity-enhancing skills, more network connections, or more information on economically rewarded cultural orientations in college than high-income children. If so, higher education should promote upward mobility. Yet, college graduates' high mobility may reflect not only heterogeneous returns to college by family origin but also self-selection into college of different types of students from different socioeconomic backgrounds (Breen et al. 2015; Zhou and Xie 2019a,b). For example, large shares of high-income students might attend college whatever their skills or ambitions, while low-income students might decide whether to attend college on the basis of their academic abilities, motivation, and college preparedness. In this case, we might observe a college premium in mobility even if the influence of parental income was unabated among college graduates.

[2]Brand and Xie (2010) focus on how economic returns to college vary according to the propensity score of college graduation. Since the propensity score is a function of a large number of pre-college characteristics and not equivalent to parental income, results from this study are not directly comparable with those in Brand and Xie (2010).

The "Long Shadow" of Family Background

In his original study on occupational class mobility, Hout (1988) reports that intergenerational association is not only weakest among college graduates, but close to zero in magnitude. Recent studies, however, indicate that the "leveling effect" associated with a bachelor's degree is not as dramatic in the realm of earnings/income mobility (e.g., Bowen and Bok 2000; Giani 2016; Witteveen and Attewell 2017). For example, Bowen and Bok (2000) find that even graduation from a highly selective private college "by no means eradicates the beneficial effect of high socioeconomic status on earned income" (p. 138). More recently, using data from the Baccalaureate & Beyond Longitudinal Study, Witteveen and Attewell (2017) conclude that income differences between college graduates from different family backgrounds are substantial both four and ten years after graduation. Although these findings do not directly challenge the college premium in intergenerational mobility, it is unmistakable that family economic background casts a long shadow over the economic wellbeing of bachelor's degree holders.

Several mechanisms may have contributed to the lingering effect of family background among college graduates. First, due to the decentralized and differentiated nature of the US higher education system, patterns of postsecondary enrollment are highly stratified by parental background. Students from low- and moderate-income families are not only more likely to attend two-year community colleges and for-profit colleges, but, even if they attend a non-profit four-year college, they are less likely to enroll in selective colleges than their high-income peers (e.g., Astin and Oseguera 2004; Bastedo and Jaquette 2011; Carnevale and Rose 2004; Davies and Guppy 1997; Karen 2002; Goldrick-Rab 2006; Grodsky 2007). These disparities are partly, but not exclusively, mediated by the advantages of high-income students on allegedly merit-based criteria such as high school GPA and standardized test scores (Alon 2009). A variety of other, non-meritocratic processes are equally important (Tam and Jiang 2014). For example, given that elite private colleges are often the most expensive, high-income students' greater ability to pay directly contributes to the income-gap in college selectivity.[3] Moreover, low-income students often

[3]At the top of the economic hierarchy, the effect of parental income/wealth can be more insidious. In a recent study, Meer and Rosen (2009) find that donations by alumni to a research university peak in the

suffer from an informational deficit about the admissions and financial aid processes of selective colleges. As Hoxby and Avery (2012, p. 1) show, the vast majority of low-income high-achievers do not even apply to any selective college—"despite the fact that selective institutions often cost them less, owing to generous financial aid, than the two-year and nonselective four-year institutions to which they actually apply." As a result, in a recent study of over 30 million college students, Chetty et al. (2017) find that children from families in the top 1% of the income distribution are 77 times more likely to attend an Ivy League college than those whose parents are in the bottom income quintile, and more broadly, "the degree of income segregation across colleges is comparable to the degree of income segregation across neighborhoods in the average American city" (p. 2). Thus, to the extent that attending a selective institution leads to greater success in the labor and marriage markets (e.g., Brand and Halaby 2006; Brewer et al. 1999; Dale and Krueger 2002; Loury and Garman 1995; Monks 2000; Thomas 2003; Thomas and Zhang 2005; see Gerber and Cheung 2008 for a review), horizontal stratification within the postsecondary system has likely contributed to the intergenerational reproduction of economic status.

Apart from horizontal stratification by institutional selectivity, even students of different socioeconomic backgrounds who attend the same college often find themselves on diverging trajectories of campus life that maintain, perpetuate, and reproduce inequalities (Armstrong and Hamilton 2013; Hamilton and Cheng 2018; Hamilton et al. 2018; Lee 2016; Stuber 2009, 2011; Thiele and Gillespie 2017). With abundant financial resources, students from affluent families are usually freed from paid employment and thus can fully engage in extracurricular activities such as Greek life, unpaid internships, intramural and varsity sports, community service, and study-abroad programs. These activities, in turn, provide them with networks of contacts, information, and cultural capital that are highly prized in the labor market. For example, Rivera (2015) finds that top-tier employers in finance, law, and management consulting reward not only prestigious university credentials, but also "high-status extracurricular activities, polished interactional styles, and personal narratives of passion, self-reliance, and self-actualization" (p. 269; see also

period when their children are of college age, drop off after the admissions decision, and "the decline is far greater when the child is rejected" (p. 281).

Laurison and Friedman 2016; Rivera and Tilcsik 2016). By contrast, students from less privileged families participate less in the collegiate extracurriculum not only because of their limited financial resources—which tend to necessitate paid employment that takes their time away—but also due to their lack of social and cultural capital at the outset, which further curtails their interest and involvement (Stuber 2011). Being unfamiliar with the cultural codes and expectations of the privileged classes, low-income students often "[find] ways to opt out and exclude themselves from social networks, organizations, and interactions that prompted feelings of alienation" (p. 15). These resource-based inequalities may have further been exacerbated by what Armstrong and Hamilton (2013) call "the party pathway" that is prevalent in many American universities. Characterized by easy majors and extensive Greek life, the party culture fosters an environment in which upper-class students are well positioned to enter media, sports, and fashion careers whereas middle- and low-income students are highly vulnerable to downward mobility and often end up in jobs with bleak career prospects.[4]

Finally, the shadow of family background can extend well beyond college graduation. First, upon entry into the labor market, college graduates from high-income families often receive generous "bridging funds" from their parents, funds that allow them to repay student loans (if any) and cover living expenses while they are searching for an ideal job, whereas their low-income peers often have to settle for a less desirable position out of financial pressure. Sometimes, high-income parents can even secure their adult children a job within their own professional or business networks, or help them pursue entrepreneurial activities through either direct financial support or a safety net to fall back on in case of failure (Mitnik et al. 2016). Second, high-income parents may also provide financial support for their children to invest in advanced degrees, especially in such lucrative fields as business, medicine, and law. As Torche (2011) shows, even among those who pursue advanced degrees, graduates with upper-class origins are more likely to attend selective institutions and attain professional degrees and MBAs than their

[4]In a recent interview-based study, Streib (2018) finds that at the junction of college-to-work transition, students from different class backgrounds who share a university and major sometimes come to earn similar amounts of income—despite their disparities in cultural and social capital. She posits that a lack of information about the labor market reward structure can mute the influence of cultural and social capital among young college graduates.

lower-class peers, which in turn leads to a "reemergence" of intergenerational reproduction among advanced degree holders. Third, social origin exerts influence not only in the labor market but also in marital formation and partner choice. While college-educated people are in general more likely than less-educated people to marry, remain married, and have college-educated spouses (DiPrete and Buchmann 2013; Schwartz and Mare 2005), the effects of college in the marriage market have been found to be largest among graduates from the most advantaged origins (Musick et al. 2012). Moreover, using data from the PSID, Arum et al. (2008) find that while women's attendance at more elite colleges was associated with marrying a man with a higher subsequent income, men's attendance at more elite colleges was associated with marrying a woman with more privileged origins. These myriad patterns of assortative mating have in all likelihood strengthened intergenerational persistence of economic wellbeing.

The Selection Problem

The above discussion suggests that the influence of family background does not vanish among college graduates; rather, family origin shapes the type of postsecondary institutions attended, the degree of extracurricular involvement during college, the level of parental economic support after graduation, and patterns of marital formation and partner choice. All these processes tend to perpetuate inequalities across generations, depressing intergenerational mobility. On the other hand, mobility researchers have long observed relatively high mobility among college graduates and attributed it to the "meritocratic power" of a bachelor's degree. How do we reconcile these seemingly conflicting findings? Given the evidence at hand, it would be reasonable to suppose that a bachelor's degree reduces but does not eliminate the influence of family origin. This interpretation, however, rests on the implicit assumption that the college premium in mobility reflects a genuine, causal effect of college completion on equality of opportunity. This assumption, as discussed earlier, might not hold if college graduates from low- and moderate-income families are highly selected on such individual attributes as ability and motivation, attributes that by themselves may have substantial returns in the labor and marriage mar-

kets. In this case, the influence of family background might persist even though mobility *appears* to be higher among college graduates.

In fact, the selection problem has long been recognized in previous research (e.g., Mare 1981; Torche 2011). For example, Torche (2011) wrote

> [G]iven the substantial economic and cultural barriers that lower-class students face in attaining postsecondary education, those who "make it" to college are positively selected on unobserved attributes such as motivation and ability. To the extent that these attributes are rewarded in the labor market, lower-class college graduates will likely experience upward intergenerational mobility (p. 800).

More recently, Witteveen and Attewell (2017) speculated about the direction of bias associated with conditioning on education:

> Based on a vast amount of empirical findings, we suspect that our sample of BA holders is likely to favor high-income students after two important previously stratifying selections: students from lower-class backgrounds are less likely to attend college (1) and less likely to complete college (2). Unobserved differences are therefore likely to underestimate the effect of household income on earnings in this specific sample (p. 1569).

Aside from these ad hoc speculations, however, no previous study (to my knowledge) has systematically assessed the validity of the two competing explanations—equalization and selection—for the college premium widely observed in intergenerational mobility research. This study aims to bridge this gap.[5]

To demonstrate the selection problem more formally, let us start with Figure 1, which depicts the process of intergenerational income reproduction in direct acyclic graphs (DAG). The left panel shows that parental income (X) affects the adult child's income

[5]This gap exists only in the scholarship of intergenerational mobility. As discussed in the preceding section, sociologists and economists have long examined the causal effects of college on earnings and how they vary across different segments of the population. While theoretically connected, these two strands of literature have followed distinct paths of development. Although selection processes have been widely investigated in the literature on economic returns to education, no previous study has attempted to assess the role of selection in shaping the college premium in intergenerational mobility.

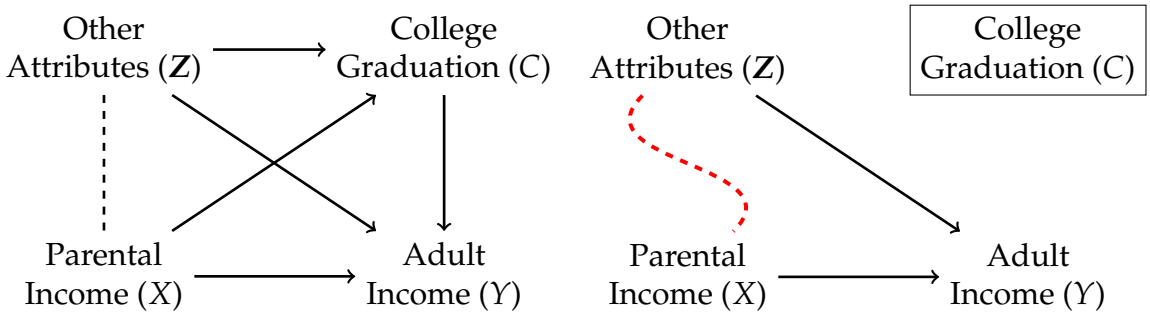

Figure 1: Conditioning on College Graduation (a Collider) Distorts the Associations between Parental Income and Other Predictors of Adult Income.

(Y) both directly and through educational attainment, which, for our purpose, is coded as a dummy variable denoting college graduation (C).[6] In the meantime, there may exist a range of individual attributes ($\boldsymbol{Z}$) other than parental income—such as family structure, cognitive ability, and motivation—that affect both the likelihood of college graduation and adult income. From this DAG, we can see that college graduation is not only an intervening variable in intergenerational income reproduction, but also a *collider variable*—a common consequence of parental income (X) and other individual attributes ($\boldsymbol{Z}$) (see Elwert and Winship 2014). Therefore, as shown in the right panel, when we condition on college graduation, the associations between parental income and other individual attributes are artificially distorted. For example, if parental income is positively associated with cognitive ability in the population, this association will likely be attenuated or even reversed among college graduates. Such a distortion in the association between parental income (X) and other individual attributes ($\boldsymbol{Z}$) can translate into a change in the marginal association between parental income and adult income—which we use to measure the degree of intergenerational *immobility*—even if neither the direct influence of parental income ($X \rightarrow Y$) nor that of other attributes ($\boldsymbol{Z} \rightarrow Y$) differs between college graduates and non-graduates. That is, observed mobility may differ between college graduates and non-graduates even if a college degree does not modify any pathways of intergenerational reproduction.

When studying intergenerational income mobility, we often focus on the slope coeffi-

[6] In the empirical analysis, I will relax this assumption by examining selective colleges and nonselective colleges separately.

cient from a linear regression of adult income (Y) on parental income (X), which I denote as β. Since β reflects the persistence of income across generations, its complement $1-\beta$ reflects the degree of intergenerational mobility. In practice, recent scholars often transform both parental income and adult income into their percentile ranks before analysis (e.g., Bloome et al. 2018; Chetty et al. 2014a,b). By ranking parents' and children's incomes within their respective generation's distributions, β can be interpreted as an intergenerational rank-rank slope.[7] An advantage of this measure is that it captures intergenerational persistence in a way that is independent of income distribution in either generation. To see the implications of the selection problem for measuring mobility, let us consider the conditional expectation function (CEF) of adult income rank given parental income rank, $\mu(x) = \mathbb{E}[Y|X = x]$. This function contains all the information we need to compute β because

$$\beta = \frac{\text{Cov}[Y, X]}{\mathbb{V}[X]} = \frac{\text{Cov}[\mu(X), X]}{\mathbb{V}[X]} \tag{1}$$

where X follows a standard uniform distribution (in expectation). The above equation holds because of the CEF decomposition property (see Angrist and Pischke 2008, chapter 3). By the law of total expectation (i.e., for any random variables X, Y, Z, $\mathbb{E}[Y|X] = \mathbb{E}\big[\mathbb{E}[Y|X, Z]|X\big]$), the CEF function $\mu(x)$ can be written as

$$\mu(x) = \int \mathbb{E}[Y|X = x, \boldsymbol{Z} = \boldsymbol{z}] f(\boldsymbol{z}|x) d\boldsymbol{z} \tag{2}$$

where $\boldsymbol{Z}$ is the vector of covariates shown in Figure 1 and $f(\boldsymbol{z}|x)$ is the probability density function of $\boldsymbol{Z}$ given $X = x$. Now, consider the CEF of adult income rank given parental income rank *among college graduates*, $\mu_1(x) = \mathbb{E}[Y|X = x, C = 1]$. By the law of total expectation, we have

$$\mu_1(x) = \int \mathbb{E}[Y|X = x, \boldsymbol{Z} = \boldsymbol{z}, C = 1] f(\boldsymbol{z}|x, c = 1) d\boldsymbol{z} \tag{3}$$

where $f(\boldsymbol{z}|x, c = 1)$ is the probability density function of $\boldsymbol{Z}$ given $X = x$ among college graduates. Comparing equation (3) with equation (2), we can see that $\mu_1(x)$ can

[7] In expectation, the percentile ranks of both parents' and children's incomes follow a standard uniform distribution. Thus β can also be interpreted as an intergenerational rank correlation.

differ from $\mu(x)$ in two ways: (a) $\mathbb{E}[Y|X = x, \boldsymbol{Z} = \boldsymbol{z}, C = 1] \neq \mathbb{E}[Y|X = x, \boldsymbol{Z} = \boldsymbol{z}]$, and (b) $f(\boldsymbol{z}|x, c = 1) \neq f(\boldsymbol{z}|x)$. Whereas (a) reflects genuine differences between college graduates and non-graduates in the strength of intergenerational reproduction ($X \rightarrow Y$, $\boldsymbol{Z} \rightarrow Y$), (b) reflects the distortion in the joint distribution between X and $\boldsymbol{Z}$ due to conditioning on college graduation. Thus, absent the distortion in the joint distribution between X and $\boldsymbol{Z}$, the CEF of adult income rank given parental income rank among college graduates would be adjusted to

$$\mu_1^*(x) = \int \mathbb{E}[Y|X = x, \boldsymbol{Z} = \boldsymbol{z}, C = 1] f(\boldsymbol{z}|x) d\boldsymbol{z} \tag{4}$$

Similarly, by setting $C = 0$, we can evaluate the unadjusted CEF $\mu_0(x)$ and adjusted CEF $\mu_0^*(x)$ for non-college graduates.

Now, we can define two measures of intergenerational mobility among college graduates (and non-graduates): *conditional mobility* and *controlled mobility*. Conditional mobility, as captured by equation (3), reflects the degree of mobility that we observe among actual college graduates (i.e., by "conditioning on" college graduation). Controlled mobility, as captured by equation (4), reflects the degree of mobility we would observe among college graduates if, given parental income, college graduation did not depend on other predictors of adult income (i.e., after we "control for" selection processes that may confound the causal effect of a college degree on intergenerational mobility). Thus, controlled mobility reflects the degree of mobility we would observe if, at each level of parental income, college graduates were a representative sample of the general population. By extension, it might also reflect the degree of intergenerational mobility we would observe in a utopian world of "college for all." The distinction between these two concepts is crucial not only in theory but also in their policy implications. While conditional mobility is a *descriptive* measure that gauges intergenerational mobility within the subpopulation of college graduates, controlled mobility has a *prescriptive* value because it better informs whether we can promote equality of opportunity by inducing more people into this subpopulation. If, for example, controlled mobility is no higher among college graduates than among non-graduates, an expansion of higher education per se may not be an effective tool for

promoting equality of opportunity—unless it simultaneously equalizes access to higher education (by weakening the arrow $X \to C$ or $\boldsymbol{Z} \to C$).

It should be noted that neither conditional mobility nor controlled mobility aims to capture the causal effect of parental income on adult income—a quantity that is beyond the scope of this study. Instead, our focus is on whether and the extent to which college completion promotes intergenerational mobility. This question, however, cannot be answered directly by conditioning on college completion, because it can distort the associations between parental income X and other predictors of adult income ($\boldsymbol{Z}$), leading to a mechanical change in conditional mobility. Controlled mobility avoids this problem by fixing the associations between X and $\boldsymbol{Z}$ at their baseline levels in the general population. Thus, a comparison between college graduates and non-graduates in controlled mobility will reveal the genuine effect of college completion on intergenerational reproduction. Below, I describe a reweighting method that allows us to estimate controlled mobility empirically.

Method

To assess conditional mobility (equation 3), we can simply estimate the intergenerational rank-rank slope from a linear regression of adult income rank (Y) on parental income rank (X) among college graduates. To obtain comparable estimates of controlled mobility (equation 4), we would ideally want to fit a linear regression on a hypothetical sample of college graduates in which the distribution of individual characteristics $\boldsymbol{Z}$ given parental income rank X was the same as that in the general population. In practice, it is difficult to construct a hypothetical sample that meets this criterion exactly. Our goal is thus to construct a set of weights such that in the reweighted sample, the associations between parental income rank X and other attributes $\boldsymbol{Z}$ are about the same between college graduates/non-graduates and the full sample. To this end, I use a reweighting method called "residual balancing," which proceeds in two steps:

1. For each of the pre-college covariates Z_j, fit a linear/logit model of Z_j (depending on its type) on parental income rank X, and save its residuals $Z_j^{\perp} = Z_j - \hat{\mathbb{E}}[Z_j|X]$.

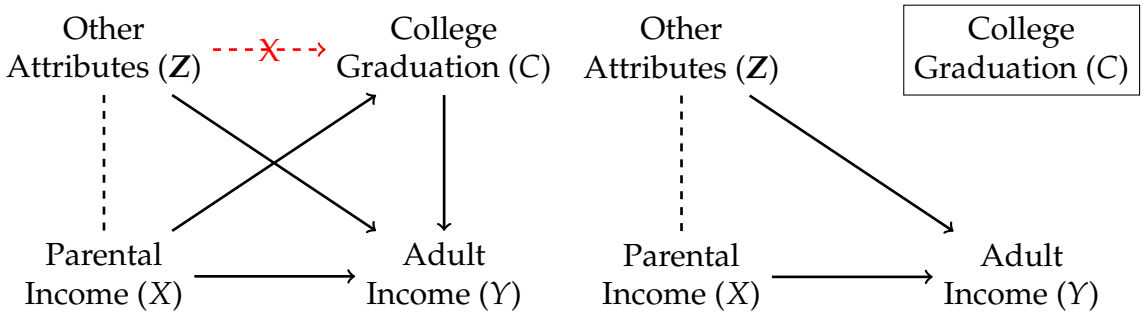

Figure 2: The Logic of Residual Balancing: After Breaking the Link between Covariates $\boldsymbol{Z}$ and College Graduation, Conditioning on College Graduation No Longer Distorts the Associations between Parental Income X and Covariates $\boldsymbol{Z}$.

In practice, we can fit a flexible model by including higher-order or spline terms of X as predictors.

2. Construct a set of weights w_i such that (a) in the reweighted sample, the residuals $Z_j^{\perp}$ are uncorrelated with both college graduation status C and parental income rank X, and (b) the variation of these weights is as small as possible. Specifically, I minimize the Kullback–Leibler divergence between the weights w_i and the NLSY custom weights subject to the constraints described in (a).[8]

The logic of residual balancing is illustrated in Figure 2 (see Supplementary A for an analytical justification). By breaking the link between college graduation (C) and the residualized pre-college covariates ($\boldsymbol{Z}^{\perp}$), we neutralize the causal path from $\boldsymbol{Z}$ to C, thereby avoiding any collider bias associated with conditioning on college graduation. Thus, in the reweighted sample, the associations between parental income rank X and the covariates $\boldsymbol{Z}$ among college graduates/non-graduates will be roughly the same as those in the general population. We can therefore estimate controlled mobility in different educational groups using a weighted regression of adult income rank (Y) on parental income rank (X), college graduation (C), and their interaction term (XC).

To address the selection problem, we could also employ propensity-score-based methods such as inverse probability weighting (IPW) and propensity score matching (PSM) (Supplementary Material B). Compared with these alternatives, the residual balancing method has two major advantages (Zhou and Wodtke 2018). First, whereas both IPW

[8]This is a constrained optimization problem that can be solved via the method of Lagrange multipliers.

and PSM hinge on a correctly specified propensity score model, the residual balancing method does not require a propensity score model and is generally more robust to model misspecification. Second, even with a correctly specified propensity score model, covariate balance is not guaranteed in inverse-probability-weighted or propensity-score-matched samples, which can lead to bias in causal effect estimates. The residual balancing method, by contrast, explicitly constructs a weighted sample in which a set of covariate balancing conditions are automatically satisfied. As a result, it is also more efficient and less susceptible to finite sample bias than propensity-score-based methods.[9]

Nonetheless, the residual balancing method, like many other approaches to covariate adjustment (including IPW and PSM), rests on the assumption that we have measured all of the relevant covariates that may lead to selection bias. In our case, it means that the $\boldsymbol{Z}$ vector includes all of the individual characteristics that affect both college education and adult income. This assumption is strong and unverifiable. In the following analyses, I include in $\boldsymbol{Z}$ a battery of individual characteristics prior to college attendance, such as parental education, family structure, cognitive ability, and educational expectation. Yet, even after all these covariates are adjusted for, college-graduates from low-income families may still be more selected in other, unobserved aspects than their more privileged peers. Given that unobserved selection can bias our estimates of controlled mobility, I also conduct a formal sensitivity analysis that investigates the direction and magnitude of potential bias.

Data and Measures

To analyze intergenerational income mobility, I use data from the 1979 cohort of National Longitudinal Study of Youth (NLSY79). The NLSY79 began with a nationally representative sample of 12,686 young adults at ages 14-22 in 1979. These individuals were interviewed annually through 1994 and biennially thereafter. Compared with other panel surveys (e.g., the PSID), the NLSY's relatively large sample size permits more precise infer-

[9] In this study, I have also implemented IPW- and PSM-based analyses of controlled mobility (Supplementary Material B). The results, shown in Tables B1-B2, are substantively similar to those reported in Table 2.

ence on how mobility varies across educational groups. Moreover, the NLSY79 Geocode data provide identifying information about each college attended by the respondent, thus allowing us to examine if the "equalizing effect" of a college education, if any, varies by institutional characteristics.

I measure origin status by averaging parental family incomes across the earliest five survey waves (1979-1983), which capture income years 1978-1982 when the respondents were 13-21 years old in 1978. I measure destination status by averaging adult family incomes when the respondents were 35-44 years old, an age range during which the respondent's income serves as the best proxy for her lifetime economic standing (Haider and Solon 2006; Mazumder 2005).[10] When the respondents were young and lived in their parents' households, parents provided income reports on a special survey section. However, since many respondents left the parental household upon completing high school, those who continued to live with their parents after age 18 may be a selected sample. Thus I limit my analysis to those respondents who were at most 18 years old in 1979 (step 1, $N = 7,217$).[11] I then restrict the sample to those with nonmissing origin status (step 2, $N = 6,472$) and nonmissing destination status (step 3, $N = 4,993$). Finally, after excluding a small fraction of respondents with missing values of pre-college covariates (see below), my analytic sample consists of 4,673 individuals. I use NLSY79 custom weights to account for differential sample selection and panel attrition.

Family income is defined as the sum of husbands', wives', and other co-residential family members' annual incomes from a variety of sources, including wages and salary, farm and business income, and several government programs such as unemployment compensation. For each survey year, I transform total family income to constant dollars using the personal consumption expenditures index (PCE) and then adjust it for need by dividing by the square root of family size. Finally, using NLSY custom weights, I transform both parental income and adult income into percentile ranks.

[10] A small fraction of respondents have only one observation of parental family income or adult family income, which may cause attenuation bias due to measurement error. In an auxiliary analysis, I exclude respondents with fewer than two observations in either parental family income or adult family income. The results are substantively similar (Supplementary Material E).

[11] Auxiliary analyses that include older respondents yield statistically more precise but substantively similar results (Supplementary Material E).

In this study, I use total family income to measure both origin and destination status. Compared with individual earnings, it is a relatively comprehensive measure of economic wellbeing. However, it is affected by a variety of non-labor-market processes such as assortative mating, joint labor supply decisions among spouses, and government transfers. If the effects of a college degree follow different patterns in the labor and marriage markets, my results may mask important variations across different determinants of family income. For example, if a college degree has a disequalizing effect in family formation (Musick et al. 2012), it may counteract its equalizing effect (if any) in the labor market, depressing income mobility among college graduates. Moreover, if the effect of government transfers is concentrated on non-college graduates from low- and moderate-income families, the inclusion of transfer income may drive up income mobility among non-graduates. Thus, both of these factors tend to reduce the observed college premium in intergenerational income mobility. To see if these processes have a significant impact on my results, I have conducted two sets of sensitivity analyses by restricting income to (a) only core family members' earnings, and (b) only the individual's own earnings. The results, as shown in Supplementary Material F, are highly consistent with those reported below.

Traditionally, mobility researchers have transformed both parental income and adult income with logs and interpreted the regression slope as an intergenerational income elasticity (IGE) (e.g., Solon 1999).[12] As noted earlier, an advantage of the rank-rank slope measure is that it captures intergenerational persistence in a way that is independent of income distribution in either generation. Sociologists have long prioritized understanding patterns of relative mobility when studying class mobility, explicitly conditioning on marginal class distributions (e.g., Breen 2004). To speak to this sociological tradition, I examine the rank-rank slope in my empirical analyses. Similar results on intergenerational income elasticity are reported in Supplementary Material C.

College graduation is coded as a dummy variable indicating whether the respondent had received a bachelor's degree by age 30.[13] Chetty et al. (2017) find that people who

[12]The standard IGE estimand has some conceptual and methodological limitations. See Mitnik and Grusky (2017) for a detailed discussion.

[13]Among people who eventually complete college, age at college completion is correlated with socioeco-

attend elite colleges experience higher economic mobility than those who attend less-selective colleges. To further investigate the equalizing effect of attending a selective college, I construct another dummy variable to indicate college graduates who had ever attended a selective college by age 30.[14] Following Carnevale and Rose (2004), I designate a college as *selective* if it is one of the 393 four-year colleges that constitute the top three tiers of *Barron's Profile of American Colleges 2000*—namely, "most competitive," "highly competitive," and "very competitive" colleges—and *nonselective* otherwise.[15] Among the 4,673 individuals in the analytic sample, 17.3% are college graduates, and 44.7% of them have ever attended selective institutions.[16]

As discussed in the previous section, there may exist some individual attributes other than parental income that affect both educational attainment and adult income. Without accounting for these attributes, the difference in mobility between college graduates and non-graduates may reflect endogenous selection rather than an equalizing (or dis-equalizing) effect of a college degree. While it is practically challenging to observe all relevant individual characteristics that may confound the causal effect of college on inter-

nomic background and other individual characteristics (Bound et al. 2012). In general, students from low-income families are likely to complete college at later ages than their high-income peers, and among low-income college graduates, those who complete early are likely more selected on such individual attributes as ability and motivation than those who complete late. Thus, the choice of the cutoff age for measuring college graduation can affect the compositions of both college graduates and non-graduates. On the one hand, choosing a low cutoff age may select a disproportionately high-ability, high-motivation group among low-income college graduates, and misclassify those who complete college late as non-graduates. On the other hand, choosing a high cutoff age may create a gap between high- and low-income college graduates in age at college completion, thus allowing more time for earnings returns to accrue among high-income college graduates. Reassuringly, the main finding of this study is fairly robust when alternative age cutoffs are used to define college graduates (Supplementary Material G).

[14]Strictly speaking, a college graduate who attended a selective college may hold her bachelor's degree from a different, nonselective institution. Unfortunately, such individuals cannot be identified from the NLSY79 data.

[15]The Barron's selectivity criteria include students' SAT I or composite ACT entrance exam score, high school class rank, average GPA, and the percentage of students accepted. See Carnevale and Rose (2004) for a more detailed description.

[16]Barron's college selectivity data were published in 2000, a time when most of the NLSY79 respondents would have already completed college. Thus, if the degree of selectivity for different colleges changed considerably in the 1990s, the selectivity variable constructed from these data would be a noisy indicator of college selectivity pertaining to college graduates in the NLSY79 sample. In this case, if selective colleges (at the time of college attendance) had an equalizing effect—for example, by helping low-income students gain more human and social capital than high-income students—the measurement error might have attenuated my estimates of this effect. Reassuringly, Barron's college rankings underwent only modest changes over time. Among the 284 colleges in the top three tiers of *Barron's Profile of American Colleges 1986*, 82.7% also appeared in the top three tiers of *Barron's Profile of American Colleges 2000*.

Table 1: Group-specific Means of Parental Income Rank, Adult Income Rank, and All Covariates among Non-College Graduates, Graduates Who Attended Nonselective Colleges, and Graduates Who Attended Selective Colleges.

	Non-College Graduates	Graduates Who Attended Nonselective Colleges	Graduates Who Attended Selective Colleges
Parental Income Rank	0.46	0.63	0.70
Adult Income Rank	0.44	0.69	0.78
Female	0.48	0.51	0.52
Black	0.17	0.10	0.04
Hispanic	0.08	0.02	0.04
Mother's Years of Schooling	11.07	13.01	13.52
Father Presence	0.77	0.84	0.87
Number of Siblings	3.41	2.63	2.47
Urban Residence	0.78	0.76	0.87
Adjusted AFQT Score	0.41	0.72	0.80
Educational Expectation	13.36	15.64	16.19
Sample Size	3863	448	362

Note: All group means are calculated using NLSY custom weights.

generational mobility, the NLSY provides information on a range of baseline covariates on which we can capitalize. In this study, I adjust for the following variables: gender, race, Hispanic status, mother's years of schooling, father's presence, number of siblings, urban residence, educational expectation, the Armed Forces Qualification Test (AFQT) percentile score. Race is coded as a dummy variable indicating black respondents. Educational expectation measures the highest grade the respondent expected to complete (measured in 1979). The AFQT score is a summary measure of cognitive ability that NLSY staff calculated from the Armed Services Vocational Aptitude Battery (ASVAB) tests that were administered in 1980. It is adjusted for age so that the scores are comparable across respondents who were at different ages in 1980.

Table 1 reports group-specific means of parental income rank, adult income rank, and

all baseline covariates among the three educational groups: non-college graduates, college graduates who attended nonselective colleges, and college graduates who attended selective colleges. From the first two rows, we can see that on average, college graduates both come from and end up in more affluent families than non-college graduates. Yet even among college graduates, similar income gaps exist between those who attended selective colleges and others, reflecting horizontal stratification by college selectivity. The following rows indicate systematic differences across the three groups in most of the covariates. For example, among non-college graduates, 17% are black, 8% are Hispanic, and the average percentile of the AFQT score is 41%. By contrast, among college graduates who attended selective institutions, only 4% are black, 4% are Hispanic, and the average percentile of the AFQT score is 80%.

Results

Does a College Degree Promote Mobility?

While Table 1 presents only univariate means of these covariates, their associations with parental income also differ across educational groups. As discussed earlier, conditioning on college graduation will distort the associations between parental income and the covariates away from their levels in the general population. To demonstrate this point, for each of the covariates Z_j, I fit a linear/logit regression of it (depending on the type of Z_j) as a natural cubic spline of parental income rank with three degrees of freedom—for both college graduates and the full sample.[17] Figure 3 shows the fitted values along with their 95% confidence intervals. First of all, we can see that conditional on parental income, several individual characteristics, such as race, father presence, and urban residence, differ little between college graduates and the general population, implying that these covariates have little independent effects (net of parental income) on college completion. However, the conditional distributions of several other covariates are highly imbalanced between college graduates and the general population. At each level of parental

[17]Natural cubic splines are a flexible yet parsimonious tool for modeling nonlinear relationships. See Hastie et al. (2009, p. 144-146)

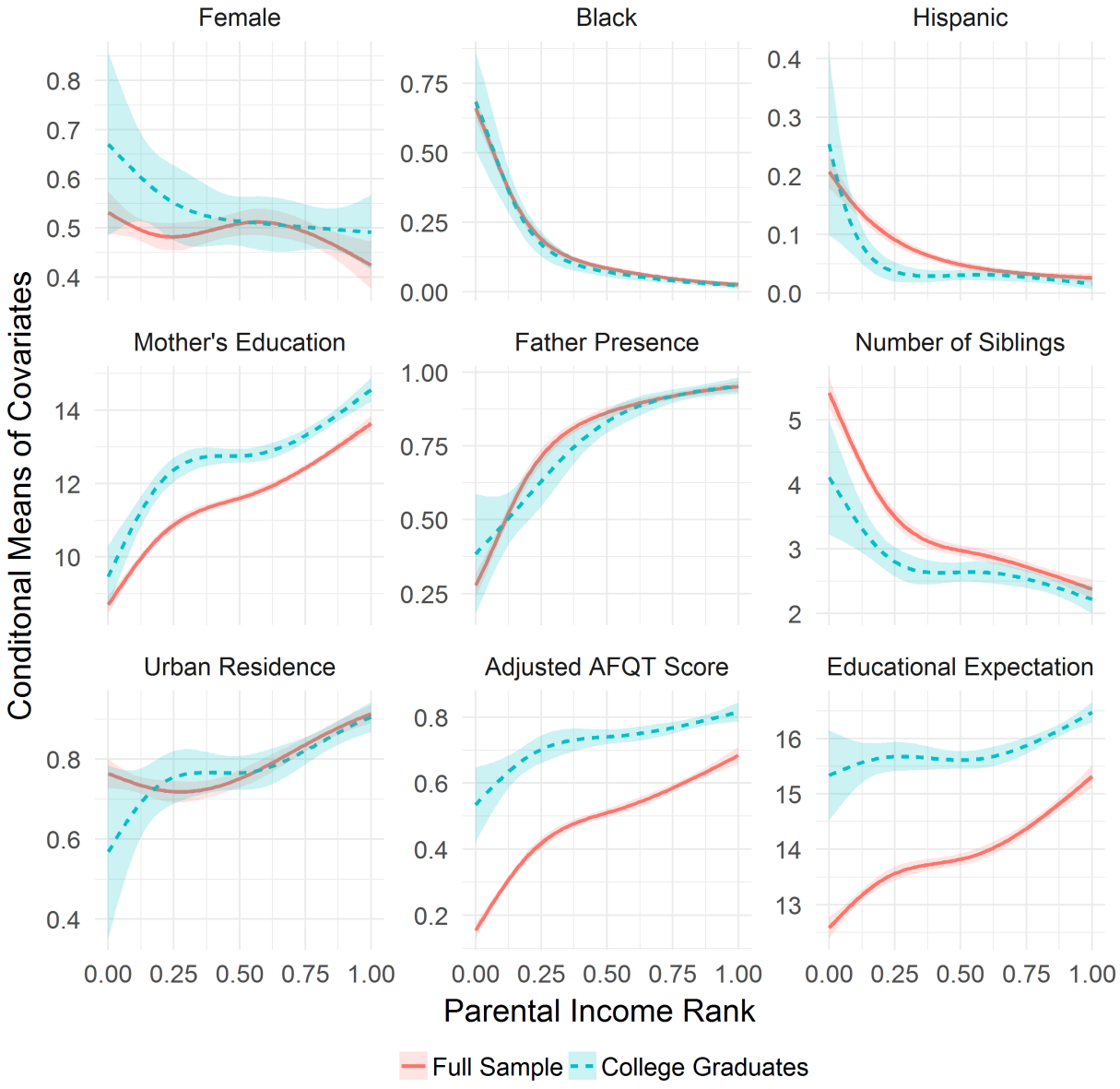

Figure 3: Fitted Conditional Means of Covariates Given Parental Income Rank among the Full Sample and College Graduates, Original Sample.

Note: All conditional means are fitted as a natural cubic spline of parental income rank with three degrees of freedom and adjusted by NLSY custom weights. Ribbons represent 95% asymptotic confidence intervals.

income, college graduates tend to have more educated mothers, better AFQT scores, and higher educational expectations than non-graduates. This result is not surprising given that parental income and these covariates have their independent effects on college graduation. Moreover, from the last two panels, we find that while parental income correlates

strongly with both the AFQT score and educational expectation in the general population, these correlations are substantially weaker among college graduates. Specifically, college graduates from low-income families tend to have much higher AFQT scores and educational expectations than low-income youth in general, whereas the differences are less pronounced among youth from high-income families. It suggests that college graduates from low-income families are more positively selected on cognitive ability and motivation than those from high-income families, for whom the distributions of these attributes are relatively homogeneous. These findings comport with my argument that conditioning on college graduation distorts the association between origin status and other predictors of educational attainment.

To adjust for such distortions, I apply the residual balancing method as described earlier. In the first step, for each of the covariates, I fit a linear/logit regression of it as a natural cubic spline of parental income rank with three degrees of freedom. In the second step, I construct a set of weights that are as close as possible to the original NLSY weights (by the Kullback–Leibler divergence metric) but subject to the constraint that in the reweighted sample, the residualized covariates are uncorrelated with both parental income rank and the dummy variable for college graduation. In the newly weighted data, the conditional distributions of the covariates given parental income are roughly balanced between college graduates and non-graduates. This is reflected in Figure 4, which shows the fitted values of each of the covariates as a function of parental income rank in the reweighted sample. Intuitively, the reweighted sample represents a "pseudo-population" in which, at each level of parental income, college graduates are no different from non-graduates in any of the nine pre-college characteristics. That is, given parental income, these characteristics no longer predict college graduation, thus no longer confounding the causal effect (if any) of college graduation on intergenerational income mobility. Thus, to the extent that these nine covariates capture most (if not all) of the confounders, any remaining difference between college graduates and non-graduates in intergenerational income mobility likely reflects a genuine effect of a bachelor's degree.

To examine the extent to which a college degree promotes mobility, I fit a linear model of adult income rank on parental income rank, college graduation, and their interaction

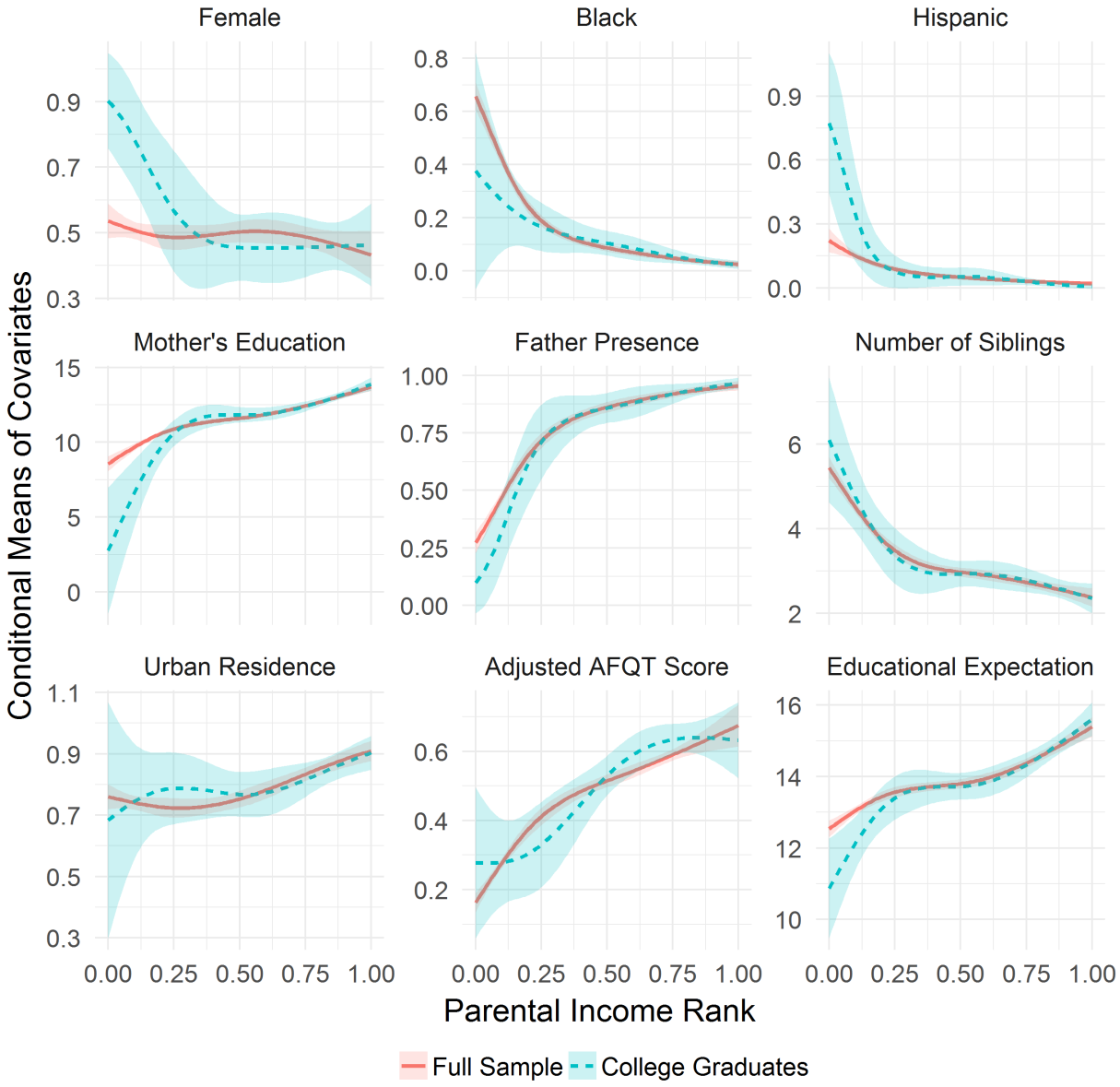

Figure 4: Fitted Conditional Means of Covariates Given Parental Income Rank among the Full Sample and College Graduates, Reweighted Sample.

Note: All conditional means are fitted as a natural cubic spline of parental income rank with three degrees of freedom and adjusted by residual-balancing weights. Ribbons represent 95% asymptotic confidence intervals.

both for the original sample and for the reweighted sample. While the former captures conditional mobility, the latter captures controlled mobility. The results are shown in the first two columns of Table 2. We find that before reweighting, the rank-rank slope is 0.312 among non-college graduates but only 0.171 (0.312-0.141) among college graduates. This

Table 2: Estimates of Intergenerational Rank-Rank Slope by College Completion

	Full Sample		Men		Women	
	Conditional Mobility	Controlled Mobility	Conditional Mobility	Controlled Mobility	Conditional Mobility	Controlled Mobility
Intercept	0.297***	0.306***	0.315***	0.323***	0.279***	0.289***
	(0.009)	(0.009)	(0.012)	(0.013)	(0.012)	(0.013)
Parental Income Rank	0.312***	0.328***	0.306***	0.326***	0.315***	0.330***
	(0.017)	(0.019)	(0.023)	(0.026)	(0.024)	(0.026)
College Degree	0.323***	0.136†	0.342***	0.192**	0.311***	0.122
	(0.024)	(0.070)	(0.034)	(0.060)	(0.033)	(0.090)
Parental Income Rank * College Degree	-0.141***	0.004	-0.157**	-0.028	-0.131**	0.000
	(0.036)	(0.090)	(0.050)	(0.078)	(0.050)	(0.116)
Sample Size	4,673		2,370		2,303	

Note: †p<.1, *p<.05, **p<.01, ***p<.001 (two-tailed tests). Numbers in parentheses are heteroskedasticity-consistent robust standard errors.

finding is consistent with previous studies showing that conditional mobility is much higher among college graduates than those with lower levels of education. However, after reweighting, the interaction effect of parental income and college graduation is substantially reduced and no longer statistically significant. In fact, the point estimates of controlled mobility are roughly the same between college graduates and non-graduates. The rank-rank slope is 0.328 among non-graduates and 0.332 (0.328+0.004) among college graduates. To explore potential gender differences, I have conducted the same analyses separately for men and for women. The results, as shown in the next four columns of Table 2, are remarkably similar across the gender line.

Figure 5 plots the rank-rank regression line separately for college graduates (dashed lines) and for non-graduates (solid lines). The left panel shows that before reweighting, a bachelor's degree exhibits a strong "leveling" effect, as reflected in the much flatter slope among college graduates. However, after selection processes are adjusted away, the rank-rank regression line among college graduates is almost parallel to that among non-graduates. In other words, while a college degree boosts economic standing for everyone,

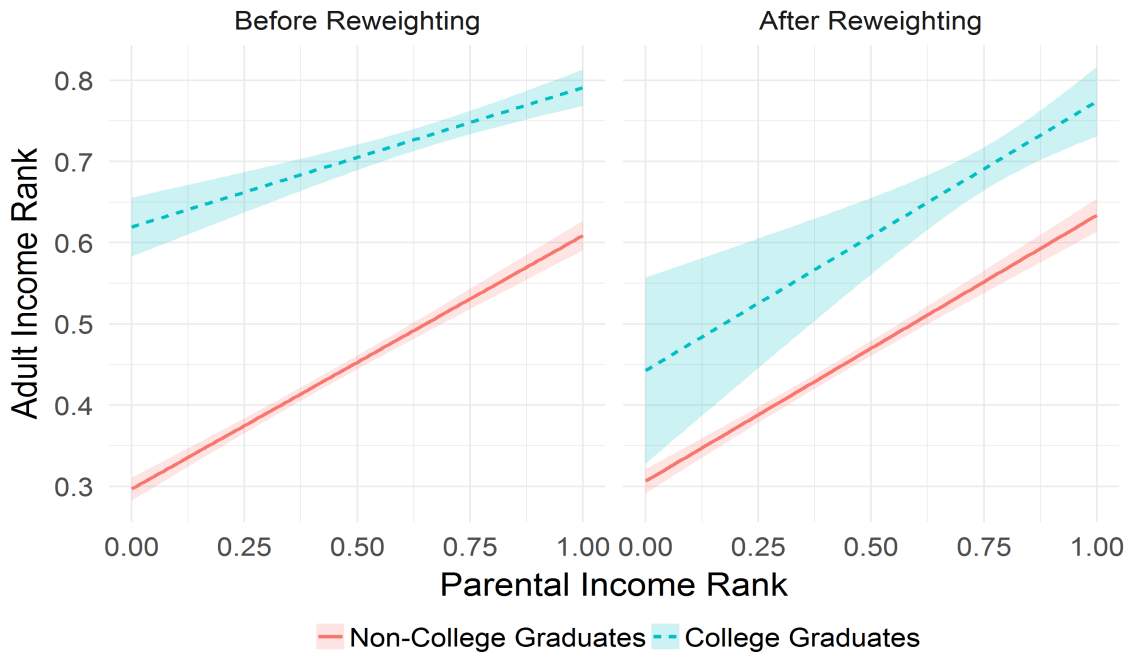

Figure 5: Rank-Rank Slopes among Non-College Graduates and College Graduates, Before and After Reweighting.
Note: Ribbons represent 95% asymptotic confidence intervals.

it does not erase—or even reduce—the influence of parental income.

In Table 2, the estimated interaction effects of parental income and college graduation are very close to zero. It should be noted, however, that these estimates are accompanied with fairly large standard errors. This is because the newly constructed weights are highly variable across units, thus reducing the effective size of the sample. Taking estimation uncertainty into account, it would be imprudent to conclude that college completion has exactly zero (equalizing or disequalizing) effect on intergenerational income mobility. Yet, the large difference between our estimates of conditional mobility and controlled mobility still suggests that selection, rather than equalization, is the main driver of the high mobility observed among college graduates. This finding is robust when IPW or propensity score matching is used to adjust for selection (Supplementary Tables B1-B2) or when IGE is used to measure intergenerational income mobility (Supplementary Table C1). It is also robust under alternative sample restriction criteria (Supplementary Tables E1-E2), alternative definitions of income (Supplementary Tables F1-F2), and alternative

age cutoffs for defining college graduates (Supplementary Tables G1-G2).

Does College Selectivity Matter?

Our earlier discussion suggests that one of the mechanisms that may have caused the persistent influence of parental background is horizontal stratification within the post-secondary system. Thanks to their academic, financial, and informational advantages, students from high-income families are far more likely to apply to, enroll in, and graduate from selective colleges than their low- and moderate-income peers. To the extent that graduates from selective colleges enjoy a premium in the labor and marriage markets, institutional selectivity likely mediates the intergenerational reproduction process. But is this the only mediating mechanism? If so, we would imagine a level playing field among graduates who have attended the same college or colleges of the same tier. In a recent study, Chetty et al. (2017) find that among those who have attended the same college, low-income students end up earning about as much in adulthood as their high-income peers. Nonetheless, as with most previous studies, Chetty et al.'s analyses do not adjust for potential selection processes that may have driven up observed mobility among college graduates, and, as they acknowledge, "[m]uch of the difference in outcomes we observe across colleges is presumably due to endogenous selection of students into colleges rather than treatment effects" (p. 5). Fortunately, the residual balancing method allows us to adjust for selection processes that are driven by observed covariates. Below, I employ the dichotomous measure of institutional selectivity defined earlier to assess whether and to what extent selective and nonselective colleges promote intergenerational mobility.

With the distinction between selective and nonselective colleges, education is now coded as a trichotomous variable. The implementation of residual balancing is the same as before except that the weights are now subject to the constraint that in the reweighted data, the residualized covariates are balanced not only between college graduates and non-graduates but also between college graduates who attended different types of colleges. After reweighting, the conditional distributions of the covariates given parental income are highly balanced across the three educational groups (shown in Supplementary Figures D1-D2). Then, I fit a rank-rank regression with interactions between parental

Table 3: Estimates of Intergenerational Rank-Rank Slope by College Selectivity

	Full Sample		Men		Women	
	Conditional Mobility	Controlled Mobility	Conditional Mobility	Controlled Mobility	Conditional Mobility	Controlled Mobility
Intercept	0.297***	0.312***	0.315***	0.323***	0.279***	0.288***
	(0.009)	(0.010)	(0.012)	(0.013)	(0.012)	(0.013)
Parental Income Rank	0.312***	0.316***	0.306***	0.326***	0.315***	0.331***
	(0.017)	(0.019)	(0.023)	(0.026)	(0.024)	(0.026)
Nonselective College	0.294***	0.147*	0.301***	0.192**	0.295***	0.104
	(0.030)	(0.060)	(0.045)	(0.067)	(0.040)	(0.096)
Selective College	0.382***	0.255*	0.415***	0.318**	0.348***	0.233†
	(0.036)	(0.116)	(0.045)	(0.109)	(0.053)	(0.126)
Parental Income Rank * Nonselective College	-0.148**	0.000	-0.174*	-0.055	-0.129*	0.046
	(0.047)	(0.079)	(0.070)	(0.091)	(0.064)	(0.132)
Parental Income Rank * Selective College	-0.173***	-0.149	-0.176**	-0.183	-0.161*	-0.169
	(0.049)	(0.145)	(0.060)	(0.141)	(0.073)	(0.154)
Sample Size	4,673		2,370		2,303	

Note: †p<.1, *p<.05, **p<.01, ***p<.001 (two-tailed tests). Numbers in parentheses are heteroskedasticity-consistent robust standard errors.

income rank and college selectivity both for the original sample and for the reweighted sample. The results are shown in Table 3. From the first column, we can see that conditional mobility is much higher among college graduates than non-graduates regardless of institutional selectivity, as reflected in the strong and significant interaction effects between parental income and both types of colleges. This college premium is also shown in the left panel of Figure 6, which plots the rank-rank regression line for each of the educational groups (along with confidence bands). The second column shows that once we reweight the sample to account for selection processes, the estimated interaction effect for nonselective colleges is much smaller and no longer statistically significant. By contrast, the estimated interaction effect for selective colleges is almost as large as that in the original sample. But due to its large standard error, it is not statistically significant either. The

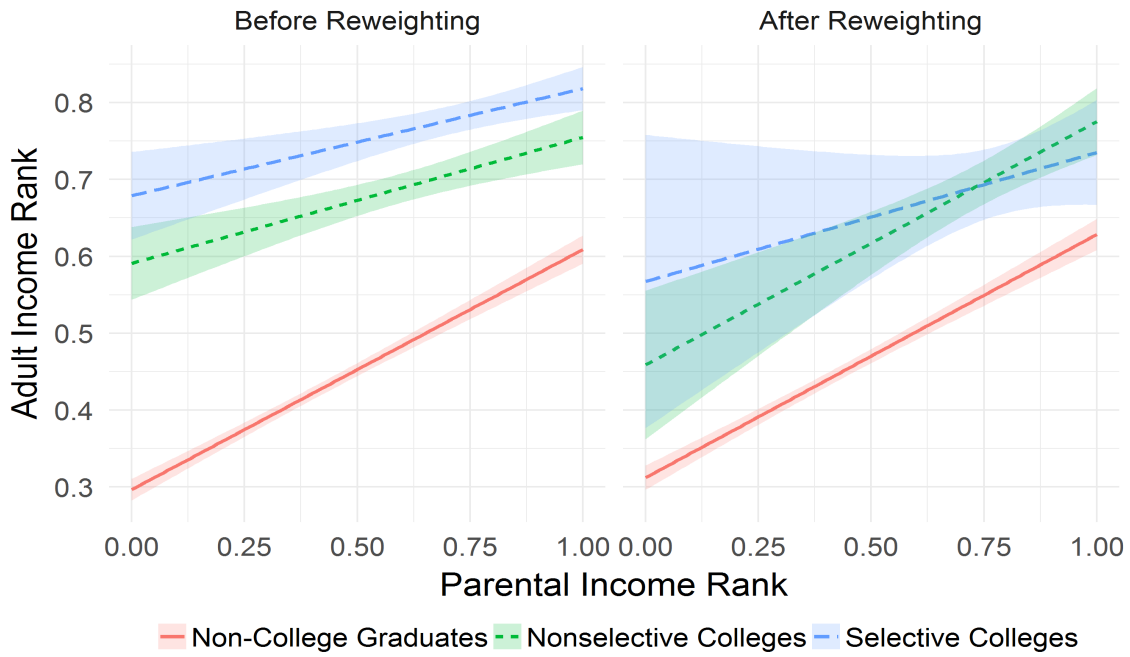

Figure 6: Rank-Rank Slopes among Non-College Graduates, College Graduates from Nonselective Colleges, and College Graduates Who Attended Selective Colleges, Before and After Reweighting.

Note: Ribbons represent 95% asymptotic confidence intervals.

lack of statistical significance, however, does not mean a zero equalizing effect of selective colleges. In fact, the point estimates suggest that absent selection processes, the rank-rank slope would be 0.316 among non-college graduates, 0.316 (0.316-0.000) among graduates who attended nonselective colleges, but only 0.167 (0.316-0.149) among graduates who attended selective colleges (see also Figure 6). Gender-specific results, shown in the next four columns of Table 3, are similar to those based on the full sample.

In sum, the above analyses suggest that the equalizing effects of nonselective colleges would be greatly overestimated without adjusting for selection. Compared with non-college graduates, the relatively high mobility among graduates from nonselective colleges is most likely a result of the selection of high-ability, high-motivation students from low- and moderate-income families into this group. Attending a selective college, on the other hand, appears to have a strong equalizing effect. Nonetheless, estimation uncertainty prevents us from reaching a definitive conclusion about the effect of selective

colleges.

The Role of Graduate Education: A Robustness Check

The above findings suggest that the reproduction of inequality among college graduates is partly but not exclusively mediated by college selectivity. Another dimension of horizontal stratification within the postsecondary system is graduate education. First, given their financial and academic advantages, college graduates from affluent families may be more likely than their less advantaged peers to pursue advanced degrees in the first place. To the extent that an advanced degree brings a premium in the labor and marriage markets, unequal access to graduate education may have perpetuated intergenerational transmission of (dis)advantages. Second, even among advanced degree holders, those from privileged backgrounds are more likely to have attended selective institutions and attained lucrative degrees in business, law, and medicine. Such disparities within graduate education, combined with class-based discrimination in elite labor markets (e.g., Rivera 2015; Rivera and Tilcsik 2016), may have caused a "reemergence" of parental influence among advanced degree holders (Torche 2011). To the extent that a graduate degree depresses mobility, the equalizing effect of a bachelor's degree (if any) may have been diluted by the presence of graduate degree holders in our previous analyses.[18]

To assess the degree to which my results are driven by unequal access to and horizontal stratification within graduate education, I now exclude respondents who had received a graduate degree (master's degree/doctoral degree/professional degree) by age 30 and rerun the previous analyses (including the reweighting step). By doing so, we are able to separate the effects of a terminal BA degree from the compounding effects of graduate education. The results, as shown in Table 4, are substantively similar to those in Table 2. While conditional mobility is always significantly higher among college graduates than non-graduates, controlled mobility is much less distinguishable, both substantively and statistically, across educational groups. Thus, income disparities in graduate education

[18]Given the small number of graduate degree holders (169 individuals) in our analytic sample, we do not have the statistical power to evaluate Torche's thesis that a graduate degree depresses mobility (compared with a terminal BA degree).

Table 4: Estimates of Intergenerational Rank-Rank Slope by College Completion, Graduate Degree Holders Excluded

	Full Sample		Men		Women	
	Conditional Mobility	Controlled Mobility	Conditional Mobility	Controlled Mobility	Conditional Mobility	Controlled Mobility
Intercept	0.297***	0.305***	0.315***	0.321***	0.279***	0.289***
	(0.009)	(0.009)	(0.012)	(0.012)	(0.012)	(0.013)
Parental Income Rank	0.312***	0.323***	0.306***	0.323***	0.315***	0.323***
	(0.017)	(0.018)	(0.023)	(0.025)	(0.024)	(0.026)
College Degree	0.309***	0.104	0.352***	0.221***	0.283***	0.065
	(0.026)	(0.076)	(0.038)	(0.063)	(0.036)	(0.091)
Parental Income Rank * College Degree	-0.141***	0.063	-0.191***	-0.056	-0.110*	0.087
	(0.04)	(0.095)	(0.057)	(0.082)	(0.055)	(0.116)
Sample Size	4,504		2,282		2,222	

Note: †p<.1, *p<.05, **p<.01, ***p<.001 (two-tailed tests). Numbers in parentheses are heteroskedasticity-consistent robust standard errors.

cannot explain away the persistent influence of parental income among BA holders.

A Sensitivity Analysis on Unobserved Selection

As noted earlier, our estimation of controlled mobility rests on the assumption that we have adjusted for all covariates that may lead to selection bias. Although our covariate set includes a variety of background characteristics, there may still be some unobserved individual attributes, such as personality and social skills, that affect both college graduation and adult income. To the extent that low-income college graduates may be more selected on these attributes than their high-income peers, our estimates of controlled mobility could be biased. Below, I conduct a sensitivity analysis to explore the direction and magnitude of potential bias.

For the sake of simplicity, let us consider a single unobserved variable U, say social skill, that affects both college graduation C and adult income rank Y. In the reweighted sample where all observed covariates are adjusted for, the association between parental

Table 5: A Sensitivity Analysis for the Interaction Effect between Parental Income Rank and College Graduation on Adult Income Rank.

	θ_3	γ	$\theta_3\gamma$ (Bias)	Adjusted Estimate of β_3
No unobserved selection			0	0.004
When selection in U is as strong as selection in				
Female	-0.034	-0.050	0.002	0.002
Black	0.238	-0.075	-0.018	0.022
Hispanic	0.109	-0.023	-0.002	0.006
Mother's Years of Schooling	-0.422	0.005	-0.002	0.006
Father Presence	-0.142	0.019	-0.003	0.006
Number of Siblings	1.540	-0.009	-0.014	0.017
Urban Residence	0.038	-0.002	0.000	0.004
Adjusted AFQT Score	-0.184	0.245	-0.045	0.049
Educational Expectation	-0.229	0.022	-0.005	0.009

Note: U denotes an unobserved confounder that affects both college graduation and adult income rank. The sensitivity analysis is based on a confounder model $\mathbb{E}[U|X = x, C = c] = \theta_0 + \theta_1 x + \theta_2 c + \theta_3 xc$ and an outcome model $\mathbb{E}[Y|X = x, C = c, U = u] = \beta_0 + \beta_1 x + \beta_2 c + \beta_3 xc + \gamma u$ for a pseudo-population where all observed covariates are already adjusted for. Y denotes adult income rank, X denotes parental income rank, and C denotes college graduation.

income rank X and social skill U could still be different between college graduates and non-graduates. This difference can be represented in the following model for the conditional mean of U given X and C (in the reweighted sample):

$$\mathbb{E}[U|X, C] = \theta_0 + \theta_1 X + \theta_2 C + \theta_3 XC. \tag{5}$$

For example, if low-income college graduates are more positively selected on social skill than their high-income peers, the association between parental income rank X and social skill U will likely be weaker among college graduates than among non-graduates, implying $\theta_3 < 0$. In addition, let us assume that social skill has an additive and positive effect

on adult income rank Y:

$$\mathbb{E}[Y|X, C, U] = \beta_0 + \beta_1 X + \beta_2 C + \beta_3 XC + \gamma U, \tag{6}$$

where $\gamma > 0$ and the expectation, again, is taken for the reweighted sample. Here, β_3 reflects the equalizing effect of a college degree on intergenerational mobility. A negative β_3 means that controlled mobility is stronger among college graduates than among non-graduates. However, since U is unobserved, our estimate of β_3 is obtained from the following model:

$$\begin{aligned}\mathbb{E}[Y|X, C] &= \beta_0 + \beta_1 X + \beta_2 C + \beta_3 XC + \gamma \mathbb{E}[U|X, C] \\ &= (\beta_0 + \gamma\theta_0) + (\beta_1 + \gamma\theta_1)X + (\beta_2 + \gamma\theta_2)C + (\beta_3 + \gamma\theta_3)XC. \end{aligned} \tag{7}$$

Thus if $\theta_3 < 0$ and $\gamma > 0$ (or vice versa), our estimate of β_3 will be downwardly biased (more negative than it should be). In other words, if selection is under-adjusted for, the equalization effect of college will likely be overestimated.

In reality, we know neither the signs nor the magnitudes of θ_3 and γ. To avoid ad hoc speculation, let us consider a U that has the same selection effect as one of our observed covariates and calculate the associated bias. Specifically, for each of the nine covariates that we have adjusted for, we can estimate its θ_3 by fitting model (5) in the original sample, and estimate its γ by fitting model (6) in the reweighted sample. The product of these estimates would mimic the potential bias associated with a U that "worked exactly like" this observed covariate. The results are shown in Table 5. The first row replicates our estimate of β_3 for the full sample (Table 2, column 2), and the following rows report what the bias and the bias-adjusted estimate of β_3 would be if selection in U was as strong as selection in each of the observed covariates. We can see that if U operated like most of the observed covariates, the associated bias for β_3 would be very small. The largest selection bias would occur if the selection effect of U was as strong as that of the adjusted AFQT score. In this case, our estimated bias would be -0.045 and the bias-adjusted estimate of β_3 would be 0.049, corresponding to a *disequalizing* effect of college completion.

Conclusion and Discussion

Three decades have passed since Hout's (1988) discovery that intergenerational mobility is higher among college graduates than among people with lower levels of education. In light of this finding, many researchers have portrayed a college degree as "the great equalizer" that levels the playing field, and hypothesized that an expansion in postsecondary education could promote mobility because more people would benefit from the high mobility experienced by college graduates. Yet, this line of reasoning rests on the implicit assumption that the "college premium" in intergenerational mobility reflects a genuine "meritocratic" effect of postsecondary education, an assumption that has rarely, if ever, been rigorously tested. In fact, to the extent that college graduates from low- and moderate-income families are more selected on such individual attributes as ability and motivation than those from high-income families, the high mobility observed among bachelor's degree holders may simply reflect varying degrees of selectivity of college graduates from different family backgrounds.

This study represents my attempt to distinguish the equalization and selection effects of college. First, I formalized the selection process using the language of DAGs, and defined two measures of intergenerational mobility—conditional mobility and controlled mobility—for college graduates. While conditional mobility reflects what we observe among actual college graduates, controlled mobility reflects what we would observe if, given parental income, college graduation did not depend on other predictors of adult family income. By fixing the associations between parental income and a range of pre-college individual characteristics at their baseline levels in the general population, controlled mobility disentangles the causal effect of college from selection processes, thus directly informing the degree to which we can promote mobility by expanding the pool of college graduates. Then, I employed a novel reweighting method, called "residual balancing," to estimate controlled mobility empirically. Using the NLSY79 data, I examined the equalization effects of both college completion in general and selective/nonselective colleges in particular. Results show that while conditional mobility is substantially higher among college graduates than non-graduates, controlled mobility differs little between

the two groups. When we break down college graduates into those who attended selective institutions and those who did not, we find little evidence for an equalizing effect of nonselective colleges. Selective colleges, on the other hand, exhibit a substantively large, yet statistically insignificant, equalizing effect. Overall, our findings suggest that the "college premium" in intergenerational income mobility is largely driven by selection processes rather than an equalizing effect of a baccalaureate degree.

Why does a college degree fall short of its perceived goal of equalizing opportunities? The theory of "effectively maintained inequality" (Lucas 2001), although originally proposed to explain inequality in secondary education, may illuminate some processes at work. It suggests that for any educational outcome, including a bachelor's degree, the socioeconomically advantaged will always "seek out whatever qualitative differences there are at that level and use their advantages to secure quantitatively similar but qualitatively better education" (p. 1652). It is worth noting that family income—our measure of social origin—reflects not only the amount of financial resources a college student can draw on, but also shapes the formation of human, social, and cultural capital well before college attendance (Coleman 1988). As shown in Figure 3, family income correlates strongly not only with other ascribed characteristics such as race, ethnicity, mother's education, and family structure, but also with achieved characteristics such as cognitive ability and educational expectations. It is the combination of these origin-based differences that perpetuate and reproduce inequality—by shaping the type of postsecondary institutions attended, the degree of engagement in the college extracurriculum, the level of parental economic support after graduation, and patterns of marital formation and partner choice. As a result, the overall influence of parental income stays unabated among college graduates, despite the appearance of high (conditional) mobility in this subpopulation.

The significance of this study is far beyond satisfying our theoretical curiosity. It has immense policy implications. The finding that economic origin exerts a lasting influence beyond the attainment of a college degree implies that a mechanical (non-preferential) expansion of higher education—for example, by supporting more for-profit colleges—would not be an effective tool for promoting mobility (Horowitz 2018).[19] Rather, college ex-

[19]See Supplementary Material H for a simulation study demonstrating this point.

pansion would be effective only if it could simultaneously narrow income-based gaps in the quantity and quality of higher education. The reduction of educational inequality, however, is neither guaranteed by nor predicated upon an expansion of postsecondary education (Breen and Jonsson 2005; Shavit and Blossfeld 1993). In fact, despite a large increase in college enrollment over the past few decades, income-based gaps in college completion rates have actually grown in the US (Bailey and Dynarski 2011). Even among those who complete college, the institutions they attended have become highly stratified by socioeconomic background. While elite private colleges are competing for students of the highest SAT scores—which would help them move up in prestige rankings such as those in the *US News & World Report*, flagship public universities are giving priorities to wealthy out-of-state and international students who will pay full tuition—which would help balance their budget in the context of declining state support (Armstrong and Hamilton 2013). By contrast, students from disadvantaged backgrounds are increasingly channeled into the for-profit sector (Gelbgiser 2018), from which a bachelor's degree tends to have limited returns (Mettler 2014). Without a reversal of these trends, expanding the pool of college graduates per se is unlikely to boost intergenerational mobility.

So, in what direction should we go? While this is not a place to offer precise policy prescriptions, two considerations are in order. First, to reduce the direct influence of parental income on the quantity and quality of higher education, more financial aid should be targeted on low-income students through federal grants, state appropriations, and a redirection from merit-based scholarships to need-based assistance by individual colleges. As Haveman and Smeeding (2006) suggest, public universities may even consider raising tuition to reflect the real costs of higher education and use added revenues to provide direct support to students from low- and moderate-income families. With more generous financial aid, low-income college students would have less need for paid employment and thus devote more time and energy to coursework, summer internships, and other rewarding extracurricular activities. Moreover, as Armstrong and Hamilton (2013) suggest, individual colleges may consider restructuring the campus life of their students by, for example, dismantling the Greek system that tends to perpetuate class-based inequalities. Of course, many of these reforms could be politically difficult to implement in today's

America.

From another perspective, a large part of parental influence on both educational and labor market outcomes tends to be indirect, through the development of cognitive and non-cognitive skills well before college attendance, as shown in the strong associations of parental income with measures of cognitive ability and educational aspiration (see Figure 3). Origin-based disparities in skills, in turn, translate into origin-based disparities in education, employment, and income, sustaining the so-called "inherited meritocracy." In this regard, a more productive (and perhaps politically less contested) approach to promoting mobility would be to reduce income-based disparities in skill formation from early childhood through high school graduation (Heckman 2013). Recent research shows that early childhood interventions designed to enhance both cognitive and non-cognitive skills, such as the Perry Preschool Program, yield much larger social and economic returns for children from disadvantaged families than later interventions (Heckman et al. 2010). Further progress in this direction calls for a concerted effort among families, neighborhoods, and state and local governments.

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