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Ties that bind? Family income dynamics and children's post-secondary enrollment and persistence

Bradley L. Hardy[1] · Dave E. Marcotte[1]

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Abstract
We examine the relationship between family income dynamics—poverty, low permanent income, and income volatility—and high school graduation, college enrollment, and dropout among young adults using the Transition to Adulthood supplement of the Panel Study of Income Dynamics. Our intent is to shed light on potential mechanisms driving the transmission of intergenerational advantage to help understand whether and how such income dynamics have played a role in the persistent gap in college achievement. We find that poverty and income volatility during adolescence is related to near term educational outcomes of high school completion and college enrollment. Some of this relationship is mediated by household instability coinciding with poverty. It also apparent that the timing of poverty spells during adolescence is vital. Poverty occurring close to the end of high school drives has relatively large deleterious effects on educational attainment.

Keywords Poverty · Educational attainment · Income volatility · Adolescence · Post-secondary education

1 Introduction

Children from low-income families are not only less likely to enroll in college, those who do are the least likely to persist and earn a degree. Recent estimates show that fewer than a third of children from families in the lowest income quintile who start college persist to earn a degree, compared to more than two-thirds of their peers in the highest quintile (Bailey and Dynarski 2012; Haskins et al. 2009). One potential mechanism for these differences in college enrollment and persistence rates is the economic volatility experienced by low-income families, which can affect investments in children (Hardy et al. 2019). In this paper, we study the impact of time spent

✉ Dave E. Marcotte
marcotte@american.edu

1 Department of Public Administration and Policy, American University, Washington, DC, USA

in poverty and family income volatility during adolescence on limiting children's access to post-secondary education. To the extent that such income dynamics occur throughout middle and high school, they could operate as important mechanisms in limiting upward mobility for those who need it most.

Our work is related to a broader literature on college enrollment and persistence. This includes research on the rapidly rising cost of college and its effects on enrollment decisions, college retention, and dropout rates (e.g. Hemelt and Marcotte 2011, 2016). While federal financial aid is the primary buffer against these costs for price-sensitive students, the provision of aid is complex and often difficult for families to negotiate (Dynarski and Scott-Clayton 2008, 2013). This may be an especially complex problem for children of families in poverty. The economic and family instability that is inherent in poverty spells may be an important barrier to college matriculation and completion—and upward economic mobility—for students from low-income families. Combined with other challenges facing children at the family, neighborhood, and school level, this further raises the possibility that education is potentially reinforcing rather than ameliorating inequality across generations, a point that has received a fair amount of attention (e.g. Andrews and Stange 2019; Duncan and Murnane 2014; Fischer 2016).

Our study provides insight into the factors that shape college attendance decisions among students who have experienced spells in poverty during adolescence. To do so, we study the role of family income dynamics during secondary school on high school graduation, college enrollment, and college persistence (2-year dropout). Specifically, we examine the relationship between these outcomes and exposure to (1) poverty over multiple years during adolescence, (2) low average or "permanent" income over these same years, and (3) volatility in family income. We believe our paper contributes to a broader understanding of the capacity and limits of higher education as a means to disrupt the inter-generational transmission of poverty, by including poverty spells and family income volatility during adolescence as a potential factor shaping of post-secondary decisions and success. As opposed to income level at a point in time, these income dynamics are an under-appreciated determinant of social opportunity.

We know that families with low incomes also have the least predictable incomes (Hardy and Ziliak 2014; Hardy 2017), and the decision to invest in college can be substantially complicated by low income and income volatility. As a result, children from low-income families could face a double burden: family support that is low on average, and less reliable. This could have a range of negative impacts during middle school and high school, including reduced engagement in academic activities (Gennetian et al. 2015), degrading the capacity to graduate high school and the decision to both enroll and persist in college. Concurrent with issues of student engagement and aptitude, the incidence of poverty, low income, and income volatility could make it more difficult for a family to plan for college (e.g. Mullainathan and Shafir 2013). Among students enrolled in college, family income dynamics can affect persistence. For example, students may feel pressured to supplement family income during transitory declines in income. On the other hand, transitory windfalls can simultaneously increase potential financial support, but also negatively affect financial aid eligibility and awards.

In this paper, we make use of data from the Panel Study of Income Dynamics (PSID) and the PSID Transition to Adulthood supplement (PSID-TA) supplement to study the experiences of young adults as they finish high school and transition into the labor force and/or post-secondary education. We find that poverty, low-income, and intertemporal volatility in family income during adolescence is followed by poorer post-secondary access and persistence, even conditioning on high school achievement, race, gender and other factors. Notably, students who matriculate to community colleges are less likely to graduate than comparable peers with similar academic profiles who enroll in four-year schools. This may reflect family commitment or social barriers that directed them to community college in the first place. Wealth positively predicts attendance and matriculation, though less so than other factors like lower income, poverty, and both family and residential stability (e.g. Addo et al. 2016).

This study provides the first evidence of the role of income instability and spells in poverty on post-secondary outcomes for young persons finishing high school in the past two decades. These results are relevant to a number of policy debates and audiences. First, understanding the importance of economic deprivation and instability within the family during a child's "launch" into adulthood can help in developing a fuller picture of the potential mechanisms of the transmission of intergenerational advantage and disadvantage. Second, our results suggest that repeated and recent exposure to poverty and low income, as well as family income volatility, may play a role in the disappointing and persistent gap in college matriculation and completion rates between high and low-income students.

Moving forward, the experience of young adults starting college provides a good opportunity to consider and evaluate the extent to which Pell Grants, federally subsidized student loans, and related subsidies serve to ensure access to higher education among students from vulnerable financial backgrounds, or whether such interventions occur too late. This is especially true for the timing of our analysis, given that students are facing this decision point roughly around the time of the Great Recession. Pell grants are the most important federal need-based financial aid program. So, understanding the ability or limits of Pell and related programs to provide affordable access to college is a policy evaluation question of real importance. Relatedly, future work can provide additional evidence on the role of a college's institutional features, including measures of academic selectivity and affordability.

2 Background

Concerns about the rising costs of higher education are ubiquitous in the United States. A number of studies have documented both the extent and origins of this run-up in costs (Bailey and Dynarski 2012; Ehrenberg 2002). Other studies have assessed the extent to which these increases have played a role in the decline in college completion rates over the past several decades (Bound et al. 2010). This is a special concern for low-income families, who have experienced a relative increase in the rate of college matriculation over the late 20th century compared to the rates of students from higher SES families, for whom college access has long been assured.

Over the past two or three decades, however, the growing equality in college attendance has been accompanied by a divergence in rates of college completion (Oreopoulos and Petronijevic 2013). This growing inequality in college completion cannot be explained by differences in student ability (Bound et al. 2010). Accordingly, a number of recent studies have explored institutional and other situational determinants that may have affected the ability of students from low-income families to succeed in college. Family income, poverty, and wealth *levels* endure as important predictors of college persistence and socioeconomic outcomes more generally (e.g. Belley and Lochner 2007; Cameron and Heckman 2001; Dahl and Lochner 2012; Duncan et al. 2011; Haider & McGarry; Haskins et al. 2009; Meghir and Palme 2005; Mullainathan and Shafir 2013; Pfeffer 2018).

For example, the low income associated with poverty could limit academic performance, therefore precluding college attendance for many otherwise capable young adults (e.g. Ladd 2012; Rothstein and Wozny 2013). Poverty and low wealth are also often bundled with other forms of family and neighborhood instability—factors that enter negatively into an individual's human capital production function and therefore likely reduce high school graduation and college persistence (e.g. Carneiro and Heckman 2002). The presence of borrowing constraints may impact persistence in a way distinct from the enrollment decision—perhaps through greater reliance on employment while enrolled (Keane and Wolpin 2001).

We know far less about the importance of poverty spells and income volatility—*changes* in economic resources—as mechanisms driving young adult educational attainment. Students facing poverty and income volatility may face credit constraints and suffer disproportionately from information deficiencies related to financial aid throughout adolescence, the peak of the college-going process (e.g. Belley and Lochner 2007; Kane and Ellwood 2000; Lochner and Monge-Naranjo 2012; Loury 1981). Even among families who typically live above poverty, many students and families will face one or more yearly spells in poverty (Hokayem and Heggeness 2014; Stevens 2012). We show that even a year in poverty during adolescence can be linked to diminished educational outcomes.

Income volatility potentially compounds the consequences of poverty and low income, as it is highest among socioeconomically disadvantaged groups—including blacks, low-income families, and those headed by an adult without a college degree (Hardy 2017; Hardy and Ziliak 2014; Keys 2008). Predating the Great Recession, survey data evidence suggests that income volatility among many American families has been on the rise[1] (Dynan et al. 2012; Gottschalk and Moffitt 1994; Ziliak et al. 2011). This increase has been attributed, at least in part, to increases in the volatility of labor market earnings, resulting from short term shocks and a structural change away from earnings protections traditionally offered by long-term employment contracts (Dahl et al. 2011; Gottschalk and Moffitt 2009). Low income families therefore rely on resources that are, on average, also more unpredictable.

Given that we do not yet have a full understanding of the implications of earnings and income volatility for workers' careers, health, and family stability, we also cannot rule out that the resource constraint and uncertainty derived from poverty and

[1] Dahl et al. (2012), using administrative data, find that there is no trend growth in the volatility of income over time.

income volatility could shape parental investments and, for children, result in stressors shaping development, attitudes, coping mechanisms, and problem-solving techniques later in childhood and into adulthood (Cunha et al. 2006; Gennetian et al. 2015; Hill et al. 2013; Lochner and Monge-Naranjo 2012). Through these channels among others, poverty and income volatility could impact educational outcomes for children and young adults.

To help address this gap, we build on the work of Stevens and Schaller (2011), Hardy (2014), and Gennetian et. al (2015), which find that on its own, income volatility and job loss during childhood is associated with lowered child educational outcomes.[2] Importantly, our use of the PSID allows us to better understand how poverty spells and income shocks relate to educational attainment along initial and intermediate stages of the educational attainment process; indeed, our findings suggest that poverty and exposure to income volatility may impact educational attainment via varying channels and at different times. Thus, our findings contribute to understanding the mechanisms driving human capital accumulation and the transmission of socioeconomic status (SES) across generations (Altonji and Dunn 2000; Charles and Hurst 2003; Solon 1992).

The limited amount of research examining resource dynamics and educational attainment likely stems, in part, from models reliant on the permanent income hypothesis. To the extent that households can borrow to smooth consumption against unanticipated income shocks, the permanent income hypothesis would predict income volatility and poverty spells to have little, if any, impact on human capital accumulation relative to poverty or low permanent income, as reflected via high school graduation or college attendance. This theory argues that families could save positive unanticipated transitory shocks in anticipation of future income swings. However, several studies have shown that the permanent income hypothesis rests on assumptions that do not hold for many low and moderate-income families (Baker and Yannelis 2017; Jappelli and Pistaferri 2010). This can have real implications for student and parent borrowers (Heller 2008).

For families trying to finance a college education, poverty spells and income volatility could negatively impact overall educational attainment and college persistence in a variety of ways—many discussed here—including via lowered investments in children and young adults (Becker and Tomes 1986; Carneiro and Heckman 2002; Lochner and Monge-Naranjo 2012; Loury 1981; Mazumder 2005).

3 Data and empirical model

To study the importance of family poverty and income dynamics on adolescents as they transition from high school into college and/or work, we use data from the Panel Study of Income Dynamics (PSID) and its Transition to Adulthood survey (PSID-TA). The PSID is a well-known data set begun in 1968, collecting detailed economic, social, and demographic information on the initially surveyed families and their descendants.

[2] There are many candidate explanations for this relationship, including family stress and dissolution, frequent moves between schools, and the need for children to work to supplement parental income.

Over time, offspring of the families are followed as they age and begin their own families, resulting in a sample spanning multiple generations.

Beginning in 2005, the PSID began supplemental interviews with members of PSID households as they entered young adulthood. This supplement, the PSID-TA, was established to understand the educational, family, and economic decisions of young adults that the standard PSID missed in the past: young people who are dependent on parents and have therefore not entered the full labor force as a head of household, but that are no longer within the CDS module.[3] The PSID estimates that less than half of young adults will become heads or wives of their own PSID family before age 24. PSID-TA respondents have participated in at least one PSID CDS module. For example, in 2013, 2156 adults were eligible for the PSID-TA, of which 34 were ineligible. From here, 1804 completed the survey, for a roughly 90 percent response rate (PSID 2013). And, internal PSID predictive models show that, based upon 1997 CDS observables, PSID-TA nonresponse is unrelated to CDS family income, race, age, or parental education (PSID 2013). This is important, given the possibility that bias could be introduced into the PSID-TA sample if sample participants are selected into the TA on the basis of these same socioeconomic characteristics.

To form our analytic data set we combine PSID family files (PSID-F) with PSID-TA files. We use the PSID-F to measure the income and structure (e.g. head's marital status) of the family in which a young adult spent her/his adolescence, prior to "transitioning" into adulthood. It is important to note that the PSID codes men as the "head" in married families; women are coded as "head" in families where they are the sole adult present, but as the "wife" within both married and cohabiting relationships (McGonagle et al. 2012). The PSID-TA collects supplemental information on PSID-F household members who: (1) are not household heads nor spouses of heads; (2) have turned 18 since the previous interview, and (3) have completed high school. Since 2005 the PSID-TA has been conducted biennially, collecting data on whether respondents have enrolled in, persisted in, and graduated from college–as well as providing information on which college(s) a student attended.[4]

We use the PSID-TA to define our analytic sample. We restrict our sample to those who have turned 18 and left high school. Then, we observe each sample member from the first year in which they are observed after high school until the age of 24, when they are no longer part of the PSID-TA sample. We measure high school graduation at the time of transition, distinguishing between those who left high school because they graduated compared to those who left high school without a diploma. We measure post-secondary education outcomes during this window. To measure family income level, poverty, income volatility, and head demographics during adolescence, we use the PSID family file for the five (biennial) surveys prior to the survey year in which the responded transitioned to adulthood and entered our sample. This period roughly covers the adolescent years of PSID-TA sample

[3] PSID-TA sample members are children from the Child Development Supplement sample who have reached the age of 18. They are surveyed biennially as part of the Transition to Adulthood sample until they reach a maximum age 28, regardless of whether they form their own households.

[4] The PSID-TA also collects information about respondents' employment, family formation and other topics.

members (most commonly from the ages of 8 to 18). Our PSID-TA cohort sample contains youth transitioning to adulthood in 2005, 2007, 2009, 2011 and 2013. The 2015 PSID-TA data are used only to collect follow up information. Dollar denominated values are adjusted for inflation using the CPI-U consumer price index for urban consumers, and we do not impute missing data. The primary definition of income includes total taxable family labor market earnings cash transfers, and social security benefits.

We use these data to model how high school graduation, college enrollment, and college persistence of young adults are affected by inter-temporal changes in their parents' income during adolescence. The results describe whether and how these outcomes are differentially affected by parental income level and income dynamics—poverty spells and volatility. In each survey year, there are typically more than 1000 young adult respondents. Of these, approximately 600 enroll at a post-secondary institution immediately after high school. In one sample year (2005) 75 students stopped attending college (without earning a degree/credential). Over the course of 5 survey years, the size of the PSID-TA has increased.

Our measures of education are all indicators of various levels of enrollment or attainment. First, we measure high school graduation as an indicator of whether a respondent reported earning a high school diploma, rather than who left high school without a diploma. We measure college enrollment with dummy variable of whether or not a respondent had enrolled in a post-secondary education program within at least four years of graduating from high school. Finally, we measure persistence using an indicator of whether a respondent had completed or was still enrolled in pursuit of his/her degree after two years of matriculation.

Formally, we estimate the following regression models to estimate the impacts of poverty spells and family income dynamics on high school graduation, college enrollment, and college completion:

$$C_{\mathrm{it}} = \alpha + P_{it}\beta + X_{1i}\delta_1 + X_{2i}\delta_2 + \rho_t + \varepsilon_{\mathrm{i}}, \tag{1}$$

where C_{it} measures educational outcomes (e.g. high school graduation, college matriculation, or college persistence) for respondent i in year t, P_{it} is a vector of dummy variables measuring years of exposure to poverty during adolescence and prior to the transition into adulthood. Given the biennal nature of the data, respondents are queried on their enrollment (whether, and within what type of institution?) and graduation status—from which we can determine both college persistence and completion. In all models, we control for a vector of family attributes that may be associated with family income and poverty during adolescence (X_{1i}). These include the family head's race and gender, mother's education, and family wealth and whether the child's parents were married in the first interview observed (about the age of 8).

The relationship between poverty during adolescence and educational attainment may be moderated by changes in family structure during adolescence. For example, a child's family may experience poverty as a consequence of family dissolution, with both shocks having potential ramifications for her education. Consequently, we add measures of changes in family structure during adolescence to assess the extent to which these factors mediate the relationship between poverty and high school completion, college matriculation and retention. These measures (X_{2i}) include family marital stability, measured as the proportion of years the TA respondent resides in a household with married adults; residential stability as measured by the proportion of years the TA respondent moves, and; SAT/ACT scores, measured late in high school. All models include the fixed effects for the year a respondent "transitions" out of adolescence (ρ_t).

We also estimate models to measure family income dynamics on educational outcomes. To do so, we estimate models similar to (1), but include measures of permanent income and income volatility during adolescence. Specifically, we estimate the following model

$$C_{\mathrm{it}} = \alpha + \beta \bar{\mathrm{I}}_{\mathrm{i}} + \gamma \mathrm{V}_i + X_{1i}\delta_1 + X_{2i}\delta_2 + \rho_t + \varepsilon_{\mathrm{i}}, \tag{2}$$

where $\bar{\mathrm{I}}_{\mathrm{i}}$ measures the average or "permanent" income level of child i's family over 5 childhood survey years prior to the transition to adulthood, and likewise V_i measures income volatility of child i's family during adolescence. For our study, transitory volatility (V_i) (Gottschalk and Moffitt 2009; Ziliak et al. 2011) will be defined by yearly deviations $y_{it} - \bar{y}_i$ from mean parental income $\bar{y}_i$ over the relevant time period m representing matriculation or graduation:

$$\mathit{Transitory\,volatility} = \mathrm{var}(v_i) = \mathrm{V}_i = \left(\frac{1}{T_i - 1}\right) \sum_{t=1}^{T_i = m} (y_{it} - \bar{y}_i)^2. \tag{3}$$

Transitory volatility is a measure of risk due to temporary increases in economic hardship consistent with adverse events such as job loss, injury, divorce, or declining health (Dynan et al. 2012; Hardy 2014). Conditional on permanent income, a family with higher income volatility may be less inclined to invest in education for their child for a variety of reasons. Of course, it may be that large income losses are especially important. To test this, we estimate supplementary models in which we include permanent income along with an indicator of whether the family ever suffered an income decline of more than 20 percent between any consecutive survey periods.

For both models, we include estimates of wealth, measured as family assets such as savings, retirement accounts and home equity. In models (1) and (2) we also transform income as the natural log, which better accounts for non-linear relationships. We estimate some models controlling for the natural log of positive wealth, assigning a value of one dollar for families with no wealth or negative wealth. In other models, rather than bottom-coding wealth we implement an inverse hyperbolic sine transformation to allow control for debt. In all cases, we include heteroskedasticity consistent (Huber-White) standard errors and weight using the individual TA sampling weight.

4 Descriptive statistics and trends

Our sample allows us to construct snapshots of the association between income dynamics, socioeconomic characteristics, and our selected set of outcomes: high school graduation, college matriculation, and persistence. About 17 percent of the respondents are black and 48 percent are female. 85 percent of the sample graduates

Table 1 Descriptive statistics

	Mean	sd
High school graduation (0/1)	0.855	0.352
College within 2 years (0/1)	0.693	0.461
College persistence (0/1)	0.551	0.498
Total Years in poverty	0.554	1.166
Years in poverty = 0 (0/1)	0.718	0.449
Years in poverty = 1 (0/1)	0.113	0.317
Years in poverty = 2 (0/1)	0.049	0.216
Years in poverty = 3 (0/1)	0.053	0.224
Years in poverty = 4 (0/1)	0.038	0.191
Years in poverty ≥ 5 (0/1)	0.029	0.168
Poverty prior to grade 11/12	0.113	0.317
Ln permanent income	11.13	0.799
Transitory volatility	0.395	0.334
Black (0/1)	0.171	0.376
Female (0/1)	0.483	0.500
Prop. years family move	0.240	0.303
Prop. years lived with married parents	0.682	0.419

$n = 2{,}500$

from high school, while almost 70 percent enroll in college within a 2-year period from being surveyed. Among those, 55 percent are still enrolled in college within 2 years of initial enrollment. The average TA respondent lived in a household that experienced roughly ½ a year in poverty over a 5-year period. Measures of family stability show that adolescents in the sample move 25 percent of the time over the 5-year survey period, and the typical respondent lived in a married household almost 70 percent of the time (Table 1).

To begin to understand the relationship between economic deprivation and educational outcomes, consider the unadjusted associations presented in Figs. 1–3. Figure 1 focuses on exposure to poverty from 1 to 5 survey years. First, we observe that the proportion graduating from high school falls from almost 90 percent when never exposed to poverty, to just over 80 percent when exposed to poverty for 1 year. Additional years in poverty are associated with a lowered likelihood of graduating from high school, falling to as low as 60 percent for those exposed to 4 or 5 years in poverty. College attendance follows a similar pattern, falling from roughly 60 percent for young adults who do not experience poverty in adolescence, to just over 40 percent for those who experience 2 years in poverty—after which college matriculation falls to below 40 percent for those in poverty over 4 or 5 years. The proportion of attendees who persist in college falls from roughly 60 percent (no years in adolescent poverty) to under 30 percent with 3 years in poverty, falling further to under 20 percent with 4 or 5 years in poverty.

While poverty thresholds are important for assessing well-being and determining program eligibility criteria, it is worthwhile documenting the link between deep poverty exposure and educational outcomes. Deep poverty, defined as income below

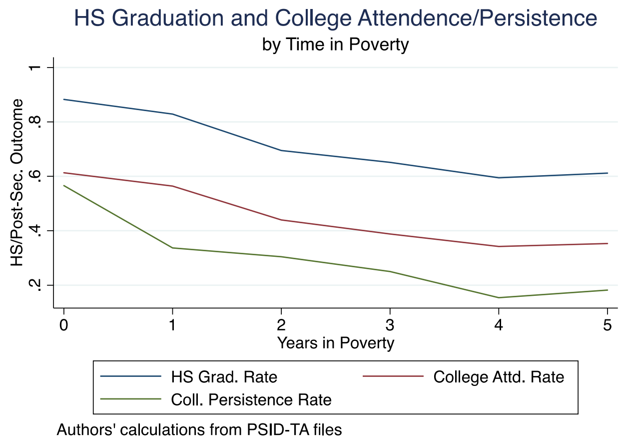

Fig. 1 High school graduation and college attendance by years in poverty

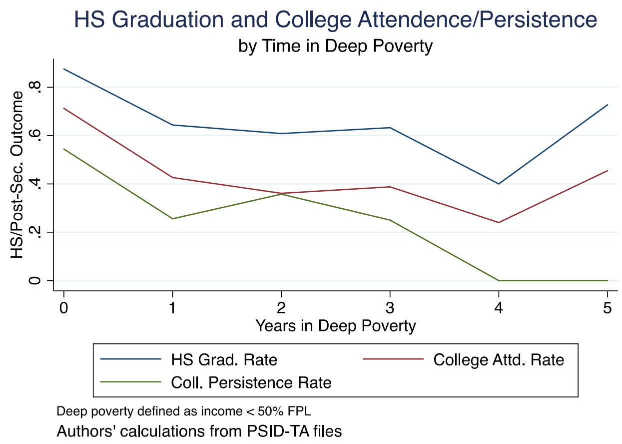

Fig. 2 High school graduation and college attendance by years below 50% of poverty

50 percent of the poverty line, is consistent with a u-shape with respect to educational outcomes. For high school graduation, exposure to deep poverty reduces high school graduation from over 80 percent (no years in deep poverty) to 60 percent with 2 years of deep poverty exposure, but this graduation rate rises from just over 40 percent to over 70 percent for young adults who experienced 4 to 5 years in deep poverty. A similar pattern holds for college matriculation within two years, though the levels of attendance are lower relative to high school graduation. On the other hand, no TA survey respondents who experience 4 or 5 years of deep poverty as adolescents go on to remain enrolled in college.

Though the plight of those in deep poverty is dire, by definition, (e.g. Shaefer et al. 2015), another group that merits attention include the near-poor—individuals and families who are above the poverty threshold but by margins small enough to put them at greater risk for transitions into poverty (Hokayem and Heggeness 2014).

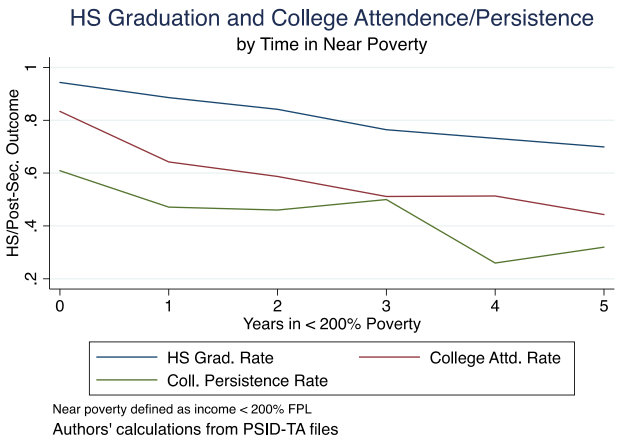

Fig. 3 High school graduation and college attendance by years in near poverty

We observe (Fig. 3) that high school graduation rates decline almost linearly with additional years in near-poverty, below 200 percent of the federal poverty level—from well over 90 percent with no near-poverty exposure to under 80 percent with 3 years of near-poverty exposure. Reductions in college attendance seem to be more immediately associated with near-poverty exposure, falling from over 80 percent with no near-poverty exposure to roughly 50 percent with 3 years of exposure. College persistence drops from 60 to 50 percent and holds while moving from no near-poverty exposure to anywhere from 1–3 years of near poverty exposure, before dropping to 30 percent persistence rates with 4 and 5 years of near-poverty exposure.

5 Regression results

The results shown in Tables 2–7 are linear probability models of high school graduation, college attendance, and college persistence. Table 2 estimates the relationship between time in poverty during adolescence and the likelihood of graduating from high school. In all models, we control for basic demographic characteristics, family attributes at the start of adolescence and transition year fixed effects. These year effects are included to control for any impacts of changing labor market conditions during the Great Recession. As our models generally follow the same specification, we provide a detailed explanation of the contents of results in Table 2; we then provide a briefer summary of results shown in Tables 3 and 4.

In the first column of Table 2, we estimate the relationship between family poverty in the survey just prior to transition and high school graduation. Recall that the transition year is the first survey conducted following a PSID-TA member's 18th birthday and completion of high school (whether or not a high school diploma was earned). These interviews were typically conducted when the teen would have been in 11th or 12th grade. We estimate that the likelihood a female respondent graduates from high school is 0.07 higher than a comparable male respondent. Recall from Table 1, that the sample mean likelihood of graduating from high school was 0.855,

Table 2 Predictors of high school graduation

	(1)	(2)	(3)	(4)
Poverty in grade 11/12	−0.193*** (0.023)		−0.142*** (0.031)	−0.127*** (0.031)
1 Yr. in poverty		−0.060** (0.022)	−0.024 (0.023)	0.004 (0.023)
2 Yrs. in poverty		−0.168*** (0.036)	−0.109** (0.038)	−0.084* (0.037)
3 Yrs. in poverty		−0.130*** (0.036)	−0.036 (0.041)	0.020 (0.042)
4 Yrs. in poverty		−0.212*** (0.041)	−0.117* (0.046)	−0.080 (0.046)
5 Yrs. in poverty		−0.249*** (0.049)	−0.101 (0.058)	−.065 (0.057)
Ln (wealth)				0.001 (0.002)
Prop. moves				−0.065** (0.025)
Prop. time married				0.028 (0.029)
Black	−0.019 (0.020)	−0.014 (0.020)	−0.013 (0.020)	−0.010 (0.020)
Female	0.070*** (0.013)	0.067*** (0.013)	0.070*** (0.013)	0.064*** (0.013)
Parents married at age 8	0.112*** (0.018)	0.093*** (0.018)	0.100*** (0.018)	0.083** (0.027)
Family wealth at age 8	0.005** (0.002)	0.004* (0.002)	0.004* (0.002)	0.001 (0.002)
Mom is a HS Grad	0.009 (0.019)	0.001 (0.019)	0.004 (0.019)	0.004 (0.019)
Mom has some college	0.053** (0.019)	0.044* (0.019)	0.046* (0.019)	0.041* (0.019)
Mom is a college grad	0.104*** (0.023)	0.097*** (0.023)	0.098*** (0.023)	0.052* (0.023)
Mom college+	0.079** (0.025)	0.071** (0.025)	0.072** (0.025)	0.034 (0.025)
Constant	0.684*** (0.028)	0.731*** (0.030)	0.715*** (0.030)	0.967*** (0.080)
Year fixed effect?	Yes	Yes	Yes	Yes
Control for SAT/ ACT score?	No	No	No	Yes
R-squared	0.121	0.115	0.124	0.186
Number of observations	2302	2331	2302	2253

All models control for transition year. Standard errors in parentheses

*$p < 0.05$; **$p < 0.01$; ***$p < 0.001$

so this is a substantive difference. Importantly, and consistent with the literature, female students have better academic outcomes even when we add controls for changes in family characteristics or student achievement (columns 2–4). Parental marital status, education and wealth prior to adolescence are all substantial predictors of high school completion. Children whose parents are married are 0.112 points more likely to graduate, and the chances increase by another 0.104 for those with mothers who completed college. We find no significant difference by race in the likelihood of graduating from high school, controlling for family composition parental education and wealth.

We estimate that the likelihood of graduating from high school was 0.193 points lower for adolescents whose families were in poverty at the end of high school. This is a very large effect size – the mean graduation rate for the sample is 0.86. In column 2, we include a series of indicator variables measuring the number of survey years that a respondent's family lived in poverty prior to transition. Since the PSID is biennial, this spans the period from approximately ages 8 to 18. It is clear that any time in poverty during this period limits the chances of graduating from high school. About 25 percent of adolescents live in a family that will experience a spell of poverty between the ages of 8 and 18. Even one year of poverty is associated with a 0.06 point decrease in the likelihood of high school graduation. For those whose

Table 3 Predictors of college matriculation (within 2 years)

	(1)	(2)	(3)	(6)
Poverty before graduation	−0.034*** (0.033)		−0.024 (0.043)	−0.016 (0.043)
1 Yr. in poverty		−0.071* (0.028)	−0.067* (0.030)	−0.028 (0.030)
2 Yrs. in poverty		−0.026 (0.051)	−0.022 (0.053)	0.033 (0.052)
3 Yrs. in poverty		−0.047 (0.051)	−0.039 (0.056)	−0.003 (0.056)
4 Yrs. in poverty		−0.045 (0.060)	−0.034 (0.066)	0.039 (0.066)
5 Yrs. in poverty		0.050 (0.074)	0.072 (0.086)	0.100 (0.083)
Ln (wealth)				0.007** (0.002)
Prop. moves				−0.109*** (0.031)
Prop. time married				−0.019 (0.038)
Black	−0.047 (0.026)	−0.051 (0.026)	−0.056* (0.027)	−0.043 (0.027)
Female	0.060*** (0.017)	0.063*** (0.017)	0.059*** (0.017)	0.054*** (0.017)
Parents married at age 8	0.066*** (0.019)	0.033 (0.024)	0.031 (0.024)	0.033 (0.035)
Family wealth at age 8	0.015*** (0.002)	0.015*** (0.002)	0.015*** (0.002)	0.009*** (0.003)
Mom is a HS grad	−0.084*** (0.024)	−0.077** (0.025)	−0.077** (0.025)	−0.077** (0.024)
Mom has some college	0.009 (0.023)	0.009 (0.024)	0.009 (0.024)	0.017 (0.024)
Mom is a college grad	0.104*** (0.027)	0.111*** (0.028)	0.106*** (0.028)	0.054 (0.028)
Mom college+	0.093** (0.029)	0.100*** (0.030)	0.098** (0.030)	0.057 (0.030)
Constant	0.590*** (0.031)	0.624*** (0.039)	0.643*** (0.039)	0.723*** (0.098)
Year fixed effect?	Yes	Yes	Yes	Yes
Control for SAT/ACT score?	No	No	No	Yes
R-squared	0.089	0.095	0.092	0.149
Number of observations	1937	1965	1937	1896

Sample restricted to respondents graduating high school. All models control for transition year fixed effects. Standard errors in parentheses

*$p < 0.05$; **$p < 0.01$; ***$p < 0.001$

families experience more than one year in poverty (about 10 percent of our sample), the chances of high school graduation fall by 0.13 to 0.25 probability points.

Poverty experienced during adolescence could have direct effects on educational outcomes, or could be mediated by other problems families go through that coincide with poverty. These might include family dissolution, for example. Or, it could be that poverty negatively affects learning and achievement, and thereby raises the costs of completing high school. To attempt to sort out direct versus indirect effects of poverty during adolescence, in columns 3 and 4 we add controls for changes in family composition, residential stability and wealth, as well as achievement while in high school as measured by SAT/ACT scores.[5]

In both columns 3 and 4, we include both the dummy variable measuring whether the respondent was in poverty at the end of high school, as well as the series of indicator variables measuring the number of survey years that a respondent's family lived in poverty prior to transition.

We find that the likelihood of high school graduation declines when we control for the number of residential moves a family makes during a child's adolescence. Clearly these measures of household stability are related to family poverty. Nonetheless,

[5] We include math and reading scores on the SAT and/or ACT. We also include indicator variables measuring whether or not a student took these exams, as this may signal attainment goals.

Table 4 Predictors of college persistence

	(1)	(2)	(3)	(4)	(5)
Poverty before graduation	−0.089** (0.073)		−0.149 (0.100)	−0.129 (0.099)	−0.061 (0.096)
1 Yr. in poverty		−0.150* (0.062)	−0.122 (0.065)	−0.074 (0.065)	−0.079 (0.063)
2 Yrs. in poverty		0.102 (0.131)	0.190 (0.143)	0.281 (0.144)	0.22 (0.14)
3 Yrs. in poverty		−0.027 (0.114)	0.037 (0.121)	0.086 (0.120)	0.003 (0.117)
4 Yrs. in Poverty		−0.084 (0.144)	0.013 (0.158)	0.066 (0.159)	0.093 (0.155)
5 Yrs. in poverty		0.060 (0.146)	0.210 (0.177)	0.250 (0.174)	0.162 (0.169)
1st enrollment: community coll.					−0.264*** (0.037)
Ln (Wealth)				0.004 (0.005)	0.004 (0.005)
Black	−0.102 (0.056)	−0.104 (0.056)	−0.102 (0.057)	−0.069 (0.057)	−0.122* (0.056)
Female	0.081* (0.033)	0.078* (0.033)	0.075* (0.033)	0.100** (0.033)	0.103*** (0.032)
Prop. moves				0.006 (0.074)	0.013 (0.074)
Prop. Time Married				0.135 (0.109)	0.117 (0.106)
Parents Married at Age 8	0.132** (0.047)	0.133** (0.047)	0.132** (0.047)	0.017 (0.094)	−0.002 (0.092)
Family wealth at age 8	0.009 (0.005)	0.008 (0.005)	0.008 (0.005)	0.004 (0.006)	0.001 (0.006)
Mom is a HS grad	0.013 (0.054)	0.016 (0.054)	0.016 (0.054)	0.042 (0.054)	0.04 (0.052)
Mom has some college	0.100* (0.048)	0.104* (0.048)	0.105* (0.048)	0.089 (0.048)	0.089 (0.046)
Mom is a College Grad	0.285*** (0.053)	0.282*** (0.054)	0.282*** (0.054)	0.224*** (0.054)	0.211*** (0.052)
Mom college+	0.343*** (0.056)	0.345*** (0.056)	0.343*** (0.056)	0.300*** (0.055)	0.269*** (0.055)
Constant	0.369*** (0.074)	0.389*** (0.078)	0.0389*** (0.078)	0.081 (0.182)	0.329 (0.180)
Year fixed effect?	Yes	Yes	Yes	Yes	Yes
Control for SAT/ACT score?	No	No	No	Yes	Yes
R-squared	0.112	0.114	0.116	0.155	0.203
Number of observations	841	845	841	840	840

Sample restricted to respondents enrolling in college within 2 years of high school graduation. All models control for transition year. Standard errors in parentheses

$^{*}p<0.05$; $^{**}p<0.01$; $^{***}p<0.001$

Table 5 Timing of poverty spells and education outcomes

	Outcome		
	High school graduation	College enrollment	College persistence
Family poor? (0/1) when respondent was:			
17–18 years old	−0.112** (0.037)	−0.008 (0.052)	−0.211 (0.128)
15–16 years old	−0.006 (0.039)	−0.037 (0.052)	−0.037 (0.120)
13–14 years old	−0.022 (0.043)	0.113* (0.057)	0.004 (0.145)
11–12 years old	0.083 (0.045)	−0.016 (0.06)	−0.221 (0.132)
Total years in poverty	−0.026 (0.026)	−0.006 (0.035)	0.092 (0.081)
Ln (Wealth)	0.002 (0.002)	0.008*** (0.002)	0.005 (0.005)
Black	0.008 (0.021)	−0.045 (0.027)	−0.103 (0.058)
Female	0.065*** (0.014)	0.057*** (0.017)	0.095** (0.033)
Prop. moves	−0.064** (0.025)	−0.104*** (0.031)	−0.01 (0.075)
Prop. time married	0.026 (0.030)	−0.009 (0.037)	0.148 (0.106)
Parents married at age 8	0.099*** (0.027)	0.027 (0.035)	0.022 (0.092)
Family wealth at age 8	0.001 (0.002)	0.010** (0.003)	0.008 (0.006)
Mom is a HS grad	0.012 (0.019)	−0.07** (0.025)	0.015 (0.054)
Mom has some college	0.053** (0.019)	0.019 (0.024)	0.066 (0.048)
Mom is a college grad	0.055* (0.024)	0.054 (0.028)	0.191*** (0.054)
Mom college+	0.037 (0.025)	0.054 (0.03)	0.264*** (0.056)
Constant	0.900*** (0.083)	0.727*** (0.10)	0.115 (0.183)
Sample restrictions	NA	HS graduates	College matriculants
R-squared	0.194	0.166	0.157
Number of observations	2178	1833	817

All models control for transition year fixed effects. Standard errors in parentheses.

*$p < 0.05$; **$p < 0.01$; ***$p < 0.001$

controlling for household stability we estimate that poverty late in adolescence significantly reduces the likelihood of graduating from high school (-0.127) and this it so even when controlling for performance on standardized college entrance tests. Informed by relatively recent work emphasizing the potential role of family wealth (e.g. Haider and McGarry 2018; Hamilton et al. 2015; Pfeffer 2018; Reeves 2018), we include a set of models controlling for a logarithmic transformation of family wealth in the previous survey year.[6] This measure is inclusive of home equity. We find no additional relationship of family wealth as measured at the end of high school, as this is substantially correlated with family wealth at baseline. We also estimate models in which we allow for debt, rather than bottom-coding wealth at zero, by implementing an inverse hyperbolic sine transformation.[7] The results of this

[6] For families with negative or no wealth, we assign a value of one dollar prior to log transformation.

[7] We use the STATA function ihstrans to compute the inverse hyperbolic sine transformation. This transformation facilitates processing of negative wealth values and zeros, the omission of which could understate the importance of wealth gaps and inequality.

Table 6 Income volatility and high school graduation and college enrollment

	Outcome: high school graduation			Outcome: college enrollment[b]		
	(1)	(2)	(3)	(4)	(5)	(6)
Ln (permanent income)	0.06*** (0.012)	0.026* (0.011)	0.034** (0.013)	0.059*** (0.015)	0.024 (0.016)	0.019 (0.016)
Income volatility	−0.094*** (0.022)	−0.067** (0.023)		−0.026 (0.029)	0.013 (0.03)	−0.01 (0.029)
Income drop > 20%			−0.011 (0.014)			−0.045** (0.017)
Ln (wealth)		0.005** (0.002)	0.003 (0.002)		0.006** (0.002)	0.006** (0.002)
Black	−0.041 (0.02)	−0.016 (0.02)	−0.015 (0.020)	−0.034 (0.026)	−0.035 (0.026)	−0.021 (0.025)
Female	0.066*** (0.013)	0.061*** (0.013)	0.061*** (0.013)	0.066*** (0.017)	0.058*** (0.017)	0.057*** (0.017)
Prop. moves		−0.054* (0.025)	−0.063* (0.025)		−0.12*** (0.031)	−0.11*** (0.031)
Prop. time married		0.084*** (0.026)	0.079** (0.027)		−0.02 (0.038)	−0.036 (0.038)
Control for family chars. at baseline?[a]	No	Yes	Yes	No	Yes	Yes
Control for SAT/ACT scores?	No	Yes	Yes	No	Yes	Yes
R-squared	0.114	0.174	0.171	0.102	0.15	0.153
Observations	2329	2259	2260	1965	1903	1903

All models control for transition year fixed effects. Standard errors in parentheses.

[a]Baseline characteristics are mother's education, family marital status and wealth at age 8, as in Tables 2–5

[b]Sample restricted to respondents graduating high school

*$p < 0.05$, **$p < 0.01$, ***$p < 0.001$

Table 7 Income volatility and college persistence

	(1)	(2)	(3)	(4)
Ln (permanent income)	0.056* (0.029)	−0.009 (0.031)	0.043 (0.028)	0.020 (0.027)
Income volatility	0.001 (0.061)	0.030 (0.063)		−0.014 (0.060)
Income drop > 20%			0.013 (0.033)	0.015 (0.032)
Ln (wealth)		0.009 (0.005)	0.006 (0.005)	0.004 (0.005)
Black	−0.097 (0.056)	−0.067 (0.057)	−0.068 (0.057)	−0.126* (0.056)
Female	0.082* (0.033)	0.105** (0.033)	0.106** (0.033)	0.107*** (0.032)
Prop. moves		−0.026 (0.075)	−0.022 (0.074)	−0.01 (0.072)
Prop. time married		0.132 (0.108)	0.129 (0.107)	0.117 (0.104)
1st college a comm. coll.				−0.272*** (0.037)
Control for family chars. at baseline? [a]	No	Yes	Yes	Yes
Control for SAT/ACT scores?	No	Yes	Yes	Yes
R-squared	0.114	0.151	0.151	0.202
Observations	845	840	840	840

Sample restricted to respondents enrolling in college within 2 years after high school graduation. All models control for transition year fixed effects. Standard errors in parentheses

[a] Baseline characteristics are mother's education, family marital status and wealth at age 8, as in Tables 2–5

*$p < 0.05$; **$p < 0.01$; ***$p < 0.001$

specification are virtually identical to those in column 4, so are not presented here for parsimony.[8]

Interestingly and importantly, it appears that the relationship between adolescent poverty and high school graduation is driven mainly by family poverty in the survey year prior to transition. We estimate that the likelihood of graduating from high school is 0.127 lower for teens living in poor families late in high school than comparable peers. This might be due to the financial demands that family poverty places on 17 and 18-year-olds to contribute to household income. Or, it could be due to changes in expectations about educational opportunities that poverty reveals to teens.

Moving to Table 3, we use the same set of covariates to assess the predictors of college enrollment, conditional on having graduated from high school. Not surprisingly, mother's education and family wealth are especially important predictors of college going among recent high school graduates. We find that poverty just prior to high school graduation is a less important predictor of college matriculation than any poverty during adolescence. In columns 1, we estimate a significant decline in college matriculation for students experiencing poverty in 11th/12th grade, but this appears to be driven by the closely related experience of spending at least one year in poverty during adolescence (columns 2 and 3). Of course, those spending one year in poverty may have spent their 11th/12th grade year in poverty. So, the effects here are additive. Importantly, this relationship is attenuated when we control for performance

[8] Results are available on request from the authors.

on standardized college entrance exams and family structure changes that are potential mediators of the relationship between poverty and college attendance. One explanation for this pattern would be that signs of a family's financial hardship while in high school limit aspirations for post-secondary education, and this shows up as reduced effort in planning and preparation for college. Also, in absolute terms, residential moves loom larger than marriage as a predictor of college-going behavior.

Over the past 30 years, U.S. higher educational institutions have recognized and moved to reduce large socioeconomic gaps in college matriculation. While these gaps have been declined, a newer gap has formed, wherein students from low-income backgrounds are far less likely to graduate college, even after successfully matriculating. In Table 4 we therefore investigate the role of family income dynamics in predicting college persistence. In all models, we find that children of mothers who are college graduates are themselves much more likely to persist in college. This may be due to shared values, knowledge, expectations, or family commitments. We also find that parental marital history is a predictor of college completion, even controlling for wealth and income. Students with married parents may feel less pull to leave college to contribute to family finances.

In column 1 we find that the recency of exposure to poverty—just prior to graduation—decreases the persistence rate by 8.9 percent.[9] We have limited power to distinguish between recent poverty and poverty persistence. In column 2, we find poverty in any one year during adolescence reduces college persistence. But, in column 3, combining these timing measures with an indicator of poverty in the last year before graduation, these coefficients are statistically insignificant even if they are similar in magnitude to those in columns 1 and 2. In column 4, we control for family stability factors and wealth, and SAT performance, all of which may be mediators of poverty. Interestingly, residential moves do not have a negative association to persistence, unlike in Tables 2–3. In our final models of Table 4, neither poverty before graduation nor extended spells in poverty are statistically significant—perhaps due to the fact that these factors operate together and are thus difficult to un-bundle.

In column 5, we find that attending community college as the initial post-secondary enrollment significantly reduces the likelihood of college persistence. We estimate that the likelihood of persisting is 0.264 lower for those starting at community colleges than at four-year colleges. This descriptive finding could reflect personal and economic circumstances, which we aim to account for, that contributed to the decision to choose community college as the entry-point into post-secondary education.

An important finding from Tables 2–4 is that poverty just prior to high school graduation seems to have an especially negative association with educational outcomes. However, the specifications in Tables 2–4 make it impossible to discern whether the timing of poverty earlier in adolescence have similarly negative consequences. There are potentially countervailing factors shaping impact of poverty timing on high school graduation and post-secondary education enrollment and persistence. First, there is evidence poverty during early childhood can have larger negative effects on early adult outcomes than poverty later in childhood (Galster et al. 2007), at least in part because of cumulative effects. But, poverty later in

[9] A decline of 0.089 in probability.

childhood is contemporaneous to high school graduation and more immediate to decisions about college enrollment.

In Table 5, we explore the relationship between poverty during different periods of adolescence and education outcomes. To do so, we include dummy variables measuring whether or not a PSID respondent's family was poor in the year of/preceding high school graduation, along with similar measures for the survey periods preceding the high school graduation year. To help with interpretation, these typically occur during the ages (in reverse chronological order) of 16–17; 14–15; 12–13, and 10–11. We also include a measure of the total number of years spent in poverty. Consistent with the results in Table 2, we find that poverty in the final interview year in high school is most substantially related to a lower probability of graduation from high school. We estimate that the likelihood of graduation is 0.112 probability points lower for those in poverty than observationally identical peers. Poverty in earlier surveys is not associated with additional reductions in high school graduation likelihood. This suggests that the immediate effects of poverty may be more salient than any residual effects poverty in early adolescence. Consistent with Tables 3 and 4, we find less evidence of immediate poverty on college matriculation and persistence, conditional on high school graduation. This could either be because the immediate effects of poverty on educational attainment operate through direct effects on high school completion, or because our power to detect post-secondary enrollment and matriculation effects are limited. Power seems to be a real concern for the models of persistence: Our point estimates here are large and in the expected direction, but not statistically significant.

We now move to examining the link between permanent income levels and income volatility of parents during adolescent years, and subsequent educational outcomes. First, in Table 6, we estimate Eq. (2) via OLS to determine the how these factors relate to high school graduation and the likelihood of enrolling in college once graduated, conditioning on family stability measures and demographics. Consistent with work by Hardy (2014) and others, we find that permanent income is a large and consistently positive predictor of high school graduation, with likelihoods ranging from 0.06 to 0.026 across columns 1-3. The permanent income-high school graduation link is attenuated by the inclusion of family stability measures and controls for SAT and ACT scores—which themselves likely capture a mix of ability, accumulated skills, and socio-economic advantage factors. Here as before, residential moves negatively predict high school graduation, from −0.054 to −0.063, and children of married parents are more likely to graduate.

In columns 1 and 2, we measure income volatility as the transitory variance definition discussed in Eq. (3). In column 3, we measure income changes with an indicator of whether the student's family ever experienced a drop in income of more than 20 percent between any two consecutive survey years. This specification is a test of whether income loss is more important than volatility, per se. We find that volatility is consistently negatively associated with the likelihood of high school graduation: We estimate that on average an increase in the variance of family income during adolescence reduces the likelihood of finishing high school by 0.094. This relationship is robust to the inclusion of family stability measures of residential moves and marital stability, as well as student test score measures. But, in column 2, the relationship is attenuated (0.067). This suggests that about a third of the relationship between volatility and high school completion operates through other changes in the household, such as mobility, and family or wealth dynamics. The literature on family stability suggests that, for many families, higher income volatility may capture a range of events occurring at the family unit level. Income volatility could be either a cause or consequence of uncertainty and instability of conditions within the household affecting children, including health, transportation, housing and neighborhoods, nutrition, and parental relationships (Hardy et al. 2019). All of these factors can shape high school completion through direct exposure of students to income volatility and related family dynamics. For young adults in college who are less embedded in the family household, income dynamics are less likely to be salient.

In columns 4–6 of Table 6, we present the results of similar models of college enrollment, conditional on high school completion. The patterns of association with demographic and family attributes are similar to those seen for high school graduation. We find that permanent family income or wealth are significantly and positively related to educational outcomes. However, we find no consistent relationship between parental income volatility during adolescence and subsequent college enrollment in columns 4 and 5. In column 6, we do find evidence that experiencing a large drop in family income while in high school reduces the chances of enrolling in college by 0.045. This may suggest that for teens in such families, the opportunity costs of post-secondary enrollment are especially acute. In any case, it appears that the role of income volatility during the teen years on education outcomes operates primarily through high school completion. In many respects, the volatility-educational attainment link to high school attainment is straightforward. In a higher education system that provides a range of low-cost, open access options (Andrews and Stange 2019), high family income volatility might simply reduce the likelihood of fulfilling the key necessary condition for college matriculation: graduating high school. Students exposed to high levels of income volatility may therefore face hard to observe threats to educational attainment and upward social mobility. For many children who nonetheless matriculate, other factors—including permanently low levels of family income—may loom larger as predictors of college persistence.

In Table 7, columns 1–3, we estimate the same models for college persistence. We find some evidence that permanent income during adolescence is a predictor of college persistence. However, neither income volatility nor experiencing a large drop in income have a statistically significant relationship with persistence, conditional on permanent income. In column 4 of Table 7, we include a measure of whether the student had matriculated first to a community college. We find that initial enrollment at a community college first lowers the likelihood of college persistence by 0.272. Indeed, college type is perhaps the most important predictor of persistence. This suggests that one important factor limiting post-secondary educational attainment for poor families may be that, compared to observationally equivalent higher income students, poor students are more likely to enroll in institutions with lower retention rates, consistent with findings from Hoxby and Turner (2015).

6 Conclusion and Policy Implications

Using the Transition to Adulthood data along with the main family file from the Panel Study of Income Dynamics, we examine the link between parental income dynamics and educational outcomes. Specifically, we examine how multiple years in poverty during adolescence as well as parental permanent income and income volatility predict educational attainment and persistence. Given the importance of educational attainment as a mechanism to facilitate upward mobility, our results are troubling, as parental economic conditions strongly predict high school graduation and post-secondary outcomes. That family economic background influences these educational outcomes is consistent with recent work by Pfeffer (2018), who finds wealth inequality to be a major driver of the intergenerational transmission of college degree attainment. Our examination is complementary and distinct, insofar as poverty spells, income volatility, and low permanent income represent unique channels through which the decision to attend college, as well as the likelihood of completion, could be impacted.

We find that multiple years of exposure to poverty during adolescence negatively predicts high school graduation, and the recency of poverty exposure seems to drive much of this association. This is important given that high school graduation is a necessary condition for matriculation into college of any type. During adolescence, poverty exposure negatively predicts college attendance as well, although much of this is mediated by family instability. Throughout our inquiry, family stability measures such as marital stability during adolescence positively predict high school graduation and college persistence, though for college matriculation family wealth renders marital stability statistically insignificant.

Our evidence with respect to the role of permanent income, in Tables 6 and 7, is consistent with the evidence on poverty exposure. Within these same models, we find that family income volatility in the adolescent years leading up to high school graduation is negatively associated with the likelihood of high school graduation or college persistence. As noted above, wealth has a consistent, albeit small, positive association with high school graduation and college matriculation; there is a weaker link between family wealth and college persistence. Finally, while policymakers have rightly emphasized the role of community college education as an affordable alternative, it is clear that young adults whose first college attendance is at a community college have lower rates of persistence. This may be due to the possibility that a share of these respondents did not intend to complete a two- or four- year degree; it is nonetheless important to note that entrance into a 2-year degree granting institution is associated with lower attainment for academically equivalent students.

The mechanisms driving the community college-4-year attainment relationship warrant further investigation. One possible explanation may be that many students choosing community colleges do so because of low tuition costs and the ability to enroll part time or at night, due to financial barriers and personal work or family obligations which themselves are likely to limit degree attainment. Indeed, we find in separate models (not shown) that poverty spells, low permanent income during adolescence, and family instability strongly predict community college attendance. At a minimum, these patterns raise questions about student readiness, and the varied instances in which community college may serve as a bridge or roadblock towards post-secondary educational attainment.

These findings are subject to some important limitations and caveats. One source of limitations our findings are due to the structure of the PSID data. Families and the young adults surveyed in the PSID-TA are interviewed only biennially. This affects the precision of our measures of both the dependent variables and key independent variable of interest. At the time of each PSID-TA survey, young adults who had been members of a PSID household and had reached the age of 18 since the last family interview were selected for inclusion in the PSID-TA sample. Since the survey is biennial, at the time of the first PSID-TA interview, respondents can be anywhere from 18 to 20 years old. So, questions about a respondent's post-secondary enrollment (or dropout) are administered at different times, introducing measurement error. Similarly, measurement of income in the family files is irregular, and our measures of inter-temporal income variation understate volatility. Both sources of measurement error likely contribute to attenuation bias. With the relatively small sample size available in the PSID-TA, the limitations this imposes on power are consequential. In our continuing work, we plan to make use of more detailed questions available about the timing of transitions to limit these problems, and to explore the use of supplemental time diary data.

A second limitation for the current paper pertains to the research design. Naturally, poverty during childhood can only be studied using observational data, so the potential for omitted variables bias in models like ours is a persistent threat to validity. While we make use of the features of the PSID to control for parental and family changes that may coincide with adolescent poverty, standardized measures of achievement, as well as cohort fixed effects, our results cannot be interpreted as causal.

Relatedly, the inclusion of controls rendering other explanatory factors insignificant does not mean those factors are unimportant in the broader human capital production function and educational attainment process. Indeed, many of these factors likely shape one another; for example, Black race is a construct reflecting social, historical, and economic exclusion from a range of markets and opportunities. Likewise, wealth likely shapes housing stability and standardized test preparation. A full exploration of the role of these important pre-market mechanisms is beyond the scope of our study.

A final limitation worth noting is that the high school graduation–college matriculation decision is likely connected for many students, as students weigh perceptions of their own academic performance and family financial capabilities as they approach graduation, along with perceptions of post-high school educational and labor market opportunities available to them. In short, students who do not anticipate college attendance, whether for reasons of affordability or aptitude, may be less motivated to graduate from high school (e.g. Stephan and Rosenbaum 2009; Stratton et al. 2008).

Despite these limitations, the current results do suggest implications relevant for policy, economic outcomes, and growth. In terms of policy, the ebbing of public funding for higher education in the United States has meant that need-based financial aid is becoming increasingly vital for access to post-secondary education for low-income families. Our findings suggest that inter-temporal variations in income—specifically poverty spells and income volatility—could negatively affect high school graduation, college going, and college completion for children from these families. This supports the possibility that need-based financial aid does not sufficiently buffer families from income loss, and that aid should not be withdrawn or limited in the case of financial windfalls. Our findings therefore suggest that, on net, these effects limit educational attainment.

A more complete understanding of how family economic circumstances, including income, exposure to poverty, and wealth, shapes young adults' educational outcomes is vital to better understanding how economic opportunity is transmitted, and how to enhance human development and growth in the future. We have not fully explored the mechanisms through which these dynamics operate, but we have attempted to account for secular trends as well as race, gender, family marital status, family residential moves, and measures of student ability. Policymakers might consider the array of immediate financial and psychic costs imposed upon students in the event of short and longer-term economic shocks that families may face. Low cost interventions may include aggressive financial counseling to help students connect with loanable funds markets, while higher cost interventions would include generous supplemental school-level financial aid loans and grants distributed to students with sudden, urgent needs.

Compliance with ethical standards

Conflict of interest The authors declare that they have no conflict of interest.

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