Trends in Income-Based Inequality in Postsecondary Education

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Dedication

To my father, Dr. Kishan J. Pandya, who would have loved to celebrate this accomplishment with me,
and to Asha, Meera, and Simran.

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Abstract

There has been widespread concern about both widening educational attainment gaps between children from upper- and lower-income families and widening disparities in parental behaviors that may be associated with widening attainment gaps. This dissertation comprises two studies that examined income-based gaps in attainment and parental behaviors between adolescents from families at the 90th and 10th percentile ranks of the income distribution for three cohorts of high school students between 1992 and 2013.

In the first paper, I examined changes over time in income-based gaps in parental involvement in the college-going process for two high school cohorts. Between the high school class of 1992 and the class of 2004, I found parents' aspirations for their adolescent's educational attainment increased across all income groups, with the largest increases among parents of low-income students, resulting in a narrowing of the gap. In contrast, income gaps in parents' financial investments for college and student college entrance exam preparation and test taking widened. I examined potential explanations for growing gaps and found support primarily for changing associations between income and parental involvement rather than rising income inequality.

In the second study, I documented income-based trends in college enrollment and college completion among cohorts comprising students enrolled in high school as of 9th or 10th grade. I found that the 90/10 college enrollment gap narrowed between 1992 and 2004 and then remained stable between 2004 and 2013. Gaps in four-year college and highly selective college enrollment also narrowed, but only slightly, and then stabilized. Finally, I found that the college completion gap narrowed between 1992 and 2004. These findings stand in contrast to some earlier studies. In attempting to reconcile results across different datasets, I showed that prior estimates of the widening of the enrollment gap between 1980 and 2000 were overstated because the relationship between enrollment timing and income has changed over time, and estimates of gap changes between cohorts were sensitive to the age/timing of when college enrollment was measured.

Introduction

Since the 1970s, income inequality has grown in the United States (Piketty & Saez, 2003, 2020). As income inequality has increased, a growing body of evidence has indicated that the starkest economic differences exist among families with children (Cooper & Pugh, 2020).

The experiences of children from different parts of the income distribution have diverged along a number of dimensions thought to impact their educational attainment (Duncan & Murnane, 2011). Residential segregation by income has grown, particularly among families with children (Owens, 2016; Reardon & Bischoff, 2011). School and school district segregation by income have increased, and there are widening gaps by income in private school enrollment (Murnane & Reardon, 2017; Owens, Reardon, & Jencks, 2016). Family composition has become increasingly correlated with income as children in high-income families are more and more likely to live with two married parents than children from low-income families and to have older mothers, who on average have higher levels education (McLanahan, 2004; Western, Percheski, & Bloome, 2008). Finally, income-based gaps in spending on children and time with children have also widened over time (Kornrich, 2016; Kornrich & Furstenberg, 2013; Ramey & Ramey, 2010; Schneider, Hastings, & LaBriola, 2018). Taken together, these findings present a bleak picture with regard to prospects for increasing social mobility and opportunity for children from low-income backgrounds (Duncan & Murnane, 2011). While the expansion of higher education enrollment could partially offset these trends, to date, it has not been enough to increase social mobility for low-income children (Bloome, Dyer, & Zhou, 2018).

Two notable studies by Reardon (2011a) and Bailey and Dynarski (2011) sounded an alarm of widening income-based gaps in educational outcomes over the period of rising income inequality. Reardon (2011a) examined gaps in educational achievement and Bailey and Dynarski (2011) examined gaps in educational attainment. In the literature, *achievement* typically refers to student performance, e.g., scores on standardized tests or grades, while *attainment* is used to indicate how far an individual has progressed in the educational system, e.g. whether an individual has graduated from high school or college or the number of years of completed education. Reardon (2011a), used multiple nationally representative datasets and documented widening income-based gaps in test scores among elementary and secondary students. Bailey and Dynarski (2011) documented widening gaps by income in college enrollment rates, bachelor's degree completion rates (interchangeably referred to as college completion), and years of education from the late 1970s to the early 2000s.

In response to these studies, scholars sought to understand to what degree widening income-based educational attainment and achievement gaps were the direct result of either increasing income inequality or the growing differences between high- and low-income children in neighborhoods, schools, families, and parental investments described above. Widening income inequality alone did not appear to fully explain widening educational gaps (Duncan, Kalil, & Ziol-Guest, 2017; Reardon, 2011a), and changes in family demographic characteristics accounted for some of the growth in the gap (Duncan et al., 2017).

Since Reardon's and Bailey and Dynarski's 2011 studies, other work has presented a more varied picture on the trends in income-based achievement and

attainment gaps. Some studies have corroborated Bailey and Dynarski's findings on gap trends in college enrollment and completion (Duncan et al., 2017; Ziol-Guest & Lee, 2016), whereas other studies have shown stable trends in income-based gaps in college enrollment in more recent periods (e.g. late 1990s – 2012) (Chetty, Hendren, Kline, Saez, & Turner, 2014). Further complicating the picture, Bastedo & Jacquette (2011) found socioeconomic status (a composite measure including parent education, parent occupation, family income and/or household possessions) gaps in college enrollment shrank between the 1970s and early 2000s. Finally, in direct contrast to Reardon's (2011a) findings, preliminary work by (Hashim, Kane, Kelley-Kemple, Laski, & Staiger, 2020) found narrowing income-based achievement gaps over the last 30 years.

This dissertation comprises two studies that contribute to the literature on the scope and potential mechanism behind income-based inequality in postsecondary educational attainment. In the first paper, I examined changes over time by income in parental behaviors related to the college-going process of their adolescents, one potential mechanism behind income-based college enrollment and completion gaps. Prior work is limited in that it has focused on income-based gaps in the educational experiences of young children or been focused broadly on investments of money or time (Bassok, Finch, Lee, Reardon, & Waldfogel, 2016; A. Kalil, Ziol-Guest, Ryan, & Markowitz, 2016; Kornrich, 2016; Kornrich & Furstenberg, 2013; Ramey & Ramey, 2010). My study is the first to examine trends by income in parental involvement and investment in activities with their adolescents that are directly related to the college-going process. Specifically, I examined changes over time in parental aspirations for their adolescents' educational attainment, discussions about college going, financial investments for postsecondary

education, and student test preparation and taking. I utilized rich student- and parent-reported survey information from two nationally representative cohorts of high school sophomores.

In the second paper, I examined trends in income-based college enrollment and completion gaps. To my knowledge, this is the first study to examine multiple types of college enrollment together with college completion for three cohorts of high school students since the 1990s. Examining four-year college enrollment and highly selective college enrollment in addition to any college enrollment allows for a more complete understanding of the scope and nature of income-based inequality in postsecondary education. Specifically, I addressed the hypothesis that four-year and highly selective college enrollment are important pathways for the maintenance of inequality in college completion (Lucas, 2001; Raftery & Hout, 1993; Ziol-Guest & Lee, 2016). Finally, I sought to reconcile my findings with prior estimates of income-based enrollment and completion gaps, and I offer several measurement, sample, and analytic considerations for future work.

In both studies, I used data from National Center for Education Statistics (NCES) longitudinal studies of high school students. In the first paper, I used the National Education Longitudinal Study of 1988 (NELS:88) and the Education Longitudinal Study of 2002 (ELS:2002) datasets. In the second study, I used the High School Longitudinal Study of 2009 (HSLS:09) dataset in addition to NELS:88 and ELS:2002.[1] I refer to each cohort by referencing the modal high school graduation year: Class of 1992, Class of

[1] I am not able to use data from HSLS:09 in the first study for two reasons. First, students were surveyed at different points in their high school career, which confounded estimates of changes over time with grade level effects. Second, the wording of many survey questions and response options were different in HSLS:09 than in the two earlier studies.

2004, and Class of 2013. All three studies followed students through their secondary and postsecondary years and were intended to measure similar constructs, which include the personal, familial, social, and institutional factors that affect their development (Ingels et al., 2015). I used detailed parent- and student-reported items on the adolescent's college-going process, college enrollment and completion information, and family income and demographic information.

I described trends by family income rank, focusing on families at the 10th, 50th, and 90th percentile ranks of the income distribution of families with adolescents of the relevant age. I refer to these as low-, median, and high-income families and/or adolescents, respectively. I also focused on the gap between high- and low-income adolescents (the 90/10 gap).

To date, these datasets had not been used to comprehensively track trends by family income in college enrollment and college completion. One likely reason is that the way income is reported in these surveys has made it challenging to compare across cohorts. Income was measured categoricially, and the categories have changed across surveys. However, Reardon (2011b) demonstrated a method to estimate a continuous income distribution from a set of ordered income categories, which I used in both studies.

Results from the first study indicated that while some income-based gaps in parental involvement and investment narrowed between the Class of 1992 and the Class of 2004, others widened. Specifically, I found that gaps between high- and low-income students narrowed in parents' aspirations for their educational attainment and discussions about college going. In contrast, however, I found that income-based gaps in parental financial investments and student college entrance exam preparation and taking widened.

I also examined potential explanations for growing gaps and found support primarily for changing associations between income and parental support. Rising income inequality and changing characteristics of families by income did not appear to explain widening gaps.

Results from the second paper showed that income-based college enrollment gaps narrowed and then remained stable between the 1990s and 2010s among cohorts comprising students enrolled in high school as of 10th grade (or 9th grade in the case of the Class of 2013). In contrast to other work (Clark, Ortman, Pharris-Ciurej, & Voorheis, 2020; Ziol-Guest & Lee, 2016), I found that college completion gaps narrowed between the high school classes of 1992 and 2004. I also examined income-based trends in four-year college enrollment and selective-college enrollment, and I found these gaps narrowed slightly and then stabilized. More generally, I found that gaps shifted in concert across the four outcomes for the cohorts that I studied. Scholars have hypothesized that completion gaps for more recent cohorts may be increasing due to widening gaps in four-year or selective college enrollment, even as overall enrollment gaps decline. However, I found that college completion gaps declined between 1992 and 2004, the two cohorts for which I have completion data, and that across cohorts, the direction and magnitude of gap changes on all four outcomes were consistent.

In the second part of the paper, I highlighted several important considerations for scholars who study income-based trends in postsecondary outcomes. First, I noted that one limitation of using samples of students who remain enrolled in tenth or twelfth grade is that rates of educational attainment are upwardly biased, particularly for low-income students. Second, I described the changing relationship between enrollment timing and

family income. An increasing share of low-income students enrolled in college more than two years after high school graduation. This delayed enrollment was almost exclusively in less than four-year institutions. Finally, I addressed the importance of appropriately using survey weights when constructing a relative measure of family income.

The rest of the dissertation proceeds as follows. In the next chapter, I present the first paper, "Income-Based Gaps in Parental Support During Adolescence: High School Classes of 1992 and 2004," in its entirety. The second paper, "Income-Based Trends in College Enrollment and Completion: 1992 – 2013" is presented in the third chapter. Finally, in the fourth chapter, I conclude with a discussion of findings from both studies and directions for future research.

Paper 1: Income-Based Gaps in Parental Support During Adolescence: High School Classes of 1992 and 2004

As income inequality has increased in the United States over the last several decades (Piketty & Saez, 2003, 2020), the experiences of children from different parts of the income distribution have diverged along a number of dimensions thought to impact their educational attainment (Cooper & Pugh, 2020; Duncan & Murnane, 2011). There has been substantial discussion in the literature about both changes in the income gap in educational outcomes and changes in parental behaviors that might be associated with them.

Scholars have documented growing disparities by family income in parental investments of money and time in their children. Education-related spending gaps between high- and low-income families (defined as top- and bottom-income decile families) have widened since the 1970s (Kornrich, 2016; Kornrich & Furstenberg, 2013; Schneider et al., 2018). Studies of parental time use have found sharp increases in time spent with children among the most highly educated families since the 1990s but not among other families. (Ramey & Ramey, 2010).

However, existing research on income-based gaps in parental behaviors over time is limited in several regards. First, many studies of parenting gaps have focused broadly on parental investments of time or money (Guryan, Hurst, & Kearney, 2008; Kornrich, 2016; Kornrich & Furstenberg, 2013; Ramey & Ramey, 2010; Schneider et al., 2018). Aggregating multiple types of expenditures or time diary responses may obfuscate trends in specific activities or behaviors, particularly if parents have reallocated their time or spending within categories. A second limitation has been a lack of attention to trends in

other types of parental involvement, such as parental aspirations for their children or educational planning and preparation, which have been shown to be associated with positive educational outcomes. In response to these limitations, studies have examined income-based gaps in parental activities with children, but their analyses have been limited to young children (e.g. Altintas, 2016; Bassok, Finch, Lee, Reardon, & Waldfogel, 2016; Kalil, Ziol-guest, Ryan, & Markowitz, 2016). To date, there has been little research exploring these questions with respect to adolescents.

In this study, I extend the research on income-based gaps in parental behaviors by examining specific measures of parental support and involvement aimed at the college-going process for adolescents. I examined activities in three domains: parental aspirations for students' educational attainment, college admissions test preparation and test taking, and financial preparation for postsecondary education expenses. (Hereafter, I refer to these as aspirations, test taking, and financial preparation, respectively.) Using a method developed by Reardon (2011b), I documented family income-rank-based trends and gaps in these domains for two cohorts of high school students, the high school classes of 1992 and 2004. I also examined the extent to which increasing income inequality, diverging family characteristics, and changing associations between income and parental behaviors explained widening income-based gaps in parental involvement in these domains.

I found that income-based gaps in some parental behaviors narrowed and others widened. Specifically, I found increasing levels of parental support in the domains of aspirations and financial preparation for low-, median-, and high-income students. Support for aspirations increased the most for low-income students, resulting in a narrowing of the parental aspiration gap between high- and low-income families between

1992 and 2004. However, income-based gaps in parental support for test taking and financial preparation for college widened between the two cohorts. Changing associations between income and parental behaviors, rather than diverging family income and family characteristics, accounted for much of the widening of the gaps.

Background

There has been substantial scholarly attention to changes in the income gap in educational outcomes over the period of rising income inequality (Bailey & Dynarski, 2011; Bastedo & Jaquette, 2011; Chetty et al., 2014; Reardon, 2011a; Ziol-Guest & Lee, 2016). Two initial and notable studies, by Reardon (2011a) and Bailey and Dynarski (2011), sounded an alarm of an apparent widening income-based gaps in educational achievement and educational attainment over the last several decades. In the literature, achievement typically refers to student performance (e.g. grades or standardized test scores), and attainment typically refers to student progress through the educational system (e.g. high school graduation or college enrollment). Reardon (2011a) documented widening gaps by income in test scores among elementary and secondary students. Bailey and Dynarski (2011) documented widening gaps by income in college enrollment rates and bachelor's degree completion rates.

In response to these two studies, scholars sought to understand to what degree widening income-based educational attainment and achievement gaps may be the direct result of either increasing income inequality or growing differences between high- and low-income children in neighborhoods, schools, families, and parental behaviors.

Class Divides in Parental Investments and Involvement

Scholars have documented growing differences between upper-income and college-educated parents, on the one hand, and lower-income and less-educated parents, on the other hand, in investments of time and money in their children. Studies of parental time use have found sharp increases in time spent with children among the most highly educated families since the 1990s but not among other families. (Ramey & Ramey, 2010). More recently, however, the growth in these time gaps has stabilized (Schneider et al., 2018). Moreover, educational "spending gaps" between high- and low-income families (defined as top- and bottom-income-decile families) and more- and less-educated parents grew between 1972 and 2010 (Kornrich, 2016; Kornrich & Furstenberg, 2013).

While the findings of the above-mentioned studies have been generally consistent with the hypothesis that upper-income families are increasingly investing more than lower-income families in their children in ways that might exacerbate income-based achievement and attainment gaps, they have been limited in that they have not examined parental engagement in activities and investments focused on fostering children's cognitive development and education. Studies that aggregate multiple types of expenditures or time diary responses may not be able to identify the trends in parental activities that are specifically educationally focused, particularly if families have reallocated investments within aggregate categories. For example, studies that examine spending on extracurricular lessons that includes both dance class and test preparation may miss trends specific to each of these activities. Educationally focused investments likely have greater impact on children's educational outcomes and failing to observe

them may also lead to a misunderstanding of the specific pathways by which parental behaviors impact educational outcomes.

Moreover, there are other parental behaviors and activities which may also impact children's educational achievement and attainment but are not captured in surveys of time use or spending. For example, parental aspirations for their children's future educational attainment and parents' planning for their children's education are not measured in these types of surveys. To date, only two studies have examined a broader range of specific income-based parental activity gaps with children over time, and these studies have been focused on young children (Bassok et al., 2016; A. Kalil et al., 2016). There is a dearth of research on these questions related to adolescents, particularly around the college-going process, a key access point for increased educational attainment and social mobility.

There are sizeable cross-sectional differences by family income in parental support aimed at college going; however, to date, studies have not examined how rates of these behaviors may have changed over time. Studies have documented large socioeconomic differences in financial preparation for college and adolescents' test taking. High socioeconomic status parents have been found to be more willing to pay for college and to save more, both of which were associated with students' college enrollment (Flaster, 2018; Hillman, Gast, & George-Jackson, 2015). Adolescents from higher-income families were more likely to engage in costly forms of college admissions test (e.g. SAT or ACT) preparation than adolescents from lower-income families, and these "shadow education" activities have implications for selective-college enrollment (Buchmann, Condron, & Roscigno, 2010). Given that upper-income parents, on average, have more human, social, and cultural capital to invest in their children, they likely have

an advantage over lower-income parents when it comes to having the resources, broadly construed, to make educationally and developmentally beneficial investments in their children (Lareau, 2002).

Explanations for Widening Divides in Parental Behaviors

Why might upper-income families be increasing their investments and involvement more than lower-income families? One explanation is growing income inequality. As the gap in income between upper- and lower-income families has grown, upper-income families may devote their additional resources to the educational development of their children (Schneider, Hastings & LaBriola, 2018). Also consistent with this argument, decomposition analyses of early childhood spending gap changes indicate that changes in the income distribution explain a large portion of the gap (Kornrich, 2016). In other words, spending gaps may be growing mechanically because higher-income families increasingly have more income to spend.

Demographic changes over the last several decades may also have contributed to widening gaps. Two trends are of particular note. First, children of more highly-educated mothers are increasingly more likely to be raised in families headed by two married parents than are children of less-educated mothers (McLanahan, 2004). Two-parent families, on average, have both more time and money to invest in their children (Hastings & Schneider, 2019). This increasing correlation over time between socioeconomic (i.e. education and income) advantage and married-parent family structure suggests that income-based parental investment gaps would increase. Some of this increase may operate through income inequality, since disparities in family structure contribute to growing income inequality (Western, Bloome, & Percheski, 2008). However, trends in

family structure may independently impact investments. Married parents have more time to spend with their children and potentially more money to invest net of income through economies of scale. The second trend is growing differences in median maternal age (McLanahan, 2004). Older mothers, on average, have more years of education, which may allow them to invest in their children in ways that are more developmentally advantageous (Kalil, Ryan, & Corey, 2012).

The growing importance of a college degree may also have elicited different responses from upper- and lower-income parents. With growing income inequality, upper-income parents may recognize that there are larger consequences to not attending a selective college and not completing college (Reeves, 2017). Alternatively, these families may feel they must increase their investments to maintain educational advantage as inequality moves to higher levels of the system (Lucas, 2001). They may also invest more because of a real or perceived sense of increased competition for scarce spots at selective colleges (Ramey & Ramey, 2010), which confer the largest average labor market returns (M. C. Long, 2008).

Based on the possible explanations above, I hypothesize that changes in the gaps across domains (aspirations, test taking, and financial preparation) would vary. If parents perceive increased competition and pressure for students to obtain elite college degrees, I would expect to find widening gaps across all three domains: parental aspirations for students' educational attainment, college admissions test preparation and test taking, and financial preparation for postsecondary education expenses. However, with rising income inequality and diverging family composition, I would expect widening gaps in test preparation and taking and financial preparation but not in aspirations.

A final possibility is that all families may be increasing their investments in their adolescents such that rates of parental involvement rise for all income groups while gaps remain unchanged. Investment theory posits that parents will invest in the development of their children's human capital because they anticipate future returns or benefits to them and their children (Becker, 1993; Guryan et al., 2008). As the monetary and non-monetary returns to a college degree grow (Autor, 2014; Baum, Kurose, & Ma, 2013), families of all income levels may invest more in their adolescents' cognitive and educational development because they anticipate a larger benefit.

In summary, the research on income-based changes in parental investments over time is limited in several regards. First, most studies have focused on investments of time and money, generally, without an examination of the specific education-focused activities in which parents are engaging. Therefore, less is known about changes over time in how parents may be fostering their children's academic and cognitive development. Second, the two studies that have examined gaps in parenting activities and educational investments over time are focused on young children, and neither study examined potential explanations for changing gaps over time.

In this study, I examined trends by family income in parental support in the domains of aspirations, test taking, and financial preparation aimed at fostering their high-school student's educational development. I focused on low-, median-, and high-income families (defined as families at the 10^{th}, 50^{th}, and 90^{th} income percentile ranks, respectively, of the income distribution of families with an adolescent in tenth or twelfth grade). My research questions are:

1. What are the trends by family income in parental support of their high school students' educational development? Have income-based parental support gaps grown?
2. To what extent do changes over time in parental support gaps reflect changes in the income gap and characteristics of low-, median-, and high-income families?

Data

I used data from two National Center for Education Statistics (NCES) surveys of high school students: the National Education Longitudinal Study of 1988 (NELS:88, hereafter referred to as the high school class of 1992) and the Education Longitudinal Study of 2002 (ELS:2002, hereafter referred to as the high school class of 2004).[2] These are nationally representative longitudinal surveys of high school students. Both studies followed students through their secondary and postsecondary years and were intended to measure similar constructs. These included the personal, familial, social, and institutional factors that affected their development (Ingels et al., 2015). Parents/guardians, teachers, and other school officials were also surveyed at various data collection waves. I used self-reported student survey items, self-reported parent/guardian survey items, and demographic data from waves conducted when students were in high school.

The survey administration processes for these two studies were similar but not identical. The class of 1992 was first surveyed when they were eighth graders (spring 1988); they were also surveyed twice in high school (tenth grade in spring 1990 and

[2] Ideally, I would have also used the most recent NCES survey of high school students the High School Longitudinal Study of 2009 (HSLS:09); however, exploratory analyses of these data indicated that differences in the timing of when students and parents were surveyed (9th and 11th grade rather than 10th and 12th grade) confounded changes over time with the timing of the survey. Additionally, survey questions and response options in HSLS:09 were not identical in many cases to questions in the other two studies.

twelfth grade in spring 1992). Students were added (i.e. the survey sample was freshened) in 1990 to ensure that the sample would be nationally representative of tenth graders. Parents of this cohort of students were surveyed twice, when students were in eighth grade and twelfth grade. The class of 2004 was first surveyed when they were in tenth grade (spring 2002), and they were also surveyed when they were in twelfth grade (spring 2004). Parents of these students were surveyed when students were in tenth grade.

Critical for this study is the fact that both cohorts of students were surveyed at the same points in their high school careers (tenth and twelfth grade).[3] However, the fact that parents were surveyed at different points in the students' high school careers posed difficulties. All parent-reported measures, including income, for the class of 1992 were from twelfth grade and for the class of 2004 were from tenth grade. It is possible that differences in the timing of survey administration may have contributed to differences in observed parent-reported measures of involvement between the two cohorts. I address this further in the limitations.

From each survey, I constructed samples of students who were enrolled in tenth grade and who responded to both waves of high school data collection.[4] In the case of the class of 1992, for whom parents were surveyed twice, I dropped students whose parents did not respond to either survey. For the class of 2004, I did not include students whose

[3] Technically, students in my sample are surveyed in 10th grade and again two years later. While I refer to this latter survey point as 12th grade because it is the modal grade for students in my sample, not all students are in 12th grade. A small number of students in each cohort have been held back or have graduated early.

[4] The ELS sample included tenth grade non-responders for whom missing data was imputed for that year.

parents did not respond to the parent survey. This resulted in a sample of 16,220 students in the class of 1992 and a sample of 12,540 students in the Class of 2004.[5]

I conducted multiple imputation using chained equations to address item-missing data on student- and parent-reported involvement measures and demographic variables. There were no missing values on income, parents' highest education, race/ethnicity, and family structure for the class of 2004 because this information was imputed by NCES; this was not done for the class of 1992. The missing rates of the variables ranged from 0.03% on student race/ethnicity to 18% on discussing going to college in the class of 1992 and from 7.6% on going on vacations or daytrips to 24% on test preparation in the class of 2004. The imputation model I used had all the variables described in the next section as well as student race, sex/gender, school type (public or private), parents' highest education level, and student year of birth. I generated 20 imputed data sets using Stata's MI command. All analytical models employed Stata's `mi estimate` command prefix to combine parameter estimates using Rubin's rules across the 20 imputed datasets.

Measures

This study focused on three domains of parental support: aspirations, test-taking, and financial preparation for postsecondary education. I examined eight measures of parental support. Five were student-reported and three were parent-reported. I selected measures that were worded similarly across the two datasets to avoid confounding changes in question wording with changes in parental involvement over time. There were a number of questions that I would have liked to use that I was unable to because they

[5] Sample sizes are rounded to the nearest ten per NCES reporting requirements.

were either asked only in one of the two studies or they were worded differently across the studies. For example, parents of students in the class of 1992 were asked "Have you ever encouraged your teenager to get a book, a manual, or a computer program, or to take a course that would help him/her to prepare" for college admissions tests (NORC, 1992, p. 36); parents were also asked, "When you and/or your teenager were deciding which school he/she would attend after high school, how many different schools did you visit with him/her?" (p. 38). These questions were not asked of parents of the class of 2004. The question posed to students in the twelfth-grade surveys about discussions with parents about college were worded differently. Students in the Class of 1992 were asked how often they had discussed "applying to college or other schools after high school" with their parents, but students in the class of 2004 were asked how often they had discussed "going to college" with their parents.

Aspirations. This domain included three student survey items which were direct or indirect measures of parents' aspirations for their adolescents' educational attainment. In tenth grade, students were asked how far in school they think their mother (or stepmother/female guardian) wanted them to go.[6] Students were presented a series of mutually exclusive options, which ranged from less than high school graduation to more than a college degree. From these, I created a binary measure indicating whether their mother wanted them to complete a bachelor's degree or more.

The remaining two questions asked students to report how frequently they discussed going to college (10th grade) and how frequently they discussed college entrance exam preparation with parents (12th grade). I consider these two measures to be

[6] In 12th grade, students responded to the same survey question. Results were similar to 10th grade responses.

indirect measures of parents' aspirations for their adolescent's college going, under the assumption that the more parents discuss these topics with their teenagers, the more they want them to attend college. Response options for these items were "never", "sometimes", or "often." I dichotomized these items with 1 indicating often and 0 indicating never or sometimes. I opted for this because conceptually, my assumption was that with regard to this domain the relevant dimension along which income-based gaps were likely was the intensive rather than the extensive margin. Additionally, as noted in the Methods section, I fit ordinary least squares regression models, and this approach resulted in the least loss of information given that "never" was the least selected response option.

Financial Preparation. I classified three measures of parental financial preparation for their teen's postsecondary education in this domain. The first measure was whether or not parents set up a college investment fund to financially prepare for their teenager's education after high school. While this item was ideal in that it was posed to parents, worded the same across the two surveys, and directly related to college-going, it was less than ideal because what constitutes "college investment funds" has changed over the time period of this study. The biggest change was the introduction of 529 College Savings Plans in 1996. Other savings vehicles for college education such as mutual funds, education IRAs (now known as Coverdell Education Savings Accounts), and Uniform Transfers/Gifts to Minors Accounts were available to families of both cohorts. Therefore, I also used a second item that asked parents whether they had made investments in stocks or real estate to prepare financially for their teen's education after high school. I considered this measure a robustness check on the first measure.

The third measure was how much money parents had set aside (approximately) for their teenager's future educational needs. Parents were asked to select a dollar value range. For the class of 1992, there were seven categories ranging from "none" to "more than $30,000." For the class of 2004, there were eight categories ranging from "none" to "more than $50,000." With the exception of the first and last categories, I recoded each category to its midpoint value. I maintained the first category as zero, and for the topmost category, which was bounded only at the minimum, I multiplied the value by 1.4. To harmonize the dollar values, I inflated them to 2018 dollars using the Consumer Price Index-All Urban Consumers (CPI-U). The resulting values ranged from zero to just over $77,000 for the Class of 1992 and from zero to just over $99,000 for the class of 2004.

Test Taking. I constructed two measures related to college-admissions testing. Both measures came from items in the twelfth-grade student survey. Students were asked whether they had taken or planned to several types of college admissions test preparation I created a binary variable for students who responded that they had taken or planned to take private one-on-one tutoring and/or a commercial test preparation course. This measure was intended to distinguish students who participated in the most costly forms of test preparation (Grodsky, 2010). I refer to this measure as expensive test preparation.

The second test-taking variable was whether or not students had taken or were planning to take either the SAT or ACT college admissions tests. During this time period, decisions to take college admissions tests likely occurred among students and families. Many of the programs and policies that have increased access to ACT and SAT test-taking among more recent cohorts, such as statewide or districtwide testing, were not

widespread at the time these cohorts were in high school.[7] Therefore, I posit that students' college admissions test taking can reasonably be considered within the umbrella of parental support and investment for these cohorts.

Family income. Family income was the key predictor of interest, and I primarily operationalized it as family income percentile rank. Family income was reported by a parent or guardian. Parents were asked to select the relevant range for the total family income in the prior calendar year (1991 for the Class of 1992, and 2001 for the Class of 2004). Parents of the Class of 1992 were specifically asked to report gross family income before taxes; however, this level of specificity was not included in the question for the Class of 2004.[8] For the Class of 1992, parents selected from 15 income categories, and for the Class of 2004, parents selected from 13 income categories. From these categorical variables, I generated a measure of family income percentile rank using a method developed by Reardon (2011b), which I describe in the next section.[9]

For some analyses, I used family income in addition to family income percentile rank. I obtained measures of household income from the Annual Social and Economic Supplement of the Current Population Survey (CPS) rather than from the NCES datasets directly.[10] I generated a continuous income distributions for households with adolescents

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[7] The exception being that Colorado and Illinois had implemented statewide ACT testing beginning with the high school class of 2002. By way of comparison, in the 2016-2017 school year 25 states required the SAT or ACT (Gewertz, 2017).

[8] The questions were as follows: Class of 1992: What was your total gross family income from all sources before taxes in 1991?; Class of 2004: What was your total family income from all sources in 2001?

[9] Reardon (2011b) found that gap estimates do not vary systematically with the number of categories in which income is reported.

[10] The lower bounds, upper bounds, and midpoint income values of the binned income categories from the NCES datasets could be used to provide measures of income percentile; however, it is not clear how accurate these would be because one has to assume a distribution of incomes across the category. For example, using the income categories of the Class of 2004, the second to last income bin ranged from approximately $142,000 to $284,000 and corresponded to the 87th to the

of the relevant ages to match my samples (adolescents who were 17 or 18 in 1992 and 15 or 16 in 2002) who were enrolled in school (Flood, King, Rodgers, Ruggles, & Warren, 2020).[11] I inflated income values to 2018 dollars using the CPI-U. I constructed my measure of income using household income, which was a continuous measure. In addition to household income, the CPS has a measure of family income. However, it was reported in binned categories, so I did not use that measure.

I matched the household income from the CPS, using its rank, to the estimated income percentile ranks in my datasets. This provided me with an income value for each income bin in my NCES datasets. I used a nearest neighbor matching strategy in cases where there was not an exact match between an income rank value in my sample and in the CPS data. Using the CPS data, I also identified incomes (in 2018 dollars) at the 10th, 50th, and 90th percentile ranks of the income distribution for each cohort.

Demographic measures. I used measures of family structure, maternal age, and parental education. I categorized families into four types: two biological/adoptive parents, one biological parent and one stepparent/partner, single biological/adoptive parent, and other. For the class of 2004, there was a continuous measure of maternal age; however, for the class of 1992 there were four categories of maternal age at the time of the teen's birth. I categorized the continuous age variable in the later cohort to match the categories

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97th percentile ranks of the distribution. Assuming that families were evenly distributed across incomes within the bin, the midpoint value of the bin, $212,677 would correspond to the 92nd percentile rank, and the 90th percentile income would be $184,312. By way of comparison, the 92nd percentile income from the CPS is $206,560, and the 90th percentile income from the CPS is $189,884.

[11] In the CPS, individuals report the previous calendar year's income, which is the same as NCES survey respondents are asked to report.

in the earlier cohort. The four categories were less than 20 years old, between 20 and 24 years, between 25 and 29 years, and 30 or more years old.

The parental education variable included five categories of parents' highest education level: less than a high school diploma, high school diploma, some college, bachelor's degree, and graduate degree. I operationalized this variable as education percentile rank using the same method (i.e. Reardon, 2011b) as I did for family income.

Methods

I would ideally have a continuous measure of family income and fit a polynomial regression model predicting each measure of parental support as a function of a family's percentile rank in the national income distribution of families with adolescents in a given grade level in high school. The model would be of the following form (assuming an equation of degree three for illustration):

$$Y = \beta_0 + \beta_1 Q + \beta_2 Q^2 + \beta_3 Q^3 + e, \quad (1)$$

where Y is the value of a given parental investment measure and Q indicates the percentile rank of the family income.

However, in these data income was measured in discrete categories rather than continuously. Reardon (2011b) demonstrated a method for estimating a continuous income distribution from a set of ordered income categories. This approach has been used in studies of income-based parental support during early childhood (Bassok et al., 2016; Kalil et al., 2016) and income-based private school enrollment trends (Murnane & Reardon, 2017). The method involves several steps. The first is to identify the proportion of the population in each income bin. The next is to determine the percentile ranks, $c_{k-1}$and c_k, associated with the lower and upper bounds of each binned income category.

Income category, k, has midpoint $\bar{Q}_k = \frac{c_k - c_{k-1}}{2}$, allowing me to define $Q^* = \bar{Q}_k$, $Q^{2*} = \bar{Q}_k^2 + \frac{(c_k - c_{k-1})^2}{12}$, and $Q^{3*} = \bar{Q}_k^3 + \frac{(c_k - c_{k-1})^3}{4}$.

Then the parameters of Equation (1) can be estimated by substituting Q^* for Q in equation (1):

$$Y = \beta_0 + \beta_1 Q^* + \beta_2 Q^{2*} + \beta_3 Q^{3*} + e, \qquad (2)$$

where Y is a parental support measure and Q^* indicates the percentile rank associated with the family's income category. I used both visual inspection and statistical tests to determine the lowest degree polynomial that reasonably fit the data. In most cases, this was degree three, so, for simplicity, I used a cubic function for all measures.[12]

To examine income-based trends and gaps in parental support, I made two types of comparisons. First, I tested differences between cohorts in average levels of parental investments at the 10th, 50th, and 90th percentile rank of the family income distribution. These estimates and associated standard errors were generated from the fitted parameters of Equation (2). Second, I computed gaps in parental investments (90/10, 90/50, and 50/10 gap) and associated standard errors for each cohort. For example, the 90/10 gap was computed as follows:

$$\hat{\delta}^{\frac{90}{10}} = \left[\hat{Y}\middle|Q = .9\right] - \left[\hat{Y}\middle|Q = .1\right] \qquad (3)$$

$$= \left[\hat{\beta}_0 + \hat{\beta}_1(.9) + \hat{\beta}_2(.81) + \hat{\beta}_3(.729)\right] - \left[\hat{\beta}_0 + \hat{\beta}_1(.1) + \hat{\beta}_2(.01) + \hat{\beta}_3(.001)\right]$$

[12] To estimate demographic characteristics at the 10th, 50th, and 90th, percentile ranks of the income distribution (Table 1.1), I fit a multinomial logit model, rather than an ordinary least squares regression model and estimated predicted values at the relevant percentile ranks. In these models, the income squared and income cubed terms were not significant; therefore, I opted for a parsimonious, linear function of income percentile rank (Q^*). Results from all three specifications were generally similar.

$$= .8\hat{\beta}_1 + .8\hat{\beta}_2 + .728\hat{\beta}_3.$$

The same process was used to calculate the 90/50 and 50/10 gaps, which are presented in the Appendix. I fit a fully interacted model and conducted *t*-tests to assess formally whether income-percentile-based parental investment gaps changed between cohorts.

While this literature has focused primarily on trends and gaps among high-, median-, and low-income families, with a particular emphasis on the gap between high- and low-income families, I also examined income-based trends and gaps for families at the 25th and 75th percentile ranks of the family income distribution; I present these results in the Appendix.

I examined potential explanations for widening income-based gaps in parental support using regression analyses and estimating gaps under two counterfactual scenarios. First, I estimated the 90/10 gap in parental support if the associations between income and support had remained at their 1992 levels and only the income distribution had changed (to the 2004 levels). I did this by estimating a within cohort regression model of the following form:

$$Y = \beta_0 + \beta_1 Q^* + \beta_2 Q^{2*} + \beta_3 Q^{3*} + \beta_4 \, HHinc18 + e \qquad (4)$$

where Y is a parental support measure, Q^* is defined as described above, and $HHinc18$ is the income (in 2018 dollars) associated with a given income percentile rank. I generated estimates of the 90/10 gap using the coefficients from this model (i.e. 1992) with 10th and 90th percentile income values from the 2004 cohort. The second counterfactual scenario I estimated was the 90/10 gap in parental support if the income distribution had remained at the 1992 level and only the associations between income and parental support had changed (to the 2004 levels). To do this, I used the coefficients from the model fit on the

class of 2004 and generated gap estimates using 10^{th} and 90^{th} income values from the 1992 cohort. If gap changes between cohorts were largely due to changes in the distribution of income, then I would expect the gap estimates from the first counterfactual scenario to approximate the gaps for the 2004 cohort. On the other hand, if the gap changes were largely due to changes in the association between income and parental support measures, then I would expect estimates from the second counterfactual scenario to approximate the gaps for the 2004 cohort.

I repeated these analyses adding in two family characteristics (family structure and maternal age) in the two counterfactual scenarios. In the first scenario, I estimated the 90/10 gap in parental support if the associations between income, family characteristics, and support had remained at their 1992 levels and only the income distribution and family characteristics had changed (to the 2004 levels). In the second scenario, I maintained the 1992 income and family characteristics and estimated the gap in parental support if the associations between income, family demographics, and support had changed (to the 2004 levels).

I also conducted the parental support trend and gap analyses using parental education percentile rank rather than family income rank as the explanatory variable. Persistent educational attainment gaps exist by parental education; however, the relative importance of parent education versus parental income to child achievement has shifted over time (Reardon, 2011a). Examining parent-education-based gaps in addition to income-based gaps is customary in this literature (e.g. Bassok et al., 2016; Kalil et al., 2016; Reardon, 2011a). I present the findings from these analyses in the main Results

section, primarily focusing on the differences between income and parent education in the trends and gaps.

All analyses took into account the complex designs of the NCES surveys by weighting the data using the relevant panel weights and by using the survey design variables to account for the clustering of the data. For both studies, I used the panel weights associated with the 10th and 12th grade waves of data collection. For the Class of 1992 respondents, this was the *f2f1pnwt* weight, and for the Class of 2004 respondents, this was the *f1pnlwt* weight. I employed Stata's `svyset` and `svy` prefix, using information on the primary sampling unit and stratum, to estimate Taylor linearized standard errors.

Results

Changes in Family Characteristics

There were stark differences in the estimated family characteristics of children at the 10th and 90th percentile ranks of the income distribution of families with a high school student (Table 1.1). In both cohorts, approximately half of low-income students but only approximately a quarter of high-income students were born to mothers younger than 25. Across cohorts, less than 40% of children in low-income families but over 80% of children in high-income families lived in two-married parent households. Finally, while approximately ten percent of low-income children had at least one parent with a bachelor's degree or more, this was the modal level of parental education for high-income children.

Three demographic trends affected all income groups. First, the share of students born to mothers 30 years of age and older (hereafter referred to as older mothers)

increased. Second, the share of two-parent families declined. The proportion of students in these types of households declined three to five percentage points across cohorts. Finally, the proportion of parents who reported having completed a bachelor's degree increased across income groups.

The data presented a mixed picture as to whether income-based family characteristic gaps increased in ways that could potentially exacerbate inequality in parental support. Changes in income gaps in maternal age were not directionally consistent with increased inequality. The 90/10 gap in the proportion of adolescents who were born to younger mothers, i.e. age <20, was approximately the same for the two cohorts, 11% and 10%, and the 90/10 gap in the proportion of adolescents who were born to older mothers declined from 16% to 13% between the two cohorts. Changes in family composition and parental educational attainment, however, were in the direction of increased inequality. The 90/10 gap in the proportion of two-parent families increased slightly, from 46% to 48%. The 90/10 gap in the proportion of parents with a bachelor's degree or higher grew by six percentage points from 54% to 60%.

A Background of Increasing Income Inequality

Income gaps between adolescents from high- and low-income families widened between the two cohorts. Table 1.1 displays family incomes (in 2018 dollars) at the 10^{th}, 50^{th}, and 90^{th} percentile ranks for both cohorts. The 90/10 income gap widened by about $26,000 from $139,000 to $165,000 between 1992 and 2004. The 90/50 income gap widened by approximately $24,000 from $83,000 to $107,000. These widening gaps were largely due to high-income families pulling away from their low- and median-income peers, as their income increased by approximately $31,000 over this time period.

Changes in Parental Support

For all but one measure, average levels of parental support increased between the two cohorts of students (Table 1.2). The proportion of students reporting that their mother wanted them to obtain a bachelor's degree increased by 13 percentage points from 69% to 82%. The proportion of students taking or planning to take college admissions tests increased by seven percentage points. One measure, whether a student had participated in any college admissions test preparation, showed no change with 58% of students participating in both cohorts. I now turn to trends in parental support by income and income-based gaps for each domain.

Aspirations. I found rising parental aspirations for students from low-, median-, and high-income families. Table 1.3 Panel A presents the proportion of parents providing support by income; within-income group changes over time in parental support are calculated by subtracting the value in 1992 from the value in 2004. The percentage of students reporting that their mother/female guardian wanted them to obtain a bachelor's degree or more increased 15, 14, and ten percentage points for low-, median-, and high-income, students respectively. For low-income students, frequently discussing college exam preparation increased by nine percentage points versus five for high-income students.

Between high- and low-income students, parental support gaps narrowed on each measure within the domain of aspirations between the 1992 cohort and the 2004 cohort (Table 1.3, Panel A.). The 90/10 gap in the proportion of students who reported that their mothers wanted them to obtain a bachelor's degree or more declined by five percentage points from 26% to 21% ($p<.05$). Figure 1.1 displays the fitted trend line and mean

values for each income bin. The shallower slope of the fitted line evidences the narrower gap for the class of 2004 (and the shift upward on the y-axis demonstrates the overall increase). The 90/10 gap in discussing college exam preparation declined by four percentage points ($p<.05$), and, while not statistically significant, the 90/10 gap in discussing college also declined.

Monetary Investments

Among the 2004 cohort, there were higher levels of parental financial investment for college going than among the 1992 cohort across all income groups (Table 1.3, Panel B). The proportion of high-income parents reporting that they had opened a college investment fund increased by 17 percentage points, and the proportion reporting that they had invested in stocks or real estate in order to save for college increased by 12 percentage points. Among low-income families, there was a one percentage point increase in the proportion who had opened a college investment fund, and there was a two-percentage point increase in the proportion who had invested in stocks or real estate.

Income-based gaps in the domain of monetary investments widened considerably between the two cohorts. The two panels of Figure 1.2 display the fitted lines for each cohort for each of these measures. The fitted functions for the class of 2004 are much steeper than for the class of 1992. The 90/10 gap in starting a college investment fund widened by 16 percentage points ($p<.001$), and the 90/10 gap in making investments in stocks or real estate widened by 10 percentage points ($p<.001$) (Table 1.3, Panel B). Finally, the gap in the amount of money families had set aside for their teen's postsecondary education also widened by approximately $2,000; however, this change was only marginally significant.

Test Taking

The measures within the domain of test taking were an exception to the pattern of rising levels of parental support across the three income groups (Table 1.3, Panel C). While students from median- and high-income families increased their participation in expensive test preparation and SAT/ACT taking, this was not the case for students from low-income families, who had small, non-significant increases in these two measures.

The 90/10 gap changes in the domain of test taking were small, positive, and in only one case statistically significant. The 90/10 gap in taking or planning to take a college admissions test widened by five percentage points ($p<.05$) from 42% to 47% between the class of 1992 and the class of 2004. Income-based gaps in expensive forms of test preparation also widened; however, this change was only marginally significant.[13]

Explanations for Widening Income-Based Parental Support Gaps

I found descriptive evidence that widening 90/10 gaps in parental support measures were due largely to changes in the association between income and parental support, and they were not due to rising income inequality. Figure 1.4 displays the 90/10 gap in 1992, the 90/10 gap under the two counterfactual scenarios (changing income distribution and changing associations), and the 90/10 gap in 2004. Gaps estimated using the 2004 model coefficients (changing associations) with 1992 income values (no change in the income distribution) largely replicated the actual gaps in 2004, whereas gaps

[13] The trends and gaps for families at the 75th and 25th percentile ranks were similar to trends for families at the 90th and 10th percentile ranks, respectively; however, as one might expect, they were attenuated. I found increased parental support in the domains of aspirations and monetary investments for 75th and 25th percentile rank families (Appendix Table A.1). I found increased parental support for test taking primarily among students at the 75th percentile rank and not among students at the 25th percentile rank. Changes in the 75/25 income-based gaps in parental support were directionally consistent with changes in the 90/10 gap, but they were attenuated.

estimated using 2004 income (changing income distribution) with 1992 model coefficients (no change in associations) did not.

One exception to this pattern, however, was the measure of the amount saved for postsecondary education. The 90/10 gap in this measure was wider under both counterfactual scenarios, which indicated that it was a combination of changes in the income distribution and the income association that explained the widening 90/10 gap in this measure (Figure 1.5).

When I included family characteristics in the two counterfactual scenarios, changing associations, rather than a changing income distribution or changing family characteristics, still explained the gap growth. More generally, the patterns were largely unchanged when I included family characteristics in the two counterfactual scenarios. Figure 1.6 displays the 90/10 gap in 1992, 2004, and under the two counterfactual scenarios that included family characteristics. Gaps estimated using the 2004 model coefficients (changing associations) with 1992 income values and family characteristics largely replicated the actual gaps in 2004. Gaps estimated using 2004 income and family characteristics with 1992 model coefficients (no change in associations) did not.

Parental Education-Based Gaps

Changes in parent-education rank gaps (hereafter referred to as "education gaps") across all three domains were consistent with the story of an increasing importance of income and a decreasing salience of education. In other words, education gaps either shrank more or widened less than income gaps; measures in the domain of test taking were an exception to this. Below, I describe the 90/10 gaps, which are presented in

Appendix Table A.3, along with the 90/50 and 50/10 gaps. Trends at the 10th, 50th, and 90th percentile ranks are presented in Appendix Table A.2.

Aspirations. The 90/10 education gaps in parental aspirations shrank by a greater amount than the income-based aspiration gaps (Figure 1.7). However, the 90/10 education gaps in parental aspirations were larger than the 90/10 income gaps for both cohorts.

Monetary Investments. The 90/10 education gaps in parents' monetary did not increase as much as the income-based gaps between cohorts (Figure 1.8). For example, the 90/10 education gap change for setting up a college investment fund was 12 percentage points and the 90/10 education gap change for making investments was about 7 percentage points; the corresponding figures for income gaps were 16 and 10 percentage points, respectively.

Test Taking. Like the 90/10 income gap in expensive test preparation, the 90/10 education gap widened. However, while the 90/10 income gap in college admissions test taking widened, the 90/10 education gap shrank, by about five percentage points between cohorts.

Limitations

There are several data limitations to the present study. Survey data can suffer from social desirability bias, namely that respondents answer questions in ways that they perceive will be viewed favorably by others. It is unclear to what degree adolescents' responses to questions about parental involvement would suffer from this form of bias; however, it is likely that parent responses were impacted. For the purposes of this study, social desirability bias is a concern if the magnitude of this bias has changed over time or

if it has changed over time in a way that is not uniform by income. Changes between cohorts may be overestimated if social desirability bias has increased over time. If social desirability bias has increased more for high- versus low-income families over time, then in the case of widening gaps, these changes may be overestimated. In measures with shrinking gap changes, these changes may be underestimated.

A second limitation is that parents of adolescents in the two cohorts were not surveyed at the same time points in the students' high school careers. For the class of 1992, parents were surveyed when students were in 12th grade, and for the class of 2004, parents were surveyed when students were in 10th grade. For the measures related to financial preparation for college, I posit that parents of 17-18 year olds have done more to prepare than parents of 15-16 year olds. Therefore, because the parents of the class of 2004 were surveyed when their children were younger, I consider the estimates of the increase across cohorts in financial preparation to be conservative.

While the parent questionnaires for the two cohorts asked the same question related to college investment funds, the financial products available to parents changed over this time period. Parents were asked: "Which of the following have you or your spouse/partner done to financially prepare for your tenth/twelfth grader's education after high school? Set up a college investment fund (such as mutual funds)." The biggest change was the introduction of 529 College Savings Plans in 1996. However, other common savings vehicles for college education such as mutual funds, education IRAs (now known as Coverdell Education Savings Accounts), and Uniform Transfers/Gifts to Minors Accounts were available to families of both cohorts.

Another data limitation was the measures of income. The NCES datasets included categorical measures of family income. In order to examine the role of income inequality, I needed a continuous measure of family income, and I used income information from the CPS, which is also a survey. This was reported at the household level and not the family level. The primary concern with household income is that it may include the income of unrelated individuals living in the household. If the likelihood of it differing varies by income, it may bias my results. However, since I limited the CPS sample to households with adolescents of a given age who attend school (not college), the sample was likely primarily composed of families. Nonetheless, the different income measures are a limitation of the present study.

Finally, it is important to note that I was only able to observe differences in the quantity and not the quality of parental support. I coded my outcome variables based on student- or parent-reported quantity of a given activity. The assumption being that a greater quantity of support has greater educational benefits. It may be the case, however, that fewer, high-quality interactions have the same or even greater benefit than frequent, low-quality interactions. A related concern is that there were qualitative differences in parental support by income that I was not able to observe. Parents who had attended college themselves or had college graduates in their social network, as high-income individuals typically do, may have had more sophisticated knowledge of the college-going process and were therefore able to give more detailed advice and information when providing support to their adolescent. My results may underestimate income-based differences in parental support by only focusing on the quantity and not the quality of the support.

Discussion

Researchers know little about whether the socioeconomic gaps in adolescents' parental support for college attendance has changed over time. This study investigated this question by examining income- and education-based trends and gaps in parental support related to college aspirations, financial preparation for postsecondary education expenses, and test taking for two cohorts of high school students in 1992 and 2004.

While prior studies have shown widening income gaps in parental financial investments and time spent with children (Kornrich, 2016; Kornrich & Furstenberg, 2013; Ramey & Ramey, 2010; Schneider et al., 2018), my results showed a less consistent picture, with gaps in some domains widening and others shrinking. I found widening income gaps in financial preparation for postsecondary education expenses and widening, although not statistically significant, gaps in expensive forms of college admissions test preparation and test taking. In contrast, I found shrinking gaps in the domain of parental aspirations for their adolescents' educational attainment.

The two domains in which I found widening gaps were those that require both financial resources as well as access to information. For test preparation and test taking, parents and/or students must have access to information about test preparation courses and/or tutors and the financial resources to pay for them as well as the resources to pay to take the tests. Similarly, financial preparation for college, using college investment funds or stocks, requires that families have both the resources to set aside funds for future education as well as the knowledge of relevant savings and investment products.

While the widening of the gaps in these domains would suggest that the mechanical effect of rising income inequality or the widening gaps in family composition

may have played a role, that was not what I found. Instead, I found that the associations between income and parental support measures increased between cohorts. This suggests "contextual effects of income inequality" (Schneider et al., 2018, p.480) such that parents' behaviors towards their adolescents shift because of perceived societal changes due to income inequality. Under this mechanism, the pathway between income inequality and parental investments is not through income per se. Rather, rising income inequality may have differentially changed parents' attitudes, beliefs, and preferences such that high-income parents feel pressured to invest in their adolescents to ensure access to particular educational experiences and labor market success (Ramey & Ramey, 2010; Reardon, 2011a; Reeves, 2017; Schneider et al., 2018). This perceived need to invest may be a result of parents' heightened sense of competition around highly selective college enrollment (Ramey & Ramey, 2010; Reeves, 2017), or their observation of the increased wage premium paid to college educated workers (Autor, 2014).

Examining the differences between family income and parent education in the 90/10 gap change patterns suggests the increasing primacy of income, rather than parent education or human capital. As noted above, the parental involvement measures that displayed increased stratification were those that required both financial resources and access to certain forms of knowledge. However, in general in both domains, I found that gaps by income widened more than gaps by education. In the case of financial preparation, the income gap in starting a college investment fund increased by more than the education gap (Figure 1.8). Similarly, the income gap in college entrance exam test taking increased by more than the education gap (which actually declined). Finally, in the

domain of aspirations, which did not require resources, the gaps narrowed more by parental education than by income.

Taken together these findings point to an increasing importance of income and a declining importance of parent education with regard to investment gaps, which has also been found in studies of income-based educational achievement gaps over time (Reardon, 2011a) and parental activity gaps with young children (Kalil et al., 2016). This is not to say that parent education was not associated with gaps in investments; it certainly was, as it has been in other studies of parental investments (e.g. Guryan et al., 2008; Ramey & Ramey, 2010; Schneider et al., 2018). Furthermore, in some cases education-based gaps were larger than income-based gaps. What these results suggests is that even with the strong correlation of family income and parental education, there were distinct effects of the two, and across cohorts the general trend was that income gaps widened more (or shrank less) while education gaps widened less (or shrank more).

The narrowing income gaps in the domain of aspirations, the set of measures which did not require financial resources, suggest that low-income families were invested in the educational attainment of their adolescents when it came to parental behaviors that did not require (much) time or money. Income-based gaps in parents' stated aspirations for their teen's educational attainment narrowed. Income gaps also narrowed for the two measures involving frequent discussions about going to college and college entrance exam preparation, albeit not significantly in the latter case. These gaps shrank because low-income families increased their involvement more than high-income families.

These findings are consistent with recent research which has shown that the norm of intensive parenting has become pervasive across socioeconomic classes (Ishizuka,

2019). These findings may also indicate a contextual effect of rising income inequality for low-income families. Low-income parents' behaviors may also have changed because of the perception of the increased importance of attending college for social mobility and financial security. The contextual effect of income inequality may be heterogeneous. Unlike high-income parents, low-income parents would not necessarily have the financial means to invest monetarily; however, they may shift their behaviors in other ways, but in service of the same ends. Finally, the narrowing of the gap in aspirations may also be the result of the penetration of the "College for All" movement over the time period of this study (Carnevale, 2008; Goyette, 2008). Advocates argued that all students should have the opportunity to attend college and, the movement was motivated by a desire to promote access and equity for students historically underrepresented in higher education.

My findings related to measures within the domain of aspirations that involved conversations between adolescents and parents can be reconciled with prior studies on parental time use, which have documented widening gaps. While overall gaps in time spent could be widening, gaps related to discussions on college-going could be shrinking if low-income parents reallocated the time they spent with their adolescents.

While not directly relevant to questions of gap changes between cohorts, two overall trends are worth highlighting. First, average levels of parental involvement increased across all three domains. This is likely because parents in all income groups were aware of the growing monetary and non-monetary returns to a college degree grow (Autor, 2014; Baum et al., 2013), and consequently, they were providing increased support to their adolescents to achieve this level of education. However, even with these increases and shrinking gaps in the domain of aspirations, absolute differences between

adolescents from high- and low-income families remained large. Over twice as many high-income students (87%) as low-income students (40%) had taken or planned to take a college admissions test in 2004. Moreover, low-income parents were not able to keep pace with high-income parents in financial preparation for college. High-income parents had saved approximately ten times as much for their adolescent's education after high school as low-income parents ($27,000 vs. $2,900).

In summary, this study contributes to a growing body of research seeking to understand whether and to what degree gaps by income and education in parental involvement are changing and what may explain changes in these gaps. Growth in these gaps, particularly against a backdrop of rising income inequality and widening disparities in other features of children's lives, are of concern because they have the potential to exacerbate educational achievement and attainment gaps by socioeconomic status. Understanding the nature, causes, and consequences of changes in parental involvement by income and education are important for identifying policy solutions aimed at reducing these gaps.

Figures

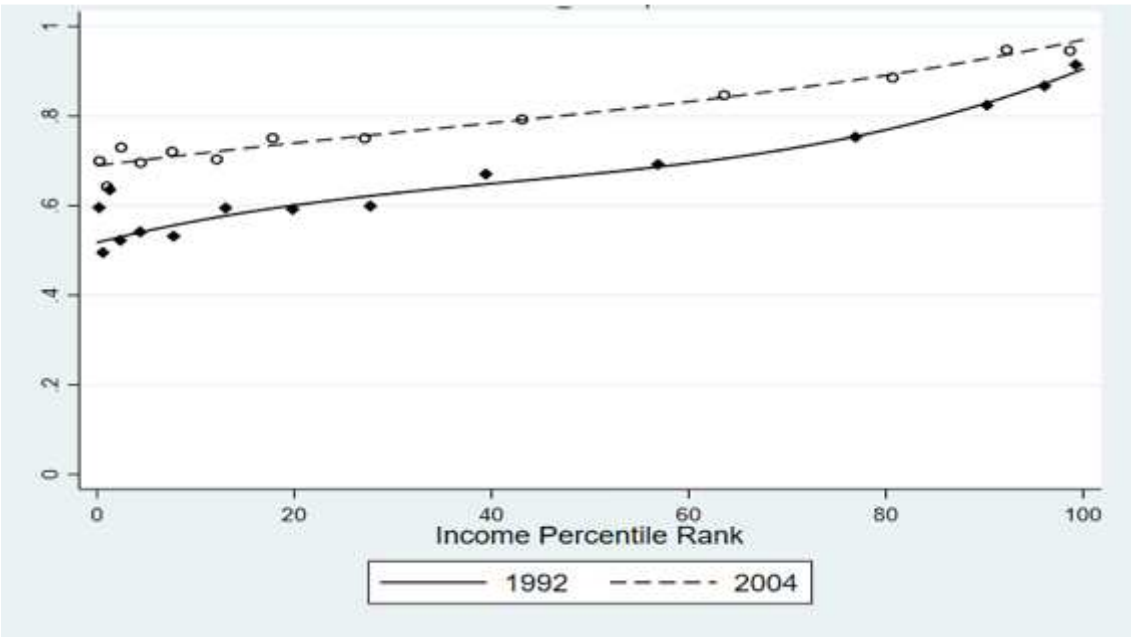

Figure 1.1. Proportion of students by income percentile rank reporting that their mothers/female guardians want them to complete a bachelor's degree or more: Class of 1992 and Class of 2004.

a. Set up a college investment fund

b. Made investments in stocks or real estate

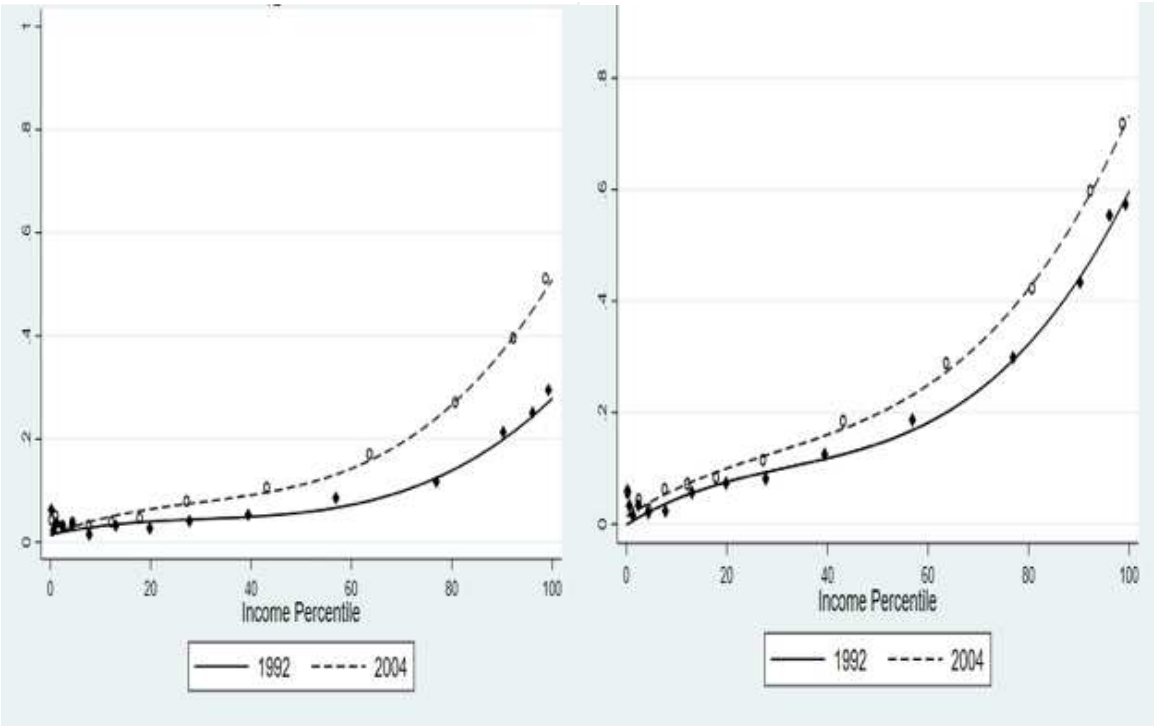

Figure 1.2. Proportion of parents who reported having (a) set up a college investment fund and (b) made investments in stocks or real estate to financially prepare for their student's education after high school: Class of 1992 and Class of 2004.

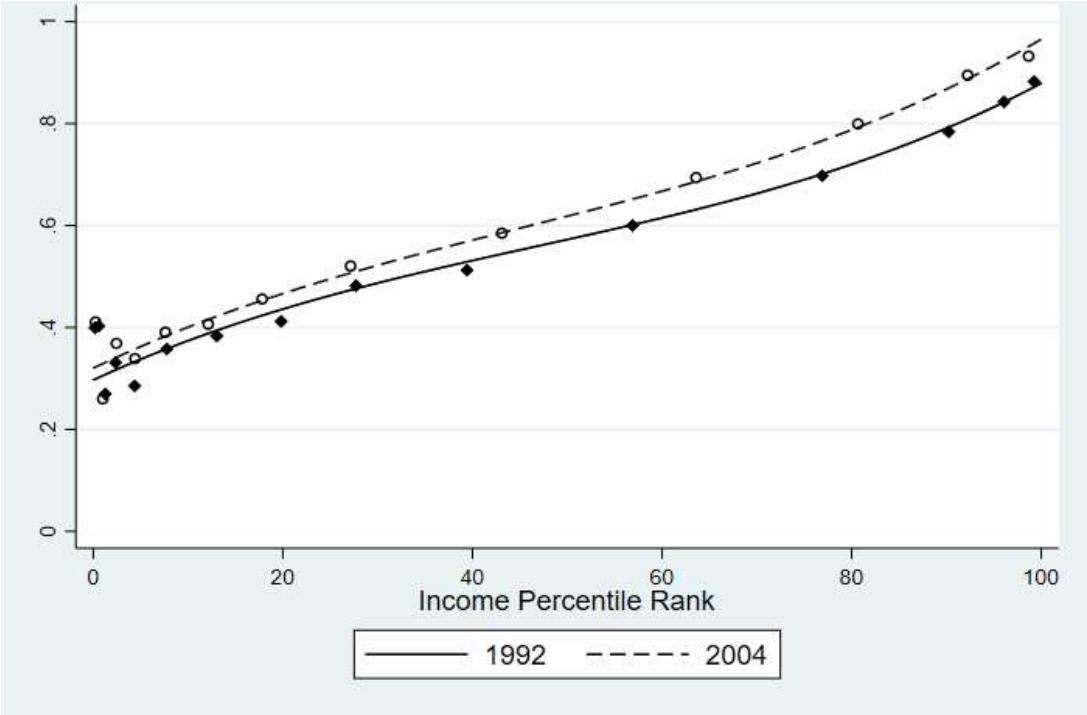

Figure 1.3. Proportion of twelfth grade students who reported having taken or planning to take a college admissions tests: Class of 1992 and Class of 2004.

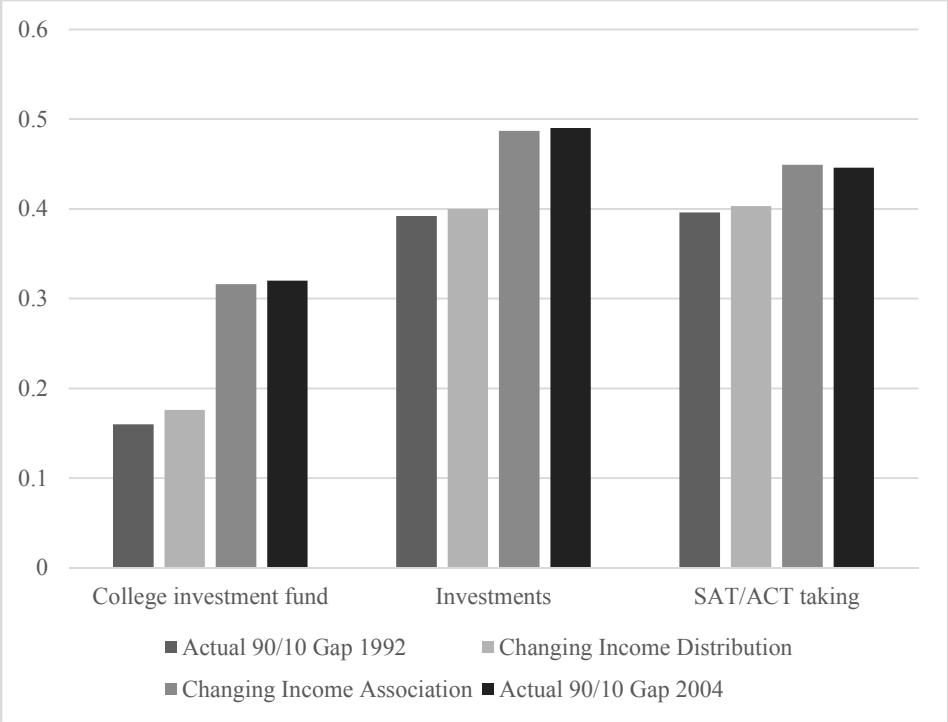

Figure 1.4. Estimated and counterfactual 90/10 parental support gaps under two scenarios: (1) changing income distribution, but no change in association between income and parent supports, and (2) changing income association, but no change in income distribution.

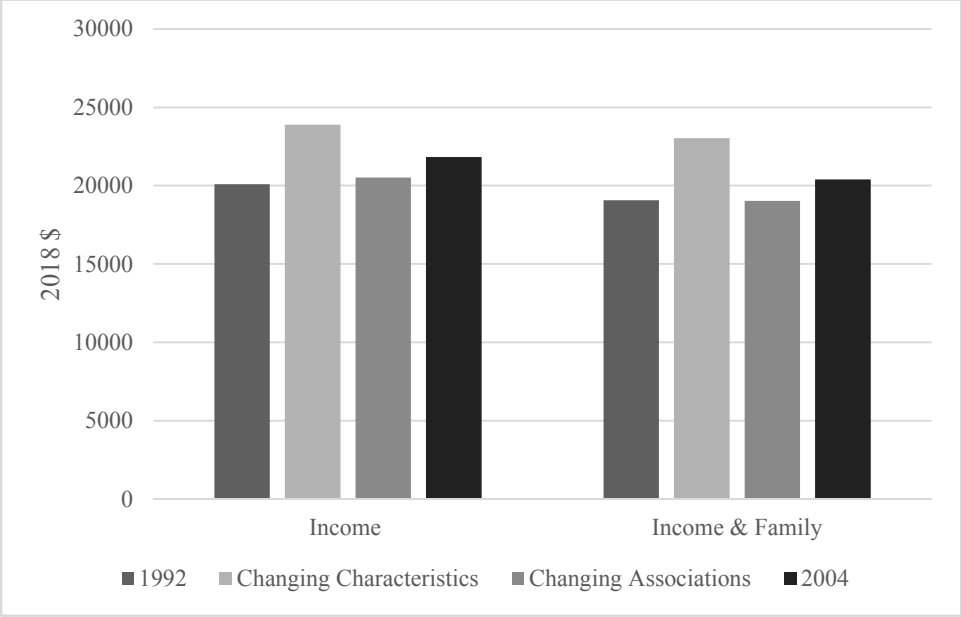

Figure 1.5. Estimated and counterfactual 90/10 gap in amount saved under two scenarios: (1) changing distribution of income (and family characteristics), but no change in associations, and (2) changing income association (and associations with family characteristics), but no change in distribution. Right-hand side panel includes family characteristics with income.

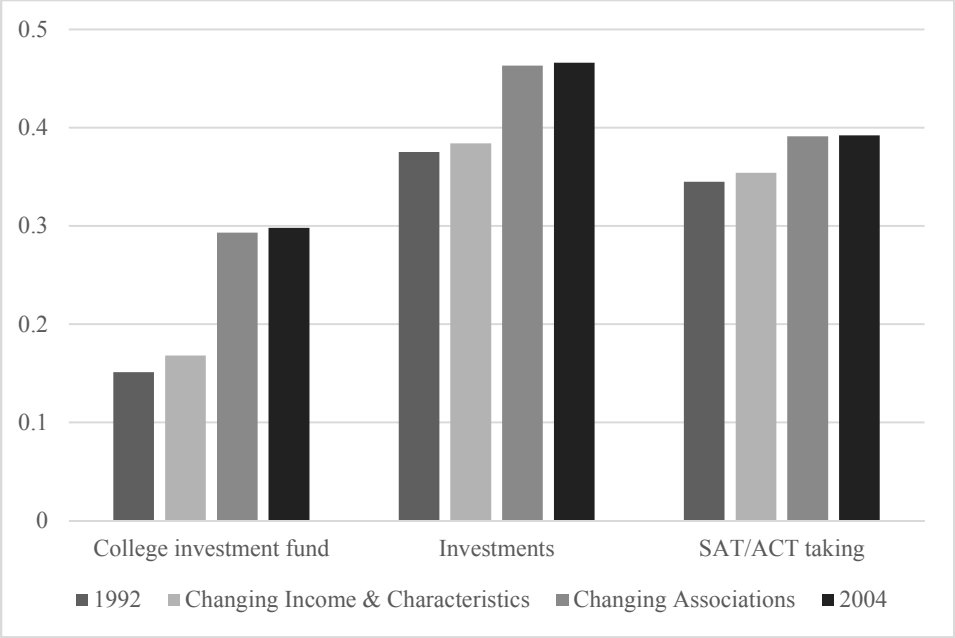

Figure 1.6. Estimated and counterfactual 90/10 parental support gaps under two scenarios: (1) changing income and family characteristics, but no changes in associations and (2) changing associations, but no change in income or family characteristics.

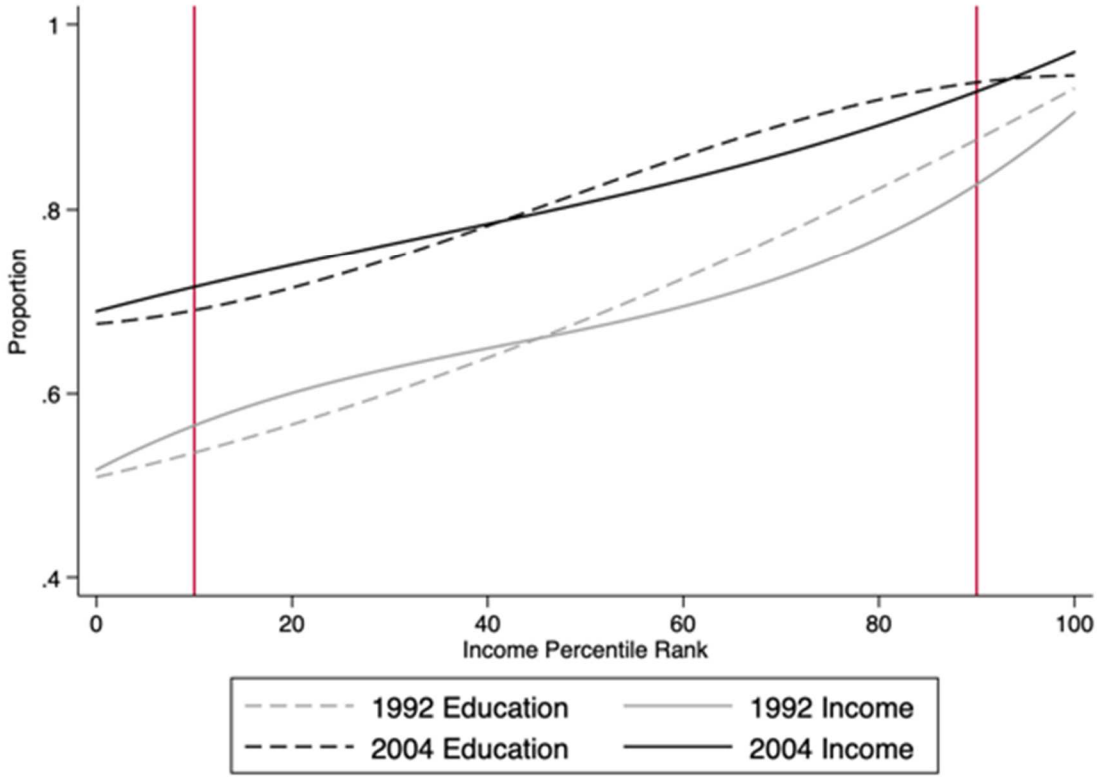

Figure 1.7. Proportion of students by income percentile rank and education percentile rank reporting that their mothers/female guardians want them to complete a bachelor's degree or more: Class of 1992 and Class of 2004.

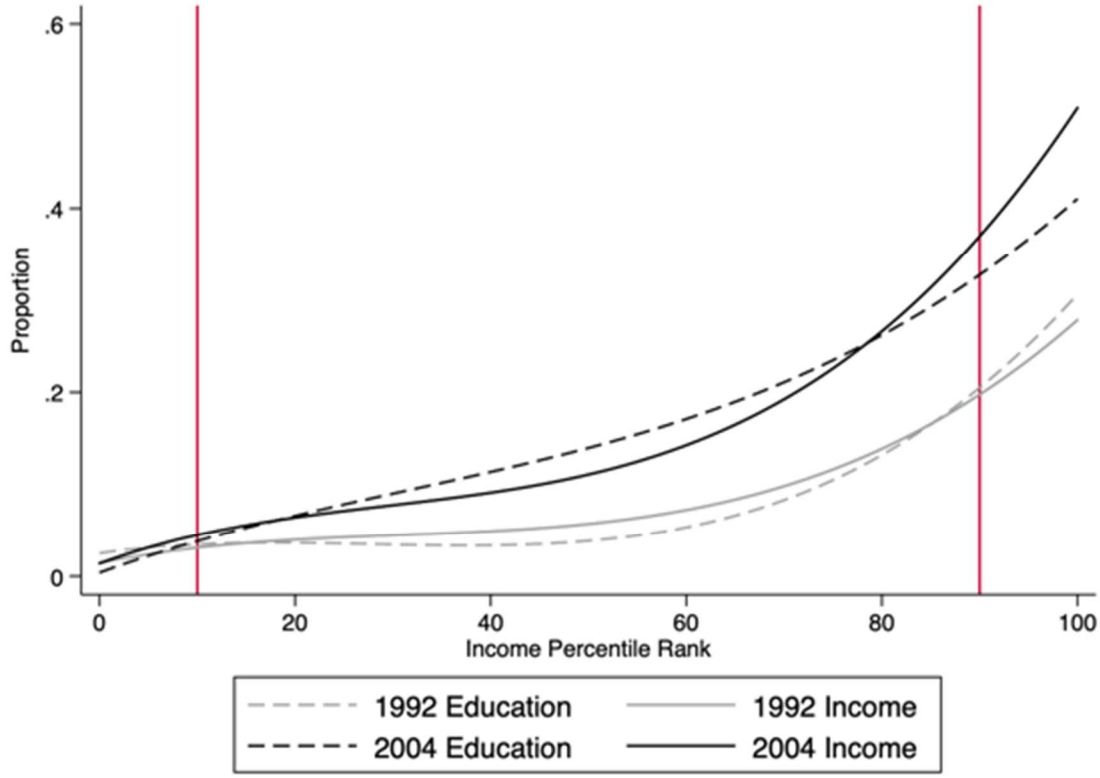

Figure 1.8. Proportion of parents by income percentile rank and education percentile rank who reported having set up a college investment fund to financially prepare for their student's education after high school: Class of 1992 and Class of 2004.

Tables

Table 1
Estimated Demographic Characteristics at the 10th, 50th, and 90th Percentile Ranks of Income: High School Class of 1992 and 2004

	10th Percentile			50th Percentile		90th Percentile		
	1992	2004	Δ	1992	2004	1992	2004	Δ
Mother's age at teen's birth								
< 20	0.16	0.14	-0.02	0.09	0.08	0.05	0.04	-0.01
20-24	0.38	0.34	-0.04	0.31	0.27	0.23	0.19	-0.04
25-29	0.27	0.26	-0.01	0.35	0.33	0.42	0.38	-0.04
≥30	0.19	0.26	0.07	0.25	0.33	0.30	0.39	0.08
Family structure								
Two married biological or adoptive parents	0.36	0.32	-0.05	0.66	0.61	0.83	0.80	-0.03
Stepfamily	0.14	0.14	0.01	0.16	0.18	0.13	0.15	0.02
Single parent	0.47	0.47	0.00	0.17	0.18	0.04	0.04	0.00
Other	0.03	0.07	0.04	0.01	0.04	0.00	0.01	0.01
Parent education								
Less than high school	0.23	0.17	-0.06	0.05	0.03	0.01	0.00	0.00
High school	0.31	0.33	0.02	0.22	0.20	0.08	0.06	-0.02
Some college	0.39	0.39	0.00	0.47	0.41	0.31	0.23	-0.08
Bachelor's degree and higher	0.07	0.11	0.04	0.26	0.36	0.61	0.70	0.10
Teen's Race								
Asian (non-Hispanic)	0.04	0.04	0.00	0.04	0.04	0.03	0.04	0.00
Black (non-Hispanic)	0.25	0.24	-0.01	0.11	0.12	0.04	0.05	0.01
Hispanic	0.17	0.27	0.09	0.08	0.14	0.03	0.06	0.03
White (non-Hispanic)	0.52	0.40	-0.12	0.76	0.65	0.89	0.82	-0.07

Other	0.01	0.06	0.05	0.01	0.05	0.01	0.04	0.03
Household Income (2018$)	19934	24813	4879	75590	82705	158542	189884	31342

Note. To estimate demographic characteristics at the 10th, 50th, and 90th, percentile ranks of the income distribution, I fit a multinomial logit model and estimated predicted values at the relevant percentile ranks. In these models, I fit a linear function of income percentile rank. Sample sizes, rounded to the nearest to 10 per the reporting rules of the National Center for Education Statistics, are 16,220 (Class of 1992) and 12,540 (Class of 2004), respectively. Household income comes from the Current Population Survey and is inflated to 2018$ using the Consumer Price Index.

Table 1.2

Average Parental Support: High School Classes of 1992 and 2004.

	Mean	
Measures	1992	2004
A. Aspirations		
Mother wants teen to obtain BA or more	0.69	0.82
Often discussed going to college with parents	0.38	0.44
Often discussed college exam preparation with parents	0.17	0.23
B. Monetary Investments		
Amount set aside for teen's education after high school (2018$)	9523	10480
Set up a college investment fund	0.09	0.17
Made investments in stocks or real estate	0.20	0.26
C. Test Taking		
Teen has taken/ plans to take a course offered by commercial test preparation service and/or one-on-one tutoring to prepare for the SAT/ACT	0.14	0.17
Teen has taken SAT or ACT	0.57	0.63

Table 1.3
Parental Support at the 10th, 50th, and 90th Percentile Ranks of the Income Distribution and the 90/10 Gap: High School Classes of 1992 and 2004.

	10th Percentile		50th Percentile		90th Percentile		90/10 Gap		
Measures	1992	2004	1992	2004	1992	2004	1992	2004	Δ
A. Aspirations									
Mother wants teen to obtain BA or more	0.57	0.72***	0.67	0.81***	0.83	0.93**	0.26	0.21	-0.05*
Often discussed going to college with parents	0.33	0.40***	0.36	0.41***	0.46	0.52**	0.13	0.11	-0.02
Often discussed college exam preparation with parents	0.13	0.23***	0.16	0.21***	0.23	0.29**	0.11	0.06	-0.04*
B. Monetary Investments									
Amount set aside for teen's education after high school (2018$)	2281	2920+	4455	3529	24436	27111*	22155	24191	2036+
Set up a college investment fund	0.03	0.04*	0.06	0.11***	0.20	0.37***	0.17	0.32	0.16***
Made investments in stocks or real estate	0.04	0.06*	0.14	0.20***	0.44	0.56***	0.40	0.49	0.10***
C. Test Taking									
Teen has taken/plans to take a commercial test preparation course and/or one-on-one tutoring	0.15	0.17	0.08	0.11***	0.22	0.26*	0.08	0.09	0.02
Teen has taken SAT or ACT	0.37	0.40	0.57	0.62**	0.79	0.87***	0.42	0.47	0.05*

+p<.10 *p < .05 **p < .01 ***p < .001.

Paper 2: Income-Based Trends in College Enrollment and Completion: 1992 – 2013

Concern over rising income inequality in the United States has generated interest in understanding the degree to which children from different income backgrounds may be differentially attaining postsecondary education. In the literature, postsecondary attainment is typically measured using college enrollment (in any type of institution, i.e. two- or four-year) and bachelor's (BA) degree completion, interchangeably referred to here and in most of the cited literature as college completion.[14] Completing college is a key pathway for social mobility, as the economic returns to a college degree are large (Autor, 2014).

The evidence on whether income-based gaps in postsecondary enrollment and completion have widened has been mixed, particularly for more recent cohorts. Several studies focusing on adolescents of college age in the 1970s to the early 2000s have reported widening income-based gaps in college enrollment and completion (Bailey & Dynarski, 2011; Duncan et al., 2017; Ziol-Guest & Lee, 2016). Studies of more recent cohorts, however, have noted that income-based trends in college enrollment have stabilized or even narrowed slightly while income-based gaps in college completion have continued to widen (Chetty et al., 2014; Clark et al., 2020; Ziol-Guest & Lee, 2016).

One limitation of prior studies is that they have not examined multiple measures of college enrollment and completion that would provide a more complete understanding of the extent of income-based inequality in postsecondary attainment. For example, some

[14] Together, enrollment and completion can also be used to measure persistence, another common postsecondary attainment measure. However, persistence is not a focus of this study.

studies have only examined socioeconomic trends in enrollment and not completion (e.g. Bastedo & Jaquette, 2011; Chetty et al., 2014; Reardon, Baker, & Klasik, 2012). Studies that have examined both enrollment and completion (e.g. (Bailey & Dynarski, 2011; Duncan et al., 2017; Ziol-Guest & Lee, 2016) have not examined enrollment trends in different types of institutions (i.e. two- vs. four-year or highly-selective). Inequality in higher education may be perpetuated through differences in quality that also lead to differences in the quantity of education attained (Lucas, 2001; Raftery & Hout, 1993)

In this study I documented income-based trends in college enrollment, type of college attended, and college completion using three National Center for Education Statistics (NCES) longitudinal studies of high school students between 1992 and 2013. The advantage of these data is that they allowed examination of trends by income of multiple college outcomes for more recent cohorts spanning three decades. I found that among cohorts of tenth-grade students income-based college enrollment gaps narrowed and then remained stable between the 1990s and 2010s. Contrary to other work, I found that college completion gaps also narrowed between the high school classes of 1992 and 2004. I examined income-based trends in four-year college enrollment and selective-college enrollment, and I found these gaps to be narrowing, although not significantly, and then stable. Cross-sectional gap estimates from these data were much smaller in magnitude than those from studies using other data [e.g. National Longitudinal Survey of Youth (NLSY) and Panel Study of Income Dynamics (PSID)].

Naturally, the question arises of why this study would fail to confirm the cross-sectional gaps and gap trends documented by other researchers. In the second part of the paper, using both NLSY and NCES data, I attempted to reconcile my findings with those

presented by Bailey and Dynarski (2011). I offer three key findings related to the datasets and analytic strategies. NCES samples of tenth grade students underestimated cross-sectional 90/10 gaps in college enrollment, but they did not appear to underestimate cross-sectional gaps in college completion. It was not possible to determine whether they understated gap changes due to the limited overlap in timing with the NLSY cohorts. Second, gap estimates and gap changes between cohorts were sensitive to the decision of the age at which college enrollment was measured, as the relationship between enrollment timing and income has changed over time. Third, failure to use weights when creating relative measures of income, such as ranks or quartiles, using survey data can bias estimates of gaps and gap changes. I conclude by identifying other unreconciled differences and potential avenues of further study.

Background

Several studies published in the last two decades have sounded an alarm about an apparent widening of income-based gaps in college enrollment and completion (Bailey & Dynarski, 2011; Belley & Lochner, 2007; Bloome et al., 2018; Duncan et al., 2017; Ziol-Guest & Lee, 2016). These studies, which examined cohorts of young adults in the 1970s through the early 2000s, showed increasing gaps between students from top and bottom income quartile or quintile families in both college enrollment and bachelor's degree completion. In one of the most frequently cited of these studies, Bailey and Dynarski (2011; hereafter BD) using data from the two NLSY surveys (1979 and 1997), documented that the gap in college enrollment between students from top and bottom income quartile families grew approximately 12 percentage points, from 39 percentage points to 51, between cohorts who graduated high school around 1980 and around 2000.

They also found that the college completion gap between these cohorts grew from 31 percentage points to 45.

For more recent cohorts, however, scholars have found that the income-based gap in college enrollment was not widening. Chetty, Hendren, Klein, Saez, and Turner (2014; hereafter CHKST), using data from income tax records, estimated that the gap in college attendance rates, which they termed the "college attendance gradient," between children from the lowest and highest-income families was 74.5 percentage points between 2002 and 2007. They also found that the gap declined to 69 percentage points in 2010. They noted that their estimate of the gap in college enrollment in 2000 was roughly consistent with that found by BD for the NLSY 1997 cohort.[15] CHKST did not examine trends in college completion because it was not available in their data.

In order to reconcile these findings, Ziol-Guest & Lee (2016) presented a longer historical view of the trends in income-based gaps in college enrollment and completion that included the time periods studied by BD and CHKST. They used data from the two cohorts of the NLSY and 31 cohorts of the Panel Study of Income Dynamics (PSID). The cohorts they studied were age 18 between 1972 and 2003. They confirmed the findings of both BD and CHKST. They summarized the trends over the period as follows. College enrollment gaps widened over the time period of their study; however, during the period studied by CHKST gaps were stable. Ziol-Guest and Lee also noted that college completion gaps widened considerably over the period studied by CHKST. Other

[15] CHKST regressed an indicator of college attendance at age 19 on parent income ranks, noting that the relationship is approximately linear. The coefficient in the regression, "the college attendance gradient," represented the gap in attendance between the lowest- and highest-income families. Using the slope coefficient, one can calculate a top-bottom income quartile gap, which is approximately 54 percentage points.

preliminary work has also suggested that college completion gaps widened among individuals who were 18-20 years old between 2002 and 2010 (Clark et al., 2020). I present a summary of the above-mentioned studies in Table 2.1, columns 1 and 4.

One hypothesis offered by Ziol-Guest and Lee (2016) for why income-based gaps in college completion may have continued to grow in the 2000s and 2010s while income-based gaps in college enrollment appeared to have stabilized was that there may have been increasing stratification by income in the type of college students were attending. Due to limited information on the type of college in which students enrolled, they were not able to address this hypothesis.

Increasing institutional segregation by family background is seen as one potential mechanism behind widening income-based college completion gaps because completion outcomes vary a great deal by sector. Put differently, inequality is perpetuated through differences in quality that also lead to differences in the quantity of education attained (Lucas, 2001; Raftery & Hout, 1993). If an increasing share of low-income students are attending two-year colleges or less selective four-year institutions, this would explain the stability in enrollment gaps and the widening of completion gaps. Students who first attended a community college instead of a four-year institution were less likely to earn a bachelor's degree (B. T. Long & Kurlaender, 2008). Students who attended less selective four-year colleges were far less likely to complete a bachelor's degree than students who attended selective colleges, even when controlling for academic background (Bowen, Chingos, & McPherson, 2011).

National Center for Education Statistics (NCES) datasets of cohorts of adolescents offer an opportunity to examine measures of college enrollment by institution

type and completion that provide a more detailed understanding of the extent of income-based inequality in postsecondary attainment. NCES has conducted five longitudinal studies of American secondary students between 1972 and 2013. Together these five studies compose the Secondary Longitudinal Studies Program. These datasets have been and continue to be widely used in quantitative education policy research. Over a ten-year period, from 2009-2019, at least 49 articles published in the top five education research journals utilized data from one of the five datasets.[16] Many of these studies addressed questions of college enrollment, persistence, and completion.

To date, however, these datasets have not been used to comprehensively track trends by family income in college enrollment and college completion. One likely reason is that the way income was reported in these surveys made it challenging to compare across cohorts. Income was measured categoricially, and the categories have changed across surveys. However, Reardon (2011b) documented a method to estimate an income distribution from a set of ordered income categories; the method results in estimates of the percentile ranks corresponding to the binned income categories. One can use these to predict a given outcome as a function of family income percentile rank. Most notably Reardon used this method to document widening income-based achievement gaps since 1970 (Reardon, 2011a). Subsequently, his approach has been used by other researchers examining other outcome trends by income across NCES datasets (e.g. Bassok, Finch, Lee, Reardon, & Waldfogel, 2016; Kalil, Ziol-guest, Ryan, & Markowitz, 2016; Murnane & Reardon, 2017).

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[16] The five journals are *Review of Educational Research*, *Educational Evaluation and Policy Analysis*, *Sociology of Education*, *Journal of Educational Psychology*, and *Education Finance and Policy*. I determined the five journals using SCImago Journal Rankings with the condition that the journals be from the United States and part of the Web of Science core collection (SCImago, n.d.).

Reardon, Baker, & Klasik (2012) used this approach to examine income-based trends in highly selective college enrollment across three NCES cohorts of high school students.[17] They found that income became more strongly associated with highly-selective college enrollment between 1982 and 1992 and then remained consistent between the 1992 and 2004 high school cohort. Extrapolating from their figures (p. 8-10, Figures 3-5), the 90/10 income gap in 1982 was approximately 8.5 percentage points and increased to 13 percentage points in 1992 where it remained in 2004. CHKST also noted that the gap trend in selectivity was stable or declining between 2002 and 2007. Neither set of findings supports the hypothesis that increasing stratification by income in highly selective college enrollment explains widening completion gaps.

Examining a longer time horizon and a more detailed set of types of postsecondary institutions, Bastedo and Jacquette (2011) found that socio-economic status (SES) gaps in four-year college enrollment and selective college enrollment increased between 1972 and 1992, but then stabilized or declined between 1992 and 2004.[18] Their measure of SES, which was constructed by NCES, included five standardized components: father's education, mother's education, father's occupation, mother's occupation, and family income (or household possessions). They did not examine income-based gaps. Bastedo & Jacquette found that the top-bottom SES quartile gap in four-year college enrollment increased to 51 percentage points in 1992 from 40

[17] Highly selective institutions are defined using Barron's Admissions Competitiveness Index categories 1 and 2 "most selective" and "highly selective."

[18] To better relate their findings to those of BD, I used Bastedo and Jacquette's (2011) results presented in Table 3 to calculate top-bottom SES quartile gaps in college enrollment and the gap changes between cohorts. I calculated college enrollment as 100-No postsecondary education "PSE" (or, equivalently, the sum of all the other categories). Four-year college enrollment includes the categories: noncompetitive, competitive, very competitive, highly competitive, and most competitive. I defined highly selective, using the same definition as Reardon et al. (2012), as the top two categories of the Barron's Admissions Competitiveness Index—highly competitive and most competitive.

percentage points 1972. Between 1992 and 2004, they found that the gap was relatively stable (51 percentage points to 49). They found that the gap in highly-selective college enrollment increased from 10 percentage points in 1972 to 17.6 percentage points in 1992, and then declined to 15.3 percentage points in 2004. Bastedo and Jacquette noted that the enrollment of bottom-SES quartile students in highly selective colleges was relatively stable over this time period, so the increase in the gap was driven by the increasing share of high-SES students enrolling in these institutions. Their findings for highly selective enrollment mirrored those of Reardon et al. (2012) and CHKST (2014), and together these three studies do not suggest institutional segregation by income has increased for cohorts of college age in the 2000s; however, Bastedo and Jacquette's work indicates that increasing institutional segregation by income may have been a driver of widening completion gaps for earlier cohorts (Table 2.1, columns 2 and 3). None of the three studies examined college completion gaps by income.

What is surprising in Bastedo and Jacquette's findings is that, contrary to BD, their analyses indicated that the SES gap in college enrollment (of any type) declined by approximately 13 percentage points. Between 1982 and 2004, the gap decreased from 45 percentage points to 32 percentage points. BD estimated that the income-based gap increased from 39 percentage points to 51 percentage points over approximately this same time period. In order for SES-based gaps to have declined while income-based gaps grew, parent education-based gaps or parent occupation-based gaps would have had to have declined considerably. This seems unlikely given that the relationship between parent education and children's achievement has been stable over the last fifty years (Reardon, 2011a).

Another possiblity is that features of the datasets, samples, and/or measures may explain the difference in trend. Questions have been raised about whether the samples from studies using NCES surveys were "more advantaged" than those from household surveys such as the PSID or NLSY (Ziol-Guest & Lee, 2016, p. 9). For example, Bastedo and Jacquette (2011) used samples of students who were still enrolled in high school in twelfth grade, thereby omitting students who had dropped out prior to twelfth grade. These types of decisions may lead to samples that were more positively selected and may potentially display cross-sectional gaps or gap trends different from the overall population.

In conclusion, it is clear that for more recent cohorts less is known about income based trends in college enrollment and completion gaps. This study aims to fill these holes. Second, there are discrepancies in findings across studies, and in this chapter, I identify sample, measurement, and analytical issues that explain some of these discrepancies.

Research Design

Data

I used student-level data from three National Center for Education Statistics (NCES) surveys of high school students: the National Education Longitudinal Study of 1988 (NELS:88), the Education Longitudinal Study of 2002 (ELS:2002), and the High School Longitudinal Study of 2009 (HSLS:09). The three surveys provided information on the college-going behavior of the high school classes of 1992, 2004, and 2013. The surveys included information on whether a student enrolled in college, the type of

institution attended, whether the student graduated from college, and the timing of college attendance and completion.

NELS:88 began as a nationally representative sample of eighth graders (surveyed in the spring 1988); they were also surveyed twice in high school (tenth grade in spring 1990, and twelfth grade in spring 1992). Students were added (i.e. the survey sample was "freshened"[19]) in 1990 and in 1992 to ensure that the sample would be nationally representative of tenth graders and twelfth graders, respectively. Postsecondary educational attainment information was collected in follow-up surveys conducted in 1994 and in 2000. ELS: 2002 was a nationally representative survey of tenth graders first surveyed in the spring of 2002. Students were surveyed again as twelfth graders in 2004. The sample was freshened in 2004 to ensure it would be representative of twelfth grade students. Two follow-up surveys were administered: in 2006 and again in 2012. Unlike the earlier studies, HSLS:09 first surveyed ninth graders in the fall of 2009. These students were surveyed again as eleventh graders in 2011. They were not surveyed in tenth or twelfth grade, and the sample was not freshened in eleventh grade. Therefore, this survey only provides a nationally representative sample of ninth graders. Follow-up surveys were administered in 2013 and in 2016. This is an ongoing study with additional rounds of data continuing to be collected.

In addition to detailed information on college-going and completion, the three surveys also contained information on individual and family background characteristics. I

[19] Freshening involved adding students to the 10th and 12th grade samples who were not in 8th grade in the United States in 1988 (Curtin et al., 2002). Students who would not have been in 8th grade in the United States in 1988 but would be part of a nationally-representative sample of 10th or 12th grade students could be those who had repeated a grade or who had recently immigrated to the United States, for example. The process of sample freshening was not used to address sample attrition.

used information on student age, race/ethnicity, foreign-born status, family income, and mother's educational attainment.

I used National Longitudinal Survey of Youth microdata from the 1979 cohort (NLSY79) and 1997 cohort (NLSY97). The NLSY79 and NLSY97 began with nationally representative samples of individuals age 14 to 22 in 1979 and age 12 to 18 in 1997. The NLSY datasets differ from the NCES datasets in two important ways. First, they were household-based surveys rather than school-based surveys. Second, NLSY79 and NLSY97 surveys were conducted annually (through 1994 and 2011, respectively) and biennially thereafter. I used NLSY79 data collected between 1979 and 1996 and NLSY97 data collected between 1997 and 2017.

Finally, I used data from the Annual Social and Economic Supplement of the March Current Population Survey (CPS), years 1979, 1992, 1997, 2002, and 2012 obtained from IPUMS (Flood, King, Rodgers, Ruggles, & Warren, 2020). This dataset has detailed information on family characteristics, demographic information, household composition, and household income.

Samples

NCES Datasets

I constructed samples using two criteria. First, for maximum comparability, I formed samples using students who were enrolled in high school as of 10th grade (for NELS and ELS) and 9th grade (for HSLS). Ideally, I would have constructed samples using the same grade level for all three studies; however, this was not possible because students in HSLS were not surveyed in 10th grade. Second, I included only the subset of these students who participated in all follow-up waves of data collection. I identified

these students using weights and flags (indicator variables) in the datasets.[20] The relevant weights were intended to adjust for unequal probabilities of selection and the effects of nonresponse (Curtin, Ingels, Wu, & Heuer, 2002). The resulting sample sizes were 10,640 for NELS:88, 13,130 for ELS:2002, and 15,910 for HSLS:09.[21]

I conducted multiple imputation using chained equations to address missing income data (White, Royston, & Wood, 2011). Approximately 17% of weighted cases in NELS:88 and 10% of weighted cases in HSLS:09 were missing income information. There were no missing values on income in ELS:02 because this information was imputed by NCES. I used Stata's MI impute command to impute twelfth-grade income in NELS:88 and eleventh grade income in HSLS:09, generating 20 imputed data sets. The imputation model included income measured in earlier survey rounds (with quadratic and cubic terms), parents' highest education level, whether the student lived in an urban, suburban, or rural community, private school attendance, gender, race, age, whether the student graduated high school, and the survey design information (stratum, primary sampling unit, and panel weight). I also included the dependent variables, college enrollment, enrollment type (two- or four-year), and college completion, in the imputation model (Allison, 2001; von Hippel, 2007). I employed Stata's `mi estimate` command prefix, which combines parameter estimates across the imputed data sets using Rubin's rules. The reported results for NELS:88 and HSLS:09 represent these combined estimates.

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[20] In NELS:88, my sample included students with non-zero values of *g10cohrt* and the panel weight *f4f1pnwt*. In ELS:2002, my sample included students with non-zero values of the panel weight *f3bypnlwt*, and in HSLS:09, my sample included students with non-zero values of *w4w1stu*.

[21] All sample sizes are rounded to the nearest 10, per the reporting requirements of NCES.

While I included cases with missing outcome data in the imputations, I dropped these cases after imputation (von Hippel, 2007). Specifically, I dropped students who were missing data on high school graduation, college enrollment, college sector, or BA attainment. The final analytic sample sizes were 10,470 for the Class of 1992 (NELS:88), 12,800 for the Class of 2004 (ELS:2002), and 15,760 for the Class of 2013 (HSLS:09).

To estimate the impact of late middle school/early high school dropout on income-based college enrollment gaps, I constructed an eighth-grade sample of the Class of 1992 in addition to the tenth-grade sample described above. I was only able to construct this comparison sample using the NELS:88 dataset because it was the only NCES survey of adolescents to first survey students in eighth grade and to provide nationally representative samples of eighth and tenth graders.[22] I imputed income in the manner described above for this sample.[23] After dropping cases with missing outcome data, my analytic sample consisted of 10,640 respondents. I refer to this sample as the eighth-grade sample of the Class of 1992.

NLSY Datasets

I created two analytic samples of NLSY79 and NLSY97. First, in order to facilitate specific comparisons with their work, I replicated the samples used by BD.[24] I refer to these as BD's sample. They limited their NLSY79 sample in several ways. They excluded adolescents who were part of supplemental oversamples of youth in the military

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[22] I selected students with non-zero values of the panel weight *f4pnlwt* (*N*=10,830). This weight applies to respondents in all five waves of the study and is most similar to *f4f1pnwt*, which I used for the tenth-grade sample. The panel weight *f4bypnwt* is another option for estimating longitudinal parameters that describe the population of eighth graders in 1988 twelve years later. It applies to respondents in the first and fifth waves of the study and produces similar results.

[23] For the 8th grade sample of NELS:88, I imputed eighth-grade family income, and I included twelfth grade income data in the imputation model.

[24] I acknowledge Martha Bailey for making their replication code available on her website (accessed March 5, 2020): https://sites.google.com/a/umich.edu/baileymj/published-research.

and Black, Latino, or economically disadvantaged youth, and they excluded adolescents who were not born in the United States. In NLSY97, they excluded adolescents not born in the United States and students reporting a race/ethnicity of "mixed." They limited their analytic sample to those born 1961 – 1964 (NLSY79) and 1979 – 1982 (NLSY97), with family income information in the base year, and grade attainment information at age 19 and 25 (NLSY79: *N*=3,709; NLSY97: *N*=2,046).[25]

In constructing the second set of analytic samples of NLSY79 and NLSY97, which I refer to as my analytic sample, I made several changes from BD. The changes fell into two categories. First, I included adolescents in my sample that BD omitted because I was concerned that excluding them could potentially bias results and because my NCES samples included similar students. For NLSY79, I included the oversampled student groups because the survey weights were intended to adjust for their inclusion. In both datasets, I included non-U.S. born adolescents. Omitting these students could bias results if the relationships between income, foreign born status, and educational attainment have changed over time. For NLSY97, I also included students who reported their race/ethnicity as "mixed."

Second, I utilized additional waves of data for NLSY97 that have become available since the time of BD's paper. This allowed me to increase the number of respondents with grade attainment data at age 25. I limited my analytical sample for this cohort to students born 1981 – 1984, with family income information in the base year, and grade attainment information at age 20 and 25. While BD included students born in

[25] BD used waves of NLSY97 data collected through 2007. Given that respondents were age 12-18 in 1997, many of the younger respondents had not yet turned 25, and, therefore did not have information on grade attainment by age 25. This explains the smaller sample size of NLSY97 as compared to NLSY79 in BD's study.

1979 and 1980, most likely to maximize the number of individuals with outcome information in their analytic sample, very few of the NLSY97 respondents were born in these years (n=259). I selected the birth years 1981 – 1984 because this captured the most common years of birth among individuals in this cohort and also provided an equal span of years to those in NLSY79. For NLSY79, I limited my sample to respondents born 1961 – 1964, with family income information in the base year, and grade attainment information at age 20 and 25. My resulting samples sizes were 4,512 for NLSY79 and 4,105 for NLSY97. In the next section, I provide additional information on why I examined educational attainment at age 20 rather than age 19 as BD did.

Measures

College Outcomes

I examined four educational attainment measures in the NCES datasets. They were college enrollment, four-year college enrollment, highly selective college enrollment, and bachelor's degree completion. I defined college enrollment as having enrolled in any type of postsecondary education within two years of the cohort's modal year of high school graduation (enrollment by 1994, 2004, and 2015).[26] The majority of respondents were 20 years old at the time college enrollment was measured. I defined four-year college enrollment as having first enrolled in a four-year college using the same time frames as described above.

My third outcome measure was whether a student enrolled in a highly selective college or university as defined by the Barron's Admissions Competitive Index within two years of the modal graduation year. Barron's rates the selectivity of all four-year

[26] In the NCES datasets, I also generated measures of college entry by age 19 and age 20 to compare with measures of college entry one and two years after high school graduation. Results were generally similar.

colleges based on the high school GPAs, high school class ranks, and SAT/ACT scores of enrolled students, as well as on the proportion of applicants admitted. Four-year colleges are rated on a scale from 1-7, where 1 is the most selective and 6 is the least selective. (Schools with a ranking of 7 are specialty schools with different admissions criteria.) I defined schools as "highly selective" if they were classified by Barron's as a 1 ("most competitive") or 2 ("highly competitive"). Because Barron's rankings of colleges and universities change over time, I used the rankings of colleges in 2004 so that the composition of highly selective schools was constant across cohorts.[27] In 2004, 171 colleges held this ranking out of approximately 2,500 four-year colleges. The list of highly selective institutions is presented in Appendix Table B.1.

My fourth college outcome measure was bachelor's degree attainment, defined as whether a student completed a bachelor's degree by the time of the third follow up survey, when respondents were approximately 26 years old. This allowed respondents approximately eight years for college completion. This outcome measure is not yet available for HSLS:09 cohort.

I examined two educational attainment outcomes in the NLSY datasets: college enrollment and college completion. I defined college enrollment as having reported attending or being enrolled in the first year of college. I measured this at age 19, which was identical to BD's measure, and at age 20 (my preferred measure), to more closely match the measure in the NCES data. Finally, I defined college completion as having reported completing four or more years of college by age 25 (identical to BD's measure).

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[27] This approach is consistent with prior work (e.g. Bastedo & Jaquette, 2011; Reardon et al., 2012). Additionally, Bastedo & Jacquette noted that while there were drawbacks to using a consistent set of rankings, namely that some institutions that were not that selective will be classified as such, there was little relative change in the order of institutions.

Income Measures

My key explanatory measure was family income percentile rank. Ideally, in all the datasets I used, I would have had a continuous measure of family income, and I would have used this to predict each college outcome measure as a function of the adolescent's family's income percentile rank. Unfortunately, family income was reported in discrete categories in the three NCES datasets.[28] Using a method developed by Reardon (2011b), I estimated an income distribution from the set of ordered income categories separately in each of the three NCES datasets. Reardon's method involved the following steps. The first was to identify the percentile ranks, $c_{k-1}$and c_k, associated with the lower and upper bounds of each binned income category; the lower bound of the first category is zero and the upper bound of the last category is one hundred. Income category, k, has midpoint $\bar{Q}_k = \frac{c_k - c_{k-1}}{2}$, allowing me to assign this rank value to respondents in income category k. I also defined higher order terms: $Q^{2*} = \bar{Q}_k^2 + \frac{(c_k - c_{k-1})^2}{12}$ and $Q^{3*} = \bar{Q}_k^3 + \frac{(c_k - c_{k-1})^3}{4}$.

Income was reported continuously in the two NLSY datasets. The exception being that 1.5% and 3% of weighted incomes were top coded in NLSY79 and NLSY97, respectively. Like BD, I used family income reported in the base year. I generated income percentile ranks, assigning the same rank to tied values.

In constructing income rank measures in each of the two datasets, I used the survey sampling weights to ensure an accurate distribution of income. I also created measures of income rank prior to imposing sample restrictions in order to generate the

[28] There are 15 categories in NELS:88 and 13 categories in both ELS:2002 and HSLS:2009. Reardon (2011b) found that gap estimates did not vary systematically with the number of categories in which income is reported.

most representative distribution. In her dissertation, Sands (2014) noted that BD did not use weights when generating their measures of income quartile, which led to an unrepresentative distribution of income. To evaluate possible bias in BD's gap change estimates stemming from their use of unweighted income data, I created an unweighted income rank measure to match BD's and compared the results using that measure to those I obtained using a weighted income distribution among their sample (Appendix Table B.2).

I also use household income data from the CPS for robustness checks. I compared the distribution of incomes between NCES and NLSY sample respondents with similar respondents to the CPS to assess the degree to which the NCES and NLSY surveys were aligned with CPS estimates of the income distribution of families with adolescents of the relevant age. In the CPS, households reported income from the prior calendar year (i.e. 2012 CPS contained 2011 household income information), as respondents do in the NCES and NLSY datasets. I inflated these values to 2018 dollars using the Consumer Price Index (CPI).

Analytic Strategy

For each of the datasets, I estimated the college enrollment (any, four-year, and highly selective) and completion rates conditional on a family's percentile rank in the income distribution, by fitting a polynomial regression model in which the outcome was a dichotomous variable assuming a value of 1 if an adolescent had enrolled in college or completed college and zero otherwise. The predictor was a family's percentile rank in the national income distribution of families of adolescents in a given cohort. The model

provided an estimate of the function that described the association between the probability of college enrollment or completion and family income.[29]

I used both visual inspection and statistical tests to determine the lowest degree polynomial that reasonably fit the data. Specifically, I examined the *t*-statistics associated with the higher-order terms in each of the regression models. In the three NCES datasets, for college enrollment, I used a linear function of family income rank, and for four-year college enrollment, highly selective college enrollment, and college completion, I used a cubic function of family income rank.[30] In the NLSY datasets, I used a cubic function for the two outcomes (college enrollment and college completion) for the 1979 cohort, and I used a quadratic function for both outcomes for the 1997 cohort, as these functional forms provided the best fit to the data.

Using the estimated functions, I computed the estimated proportion of students enrolled in college at the 10^{th}, 50^{th}, and 90^{th} percentile ranks of the income distribution in a given cohort. I refer to these ranks as low, middle (or median), and high. I also computed the 90/10 gap and the change in the size of the 90/10 gap between cohorts. I calculated the standard error of the 90/10 gap estimates from the estimated variance-covariance matrix of the regression model.

Prior work examining income-based attainment gaps using the NLSY has examined top-bottom income quartile or top-bottom income quintile gaps in college

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[29] Two limitations of linear probability models include violation of the assumption of homoscedastic error terms and predicted probabilities that are less than zero or greater than one. None of my estimated models resulted in predictions that were out of range. I also fitted models used logistic regression, and the results were generally similar. In cases where I did not estimate standard errors using the relevant survey design information, I estimated robust standard errors in order to obtain unbiased standard errors given the heteroskedasticity.

[30] CHKST (2014) noted that the relationship between college enrollment and family income was linear in the percentile ranks.

outcomes (e.g. Bailey & Dynarski, 2011; Ziol-Guest & Lee, 2016). However, given that I did not have a continuous measure of income in the NCES datasets, I was not able to construct income quartiles or quintiles. Therefore, for comparability between the two sets of data, I used the analytic approach described above. To facilitate direct comparison of my results using the NLSY data to those of BD, I estimated models using their samples. I present those results in Appendix Table B.2.

All analyses took into account the complex designs of the NCES surveys by weighting the data using the relevant panel weights and by using the survey design variables to account for the clustering of the data. I employed Stata's `svyset` and `svy` prefix commands. As noted above, I used the panel weights to construct measures of family income percentile rank in the national income distribution of families with an adolescent in the relevant cohort. When fitting models, I also used the panel weights to obtain unbiased point estimates. For NELS:88 and ELS:2002, I used information on the primary sampling unit and stratum to estimate Taylor linearized standard errors. The public-use HSLS:09 data did not include information on the primary sampling unit and strata and instead provided weights for computing standard errors using balanced repeated replication (BRR). Stata, the statistical program I used for all my analyses, does not allow BRR estimation with multiply imputed data. For the HSLS:09 data, I estimated robust standard errors.[31] For the NLSY datasets, I used the base year sampling weights when constructing estimates of family income percentile rank and when estimating the models. I selected this weight because it is the one used by BD. I also estimated robust standard errors.

[31] I opted to estimate robust standard errors to account for violation of the assumption of normally distributed error terms in the linear probability models.

Robustness Checks

I conducted several robustness checks to assess the sensitivity of my results. First, in addition to estimating college enrollment within two years of the modal year of high school graduation for the NCES datasets, I also estimated college enrollment by age 20.[32] Cross-sectional 90/10 gap estimates were approximately one to three percentage points larger when using college enrollment by age 20 for the NCES datasets; however, gap change estimates were largely unchanged. Because the results were generally similar, I opted to present the results from enrollment within two years, as this was the typical way this measure has been constructed by other researchers using these data (Bastedo & Jaquette, 2011; Reardon et al., 2012).

I assessed the sensitivity of enrollment gaps and gap changes to students who enrolled in college more than two years after the modal year of graduation. Specifically, I estimated the enrollment-income association in the modal year of graduation and then each year up to eight years post-graduation for the Class of 1992 and the Class of 2004 and three years post-graduation for the Class of 2013.

To assess the potential sensitivity of results to students who dropped out prior to tenth grade, I fitted models using the eighth-grade sample of the Class of 1992 to compare estimates of college enrollment and completion by income with the tenth-grade sample of the Class of 1992. I also compared the cross-sectional 90/10 gap estimates using these two samples.

In order to assess the degree to which NCES surveys may not or may not be capturing students of a given income level in proportion to their representation in the

[32] This is within the year the adolescent turned 20 because the data includes only year of birth, not month and year.

population, I compared the distribution of incomes between NCES sample respondents with respondents to the CPS. It bears noting that the CPS is also a survey and estimates from it are also survey-based estimates of the population (not population estimates). Ideally, I would have used population-based data of family income; however, there are none available, and the CPS provided the next best option because of their representativeness and consistency over time. The CPS data are widely used for sample-based estimates of the population by both social scientists and federal agencies (Flood et al., 2020).

To conduct these analyses, I took the following steps. First, I inflated income values in all the surveys to 2018 dollars using the Consumer Price Index (CPI). Second, I selected a sample in the CPS similar to those in the NCES surveys I use. Specifically, to match the NELS sample, I included families with adolescents who were 17 and 18 years old in the 1992 CPS.[33] To match the ELS sample, I selected a sample of adolescents age 15 or 16 in the 2002 CPS, and to match the HSLS sample, I selected a sample of adolescents age 16 or 17 in the 2012 CPS. I then created binned income categories to match those found in each of the NCES surveys (see Appendix Table B.3). I compared the weighted proportion of respondents in each income category in the two sets of surveys using visual comparison and calculating the correlation.

I conducted the same comparison with NLSY datasets and CPS data, with one minor difference. Since income is reported continuously in the NLSY datasets, I binned both the NLSY and CPS data using the NELS income categories (Appendix Table B.4).

[33] Both sets of surveys (NCES and NLSY) asked respondents about the prior year's (*t-1*) income. For example, when NELS was administered in 1992, it asked families to report 1991 income. Similarly, the March 1992 CPS asked families to report 1991 income. I use the *t-1* CPI to inflate income value to 2018 dollars.

Descriptive Characteristics

Several notable demographic shifts occurred among the NCES cohorts of high school students over the time period of this study. The share of high school students who were non-Hispanic white decreased while the share of Hispanic students increased (Table 2.2). Second, average maternal education increased. The proportion of mothers who had less than a high school degree declined, and the proportion of mothers with a bachelor's degree increased.

Among high school students, the percentage completing high school increased slightly from 92.6% in 1992 to 94.2% in 2013; however, average college attainment outcomes remained relatively stable or declined. Approximately 70% of students attended college within two years of the modal high school graduation in the class of 2013. This was a decline of three to five percentage points from the two earlier cohorts. Four-year college enrollment was around 40% in all three cohorts. Bachelor's degree completion was also relatively stable, approximately 33%, between the class of 1992 and the class of 2004.

In contrast, average rates of college enrollment and college completion increased between the two NLSY cohorts (Table 2.3). College enrollment by age 20 increased 18 percentage points between 1979 and 1997, and college completion increased approximately 12 percentage points. These differences between the two sets of data were likely the result of several factors including differing time periods and samples (home- vs. school-based).

Results

NCES Trends in College Enrollment and Completion: 1992 – 2013

Income-based gaps in enrollment in any type of college declined between 1992 and 2013 (Table 2.4). This is evidenced by the flattening of the fitted trend lines in Figure 2.1. In 1992, the estimated 90/10 gap in college enrollment was 39 percentage points, with 53% of low-income students attending college and 92% of high-income students attending college. However, by 2004, the 90/10 gap had narrowed to 30 percentage points. This decline was the result of a larger share of low-income students attending college, 59%, and a smaller share of high-income students attending college. The gap increased slightly, but not significantly, between 2004 and 2013. Notably, there was a downward shift across income groups for the Class of 2013. This may be a result of the fact that this sample was composed of ninth rather than tenth grade students. As I discuss later, NCES samples comprising students enrolled as of lower grades have lower rates of college enrollment.

It is possible that while overall gaps in college enrollment shrank, gaps in four-year college enrollment could have widened thereby exacerbating inequality. However, this was not what I found. The 90/10 income rank gap in four-year college enrollment shrank between 1992 and 2013 from 46 percentage points to 42 percentage points (Table 2.4). This narrowing of the gap was driven by a decline in the share of high-income students attending four-year colleges. In 1992, 68% of high-income students attended a four-year college, and in 2013, 65% of high-income students attended a four-year college.

I also found no evidence of widening gaps by income in selective college enrollment. In fact, I found the opposite. In 1992, the 90/10 gap in selective college enrollment was approximately 16 percentage points, and it declined to 13 percentage points in 2013. Similar to four-year colleges, the narrowing of the gap was the result of a declining share of high-income students attending highly selective colleges (18% in 1992 and 14% in 2013).

Potentially most important for social mobility, the income-based gap in bachelor's degree completion narrowed between the high school cohorts of 1992 and 2004, from 48 percentage points to 40 percentage points. This narrowing of the gap was due to a five-percentage-point increase in the share of low-income students obtaining a bachelor's degree and to a three-percentage-point decline in the share of high-income students obtaining a bachelor's degree by age 26. It is not clear whether this narrowing trend will continue for the Class of 2013, as college completion data is not yet available.

Estimates of income-based college enrollment gaps were sensitive to the age at which they were measured because lower-income students were more likely to delay enrollment. In Panel A of Figure 2.4, I plotted the estimated enrollment rates for students at the 10^{th} and 90^{th} percentile ranks of the income distribution for each cohort by the number of years since the modal year of high school graduation. Year 0 represents the year of high school graduation (i.e. 1992, 2004, or 2013). For the Classes of 1992 and 2004, college enrollment rates increased each year for low-income students, with some leveling off by year seven or eight. Enrollment among high-income students also increased, but it did not increase as much and leveled off by year four post high school. Among the Class of 1992, 40% of low-income students enrolled in college in the year of

high school graduation; however, this rate was 65% by year 8 (2000). For high-income students, enrollment increased from 82% to 95% over the same time period. Consequently, the college enrollment gap between high and low-income students was largest in Year 0 (42 percentage points) and declined thereafter. It declined by 11.5 percentage points or 28% over the eight years after high school graduation.

The relationship between income and timing of college enrollment also changed between the 1992 and 2004 cohorts; therefore, the estimated change in the 90/10 gap was sensitive to when college enrollment was measured, particularly in the first few years after high school graduation (Figure 2.4, Panel B). Using the 90/10 gaps from the year of high school graduation, the gap narrowed by four percentage points, from 42 to 38 percentage points between the two cohorts. However, measuring it one or two years after the high school graduation year resulted in an estimated narrowing of eight percentage points. Measuring the gap eight years after high school graduation resulted in a decline of nine percentage points between these two cohorts.

Unlike gaps in enrollment in any type of postsecondary education, gaps in four-year college enrollment remained consistent (Figure 2.5, panels A and B). For the Class of 1992, the gap in four-year college enrollment was 46 percentage points in 1992 and declined to 44 percentage points in 2000 (eight years after high school graduation). Similarly, the gap only declined one percentage point for the Class of 2004 over the eight-year period after high school graduation. Therefore, estimates of the change in the four-year college enrollment gap were not sensitive to the timing or age at which they were measured.

Reconciling NCES and NLSY Estimates

NLSY Trend Estimates

Using my NLSY samples and the measures that most closely matched those I used with the NCES samples, I found a that the 90/10 college enrollment gap (at age 20) widened by 5 percentage points between 1979 and 1997 from 44 to 49 percentage points (Table 2.5). Rates of college-going increased across income groups, but they increased more for adolescents from middle- and high-income families. The share of high-income students who enrolled in college increased from 68 to 85 percent, while the share of low-income students increased from 23 to 36 percent.

I found that the 90/10 gap in college completion by age 25 increased by 13 percentage points between the two cohorts from 35 to 48 percentage points. The growth in this gap was driven by the fact that the share of high-income students earning a BA increased by 19 percentage points as compared to a seven-percentage point increase in the share of low-income students earning a college degree.

In contrast, replicating these analyses with BD's samples and measures, I obtained larger estimates of the gap changes for their outcome measures. I found that the college enrollment gap, measured at age 19, widened by 13 percentage points, from 41 percentage points among the 1979 cohort to 54 percentage points in the 1997 cohort (Appendix Table B.2). The 90/10 college completion gap widened by 15 percentage points from 32 to 47.

Re-analyzing the NLSY data did not entirely reconcile the college enrollment trend differences between these data and NCES data, but there were two analytic decisions that BD made that resulted in larger estimated changes in the gaps between

cohorts than what I obtained with my samples and measures. First, BD measured college enrollment at age 19, resulting in a greater estimated change in the gap (13 percentage points) in college enrollment than measuring college enrollment at age 20 (11 percentage points) in their samples. Using my NLSY samples and measures, I compared the change in the 90/10 income gap in college enrollment when measuring college enrollment at age 19 and at age 20. The gap widened by 9 percentage points when measuring college enrollment at age 19; however, the estimated gap change was half as much (5 percentage points) when college enrollment was measured at age 20 (Table 2.5).

Among the 1979 cohort, a larger share of high-income adolescents enrolled in college between age 19 and 20, leading to a larger estimated 90/10 gap at age 20 than at age 19 (Table 2.5). That trend, however, reversed for the later cohort, with a larger share of low-income students enrolling in college between age 19 and 20. In Figure 2.6, I show the enrollment-income association at age 19 and at age 20 for each cohort. The net effect of measuring college enrollment at age 20 was that it reduced the estimated change in the gap over this period.

Second, BD did not use sample weights when creating their income quartile measures. The 1979 survey included several oversampled groups, and the failure to weight the data led to biased estimates of the income gaps in college enrollment and completion in 1979 (Appendix Table B.2). The between-cohort gap changes reported by BD were upwardly biased. Using BD's analytic samples, I estimated 90/10 gap changes with unweighted and weighted measures of family income percentile rank. In terms of college enrollment by age 19, the gap change using an unweighted measure of income was 13 percentage points whereas the gap change using a weighted income measure was

nine percentage points. Measuring college enrollment at age 20 in BD's sample, the gap change was 11 percentage points using the unweighted measured and 7 percentage points using the weighted measure. The growth in the bachelor's degree gap by income was also overestimated by three percentage points (15pp vs. 12pp). Remaining differences between my results with the NLSY cohorts and BD's were due to differences in samples noted in the Research Design section.

Even after reanalyzing the NLSY data, college enrollment trend differences remained between the NCES data and the NLSY data. By way of summary, NLSY data indicated that the college enrollment gap increased modestly between 1979 and 1997 cohorts, from 44 to 49 percentage points. NCES data indicated that this gap decreased between 1992 and 2004 from 38 percentage points to 30 percentage points. It is unlikely that the gap declined and then increased so abruptly between these cohorts. Instead, the striking differences in the magnitude of the 90/10 enrollment gaps between datasets suggested that there may be systematic differences in the samples, which I address in the next section.

College completion trends by income in NCES and NLSY data were more aligned. NLSY data showed that the 90/10 income-based completion gap was 48 percentage points among adolescents in the 1997 cohort. This was similar to the gap in college completion among the high school class of 1992. The income gap in college completion for the class of 2004 was lower than for the Class of 1992 and NLSY97. Given that there is no subsequent NLSY cohort, it is impossible to know whether a similar gap narrowing would have occurred.

Cross-Sectional Differences

The differences in the 90/10 enrollment gaps between the two sets of data were quite large as were the differences in average rates of college enrollment (Table 2.3). In this section I focus on cross-sectional differences between the two earlier NCES datasets (NELS:88, ELS:2002) and NLSY97 because they overlap in their cohorts of adolescents. The cross-sectional gap differences were primarily due to differential rates of college enrollment among low-income students in the two datasets. Approximately 55% of low-income students in the NELS:88 and ELS:2002 datasets enrolled in college by age 20; however, in the NLSY97 cohort, 36% of low-income students enrolled in college by age 20. College enrollment rates for median-income students were also higher in the NELS:88 and ELS:2002, and enrollment rates for high-income students were more similar between the two datasets, although they were again higher in the NCES data.

Conditioning on being enrolled in tenth grade explained nearly all of the difference in the 90/10 gap between NELS:88 and NLSY97. Using a sample of eighth grade students from NELS:88 (still the Class of 1992), I found that the 90/10 gap in college enrollment was 47 percentage points, approximately eight percentage points larger than the gap for the tenth grade sample, and similar to the 90/10 enrollment gap in NLSY97 (49 percentage points).[34] The wider gap among the eighth-grade cohort primarily resulted from lower rates of college enrollment among low-income students in the eighth-grade cohort than in the tenth-grade cohort (Figure 2.7). Fifty-three percent of

[34] Dropout prior to eighth grade may also generate upward bias in measures of educational attainment when conditioning on a sample of students enrolled in eighth grade; however, Kearney and Levine (2015) have argued that this bias is much smaller (see their Data Appendix). Using the two NLSY datasets, they calculated that approximately 0.5 percent of students drop out prior to eighth grade

low-income students in the tenth-grade cohort enrolled in college by 1994 as compared to 46% of low-income students in the eighth-grade cohort.

Using the eighth-grade sample of NELS:88 respondents resulted in comparable 90/10 enrollment gap estimates as NLSY97; however, cross-sectional differences by income remained. Estimates of college enrollment were 7-10 percentage points higher across all three income groups in the eighth-grade sample of NELS as compared to the NLSY97 sample.

Consistent with the finding that conditioning on enrollment in 10th grade explained nearly all of the cross-sectional differences in enrollment gaps, I found no evidence that systematic observable demographic or income differences between NCES and NLSY respondents accounted for any of the gap differences. They also did not appear to explain any of the remaining cross-sectional differences by income. These robustness checks are presented in Appendix B.3.

Cross-sectional college completion rates by income and the 90/10 gap in college completion were nearly identical between the tenth-grade cohort of the Class of 1992 and NLSY97 (Tables 2.3 and 2.4). The gap in college completion for the Class of 1992 remained relatively consistent when using an eighth-grade sample. The estimated 90/10 gap in BA completion was 48 percentage points using the 10th grade sample and 49 percentage points using the 8th grade sample. This resulted from the fact that while a smaller proportion of low-income students completed a BA using the 8th grade sample (10% versus 13%), a smaller proportion of high-income students in the 8th grade sample completed a BA (59% versus 61%).

Discussion

In this study, I examined income-based changes in college enrollment, four-year and highly selective enrollment, and college completion for several cohorts of high school students. I did so using three National Center for Education Statistics datasets that have been widely used in education research but that to date have not been used to comprehensively track income-based college enrollment and completion gaps. I sought to reconcile estimates from the NCES datasets with prior research that used NLSY datasets. While it was not possible to completely reconcile differences between the NCES data and NLSY data given the limited overlap in timing of the cohorts and limitations of the datasets, several key findings related to the trends and measurement of income-based college enrollment and completion gaps emerged. I discuss the implications of the findings here.

My findings related to income-based trends in the gap in college enrollment were only partially consistent with other studies. I found that income-based gaps in college enrollment narrowed between cohorts of 10th grade students in the Class of 1992 and 2004. Other studies have found that the income-gap in college enrollment widened slightly over this time period (Ziol-Guest & Lee, 2016). Consistent with past research, I found that the income-gap in college enrollment was stable between the high school classes of 2004 and 2013 (Chetty et al., 2014; Ziol-Guest & Lee, 2016).

I was not able to directly ascertain the reason for the inconsistency of my results related to gap changes; however, the most plausible explanation is that it was at least in part due to the fact that my samples were composed of students who were still enrolled in high school in tenth grade, thereby omitting students who had dropped out earlier in their

schooling. The samples in the two cited studies did not suffer from this limitation because they used either household-based samples (Ziol-Guest & Lee, 2016) or administrative data (Chetty et al., 2014).

My findings suggest that the income-based trend in college enrollment gaps among students who remained in high school were not representative of the trend among the age cohort more broadly. It is clear from comparing my NCES findings with those from the NLSY that results from the NCES samples should not be considered representative of a given age group, but rather of a particular grade cohort that was still enrolled in school. Moreover, the trends were not even directionally consistent (between 1992 and 2004). Researchers should consider the implications of these "missing students" when using the NCES datasets, particularly as it is common to use samples of tenth (e.g. Reardon et al., 2012) or even twelfth graders (e.g. Bastedo & Jacquette, 2011) from these data because tenth and twelfth graders are the only available representative samples for cross-cohort comparisons.

While the impact of tenth grade samples on estimates of the change in the enrollment gap between cohorts was not clear, I was able to identify the impact of early dropouts on the cross-sectional gap for the Class of 1992. The 90/10 gap in college enrollment was 39 percentage points using the tenth-grade sample versus 47 percentage points using the eighth-grade sample, which included students who dropped out prior to tenth grade. Low-income students accounted for almost all of the difference in the gap estimates. Forty-six percent of low-income students in the 8^{th} grade cohort enrolled in college whereas 53% did in the 10^{th} grade cohort. Furthermore, while 85% of low-income

tenth graders graduated high school (with a diploma or GED) only 72% of low-income eighth graders graduated.

These findings indicate that continuing in school through tenth grade and completing high school were salient transition points in the college access of low-income students. Recent headlines (e.g.(Gewertz, 2019): "High School Graduation Rate Reaches Another All-Time High") may obfuscate the extent to which high school graduation is far from universal particularly for low-income students. As Bloome and colleague (2018) noted with regard to the NLSY datasets, high school graduation became *more* stratified by income between the two NLSY cohorts (p. 1239, emphasis added). It is possible that high school graduation rates could have widened while also rising; however, that was not the case. High school graduation rates declined between 1970 and 2000 and then increased between 2000 and 2010 (Heckman & LaFontaine, 2010; Murnane, 2013).

Among low-income students who remained enrolled in high school, there were two important trends in college enrollment between 1992 and 2004. First the share of students who enrolled in college increased. Second, however, they were increasingly likely to enroll in college more than two years after their cohort graduation year. Increasingly, it appears that for adolescents from low-income backgrounds the question is not whether to enroll in college but when. This trend was striking in the NCES data with an additional 8% of students in low-income families enrolling in college by age 20 as compared to age 19 in the eighth-grade sample of the Class of 1992. A non-trivial share of low-income students enrolled in college as many as 5-7 years after their high school graduation.

It is important to note, however, that when students enrolled in college more than two years after high school graduation, they were generally not enrolling in four-year colleges as their first institution. If this trend continues, one implication is that college enrollment increasingly means different things for students from different income groups, with low-income students predominantly attending two-year institutions and high-income students predominantly attending four-year institutions. Moreover, researches indicates that when students' first enrollment was in a two-year institution, their likelihood of earning a bachelor's degree was reduced (B. T. Long & Kurlaender, 2008). Because there were not additional waves of data collection beyond eight years after the modal high school graduation, I was not able to ascertain whether students who delayed enrollment went on to earn a bachelor's degree.

Another concern with measuring college enrollment, not directly addressed in this study but potentially an import question for further research, is what precisely do researchers and policymakers care about in terms of college enrollment and do these datasets or others provide a measure of it? In both the NCES and NLSY datasets, respondents were asked whether they had attended or enrolled in the first year of college and when. These measures did not require any minimum duration or credit progress.

As an increasing share of students, particularly low-income students, do not attend college in the traditional manner, meaning full-time and in consecutive semesters (O'Toole, Stratton, & Wetzel, 2003), measuring college enrollment raises substantive questions for researchers and policymakers. Is it the act of enrollment itself that is relevant for our understanding of inequality and attainment or do researchers and policymakers care about enrollment coupled with a measure of progress? If the latter,

recent scholarship suggests that credit attainment may be a better measure of progress than duration of enrollment (Mabel, 2018). One complexity however, is that self-reports of educational attainment not corresponding to a degree tend to be less accurate than self-reports corresponding with degree attainment (Kane, Rouse, & Staiger, 1999). As college "enrollment" increasingly comes to mean different things for students of different income levels, using it as a common measure of educational attainment may mask important differences.

The low-income students mostly likely to be attending college in the "traditional" manner are often doing so in highly or moderately selective four-year institutions, where the probability of completion is higher. There is a growing body of evidence indicating that access to a four-year or highly-selective college matters a great deal for the completion outcomes of marginal students (Black, Denning, & Rothstein, 2020; Goodman, Hurwitz, & Smith, 2017). In line with this, I found that the income-based gaps in college completion shrank for the high school class of 2004 for whom four-year college and highly selective college enrollment gaps also narrowed slightly (Table 2.4).

While I found narrowing gaps in college completion, there were discrepancies between my findings and those of other studies in the direction of the trend in this measure, as there were with enrollment trends. While I obtained similar 90/10 gap estimates for the NCES Class of 1992 as I did for the NLSY97 cohort, I found a shrinking of bachelor's degree completion gaps for the Class of 2004. This was in contrast to other work that has found widening college completion gaps (Clark et al., 2020; Ziol-Guest & Lee, 2016). BD's study did not include adolescents of college age after the early 2000s. Therefore, further study of trends in college completion gaps is an

important avenue for future work on inequality in educational attainment. Moreover, college completion does not suffer from some of the measurement challenges of college enrollment noted above.

Income-based college completion trends and gaps also continue to be a substantively important area of study to understand inequality. The economic and non-economic returns to completing college are large, and completing college increases social mobility and improves economic security (Autor, 2014; Baum et al., 2013; Bloome et al., 2018; Chetty et al., 2017). Yet, college completion gaps, even with the estimated decline between 1992 and 2004, continued to be large (approximately 40 percentage points). Furthermore, the share of adolescents from low-income backgrounds earning bachelor's degrees continues to be low.

In this study, I addressed the question of whether postsecondary educational attainment is becoming more unequal among children from different income backgrounds. I examined this question for three high school cohorts, spanning 1992-2013, a period over which income inequality also rose. I did not find evidence of widening disparities across the college enrollment and completion measures that I examined. I did find, however, increasing inequality between adolescents from low- and high-income families in the timing of college enrollment, which may have implications for completion. While not directly related to income-based gap changes, I also found average levels of educational attainment (high school graduation, college enrollment, and bachelor's degree completion) to be generally stagnant. In conclusion, this study contributes to a growing body of research seeking to understand the nature of income-based educational attainment gaps. It also contributes by identifying important

measurement, analysis, and sample-related issues for researchers and policymakers to consider.

Figures

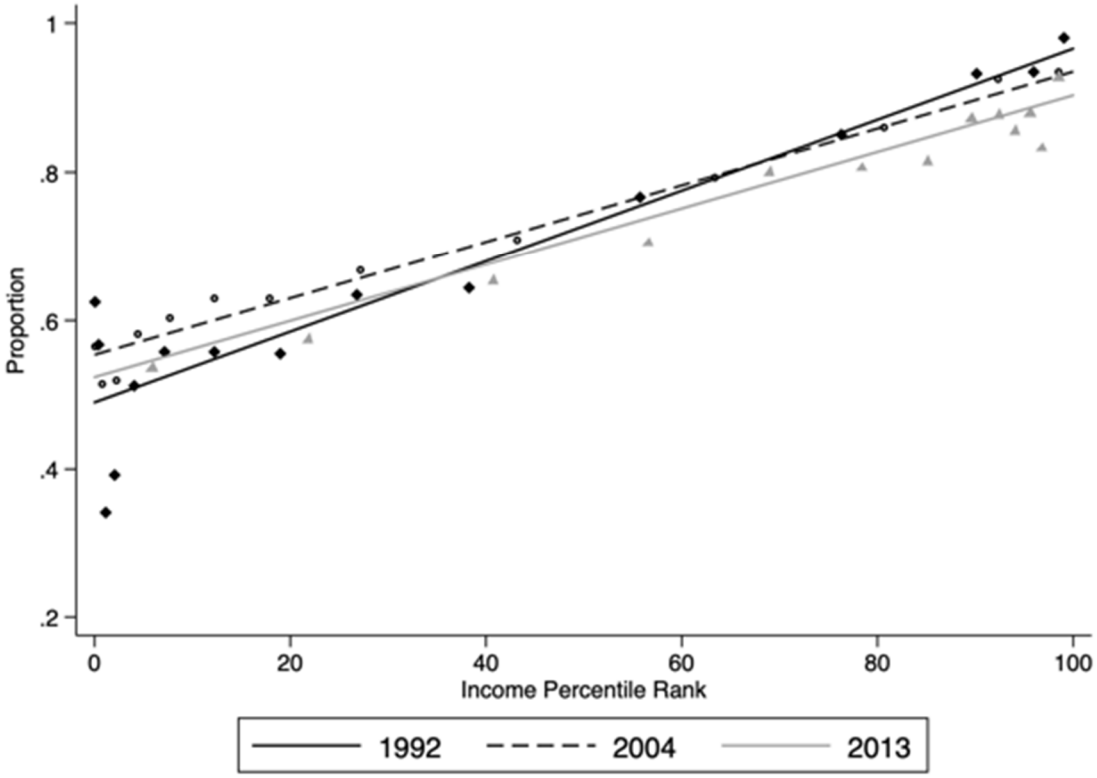


Figure 2.1. Income-based trend in college enrollment for three high school cohorts: Class of 1992, Class of 2004, and Class of 2013.

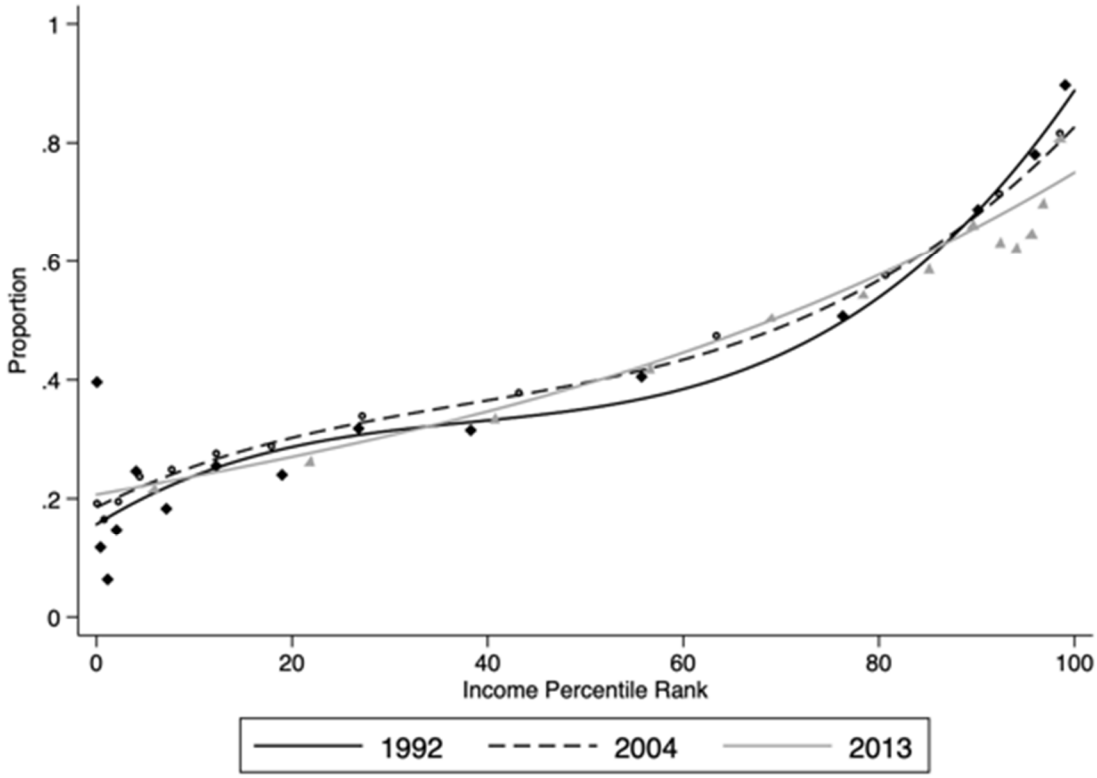


Figure 2.2. Income-based trend in four-year college enrollment for three high school cohorts: Class of 1992, Class of 2004, and Class of 2013.

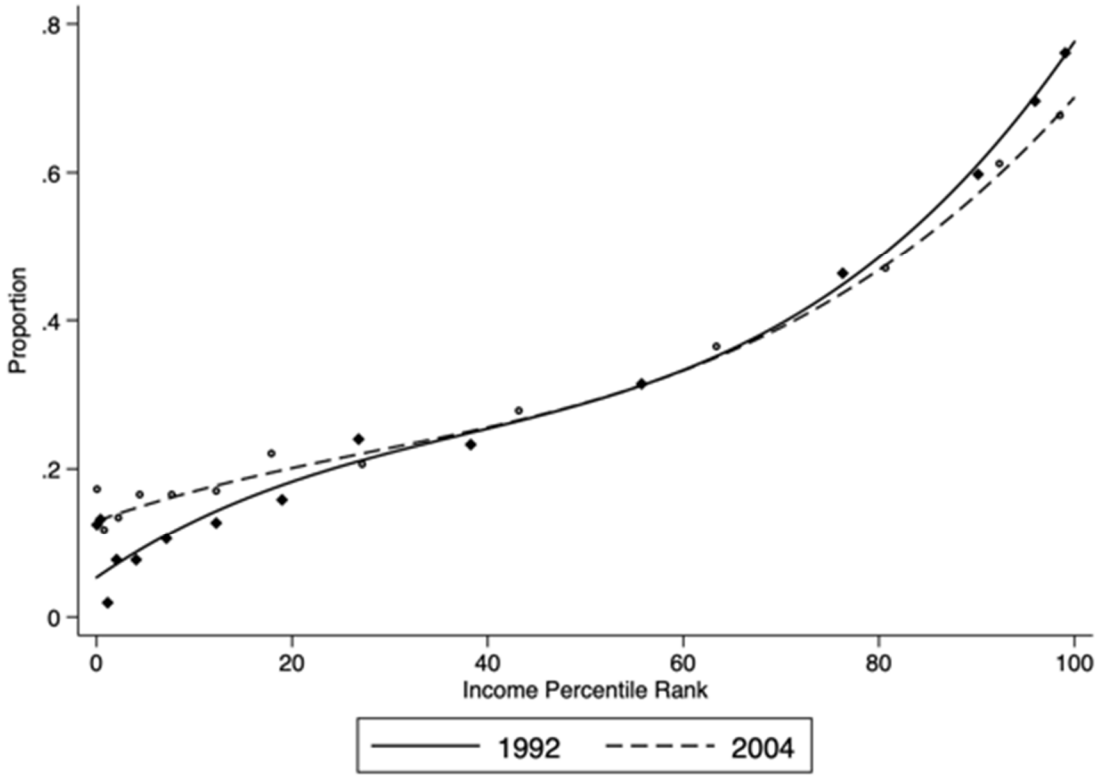
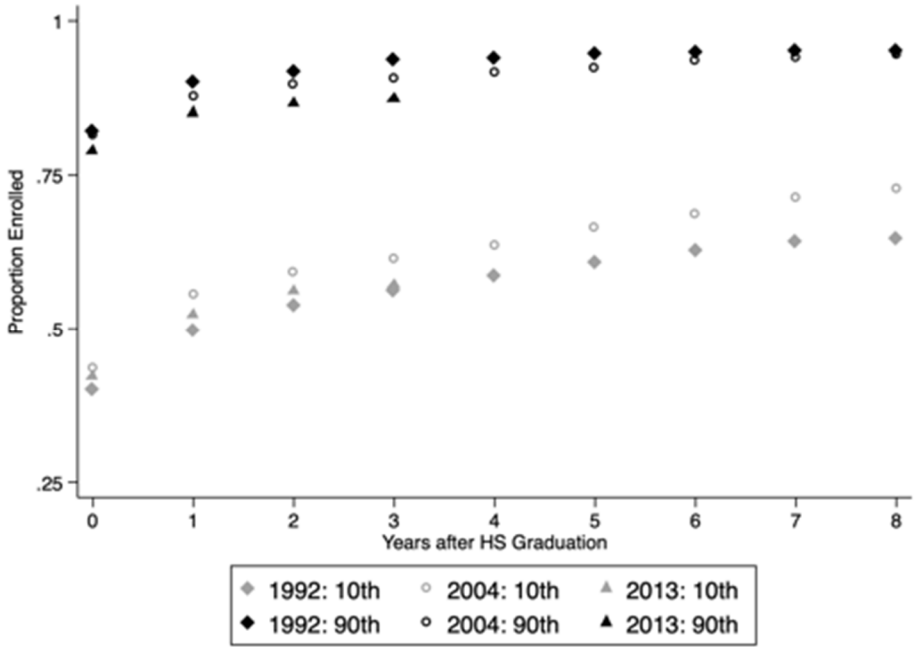


Figure 2.3. Income-based trends in college completion for two high school cohorts: Class of 1992 and Class of 2004.

a. Enrollment Trends by Income and Years Since High School Graduation



b. Enrollment Gap by Years Since High School Graduation

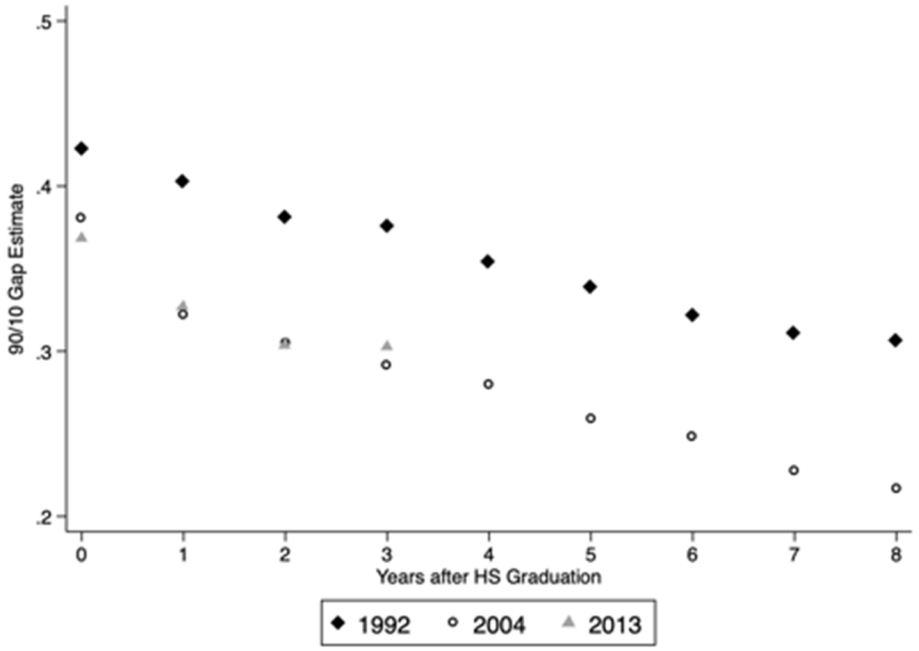
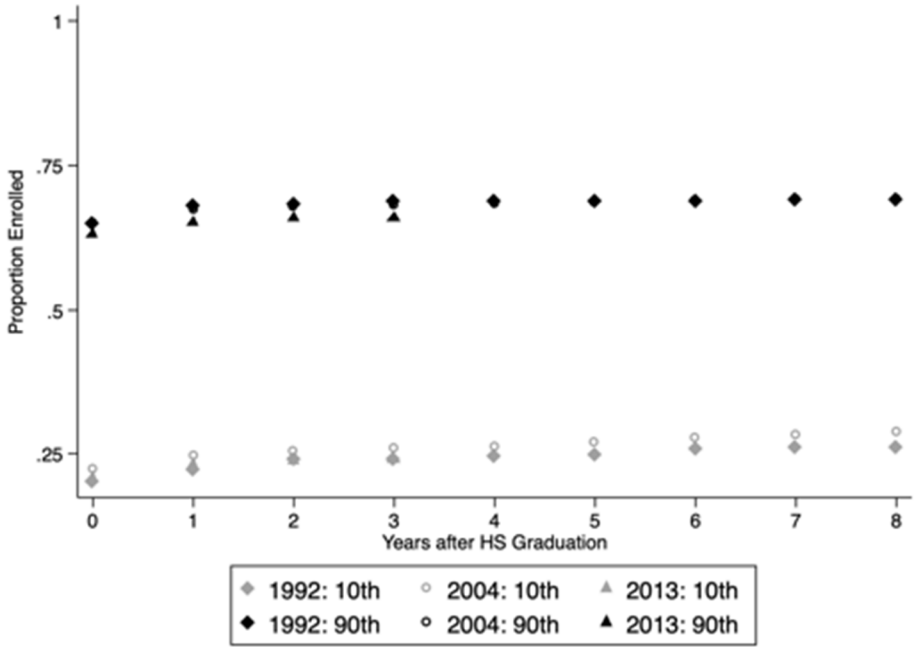


Figure 2.4. Income-Based College Enrollment Trends and Gaps by Years Since High School Graduation: High School Classes of 1992, 2004, and 2013.

a. Four-Year Enrollment Trends by Income and Years Since High School Graduation



b. Four-Year College Enrollment Gap by Years Since High School Graduation

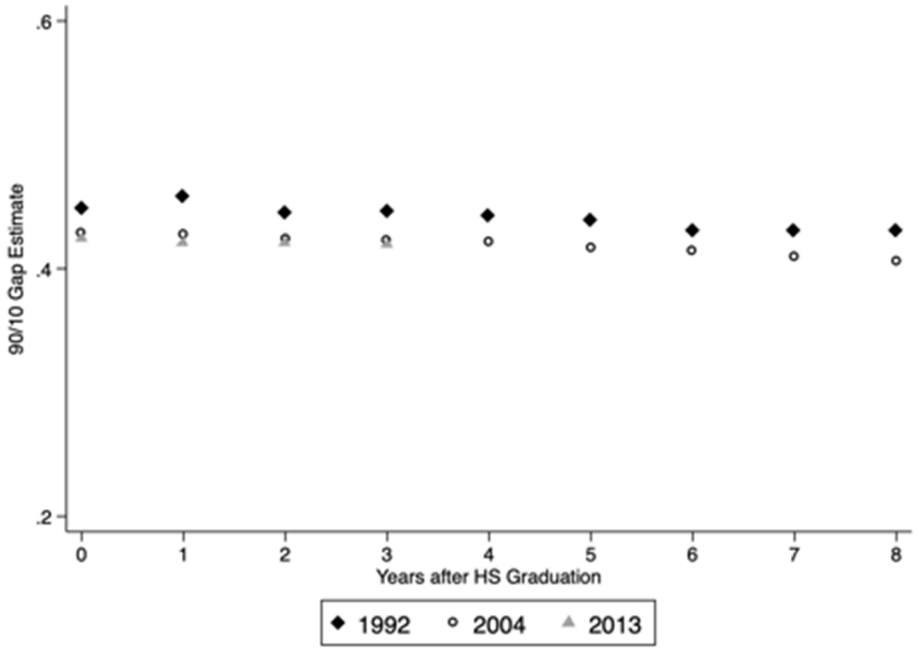


Figure 2.5. Income-Based Four-Year College Enrollment Trends and Gaps by Years Since High School Graduation: High School Classes of 1992, 2004, and 2013.

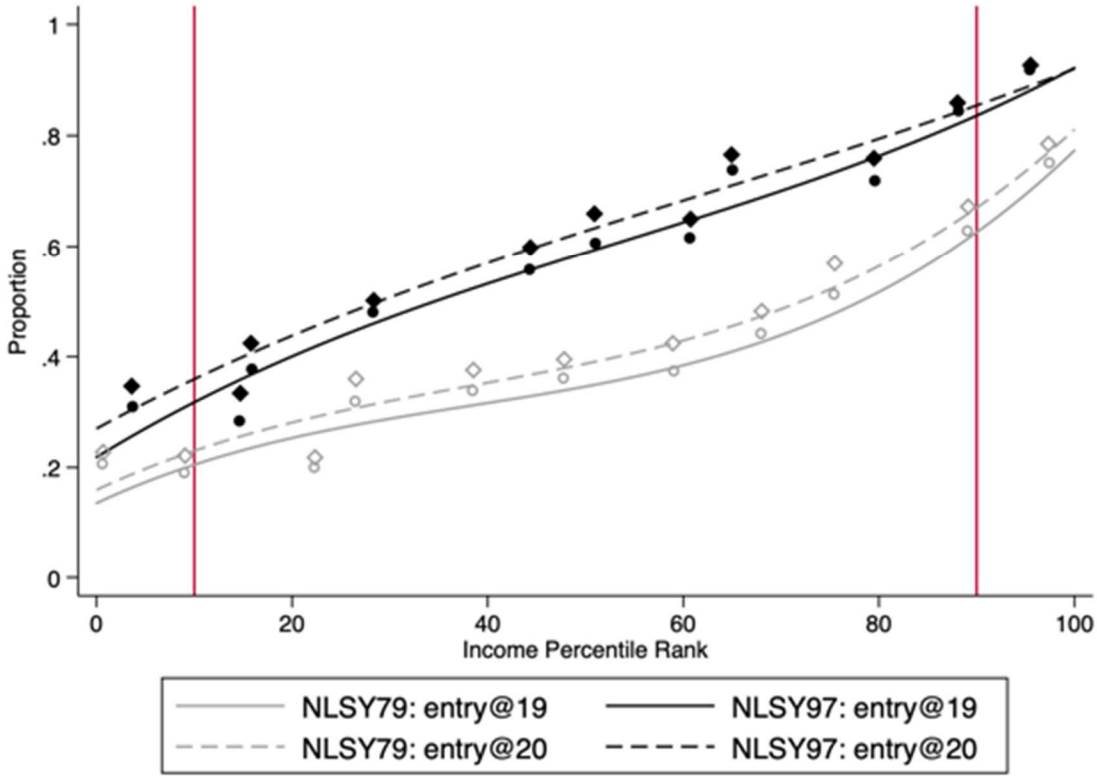


Figure 2.6. Income-based trend in college enrollment at age 19 and 20 for two NLSY Cohorts: 1979 and 1997.

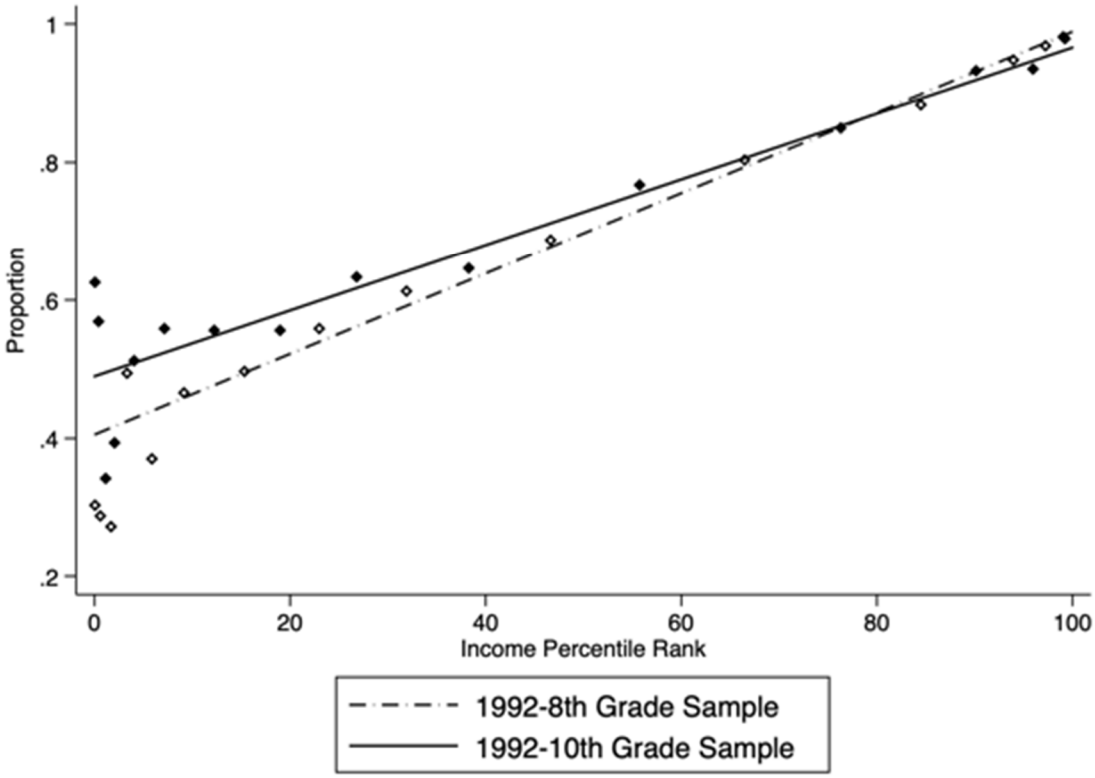


Figure 2.7. Income-based trends in college enrollment using the eighth and tenth grade samples of the high school class of 1992.

Tables

Table 2.1

Summary of Trends in Income Gap (SES Gap) in College Enrollment and Completion and Source

Year when 18	**College Enrollment**	**Four-Year College Enrollment**	**Selective College Enrollment**	**College Completion**
1972 – 1981	Increased[2] Flat[3]	Increased[3]	Increased[3]	Flat/Increased[2]
1982 – 1992	Increased[1, 2] Declined[3]	Increased[3]	Increased[3, 4]	Increased[1, 2]
1993 – 2002	Increased[1] Flat[2] Declined[3]	Flat[3]	Declined[3] Flat[4]	Increased[1, 2]
2003 – 2012	Flat/Declined[5]		Flat/Declined[5]	Increased[6]
2013 –				

[1](Bailey & Dynarski, 2011); [2](Ziol-Guest & Lee, 2016); [3](Bastedo & Jacquette, 2011); [4](Reardon et al., 2012); [5](Chetty et al., 2014); [6](Clark et al., 2020)

Table 2.2

Demographic Characteristics of the High School Cohorts of 1992, 2004, and 2013.

	1992	2004	2013
Teen's Race			
Asian (non-Hispanic)	0.038	0.041	0.039
Black (non-Hispanic)	0.118	0.143	0.13
Hispanic	0.094	0.158	0.216
White (non-Hispanic)	0.741	0.606	0.533
Other	0.008	0.051	0.081
Foreign Born	0.039	0.08	0.067
Modal Year of Birth (proportion of students)	1974 (.68)	1986 (.58)	1995 (0.57)
Mother's Highest Education			
Less than high school	0.127	0.130	0.108
High school or some college	0.606	0.623	0.603
Bachelor's degree or higher	0.267	0.250	0.289
High School Degree (Diploma or GED)	0.926	0.923	0.955
College Enrollment	0.730	0.745	0.714
Four-Year College Enrollment	0.419	0.438	0.422
Highly Selective College Enrollment	0.082	0.064	0.06
College Completion	0.339	0.334	n/a
N (unweighted)	8,940	12,800	14,760

Note. Sample sizes are rounded to the nearest to 10 due to the reporting rules of the National Center for Education Statistics. College enrollment and four-year enrollment are measured as of two years after the modal high school graduation year. College completion is measured eight years after the modal high school graduation. College completion data is not yet available for the Class of 2013.

Table 2.3

Demographic Characteristics of the NLSY and NCES Cohorts

	NLSY		NCES	
	1979	1997	1992	2004
Teen's Race				
Black (non-Hispanic)	0.149	0.147	0.118	0.143
Hispanic	0.065	0.12	0.094	0.158
Non-Black and Non-Hispanic	0.786	0.733	0.788	0.699
Foreign Born	0.041	0.044	0.039	0.08
Year of Birth	1961-1964	1981-1984	1972-1975	1983-1987
Mother's Highest Education				
Less than high school	0.329	0.167	0.127	0.130
High school and some college	0.569	0.627	0.606	0.623
Bachelor's degree and higher	0.102	0.205	0.267	0.250
High School Degree (Diploma or GED) by Age 20	0.81	0.868	0.926	0.923
College Enrollment by Age 20	0.434	0.614	0.745	0.729
College Graduation by Age 25/26	0.203	0.327	0.339	0.334
N (unweighted)	4512	4105	8,940	12,800

Note. NLSY respondents were 15-18 years old in 1979 and 13-16 years old in 1997. NCES respondents were cohorts of tenth grade students in 1990 and 2002. Sample sizes for NCES data are rounded to the nearest to 10 due to disclosure rules. In the NCES datasets, college completion is measured eight years after the modal high school graduation. NCES = National Center for Education Statistics; NLSY = National Longitudinal Survey of Youth.

Table 2.4

College Enrollment and Completion at the 10th, 50th, and 90th Percentile Ranks of the Income Distribution and the 90/10 Gaps: High School Classes of 1992, 2004, and 2013.

	10th Percentile			50th Percentile			90th Percentile			90/10 Gap		
	1992	2004	2013	1992	2004	2013	1992	2004	2013	1992	2004	2013
College Enrollment	0.528	0.592	0.533	0.723	0.744	0.694	0.918	0.897	0.855	0.390	0.305	0.322
	(.017)	(.009)	(.013)	(.008)	(.006)	(.006)	(.012)	(.007)	(.009)	(.024)	(.012)	(.019)
Four-Year College Enrollment	0.221	0.253	0.222	0.342	0.391	0.374	0.679	0.682	0.646	0.458	0.429	0.424
	(.016)	(.011)	(.012)	(.015)	(.009)	(.009)	(.019)	(.012)	(.011)	(.025)	(.015)	(.017)
Highly-Selective College Enrollment	0.023	0.018	0.012	0.050	0.041	0.026	0.179	0.147	0.139	0.157	0.129	0.127
	(.006)	(.003)	(.003)	(.004)	(.003)	(.006)	(.015)	(.009)	(.010)	(.016)	(.009)	(.010)
College Completion	0.115	0.170	n/a	0.276	0.289	n/a	0.597	0.571	n/a	0.482	0.403	n/a
	(.010)	(.009)		(.012)	(.008)		(.021)	(.011)		(.023)	(.013)	

Note. Standard errors presented in parentheses. Sample sizes, rounded to the nearest to 10 due to the reporting rules of the National Center for Education Statistics, were 10,470, 12,800, and 15,760 for the Classes of 1992, 2004, and 2013. College enrollment and four-year enrollment were measured as of two years after the modal high school graduation year. College completion was measured eight years after the modal high school graduation. College completion data is not yet available for the Class of 2013.

Table 2.5

College Enrollment and Completion at the 10th, 50th, and 90th Percentile Ranks of the Income Distribution and the 90/10 Gaps: NLSY79 and NLSY97

	10th Percentile		50th Percentile		90th Percentile		90/10 Gap		
	1979	1997	1979	1997	1979	1997	1979	1997	Δ
College Enrollment by age 19	0.205	0.320	0.346	0.588	0.626	0.833	0.421	0.513	0.092
	(.014)	(.014)	(.013)	(.012)	(.019)	(.013)	(.023)	(.019)	
College Enrollment by age 20	0.23	0.361	0.387	0.628	0.670	0.853	0.440	0.492	0.052
	(.014)	(.014)	(.013)	(.012)	(.018)	(.012)	(.023)	(.019)	
College Completion by age 25	0.067	0.114	0.144	0.299	0.414	0.595	0.347	0.481	0.134
	(.009)	(.010)	(.010)	(.012)	(.019)	(.017)	(.021)	(.020)	

Note. Standard errors presented in parentheses. Sample sizes are 4,512 and 4,105 for NLSY79 and NLSY97, respectively. NLSY=National Longitudinal Study of Youth.

Conclusion

The two studies in this dissertation contribute to the literature on trends in income-based inequality in postsecondary educational attainment. In the first paper, I examined changes over time by income in parental involvement in the college-going process of their adolescents, which has been hypothesized to be one potential mechanism behind widening educational attainment gaps. In the second paper, I examined trends in income-based gaps in college enrollment, four-year college enrollment, highly selective enrollment, and college completion, a comprehensive set of postsecondary educational attainment measures.

In both studies, I used data from National Center for Education Statistics (NCES) longitudinal studies of high school students. In the first paper, I used the National Education Longitudinal Study of 1988 (NELS:88) and the Education Longitudinal Study of 2002 (ELS:2002) datasets. In the second study, I also used the High School Longitudinal Study of 2009 (HSLS:09) dataset. The three studies provided detailed information on students in their secondary and postsecondary years as well as demographic information (Ingels et al., 2015). I described trends by family income rank, focusing on families at the 10^{th}, 50^{th}, and 90^{th} percentile ranks, and the gap between high- and low-income adolescents (the 90/10 gap), using a method developed by Reardon (2011b).

Results from the first study indicated that while some 90/10 income-based gaps in parental involvement and investment narrowed between the Class of 1992 and the Class of 2004, others widened. Specifically, I found narrowing gaps between high- and low-income students in parents' aspirations for their educational attainment and discussions

with parents about college going. In contrast, however, I found that income-based gaps in parental financial investments and student college entrance exam preparation and taking widened. I also examined potential explanations for growing gaps and found support primarily for changing associations between income and parental support. Rising income inequality and changing characteristics of families by income did not appear to explain widening gaps.

Results from the second paper showed that income-based college enrollment and completion gaps narrowed. Enrollment gaps (measured as enrollment in any type of postsecondary institution) narrowed and then remained stable between the 1990s and 2010s among cohorts comprising students enrolled in high school as of 10th grade (or 9th grade in the case of the Class of 2013). In contrast to other work (e.g. Clark, Ortman, Pharris-Ciurej, & Voorheis, 2020; Ziol-Guest & Lee, 2016), I found that college completion (measured as bachelor's degree attainment) gaps narrowed between the high school classes of 1992 and 2004. I also examined income-based trends in four-year college enrollment and selective-college enrollment, and I found these gaps narrowed slightly and then stabilized.

Both studies were motivated by the premise that rising income inequality may be associated with widening inequality in educational outcomes and widening disparities in parental behaviors that may be associated with widening educational attainment gaps. There is an increasingly large body of evidence indicating that rising income inequality has led to both widening economic differences among families with children and also widening differences in the experiences of children from the bottom and top of the

income distribution, which separately or jointly could lead to widening gaps in educational attainment.

My findings were only partially consistent with this hypothesis. On the one hand, I did find widening income-based gaps in two domains of parental involvement between the 1992 and 2004 cohort: financial preparation for postsecondary education and college admissions preparation and test taking. These findings were consistent with other studies that have shown widening gaps by income in investments of money in children and adolescents (Kornrich, 2016; Kornrich & Furstenberg, 2013; Schneider et al., 2018). On the other hand, however, I found narrowing gaps in parents' aspirations and discussions about college-going with their teens. Most surprisingly, I found narrowing or stable gaps in all four of the measures of educational attainment. Numerous other studies have documented an apparent widening of income-based gaps in similar measures of educational attainment over portions of the time period covered by the cohorts I studied.

Aspects of the NCES datasets may account for some of these discrepancies in findings related to trends in the gaps in educational attainment. One limitation of the NCES datasets is that two of them were comprised of high-school-based samples, thereby conditioning on students being enrolled in ninth or tenth grade and omitting students who had dropped out. While it was not entirely possible to identify the impact of this limitation on gap change estimates, high school samples demonstrated upwardly biased cross-sectional gap estimates. Ideally for a study such as this, one would have administrative data or household-based survey data of multiple cohorts that also included a range of specific measures of postsecondary educational enrollment and completion (like the NCES datasets). Unfortunately, no such datasets exist.

Across the two studies, the patterns of results were in some cases consistent with expectations about the impact of parental involvement gap changes on educational attainment gaps, but in other cases they were not. For example, the results related to aspirations for educational attainment and actual educational attainment were aligned. Specifically, in the first study, I found that the 90/10 gap in parents' aspirations for their teen's educational attainment narrowed, and in the second study I found that both the college enrollment gap and the completion gap also narrowed between 1992 and 2004. In all three cases, the shrinking gaps were the result of increases in the three measures among low-income students and their families.

The widening gaps in other parental investment measures suggested that there may be widening in measures of educational attainment; however, that was not the case. The widening gap in college admissions test taking would have led me to expect widening gaps in four-year and highly selective college enrollment. Similarly, the widening gaps in parents' financial preparation for postsecondary educational expenses would have led me to expect widening gaps in the measures of college enrollment and/or in bachelor's degree completion. However, again, this was not what I found.

Understanding which parental behaviors matter for which educational outcomes is an important area for future research. Much of the literature that examines trends over time in gaps in parental investments of time and money assumes a positive (linear) relationship between these investments and children's outcomes. For example, Kornrich and Furstenberg noted, "…monetary investments should be related to achievement, and, if nothing else, serves as a reflection of parents' level of motivation to invest in their children" (2013, p. 21). While it is certainly true that parental investments of time and

money in their children, particularly in developmentally appropriate activities are likely positively associated with educational outcomes, it is less clear whether the relationship is linear. Beyond a certain point, the returns to certain parental behaviors may be minimal. Moreover, it is the quality as well as the quantity of involvement and investment that likely matters for children's life outcomes.

While not directly relevant to questions of gap changes between cohorts, two overall trends related to parental involvement in the college-going process, are worth highlighting. First, average levels of parental involvement increased across the three domains (aspirations, financial preparation, and test taking). This may have been because parents in all income groups were aware of the growing monetary and non-monetary returns to a college degree grow (Autor, 2014; Baum et al., 2013), and consequently, they were providing increased support to their adolescents to achieve this level of education. However, even with these increased investments, absolute differences between adolescents from high- and low-income families remained large. Over twice as many high-income students (87%) as low-income students (40%) had taken or planned to take a college admissions test in 2004. Moreover, low-income parents were not able to keep pace with high-income parents in financial preparation for college. High-income parents had saved approximately ten times as much for their adolescent's education after high school as low-income parents ($27,000 vs. $2,900).

Among the educational attainment measures, it is also worth noting that average levels of educational attainment were generally stagnant across these three cohorts of high school students. This implies that educational expansion (i.e. the extent to which increasing shares of the population are achieving higher levels of education) may have

slowed. The high school graduation rate increased by three percentage points between the Class of 1992 and the Class of 2013, and this was the largest increase among the attainment measures (Table 2.2). The college enrollment rate ranged between 71.4% and 74.5%. Finally, the college completion rate declined by half a percentage point between 1992 and 2004, with only one third of high school students going on to earn a bachelor's degree. Together, these statistics from the NCES datasets suggest very little expansion of educational attainment over the three decades of this study. This contrasts with the NLSY datasets, which indicated significant expansion of postsecondary educational attainment over the twenty-year period between the two cohorts (Table 2.3). This trend is of concern because the labor market returns to college are large and earning a college degree is important for social mobility. The continuation of this trend may also be harmful to social mobility. To date, intergenerational mobility has not declined even with rising income inequality (Chetty et al., 2014) because the expansion of higher education enrollment has partially offset these trends (Bloome et al., 2018)

In summary, the two studies in this dissertation contribute to a growing body of research seeking to understand to what extent socioeconomic gaps in educational achievement and attainment are widening and to what extent there are widening disparities in parental behaviors that may be associated with widening attainment gaps. Understanding the nature, causes, and consequences of changes in parental involvement and educational attainment by income and education are important for identifying policy solutions aimed at reducing these gaps.

Appendix A – Paper 1

Table A.1

90/50 and 50/10 Income-Based Parental Support Gaps: HS Class of 1992 and HS Class of 2004.

	90/50 Gap				50/10 Gap			
Measures	1992	2004	Δ		1992	2004	Δ	
A. Aspirations								
Mother wants teen to obtain BA or more	0.16	0.12	-0.04	*	0.10	0.09	-0.01	
Often discussed going to college with parents	0.10	0.10	0.00		0.04	0.01	-0.02	
Often discussed college exam preparation with parents	0.08	0.08	0.00		0.03	-0.02	-0.04	
B. Monetary Investments								
Amount set aside for teen's education after high school (2018$)	20246	23582	3336	**	1909	609	-1300	*
Set up a college investment fund	0.14	0.26	0.12	***	0.03	0.07	0.04	***
Made investments in stocks or real estate	0.30	0.36	0.06	***	0.10	0.13	0.04	*
Often attend concerts, plays, or movies outside of school with student	0.02	0.04	0.02		0.01	0.03	0.02	
Often take day trips or vacations with student	0.12	0.13	0.01		0.05	0.08	0.03	
C. Test Taking								
Teen has taken/plans to take a course offered by commercial test preparation service and/or one-on-one tutoring	0.15	0.15	0.00		-0.07	-0.06	0.01	
Teen has taken SAT or ACT	0.22	0.25	0.03	+	0.20	0.22	0.02	

+p<.1 *p < .05 **p < .01 ***p < .001.

Table A.2[35]

Income-based Parental Support Trends and Gaps 25th and 75th Percentile Ranks: HS Class of 1992 and HS Class of 2004.

Measures	25th Percentile Rank				75th Percentile Rank				75/25 Gap			
	1994	2004	Δ		1994	2004	Δ		1992	2004	Δ	
A. Aspirations												
Mother wants teen to obtain BA or more	0.61	0.75	0.14	***	0.75	0.87	0.13	***	0.13	0.12	-0.01	
Often discussed college exam preparation with parents	0.14	0.22	0.08	***	0.19	0.24	0.05	**	0.04	0.02	-0.03	
B. Monetary Investments												
Amount set aside for teen's education after high school (2018$)	4455	5099	644	+	11088	10932	-156		6632	5833	-800	
Set up a college investment fund	0.04	0.07	0.03	***	0.12	0.23	0.11	***	0.07	0.15	0.08	***
Made investments in stocks or real estate	0.09	0.12	0.03	**	0.28	0.37	0.09	***	0.19	0.25	0.06	**
C. Test Taking												
Teen has taken/ plans to take a course offered by commercial test preparation service and/or one-on-one tutoring	0.12	0.15	0.03	*	0.11	0.16	0.04	**	-0.01	0.01	0.02	
Teen has taken SAT or ACT	0.46	0.50	0.03	+	0.69	0.75	0.06	***	0.23	0.26	0.03	

+p <.10 *p < .05 **p < .01 ***p < .001.

[35] Tables A.2 – A.4 do not include the measure "frequently discussed going to college" because the results I had were incorrect, and I was not able to update them due to restrictions on data access as a result of the Covid pandemic.

Table A.3

Parental Support at the 10th, 50th, and 90th Percentile Ranks of the Parent Education Distribution: HS Class of 1992 and HS Class of 2004.

	10th Percentile		50th Percentile		90th Percentile	
Measures	1992	2004	1992	2004	1992	2004
A. Aspirations						
Mother wants teen to obtain BA or more	0.536	0.690***	0.680	0.820***	0.876	0.937***
Often discussed college exam preparation	0.117	0.182***	0.154	0.233***	0.243	0.285+
B. Monetary Investments						
Amount set aside for teen's education after high school (2018$)	3195	2965	5523	7371**	20749	21687
Set up a college investment fund	0.035	0.038	0.038	0.140***	0.205	0.328***
Made investments in stocks or real estate	0.071	0.082	0.162	0.246***	0.375	0.452***
C. Test Taking						
Teen has taken/plans to take a course offered by commercial test preparation service and/or one-on-one tutoring	0.117	0.138	0.101	0.139**	0.208	0.266**
Teen has taken/plans to take SAT or ACT	0.354	0.416**	0.556	0.625***	0.830	0.848

+p<.1 *p < .05 **p < .01 ***p < .001.

Table A.4

Parental Investments Gaps by Parent Education Percentile Rank: HS Class of 1992 and HS Class of 2004.

	90/10 Gap		90/50 Gap		50/10 Gap	
Measures	1992	2004	1992	2004	1992	2004
A. Aspirations						
Mother wants teen to obtain BA or more	0.340	0.247***	0.196	0.117***	0.144	0.130
Often discussed college exam preparation	0.126	0.103	0.090	0.051+	0.037	0.051
B. Monetary Investments						
Amount set aside for teen's education after high school (2018$)	17553	18723	15226	14316	2328	4406**
Set up a college investment fund	0.170	0.289***	0.167	0.188	0.004	0.101***
Made investments in stocks or real estate	0.304	0.370**	0.213	0.206	0.09	0.164***
C. Test Taking						
Teen has taken/plans to take a course offered by commercial test preparation service and/or one-on-one tutoring	0.091	0.128+	0.106	0.127	-0.015	0.001
Teen has taken/plans to take SAT or ACT	0.476	0.432+	0.274	0.223*	0.202	0.209

+p<.1 *p < .05 **p < .01 ***p < .001.

Appendix B – Paper 2

B.1. Highly selective four-year colleges

Table B.1.

Highly selective four-year colleges, based on Barron's Admissions Competitive Index Ranking, 2004.

Agnes Scott College	Oberlin College
Amherst College	Occidental College
Austin College	Pennsylvania State University
Babson College	Pitzer College
Bard College	Pomona College
Barnard College	Princeton University
Bates College	Providence College
Beloit College	Reed College
Bennington College	Rensselaer Polytechnic Institute
Boston College	Rhodes College
Boston University	Rice University
Bowdoin College	Rose-Hulman Institute of Technology
Brandeis University	Rutgers University-New Brunswick
Brigham Young University	Santa Clara University
Brown University	Sarah Lawrence College
Bryn Mawr College	Scripps College
Bucknell University	Sewanee: The University of the South
California Institute of Technology	Skidmore College
Carleton College	Smith College
Carnegie Mellon University	Southern Methodist University
Case Western Reserve University	Southwestern University
Centre College	St John's College
Claremont McKenna College	St. Olaf College
Clemson University	Stanford University
Colby College	Stevens Institute of Technology
Colgate University	Stonehill College
College of Charleston	Stony Brook University
College of the Holy Cross	SUNY at Albany
College of William and Mary	SUNY at Binghamton
Colorado College	SUNY at Geneseo
Colorado School of Mines	Swarthmore College
Columbia University	Syracuse University
Connecticut College	Texas A & M University
Cooper Union	The College of New Jersey
Cornell University	The College of Wooster
Dartmouth College	The University of Texas at Austin

Davidson College
Denison University
DePauw University
Dickinson College
Duke University
Emerson College
Emory University
Fairfield University
Florida State University
Fordham University
Franklin and Marshall College
Furman University
George Washington University
Georgetown University
Georgia Institute of Technology
Gettysburg College
Gonzaga University
Goucher College
Grinnell College
Grove City College
Hamilton College
Hampshire College
Harvard University
Harvey Mudd College
Haverford College
Hillsdale College
Hobart William Smith Colleges
Illinois Institute of Technology
Illinois Wesleyan University
Ithaca College
Jewish Theological Seminary of America
Johns Hopkins University
Kalamazoo College
Kenyon College
Kettering University
Lafayette College
Lawrence University
Lehigh University
Loyola College in Maryland
Macalester College
The University of Texas at Dallas
Trinity College
Trinity University
Truman State University
Tufts University
Tulane University of Louisiana
Union College
United States Air Force Academy
United States Coast Guard Academy
United States Merchant Marine Academy
United States Military Academy
United States Naval Academy
University of California-Berkeley
University of California-Irvine
University of California-Los Angeles
University of California-San Diego
University of Chicago
University of Delaware
University of Florida
University of Illinois at Urbana-Champaign
University of Mary Washington
University of Maryland-College Park
University of Miami
University of Michigan-Ann Arbor
University of North Carolina at Chapel Hill
University of Notre Dame
University of Pennsylvania
University of Pittsburgh
University of Puget Sound
University of Richmond
University of Rochester
University of San Diego
University of Southern California
University of Virginia-Main Campus
Vanderbilt University
Vassar College
Villanova University
Wake Forest University
Washington and Lee University
Washington University in St Louis

Massachusetts Institute of Technology
Miami University-Oxford
Middlebury College
Missouri University of Sci and Tech
Mount Holyoke College
Muhlenberg College
New College of Florida
New York University
Northeastern University
Northwestern University
Webb Institute
Wellesley College
Wesleyan University
Wheaton College
Whitman College
Williams College
Wofford College
Worcester Polytechnic Institute
Yale University

B.2. Comparing NLSY Estimates Using Unweighted and Weighted Measures of Income

Table B.2

College Enrollment and Completion using BD Samples and Unweighted and Weighted Measures of Income Percentile Rank: NLSY79 and NLSY97.

	10th Percentile		50th Percentile		90th Percentile		90/10 Gap		
Outcome Measures	1979	1997	1979	1997	1979	1997	1979	1997	Δ
College Enrollment by age 19	0.20	0.27	0.32	0.54	0.60	0.81	0.41	0.54	0.13
College Enrollment by age 19 weighted	0.22	0.30	0.38	0.58	0.65	0.82	0.43	0.52	0.09
College Enrollment by age 20	0.23	0.31	0.36	0.41	0.65	0.84	0.42	0.53	0.11
College Enrollment by age 20 weighted	0.25	0.33	0.58	0.63	0.70	0.85	0.44	0.52	0.07
College Completion by age 25	0.06	0.09	0.14	0.17	0.37	0.43	0.32	0.47	0.15
College Completion by age 25 weighted	0.07	0.11	0.25	0.29	0.56	0.58	0.36	0.47	0.12

Note. Sample sizes were 3,709 and 2,046 for the 1979 and 1997 cohorts, respectively. Outcomes denoted as "weighted" indicate that the income distribution was weighted when constructing income percentile ranks.

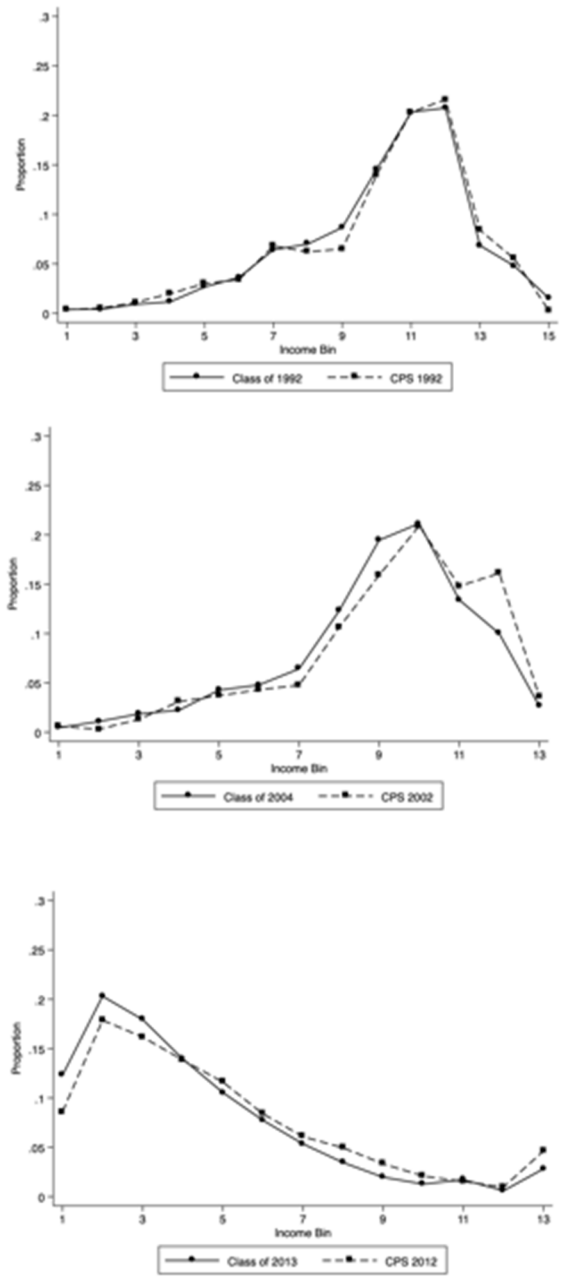
B.3. Income and Demographic Comparison of NCES and NLSY Datasets

Systematic income differences between the NCES and NLSY survey respondents did not appear to explain the cross-sectional differences in college enrollment rates. I focused this comparison on the two earlier NCES datasets (NELS:88 and ELS:2002) and the NLSY97 because these cohorts overlapped. The distribution of incomes in both sets of data were similar to the distribution of the incomes of families with adolescents of the same age range in the CPS. In Appendix Figure B.1, I present each cohort's income distribution from the NCES surveys and the associated CPS year.[36] While there was some variation across cohorts in under- and overrepresentation of different parts of the distribution, there were no systematic differences with the CPS. The distribution of family income in NELS was most similar to the CPS (panel A). The correlation of the two distributions was also the highest at 0.99 (Appendix Table B.3). For ELS the correlation with the CPS was 0.95, with some underrepresentation of higher income families (i.e. those in income bin 12). The HSLS sample overrepresented adolescents from families in the lower end of the income distribution compared to the CPS (panel C), with a correlation of 0.98. I present NLSY-CPS income distributions in Appendix Figure B.2. The correlations of each of sample with their respective CPS samples were 0.987 (1979) and 0.985 (1997). Visually, there was little under- or overrepresentation of families from different parts of the income distribution.

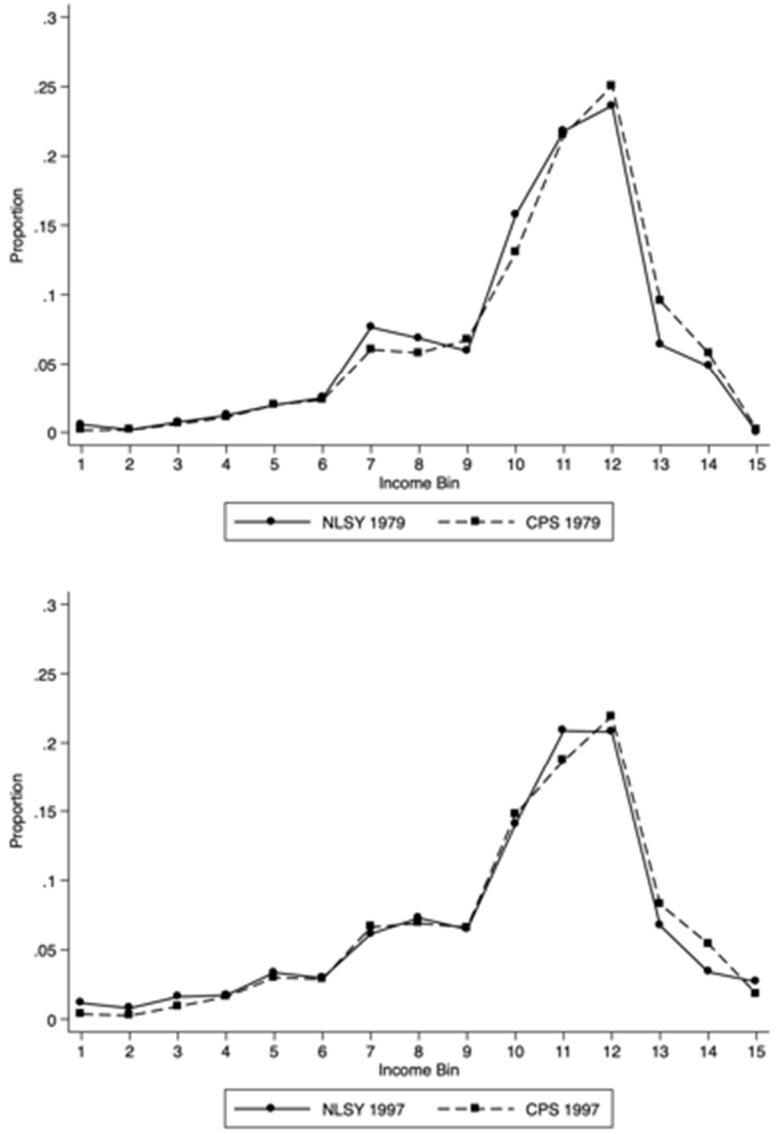
I examined whether the demographic characteristics of the samples could explain the large cross-sectional differences, and I found little evidence to support this. I found

[36] Family income information was collected in survey years 1992, 2002, and 2012 for the NCES datasets. Families provided information on the prior calendar year's earnings. I use CPS data from 1992, 2002, and 2012, as the CPS also asks about prior calendar year's earnings.

some evidence that the NCES samples of tenth grade students were more "advantaged"; however, these dissimilarities did not appear sizeable enough to account for the large differences in college enrollment. Adolescents in the NCES high school classes of 1992 and 2004 had mother's with higher levels of education than in the NLSY97 cohort (Table 2.3). Specifically, a smaller proportion had mothers who had not completed high school and a larger proportion had mothers with a bachelor's degree. More of these adolescents in the NCES datasets have earned a high school diploma or GED by age 20.



Appendix Figure B.1. Distribution of family income in NCES samples and household income in CPS samples of adolescents: 1992, 2004, and 2012.



Appendix Figure B.2. Distribution of family income in NLSY samples and household income in CPS samples of adolescents: 1979 and 1997.

Appendix Table B.3

Proportion of respondents in each income category (2018$) in NCES and CPS datasets

1992			2002			2012		
Income Range	NCES	CPS	Income Range	NCES	CPS	Income Range	NCES	CPS
0	0.004	0.004	0	0.005	0.006	0-17,495	0.123	0.086
1-1,843	0.004	0.005	0-1,418	0.011	0.003	17,496-40821	0.203	0.179
1,844-5,530	0.009	0.011	1,419-7,090	0.019	0.013	40,822-64,147	0.179	0.162
5,531-9,217	0.012	0.020	7,091-14,179	0.022	0.031	64,148-87,474	0.139	0.138
9,218-13,826	0.027	0.030	14,180-21,268	0.043	0.037	87,475-110,800	0.105	0.116
13,827-18,435	0.036	0.034	21269-28,357	0.048	0.043	110,801-134,126	0.077	0.084
18,436-27,653	0.064	0.068	28,358-35,446	0.064	0.048	134127-157,452	0.053	0.061
27,654-36,871	0.070	0.062	35,447-49,625	0.123	0.106	157,453-180,779	0.034	0.049
36,872-46,089	0.087	0.065	49,626-70,893	0.195	0.159	180,780-204,105	0.020	0.033
46,090-64,525	0.145	0.140	70,894-106,339	0.211	0.209	204,106-227,431	0.013	0.021
64526-92,180	0.203	0.203	106,340-141,785	0.134	0.148	227,432-250,757	0.017	0.015
92,181-138,270	0.207	0.216	141,786-283,569	0.100	0.161	250,758-274,084	0.006	0.010
138,271-184,360	0.068	0.084	283,570 and up	0.026	0.036	274,085 and up	0.028	0.046
184,361-368,721	0.048	0.055						
368,722 and up	0.015	0.003						
Correlation	0.991			0.948			0.978	

Note. Income is from prior calendar year (*t-1)* and is inflated to 2018 dollars using the Consumer Price Index. CPS = Current Population Survey; NCES = National Center for Education Statistics.

Appendix Table B.4

Proportion of Respondents in each Income Category (2018$) in NLSY and March CPS datasets

	1979		1997	
Income Range	NLSY	CPS	NLSY	CPS
0	0.006	0.002	0.012	0.004
1-1,843	0.002	0.002	0.008	0.002
1,844-5,530	0.007	0.006	0.016	0.009
5,531-9,217	0.012	0.011	0.017	0.016
9,218-13,826	0.020	0.020	0.034	0.030
13,827-18,435	0.025	0.023	0.030	0.029
18,436-27,653	0.076	0.060	0.061	0.066
27,654-36,871	0.069	0.058	0.073	0.069
36,872-46,089	0.059	0.068	0.065	0.066
46,090-64,525	0.158	0.130	0.140	0.147
64526-92,180	0.218	0.215	0.209	0.187
92,181-138,270	0.236	0.251	0.208	0.219
138,271-184,360	0.064	0.095	0.068	0.083
184,361-368,721	0.048	0.058	0.034	0.054
368,722 and up	0.000	0.002	0.027	0.018
Correlation	0.985		0.988	

Note. Income is from prior calendar year (*t-1)* and is inflated to 2018 dollars using the Consumer Price Index. CPS = Current Population Survey; NLSY = National Longitudinal Survey of Youth.

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