Wealth Accumulation in College Savings Accounts and Educational Opportunities*

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Abstract

529 college savings plans have become more prevalent than student loans among undergraduates, yet their educational impacts remain largely unexplored. This paper examines how wealth gains in 529 plans shape educational opportunities using variation in target-date fund designs within these plans. I find that 529 wealth gains substantially increase four-year college attendance, with the effect per $1,000 similar to that of targeted grant aid. These wealth gains also reduce student loan borrowing and boost private K-12 school enrollment. However, 529 wealth gains accrue disproportionately to upper-income households, exacerbating the four-year college attendance gaps across both socioeconomic and racial lines.

JEL classification: D14, G50, I22, I23, I24

Keywords: 529 College Savings Plans, Target-Date Funds, College Attendance, Student Loans, K-12 Schools, Inequality in College Access

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1 Introduction

College education serves as a powerful vehicle for human capital investment, generating benefits that extend from increased earnings and income mobility to improved health outcomes and other non-pecuniary gains (e.g., Card 1995; Chetty et al. 2020; Currie and Moretti 2003; Oreopoulos and Salvanes 2011). Yet the substantial costs of higher education impose severe financial burdens on millions of families worldwide, prompting governments across multiple countries to launch educational savings programs.[1]

In the United States, 529 college savings plans have become the dominant educational savings vehicle since their introduction in the late 1990s. These state-sponsored investment accounts serve 35% of undergraduates as of 2024, making them more prevalent than student loans, which are used by fewer than 30% of undergraduate students.[2] The plans facilitate wealth accumulation through access to investment funds that generate returns over time, while investment gains remain tax-exempt when used for qualified expenses. This tax-exempt treatment represents an implicit government subsidy worth several billion dollars annually.[3]

Despite accumulating half a trillion dollars in household savings and receiving substantial government support, 529 college savings plans lack clear evidence of their effectiveness in expanding college access. These plans emerged not from demonstrated educational need but from state lobbying for federal tax relief on existing local savings initiatives. The evidence gap is particularly striking given that prior research often finds very small effects of household income and wealth on college attendance in the U.S., yet no rigorous causal evidence exists on whether savings specifically designated for college make any difference.[4] If college savings prove similarly ineffective, 529 plans may represent a massive misallocation of private and public resources. These concerns motivate two questions: How do wealth gains in 529 plans affect college attendance and other educational opportunities among account beneficiaries? And what are the implications

[1] Online Appendix Table B.1 lists savings initiatives for postsecondary education across countries.

[2] Sources: Sallie Mae, "How America Pays for College 2024"; Ma, Jennifer, Matea Pender, and Meghan Oster (2024), "Trends in College Pricing and Student Aid 2024," College Board, New York.

[3] Federal tax expenditures for educational savings programs totaled $3.4 billion in 2024, excluding state-level tax expenditures (U.S. Department of the Treasury). Many states also provide matching grants and tax benefits for 529 plan contributions, though research documents that such incentives have limited effectiveness in enhancing wealth accumulation (Chetty et al. 2014; Heim and Winecoff 2023).

[4] For example, Hilger (2016) and Bulman et al. (2021) show that an additional $100k in household income or wealth raises college attendance by fewer than 1 pp. Lovenheim (2011) and Manoli and Turner (2018) document substantially larger effects for lower-income students, but these students rarely hold 529 plans.

of wealth accumulation in 529 plans for inequality in college attendance?

This paper leverages cumulative investment returns in 529 college savings plans as a measure of wealth gains to examine how these gains shape educational opportunities and inequality in college attendance. My empirical analysis draws on two complementary datasets. The first dataset provides data on investment funds offered in 529 plans from Morningstar, spanning 2002 to 2023. This dataset includes monthly time-series data on key fund variables, including investment returns, net assets under management, and the shares of assets allocated to specific asset classes (stocks, bonds, other risky assets, and cash), along with detailed fund characteristics including investment strategies and management company information. The second dataset is the Survey of Income and Program Participation, which provides student panel data covering 2013 to 2023 across multiple survey panels, with individual panel durations ranging from one to four years. This dataset captures educational outcomes, household sociodemographic characteristics, and detailed financial information encompassing both assets and liabilities at the individual and household levels, including educational savings accounts and student loans. The information on educational savings accounts includes account balance, owner, and beneficiary for up to 3 accounts per household, but does not specify which funds individual households select or whether they choose in-state versus out-of-state plans. The student panel data encompasses approximately 4,000 secondary school students and college-age adults who have college savings accounts.

My empirical strategy is motivated by three key patterns observed in aggregated statistics on college savings accounts: (1) almost all such accounts are 529 college savings plans, (2) the majority of households establish accounts through their resident state's plan, and (3) most 529 accounts are allocated to target-date funds. Based on these patterns, I match each individual with a college savings account in the student panel data to the historical performance of target-date funds in their state of residence's 529 plan. I employ an intention-to-treat framework to estimate how target-date fund returns in state 529 plans affect educational outcomes for all students with 529 accounts in that state. This yields the average treatment effect for this population. To recover the average treatment effect on the treated—students whose accounts are actually invested in target-date funds within their state's plan—I scale the intention-to-treat estimates by the aggregate share of accounts following this investment pattern.

Estimating the causal effect of investment performance on educational outcomes faces

endogeneity concerns. For example, a state budget may serve as a common confounder, affecting both investment performance through plan fee structures set by state authorities and college attendance through expenditures on higher education. To address these endogeneity concerns, I develop a shift-share instrumental variable that exploits plausibly exogenous variation in target-date fund design across 529 plans. Most target-date funds offered through 529 plans are managed by large, established asset management firms including Fidelity, Vanguard, BlackRock, TIAA, and Ascensus. These firms employ distinct investment philosophies, resulting in substantial differences in their target-date funds' glide paths—the predetermined rules governing asset allocation changes as students age. These differences generate differential investment returns across states and time periods. I construct the shift-share instrument using the predetermined allocation to stocks, bonds, and cash specified in each fund's glide path as the "shares," while employing the historical performance of these broad asset classes as the common "shifts." The key identifying assumption requires that glide path allocations be exogenous to state- and household-level factors that might influence account holders' educational outcomes (Goldsmith-Pinkham et al. 2020). Two primary sources of evidence support the validity of this assumption. First, glide path decisions are made at the asset management company level, with firms typically operating across multiple states simultaneously. Local conditions in any single state do not influence these firms' strategic allocation decisions for stocks, bonds, and cash within their glide paths. Additionally, extensive literature document households' limited financial literacy (e.g., Li et al. 2023), suggesting that most families cannot meaningfully incorporate glide path allocation information into their savings and portfolio decisions, further supporting the exogeneity assumption.

Employing this identification strategy, I find that a 5 percentage point higher cumulative investment return during high school years increases average 529 account balances by around \$12,050 (23%) and raises four-year college attendance rates among account holders by 11.0 percentage points. The percentage increase in account balances exceeds the magnitude of cumulative returns themselves, as households respond to superior investment performance by making additional contributions to their 529 accounts. The effect of cumulative investment returns on four-year college attendance also exhibits concavity, disappearing once account balances reach approximately the total tuition costs of a four-year public university. Translating the estimates into dollar terms, a \$1,000 increase in 529 plan wealth gains raises four-year college attendance by 0.6 to 0.9 percentage points,

depending on regression specification. To assess the economic significance of this magnitude, I compare it with the impacts of other financial aid interventions and tuition tax credits/deductions. Targeted grant aid programs increase four-year college attendance by 3-4 percentage points per $1,000 in annual aid (e.g., Dynarski 2000; Van der Klaauw 2002; Dynarski 2003; Kane 2003; Linsenmeier et al. 2006; Abraham and Clark 2006). Assuming four years of eligibility, this translates to 0.75-1.0 percentage points per $1,000 in total aid—closely aligned with my 529 wealth gains' estimates, suggesting comparable effectiveness. Dynarski (2002) finds student loan eligibility increases attendance by 1.7 percentage points per $1,000 annually, or 0.43 percentage points per $1,000 cumulatively—lower than the effect of 529 wealth gains. Finally, research examining tax credits and deductions for college tuition consistently finds no significant effects on enrollment decisions (Long 2004; Bulman and Hoxby 2015; Hoxby and Bulman 2016; Bergman et al. 2019). In contrast, my results demonstrate that tax exemptions on investment gains in 529 plans generate substantial impacts on college attendance, indicating that the timing of tax benefits critically determine their effectiveness in promoting educational investment.

Beyond four-year college attendance, I also examine how wealth gains in 529 plans affect student loan borrowing and high school graduation. I find that a 10 percentage point increase in cumulative 529 investment returns during high school reduces the probability of student loan borrowing by 6.7 percentage points, but has no significant effect on high school graduation rates.

Several mechanisms explain my findings. First, higher investment returns mechanically increase 529 account balances, enabling families to attend more expensive colleges and reduce student loan borrowing. Second, households respond to superior investment returns by increasing their contributions to 529 accounts, consistent with the flow-performance sensitivity documented in the asset management literature. These additional contributions do not significantly crowd out other household savings, resulting in higher accumulated college savings. The contribution response appears behaviorally driven rather than wealth-driven, as households increase only 529 contributions without expanding risky asset investments outside these accounts. Third, higher investment returns increase private K-12 school enrollment, potentially enhancing students' four-year college prospects. Finally, using additional student longitudinal data from the High School Longitudinal Study of 2009, I find evidence that college savings beyond the total

tuition costs of a four-year public university are not associated with a higher probability of attending any four-year college (confirming my main findings), but are associated with a higher probability of attending private nonprofit and highly selective four-year colleges. This suggests that 529 wealth may particularly facilitate access to higher-quality educational opportunities.

To investigate how 529 plan wealth accumulation benefits contribute to disparities in four-year college attendance, I use data from the Survey of Income and Program Participation over the 2020-2023 period. I stratify the sample by key demographic characteristics—including household income, parental college attendance, and race—and compare observed four-year college attendance rates for each demographic group with counterfactual rates representing what attendance would be without 529 plan accumulation benefits. Constructing these counterfactual rates requires accounting for substantial variation in 529 wealth accumulation benefits across populations. These benefits differ through four key channels. First, some demographic groups (e.g., higher-income families) are disproportionately likely to establish 529 accounts and make substantial contributions, allowing them to capture greater wealth accumulation benefits. Second, families face varying capital gains tax rates (Dynarski 2004b) depending on their income, which they would pay in the absence of the tax-exempt treatment provided by 529 plans. Third, there is substantial heterogeneity in financial aid taxes (Dynarski 2004b,a) depending on family income and structure. Finally, families differ in their alternative savings behaviors: those who would not otherwise invest in stocks gain the entire investment return through 529 plans, while families who would invest in stocks regardless gain only the tax exemption on those returns. The first three channels disproportionately advantage higher-income families and thus may exacerbate college attendance disparities. The final channel may work in the opposite direction by reducing disparities, because lower-income families are less likely to have stock market exposure in the absence of 529 plans and therefore capture the entire investment return through 529 plans, while higher-income families capture only the tax benefits on those returns.

I incorporate all four channels when calculating 529 plan wealth accumulation benefits for each demographic group and translate them into attendance effects using estimates from my main empirical findings. The results demonstrate that 529 wealth accumulation benefits exacerbate disparities in four-year college attendance across socioeconomic and racial lines over the 2020-2023 period. These benefits account for approximately 7% of

the four-year attendance gap between students in the highest and lowest income quartiles and around 5% of the gap between students with at least one parent who attended college and those without. They also explain nearly 50% of the four-year attendance gap between White and Black students. Given that annual 529 distributions to undergraduates continue to grow, the 529 plan system represents a sizable and increasing source of inequality in four-year college attendance nationwide.

Overall, my findings indicate that 529 college savings plans significantly influence human capital investment through investment returns and tax-exempt status on these returns, which collectively affect both college attendance and pre-college private educational expenditures. The design features of 529 plans—particularly the quality of investment funds offered within these plans—will impact human capital investment by determining the returns investors receive. However, the 529 plan system creates an unintended amplification effect on college attendance disparities. Given that college education contributes to wage inequality later in life (e.g., Lemieux 2006; Goldin and Katz 2008; Autor 2014; Autor et al. 2020), these findings suggest that 529 plans may inadvertently amplify long-term economic disparities.

Related Literature. This paper contributes to several distinct strands of the literature. First, it adds to the body of research examining how financial resources and interventions that enhance these resources influence college enrollment decisions. This study contributes to the literature by examining how wealth accumulation in 529 college savings plans influences college attendance. Numerous studies have estimated the impact of family financial resources on college enrollment, with most estimates indicating less than a 1 percentage point increase in enrollment for every $100,000 in additional financial resources among middle- and high-income households (e.g., Bulman et al. 2021).[5] I find that $1,000 in 529 savings increases four-year college attendance by 0.6-0.9 percentage points, substantially exceeding the effects of general household wealth documented in prior literature. The extensive literature also examines how various financial aid pro-

[5]These studies employ various sources of quasi-exogenous variation to identify causal effects, including housing wealth fluctuations (e.g., Lovenheim 2011; Lovenheim and Reynolds 2013; Cooper and Luengo-Prado 2015; Hotz et al. 2018), parental job loss (e.g., Coelli 2011; Pan and Ost 2014; Hilger 2016), oil revenue shocks (e.g., Løken 2010), income transfers (e.g., Akee et al. 2010), tax credit policies (e.g., Manoli and Turner 2018; Bastian and Michelmore 2018), and lottery winnings (Bulman et al. 2021). Bulman et al. 2021 provide a comprehensive review of existing estimates in this literature. Related research examines whether households face binding financial constraints when borrowing for college expenses (e.g., Cameron and Heckman 1998, 2001; Keane and Wolpin 2001; Belley and Lochner 2007; Lochner and Monge-Naranjo 2011; Ebrahimian 2025) and whether families derive consumption value from college attendance (e.g., Alstadsæter 2010; Jacob et al. 2018; Gong et al. 2019).

grams affect college enrollment. Targeted grant aid programs increase enrollment by 3-4 percentage points per $1,000 in annual aid (e.g., Dynarski 2000; Van der Klaauw 2002; Dynarski 2003; Kane 2003; Linsenmeier et al. 2006; Abraham and Clark 2006). Dynarski et al. (2023) provide a comprehensive review of this literature.[6] Converting these annual effects to total program value, assuming four years of aid eligibility, yields estimates of 0.75-1.0 percentage points per $1,000 in total aid. This range closely aligns with my finding (0.6-0.9 pp per $1,000), indicating that college savings programs achieve effectiveness comparable to the most successful targeted grant aid initiatives. Additionally, several studies examine the impact of tax credits and deductions for college tuition on enrollment decisions, consistently finding no significant effects (Long 2004; Bulman and Hoxby 2015; Hoxby and Bulman 2016; Bergman et al. 2019). My results demonstrate that tax exemptions on investment gains in 529 plans generate meaningful impacts on college attendance, suggesting that the timing and structure of tax benefits substantially influence their effectiveness in promoting educational investment.

Several studies provide non-causal evidence of a positive association between education savings accounts and student outcomes (e.g., Elliott and Beverly 2011; Elliott et al. 2014; Nam and Ansong 2015; Briscese et al. 2025). One contemporaneous paper, Long and Bettinger (2017), examines how providing information about 529 accounts, offering families assistance with opening these accounts, and providing a $50 initial deposit affect savings accumulation and subsequent four-year college attendance. The primary challenge in estimating the causal effect of 529 savings on college attendance is the lack of quasi-experimental variation that would be sufficiently large relative to college expenses to meaningfully impact enrollment decisions. This study addresses this limitation by exploiting quasi-natural variation in 529 plan design, which generates differential investment returns and wealth accumulation patterns across plans. My results reveal that college savings increase four-year college attendance by 6-9 pp per $10,000.

This paper also contributes to the literature examining policy interventions aimed at mitigating student debt burdens. A substantial body of research investigates the effects of direct policy interventions, including student loan consolidation (e.g., Lucas and Moore 2019), student loan forgiveness (e.g., Di Maggio et al. 2019; Catherine and Yannelis 2023; Jacob et al. 2024; Dinerstein et al. 2025), student loan forbearance (e.g., Dinerstein et al.

[6]Dynarski and Scott-Clayton (2013) and Page and Scott-Clayton (2016) also provide the review of the financial aid literature.

2024; Hamdi et al. 2024; Chava et al. 2023), income-contingent and alternative repayment plans (e.g., Mueller and Yannelis 2019, 2022; Herbst and Hendren 2024; Catherine et al. 2024; Boutros et al. 2024; de Silva 2025), and no-loan policies (e.g., Waddell and Singell 2011; Rosinger et al. 2019; Hampole 2022).[7] In contrast to these direct interventions, this study examines an indirect policy approach: the establishment of tax-advantaged 529 college savings accounts with exemptions on wealth gains.

This paper additionally adds to the literature on socioeconomic inequalities and their persistence in the United States. Extensive research documents wealth inequality (e.g., Saez and Zucman 2016) and demonstrates how various financial products and constraints contribute to these disparities, including differential wealth returns (e.g., Fagereng et al. 2020), social insurance programs (Catherine et al. 2025; Catherine and Sarin 2025), retirement plan design (Choukhmane et al. 2023; Pool et al. 2024), and mortgages and housing returns (e.g., Bayer et al. 2016; Bhutta and Hizmo 2020; Kermani and Wong 2021). This study demonstrates that the current design of 529 college savings plans amplifies inequality in college savings, thereby contributing to broader wealth disparities.

A substantial literature examines another dimension of socioeconomic inequality: disparities in college attendance and potential interventions to address them. These studies document inequalities by socioeconomic and legacy status (e.g., Bailey and Dynarski 2011; Hoxby and Turner 2013; Hoxby and Avery 2013; Chetty et al. 2020; Arcidiacono et al. 2022; Chetty et al. 2023; Abramitzky et al. 2024) and race (e.g., Cameron and Heckman 2001; Billings et al. 2013; Bleemer 2021; Abramitzky et al. 2024). This paper shows that 529 plans exacerbate college attendance disparities across both socioeconomic status and race. The 529 plan system functions as a mechanism for the intergenerational transmission of wealth inequality. By amplifying existing disparities in family college savings and transforming them into unequal human capital investments, the system generates earnings inequality among adults through the college wage premium. This mechanism contributes to the well-documented persistence of wealth inequality across generations (e.g. Charles and Hurst 2003).

This paper also pertains to the growing literature examining the effects of target-date funds on investor behavior and market dynamics. Chalmers and Reuter (2020), Mitchell and Utkus (2022), and Parker et al. (2022) demonstrate that the proliferation of target-

[7]For comprehensive reviews of the student loan literature, see Lochner and Monge-Naranjo (2016), Yannelis and Tracey (2022), and Looney and Yannelis (2024).

date funds significantly alters investor portfolio allocation decisions. A substantial body of research examines the characteristics and performance of these investment vehicles (Elton et al. 2015; Balduzzi and Reuter 2018; Brown and Davies 2024; Massa et al. 2020; Shoven and Walton 2020). Parker et al. (2023) and Parker and Sun (2025) provide evidence that target-date funds serve as market-stabilizing mechanisms through systematic portfolio rebalancing that reduces deviations from target glide path allocations. Similarly, Andonov et al. (2024) document that target-date funds implement contrarian rebalancing strategies based on rigid domestic and foreign equity allocation weights. This rebalancing activity increases the correlation between foreign stocks with higher TDF ownership and U.S. equity markets, while causing currencies in countries most affected by TDF flows to appreciate more strongly during periods of positive U.S. stock returns. Zhang (2022) examines the general equilibrium effects of target-date fund adoption on asset prices, inequality, and welfare outcomes. Building on this literature, this paper examines how the design of 529 plan target-date funds shapes college education in the United States.

Finally, this paper contributes to the emerging literature examining 529 college savings plans. Dynarski (2004a) investigates how savings in 529 college savings plans and Coverdell Educational Savings Accounts can negatively affect financial aid eligibility. Dynarski (2004b) documents that the advantages of these vehicles increase substantially with family income. Bogan (2014) finds a positive relationship between state tax benefits and 529 plan fees, while Balthrop and Cici (2022) demonstrate that 529 plans in revenue-extracting states offer investment menus characterized by higher fees, weaker performance, and more limited options. Curtis (2020) provides a comprehensive evaluation of 529 plan menu quality across states. Li et al. (2023) present evidence that most 529 accounts are opened in plans that fail to generate the highest expected payoff, attributing this suboptimal behavior to limited financial literacy and complex plan disclosure requirements. This study extends the literature by examining how 529 plan design features affect human capital investment decisions and student loan borrowing patterns.

The remainder of the paper is structured as follows. Section 2 provides institutional background on college savings accounts, followed by a description of the data in Section 3. Section 4 introduces the empirical strategy. Section 5 reports the results for the effect of 529 wealth gains on college attendance. Section 6 additionally investigates how 529 wealth gains affect student loan borrowing and K-12 school enrollment. Section 7 provides additional evidence on the mechanisms driving the main results, while Section

8 discusses the implications of 529 wealth accumulation benefits for inequality in college attendance. Finally, Section 9 concludes.

2 Institutional Background

This section examines the institutional framework governing college savings accounts in the United States, focusing primarily on 529 college savings plans. It traces the historical development of these tax-advantaged investment vehicles and details the role of asset management firms in their administration and portfolio management.

2.1 History of College Savings Accounts in the United States

The United States offers several tax-advantaged educational savings vehicles, including 529 college savings plans, 529 prepaid tuition plans, Coverdell Education Savings Accounts, and UGMA/UTMA custodial accounts. Among these options, 529 college savings plans have become the dominant choice, utilized by more than 95% of families saving for college expenses in 2024.[8]

529 plans operate as tax-advantaged investment accounts where contributions grow tax-deferred and withdrawals remain tax-free when applied to qualified educational expenses. Additionally, many states enhance these federal benefits by offering tax deductions, tax credits, or matching grants for contributions to their respective state-sponsored 529 plans. Plan distributions may be used tax-free for a comprehensive range of educational costs, including tuition, fees, books, supplies, and room and board at accredited post-secondary institutions. Since 2018, families may also utilize up to $10,000 annually for tuition expenses at private K-12 schools. Congress has significantly expanded 529 plan utility through recent legislation. Since 2020, beneficiaries may use up to $10,000 in lifetime distributions per beneficiary, plus an additional $10,000 for each sibling, toward student loan repayments. Beginning in 2024, unused 529 funds may be rolled over to a Roth IRA, subject to a $35,000 lifetime limit per beneficiary. While 529 plans impose no annual contribution limits, contributions exceeding $18,000 per contributor in 2024 may trigger federal gift tax considerations.

Four states—Florida, Michigan, Ohio, and Wyoming—pioneered education savings

[8]Online Appendix C presents a comparison of usage across tax-advantaged education savings account types in the U.S.

programs in the late 1980s, establishing the foundation for what would become a nationwide movement. The legal framework for these programs underwent significant transformation in 1994 when Michigan achieved a landmark victory in the Sixth Circuit Court of Appeals, securing tax-exempt status for its Michigan Education Trust Prepaid Tuition Plan. This judicial victory proved short-lived as the Internal Revenue Service subsequently announced its intention to challenge the tax-exempt status of each state program through individual case-by-case reviews. This IRS position created substantial regulatory uncertainty for all existing state education savings programs, prompting affected states to intensify their congressional lobbying efforts to secure permanent federal tax advantages for these initiatives.[9] The coordinated state advocacy efforts culminated in the passage of the Small Business Job Protection Act of 1996, which formally legalized 529 college savings plans and provided the regulatory framework enabling other state governments to establish their own programs. Today, most states operate one or two 529 college savings plans, though several states maintain multiple options to serve diverse investor needs.[10] In states offering dual programs, the typical structure features one plan sold directly to consumers and another distributed through financial advisor networks.

2.2 College Savings Accounts: Participation, Average Account Balance, and Total Distributions

Figure 1 documents substantial growth in college savings account participation and balances over the past decade. Panel A reveals a consistent upward trajectory in account adoption among freshman undergraduates, with participation rates more than doubling from 13.5% in 2014 to 31.3% in 2022. Panel B demonstrates concurrent growth in account balances among 12th grade beneficiaries, with mean balances rising from approximately $30,150 in 2013-2014 to $60,500 in 2021-2022 (in constant 2022 dollars).

These trends underscore the expanding role of 529 college savings plans in educational financing. By 2022, college savings account participation rates surpassed those of federal undergraduate student loans (25%).[11] The average 2022 college savings account balance was equivalent to 138% of four-year, in-state public tuition costs and 38% of four-year

[9] Source: https://www.collegesavings.org/history-of-529-plans

[10] As of Q4 2021, state participation in 529 college savings programs varied considerably, with Wyoming operating no plans while several states maintained multiple offerings: Alaska (3 plans), Arizona (3), Colorado (4), Indiana (3), Kansas (4), Nebraska (4), Nevada (5), and West Virginia (3).

[11] Data on usage and average balance of federal student loans are from the College Board's Trends in College Pricing and Student Aid 2023 report.

private tuition costs.[12]

INSERT FIGURE 1

Figure 2 additionally illustrates a dramatic transformation in undergraduate financing patterns over 2014-2022, revealing the rapid growth of college savings distributions alongside substantial declines in federal funding sources. The data demonstrate a fundamental shift in how American families finance higher education.

Federal loans, historically the dominant funding source, declined significantly from $80.3 billion in 2014 to $46.2 billion in 2022, representing a 42% reduction. Federal grants also decreased substantially, falling from $54.1 billion in 2014 to $38.0 billion in 2022, a 30% decline. In stark contrast, distributions from college savings accounts experienced remarkable growth, rising from $11.7 billion in 2014 to $56.1 billion in 2022—a nearly five-fold increase. This substantial expansion reflects both increased 529 plan participation and higher account balances. By 2022, college savings distributions exceeded federal loan and grant disbursements, positioning 529 plans as a major component of the higher education financing system.

INSERT FIGURE 2

2.3 529 College Savings Plan Menus and Asset Management Companies

When households open 529 college savings accounts, they select from a limited menu of investment options offered by their state's plan.[13] These investment options fall into two categories: static funds, which maintain constant portfolio allocations over time, and target-date funds, which automatically rebalance as beneficiaries age. Target-date funds follow 'glide paths'—predetermined allocation rules that systematically reduce equity exposure and increase allocation to lower-risk assets such as government bonds and cash as students approach college enrollment. This rebalancing occurs either based on the beneficiary's actual age (age-based funds) or the number of years until expected college enrollment (target-enrollment funds).

[12]Data on college tuition are from the College Board's Trends in College Pricing and Student Aid 2022 report.

[13]Five 529 college savings plans provide only bank deposits or structured products rather than diversified investment menus.

State authorities regulate 529 plans and contract with asset management firms to serve as program managers, jointly establishing investment menus. Consequently, a small number of prominent asset management firms—including TIAA, Fidelity, Ascensus, and T. Rowe Price—manage the majority of 529 plans.[14] Program managers typically offer their proprietary funds or select funds from external asset management firms. This structure results in substantial market concentration: in 2020, 85% of 529 plan funds were managed by asset management firms operating across multiple states.

This institutional framework generates plausibly exogenous variation in glide path designs across states. Different asset management firms employ distinct investment philosophies when designing target-date funds with identical investment objectives, resulting in systematic differences in risk exposure and rebalancing schedules. Figure 3 illustrates this variation among three major firms—Fidelity, TIAA, and Vanguard/Ascensus—for beneficiaries aged 7 and 18. While each firm offers identical target-date options across multiple states, their glide paths differ substantially. Vanguard/Ascensus maintains the most conservative approach with lower equity exposure and higher cash holdings, while TIAA adopts the most aggressive stance with maximum equity allocation and minimal cash positions.

INSERT FIGURE 3

Figure 4 demonstrates both the typical target-date glide path pattern and substantial variation in glide path designs across states. The figure plots the median shares of risky assets and stocks across states by beneficiary years until high school graduation in 2023, along with the minimum and maximum allocation ranges. The heterogeneity in glide path design stems from two primary sources. First, asset management firms employ divergent philosophies regarding optimal age-based rebalancing strategies. Second, firms maintain systematic differences in their default cash holdings across all portfolios, consistent with documented variation among mutual fund managers (Wermers 2000; Simutin 2013). The variation in rebalancing philosophies mirrors heterogeneity observed in financial advisor recommendations (Foerster et al. 2017; Linnainmaa et al. 2021) and target-date pension fund designs (Balduzzi and Reuter 2018). Together, these institutional features create systematic variation in investment exposure that is predetermined by asset management firms' strategic decisions rather than household-specific characteristics.

[14]In 2022, 81 of 91 529 college savings plans were managed by large asset management firms, while the remaining 10 were managed directly by state authorities or state-affiliated entities.

INSERT FIGURE 4

2.4 Investment Patterns in 529 College Savings Plans

Households predominantly establish 529 college savings accounts through their resident state's plan for two primary reasons. First, most states provide tax benefits and matching grants to in-state residents for contributions to in-state 529 plans, supplementing the tax-free earnings growth available to all participants regardless of residency.[15] Second, Li et al. (2023) demonstrate that even when out-of-state 529 plans offer superior expected payoffs after accounting for tax benefits and matching grants, most households still invest locally due to limited financial literacy and the complexity of plan disclosure documents.

Within 529 accounts, portfolio allocation patterns reveal strong preferences for target-date funds. Industry statistics from leading 529 plan providers show that approximately 70% of all 529 accounts are invested in target-date options, though these funds represent only half of total plan assets.[16] This disparity reflects systematic differences in investor behavior: families with limited financial sophistication gravitate toward target-date funds for their simplicity and automatic rebalancing features, while more financially sophisticated households—who typically maintain larger account balances—construct customized investment strategies using other available options.

3 Data

To investigate how investment returns in 529 plans affect educational opportunities, I employ two complementary datasets that together cover 529 college savings plans and educational outcomes. I first describe each dataset, then explain how I combine them in the empirical analysis.

[15] As of end-2022, only 10 states did not provide tax benefits or matching grants for 529 plan contributions: Alaska, Delaware, Florida, Hawaii, Kentucky, Nevada, North Carolina, South Dakota, Texas, and Washington. Several of these states lack such benefits due to zero state income tax policies.

[16] Sources: `https://corporate.vanguard.com/content/dam/corp/research/pdf/saving_and_investing_in_529_plans.pdf`; `https://pulse.ascensus.com/educationsavings.html`

3.1 Student Panel Data

3.1.1 Survey of Income and Program Participation

The primary dataset for my empirical analysis is the Survey of Income and Program Participation (SIPP), a longitudinal survey administered by the U.S. Census Bureau. Originally designed to track income dynamics and government program participation, SIPP has evolved into a comprehensive source of socioeconomic data on U.S. households, providing nationally representative panel data that follows individuals and households over multiple years.

My analysis utilizes individual-level data from eight SIPP panels covering 2013-2023: SIPP 2014 (2013-2016), SIPP 2018 (2017-2020), SIPP 2019 (2018), SIPP 2020 (2019-2022), SIPP 2021 (2020-2023), SIPP 2022 (2021-2023, ongoing), SIPP 2023 (2022-2023, ongoing), and SIPP 2024 (2023, ongoing). Each panel covers one to four years and provides monthly data on educational outcomes and household sociodemographics, alongside annual data on personal and household assets and liabilities, including educational savings accounts and student debt.

SIPP's educational variables enable precise quantification of student choices across both K-12 and post-secondary education. For each individual, SIPP records monthly school enrollment status, institution type, degree pursued, and academic year or grade level, as well as cumulative educational attainment by survey date. Additional variables track K-12 student performance indicators, including gifted class participation and grade repetition.

The survey provides comprehensive household background information, including household income, parental education, race and ethnicity, and other sociodemographic characteristics.

Detailed asset and liability data encompass home equity, bank accounts, stock holdings, and various forms of debt, enabling thorough assessment of household financial circumstances.

Regarding educational savings, SIPP collects information on the number of educational savings accounts per household, along with account balances, beneficiaries, and account owners for up to three accounts per household. Given that 529 college savings plans constitute the majority of educational savings accounts (as discussed in Section 2), most educational savings accounts in SIPP correspond to these plans. SIPP also captures

student debt information, including borrowing status and loan amounts.

3.1.2 High School Longitudinal Study of 2009

For validation and auxiliary analyses conducted separately from the main estimation sample, I utilize data from the High School Longitudinal Study of 2009 (HSLS:09). HSLS:09 is a nationally representative longitudinal survey following over 23,000 students who were ninth-graders in fall 2009, drawn from 944 high schools across the United States. The study tracked this cohort through high school and into postsecondary education, conducting a base-year survey in 2009 with follow-up waves in spring 2012 (when students were in the spring of their 11th grade) and 2016 (after high school completion).

This comprehensive dataset provides detailed information on students' postsecondary outcomes, including enrollment timing, institutional characteristics (public, private nonprofit, or for-profit), and college selectivity. For the pre-college period, HSLS:09 captures family college savings through categorical amount variables and binary indicators for dedicated college savings accounts.

The dataset includes extensive student and family background measures, encompassing demographics (parental education, household income), educational experiences, and direct ability assessments through standardized mathematics tests administered in both 9th and 11th grades. This rich longitudinal structure enables validation of the main findings using a nationally representative high school cohort and exploration of supplementary research questions not addressable with the primary SIPP dataset.

3.2 Data on 529 College Savings Plans

My empirical analysis additionally utilizes data on 529 college savings plan investment funds from Morningstar, spanning 2002 to 2023. These data provide comprehensive historical information, including net assets, investment returns, asset allocation shares across stocks, bonds, and other risky assets, fund type classifications, and managing asset management firms. Morningstar also provides detailed fund characteristics, including glide path asset allocations that specify predetermined portfolio rebalancing rules as beneficiaries age.

The Morningstar data achieves near-universal coverage of the 529 marketplace, encompassing all but six small plans that collectively represented only 0.27% of total net

assets and 0.15% of total accounts across all 529 plans in 2021.

My analysis focuses specifically on target-date funds, which manage college savings for beneficiaries based either on a specified number of years until college enrollment (target-enrollment funds) or on beneficiary age (age-based funds). To establish the correspondence between target-date funds and specific beneficiary age groups or enrollment timelines, I conduct textual analysis of fund names.

3.3 Sample Construction

My empirical analysis employs two samples of individuals with college savings accounts drawn from SIPP data spanning 2013-2023: college-aged adults and secondary school students expected to be in grades 7-12. Sample construction utilizes SIPP information from December of each calendar year and begins by determining each individual's expected educational stage based on birth year and month relative to state-specific kindergarten admission cutoffs. Following established practice (e.g., Bulman et al. 2021), I employ expected rather than actual educational stages to avoid endogeneity bias, as actual educational progression may respond to cumulative investment returns in 529 plans and family college savings decisions.

Expected educational stage determination relies on historical kindergarten admission cutoffs compiled from multiple sources: "Kindergarten Entrance Ages: 35-Year Trend Analysis" (2011), the Connecticut General Assembly report, the Education Commission of the States database, and the Arkansas General Assembly's "Kindergarten Entrance Age" (December 2010). For states without specific cutoff dates, I apply September 1 as the default. The methodology proceeds as follows: I identify the historical kindergarten cutoff date applicable when each individual would have entered kindergarten, compare this to their birth year and month to determine expected kindergarten entry, then add 13 years (kindergarten plus K-12 education) to establish expected high school graduation year. Expected K-12 grades are calculated by adding the appropriate number of years from kindergarten admission.

Sample construction proceeds as follows. The college-aged adult sample includes individuals with college savings accounts first observed during their expected high school graduation year or the subsequent year. To address potential account closures following college enrollment, I exclude individuals first observed more than one year after expected

high school graduation. Each selected individual is then tracked over a four-year observation window within the corresponding SIPP panel. The secondary school sample comprises students with college savings accounts expected to be in grades 7-12, with individuals tracked throughout their expected tenure in these grade levels as determined by birth year and month calculations. Each individual in the secondary school sample is observed for up to four years within the corresponding SIPP panel.

Investment return calculation employs Morningstar data to compute lagged cumulative returns for target-date funds within in-state 529 plans over three-year periods. For college-aged adults, I calculate cumulative returns spanning three calendar years corresponding to expected grades 9-10, 10-11, and 11-12, excluding the graduation year since college attendance decisions precede those returns. Annual returns correspond to target-date funds appropriate for each expected grade level. For secondary school students, I calculate cumulative returns over periods $t-3$ to $t-1$ using corresponding target-date fund annual returns.

3.4 Summary Statistics

Table 1 presents summary statistics for two samples drawn from SIPP data: college-aged adults with college savings accounts (Panel A: 1,692 individuals, 3,050 person-year observations) and younger beneficiaries expected to be in grades 7-12 (Panel B: 2,267 individuals, 3,475 observations).

INSERT TABLE 1

Panel A describes college-aged adults with 529 accounts, with a mean age of 20.5 years. A substantial portion (29%) lives independently without parents, for whom parental characteristic variables (education, marital status) are coded as zero, and household income reflects only their own earnings rather than parental income. Among the full sample, 53% have college-educated parents and 59% have married parents, though these figures include the zeros for those living independently. The sample is predominantly White (85%), with modest Black (4%) and Asian (6%) representation. Educational outcomes in Panel A demonstrate high college participation, with 81% attending any college and 71% enrolling in four-year institutions—rates substantially exceeding national averages. Mean household income is $193,613, reflecting both independent earners and those living with higher-income parents. Educational savings account balances average $24,932 with

considerable variation (median $5,622), though these balances reflect remaining funds after students have already used portions for college expenses, making them lower than original accumulations. Cumulative investment returns during high school average 11.4% with a standard deviation of 6.06%, ranging from 0% to 27%.

Panel B covers younger beneficiaries who predominantly live with parents. These families display higher socioeconomic status, with mean household income of $260,294 and 80% having college-educated parents. The racial composition is similarly concentrated, with 83% White, 3% Black, and 8% Asian students. College savings account balances exhibit substantial right-skewness, with a mean of $45,260, a large standard deviation of $65,596 and balances ranging from $0 to $581,758. Investment returns are notably higher for Panel B, averaging 15.3% compared to 11.4% in Panel A. This difference reflects the methodology for calculating lagged cumulative returns: Panel B uses a three-year window that captures target-date fund performance at younger beneficiary ages, when glide path designs mandate higher equity exposure. Since younger-age target-date funds maintain more aggressive asset allocations with greater stock market exposure, they generate higher average returns over the sample period.

The substantial variation in investment returns across both panels—the key source of identification in this study—reflects differential performance of target-date funds with varying glide path designs across asset management firms and time periods. The concentration of 529 benefits among affluent, predominantly White families in both samples foreshadows the inequality implications examined in the paper's analysis.

Table B.3 in the Online Appendix additionally provides summary statistics for 529 plan fund data from Morningstar, while Table B.4 in the Online Appendix reports summary statistics for students from the High School Longitudinal Study of 2009 whose families report saving for college.

3.5 Motivating Evidence

Figure 5 provides initial evidence of the relationship between 529 plan investment performance and college attendance outcomes. Panel A displays substantial cross-state variation in both cumulative investment returns during high school and four-year college attendance rates among students with 529 accounts. States with higher cumulative returns in their target-date funds exhibit correspondingly higher college attendance rates,

with the fitted regression line indicating a strong positive correlation. This cross-sectional relationship suggests that differential investment performance across state 529 plans may systematically influence educational outcomes.

Panel B demonstrates that this relationship also holds over time, with yearly averages from 2013 to 2023 showing a similar positive association between cumulative returns and college attendance rates. The time variation reflects both changing market conditions affecting fund performance and evolving college attendance patterns among 529 account holders. Years characterized by stronger investment performance in 529 target-date funds correspond to higher four-year college attendance rates among beneficiaries.

INSERT FIGURE 5

These patterns provide preliminary support for the hypothesis that investment returns in 529 plans meaningfully affect college attendance decisions.

4 Empirical Strategy

This section outlines the empirical strategy I employ to examine how cumulative investment returns in 529 college savings plans affect educational outcomes. The methodology combines an intention-to-treat framework with a shift-share instrumental variable approach.

4.1 Estimating Equation

I estimate the effect of cumulative investment returns in 529 plans on educational outcomes using an intention-to-treat framework with both OLS and two-stage least squares (2SLS) specifications. The baseline estimating equation is:

$$Y_{i,cohort,s,t} = \beta CumReturn_{cohort,s} + \gamma X_{i,s,t} + \alpha_m + \alpha_s + \alpha_t + \alpha_{\text{cohort}} + \epsilon_{i,cohort,s,t} \quad (1)$$

where $Y_{i,cohort,s,t}$ represents an educational outcome for individual i from state s observed at time t, whose expected high school graduation year is *cohort*. I employ several measures, including binary indicators for four-year college attendance, any college attendance encompassing both two-year and four-year institutions, two-year college attendance, student loan borrowing, and high school graduation.

The key explanatory variable, $CumReturn_{cohort,s}$, captures cumulative investment returns in target-date funds within in-state 529 plans during high school years. This variable measures wealth gains generated by 529 plans for accounts invested in target-date funds. The coefficient β represents the parameter of interest, quantifying how a one percentage point increase in cumulative returns affects educational outcomes.

The specification includes comprehensive controls $X_{i,s,t}$ spanning individual, household, and state-level characteristics. Individual and household demographics encompass parental marital status, parental college education, metropolitan residence, student gender, race and ethnicity indicators (White, Black, Asian), and independent living status. These variables capture baseline differences in family structure, socioeconomic background, and demographic attributes that influence educational outcomes. Household composition controls include parental age and the number of children under 18, accounting for life-cycle differences and competing financial obligations. State-level education environment controls comprise in-state four-year public college tuition and state and local higher education funding per full-time equivalent student, reflecting both direct college costs and public educational resource availability.

The model incorporates multiple fixed effect specifications: management company fixed effects (α_m) absorb persistent differences across 529 plan managers, state fixed effects (α_s) control for time-invariant state characteristics, year fixed effects (α_t) account for nationwide shocks, and cohort fixed effects (α_{cohort}) capture systematic differences across students' high school graduation cohorts.

Standard errors are clustered at the management company $\times$ expected high school graduation year level, addressing correlation in outcomes among students sharing the same 529 plan manager and graduation cohort, which represents the primary level of variation in cumulative returns.

The intention-to-treat framework recognizes that not all students hold accounts in in-state 529 plans invested in target-date funds. Some may invest in out-of-state plans, alternative savings vehicles, or static funds within their state's plan. The coefficient β represents an intention-to-treat estimate, measuring the average effect across all students in the sample, including those not directly exposed to the return variation. To estimate the treatment effect on the treated, I divide the coefficient β by the aggregate share of in-state 529 plan participants invested in target-date funds, yielding the expected impact among students actually exposed to the glide path variation.

4.2 Shift-Share IV Specification

Estimating the causal effect of investment performance on educational outcomes faces several endogeneity concerns. State budgets may serve as common confounders, affecting both investment performance through plan fee structures set by state authorities and college attendance through expenditures on higher education. Additionally, household expectations regarding their children's college attendance may influence state government decisions on 529 plan fees, creating reverse causality concerns.

To address these endogeneity concerns, I construct a shift-share instrument that combines predetermined target-date fund allocations to stocks, bonds, and cash specified in glide paths (the "shares") with historical performance of these broad asset classes (the common "shifts"). This approach generates a classic shift-share instrument structure: state-cohort-specific portfolio returns derived from the interaction of predetermined exposure weights and common market shocks.

The instrument $Z_{cohort,m}$ represents the product of portfolio returns across three high school calendar years (grades 9-10, 10-11, and 11-12):

$$\begin{aligned} Z_{cohort,m} &= 100 * \Big(\prod_{j=1}^{3} \Big(s_{st,m,12-j,cohort-j}(1 + r_{st,cohort-j}) + \\ &+ s_{bo,m,12-j,cohort-j}(1 + r_{bo,cohort-j}) \\ &+ s_{ca,m,12-j,cohort-j}(1 + r_{ca,cohort-j}) \Big) - 1 \Big) \end{aligned} \tag{2}$$

Each parenthetical term captures the grade-specific target-date portfolio return in year $cohort-j$, computed as a weighted average of realized asset-class returns for equities (st), bonds (bo), and cash (ca), where weights $s_{k,m,\text{gr},cohort}$ are predetermined by management company m's glide path design.

Expanding this product across the three-year high school period yields:

$$\begin{aligned} Z_{cohort,m} &= 100 * \Big(\sum_{k_0 \in \{st,bo,ca\}} \sum_{k_1 \in \{st,bo,ca\}} \sum_{k_2 \in \{st,bo,ca\}} s_{k_0,m,11,cohort-1} s_{k_1,m,10,cohort-2} s_{k_2,m,9,cohort-3} \\ &\times (1 + r_{k_0,cohort-1})(1 + r_{k_1,cohort-2})(1 + r_{k_2,cohort-3}) - 1 \Big) \end{aligned} \tag{3}$$

This formulation clarifies that the instrument represents a sum of products, where each term corresponds to one possible sequence of asset exposures across the three-year period. The total number of such sequences equals $3^3 = 27$, encompassing all possible

combinations of asset class exposures.

The instrument can be expressed in standard shift-share form by defining $w_{m,k} = s_{k_0,m,11,cohort-1} s_{k_1,m,10,cohort-2} s_{k_2,m,9,cohort-3}$ and $\widetilde{R_k} = (1+r_{k_0,cohort-1})(1+r_{k_1,cohort-2})(1+r_{k_2,cohort-3})$:

$$Z_{cohort,m} = 100 * \Big(\sum_k w_{m,k} \, \widetilde{R_k} - 1 \Big) \tag{4}$$

where $w_{m,k}$ denotes the predetermined exposure weight for a specific three-year asset allocation sequence under management company m, and $\widetilde{R_k}$ represents the corresponding realized cumulative return for that asset-class path during the student's high school years.

The "shares" $w_{m,k}$ are determined by target-date glide paths, reflecting portfolio design decisions made by management companies prior to outcome realization. The "shifts" $\widetilde{R_k}$ represent realized market returns to equities, bonds, and cash across high school years—common shocks experienced across all states and cohorts. The instrument value thus constitutes a weighted average of these market shocks, with weights varying systematically across management companies and student cohorts.

The first-stage equation relates cumulative returns in target-date funds within in-state 529 plans to the shift-share instrument:

$$CumReturn_{cohort,s} = \pi Z_{cohort,m} + \theta X_{i,s,t} + \alpha_m + \alpha_s + \alpha_t + \alpha_{\text{cohort}} + \eta_{i,cohort,s,t} \tag{5}$$

The fitted values $\widehat{CumReturn}_{cohort,s}$ from this first stage are employed in the second-stage regression to provide causal evidence of 529 investment return effects on educational outcomes. Since the instrument varies at the management-company-by-cohort level, identification stems from differential student exposure to common asset-class shocks across distinct glide path designs.

4.3 Identifying Assumptions and Tests

IV estimates of equation (1) provide consistent estimates of the local average treatment effects of cumulative investment returns in target-date funds within 529 plans on educational outcomes under three key identifying assumptions (Goldsmith-Pinkham et al. 2020): strict exogeneity, relevance, and monotonicity.

Strict Exogeneity. The strict exogeneity assumption requires that glide path asset

class allocations do not correlate with the error term in the second stage, conditional on controls and fixed effects. This assumption faces three potential threats.

First, glide path allocations could be influenced by unobserved state- and local-level factors that also affect account holders' educational outcomes. However, glide path decisions are made at the asset management company level, with firms typically operating across multiple states simultaneously. Local conditions in any single state do not influence firms' strategic allocation decisions for stocks, bonds, and cash within their glide paths. Since the majority of 529 investment options are managed by a handful of large asset management firms that offer identical investment options across multiple states, unobserved state- and local-level factors are unlikely to affect allocation decisions for funds offered simultaneously in multiple jurisdictions. Table B.5 in the Online Appendix provides supporting evidence by regressing glide path allocation measures on annual state-level variables over 2013-2023, including unemployment rate, log real per capita personal income, log population, real GDP growth, and the share of adults with bachelor's degrees. The results indicate no significant relationship between state-level variables and glide path allocations.

Second, unobserved household-level factors could correlate with both glide path allocations and educational outcomes if households meaningfully incorporate glide path information into their portfolio decisions. However, extensive literature documents households' limited financial literacy (Li et al. 2023), suggesting that most families cannot meaningfully process glide path allocation information when making savings and investment decisions, supporting the strict exogeneity assumption.

Third, the instrument could affect sample selection by influencing whether households open 529 accounts. Table 4 demonstrates that the instrument does not predict 529 account opening decisions. This result is consistent with the timing of account establishment, as the median age of children at account opening is 5 years, meaning realized asset returns during high school occur after the account-opening decision for almost all families.

Relevance. The relevance assumption requires that the instrument strongly predicts cumulative returns in 529 target-date funds. This condition is satisfied mechanically, as actual portfolio returns are determined precisely by the interaction of glide path weights and realized market returns that the instrument replicates. Empirically, Kleibergen-Paap rk Wald F-statistics consistently exceed 45 across all IV specifications, confirming strong

instrument relevance. First-stage regression results are reported in Table B.6 in the Online Appendix.

Monotonicity. The monotonicity assumption requires that higher instrument values cannot reduce any individual's cumulative 529 returns while increasing returns for at least some individuals, enabling a Local Average Treatment Effect interpretation. This assumption is highly plausible given the mechanical nature of the instrument construction. Figure A.2 in the Online Appendix provides additional empirical evidence supporting this assumption.

5 Main Results: College Attendance and Wealth Accumulation

5.1 College Attendance

Table 2 presents the main results examining how cumulative investment returns in 529 plans during high school affect college attendance outcomes. The analysis reveals a significant positive relationship between investment returns and four-year college attendance, with notably larger effects under the instrumental variables specification compared to ordinary least squares.

For four-year college attendance, the preferred IV-2SLS estimates indicate that a 1 percentage point increase in cumulative investment returns during high school increases the probability of attending a four-year college by 2.2 percentage points, significant at the 5% level. This represents a substantial effect relative to the baseline attendance rate of 71.5%. The corresponding OLS estimate of 1.4 percentage points is also statistically significant, indicating a smaller but still meaningful relationship.

Scaling these results to obtain the Average Treatment Effect on the Treated (ATT), which isolates the impact for students whose 529 accounts are actually invested in target-date funds within in-state plans, yields even larger magnitudes. The ATT for the IV specification implies that a 1 percentage point increase in returns increases four-year college attendance by 3.5 percentage points among directly treated students.

The results for broader college participation measures reveal significant positive effects. Cumulative investment returns show a 2 percentage point increase in any college attendance (encompassing both two-year and four-year institutions) per 1 percentage

point of returns, significant at the 5% level. This represents a meaningful effect relative to the baseline attendance rate of 83.7%, indicating that 529 investment returns operate through both extensive and intensive margins. Examining two-year college attendance specifically reveals small negative point estimates of -0.2 percentage points, suggesting minimal shifting from two-year to four-year institutions. However, this estimate is not statistically significant and represents a small magnitude compared to the baseline two-year college attendance rate of 12.1%.

The instrumental variables approach demonstrates adequate relevance, with Kleibergen-Paap F-statistics of 47 across all specifications, exceeding conventional thresholds for weak instrument concerns. This confirms that the shift-share instrument based on glide path variation effectively predicts actual investment returns in target-date funds.

INSERT TABLE 2

These findings indicate that 529 investment returns significantly affect college attendance through both extensive and intensive margins. The substantial positive effect on any college attendance (2 percentage points) combined with the strong four-year college effect (2.2 percentage points) demonstrates that investment returns both encourage new college entrants and facilitate attendance at four-year institutions. The minimal effect on two-year college attendance suggests that most of the increased participation flows directly to four-year institutions rather than representing substitution between college types. The magnitude of effects is economically meaningful, suggesting that investment performance in college savings accounts plays an important role in shaping higher education decisions among account holders.

5.2 Heterogeneous Effects on College Attendance

Figure 6 examines the dynamic relationship between 529 investment returns and four-year college attendance by estimating effects separately for each year following expected high school graduation. The figure displays coefficients from OLS regressions where cumulative investment returns during high school are interacted with indicators for years elapsed since expected graduation, ranging from the expected graduation year itself through four years post-graduation.

The results reveal that the impact of 529 investment returns on four-year college attendance is weakest immediately following expected high school graduation, with a 10

percentage point increase in cumulative returns increasing four-year college attendance by approximately 8.4 percentage points. This effect strengthens substantially over time, rising to roughly 20 percentage points four years after expected graduation.

This increasing effect magnitude over time reflect delayed college entry among students who initially pursue other options such as employment or gap years, but later utilize their 529 savings to finance four-year college attendance.

INSERT FIGURE 6

Table 3 explores heterogeneous effects of 529 investment returns on four-year college attendance by account balance size and family background characteristics. Column 1 examines how effects vary by account balance size, revealing a concave relationship between 529 wealth and college attendance. For accounts with balances of $70,000 or less, a 1 percentage point increase in cumulative investment returns raises four-year college attendance by 1.3 percentage points, significant at the 5% level. Notably, $70,000 represents the cost of the most expensive in-state four-year college degree. However, the interaction term indicates that this effect diminishes significantly for larger accounts, with the marginal impact falling by 1.7 percentage points for accounts exceeding this threshold, significant at the 1% level. This pattern suggests diminishing returns to 529 wealth accumulation once savings can cover full college costs.

Column 2 investigates heterogeneity across family background characteristics, particularly living arrangements and parental education levels. The results reveal striking disparities in responsiveness to 529 investment returns. Students living with college-educated parents exhibit the strongest response, with a 1 percentage point increase in cumulative returns raising four-year college attendance by 1.7 percentage points, significant at the 1% level. Students with high school-educated parents show substantial responsiveness at 1.6 percentage points, significant at the 5% level. In contrast, students living without parents show minimal and statistically insignificant responsiveness (0.3 percentage points).

These heterogeneous effects have important implications for understanding both the mechanisms through which 529 plans operate and their distributional consequences. The stronger responsiveness among students from families with parents suggests that the benefits of 529 wealth gains are amplified by complementary family investments in education, including information about college opportunities, application assistance, and academic

preparation. Conversely, students living independently may face additional constraints that limit their ability to capitalize on accumulated college savings.

INSERT TABLE 3

5.3 Account Balance and Participation

Table 4 examines the mechanisms through which 529 investment returns affect wealth accumulation, investigating whether higher returns operate by increasing account balances among existing account holders or by encouraging account opening among non-participants.

Column 1 focuses on the intensive margin of wealth accumulation using state-year aggregated data for students who already possess 529 accounts. The results demonstrate that cumulative investment returns significantly increase account balances, with a 1 percentage point increase in mean returns raising mean log account balances by 0.046, significant at the 1% level. This translates to approximately a 4.6% increase in account balances for each percentage point of additional returns. Given the mean account balance of $52,399 in the sample, this effect corresponds to an increase of approximately $2,410 per percentage point of cumulative returns. The effect suggests that superior investment performance mechanically increases accumulated wealth and may also induce additional household contributions in response to favorable returns.

Column 2 examines the extensive margin using state-year aggregated data to test whether mean investment returns influence average college savings account ownership rates. The coefficient is negative and insignificant (-0.098), indicating that investment return performance does not meaningfully affect account opening decisions. This finding supports the identifying assumption that account opening occurs independently of subsequent investment performance, as families typically establish 529 accounts when children are young (median age 5) and base opening decisions on factors other than anticipated short-term market performance.

INSERT TABLE 4

To quantify the effect of accumulated wealth on college attendance, I link the investment return effects on four-year college attendance (Table 2) with the effect on account balances (Table 4). The IV-2SLS estimate in Table 2 indicates that a 1 percentage point

increase in cumulative returns raises four-year college attendance by 1.4-2.2 percentage points while simultaneously increasing account balances by $2,410. Thus, each additional $1,000 in 529 account balance increases the probability of four-year college attendance by 0.6-0.9 percentage points.

5.4 Savings in 529 Accounts versus Other Financial Resources

I find that a $10,000 increase in college savings is associated with a 6-9 percentage point increase in four-year college attendance. This estimate substantially exceeds existing estimates for middle- and higher-income households from prior literature. Bastian and Michelmore (2018) find no significant effect on initial college attendance, while Hilger (2016) reports 0.5 percentage points per $100,000, Bulman et al. (2021) find 0.6 percentage points per $100,000, and Lovenheim (2011) estimates 0.7 percentage points per $10,000 on average. However, my estimate aligns with findings for lower-income households: Lovenheim (2011) reports 5.7 percentage points per $10,000 for lower-resource families, and Manoli and Turner (2018) find 1.3 percentage points per $1,000 for students from very low-income families.

The magnitude difference can be explained by two key distinctions between my empirical design and previous approaches. First, I examine funds saved specifically for college rather than general family financial resources. General financial resources may be accumulated for purposes other than college financing. For instance, a family with $100,000 in total savings may have only $10,000 designated for college. Previous literature would calculate effects per $100,000 in total savings, whereas I calculate the same effect per $10,000 in college-specific savings, resulting in substantially higher per-dollar estimates for the same underlying impact.

Second, I employ a sample of students whose families actively save for college, which likely differs systematically from the general population. Only approximately half of families save for their children's college education, as evidenced by HSLS 2009 data showing that 46.2% of 9th grade and 50.5% of 11th grade student families report positive college savings.[17] Students from college-saving families may exhibit greater sensitivity to financial resources for several reasons: these families demonstrate revealed preferences for higher education investment, possess better information about college opportunities and

[17] According to the High School Longitudinal Study of 2009, parents of 46.2% of 9th grade students and 50.5% of 11th grade students report a positive amount of college savings.

costs, and may have established college attendance as a more concrete goal. Consequently, the marginal effect of additional resources may be larger for this population than for families who have not committed to college savings.

The extensive literature also examines how various financial aid programs affect college enrollment. Targeted grant aid programs increase enrollment by 3-4 percentage points per $1,000 in annual aid (e.g., Dynarski 2000; Van der Klaauw 2002; Dynarski 2003; Kane 2003; Linsenmeier et al. 2006; Abraham and Clark 2006). Converting these annual effects to total program value, assuming four years of aid eligibility, yields estimates of 0.75-1.0 percentage points per $1,000 in total aid. This range closely aligns with my finding that $1,000 in 529 savings increases four-year college attendance by 0.6-0.9 percentage points, indicating that college savings programs achieve effectiveness comparable to the most successful targeted grant aid initiatives.

Dynarski (2002) additionally investigates the impact of student loan eligibility on college attendance and finds an effect of 1.7 percentage points per $1,000 of annual loan eligibility. Converting this to total undergraduate loan eligibility over a four-year degree yields 0.43 percentage points per $1,000 of cumulative loan eligibility, which is substantially lower than the 0.6-0.9 percentage point effect of 529 savings documented in this paper.

Finally, research examining tax credits and deductions for college tuition consistently finds no significant effects on enrollment decisions (Long 2004; Bulman and Hoxby 2015; Hoxby and Bulman 2016; Bergman et al. 2019). In contrast, my results demonstrate that tax exemptions on investment gains in 529 plans generate substantial impacts on college attendance, indicating that the timing and institutional structure of tax benefits critically determine their effectiveness in promoting educational investment.

5.5 Robustness

To assess the robustness of the main findings, I conduct several checks involving an alternative instrument specification and alternative clustering of standard errors.

5.5.1 Alternative Instrument Specification

I re-estimate the primary results from Table 2 using an alternative instrument specification that calculates cumulative returns over the two-year period preceding expected

high school graduation. Table B.7 in the Online Appendix demonstrates that the results are considerably stronger under this alternative specification. This pattern reflects the mechanical relationship between timing and wealth accumulation: investment returns earned closer to graduation affect a larger base of previously accumulated contributions, generating proportionally larger effects on final account balances and, consequently, on college attendance decisions.

5.5.2 Alternative Clustering

I examine the sensitivity of inference to alternative standard error clustering approaches by clustering at the state level rather than the management company × cohort level. This specification addresses potential concerns about within-state correlation in educational and economic conditions. Table B.8 in the Online Appendix confirms that the main results remain statistically significant under state-level clustering, providing additional evidence for the robustness of the main findings.

6 Broader Educational Effects: Student Loan Borrowing and K-12 School Outcomes

Table 5 examines how 529 investment returns affect student loan borrowing and high school completion, providing evidence on additional consequences of wealth accumulation in college savings accounts.

The results demonstrate that higher 529 investment returns significantly reduce student loan borrowing, with the strongest evidence coming from the IV-2SLS specification. Column 3 shows that a 1 percentage point increase in cumulative investment returns reduces the probability of having student loans by 0.67 percentage points, significant at the 5% level. This represents a substantial effect relative to the baseline borrowing rate of 12.4%, suggesting that accumulated wealth in 529 accounts serves as an effective substitute for debt financing of college expenses. The time-varying analysis in column 2 reveals that the debt reduction effects are most pronounced immediately following expected high school graduation, with a 0.60 percentage point decrease in the graduation year itself, significant at the 1% level. The effect diminishes to -0.28 percentage points one year after graduation (not statistically significant) and becomes slightly positive (0.07 percentage

points) two years after graduation, indicating that 529 wealth primarily influences initial college financing decisions rather than ongoing borrowing patterns throughout college.

The relationship between 529 investment returns and high school completion presents a complex temporal pattern. While the pooled IV-2SLS estimate in column 6 shows no significant effect overall (0.36 percentage points), the time-varying analysis in column 5 reveals significant dynamics across the post-graduation period. Higher investment returns are associated with a 0.47 percentage point decrease in high school completion rates during the expected graduation year, significant at the 10% level. This finding may reflect that students with better investment returns delay formal graduation to pursue additional opportunities or preparation. However, this negative effect reverses dramatically in subsequent years, with positive and significant effects of 0.86 percentage points one year after expected graduation and 0.89 percentage points two years after, both significant at the 1% level.

INSERT TABLE 5

Table 6 investigates whether 529 investment returns influence K-12 educational investments and outcomes, with particular attention to the policy change that allowed 529 funds to be used for private school tuition starting in 2018.

The results provide evidence consistent with the 2018 policy expansion. Column 1 shows that a 1 percentage point increase in cumulative investment returns raises private school enrollment by 0.91 percentage points among 11th graders, significant at the 5% level. This represents a substantial effect relative to the baseline private school enrollment rate of 14.5%. The interaction term for years 2018 and earlier is negative (-1.08 percentage points) though not statistically significant, suggesting the private school effect emerged primarily after families gained the ability to use 529 funds for K-12 expenses. This temporal pattern aligns with the institutional timeline, as the policy change would have affected school choice decisions made in 9th and 10th grades, with effects observable among 11th graders in the post-2018 sample period. The results suggest that 529 wealth accumulation enables families to access private educational options that were previously financially constrained.

The effects on gifted class participation show a clearer temporal break around the policy change. The main effect indicates that higher 529 returns increase gifted class participation by 1.92 percentage points, significant at the 10% level. However, the in-

teraction term reveals that this effect was significantly smaller in the pre-2018 period, with a reduction of 1.82 percentage points (significant at the 5% level). This suggests that in the earlier period, the net effect was minimal (1.92 - 1.82 = 0.10 percentage points), while the post-2018 effect is substantially larger. The strengthened relationship between 529 returns and gifted program participation after 2018 may reflect increased family investment in educational enhancement once 529 funds became available for K-12 use.

Column 3 shows no significant relationship between 529 investment returns and grade repetition in either time period, suggesting that wealth accumulation in college savings accounts does not meaningfully affect this academic outcome.

INSERT TABLE 6

These findings provide evidence that 529 plans operate through additional channels beyond college financing, influencing pre-college educational investments.

7 Additional Evidence on the Mechanism

7.1 529 Plan Flow-Performance Sensitivity

The results in Table 4 suggest that the effect of cumulative returns on 529 plan account balances significantly exceeds the mechanical effect alone, indicating that families likely increase their contributions to these accounts in response to positive performance. While the individual-level SIPP data do not include information on contributions to 529 accounts, the Morningstar data on 529 investment options allow for the calculation of flows to these options, which serve as a proxy for household contributions to 529 accounts. To provide additional evidence for this behavioral response, I examine flow-to-performance sensitivity in 529 plans at the state level.

I calculate the flow for each K-12 grade cohort in state s during year t as follows:

$$\text{Flow}_{grade,s,t} = \frac{TNA_{grade,s,t} - (1 + r_{grade,s,t})TNA_{grade-1,s,t-1}}{(1 + r_{grade,s,t})TNA_{grade-1,s,t-1}} \tag{6}$$

where $TNA_{grade,s,t}$ denotes the total net assets invested in target-date funds for grade cohort $grade$ in state s during year t, and $r_{grade,s,t}$ represents the weighted average return earned by this grade cohort's target-date funds in state s during year t.

To estimate flow-performance sensitivity, I employ the following regression model:

$$\text{Flow}_{grade,s,t} = \beta r_{grade-1,s,t-1} + \alpha_s + \alpha_t + \alpha_{grade} + \epsilon_{grade,s,t} \tag{7}$$

where α_s, α_t, and α_{grade} represent state, year, and grade fixed effects, respectively. The state fixed effects control for time-invariant state-specific characteristics that may influence 529 plan flows. Year fixed effects account for common time-varying factors affecting all states, while grade fixed effects capture systematic differences in savings behavior across beneficiary ages. The coefficient β captures the flow-performance sensitivity, measuring the percentage point change in annual flows associated with a one percentage point increase in lagged returns, net of these systematic confounding factors. Standard errors are clustered at the state level.

Table 7 presents estimates of flow-performance sensitivity across different grade levels in 529 plans. The results consistently demonstrate substantial flow-performance sensitivity among high school students (grades 9-12). Column (1) shows that for high school students, a one percentage point increase in lagged returns is associated with a 3.56 percentage point increase in subsequent flows. This sensitivity remains robust in column (2) at 3.07 when cohort fixed effects are included to control for birth-year specific factors.

Column (1) suggests that flow-performance sensitivity may be lower for younger beneficiaries, with statistically significant negative interaction terms for both middle school students (grades 5-8) and elementary school students (grades 1-4). However, column (2) reveals that these differences are not robust to the inclusion of cohort fixed effects.

INSERT TABLE 7

These results demonstrate that the substantial effect of cumulative returns on 529 plan account balances documented in Table 4 stems not only from direct investment performance but also from increased household contributions responding to superior returns. Specifically, of the 4.5 percentage point increase in account balances resulting from a one percentage point increase in cumulative returns, approximately one percentage point reflects the direct mechanical effect of investment performance. The remaining 3.5 percentage point increase likely represents amplification through enhanced household contributions, as this magnitude closely aligns with our estimated flow-performance sensitivity

Households may increase contributions to 529 accounts based on prior personal investment experience, similar to the behavior observed outside of 529 accounts (Malmendier and Nagel 2011). Under this mechanism, higher contributions to 529 plans may crowd out other forms of household savings. Alternatively, households may increase their contributions to 529 plans as a result of the wealth effect. Under this alternative mechanism, they would also likely increase investment in other risky assets such as stocks and mutual funds. Determining which channel plays the dominant role requires investigating the effect of cumulative investment returns in 529 plans on other forms of household wealth.

7.2 Other Forms of Household Wealth

A critical question for interpreting the 529 wealth accumulation effects documented earlier concerns whether 529 investment gains crowd out or amplify other forms of household savings. If families respond to superior 529 performance by reducing investments in stocks, mutual funds, or bank accounts, the net wealth effect would be smaller than the gross increase in 529 balances suggests. Conversely, if 529 gains represent pure wealth creation without substitution effects, this would strengthen the interpretation that investment returns generate meaningful increases in household resources available for college financing. Additionally, 529 wealth accumulation might stimulate households to invest more in other risky assets, as enhanced financial security from college savings could increase families' risk tolerance and willingness to pursue higher-return investments in their broader portfolio. Under this third scenario, such additional investment outside of 529 plans would further contribute to increased college attendance through enhanced overall household wealth accumulation.

Table 8 examines whether cumulative 529 investment returns affect four dimensions of household savings behavior: stock market participation, stock and mutual fund values, bank account ownership, and bank account balances. The analysis employs the same identification strategy as the main results, using variation in target-date fund glide paths to generate quasi-experimental differences in investment returns.

The results provide no evidence of either crowding out or wealth-induced increases in risky asset investment. Column 1 shows that a 1 percentage point increase in cumulative 529 returns generates only a 0.05 percentage point increase in stock market participation, with a standard error of 0.22 percentage points, indicating no statistically significant

relationship. Similarly, Column 2 demonstrates that 529 returns do not meaningfully affect the value of stock and mutual fund holdings among participants, with a coefficient of 0.01 and standard error of 0.01. Bank account patterns in Columns 3 and 4 reveal similar null effects. Neither bank account ownership rates nor account balances respond significantly to 529 investment performance, with coefficients of 0.03 and 0.01 respectively, both statistically indistinguishable from zero.

INSERT TABLE 8

Thus, the positive effect of 529 plan wealth accumulation on four-year college attendance is primarily driven by wealth accumulation within these accounts rather than spillover effects to other forms of household savings.

7.3 College Savings and Four-Year College Characteristics

The preceding analysis demonstrates that college savings significantly influences both college attendance and educational financing mechanisms. These findings prompt an important question about institutional selectivity: does college savings merely facilitate access to any four-year institution, or does it systematically channel students toward higher-quality educational opportunities?

Please improve this: To investigate these patterns, I employ a complementary empirical strategy using longitudinal data from the High School Longitudinal Study of 2009 (HSLS:09). I estimate the following empirical model using the sample to students whose families report having college savings:

$$Y_i = \beta_1 \mathbb{1}_{i,\text{5k-60k}} + \beta_2 \mathbb{1}_{i,>\text{60k}} + \gamma X_i + \epsilon_i \tag{8}$$

where Y_i represents an indicator variable for four-year college attendance expressed in percentage terms for individual i. The reference group consists of 9th grade students whose families have less than \$5,000 in college savings held outside dedicated college savings accounts. The model includes indicators for savings levels ($\mathbb{1}_{i,\text{5k-60k}}$ and $\mathbb{1}_{i,>\text{60k}}$). The vector X_i includes fixed effects for family income, parental college education, student ability, marital status, gender, US birth status, race/ethnicity, urban residence, and region, with controls for parental age and household size. Standard errors are heteroskedasticity robust standard errors.

Table 9 reveals striking heterogeneity in how college savings affects access to different types of institutions. Column 1 confirms the basic college attendance effect, showing that families with $5,000-$60,000 in savings experience a 4.5 percentage point increase in four-year college attendance, while those with savings exceeding $60,000 show a 3.9 percentage point increase, both relative to families with minimal savings.

However, the institutional quality effects demonstrate much steeper gradients. Column 2 examines attendance at private non-profit four-year institutions, which typically charge substantially higher tuition but offer smaller class sizes, superior faculty-student ratios, and enhanced resources. For families in the moderate savings category ($5,000-$60,000), the effect on private college attendance is modest at 2.1 percentage points and statistically insignificant. In contrast, families with savings exceeding $60,000 experience a substantial 9.98 percentage point increase in private college attendance, significant at the 1% level.

The selectivity effects in Column 3 reveal even more pronounced patterns. Highly selective institutions, defined as those admitting fewer than 25% of applicants, represent the most competitive segment of higher education and typically generate the largest long-term economic returns. Families with moderate savings ($5,000-$60,000) show a 4.7 percentage point increase in attendance at highly selective institutions. However, families with the highest savings levels ($> 60,000$) experience a dramatic 13.8 percentage point increase in highly selective college attendance, representing nearly half of the baseline attendance rate of 29.95%.

INSERT TABLE 9

8 Wealth Accumulation in 529 College Savings Plans and College Attendance Disparities

This section analyzes the distributional implications of 529 wealth accumulation benefits for four-year college attendance inequality across socioeconomic and demographic groups.

8.1 Methodology: Back-of-the-Envelope Calculations

To investigate how 529 plan wealth accumulation benefits contribute to inequality in four-year college attendance, I analyze data from the Survey of Income and Program Par-

ticipation over the period 2020-2023, focusing on individuals around their expected high school graduation age. Each year receives equal weight in the calculations, and within each year, individuals are weighted based on the survey-provided weights. I stratify the sample by key demographic characteristics, including socioeconomic factors (household income and parental college attendance) and race. For each demographic group, I calculate both the observed historical four-year college attendance rate one year after expected graduation and a counterfactual attendance rate representing what would occur in the absence of 529 plan accumulation benefits.

Constructing these counterfactual rates requires accounting for substantial variation in 529 wealth accumulation benefits across populations. These benefits differ through four key channels. First, some demographic groups (e.g., higher-income families) are disproportionately likely to establish 529 accounts and make substantial contributions, allowing them to capture greater wealth accumulation benefits. Second, families face varying capital gains tax rates (Dynarski 2004b) depending on their income, which they would pay in the absence of the tax-exempt treatment provided by 529 plans. Third, there is substantial heterogeneity in financial aid taxes (Dynarski 2004b,a) depending on family income and structure. Finally, families differ in their alternative savings behaviors: those who would not otherwise invest in stocks gain the entire investment return through 529 plans, while families who would invest in stocks regardless gain only the tax exemption on those returns. The first three channels disproportionately advantage higher-income families and thus may exacerbate college attendance disparities. The final channel may work in the opposite direction by reducing disparities, because lower-income families are less likely to have stock market exposure in the absence of 529 plans and therefore capture the entire investment return through 529 plans, while higher-income families capture only the tax benefits on those returns.

I calculate the counterfactual four-year college attendance rates by incorporating all these channels and applying the estimates from my main empirical findings. By comparing observed and counterfactual attendance rates across demographic groups, I assess the extent to which 529 plan wealth gains contribute to disparities in four-year college attendance. Below, I explain in greater detail how I implement this methodology through several steps.

Step 1: Group-Specific Parameters. I divide the sample into demographic categories (household income quartiles, parental college attendance, and racial groups) and

calculate group-specific parameters:

- 529 account ownership rates;
- The average of account balances capped at the maximum total tuition costs of a four-year degree at a public university among account holders, measured one year prior to expected high school graduation. The cap is applied because the effect of 529 wealth gains on four-year college attendance is most pronounced for account balances below this threshold;
- Four-year college attendance rates, separately for families with and without 529 accounts;
- Stock market participation rates among 529 account beneficiary families, proxied by stock market participation outside of 529 accounts through a non-retirement investment account;
- The average of long-term capital gains tax rates obtained for each account owner through NBER TAXSIM;
- Average financial aid tax on wealth gains in 529 plans, calculated for each individual using information on family structure and income following Dynarski (2004a).

Step 2: Heterogeneous Wealth Effect Calculation. For each demographic group g, I calculate two distinct attendance effects from 529 wealth accumulation benefits. For families who would not invest in stocks to save for college without 529 plans, entire investment returns represents a wealth gain attributable to the 529 plan, $\Delta_{\text{entire,g}}$:

$$\Delta_{\text{entire,g}} = 0.75 \times \left(\frac{\text{average account balance}_g}{1,000} \right) \times \pi \times (1 - \theta_g) \tag{9}$$

where *average account balance*$_g$ indicates the average of account balances capped at the maximum total tuition costs of a four-year degree at a public university among account holders for demographic group g, 0.75 represents the midpoint magnitude for the effect of \$1,000 in account balance on four-year college attendance in percentage points (Section 5.3 finds a range of 0.6–0.9), π is the share of final account balances attributable to wealth gains, which I calculate using data from Morningstar on target-date funds. θ_g represents the average financial aid tax on assets in 529 plans for demographic group g.

For families who would invest in stocks anyway, where 529 plans provide only tax advantages, 529 plan wealth gains $\Delta_{\text{tax exemptions,g}}$ are calculated as follows:

$$\Delta_{\text{tax exemptions,g}} = 0.75 \times \left(\frac{\text{average account balance}_g}{1,000} \right) \times \pi \times (1 - \theta_g) \times \tau_g \tag{10}$$

where τ_g represents the average marginal tax rate on long-term capital gains for demographic group g.

Step 3: Counterfactual Construction. The counterfactual four-year college attendance rate takes into account heterogeneous alternative investment behavior and is calculated as follows for each demographic group g:

$$\begin{aligned} &\text{Counterfactual attendance}_g = (1 - \text{529 ownership rate}_g) \times \text{attendance}_{\text{without 529},g} \\ &+ \text{529 ownership rate}_g \times (1 - \phi_g) \times (\text{attendance}_{\text{with 529},g} - \Delta_{\text{entire,g}}) \\ &+ \text{529 ownership rate}_g \times \phi_g \times (\text{attendance}_{\text{with 529},g} - \Delta_{\text{tax exemptions,g}}) \end{aligned} \tag{11}$$

where $\textit{attendance}_{\text{with 529},g}$ and $\textit{attendance}_{\text{without 529},g}$ indicate the historical four-year college attendance rates for account holders and non-account holders for demographic group g, respectively. $\textit{529 ownership rate}_g$ is the 529 ownership rate for demographic group g. ϕ_g represents the stock market participation rate among 529 account beneficiary families from demographic group g, capturing the share who would invest in stocks to save for college even without 529 plans. $\Delta_{\text{entire,g}}$ and $\Delta_{\text{tax exemptions,g}}$ indicate 529 wealth gains for families who would not invest in stocks to save for college without 529 plans and who would invest in stocks anyway, respectively, from demographic group g.

Step 4: Inequality Decomposition. The difference between observed and counterfactual four-year college attendance rates represents the net contribution of 529 wealth accumulation benefits to four-year college attendance disparities.

8.2 Results

Figure 7 illustrates the distributional effects of 529 wealth accumulation benefits on four-year college attendance rates across household income quartiles (Panel A) and parental college attendance (Panel B). Grey segments show the counterfactual attendance rates without 529 wealth accumulation benefits, while black segments indicate the contribution of these benefits. Panel A demonstrates substantial variation in how 529 wealth

accumulation benefits affect attendance across income quartiles. Lower-income families derive minimal attendance improvements, as indicated by small black segments, while higher-income families receive substantially larger increases. This pattern reveals that 529 plans operate as a regressive transfer mechanism, concentrating benefits among families with higher baseline attendance rates. Panel B shows similar disparities based on parental college education. Students with at least one parent who attended college experience much larger attendance gains from 529 wealth accumulation benefits than students whose parents did not attend college.

INSERT FIGURE 7

Figure 8 demonstrates the distributional effects of 529 wealth accumulation benefits on four-year college attendance rates across racial groups. Asian students receive the largest attendance increases from 529 wealth accumulation benefits, White students receive slightly smaller attendance improvements, and Black students capture almost no effects on four-year college attendance from 529 wealth accumulation benefits. These disparities indicate that existing socioeconomic inequalities translate directly into differential access to 529 wealth accumulation benefits. Asian and White families' higher participation rates and account balances enable them to capture most of the attendance improvements from 529 wealth accumulation benefits.

INSERT FIGURE 8

Figure 9 additionally quantifies the part four-year college attendance disparities explained by 529 plan wealth accumulation benefits. These benefits account for approximately 7% of the four-year attendance gap between students in the highest and lowest income quartiles and around 5% of the gap between students with at least one parent who attended college and those without. They also explain nearly 50% of the four-year attendance gap between White and Black students. This amplification of attendance disparities occurs because higher-income families, college-educated parents, and White families are disproportionately likely to establish 529 accounts and benefit from their wealth accumulation advantages. As demonstrated in Figure 2, annual 529 distributions to undergraduates now exceed total federal undergraduate loan disbursements and have been growing over time, making these tax-advantaged savings vehicles a sizable and increasing source of inequality in four-year college attendance nationwide.

INSERT FIGURE 9

9 Conclusion

This paper studies how wealth gains in 529 college savings plans shape educational opportunities and inequality. I find that 529 wealth gains substantially increase four-year college attendance, with the effect per $1,000 similar to that of targeted grant aid. These wealth gains also reduce student loan borrowing and boost private K-12 school enrollment. However, the positive effect of wealth gains in 529 plans on four-year college attendance also masks concerning implications for college attendance disparities. Wealth gains from 529 plans primarily accrue to students from higher-income households, as these families are more likely to open accounts and make substantial contributions. As a result, the 529 system exacerbates the four-year college attendance gap across both socioeconomic and racial lines.

Overall, my findings indicate that 529 college savings plans significantly influence human capital investment through investment returns and tax-exempt status on these returns, which collectively affect both college attendance and pre-college private educational expenditures. The design features of 529 plans—particularly the quality of investment funds offered within these plans—will impact human capital investment by determining the returns investors receive. However, the 529 plan system unintentionally amplifies college attendance disparities, suggesting the need for policy changes to better serve equity goals. While investigating the optimal design of 529 college savings plans remains beyond the scope of this paper, these findings highlight important directions for future research.

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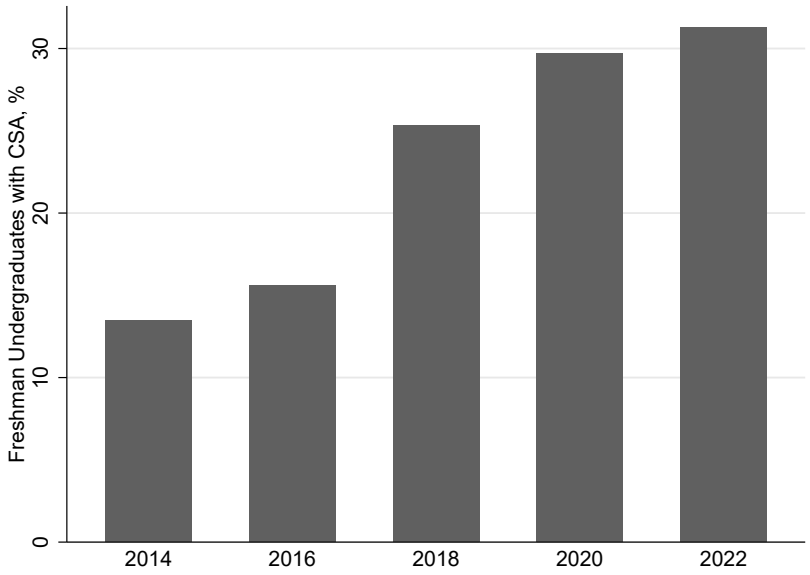
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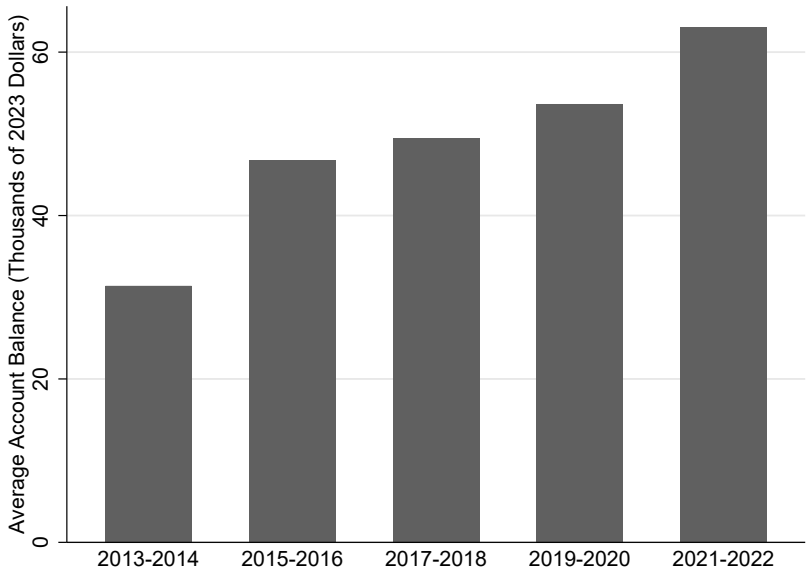
Figures

Figure 1. Growth of College Savings Accounts over Time

Panel A. Proportion of Freshman Undergraduates with College Savings Accounts

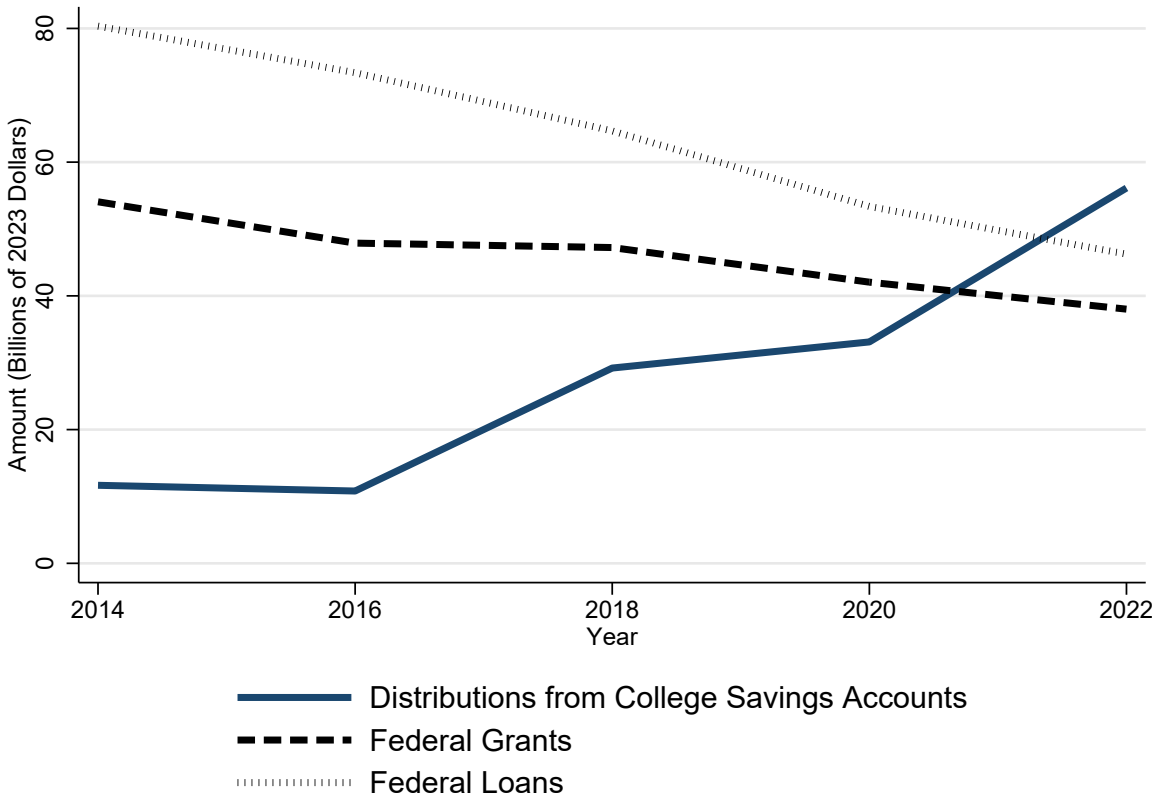


Panel B. Average Account Balance for 12th Grade Beneficiaries



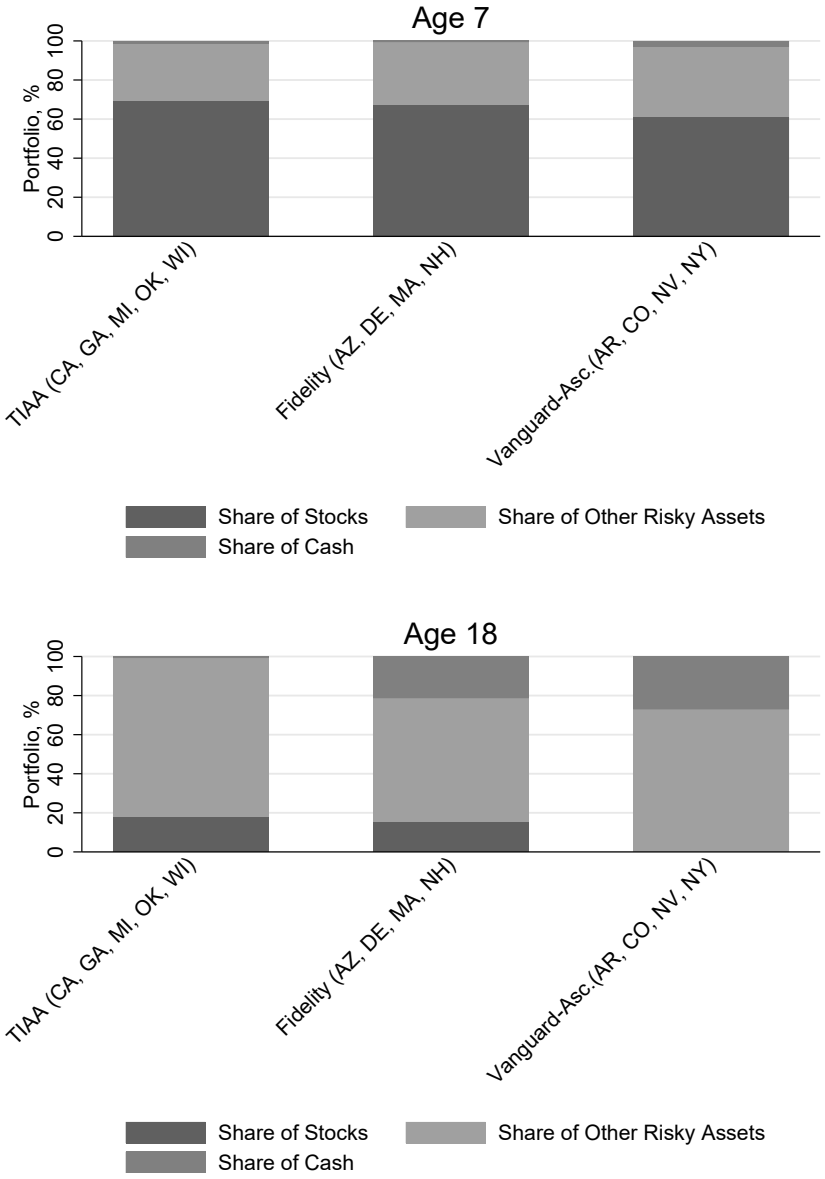
Notes: This figure illustrates trends in college savings account participation and balances using Survey of Income and Program Participation (SIPP) data. Panel A presents the proportion of freshman undergraduates with college savings accounts across years 2014, 2016, 2018, 2020, and 2022. The sample is restricted to students with at least one high school observation prior to college enrollment. Panel B depicts mean account balances for 12th grade beneficiaries with college savings accounts during 2013-2022. Account balances are winsorized at the 1nd and 99th percentiles and adjusted to 2023 dollars.

Figure 2. Undergraduate Funding Sources: College Savings Accounts, Federal Grants, and Federal Loans (2014-2022)



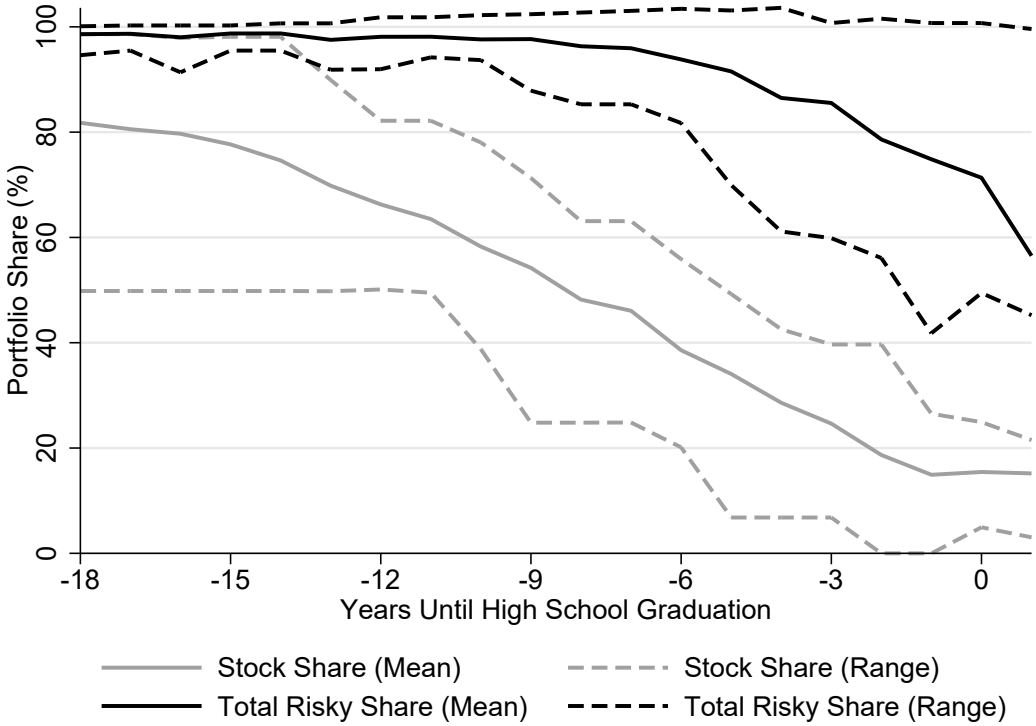
Notes: This figure compares the amount of college funding for undergraduate students from college savings accounts, federal grants, and federal loans over the period 2014-2022. Federal grant and loan data are from Trends in Student Aid 2024 (College Board). College savings account distributions are calculated using Survey of Income and Program Participation (SIPP) data through a three-step procedure. First, for each undergraduate with an educational savings account observed in December, an annual distribution is calculated as the previous year balance multiplied by the average annual return on target-date funds within 529 plans for college students, minus the current year balance. Second, I compute the weighted average annual distribution using SIPP survey weights. Third, I scale this average by total U.S. undergraduate enrollment from the Digest of Education Statistics (National Center for Education Statistics). All values are expressed in 2023 dollars.

Figure 3. Asset Allocation Variation in 529 Target-Date Funds Across Major Plan Managers (2021)



Notes: This figure illustrates systematic asset allocation differences across three major asset management firms offering target-date funds in 529 college savings plans. Portfolio compositions are shown for beneficiaries aged 7 and 18, demonstrating both the glide path effect—declining risk exposure as beneficiaries approach college age—and persistent allocation differences across firms. TIAA maintains the most aggressive strategy with maximum equity exposure and minimal cash holdings, Vanguard-Ascensus employs the most conservative approach with substantial cash allocations, and Fidelity adopts an intermediate position. State abbreviations in parentheses indicate states where each firm offers target-date funds within 529 plans. Data comes from Morningstar.

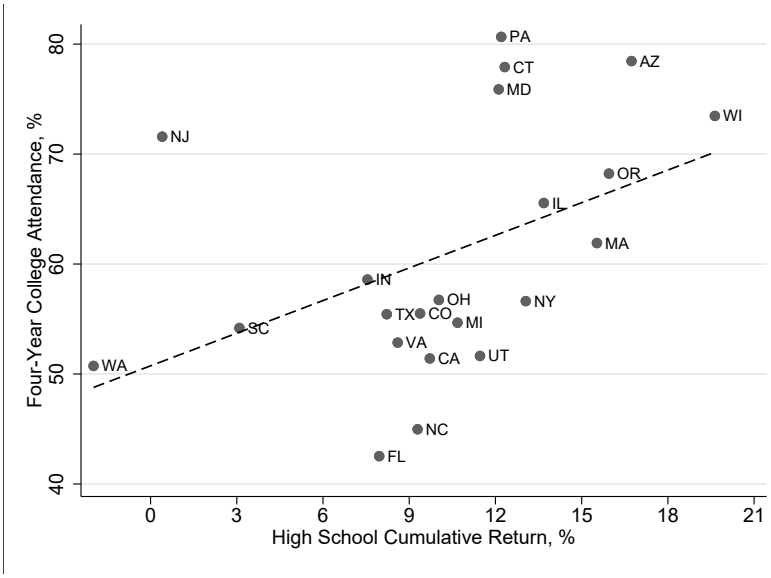
Figure 4. Variation in 529 Plan Glide Paths by Years Until High School Graduation (2023)



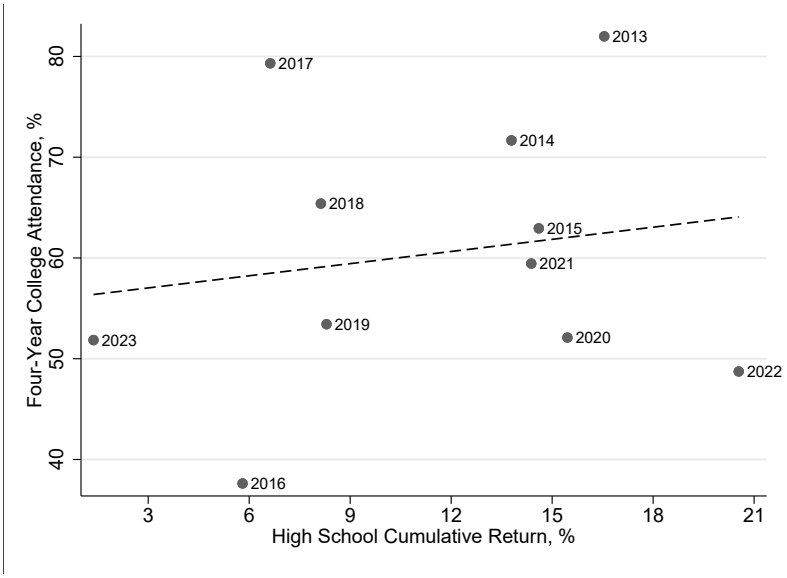
Notes: This figure displays the variation in 529 target-date fund glide paths by years until high school graduation in 2023. The solid lines represent median portfolio allocations across states, while the dotted lines show the range between minimum and maximum allocations. Navy indicates total risky asset allocations (stocks, bonds, and other risky assets), and gray represents stock allocations only. The figure illustrates the typical glide path pattern of declining risk exposure as beneficiaries approach high school graduation age, as well as substantial heterogeneity in allocation strategies across asset management firms managing 529 plans. Data comes from Morningstar.

Figure 5. 529 Cumulative Investment Returns during High School and Four-Year College Attendance

Panel A. Across States

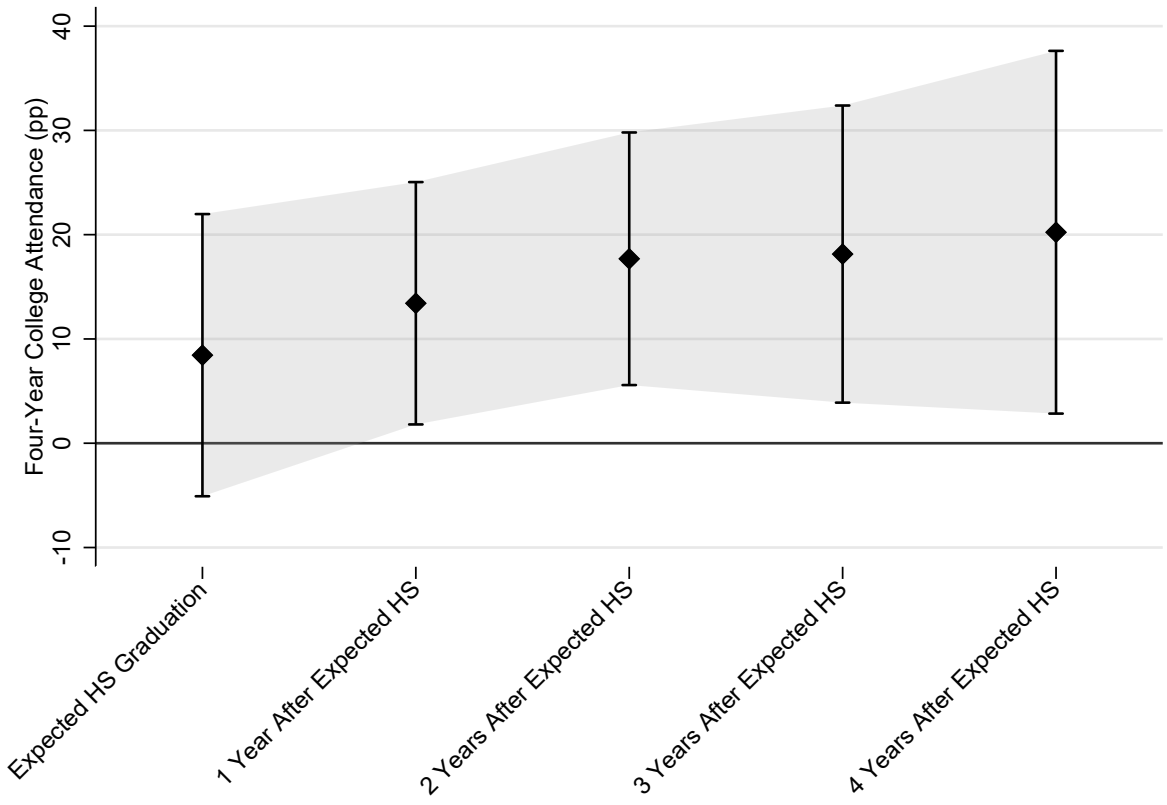


Panel B. Over Time



Notes: This figure examines the relationship between 529 plan cumulative investment returns during high school and four-year college attendance rates among students with college savings accounts in the Survey of Income and Program Participation (SIPP). Panel A presents cross-state variation, with each point representing state-level averages for students in their expected high school graduation year, determined using birth year and month relative to state-specific kindergarten admission cutoffs. States with fewer than 10 SIPP observations are excluded from the analysis. Panel B displays time variation, with each point representing annual averages from 2013 to 2023. Both panels present weighted estimates using SIPP survey weights and include fitted regression lines. Cumulative returns reflect total investment performance in target-date funds within in-state 529 plans during the high school period. Investment return data are from Morningstar.

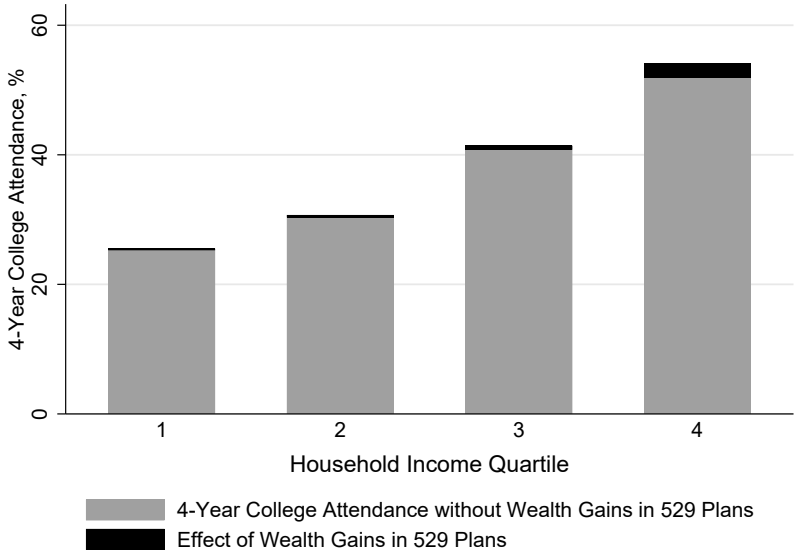
Figure 6. Effects of a 10 pp Increase in 529 Cumulative Investment Returns on Four-Year College Attendance by Expected Educational Stage



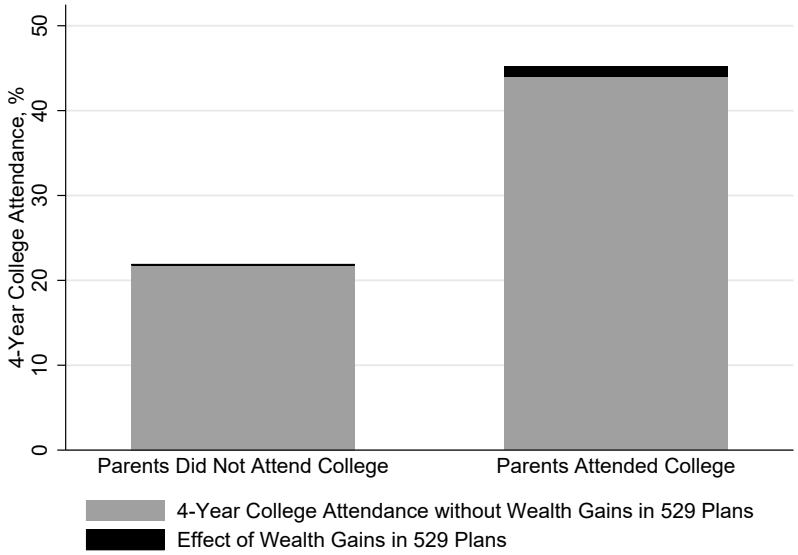
Notes: This figure displays the effect of a 10 percentage point increase in cumulative 529 investment returns during high school on four-year college attendance, estimated separately by years elapsed since expected high school graduation. Coefficients are from OLS regressions where cumulative returns are interacted with indicators for years since expected graduation (0 through 4 years). The sample includes individuals with college savings accounts observed during 2013-2023, restricted to those observed within the first five years after expected high school graduation. All specifications include management company, state, year, and cohort fixed effects, along with controls for individual and household characteristics, in-state four-year college tuition rates, and state higher education funding per FTE student. Expected high school graduation timing is determined using birth year and month relative to state-specific kindergarten admission cutoffs. Confidence intervals represent 95% confidence levels with standard errors clustered at the management company × cohort level.

Figure 7. 529 Wealth Accumulation Benefits and Four-Year College Attendance by Household Income Quartile and Parental College Attendance (2020-2023)

Panel A. By Household Income Quartile

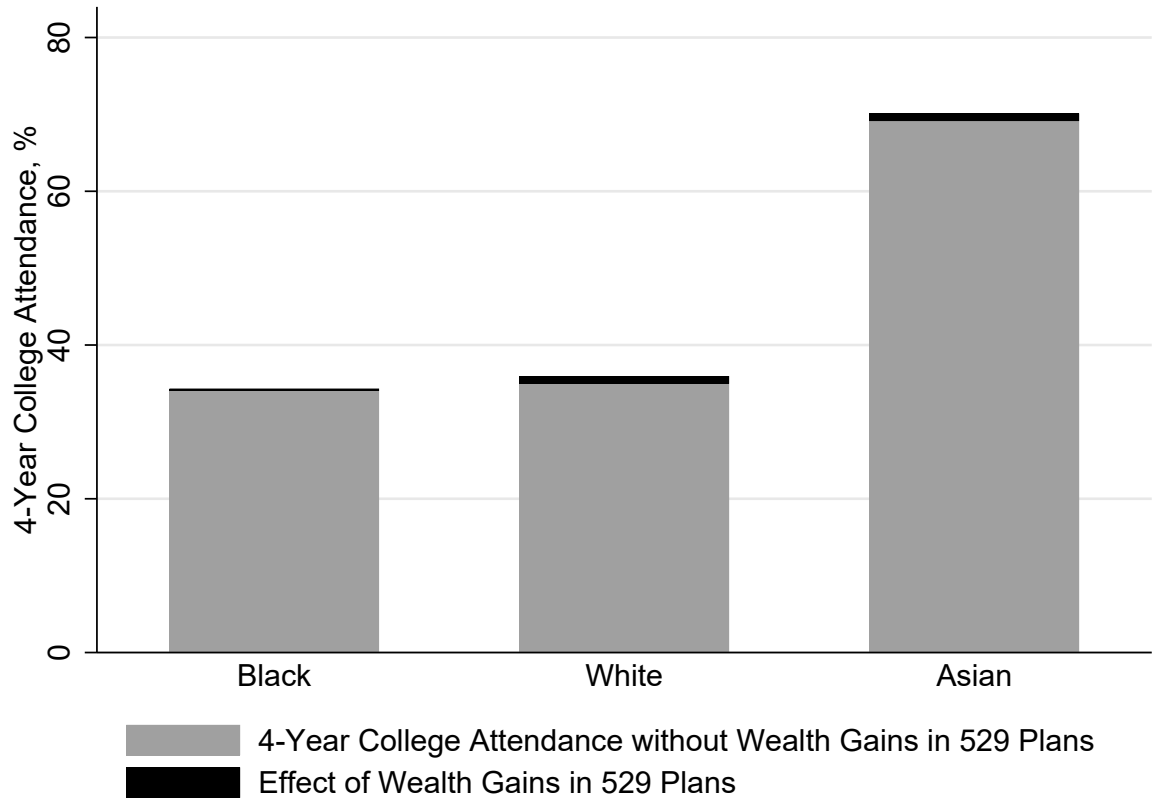


Panel B. By Parental College Attendance



Notes: This figure illustrates how 529 wealth accumulation benefits contribute to four-year college attendance across household income quartiles (Panel A) and parental college attendance (Panel B) over the 2020-2023 period.. The stacked bars decompose total four-year college attendance rates from the Survey of Income and Program Participation into two components: counterfactual attendance rates that would exist without the wealth accumulation benefits of 529 plans (gray bars) and the additional attendance attributable to 529 wealth gains (black bars). The counterfactual attendance rates are calculated using the methodology described in Section 8. Four-year college attendance is measured one year after expected high school graduation, which is determined using birth year and month relative to state-specific kindergarten admission cutoffs. The sample includes only individuals who are part of the same household as their parents and would be considered dependent students for financial aid purposes, including those who live separately on campus.

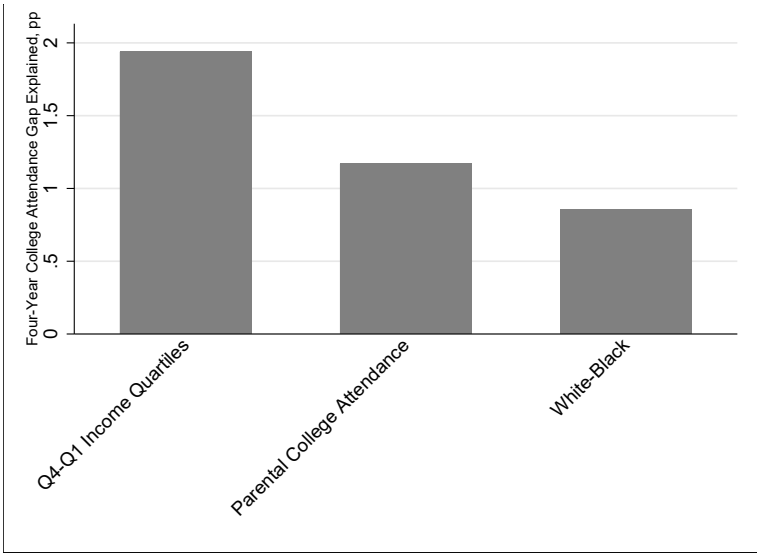
Figure 8. 529 Wealth Accumulation Benefits and Four-Year College Attendance by Race (2020-2023)



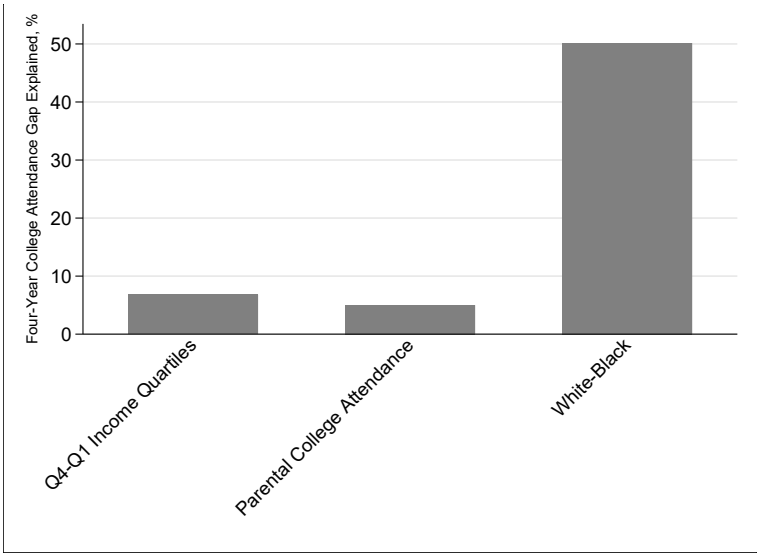
Notes: This figure illustrates how 529 wealth accumulation benefits contribute to four-year college attendance across racial groups over the 2020-2023 period. The stacked bars decompose total four-year college attendance rates from the Survey of Income and Program Participation into two components: counterfactual attendance rates that would exist without the wealth accumulation benefits of 529 plans (gray bars) and the additional attendance attributable to 529 wealth gains (black bars). The counterfactual attendance rates are calculated using the methodology described in Section 8. Four-year college attendance is measured one year after expected high school graduation, which is determined using birth year and month relative to state-specific kindergarten admission cutoffs. The sample includes only individuals who are part of the same household as their parents and would be considered dependent students for financial aid purposes, including those who live separately on campus.

Figure 9. 529 Wealth Accumulation Benefits and Four-Year College Attendance Disparities (2020-2023)

Panel A. Part of Four-Year College Attendance Disparities Explained by 529 Wealth Accumulation Benefits (pp)



Panel B. Percentage of Four-Year College Attendance Disparities Explained by 529 Wealth Accumulation Benefits (%)



Notes: This figure illustrates the part of four-year college attendance disparities explained by 529 wealth accumulation benefits over the 2020-2023 period using data from the Survey of Income and Program Participation. Panels A and B show the results in percentage points and in percent, respectively. The first bar in both panels demonstrates the part of the four-year college attendance gap between students from the highest and lowest income quartiles explained by 529 wealth accumulation benefits. The second bar illustrates similar results for the gap between students with at least one parent who attended college and those without, while the third bar shows the same results for the gap between White and Black students. The methodology for quantifying the contribution of 529 wealth accumulation benefits to four-year college attendance disparities is described in Section 8. Four-year college attendance is measured one year after expected high school graduation, which is determined using birth year and month relative to state-specific kindergarten admission cutoffs. The sample includes only individuals who are part of the same household as their parents and would be considered dependent students for financial aid purposes, including those who live separately on campus.

Tables

Table 1. Summary Statistics on Account Beneficiaries

	Mean	Median	SD	Min	Max	# Obs.
Panel A - College-Aged Adults with College Savings Accounts (N=1,692 Individuals)						
Student and Family Characteristics						
Female	0.51	1	0.50	0	1	3,050
White	0.85	1	0.35	0	1	3,050
Black	0.04	0	0.20	0	1	3,050
Asian	0.06	0	0.24	0	1	3,050
Age, Years	20.51	20	2.02	18	26	3,050
Parental College Education	0.53	1	0.50	0	1	3,050
Parental Marital Status	0.59	1	0.49	0	1	3,050
Household Metropolitan Status	0.82	1	0.38	0	1	3,050
Number of Children in a Household	0.45	0	0.76	0	5	3,050
Annual Household Income, $	193,613.45	157,126	175075.00	0	1,060,986	3,050
Live without Parents	0.29	0	0.45	0	1	3,050
Education						
Attended Any (Two- or Four-Year) College	0.81	1	0.39	0	1	3,050
Attended a Four-Year College	0.71	1	0.46	0	1	3,050
Attended a Private Four-Year College	0.23	0	0.42	0	1	3,050
Finished High School	0.95	1	0.22	0	1	3,050
In-State College Tuition, $	10,634.94	10,205	2,512.57	4,404	17,747	3,050
State/Local Higher Educ. Funding per Student, $	9,274.77	8,444	3,279.05	3,346	27,206	3,048
Educational Savings Accounts & Student Loans						
Educational Savings Account Balance, $	24,931.95	5,622	49,601.27	0	452,088	3,050
Cumulative Investment Returns, %	11.40	11	6.06	0	27	2,216
Instrument, %	14.82	13	6.03	3	28	2,281
Student Loan Indicator Variable	0.17	0	0.37	0	1	3,050
Student Loan Balance, $	4,080.75	0	16,248.62	0	280,254	3,050
Panel B - Account Beneficiaries Expected to Be in School Grades 7-12 (N=2,267 Individuals)						
Student and Family Characteristics						
Female	0.50	1	0.50	0	1	3,475
White	0.83	1	0.38	0	1	3,475
Black	0.03	0	0.16	0	1	3,475
Asian	0.08	0	0.27	0	1	3,475
Age, Years	14.77	15	1.73	12	18	3,475
Parental College Education	0.80	1	0.40	0	1	3,475
Parental Marital Status	0.85	1	0.36	0	1	3,475
Household Metropolitan Status	0.84	1	0.37	0	1	3,475
Number of Children in a Household	1.98	2	0.94	0	8	3,475
Annual Household Income, $	260,293.70	207,474	188796.01	0	1,168,172	3,475
In Private School	0.13	0	0.33	0	1	3,475
Repeated Grade	0.03	0	0.18	0	1	3,475
In Gifted Class	0.49	0	0.50	0	1	3,475
In-State College Tuition, $	10,640.13	10,294	2,478.93	4,404	17,772	3,475
State/Local Higher Educ. Funding per FTE Student, $	9,452.80	8,569	3,654.63	2,183	28,284	3,471
Educational Savings Accounts & Savings						
Educational Savings Account Balance, $	45,260.35	21,132	65,595.44	0	581,758	3,475
Cumulative Investment Returns, %	15.27	15	7.53	2	36	2,758
Instrument, %	18.24	18	7.93	4	42	2,872
Bank Account Indicator Variable	1.00	1	0.07	0	1	3,475
Bank Account Balance, $	87,541.28	30,420	138040.71	0	1,310,974	3,475
Stock Market Participation Indicator Variable	0.54	1	0.50	0	1	3,475
Value of Stocks & Mutual Funds, $	142,177.85	2,082	353778.44	0	3,830,000	3,475

Notes: This table presents summary statistics for two distinct samples of individuals with college savings accounts drawn from the Survey of Income and Program Participation covering the period 2013-2023. Panel A reports statistics for college-aged adults with college savings accounts, comprising 1,692 unique individuals observed across 3,050 individual-year observations. This sample includes individuals observed within four years after their expected high school graduation year, which is determined based on birth year and month in conjunction with state-specific kindergarten admission cutoff dates. Panel B presents statistics for younger account beneficiaries expected to attend school grades 7-12, totaling 2,267 unique individuals across 3,475 individual-year observations. The expected K-12 school grades for the sample in Panel B are also determined based on birth year and month in conjunction with state-specific kindergarten admission cutoffs. Cumulative investment returns earned by target-date funds in in-state 529 plans and instrument are calculated using Morningstar data. All dollar amounts are inflation-adjusted to 2023 and winsorized at the 1st and 99th percentiles.

Table 2. Effects of 529 Plan Cumulative Investment Returns on College Attendance

	4-Year College Attendance$_{i,cohort,s,t}$		**Any College Attendance**$_{i,cohort,s,t}$		**2-Year College Attendance**$_{i,cohort,s,t}$	
	OLS	IV-2SLS	OLS	IV-2SLS	OLS	IV-2SLS
	(1)	(2)	(3)	(4)	(5)	(6)
Cumulative Return$_{cohort,s}$	1.39***	2.20**	0.81*	2.00**	-0.58	-0.20
	(0.51)	(1.11)	(0.45)	(0.98)	(0.41)	(0.81)
ATT	2.20	3.50	1.28	3.18	-0.92	-0.32
Mean Attendance	71.5	71.5	83.7	83.7	12.1	12.1
FEs and Controls	Yes	Yes	Yes	Yes	Yes	Yes
KP F-statistic		47		47		47
Observations	1,380	1,298	1,380	1,298	1,380	1,298
R^2	0.21		0.19		0.08	

Notes: This table presents estimates of the effect of cumulative investment returns in 529 plans during high school on college attendance. Columns 1, 3, and 5 report OLS estimates, whereas columns 2, 4, and 6 present IV-2SLS estimates. Dependent variables are binary indicators for four-year college attendance (columns 1-2), any college attendance encompassing both two-year and four-year institutions (columns 3-4), and two-year college attendance specifically (columns 5-6). The key explanatory variable, *Cumulative Return*$_{cohort,s}$, represents cumulative investment returns in target-date funds within in-state 529 plans during high school. The sample comprises individuals with college savings accounts observed during 2013-2023, covering the five-year period starting from their expected high school graduation year. Expected high school graduation year is determined using birth year and month relative to state-specific kindergarten admission cutoffs. The IV strategy exploits a shift-share instrument that combines plausibly exogenous variation in target-date fund glide paths across asset management firms with differential performance of broad asset classes over time. Individual-level data are from SIPP, while investment returns and fund allocation data are from Morningstar. All specifications include state, year, and cohort fixed effects, along with controls for individual and household characteristics, in-state four-year college tuition rates, and state higher education funding per FTE student. Average Treatment Effect on the Treated (ATT) estimates scale coefficients by the aggregate share of 529 accounts invested in target-date funds within in-state plans, isolating effects for individuals directly exposed to return variation. Mean attendance reports the sample average of each dependent variable. The Kleibergen–Paap rk Wald F statistic (KP F-statistic) tests the null hypothesis of weak instruments in the IV specifications. Standard errors are clustered at the management company × cohort level. The symbols *, **, and *** denote statistical significance at the 10%, 5%, and 1% levels, respectively.

Table 3. Heterogeneous Effects of 529 Plan Cumulative Investment Returns on Four-Year College Attendance

	4-Year College Attendance$_{i,cohort,s,t}$	
	By Account Balance	By Independent Living/Parental Education
	(1)	(2)
Cumulative Return$_{cohort,s}$	1.31**	
	(0.53)	
Cumulative Return$_{cohort,s}$ × Account Balance > 70,000	-1.66***	
	(0.50)	
Cumulative Return$_{cohort,s}$ × W/O Parents		0.32
		(0.66)
Cumulative Return$_{cohort,s}$ × HS. Parents		1.60**
		(0.75)
Cumulative Return$_{cohort,s}$ × Coll. Parents		1.68***
		(0.56)
FEs and Controls	Yes	Yes
Observations	473	1,380
R^2	0.28	0.21

Notes: This table presents estimates of heterogeneous effects of cumulative investment returns in 529 plans during high school on four-year college attendance by account balance size and family background characteristics. Column 1 investigates effect heterogeneity by account balance size, where the baseline effect applies to accounts with balances of $70,000 or less, and the interaction term captures additional effects for larger accounts. Column 2 explores heterogeneity by living arrangement and parental education, comparing students living without parents, students living with parents who have high school education or less, and students living with college-educated parents. The dependent variable is a binary indicator for four-year college attendance. *Cumulative Return*$_{cohort,s}$ represents cumulative investment returns in target-date funds within in-state 529 plans during high school. The sample includes individuals with college savings accounts observed during 2013-2023, restricted to those observed within four years after expected high school graduation. All specifications employ OLS estimation and include management company, state, year, and cohort fixed effects, along with controls for individual and household characteristics, in-state four-year college tuition rates, and state higher education funding per FTE student. Account balance reflects the account value observed in years prior to expected high school graduation. Standard errors are clustered at the management company level in Column 1 and at the management company × cohort level in Column 2. The symbols *, **, and *** denote statistical significance at the 10%, 5%, and 1% levels, respectively.

Table 4. Effects of 529 Plan Cumulative Investment Returns on 12th Grade Student Account Balances and Participation

	$\overline{\textbf{Log(Account Balance)}}_{s,t}$	$\overline{\textbf{Have a College Savings Account}}_{s,t}$
	(1)	(2)
Cumulative Return$_{s,t}$	0.046***	-0.098
	(0.017)	(0.340)
Mean Value	52,399.3	10.1
Year FE	Yes	Yes
State FE	Yes	Yes
Observations	207	422
R^2	0.28	0.29

Notes: This table presents estimates of the relationship between cumulative 529 investment returns and wealth accumulation mechanisms using state-year level aggregated data. Column 1 investigates the effect of mean investment returns on mean log account balances among students with existing 529 accounts. Column 2 tests whether mean investment returns influence average college savings account ownership rates. The sample includes students observed one year before their expected high school graduation during 2013-2023. *Cumulative Return*$_{s,t}$ represents cumulative investment returns in target-date funds within in-state 529 plans measured over the lagged three-year period. Both specifications employ OLS estimation with state and year fixed effects. Mean Value reports the sample average account balance in column 1 and the sample average account ownership rate in column 2. Heteroskedasticity robust standard errors are reported in parentheses. The symbols *, **, and *** denote statistical significance at the 10%, 5%, and 1% levels, respectively.

Table 5. Effects of 529 Plan Cumulative Investment Returns on Student Loan Borrowing and High School Graduation

	Student Loan Borrowing$_{i,cohort,s,t}$			**High School Diploma**$_{i,cohort,s,t}$		
	OLS (1)	OLS (2)	IV-2SLS (3)	OLS (4)	OLS (5)	IV-2SLS (6)
Cumulative Return$_{cohort,s}$	-0.34*		-0.67**	0.36		0.36
	(0.19)		(0.29)	(0.32)		(0.42)
Cum.Return$_{cohort,s} * \mathbb{1}$.Expected HS		-0.60***			-0.47*	
		(0.22)			(0.26)	
Cum.Return$_{cohort,s} * \mathbb{1}$.1 Year After Exp.HS		-0.28			0.86***	
		(0.20)			(0.25)	
Cum.Return$_{cohort,s} * \mathbb{1}$.2 Years After Exp.HS		0.07			0.89***	
		(0.26)			(0.28)	
ATT	-0.54		-1.07	0.57		0.57
Mean Dependent Variable	12.4	12.4	12.4	91.2	91.2	91.2
FEs and Controls	Yes	Yes	Yes	Yes	Yes	Yes
KP F-statistic			338			338
Observations	1,276	1,276	1,204	1,276	1,276	1,204
R^2	0.10	0.11		0.07	0.14	

Notes: This table presents estimates of the effects of cumulative 529 investment returns during high school on student loan borrowing and high school completion. Columns 1-3 analyze student loan borrowing as the dependent variable, while columns 4-6 examine high school diploma attainment. Both dependent variables are binary indicators expressed in percentage terms. Columns 1 and 4 present pooled OLS estimates, columns 2 and 5 show time-varying effects by years since expected high school graduation, and columns 3 and 6 provide IV-2SLS estimates using the shift-share instrument. The sample includes individuals with college savings accounts observed during 2013-2023, restricted to those observed within three years after expected high school graduation. All specifications include management company, state, and year fixed effects, along with controls for individual and household characteristics, in-state four-year college tuition rates, and state higher education funding per FTE student. Average Treatment Effect on the Treated (ATT) estimates scale coefficients by the share of 529 accounts invested in target-date funds within in-state plans. Standard errors are clustered at the management company × cohort level. The symbols *, **, and *** denote statistical significance at the 10%, 5%, and 1% levels, respectively.

Table 6. Effects of 529 Plan Cumulative Investment Returns on 11th Grade School Outcomes

	Private School$_{i,s,t}$	**Gifted Class**$_{i,s,t}$	**Repeated Grade**$_{i,s,t}$
	(1)	(2)	(3)
Cumulative Return$_{s,t}$	0.91**	1.92*	-0.22
	(0.45)	(1.01)	(0.35)
Cum.Return$_{s,t} * \mathbb{1}$.Year ≤ 2018	-1.08	-1.82**	-0.00
	(0.71)	(0.84)	(0.36)
Mean Dependent Variable	14.5	58.0	3.9
FEs and Controls	Yes	Yes	Yes
Observations	319	319	319
R^2	0.28	0.33	0.21

Notes: This table presents estimates of the relationship between cumulative 529 investment returns and K-12 educational outcomes among 11th grade students. Column 1 analyzes private school enrollment, column 2 examines gifted class participation, and column 3 investigates grade repetition. All dependent variables are binary indicators expressed in percentage terms. The sample includes 11th grade students with college savings accounts and account balances exceeding $500, observed during 2013-2023. *Cumulative Return*$_{s,t}$ represents cumulative investment returns in target-date funds within in-state 529 plans measured over the three-year period preceding 11th grade. All specifications include management company, state, and year fixed effects, along with controls for individual and household characteristics, in-state four-year college tuition rates, and state higher education funding per FTE student. Standard errors are clustered at the management company level. The symbols *, **, and *** denote statistical significance at the 10%, 5%, and 1% levels, respectively.

Table 7. 529 Plan Flow-Performance Sensitivity

	$\textbf{Flow}_{grade,s,t}$	
	(1)	(2)
$r_{grade-1,s,t-1}$	3.56***	3.07***
	(1.07)	(1.03)
$r_{grade-1,s,t-1} * \mathbb{1}$.grades 5-8	-0.92**	-0.40
	(0.43)	(0.39)
$r_{grade-1,s,t-1} * \mathbb{1}$.grades 1-4	-1.10*	0.04
	(0.64)	(0.71)
Fixed Effects:		
State	Yes	Yes
Year	Yes	Yes
Grade	Yes	Yes
Cohort	-	Yes
Observations	3,621	3,621
R^2	0.11	0.11

Notes: This table reports estimates of flow-performance sensitivity in 529 plans by grade level. The dependent variable is the annual flow (in percentage points) for each grade-state-year cell. The baseline coefficient captures flow-performance sensitivity for high school students (grades 9-12), while interaction terms show how this sensitivity differs for middle school (grades 5-8) and elementary school (grades 1-4) students. Column (1) includes state, year, and grade fixed effects. Column (2) adds cohort fixed effects. Standard errors clustered at the state level are reported in parentheses. The symbols *, **, and *** denote statistical significance at the 10%, 5%, and 1% levels, respectively.

Table 8. Effects of 529 Plan Cumulative Investment Returns on Other Household Savings

	Stock Market Part.$_{cohort,s,t}$	**Log(Stock-MF Value)**$_{cohort,s,t}$	**Have a Bank Account**$_{cohort,s,t}$	**Log(Bank Acc. Balance)**$_{cohort,s,t}$
	(1)	(2)	(3)	(4)
Cum. Return$_{cohort,s,t}$	0.05	0.01	0.03	0.01
	(0.22)	(0.01)	(0.04)	(0.01)
Mean Variable	52	133,591	99	81,931
FEs and Controls	Yes	Yes	Yes	Yes
Observations	3,720	1,910	3,720	3,691
R^2	0.14	0.14	0.06	0.20

Notes: This table presents estimates of the relationship between cumulative 529 investment returns and other forms of household savings. Column 1 analyzes stock market participation as a binary indicator expressed in percentage terms. Column 2 examines the log value of stocks and mutual fund holdings among participants. Column 3 investigates bank account ownership as a binary indicator expressed in percentage terms. Column 4 analyzes log bank account balances among account holders. The sample includes individuals with college savings accounts observed during 2013-2023, covering up to seven years before their expected high school graduation. All specifications employ OLS estimation and include management company, state, year, and years-since-expected-graduation fixed effects, along with controls for individual and household characteristics, in-state college tuition rates, and state higher education funding per FTE student. Standard errors are clustered at the management company × cohort level. Mean Variable reports the sample average for participation rates (columns 1 and 3) and dollar values for balance variables (columns 2 and 4). The symbols *, **, and *** denote statistical significance at the 10%, 5%, and 1% levels, respectively.

Table 9. Relationship between College Savings and Four-Year College Characteristics

	Attend a 4-Year College$_i$	**Attend a 4-Year Private College**$_i$	**Attend a 4-Year Highly Selective College**$_i$
	(1)	(2)	(3)
$\mathbb{1}$.Coll.Savings 5,000-60,000	4.51***	2.12	4.66***
	(1.57)	(1.35)	(1.32)
$\mathbb{1}$.Coll.Savings > 60,000	3.93*	9.98***	13.84***
	(2.32)	(2.81)	(2.69)
Mean Attendance	70.93	22.63	29.95
FEs and Controls	Yes	Yes	Yes
Observations	4,735	4,735	4,735
R^2	0.20	0.09	0.25

Notes: This table presents estimates of the relationship between the amount of college savings and different types of four-year college attendance using data from the High School Longitudinal Study of 2009. The sample is restricted to students whose families have college savings. Dependent variables are binary indicators for four-year college attendance (column 1), four-year private non-profit college attendance (column 2), and four-year highly selective college attendance (column 3), expressed in percentage terms. The reference group consists of students whose families have less than $5,000 in college savings. The model includes indicators for savings levels ($5,000-$60,000 and above $60,000). All specifications include fixed effects for family income, parental college education, student ability, marital status, gender, US birth status, race/ethnicity, urban residence, and region, with controls for parental age and household size. Mean attendance reports the sample average of each dependent variable. Heteroskedasticity robust standard errors are reported in parentheses. The symbols *, **, and *** denote statistical significance at the 10%, 5%, and 1% levels, respectively.

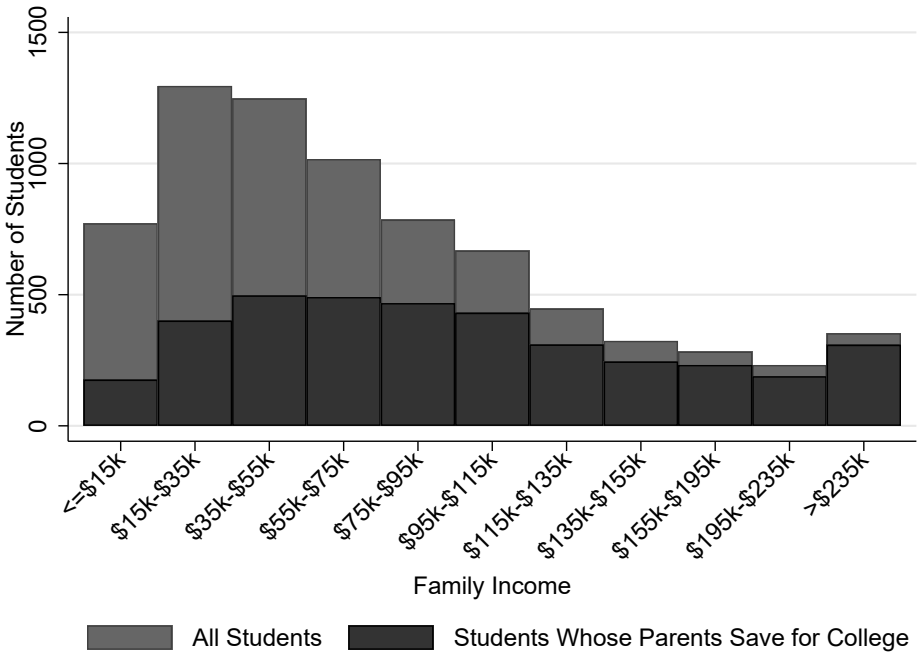
Online Appendix to "Wealth Accumulation in College Savings Accounts and Educational Opportunities"

Alexey Vasilenko

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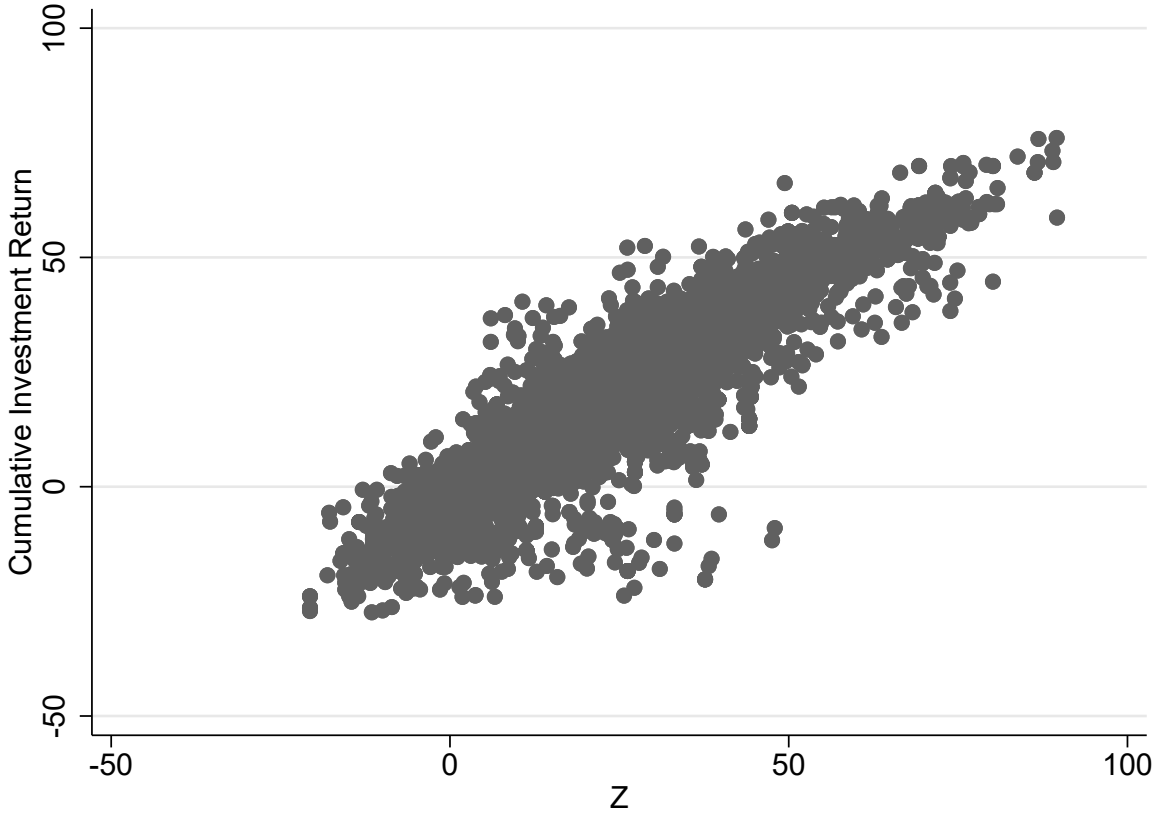
A Figures

Figure A.1. Family Income Distribution Among High-School Students by Parental Savings Behavior



Notes: This figure compares the family income distribution of all high-school students with those whose parents save for college. Data are from the High School Longitudinal Study of 2009 (HSLS:09). College savings are measured in spring 2012 (when most students were in the eleventh grade), and family income is measured in 2011.

Figure A.2. First-Stage Relationship



Notes: This scatter plot illustrates the relationship between the instrumental variable (Z) and cumulative investment returns. Each point represents an observation showing the cumulative investment return at a given level of the instrument.

B Tables

Table B.1. Examples of National Initiatives Supporting Postsecondary Education Savings by Country

Country	**Savings Initiative**
Australia	Education Bonds
Brazil	Pé-de-Meia
Canada	Registered Education Savings Plan
China	Education Savings Deposits
India	Sukanya Samriddhi Yojana*
Israel	Saving for Every Child Program*
Korea	Didim Seed Savings Accounts*
Malaysia	Skim Simpanan Pendidikan Nasional
Singapore	Post-Secondary Education Account
United Kingdom	Junior Individual Savings Account (Child Trust Fund before 2011)*
United States	529 College Savings Plans*
United States	529 Prepaid College Tuition Plans
United States	Coverdell Education Savings Accounts*
United States	Education Savings Bond Program

Notes: This table lists examples of national savings initiatives designed, at least in part, to help families save for postsecondary education. A star (*) indicates initiatives that can also be used for K-12 education or other expenses.

Table B.2. Assets and Total Accounts in 529 Plans by Plan Type

	529 College Savings	529 Prepaid Tuition
Assets under management, in million $	453,170.24 (94.34%)	27,190.04 (5.66%)
Total accounts	14,759,716 (94.18%)	911,606(5.82%)

Notes: This table presents net assets and total accounts for the two types of 529 plans in the fourth quarter of 2021: college savings plans and prepaid tuition plans. Figures in parentheses represent the percentage share of the combined total for both plan types. Data are from the College Savings Plans Network.

Table B.3. Summary Statistics for 529 College Savings Plan Investment Funds

	Mean	Median	SD	Min	Max	# Obs.
Net Assets ($ million)	43.99	6.13	106.34	0.00	707.15	824,035
Monthly Return (%)	0.48	0.44	3.18	-9.82	9.59	1,067,355
Allocation to Stocks (%)	51.61	54.96	37.63	0.00	99.97	913,194
Allocation to Bonds (%)	32.97	28.80	32.16	0.00	113.46	913,194
Allocation to Cash (%)	9.77	2.93	19.94	-24.07	100.00	913,194
Allocation to Other Assets (%)	5.77	0.57	18.06	-0.40	100.00	913,194
𝟙.Target-Date Funds	0.48	0.00	0.50	0.00	1.00	1,258,338
𝟙.Static Funds	0.52	1.00	0.50	0.00	1.00	1,258,338

Notes: This table presents summary statistics for share-class level data on 529 college savings plan investment funds from Morningstar. The sample covers 49 U.S. states and the District of Columbia over the period 2000–2023, encompassing 11,242 unique share classes. The unit of observation is share-class-month. Net assets are reported in millions of dollars. Monthly returns and asset allocations are expressed as percentages. Target-Date Funds include both age-based and target-enrollment funds that automatically adjust asset allocation over time. Static Funds maintain a fixed asset allocation. All continuous variables (net assets, monthly returns, and asset allocations) are winsorized at the 1st and 99th percentiles.

Table B.4. Summary Statistics: High School Longitudinal Study of 2009

	Mean	Median	Min	Max	# Obs.
College Savings					
𝟙.College Savings Accounts	0.49	0.00	0	1	6,730
𝟙.Coll.Savings 5,000-60,000	0.61	1.00	0	1	6,841
𝟙.Coll.Savings > 60,000	0.08	0.00	0	1	6,841
Student & Family Characteristics					
𝟙.Male	0.50	0.00	0	1	6,841
𝟙.Born in US	0.94	1.00	0	1	6,841
𝟙.White	0.64	1.00	0	1	6,841
𝟙.Asian	0.08	0.00	0	1	6,841
𝟙.African American	0.09	0.00	0	1	6,841
𝟙.Urban Location	0.79	1.00	0	1	6,841
Mathematics Quintile Score	3.61	4.00	1	5	6,726
𝟙.Parent's Marital Status	0.81	1.00	0	1	6,832
𝟙.Parent's College Education	0.52	1.00	0	1	6,797
Household Members	4.28	4.00	2	11	6,832
Parent's Age	46.35	46.00	30	67	6,825
College Attendance					
𝟙.Four-Year College	0.72	1.00	0	1	4,953
𝟙.Private Nonprofit Four-Year College	0.23	0.00	0	1	4,953
𝟙.Selective Four-Year College	0.31	0.00	0	1	4,953

Notes: This table presents summary statistics from the High School Longitudinal Study of 2009 (HSLS:2009) for students whose parents reported positive college savings amounts. Baseline data on student and family characteristics and savings were collected in 2009 when respondents were in the ninth grade, with college enrollment outcomes measured approximately three years after high school graduation.

Table B.5. State Variables and Glide Path Allocations in 529 Plans

	Equity Allocation, %	**Risky Asset Allocation, %**
	(1)	(2)
State Higher Education Funding per FTE Student$_{s,t}$	-0.00	0.00
	(0.00)	(0.00)
In-State Four-Year College Tuition$_{s,t}$	-0.00	0.00
	(0.00)	(0.00)
Bachelor's Degree Attainment (%)$_{s,t}$	0.42	1.38
	(0.65)	(0.84)
Log(Population)$_{s,t}$	0.95	-14.73
	(21.65)	(25.88)
Real GDP Growth (%)$_{s,t}$	-0.04	0.27
	(0.19)	(0.30)
Real Per Capita Personal Income$_{s,t}$	-0.00	-0.00*
	(0.00)	(0.00)
Unemployment Rate (%)$_{s,t}$	-0.36	-0.21
	(0.55)	(0.33)
State FE	Yes	Yes
Year FE	Yes	Yes
Years to Expected Graduation FE	Yes	Yes
Observations	13,692	13,692
R^2	0.79	0.31

Notes: This table presents results from panel regressions examining the relationship between state-level characteristics and glide path portfolio allocations in target-date funds offered through in-state 529 college savings plans during the period 2008–2023. The dependent variable in Column 1 is Equity Allocation, defined as the percentage of target-date fund assets invested in equities. Column 2 uses Risky Asset Allocation as the dependent variable, defined as the percentage of target-date fund assets invested in equities, bonds, and other risky assets. Independent variables include state appropriations for higher education per full-time equivalent (FTE) student, average in-state tuition and fees at four-year public institutions, the proportion of adults aged 25 and older with a bachelor's degree or higher, log population, real GDP growth rate, real per capita personal income, and the unemployment rate. Fund allocation data are obtained from Morningstar. State demographic and macroeconomic data are sourced from the Federal Reserve Bank of St. Louis FRED database. In-state tuition data are from the College Board's Trends in College Pricing 2024 report. State appropriations for higher education per FTE student are calculated from the State Higher Education Executive Officers Association (SHEEO) State Higher Education Finance (SHEF) report as total state and local support divided by net FTE enrollment. All dollar amounts are expressed in constant 2023 dollars using the Consumer Price Index for All Urban Consumers (CPI-U). All specifications include state, year, and years-to-expected-high-school-graduation fixed effects. Standard errors are clustered at the state level. The symbols *, **, and *** denote statistical significance at the 10%, 5%, and 1% levels, respectively.

Table B.6. First-Stage Regressions

	College-Aged Adults with CSA	Account Beneficiaries Expected to Be in School Grades 7-12
	(1)	(2)
$Z_{cohort,s,t}$	0.53***	0.61***
	(0.03)	(0.02)
FEs and Controls	Yes	Yes
Observations	1,348	2,613
R^2	0.88	0.88
F-statistic	53.4	183.6

Notes: This table presents first-stage IV regression estimates based on equation 5. The dependent variable is cumulative investment returns in target-date funds within in-state 529 plans over the past three years. The key variable, $Z_{cohort,s,t}$, is a shift-share instrument combining plausibly exogenous variation in target-date fund glide paths across asset management firms with differential performance of broad asset classes over time. Column 1 restricts the sample to individuals with college savings accounts observed during 2013-2023, covering the five-year period starting from their expected high school graduation year. Expected high school graduation year is determined using birth year and month relative to state-specific kindergarten admission cutoffs. Column 2 restricts the sample to account beneficiaries expected to be in school grades 7-12 during 2013-2023. Both cumulative returns and the instrument are winsorized at the 5th and 95th percentiles. Individual-level data are from SIPP, while investment returns and fund allocation data are from Morningstar. All specifications include state, year, and cohort fixed effects, along with controls for individual and household characteristics, in-state four-year college tuition rates, and state higher education funding per FTE student. Heteroskedasticity robust standard errors are reported in parentheses. The symbols *, **, and *** denote statistical significance at the 10%, 5%, and 1% levels, respectively.

Table B.7. Effects of 529 Plan Cumulative Investment Returns on College Attendance: Alternative Instrument Specification

	4-Year College Attendance$_{i,cohort,s,t}$		**Any College Attendance**$_{i,cohort,s,t}$		**2-Year College Attendance**$_{i,cohort,s,t}$	
	OLS	IV-2SLS	OLS	IV-2SLS	OLS	IV-2SLS
	(1)	(2)	(3)	(4)	(5)	(6)
Last Year Return$_{cohort,s}$	1.46**	3.62**	0.70	2.85**	-0.76	-0.77
	(0.72)	(1.74)	(0.60)	(1.40)	(0.61)	(1.39)
ATT	2.32	5.75	1.11	4.52	-1.21	-1.22
Mean Attendance	71.5	71.5	83.7	83.7	12.1	12.1
FEs and Controls	Yes	Yes	Yes	Yes	Yes	Yes
KP F-statistic		82		82		82
Observations	1,527	1,450	1,527	1,450	1,527	1,450
R^2	0.19		0.17		0.09	

Notes: This table presents estimates of the effect of cumulative investment returns in 529 plans during high school on college attendance. Columns 1, 3, and 5 report OLS estimates, whereas columns 2, 4, and 6 present IV-2SLS estimates. Dependent variables are binary indicators for four-year college attendance (columns 1-2), any college attendance encompassing both two-year and four-year institutions (columns 3-4), and two-year college attendance specifically (columns 5-6). The key explanatory variable, *Last Year Return*$_{cohort,s}$, represents investment returns in target-date funds within in-state 529 plans over the last high school year (grades 11-12). The sample comprises individuals with college savings accounts observed during 2013-2023, covering the five-year period starting from their expected high school graduation year. Expected high school graduation year is determined using birth year and month relative to state-specific kindergarten admission cutoffs. The IV strategy exploits a shift-share instrument that combines plausibly exogenous variation in target-date fund glide paths across asset management firms with differential performance of broad asset classes over time. Individual-level data are from SIPP, while investment returns and fund allocation data are from Morningstar. All specifications include state, year, and cohort fixed effects, along with controls for individual and household characteristics, in-state four-year college tuition rates, and state higher education funding per FTE student. Average Treatment Effect on the Treated (ATT) estimates scale coefficients by the aggregate share of 529 accounts invested in target-date funds within in-state plans, isolating effects for individuals directly exposed to return variation. Mean attendance reports the sample average of each dependent variable. The Kleibergen–Paap rk Wald F statistic (KP F-statistic) tests the null hypothesis of weak instruments in the IV specifications. Standard errors are clustered at the management company × cohort level. The symbols *, **, and *** denote statistical significance at the 10%, 5%, and 1% levels, respectively.

Table B.8. Effects of 529 Plan Cumulative Investment Returns on College Attendance: Alternative Clustering by State

	4-Year College Attendance$_{i,cohort,s,t}$		**Any College Attendance**$_{i,cohort,s,t}$		**2-Year College Attendance**$_{i,cohort,s,t}$	
	OLS	IV-2SLS	OLS	IV-2SLS	OLS	IV-2SLS
	(1)	(2)	(3)	(4)	(5)	(6)
Cumulative Return$_{cohort,s}$	1.39**	2.20**	0.81	2.00**	-0.58	-0.20
	(0.53)	(0.93)	(0.52)	(0.94)	(0.35)	(1.17)
ATT	2.20	3.50	1.28	3.18	-0.92	-0.32
Mean Attendance	71.5	71.5	83.7	83.7	12.1	12.1
FEs and Controls	Yes	Yes	Yes	Yes	Yes	Yes
KP F-statistic		30		30		30
Observations	1,380	1,298	1,380	1,298	1,380	1,298
R^2	0.21		0.19		0.08	

Notes: This table presents estimates of the effect of cumulative investment returns in 529 plans during high school on college attendance. Columns 1, 3, and 5 report OLS estimates, whereas columns 2, 4, and 6 present IV-2SLS estimates. Dependent variables are binary indicators for four-year college attendance (columns 1-2), any college attendance encompassing both two-year and four-year institutions (columns 3-4), and two-year college attendance specifically (columns 5-6). The key explanatory variable, *Cumulative Return*$_{cohort,s}$, represents cumulative investment returns in target-date funds within in-state 529 plans during high school. The sample comprises individuals with college savings accounts observed during 2013-2023, covering the five-year period starting from their expected high school graduation year. Expected high school graduation year is determined using birth year and month relative to state-specific kindergarten admission cutoffs. The IV strategy exploits a shift-share instrument that combines plausibly exogenous variation in target-date fund glide paths across asset management firms with differential performance of broad asset classes over time. Individual-level data are from SIPP, while investment returns and fund allocation data are from Morningstar. All specifications include state, year, and cohort fixed effects, along with controls for individual and household characteristics, in-state four-year college tuition rates, and state higher education funding per FTE student. Average Treatment Effect on the Treated (ATT) estimates scale coefficients by the aggregate share of 529 accounts invested in target-date funds within in-state plans, isolating effects for individuals directly exposed to return variation. Mean attendance reports the sample average of each dependent variable. The Kleibergen–Paap rk Wald F statistic (KP F-statistic) tests the null hypothesis of weak instruments in the IV specifications. Standard errors are clustered at the state level. The symbols *, **, and *** denote statistical significance at the 10%, 5%, and 1% levels, respectively.

C U.S. College Savings Accounts: Market Composition

Table B.2 reports total assets and accounts for both types of 529 plans: college savings and prepaid tuition. As of 2021, college savings plans held $453.2 billion in assets across 14.8 million accounts, while prepaid tuition plans held $27.2 billion across 0.9 million accounts. Consequently, college savings plans accounted for more than 94% of both total assets and accounts across the two plan types. The dominance of college savings plans stems from two primary factors. First, these plans offer greater flexibility than prepaid tuition plans. College savings account funds can be used for qualified education expenses at postsecondary institutions throughout the U.S. and at select foreign universities.[18] Qualified expenses encompass not only tuition and fees but also room and board, books, computers, and internet access. In contrast, prepaid tuition plans cover only tuition at a limited number of participating postsecondary institutions. Second, college savings plans are more widely available: as of Q4 2021, 49 states and the District of Columbia offered college savings plans, compared to only 14 states offering prepaid tuition plans.[19]

Recent data on total assets and accounts for Coverdell education savings accounts are unavailable. However, Crandall-Hollick (2021) estimates that tax benefits associated with the exclusion of earnings from Coverdell accounts totaled $0.3 billion for 2020-2024, approximately 24 times lower than the $7.3 billion in estimated tax benefits from 529 college savings plans over the same period. This disparity suggests that Coverdell accounts, like 529 prepaid tuition plans, represent a small fraction of the education savings account market, with 529 college savings plans constituting the predominant vehicle for education savings.

[18] Since 2018, 529 college savings accounts can also be used to cover up to $10,000 in tuition expenses at elementary or secondary schools.

[19] The following states had 529 prepaid tuition plans in 2021 Q4: Alabama, Florida, Illinois, Kentucky, Maryland, Massachusetts, Michigan, Mississippi, Nevada, Pennsylvania, South Carolina, Texas, Virginia, and Washington. Only Wyoming does not have a 529 college savings plan, as its program was terminated in 2006.