A Cost-Benefit Analysis of College and Career Pathways

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October 26, 2026

Abstract

We review the evidence on the effectiveness of college and career pathways programs and provide cost-benefit analyses of representative policies adapted to the Connecticut context. The existing research supports the idea that career and technical coursework, well-designed dual enrollment, comprehensive advising, and targeted training can improve student outcomes and prove cost effective for society at large. Our cost-benefit analyses reinforce this narrative: nearly all the policies we review either pay for themselves or generate earnings impacts on participants at several times the cost to the government, returns that are large relative to other public policies evaluated using a similar approach. We emphasize that these programs should complement, rather than replace, traditional college. Moreover, many of the most credible evaluations are small in scale and bundle several treatments. We urge policymakers to build the data infrastructure needed to rigorously evaluate these programs.

1 Overview

The last several decades have witnessed a stark increase in economic inequality, driven in part by technological change and associated with a growing gap in earnings between college and non-college workers [Goldin and Katz, 2008, Acemoglu and Autor, 2011]. As a result, policymakers have encouraged students to pursue a college education. Although the evidence still shows that college pays off [Zimmerman, 2014, Mountjoy, 2026], a traditional four-year degree is a costly investment that is neither feasible nor desirable for all students. Only 40.5 percent of Connecticut residents have a four-year degree.[1] Those who do not pursue the traditional four-year college pathway have long been underserved by a fragmented workforce development system that invests

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[1]Authors' calculations from the 2024 American Community Survey for Connecticut residents aged 25 to 54.

in its workers far less than many of its European counterparts do [Holzer, 2026]. Developing educational systems that build the skills of all residents — both those who do and do not go on to complete college — is necessary to meet the demands of a rapidly changing economy.

In response to these developments, policymakers have increasingly turned to a broader "pathways approach" to skill development. At times defined in contrast to a narrower "college-for-all" policy goal, the pathways paradigm encompasses a broad umbrella of policies that span K–12 curricular choices, postsecondary educational institutions, and workforce development initiatives. Our understanding of the pathways toolkit builds on the influential Pathways to Prosperity report [Symonds et al., 2011]. These policies can be characterized by:

1. *Strong coordination between K–12, postsecondary, and workforce systems*
2. *Well-articulated career steps targeted to sectors with high local demand*
3. *Combining classroom and on-the-job learning through formal training and apprenticeships*
4. *Emphasizing career and technical education*[2] *(CTE) and early college enrollment in high school*

In this report, we review what economists know about these approaches and provide cost-benefit analyses of policies that are representative of the pathways approach. Existing research supports the idea that pathways policies can improve labor market outcomes for students and provides many examples of existing policies that yield high returns on investment from the perspective of both individuals and society at large. These returns are large relative to other policies a state may consider investing in when evaluated using a similar approach [Hendren and Sprung-Keyser, 2020].

Our analysis yields six key principles for high-return pathways policies:

1. **Career pathways complement, rather than replace, traditional college.** While a four-year degree is not necessarily a feasible or desirable path for all students, studies repeatedly show high returns to four-year college attendance as well as earnings gains from the completion of community college credentials.
2. **Early college and dual enrollment increase participation in the higher education system, but diversion is a concern.** Policies that let students earn college credit in high school tend to raise college-going and likely speed credential attainment. However, gains tend to be concentrated in the two-year sector and associate degrees, raising concerns about diversion from four-year college.
3. **Comprehensive advising and supports consistently produce sizable impacts.** Intensive programs that combine financial assistance with comprehensive advising consistently im-

[2]CTE refers to what might otherwise be called vocational education, updated to emphasize career preparation for modern and technically demanding fields.

prove outcomes, including on earnings. Similarly, there is suggestive evidence that wraparound services are key to the success of sectoral training programs.

4. **High-quality CTE can improve education and labor-market outcomes.** Studies consistently show that high-quality and upper-level CTE can improve high school completion, college enrollment, and early-career earnings, especially for male students. High-quality evaluations from the United States, together with evidence from European reforms, show that CTE is most effective when it provides clear career preparation alongside academic coursework, preserving flexibility for further education.
5. **Employer-focused training can be cost effective and may correct market inefficiencies.** Subsidizing employer-based training generates modest earnings impacts but can be especially cost-effective. This is partially because it avoids long periods out of work, and also because it leverages employers' knowledge of their workforce needs, such as which workers are likely to benefit from training. Economists also believe that employers likely underinvest in training, a hypothesis with empirical support.
6. **Target in-demand sectors.** Studies of two-year credentials and sectoral training programs indicate that targeting high-demand industries, such as health care, IT, and advanced manufacturing, generates large earnings gains.

Our review also suggests three important points of caution for policymakers seeking to expand pathways programming:

1. **Pathway policies should avoid steering otherwise college-bound students away from the four-year sector.** If career pathways policies divert students who would be better-served by traditional four-year degrees away from those programs, this may save money up front but will likely reduce earnings by more in the long run. Matching pathways with students' needs is important.
2. **There is a risk of crowding out private investment in training.** There is a risk of public funds paying for training that would have been conducted anyway. Both rigorous evaluation and buy-in from relevant stakeholders are necessary to ensure benefits for the public as well as for firms.
3. **Many of the most credible evaluations of the pathways approach are small in scale, involve the screening of participants, or bundle several interventions.** To the extent that state policymakers seek to scale interventions along these lines, systematic evaluation and regular monitoring are crucial for ensuring that new programs are obtaining private and social returns similar to previously evaluated programs.

We summarize these takeaways and concerns in Table 1.

Table 1: Summary of the Literature

Policy Domain	Pathway Policies	Key Lessons	Key Risks	Focal References
Higher Education	Four year degrees; two-year credentials; advising and supports	• Four year degrees have high earnings impacts for marginal applicants • Two-year degree completion has earnings impacts, especially in health and technical fields • Comprehensive advising and supports boost completion	• Completion and transfer in the two-year sector • Diversion from the four-year sector	• Zimmerman [2014] • Hill et al. [2025]
High School	Early college; dual enrollment; career academies; CTE; high school majors; vocational tracking	• Career-focused CTE improves attainment and earnings • High-quality, upper-level courses matter • AP/dual enrollment speeds later degree attainment • Flexibility improves CTE	• Scalability of small and screened programs • Lack of flexibility in tracked vocational pathways • Gender differences and equity in effectiveness	• Speroni [2011] • Kemple and Willner [2008] • Brunner et al. [2023]
Workforce Development	Traditional, sectoral, and incumbent worker training; apprenticeships	• Sector-based and incumbent worker training works more than traditional, broad-based training • Effective programs combine job placement services with targeting of high demand sectors	• Scalability of small and screened programs • Crowding out of private investment in training	• Schochet et al. [2008] • Katz et al. [2022] • Millar [2025]

2 Costs and Benefits: The Marginal Value of Public Funds

Throughout the review, we apply the marginal value of public funds (MVPF) framework to case studies of several policies, adapting the procedures from Hendren and Sprung-Keyser [2020] to the Connecticut context. The MVPF compares the benefits of different government policies relative to the net cost to the government of implementing those policies, adjusting for any increases or losses in tax revenue due to changes in participants' earnings.

To build intuition, consider a training program that has an upfront cost but raises participants' future earnings. Because participants' earnings go up, and the government taxes earnings, tax revenues go up. Further, because participants are earning more, they may be less likely to participate in other public programs, for example by receiving means-tested benefits. These future increases in government revenue and reductions in government costs should be deducted from the upfront cost of the training program if we want to capture the true net cost of the program to

the public. We then want to compare that net cost to the (after-tax) benefits participants get from the program to evaluate the overall social return. This is what the MVPF does.

Formally, the MVPF can be written as:

$$\text{MVPF} = \frac{\text{Participant Post-Tax Benefits}}{\text{Net Cost to Government}}$$

One interprets the MVPF as the benefits to participants per dollar of *net* government spending, both in present value terms. We measure benefits to participants in terms of earnings impacts estimated in the studies we review. For example, an MVPF of 2 indicates that participants realize \$2 of benefits for each \$1 spent. In the case that the MVPF > 1, the policy is valued at more than cost. Otherwise, if MVPF < 1, it would be better to subsidize participants directly rather than spend money on the program. Finally, if government costs are completely offset by increases in future tax revenues, then the MVPF $= \infty$ and the policy "pays for itself." This will be the case with several of the education policies we consider.

We use the MVPF framework to conduct cost-benefit analyses for a variety of pathways and pathways-adjacent policy types. We considered several factors when choosing which policies to analyze. First, we only analyze policies for which there is a credible randomized or quasi-randomized evaluation conducted in the United States and for which cost data are available, preferring studies that evaluate impacts on participants' earnings.[3] Second, we choose policies that illustrate the breadth of policy types under that pathways header, and which are representative of broader themes that emerge from the detailed review in section 4 below. Third, we present results from Connecticut-specific evaluations wherever possible, although there are few evaluations of Connecticut policies that fit the previous two criteria.

The technical details are important here. When evaluating net costs, we take the perspective of the state government, and offset gross costs using revenues from state income taxes only, not federal income taxes. We assume a 4.5 percent state tax rate on earnings gains. This is the marginal tax rate for individuals earning between \$10,000 and \$50,000 in Connecticut [Pinho, 2024]. Higher tax rates will improve our estimates of programs' cost effectiveness. When evaluating benefits for participants, we consider both state and federal taxes, because individuals in Connecticut must of course pay both. We assume a 19.9 percent combined marginal rate, following Hendren and Sprung-Keyser [2020]'s argument that individuals within a relatively wide income range face roughly this rate after accounting for both tax and transfer policy.[4] In all cases, we project

[3] In our analysis of Speroni [2011], which studies dual enrollment, we only have impact estimates on college degree attainment. In this case, we infer the program's impacts on earnings using estimates from Zimmerman [2014].

[4] This tax rate adjusts for differences between Connecticut and the typical state's tax rate, as reflected in the tax and transfer

program impacts on earnings over the life cycle from the age at which costs are realized through age 65 using age-earnings profiles for Connecticut adults based on the 2021 to 2024 American Community Survey waves. We use the last year of measured impacts in each study as the starting point of the age projection. Following Hendren and Sprung-Keyser [2020], we assume a 0.5 percent real earnings growth in future ages and discount back to the time of initial enrollment and cost realization using a 3 percent discount rate. The qualitative conclusions from our analysis are unchanged by different assumptions on the tax and discount rates within reasonable ranges.

3 Cost-benefit case studies

Table 2 summarizes the results of our cost-benefit analyses. The policies we consider span much of the pathways policy space and include academic classroom and on-the-job learning, as well as advising and job placement supports.

Higher education. Zimmerman [2014] studies the effects of admission to the public university system in Florida. Results from that study show that each additional admission results in $4,475 of additional upfront costs for the government. This reflects additional public expenditure on four-year attendance, net of reduced public spending on two-year college attendance and private payments. Individuals who gain access to college have higher earnings throughout their careers, resulting in $167,832 in additional post-tax and post-tuition earnings for individuals and $9,703 in additional tax payments to the state government. Subtracting the additional tax payments from the upfront cost yields a post-tax net cost of -$5,228. A negative cost means that sending more people to college in fact *increases* government revenue. The MVPF is therefore infinite, because the cost of this policy is less than zero. This example is representative of a broader theme in the literature, which is that traditional public higher education pathways offer high average returns.

Advising and Comprehensive Supports. Hill et al. [2025] study Ohio-ASAP, an intensive intervention for community college students that combines financial assistance, college and career counseling, and full-time enrollment requirements. The cost of this program is about $10,519 per participant. This intervention led to earnings gains, generating $66,183 additional earnings over the course of one's career. This raises an additional $3,718 in tax revenue, resulting in $6,801 in costs net of additional taxes. The MVPF is 9.7 – indicating that each dollar in net spending generates $9.7 in tax-adjusted benefits to participants. This study indicates that advising and wraparound services are likely to generate benefits on top of simply providing access to additional educational opportunities.

Dual Enrollment. Speroni [2011] studies dual enrollment in Florida, both for any course as

rate used in Hendren and Sprung-Keyser [2020].

well as college algebra. In this case, we only observe impacts on degree attainment and need to infer earnings impacts.[5] The study indicates that basic dual enrollment actually reduces overall attainment by about 1 year of schooling, which we associate with a $61,977 reduction in after-tax earnings over the course of one's career.[6] In contrast, college algebra shows strong impacts, corresponding to an additional 0.958 years of schooling and $59,374 additional after-tax earnings. The upfront cost of dual enrollment is about $1,184, based on estimates from Miller et al. [2018]. However, changes in years of college education also increase or decrease these costs. After adjusting for changes in tax revenue, we estimate net cost reductions of $7,780 for basic dual enrollment and increases of $9,704 for college algebra dual enrollment. In the case of basic dual enrollment, the MVPF is not defined. For college algebra, we estimate a cost-effective MVPF of 6.1. Held in conjunction with the detailed review below, the mixed results from this study illustrate that dual enrollment can lead to increases in student achievement, but that implementation details are likely to matter.

Career-focused high school programming. Kemple and Willner [2008] study career academies, which embed career-focused education within a traditional high school. Upfront expenditures of career academy programming are about $8,026 per student. Career academy participation leads to long-run earnings gains, which over the career accumulate to about $115,431 after taxes, and generate $6,485 in state tax revenue. Subtracting tax revenue from upfront costs yields a net cost of $1,541. The benefit-cost ratio, or MVPF, is then 74.9. The program generates $74.9 in benefits per dollar of costs. A similar calculation based on Brunner et al. [2023]'s analysis of Connecticut technical high schools yields an MVPF of 28.5—$28.5 in benefits per dollar of costs. These examples illustrate the point that career-focused education at the high school level often yields high economic returns.

Sectoral training. Katz et al. [2022] evaluates the sector-specific training program WorkAdvance. As is common with sector-specific programs, WorkAdvance prepares participants for high-demand jobs through sector-specific selection, training, placement, and advancement services. Program services cost about $7,844 per participant, and generate about $43,819 in post-tax gains as well as about $2,462 in state tax revenue. On net, the program generates $8.1 in benefits per dollar of net expenditure. This evaluation is illustrative of a broader literature showing that training targeted at high-demand sectors often yields high economic returns.

Customized job training. Millar [2025] studies a Tennessee program that provides grants

[5] We also scale costs and impact estimates from this study in 9 credit hour equivalents.

[6] Speroni [2011] notes that the basic dual enrollment impact on attainment is sensitive to choice of bandwidth and included controls, making it "difficult to draw conclusions" although they "if anything, point to a relative decline in the probability of obtaining a degree." (p. 38). See Table 4 in Speroni [2011].

to firms so they can provide customized training for their employees. This program produces relatively modest gains for workers compared to some of the other programs we consider, at about $27,716 over the course of the career. However, it is also inexpensive, with an upfront cost of only about $1,124. These costs are more than fully defrayed by additional tax revenues. The result is a program that generates public revenue. This case study illustrates the value of leveraging firm expertise to determine what training is needed and for whom.

General vocational training. Schochet et al. [2008] study Job Corps, a residential program that provides academic and vocational training for disadvantaged young people. The program is very expensive, with a per-person upfront cost of $34,640. Earnings effects are very small, with an estimated lifetime after-tax value of $851. As a result of the small earnings impacts, there is only $48 raised in additional tax revenue. This results in tax-adjusted net costs of around $34,592, resulting in a low MVPF of $\frac{851}{34{,}640-48} = 0.025$. In other words, for each $1 in net spending by the government, participants only realize $0.025 in benefits. This example illustrates the risks of programs that are (a) expensive and (b) lack a clear sectoral focus.

Comparison to Other Policies. The cost-effectiveness of pathways policies, shown in Table 2, stands out further when compared with other policies a policymaker might consider. Reviewing 133 U.S. policies, Hendren and Sprung-Keyser [2020] find that investments in children's health and education often pay for themselves, while most policies targeting adults have MVPFs between 0.5 and 2. For example, they estimate MVPFs of 0.40 to 1.63 for adult health insurance expansions, 0.43 to 1.03 for unemployment insurance, and 1.12 to 1.20 for earned income tax credits. Unlike this review, which focuses on the tradeoffs facing Connecticut, Hendren and Sprung-Keyser [2020] take a national perspective, counting both federal and state tax revenue. The comparison therefore understates the cost-effectiveness of the policies we consider, as counting federal revenue as well would recoup even more of their upfront cost from participants' earnings gains.

4 Detailed Review by Policy Domain

4.1 Higher Education

Four-Year College As the workforce pathways policy bundle is primarily aimed at students outside the four-year college pathway, a natural starting point is to frame the evidence relative to this educational route. The highest-quality evidence in this area comes from cutoffs in admissions policies, which consistently show large earnings gains for applicants who were just barely admitted to a college relative to those who were just barely rejected. Hoekstra [2009] finds earnings gains of 20 percent for white men admitted to a flagship public university. Aggregating evidence

Table 2: Summary of Cost and Benefit Analyses

Policy	Reference	Pre-Tax Cost	Post-Tax Benefits	Post-Tax Net Cost	MVPF
Higher Education					
FIU Admission	Zimmerman [2014]	$4,475	$167,832	-$5,228	∞
Comprehensive Supports	Hill et al. [2025]	$10,519	$66,183	$6,801	9.73
High School					
Dual Enrollment: Basic	Speroni [2011]	-$11,262	-$61,977	-$7,780	Not defined
Dual Enrollment: Algebra	Speroni [2011]	$13,040	$59,374	$9,704	6.12
Career Academies	Kemple and Willner [2008]	$8,026	$115,431	$1,541	74.92
CTE High School	Brunner et al. [2023]	$19,180	$210,254	$7,368	28.54
Workforce					
Job Corps Training	Schochet et al. [2008]	$34,640	$851	$34,592	0.025
Sectoral Training (WorkAdvance)	Katz et al. [2022]	$7,844	$43,819	$5,382	8.14
Customized Job Training	Millar [2025]	$1,124	$27,716	-$433	∞

Notes: All dollar values are deflated to constant 2026 dollars and converted to present values at the time costs are first realized using a 3% discount rate. "Policy domain" is the broad policy type. "Policy" is the specific example for which we conduct a cost-benefit analysis. "Pre-tax cost" is the gross cost of the policy to government, prior to considering tax revenues. "Post-tax benefits" are the gains in dollar terms to policy beneficiaries, net of tax payments and any private costs. "Change in tax revenue" is the additional state taxes paid to the government by policy beneficiaries. "Post-tax net cost" is pre-tax cost net of the change in tax revenue. The MVPF is the marginal value of public funds, equal to the ratio of post-tax benefits to post-tax net costs.

across the Texas higher education system, Mountjoy [2026] finds returns of 8 percent.

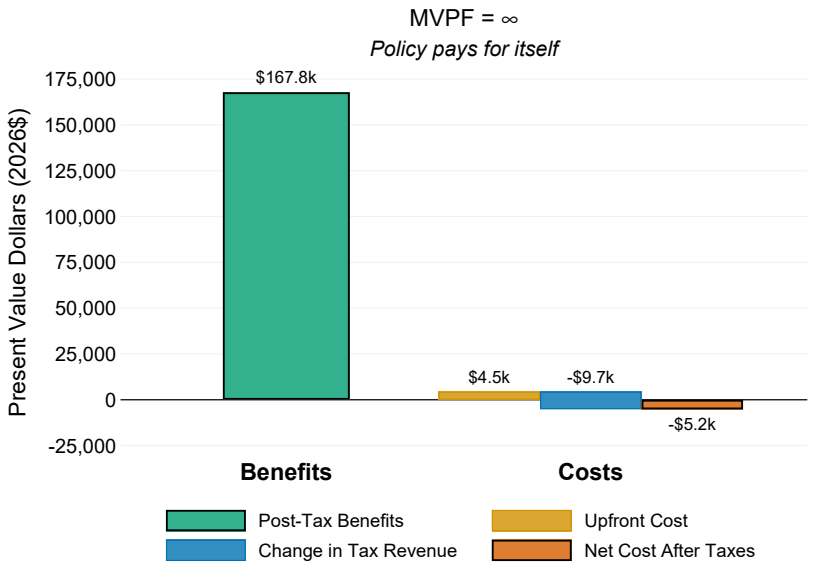
Zimmerman [2014] focuses on a population highly relevant to the pathways approach — students who likely would not have attended a four-year college in the absence of admission to a public university. He studies admissions to Florida International University and finds increases in earnings of 22 percent. Figure 1 shows the cost-benefit analysis of expanding access to college for this set of students. We expect students to realize about an additional $167,832 in post-tax and post-tuition earnings over their life cycle, discounted to the present day. The upfront cost of $4,475 accounts for offsets from student tuition payments as well as subtracting the expenditures saved by a student not attending a community college. Due to the increase in earnings, we expect students to pay about an additional $9,703 in taxes,[7] more than offsetting the upfront costs to the government of expanding college access.

These studies focus on a population that has chosen to apply to college and is likely both motivated and at least somewhat prepared to attend college. Other studies that look at different policy changes and student populations show weaker earnings impacts [Black et al., 2023b], indicating that these returns may not generalize to a broader population of less-prepared students who are not on the margin of enrollment.[8] In this vein, Heckman et al. [2018] develop an empirical framework to assess the earnings impacts of high school and college across all levels of student preparation and ability. While they find that everyone should graduate high school, they find that college is not for everyone. However, consistent with the high earnings gains around the

[7] This increase accounts for lost tax payments while students are enrolled in college.

[8] Black et al. [2023b] study Texas' "Top Ten" policy, which guaranteed admission to students in the top 10 percent of their high school class, focusing on students who would not have been admitted to college otherwise (and thus have weaker traditional admissions characteristics). While they can reject negative earnings impacts, they find only a small initial earnings gain of 4 percent that falls to zero by 13 years after high school graduation.

Figure 1: Public College Admission in Florida: Zimmerman [2014]



Notes: All dollar values are deflated to constant 2026 dollars. Calculations assume a 3 percent discount rate and a 4.5 percent tax rate. See section 2 for more details.

admissions cutoffs described above, they find returns for students on the margin of enrollment. This naturally raises the question of what policies we can adopt for students who would not be sensitive to changes in four-year college access.

Returns to Sub-Baccalaureate Credentials A well-developed literature uses administrative unemployment insurance records across multiple states to measure the earnings impacts of different kinds of two-year credentials, consistently finding higher earnings gains in health and technical fields. For example, Jepsen et al. [2014] study degree receipt in Kentucky community colleges while Stevens et al. [2019] study CTE awards in California community colleges, both finding large returns to associate degrees, around 25 to 55 percent, that are largely concentrated in health. Other studies have found similar results for unemployed and displaced workers in Washington [Jacobson et al., 2005] and Ohio [Leung and Pei, 2025]. Using admissions lotteries, Grosz [2020] provides corroborating evidence by showing earnings impacts of 44 percent for associate degrees in nursing in California.

A limitation of some of the previous studies is a focus on degree receipt, which does not account for the many enrollees who do not complete programs. This is especially concerning as only 31.1 percent of students enrolling in a Connecticut community college will receive any credential within 6 years of enrollment, below the already disappointing national average of 43.4

percent [Lee and Shapiro, 2023].[9] Bound et al. [2010] show that this completion issue has worsened over time and is mostly explained by declines in higher education resources rather than student preparation.[10] In practice, this resource-scarcity may result in difficulty enrolling in high-demand courses needed to graduate [Robles et al., 2021]. Capacity constraints may explain an imperfect responsiveness of community colleges to changes in local labor demand [Grosz, 2022]. Complementing this evidence, Schulze [2025] develops an empirical framework to study adult workers enrolling in Texas community colleges in response to labor market shocks. He finds that the benefits of training can be highly sector-specific: workers who successfully transition into relevant sectors such as health care can experience large earnings gains, but those who fail to find jobs in sectors where their training is valued may experience earnings losses, potentially mediated by completion. Taken together, this literature highlights that high returns to completed degrees do not necessarily translate into high returns from expanded enrollment.

Mountjoy [2022] develops an empirical framework to study community colleges' role in diverting students from the four-year sector and the consequences for student earnings. While many students are diverted from the higher-resourced four-year sector and consequently suffer earnings losses, many more students would not have attended college without the two-year colleges and see positive earnings outcomes. As a result, he finds that community colleges in Texas generate positive earnings gains on average.

Transfer and Articulation Research has consistently found that students who start at a community college are much less likely to complete a degree than similar students who start at a four-year institution, even after conditioning on rich controls [Long and Kurlaender, 2009, Sotherland and Stange, 2026]. Given the clear importance of completion in determining student outcomes, a natural question is what policymakers could do to improve it. A likely mechanism behind this gap is credit loss upon transfer. A report by the Government Accountability Office [U.S. Government Accountability Office, 2017] found that students who transferred between 2004 and 2009 lost an estimated 43 percent of their credits, with 37 percent lost between public institutions. Student progress is further disrupted by constraints within the community college itself, including limited course availability [Robles et al., 2021].

Some states have responded with articulation policies intended to guarantee credit transfer. While evidence on their effectiveness is limited, it is generally positive. Zhu [2022] uses adminis-

[9] This number focuses on the 2017 enrollment cohort and includes transfers. Excluding transfers, only 24.0 percent complete a credential at their initial two-year institution within 6 years, compared to 57.9 percent across all higher education sectors in Connecticut. These numbers are reported in Table 21 in the online appendix to Lee and Shapiro [2023].

[10] Denning et al. [2022] shows that completion has increased more recently than shown in Bound et al. [2010], but that this is mostly explained by grade inflation rather than correcting the fundamental funding issues.

trative data from Georgia to show that institutional consolidation can improve the BA attainment of two-year college students, largely driven by decreased credit loss at transfer. Similarly, Baker et al. [2023] study the California Student Transfer Achievement Reform Act, which eased transitions between community colleges and public four-year universities. Leveraging the differential rollout of the policy across institutions, they find an increase in the rate of transfer following the policy.

Evidence on earnings is thin, and suggests that *which* students transfer matters as much as how many. Miller [2026] studies students near transfer GPA cutoffs in Texas, finding increased BA completion but *negative* earnings impacts for marginal transfer applicants, persisting six to ten years after transfer. This negative result likely reflects that students at the policy margin of being allowed to transfer, those with low community college GPAs, are poorly prepared for coursework in the four-year colleges into which they are seeking to transfer. This indicates that effective policy should not lower standards in order to increase transfer rates. Instead, focus should be on improving the transfer process for those who do switch institutions.

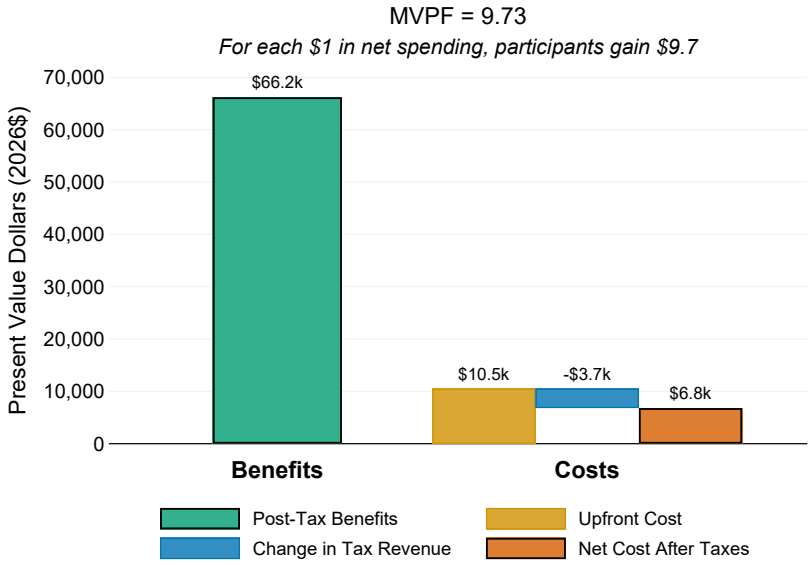
Information, Advising, and Comprehensive Interventions Students face a complex set of high school and college course-taking opportunities. The guidance one receives in navigating these routes appears to matter. Mulhern [2023] studies quasi-random assignment of students to counselors in Massachusetts, finding that high school counselors matter for student completion and educational attainment. However, counselors also differ markedly in their effectiveness. In particular, Mulhern [2023] finds that a 1 standard deviation increase in counselor effectiveness raises both high school graduation and college attendance by 2 percentage points, comparable to the importance of having a high-quality teacher. Importantly, gains are also strongest for lower-income and lower-achieving students.

The most promising programs are intensive interventions that combine financial assistance with college and career counseling and full-time enrollment requirements. Experimental evaluations of one such model targeting community college students, the City University of New York's Accelerated Study in Associate Programs (CUNY ASAP), have been shown to have large impacts on completion. Six years after the intervention, degree attainment improved by 10.4pp relative to a control mean of 40.4 percent, likely driven by both new graduates and improved time-to-degree, but with little impact on 4-year degree attainment [Weiss et al., 2019].

Importantly, this intervention has generalized to other contexts as well as earnings outcomes, highlighting the potential reproducibility of this model. Hill et al. [2025] report attainment and earnings impacts from an experimental evaluation of the model in Ohio community colleges

(Ohio ASAP). Eight years after the intervention, the Ohio ASAP intervention improved degree attainment by 15pp, similar to the CUNY ASAP intervention. However, Ohio ASAP also increased BA attainment by 6.2pp and increased annual earnings by $3,337, a 14 percent increase relative to a control baseline of $24,596. As treated participants in this intervention were no more likely to work overall, this increase in earnings likely reflects an increase in wage rates and hours worked that we would typically associate with increased skills and qualifications. We analyze the cost effectiveness of this program in Figure 2. Extrapolating indicates that the participants gain $66,183 in post-tax earnings. The upfront costs of the program are $10,519, but are offset by increased taxes from higher earnings of around $3,718, resulting in net costs to the government of $6,801. The program is cost effective with gains valued at $9.7 for every $1 of spending.

Figure 2: Comprehensive Supports (Ohio ASAP): Hill et al. [2025]



Notes: All dollar values are deflated to constant 2026 dollars. Calculations assume a 3 percent discount rate and a 4.5 percent tax rate. See section 2 for more details.

A similar program in Chicago implemented by a nonprofit, One Million Degrees (OMD), offered similar wraparound services to both high school and already-enrolled community college students [Hallberg et al., 2026]. OMD raised attainment and labor market outcomes, with high school participants earning $2,773 more (10.7 percent). However, the impacts from OMD are smaller and not statistically significant for community college enrollees, which the authors take as suggesting that intervening at the point of initial college entry is key for program effectiveness. As a further cautionary note, attempts to reproduce the same impacts of these intensive investments at lower costs have been shown to have no impact [Saunier et al., 2025], indicating that the

effectiveness of this program is directly related to its intensiveness (and perhaps high cost).[11]

4.2 High School Curriculum and School-to-Career Transitions

Early College, AP Credit, and Dual Enrollment One approach to increase college access is to encourage students to earn college credit in high school, which both directly lowers the cost of future college attendance and increases the salience of higher education. Policies that encourage early college are pervasive, with 34 percent of students in 2009 earning some college credit[12] by high school graduation [NCES, 2019]. Early evaluations using U.S. survey-based evidence to study such high school programs (sometimes incorporating CTE and early work experiences) saw increases in post-high school employment with little diversion from four-year college [Neumark and Rothstein, 2006]. In contrast, early enrollment at community colleges seemed to increase subsequent two-year enrollment but diverted at the expense of four-year college [Cellini, 2006], underscoring the risk for diversion and potential nuance in policy implementation.[13]

Providing increased access to Advanced Placement (AP) courses is one way to allow students to earn college credit in high school. The best evidence suggests AP credits speed up completion by reducing time in college for students who would graduate anyway, rather than shifting new students into college. Smith et al. [2017] use raw exam scores from the College Board to compare students who just barely achieved a higher final rounded score to those who just barely received a lower score, based on specific question responses. They find that higher AP scores that result in college credit are associated with a 1-2pp increase in completion of BAs within 4 years, but that effects fade by 6 years, indicating AP credits mostly work by speeding up completion. Application of the same exam score cutoff design finds impacts of receiving AP credit on enrolling in the college major in the field in which the exam occurred [Avery et al., 2018].[14] Jackson [2010] studies the staggered adoption of Texas' AP incentive program across high schools, which incentivizes AP test taking through payments to teachers and students, finding increases in AP course and exam taking. In addition, Jackson [2014] finds increases in earnings of 2.7 percent despite little impact on degree attainment. However, Celebi [2026] studies the subsequent expansion of that program and finds few impacts when scaled out of the early adopting schools where demand for AP was already high, including on AP exam taking altogether. Similarly, other papers have

[11] As noted in Saunier et al. [2025], the implementation was complicated due to the COVID-19 pandemic, with much advising taking place virtually and many institutions not enforcing the ASAP model's full-time enrollment requirement.
[12] This number excludes Advanced Placement (AP) courses [NCES, 2019].
[13] These studies are based on the National Longitudinal Survey of Youth 1997. These papers refer to "Cooperative education" as a mix of academic and CTE/vocational instruction and "Tech-Prep" as programs meant to ease the transition between high school and community college.
[14] As these impacts partially persist at colleges that do not honor the AP credit, the authors attribute this major choice effect to both a mechanical credit channel and a behavioral channel from students updating their beliefs about their own ability in response to higher scores, where the second channel is consistent with an importance for advising, discussed more below.

studied the effect of access to AP courses on education outcomes [Owen, 2025], including using experimental variation [Conger et al., 2023], finding either no or weak effects on college-going. A likely explanation for these disparate findings is whether students given AP access are likely to pass the exam in order to earn college credit.

An alternate approach is to encourage students to earn college credit in high school through dual enrollment policies, enabling students to take courses at a nearby college, often a community college. In general, the literature consistently finds positive impacts on college-going and attainment overall, but with some mixed evidence on whether it shifts students towards or away from four-year colleges. Britton et al. [2019] exploit an exam-based eligibility cutoff in New York City's College Now program, one of the largest dual enrollment programs in the country. Comparing students who just barely qualify for dual enrollment, the authors find college enrollment rising 7pp and four-year enrollment 8.6pp at eligibility. Hemelt et al. [2020] examine the experimental rollout of an advanced algebra dual credit policy in Tennessee, finding shifts towards four-year enrollment (2.6pp) that are strongest for middle-achievement students, but no impact on college-going overall. Corroborating this evidence, Liu et al. [2024] use a GPA-based eligibility cutoff to show that students just-eligible for dual credit shift their applications towards more selective four-year colleges. On the other hand, several studies find more mixed results on the diversion margin of dual enrollment and credit opportunities. Ross and Hemelt [2024] study the effect of receiving CTE dual credit in Tennessee, finding that students who just barely pass a course exit exam (and thus receive college credit) increase enrollment at 2-year colleges but that these students are drawn away from 4-year colleges (especially privates) with little impact on overall college enrollment.

An example of the mixed results associated with dual enrollment comes from Speroni [2011], which studies dual enrollment in Florida using eligibility cutoffs to provide highly credible evidence. First, Speroni [2011] finds that eligibility for any dual enrollment course, based on high school GPA cutoffs, has negative impacts on BA attainment, consistent with diversion.[15] Second, she finds that eligibility for college algebra, based on a placement exam score cutoff, has strong impacts on college enrollment and BA attainment. Figure 3 shows the costs and benefits of the policies at these two margins, inferring the earnings impacts from implied impacts on years of schooling from these attainment effects.[16] First, as eligibility for any course ends up reducing

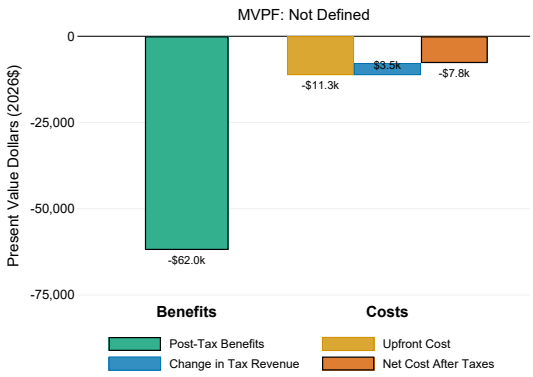
[15] Speroni [2011] estimates a negative effect on first enrollment that is not significant, indicating that she cannot rule out zero effect, making precise conclusions regarding mechanisms inconclusive.

[16] We compute that any dual enrollment results in a reduction of about 1 year of schooling and algebra dual enrollment results in about 0.958 additional years of schooling, after scaling estimates to the impact of 9 credit hours (the policy studied in Speroni [2011] consisted of an average of 12.2 credits attempted). Following Hendren and Sprung-Keyser [2020], we use the estimates from Zimmerman [2014] to extrapolate the impacts of a year of a college education on earnings using a 6.6 percent decline per year of schooling in earnings for ages 19 to 25 and an 11.3 percent increase in earnings for ages 26 to 33 per year of schooling, using our standard extrapolation procedure for ages 34 onwards. Since

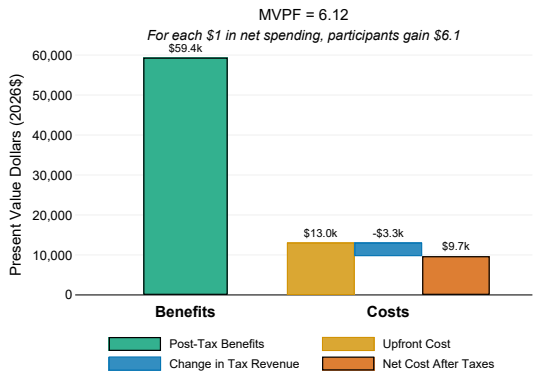
overall attainment, we find after-tax earnings declines of $61,977. The upfront cost includes both the direct cost of 9 hours of dual enrollment, estimated at $1,184 using cost estimates from Miller et al. [2018], as well as net costs from changes in years of schooling at a four-year college.[17] As four-year college is costly, the diversion effects end up reducing social costs, resulting in savings of $11,262 to the state from reduced attainment. However, the earnings declines end up *increasing* costs due to lost tax revenue, resulting in a post-tax net savings of $7,780 at the cost of participant earnings. As this both saves the state money on net and reduces earnings, the MVPF is not well defined. For the algebra dual enrollment margin, likely targeted at more academically prepared students, we find lifetime earnings impacts of $59,374 and after-tax net costs of $9,704, resulting in an MVPF of 6.1. Overall, the differential results from these two programs, taking place within the same study and the same state, underscore that the implementation details and the preparation of exposed students likely matter for effective dual enrollment policy.

Figure 3: Dual Enrollment: Any Course and College Algebra Speroni [2011]

(a) Any Course



(b) College Algebra



Notes: Earnings impacts are imputed from impacts on attainment. All dollar values are deflated to constant 2026 dollars. Calculations assume a 3 percent discount rate and a 4.5 percent tax rate. See section 2 for more details.

While there is no high-quality quasi-experimental paper we could find assessing earnings directly, several papers use observational methods to adjust for selection into dual enrollment based on rich controls, such as high school test scores. However, these estimates should be interpreted cautiously. As students who expect the largest gains from dual enrollment are those most likely to take it up, we should not expect observational comparisons to entirely eliminate selection issues.[18] Edmunds et al. [2024] uses these methods to find that CTE-focused dual enrollment in

we do not have control group earnings for the Speroni [2011] study, we use the average earnings of individuals without a BA as our comparison group anchor at age 32.

[17] As Speroni [2011] takes place in Florida and most attainment impacts are on the BA margin, we use the net expenditure at Florida colleges reported in Zimmerman [2014].

[18] For example, we would expect college-bound students to be very likely to take up dual enrollment opportunities, and

North Carolina raises overall postsecondary enrollment by 3.8pp but at the cost of diverting students away from four-year colleges (-3.6pp). Henneberger et al. [2022] examines dual enrollment in Maryland using administratively linked data, finding large impacts on college enrollment, BA completion (+9pp), and earnings up to 6 years after high school ($1,787 or 7.2%).[19] A more recent evaluation by Dhaliwal et al. [2026], using Texas administrative data, finds that those participating in dual enrollment see earnings declines in the years after high school graduation, likely driven by increased college enrollment, but see positive earnings impacts of 17 percent by year 10.

A closely related policy to dual enrollment is the early college high school (ECHS) model: small, specialized schools in which students pursue a compressed, traditional high school curriculum alongside college coursework, sometimes embedded in a college campus. As these schools are often oversubscribed, they usually admit students by lottery, enabling experimental evaluations among applicants. Two independent sets of lottery studies find similar impacts on enrollment and attainment. In North Carolina, Edmunds et al. [2017, 2020] find college enrollment gains and large impacts on associate degree attainment (+21.8pp). Impacts on BA attainment mostly operate by speeding completion, as early gains of +3.9pp at four years fade to +0.9pp at six years as the control group catches up. In a sample spanning several states, Berger et al. [2014] similarly find enrollment gains that translate into degree attainment (+8.5pp at ten years), driven almost entirely by early attainment of associate degrees [Song et al., 2024a]. Strong BA impacts at year 4 (+9.0pp) fade to small and insignificant by year 10 (+1.9pp). Song et al. [2024b] follow the same lottery sample with a survey twelve to fourteen years after high school and find earnings and employment impacts too imprecise to distinguish from zero. Overall, the ECHS studies show consistent impacts on enrollment and associate attainment, a speeding up of BA completion that fades over time, similar to findings in the AP literature (e.g., Smith et al., 2017), and little evidence of diversion from four-year enrollment.

Similarly high-quality evidence in this area comes from the evaluation of P-TECH 9-14 schools [Rosen et al., 2023], leveraging random assignment from admissions lotteries created by New York City's school matching process, mirroring an experimental evaluation. These schools collaborate with local colleges so that students can enroll in cost-free industry-recognized associate degree programs while also partnering with local employers to provide internships and other work-based learning opportunities. The study finds large increases in degree attainment three years into college (5.3pp on a base of 8 percent).

these types of students may have higher earnings in the absence of dual enrollment opportunities.

[19] This earnings effect is partially driven by increased participation and non-missing observations in the Maryland wage records.

A challenge with evaluating pathways programs is that there is little evidence of how programs may scale statewide. One exception is the work studying the effects of the California Career Pathways Trust grants [Bonilla, 2020, Bonilla and Thim, 2023], a statewide program that awards grants meant to expand career pathways in secondary schools. The authors exploit cutoffs in award formulas to find that secondary schools receiving the grants respond by sharply increasing spending on CTE, with per-pupil CTE expenditures increasing by 22 percent. This results in declines in high school dropout rates and increases in post-secondary enrollment in healthcare fields. Effects from this policy are stronger for females, potentially driven by the investment in healthcare pathways, which stands in contrast to the other evidence on CTE discussed below.

In general, the literature shows that early college and dual enrollment policies increase participation in the higher education system. Most studies find impacts on associate degree attainment, while gains in BA attainment largely reflect faster completion that eventually fades out. Diversion toward the two-year sector and away from the four-year sector remains a concern, though it may be a feature of program design and characteristics of participants. Across all studies, the largest and most durable impacts come from intensive, bundled models, early colleges, and P-TECH, in contrast to standalone credit and enrollment opportunities which show more mixed results. While observational studies tend to find impacts on earnings, we could find no study that links early college to administrative earnings using a high-quality, quasi-experimental research design.

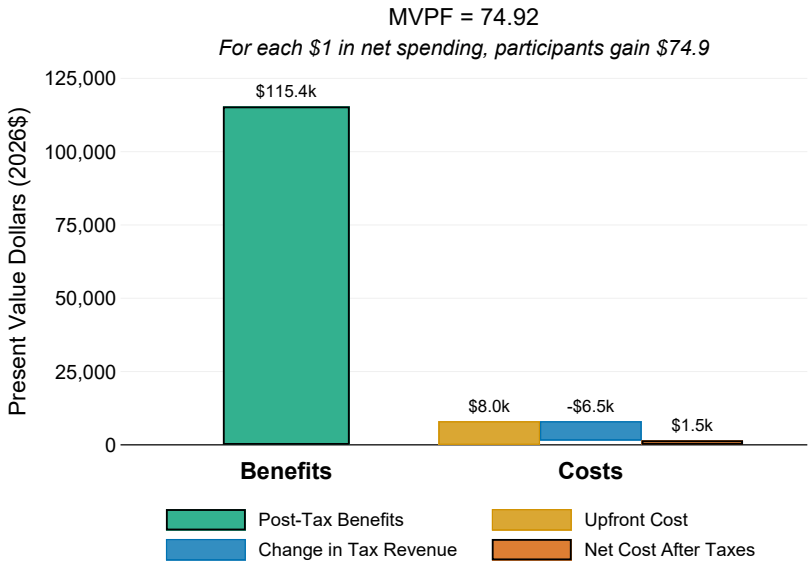
Career Academies Career academies are emblematic of a pathways approach, combining CTE and career-focused instruction. The key distinction of these small programs is that they are embedded within a traditional high school, rather than being a specialized high school. Kemple and Willner [2008] leveraged random assignment among applicants to career academies embedded within nine high schools,[20] finding strong earnings impacts (11% of a base of $37,313 in 2026 dollars) as a result of random assignment to career academies. While there are large impacts on earnings, there is no impact on high school graduation or college completion, indicating both a limited role for diversion as well as that these programs can improve labor market outcomes without increasing college attainment. Other lottery-based studies have replicated this limited impact on education outcomes [Sepanik et al., 2024] or have shown positive impacts for admission to technology-focused academies [Hemelt et al., 2019]. However, no other study to our knowledge has examined earnings outcomes.

Figure 4 forecasts the cost effectiveness of career academies using results from Kemple and Willner [2008] combined with cost estimates from Hemelt et al. [2019]. Students are expected to

[20]The control group consists of randomly rejected applicants who continued through regular education within the same high school as treated participants.

gain about $115,431 in post-tax earnings over the course of their careers. The additional cost of operating a career academy within a high school is expected to be about $8,026, which is partially offset by an increase in tax revenues of around $6,485. As a result, there is a present value net cost of $1,541. Thus, the program does not "pay for itself," but comes close to breaking even and is expected to generate benefits for participants.

Figure 4: Career Academies: Kemple and Willner [2008]



Notes: All dollar values are deflated to constant 2026 dollars. Calculations assume a 3 percent discount rate and a 4.5 percent tax rate. See section 2 for more details.

High School Curriculum and CTE Education While early studies found little role for specific high school courses [Altonji, 1995], later work has found a large role for upper-level and more specialized high school classes [Rose and Betts, 2004]. Mathematics courses have been shown to be particularly impactful — on the order of a 10 percent increase in earnings for each additional math class for at least some students [Goodman, 2019].

Relative to Europe, where CTE is integrated into well-developed apprenticeship systems, the United States has been resistant to adopting vocational and CTE curricula due to its association with tracking and social stratification. As a result, between 1990 and 2009, the number of vocational or CTE credits earned by high school graduates dropped by 14 percent [Hudson, 2013]. Survey-based evidence suggests that occupationally-directed CTE generates earnings gains [Bishop and Mane, 2004, Meer, 2007]. However, this pattern may only matter for upper-level CTE courses [Kreisman and Stange, 2020], indicating that the availability of CTE alone is not sufficient

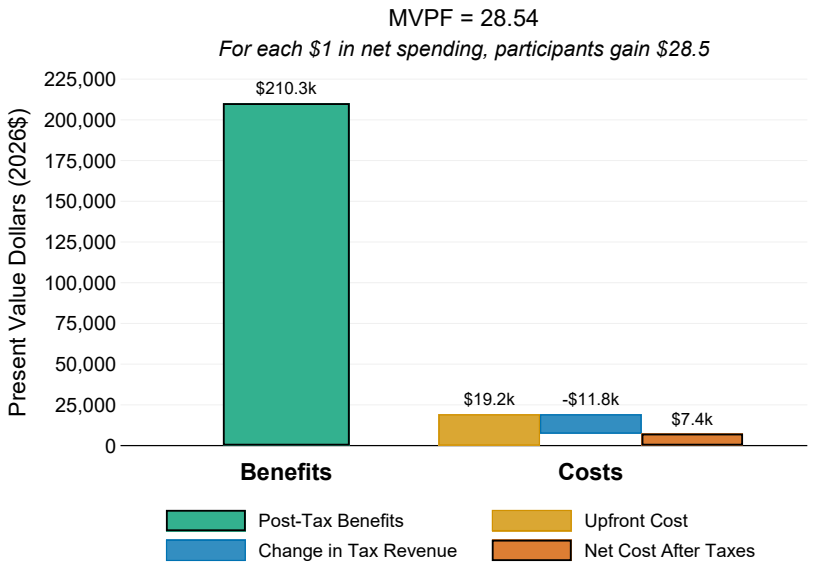
without investment in course quality. A consistent theme in these papers is suggestive evidence that those who enroll in CTE courses may be a particularly good fit for them, indicating that this pathway does not benefit all students equally and benefits some more so than others. This mirrors patterns found in Europe discussed below.

Like early college and career academies, the highest-quality evidence on CTE comes from admission to a few specialized high schools. These studies consistently find that secondary technical education increases high school completion, college enrollment, and early-career earnings, with much stronger effects on male students. For example, Dougherty [2018] shows that CTE-focused high schools in Massachusetts substantially increases high school graduation. Additional evidence in this area comes from close to home in the form of the Connecticut Technical High School System (CTHSS). Brunner et al. [2023] show that male applicants near an admissions cutoff who attend a CTHSS school experience large gains in high school graduation, tenth-grade test scores, and early-career earnings. In particular, male students are 10 percentage points more likely to graduate from high school and have 32 percent higher average quarterly earnings. In contrast, there are no effects for female students, which likely reflects gender differences in field choices, with men selecting into higher-earning fields. As noted by Brunner et al. [2023], the effects measured in the paper likely reflect a mix of increased CTE exposure as well as the unique effects of the CTHSS model more generally.

Figure 5 uses the estimates reported in Brunner et al. [2023] to evaluate the costs and benefits of CTHSS, combining results for both men and women. Compared to the other policies we evaluate, CTHSS has higher costs but also higher benefits. Projecting the earnings impacts forward, enrollees are expected to earn about an additional $210,254 at a net, after-tax cost of about $7,368 to the state. As a result, enrollees are expected to gain $28.5 for every $1 in net spending by the state.

Evidence from Europe The European setting provides national-level evidence that CTE and vocational education have positive earnings impacts but also indicates that this channel may work better for some students than others. One concern with vocational education is that it may result in flatter life-cycle earnings profiles resulting from a lower return to experience [Hanushek et al., 2017]. Silliman and Virtanen [2022] use admissions cutoffs to upper-secondary schools in Finland to find that assignment to the vocational track increases earnings by 6 percent through age 33. In contrast to the observational patterns in Hanushek et al. [2017], there is no evidence of fade-out of earnings impacts, at least for the marginal enrollee. Silliman and Virtanen [2022] also find that effects are strongest for applicants who rank the vocational track above the academic

Figure 5: Connecticut Technical High School System: Brunner et al. [2023]



Notes: All dollar values are deflated to constant 2026 dollars. Calculations assume a 3 percent discount rate and a 4.5 percent tax rate. See section 2 for more details.

track, consistent with some students being a better fit for vocational schooling than others. Dahl et al. [2023] study specialization into high school majors in Sweden, where students can similarly choose between programs in academic and non-academic tracks. They find that the highest-return high school majors are in engineering, science, and business. Consistent with Silliman and Virtanen [2022], they find evidence that certain students are a better fit with the academic track than others — academic programs do not benefit students if their next-best option is a non-academic major. In related work, Humphries et al. [2025] apply an empirical framework to Swedish administrative earnings data linked with secondary and postsecondary education records, showing that specialization in high school increases the earnings impact of later college-major choices.

Studies of European systems of vocational tracking in high school show that these approaches are most effective when combined with an increased use of work-based learning, flexibility to switch into an academic track, and strong coordination with the higher education system. Despite concerns that European vocational systems are rigid and increase social stratification, studies have shown these systems are actually quite flexible. For example, Dustmann et al. [2017] find no effect on lifetime outcomes of being tracked into the vocational track early, which the authors explain by the flexibility of switching in Germany. Hall [2012] and Malamud and Pop-Eleches [2011] both study reforms that increased the academic orientation of the vocational track or delayed

admission into the vocational track in Sweden and Romania, respectively.[21] While high school completion and college readiness increase, there is little effect on college enrollment or later-life earnings. In the case of Romania [Malamud and Pop-Eleches, 2011], the authors suggest this was due to the higher education system not having the capacity for additional students, underscoring the importance of coordination with the four-year sector. However, these systems may be improved with increases in quality and flexibility in the vocational track. For example, a reform in Norway in 1994 increased the use of apprenticeships in the vocational track while also easing switching across academic and vocational tracks. This resulted in increased earnings, especially so for disadvantaged men, but with no impact on women [Bertrand et al., 2021].

4.3 Workforce Development and On-The-Job Training

U.S. Government-Sponsored Training The literature on government-sponsored training and employment programs provides a useful benchmark for more recent employer-focused training models. Traditional public job training in the United States has a long history of mixed results, with few cases of persistent earnings gains that are clearly cost-effective [McCall et al., 2016].[22] The large experimental evaluation of the Job Training Partnership Act found at most modest earnings gains from classroom training that were not statistically different from zero [Orr et al., 1995, Bloom et al., 1997].[23] More recent evaluations of related programs also reach similarly mixed conclusions [Andersson et al., 2024], even with experimental evaluations [Fortson et al., 2017].

Among government-sponsored training programs most relevant to the pathways approach, the closest evidence comes from Job Corps, a large, intensive, residence-based training program for disadvantaged youth. This program has been shown to generate medium-run earnings gains for older enrollees and to reduce criminal activity. However, the earnings impacts are not sustained for most participants in the full sample. Moreover, due to its intensive nature, at an upfront cost of $34,640 per participant in 2026 dollars, it is far from cost effective [Schochet et al., 2008, Schochet, 2018].[24] We apply our Connecticut-focused MVPF framework using the earnings impacts from a 20-year follow-up that uses tax records as the source of impacts [Schochet, 2018]. We estimate post-tax earnings benefits to participants at only $851. Increased tax revenue is only $48, barely

[21] This reform occurred while Romania was under the control of a communist regime.

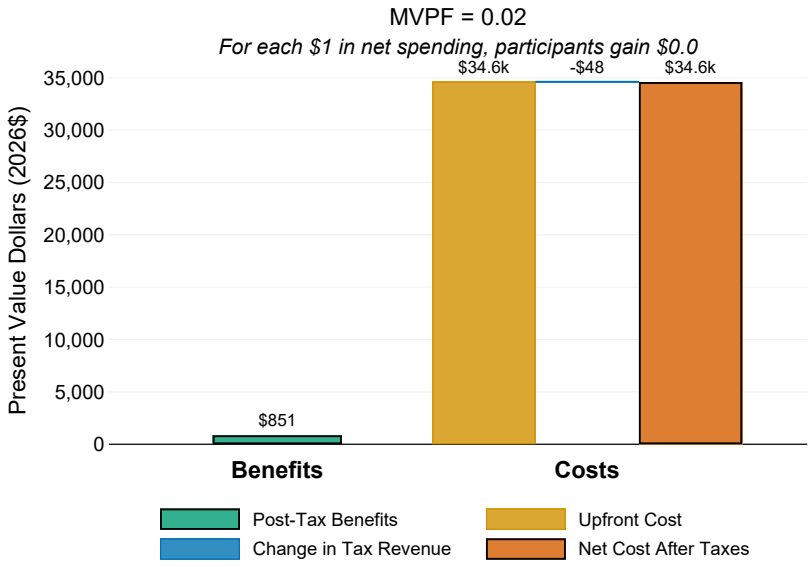
[22] McCall et al. [2016] succinctly summarize the training literature with: "More broadly, the US literature suggests that zero is sometimes, but not always, a good summary of the impact of training programs" (p. 557).

[23] Early U.S. studies emphasized the difficulty of evaluating these programs, since trainees often enroll after sharp declines in earnings and may therefore differ from otherwise similar nonparticipants [Ashenfelter, 1978, Ashenfelter and Card, 1985, Heckman and Smith, 1999]. These concerns had an important role in hastening the broader adoption of experimental methods to evaluate programs.

[24] An interesting complement to Job Corps is a study that evaluates the New Deal-era Civilian Conservation Corps, which served as the model for Job Corps [Aizer et al., 2024]. That study finds long-run increases in lifetime earnings and longevity, but observes no short-run earnings impacts, broadly consistent with the results from most training evaluations. While some results may be specific to the improved health of disadvantaged Depression-era youth, the main message is that short-run evaluations of training programs may miss important lifetime effects that do not appear until later.

offsetting the large upfront costs of such an intensive program. As a result, participants from this program realize only $0.025 of benefits from every $1 of government spending, making it far from cost effective.

Figure 6: Job Corps Training: Schochet et al. [2008], Schochet [2018]



Notes: All dollar values are deflated to constant 2026 dollars. Calculations assume a 3 percent discount rate and a 4.5 percent tax rate. See section 2 for more details.

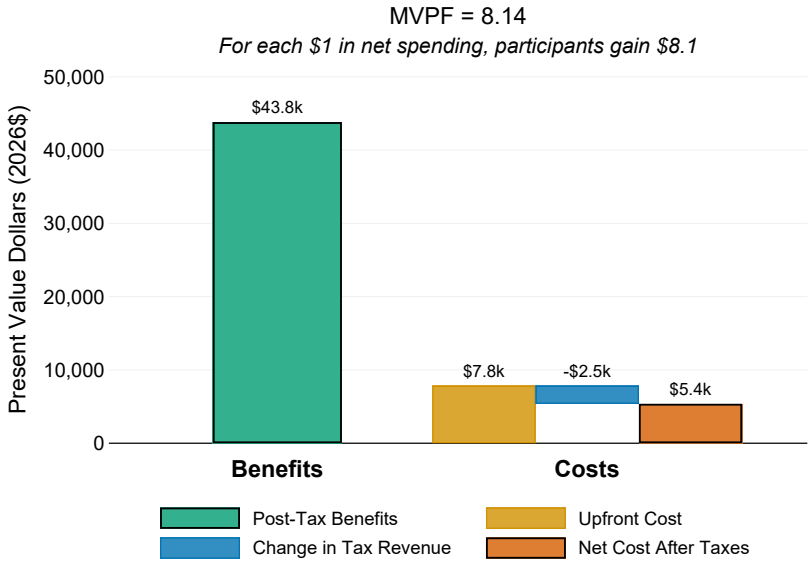
A possible qualification to this discussion is that the United States spends relatively little on active labor market policies relative to other countries, especially when excluding postsecondary education. This relative underinvestment has been argued to limit the effectiveness of training programs [Holzer, 2026], resulting in disappointing evaluations. The lesson from traditional job training is not that it can never work, but that lightly funded programs with weak connections to employers are unlikely to generate impacts that are cost effective.

Sectoral Training Partially in response to this disappointing evidence, there has been great interest in a host of *sectoral* training programs. These programs combine occupational skills with job placement and career coaching to secure jobs for workers in a specific, high-demand sector. While typically serving adult workers, they are emblematic of the career pathways approach. Although small in scale, these programs have been shown to generate large earnings impacts. Katz et al. [2022] summarize the experimental evidence from a variety of sectoral training programs, which randomize enrollment among screened applicants. They report earnings impacts from these programs of 12–34 percent up to 6 years after enrollment. Focusing on one program, WorkAdvance,

they show that these gains are largely driven by moving participants into higher-wage jobs in growing industries. WorkAdvance targeted a variety of high-demand sectors: IT, health, manufacturing, transportation, and environmental remediation.[25] Corroborating evidence comes from the Sectoral Employment Impact Study [Maguire et al., 2010], which similarly showed impacts of up to 29 percent two years after participation. Another program, Project QUEST, supported longer-duration training for health care occupations, partnering with community colleges in San Antonio. Studies of the program have found cumulative earnings impacts of 13.5 percent through a 14-year follow-up in an experimental evaluation of eligible applicants [Elliott and Roder, 2017, 2021, 2024].

Figure 7 uses the estimates reported in Katz et al. [2022] to evaluate the costs and benefits of sectoral training through WorkAdvance. Projecting the earnings impacts forward, enrollees are expected to earn about an additional $43,819 at a net tax-adjusted cost of around $5,382 to the state. As a result, participants are expected to gain $8.1 for every $1 in net spending by the state. Unlike the previous high school and college evaluations, WorkAdvance participants are older, so we compute our forecasts using age 34 as the baseline. The smaller impacts underscore one minor lesson — programs that take effect later in life will mechanically have fewer working years over which to realize impacts and thus accumulate tax revenue prior to retirement.

Figure 7: Sectoral Training from WorkAdvance: Katz et al. [2022]



Notes: All dollar values are deflated to constant 2026 dollars. Calculations assume a 3 percent discount rate and a 4.5 percent tax rate. See section 2 for more details.

[25]One training site, Per Scholas (which targeted IT), showed much larger impacts than the other WorkAdvance sites.

Another sectoral training program, Year Up, targets a younger population of disadvantaged young adults. The program is separated into a classroom training phase (focusing on IT, finance, sales, business support, or software development/support) combined with an internship phase. Experimental evaluations of Year Up have consistently shown large earnings impacts up to 38 percent that persist up to five years after enrollment [Elliott and Roder, 2014, Fein et al., 2020]. Recently, Narain and Noray [2023] evaluate differences across participants in who benefits from Year Up using machine learning techniques, finding that those benefiting the least tend to be poorer, Black, and female. They also find that Year Up primarily succeeds by matching workers to jobs rather than measurable increases in skills. This last result underscores an important tension in evaluating training and pathways programs more generally — it is difficult to separate the effect of the skills built through education itself from the effects of wraparound services, like job placement assistance. In practice, workforce development initiatives are a bundle of services that participants receive simultaneously.

While apparently effective, an important and unknown question is whether sectoral programs are scalable. In their review article, Black et al. [2023a] identify the substantial screening of participants prior to enrollment as a significant concern for sectoral training, especially as more broad-based training programs have shown disappointing results. At a statewide scale, similar programs may require bringing in less-prepared or less-motivated participants who may have lower benefits.[26] Moreover, it appears that at least some of the effectiveness comes from the wraparound services that help match workers with jobs and internships [Narain and Noray, 2023]. This could be problematic if it generates displacement effects at scale. For example, Crépon et al. [2013] provide strong, experimental evidence that participants in a job search program can displace each other when competing for scarce jobs.

Employer-Provided Training A potential alternative is to encourage training to be undertaken by employers themselves, for example through apprenticeship or incumbent worker training programs. This approach could be effective as it leverages employers' superior knowledge of their own workforce needs and which employees are likely to benefit from training. Barbanchon et al. [2023] show that difficulties in hiring qualified workers can harm firm growth, indicating that there are likely to be benefits to firms from upskilling their workforce. In addition, standard labor economics theory suggests that firms may under-invest in transferable skills when they cannot fully capture the returns to those investments [Becker, 1962], in part because of poaching risks [Acemoglu and Pischke, 1998].

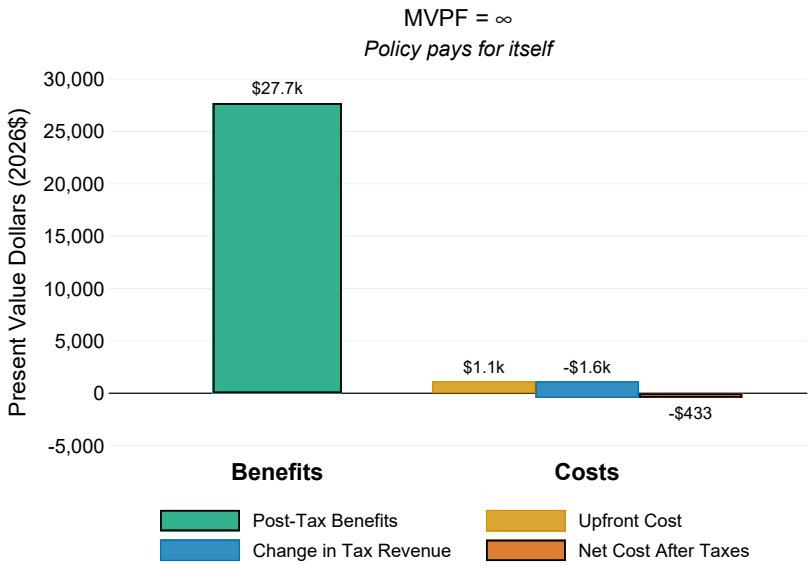
[26] However, this is just a hypothesis. It may be that participants who are the least able are the ones who would benefit from training the most.

Much of the related literature has focused on testing theories of when and why an employer would provide training in transferable skills [Wolter and Ryan, 2011, Black et al., 2023a]. Economists think that this under-provision of training should be worse in more competitive markets, where firms are more likely to lose recently trained employees. Adams et al. [2026] use job posting data to provide evidence consistent with this hypothesis. Dillon et al. [2026] study the take-up of incumbent worker training grants using firm-level data. Consistent with the hypothesis, they find that grants are more commonly used in more competitive labor markets. Participating firms subsequently expand employment and vacancies while shifting postings toward lower-skill jobs.

Unfortunately, the literature has had difficulty assessing the impact of employer-based training on workers due to a lack of firm-worker linked data identifying training participation and difficulty in finding high-quality research designs. A notable exception to this lack of evidence comes from Millar [2025]'s recent study of Tennessee's subsidized customized job training program. In this program, the state subsidizes firms to conduct formal training programs that they design to meet their own workforce needs. Millar [2025] uses changes in funding scarcity across offices and high-quality state administrative data to compare the impacts of training on otherwise similar firms and workers. While quarterly earnings gains are modest at 3%, the program costs are quite low at just $1,124 in 2026 dollars. Figure 8 forecasts the costs and benefits of this customized job training program in the Connecticut context using Millar [2025]'s estimates. Participants gain about $27,716 in extra post-tax earnings from the policy. Although this gain is much less than previously considered policies, the taxes brought in from the extra earnings just offset the upfront cost of the program, indicating that the policy will pay for itself and raise $433 in tax revenue.

Benefits to Firms and Employer Participation A limitation of the previous cost-benefit analysis is that it only focuses on workers and does not consider the benefits to firms. Unfortunately, there are few high-quality studies that quantify the benefits to employers in the provision of such training, although the existing evidence indicates that it improves firm outcomes. Konings and Vanormelingen [2015] apply a theoretical framework to the balance sheet data of Belgian firms, estimating that an increase in the share of trained workers improves average worker earnings with stronger impacts on firm productivity. Negoita and Goger [2020] study the effects of California's incumbent worker training program on firms and find that it increases firm sales relative to observably similar, matched firms. Similarly, Dillon et al. [2026] show that firm employment grows after receiving a training grant relative to observably similar firms. Nevertheless, no study to our knowledge has combined a high-quality research design with firm balance sheet data to make

Figure 8: Customized Job Training in Tennessee: Millar [2025]



Notes: All dollar values are deflated to constant 2026 dollars. Calculations assume a 3 percent discount rate and a 4.5 percent tax rate. See section 2 for more details.

causal statements about the benefits of training to employers.

Given that both formal and informal on-the-job training is ubiquitous [Black et al., 2023a], an important consideration is whether this actually shifts employer behavior or whether training subsidies merely crowd out private investment in training. Cautionary evidence on this front comes from the United Kingdom [Abramovsky et al., 2011], where an evaluation of a rollout of an incumbent worker training subsidy *did not* affect overall training provision despite take-up of the subsidy. Similarly, Leuven and Oosterbeek [2004] find that tax credits for training older workers in the Netherlands resulted in simply shifting training away from younger workers and toward older workers. In the context of pathways, these results indicate that we should be careful to combine firm discretion with oversight and buy-in from relevant stakeholders to ensure that workers, firms, and the state all realize benefits.

5 Concluding Thoughts

The academic literature provides an optimistic view that well-designed career pathways programs can generate returns for individuals and society. Early college and college pathways have been shown to increase high school completion and speed college completion. Career and technical education, especially when it is high quality and maintains academic flexibility, can improve student outcomes, especially for men. The completion of community college credentials in tech-

nical and health fields is associated with higher earnings in the labor market. Advising and wraparound services have been shown to increase attainment in these degrees. Finally, training at firms can address potential underinvestment in transferable skills and exploit firms' superior knowledge of their workforce needs, potentially generating cost-effective returns for all parties. However, we caution that policymakers should be concerned about potentially diverting students from four-year colleges, that much of the strongest evidence comes from small and selective programs that may prove difficult to scale statewide, and that there is a risk of subsidizing training that firms would have conducted regardless of specific policies.

Our cost-benefit analyses reinforce this narrative — nearly all the policies we reviewed either pay for themselves or generate earnings impacts on participants at several times the cost to the government. Career academies and firm-based job training appear to create especially large earnings gains relative to their costs. While more expensive, Connecticut's homegrown career and technical education high schools are shown to generate large earnings impacts, at least for men. Sectoral training can generate large earnings impacts, indicating that career advising and job placement assistance targeting high-demand sectors can improve the effectiveness of training, especially when compared to traditional training programs.

Given the rise in interest in college and career pathways policies, there is a pressing need to create more evidence examining these policies. Most of the strongest evidence comes from specialized schools or academies, and other work often lacks a high-quality research design. We urge policymakers to develop procedures for rigorous evaluation, including pilot rollouts involving randomization across schools, firms, and students. Integration of evaluation with state data systems is also crucial — to our knowledge, the only published statewide evaluations of specific pathways policies in the United States, Bonilla [2020] and Bonilla and Thim [2023], do not observe participants' subsequent earnings. By contrast, many European countries have developed linked administrative data systems with the express intention of facilitating rigorous evaluations of education and workforce policies [Black et al., 2023a].[27] Within the United States, the explosion of research and evaluation coming out of the education research centers in Texas[28] provides a likely roadmap for similar statewide data infrastructure in Connecticut. Such steps are essential if Connecticut is to make progress in designing effective college and career pathways programs.

[27] McCall et al. [2016] write that "The United States has led the world in the use of experimental evaluations of its training programs...On the negative side, the United States now lags behind many European countries in the quality and coverage of the administrative data available for evaluating training programs, and in the ease with which serious researchers can gain access to the data" (p. 557)

[28] https://tsp.utdallas.edu/

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